SNACKING AND BREAKFAST: TYPE, FREQUENCY AND ASSOCIATIONS WITH MOOD, HEALTH AND COGNITION

Katherine Chaplin

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Summary

This thesis addressed the issue of breakfast, snacking and their effects on mental health and well-being, accidents at injuries at work, memory, attention and performance on the hazard perception test. The first point of interest was to examine and extend current knowledge about breakfast consumption and its associations with mental health and well-being. Alongside this it was of interest whether these associations were also found following consumption of a snack. This thesis considered both the type of snack consumed and frequency of consumption. Overall frequency of breakfast consumption was found to show strong and positive associations with all of the health, well-being and occupational outcomes, supporting the view that breakfast is a positive health behaviour which should be encouraged. The pattern was more complex with regard to snack consumption. Consumption of unhealthy snacks, such as chocolate and crisps, was strongly and negatively associated with all of the health, well-being, occupational and cognitive outcomes. Further examination revealed that breakfast and unhealthy snacking are not different sides of the same coin but are two independent behaviours. Increasing breakfast consumption and decreasing unhealthy snack consumption should be the focus of dietary interventions. Conversely healthy snack consumption, such as fruit and nuts, showed a similar pattern of results as breakfast, albeit weaker. In effect they are both measuring the same underlying healthiness factor. All of these results remained after controlling for other lifestyle factors and were replicated in a number of samples including students, members of the general public, nurses and primary school children.

CHAPTER ONE

EXAMINATION OF THE ASSOCIATIONS BETWEEN BREAKFAST AND SNACKING, AND NUTRITIONAL INTAKE, PHYSICAL HEALTH, MENTAL HEALTH AND WELL-BEING

1.1   Aims of the thesis

This thesis considered the associations between breakfast and snack consumption, and health, mood and cognitive functioning. The key areas of interest were as follows: (1) to consider a broader range of outcomes, including measures of mental health, well-being, mood, work related outcomes, cognitive performance and hazard perception while driving; (2) to examine the associations between breakfast and snacking, and health and well-being in a range of different samples to establish the generalisability of the findings; (3) to compare different measures of breakfast and snack consumption, specifically frequency of consumption vs. type of food consumed; (4) to examine the relationship between breakfast and snacking and (5) to investigate the role of other demographic and lifestyle factors on the relationships between breakfast, snacking and the outcome measures.

1.2   Rationale for the thesis

The idea that diet might affect our health and well being is not a new one. In China and Europe "naturopathic" medicine dates back thousands of years. The Greek physician Hypocrates (approx 400BC) is quoted as saying "Let food be your medicine and medicine be your food." Thayer (1989) suggested that although the relationship between eating and mood is of intense interest in the general culture, it is an area of research highly underrepresented in the scientific literature. This literature has grown somewhat since the 1980's but is remains rather small.

The eating occasion which has received the most interest has been breakfast. Breakfast is considered a positive health behaviour which should be encouraged. There are a number of reasons for this. Breakfast makes a significant contribution to nutritional intake due to high levels of fortification in most breakfast cereals. In addition, breakfast literally breaks the fast and provides the brain with the glucose

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required to start the day, whether at work or school. However even though breakfast is considered a positive behaviour which should be encouraged in a society which is preoccupied with health messages, the research to date has been conducted in limited samples and using limited range of outcomes. This thesis aims to replicate some of the previous findings reported and further extend the current knowledge about the effects of breakfast. It is important that the previous effects are re-examined as replication of these results will increase the reliability of these findings and subsequently their potential implications. As noted above there is currently a lack of scientific studies of nutrition and health, especially mental health. Therefore although previous knowledge of breakfast is somewhat limited it still offers the greatest support to other research conducted within this area.

If breakfast is considered to be a strong positive health behaviour then snacking is perceived as being an equally strong negative behaviour. Snacking is associated with foods which are typically high in fat and sugar and provide both empty and extra calories. Increased snacking has been identified as one of the leading causes for the current increase in obesity in the Western world. In today's society there is a culture of increased health awareness and this is characterised by numerous dietary guidelines for example eating 5 portions of fruit and vegetables a day, drinking 2 litres of water. It is important that scientific studies of snacking are conducted in order to fully understanding the possible implications of a snacking pattern of eating on health. This thesis aimed to explore snacking behaviour and extend the current knowledge about its effects, specifically on mental health.

The nutrition and health research has been dominated by obesity research. Although this remains both an interesting and important area of research other outcomes also need to be considered. Mental health problems also appear to be more common nowadays. Linked into this is increased report of stress, particularly work based stress. Accidents and injuries in the workplace are a leading cause of sick leave and they are associated with significant costs to the individual, the company and society as a whole. The association between breakfast, snacking and accidents, injuries and work stress was investigated in this thesis.

The final area of interest is the potential effects of dietary intake on cognitive functioning. The results of studies conducted with breakfast provide some evidence that regular breakfast consumption is associated with improved memory and mood.

Initial studies of snacking on cereal bars also appear to demonstrate positive effects on memory and mood. Conversely consumption of confectionary snacks appear to improve concentration and attention. These results suggest that snacking type may be an important consideration. This is an idea which has been explored throughout this thesis and extended to other outcomes.

1.3   Organisation of the thesis

The first part of the thesis is concerned with the associations between breakfast, snacking and health and well-being. The remainder of this Chapter reviews the current literature examining associations between breakfast, snacking and nutritional intake, obesity, well-being, mental health and academic performance. In addition proposed mechanisms are discussed as are potential problems faced when assessing dietary intake. Chapter 2 examines (1) the prevalence of snacking and (2) associations between snack and breakfast consumption and mental health and well-being in a general population sample and the use of appropriate methodologies. Chapter 3 considers (1) whether breakfast and snack consumption are in fact markers of a healthy / unhealthy lifestyle per se, (2) whether snack type is more important than snacking frequency and (3) whether breakfast and snacking are associated with a broader range of outcomes, particularly work based outcomes. Chapter 4 explores the pattern of consumption in children. In addition the relationship between breakfast and snacking is examined. Chapter 5 investigates the longer term effects of breakfast and snack consumption on health and well-being.

The second part of the thesis is concerned with the acute effects of breakfast and snack consumption on cognitive performance and situation awareness. Chapter 6 reviews the current literature surrounding breakfast and snack consumption, and mood and cognitive functioning. The possible mechanisms involved are considered. Chapter 7 examines the effects of different mid-morning snacks on mood and cognitive function in students and members of the general public. Chapter 8 reviews the literature surrounding situational awareness and driving, and investigates different breakfast and mid-morning snack combinations on mood and hazard perception while driving. Finally Chapter 9 discusses the findings from the studies reported in this thesis within the context of the existing literature and the original aims of the thesis.

1.4   Prevalence of snacking behaviour

'Cultural Man' has been on earth for some 2,000,000 years; for over 99 per cent of this period he has lived as a hunter-gatherer (Massey & Hendry, unpublished report). Foraging (hunting and gathering) denotes eating food as it is gathered / hunted. Although accessibility of food and the types of foods available have changed dramatically, our eating pattern appears to have reverted back to the same as that of our ancestors. It would appear that humans are biologically, metabolically and physiologically suited to grazing.

The popular press often notes that a snacking or a grazing pattern of eating (eating smaller amounts of food more frequently) as opposed to eating 3 substantial meals a day has increased. This pattern of eating has been identified in both adults and children with adults eating approximately 1.68 meals and 4.76 non-meals or 6.5 times per day, (British Nutrition Foundation, 1984) and children having 6 eating and / or drinking episodes per day (Livingstone, 1991). Decreases in the frequency of eating episodes have been found in the elderly (6.02) and very elderly (5.60). Students reported consuming 2.8 meals and 1.6 snacks per day on average (Bellisle, Monneuse, Steptoe & Wardle 1995). In the same study women reported consuming fewer meals (2.7 v. 2.8) and more snacks (1.7 v. 1.5) than males. These findings are in agreement with other data (Gatenby, Anderson, Walker, Southon & Mela 1995).

A study of American adolescents found that half reported eating one or two snacks a day, and a third consumed three-four snacks per day. Only 5% reported eating 5-8 snacks (Ezell, Skinner & Penfield 1985). In the UK most children were found to have between 3-6 eating and / or drinking occasions per day (Livingstone, 1991). A similar pattern was also identified for Australian children (Dugdale, Townsend & Rigsby 1988). Differences were found in Mexico where the diet mainly consists of low energy density foods. These children were found to eat up to thirteen times daily and consumed as much as 45% of their energy from snacks (Eastwood Garcia, Kaiser & Dewey 1990).

It has been assumed that the number of snacks eaten has increased within the last decade and that it will continue to increase. Contrary to this, research in 10 year old children has shown that number of eating episodes has actually decreased from 6.6 in 1973 to 5.2 in 1994 (Nicklas, Morales, Linares, Yang, Baranowski, De Moor & Berenson 2004).

Although there is anecdotal information about eating frequency, specifically in adolescents, there is a lack of published studies involving longitudinal data. It is hard to say with any certainty whether eating frequency has actually changed with time or whether the distinction between snacks and meals has become blurred.

1.5   Definitions of snacking

It is currently difficult to accurately measure consumption of snacks and consequently investigate their effects due to a lack of an agreed definition of snacking. Defining snacking is exacerbated by relatively little quantitative information being provided. "Having a snack" can refer to either eating food between meals or eating a light meal. Consistent differences in the usage of the terms snack, snacking and snack foods have been identified, although these differences were often marginal (Chamontin, Pretzer & Booth 2003). Snacks have been defined with respect to caloric consumption (Bernstein, Zimmerman, Czeisler & Weitzman 1981), in relation to social interaction (Rotenberg, 1981) and based on time of day of consumption (Summerbell, Moody, Shanks, Stock & Geissler 1995). However, these definitions fail to consider the influence of social patterns and/or cultural norms on timing and size of eating occasions. Snacks are frequently defined relative to meals, with snacks being smaller, less structured eating episodes (Gatenby, 1997).

A distinction has also been made with respect to motivation for eating with snacks being defined as eating episodes not triggered by hunger (Marmonier, Chapelot, Fantino & Louis-Sylvestre 2002). Bellisle, Dalix, Mennen, Galan Hercberg, de Castro & Gausseres (2003) observed that human participants appear to eat enough meals and snacks to reduce feelings of subjective hunger but not enough to prevent the return of hunger before the next eating episode. They speculate that snacks were used as modulators of hunger between socially determined meals, which allowed hunger to return and the possibility for appetite to increase before the next meal. Le Magnen (1992) also found that humans seem to eat just enough in snacks, in order to be hungry at the next meal.

Snacks differ from meals in terms of size, nutritional content and hunger and thirst sensations before and after the event with more intense hunger and thirst being reported before meals compared to snacks (Bellisle et al, 2003). They found that meals were twice the size of snacks. In addition snacks had a relatively high

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carbohydrate content and less fat and protein than meals. Different foods were selected for meals and snacks. Sweets, cereal bars, biscuits and fizzy drinks were more likely to be reported as snacks whereas white meat, fish, dairy products and fruit were more likely to be seen in the context of meals. It needs to be noted that this survey was conducted using a sample of French adults and therefore further research is needed in order for the findings to be generalisable to other cultures.

Research has found that males and females snack on different types of foods with males consuming more fruit, soft drinks and sandwiches and females eating more chocolate, biscuit, cakes and crisps as snacks (Drummond et al. cited in Gatenby, 1997). It is generally believed that women derive more of their energy from fat in snacks than men (Gregory, Foster, Tyler & Wiseman 1990; New & Grubb, 1996; 1997). Positive correlations were found between percentage energy from carbohydrates and eating frequency in males and between percentage energy from carbohydrates and sugars and eating frequency in females (Rugg-Gunn, Adamson, Appleton, Butler & Hackett 1993).

In summary although there is no clear consensus on a definition, the majority of papers define a snack relative to a meal as food or drink consumed other than during main meal times. This is the definition which has been adopted for this thesis.

Regardless of how it is defined snacking has been found to contribute 15-20% of our daily energy intake (Summerbell et al. 1995), 15-20% of our daily mineral intake and 13-17% of our daily vitamin intake (McCoy, Moak, Kenney, Kirby, Chopin, Billon, Clark, Disney, Ercarli, Glover, Korslund, Lewis, Ritchey, Schiling, Achuffner & Wakefield 1986). Bellisle et al (2003) examined a sample of 54 French adults and reported that 18.5% of total daily energy came from snacks. This is similar to the 17% that is reported to come from snacks in American men (Dreon, Frey-Hewitt, Ellsworth, Williams, Terry & Wood 1988) but both are lower than the 25% reported for adults living in the UK (Drummond, Crombie & Kirk, 1996).

1.6   Current beliefs and attitudes about snacking

1.6.1 Empty calories

Snacks are perceived as being unhealthy foods, for example confectionery, which are believed to provide "empty" calories i.e. no other nutrients. It is also argued

that these snacks are replacing foods with a greater nutritional content, which further disadvantages the frequent snacker. Contrary to this assumption evidence suggests that eating snack foods which are low-fat and high-carbohydrate actually reduces the proportion of fat intake (Summerbell et al., 1995; Drummond et al., 1996). Eating certain foods as snacks can significantly contribute to the nutritional quality of a diet (Gatenby, 1997). Bellisle et al. (2003) studied the contribution of meals and snacks to the French diet. The results identified no difference for total energy intake when extraprandial intake occurred. This suggests that consumption of snacks does not significantly increase daily energy intake. Other physiological benefits of frequent eating are decreased blood cholesterol and improved glucose tolerance (Arnold, Ball, Duncan & Man, 1993; Jenkins, Ocana, Jenkins, Wolever, Vuksan, Katzman, Hollands, Greenberg, Corey, Patten et al. 1992). It is believed that snacking can help control body weight by maintaining blood sugar levels and minimising hunger. This results in shifting the balance of energy intake so that more energy is consumed in the morning as opposed to large evening meals. It also positively influences the carbohydrate: fat dietary ratio by increasing the amount of carbohydrate eaten.

There is little evidence that frequent snackers are nutritionally disadvantaged or have a higher percentage of body fat (Drummond, Kirk & de Looy 1995). Examinations of the snacking habits of 136 school children found no significant differences between frequent and non-frequent snackers with respect to micro- and macronutrient intake (Ruxton, Kirk, Belton & Holmes 1994). In addition no differences were found for energy intake between frequent and infrequent snackers (Anderson, cited in Drummond et al. 1995). There is little evidence to suggest that increased consumption of snacks leads to an excess of "empty" calories (Drummond et al.).

The majority of snacks available contain high amounts of sugar and fat and are energy dense, 400-500kcal/100g (Whybrow, 2005) and those snacks which have a low energy density are consumed in larger portion sizes (de Graaf, 2006). In contrast to the negative perception of snacking, a number of studies have identified that foods consumed as snacks significantly contribute to the nutritional quality of diet (Gatenby, 1997). Snacking can be a useful strategy to increase nutritional diversity in the diet without compromising energy balance (Bellisle et al., 2003).

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1.6.2 Snacking and obesity

It is a popular belief that snacking is indicative of a bad diet and that people who snack frequently are either thought to be overweight or will become overweight. Some researchers believe that snacking provides extra calories and may play an etiologic role in obesity (Booth, 1988a,b; Basdevant, Craplet & Guy-Grand 1993; Takahashi, Yoshida, Sugimori, Miyakawa, Izuno, Yamagami & Kagamimori1999). Snacks are viewed as food that is eaten in addition to 3 standard meals and therefore they are perceived as providing extra calories. The presumed increase in snacking frequency over the last decade has been considered one of the dietary changes which have contributed to the increase of the prevalence of obesity (Jahns, Siega-Riz & Popkin 2001; Zizza, Siega-Riz & Popkin 2001). However many of these claims are based on anecdotal assumptions. Scientific studies have provided evidence that frequent eating episodes (snacking) are actually associated with lower body weight than eating fewer meals per day (Summerbell, Moody, Shanks, Stock & Geissler 1996; Stockman, Schenkel, Brown & Duncan, 2005). Metzner, Lamphiear, Wheeler & Larkin (1977) examined eating frequency and adiposity and found an inverse relationship between the two. The participants consuming 6 meals per day were significantly thinner than those who ate 2 meals per day. Edelstein, Barrett-Connor, Wingard & Cohn (1992) found a significant difference with respect to waist hip ratio; again those participants with a higher eating frequency had a lower waist hip ratio than those with a lower eating frequency.

A study of 7147 adults from America is one of a few investigations to examine the long term effects of eating frequency on body weight (Kant, 1995). Baseline data were collected between 1971 and 1975 and follow up data between 1982 and 1984. The outcome measures were body weight change, BMI and skin-fold thickness. At baseline significant differences were found between participants who ate 2 meals and fewer and participants who ate 7 meals or more for all of the outcome measures. However no significant differences were found for any of the outcome measures at the follow up. It is not possible however to conclude that eating frequency has no effect on body weight due to a number of methodological problems with the study.

Some researchers argue that a decrease in meal frequency is a result of increased body weight as opposed to the cause as many people will skip a meal in an attempt to lose weight.

1.6.3 Energy compensation

A final criticism of snacking is that people are unable to compensate for this energy intake at subsequent eating occasions. It is reported that a small amount of food eaten approximately an hour before a meal is unlikely to decrease intake at the next meal (Booth, 1980). It is hypothesised that it is fattening to consume even a small amount of energy (from food or drinks) between main meals (Booth, 1988a). Studies specifically examining the effects of snacks on subsequent energy intake have found no evidence of energy intake compensation after snacks (Hulshof, De Graaf & Weststrate 1993; Marmonier et al., 2002; Zandstra, Stubenitsky, de Graaf & Mela, 2002). However there is evidence that the ability to compensate for energy intake after snacks is dependent on how often people usually eat. "Nibblers", those with high eating frequency, have been found to compensate better than "gorgers" (those with low eating frequency) [Westerterp-Plantenga, Wijckmans-Duysens & Ten Hoor, 1994]. The authors note that nibblers, due to their higher eating frequency, have more opportunity to compensate. Another consideration is that the time delay between eating occasions is shorter in nibblers, which leads to higher compensatory responses (Rolls, Kim, McNelis, Fischman, Foltin & Moran 1991). It has also been found that daily energy intake varies greatly between and within individuals and is scarcely associated with daily energy expenditure (Edholm, 1977). The key to a snacking or grazing pattern of eating is to eat little and often and relies on meals being modified based on previous eating episodes.

Snacking is generally perceived to be a negative health behaviour in today's society. However much of this is based on anecdotal assumptions. The scientific research which has been undertaken to date is mixed but overall it has provided very little support for these anecdotal assumptions. The reasons outlined above offer support for why consideration of snacking is important and provide some insight into why snacking may be perceived as a negative behaviour. This thesis aims to examine individuals' perceptions and beliefs about snacking as well as their habitual snacking habits and usual eating patterns. It is important that scientific studies consider these factors. These are addressed in the study reported in Chapter 2.

1.7 Methodology

A recurring criticism and limitation of these studies is the use of different

methodologies. A variety of different foods have been provided as snacks. In addition only a few studies have tried to match control meals / snacks with respect to size, texture and nutritional balance. Before researching the effects of snacking it is important to consider how best to measure and examine snacking.

Measuring dietary intake accurately has been addressed numerous times in research. Garrow (1974) observed that "the measurement of the habitual food intake of an individual must be among the most difficult task a physiologist can undertake." However accurate assessments of dietary intake are important for assessing the relationship betweens food intake and health. Data collection can be retrospective, prospective or observational. Common retrospective methodologies are 24 hour recall method, diet history and food frequency questionnaires. The major advantages of these methods are they are quick and easy to administer and they are non-invasive. However these measures rely on recall of food eaten and estimation of portion sizes. These methods have commonly been used in large survey studies (Morgan, Jain, Miller, Choi, Matthews, Munan, Burch, Feather, Howe & Kelly1978, Blom, Lundmark, Dahlquist & Persson 1989).

Prospective methodologies, specifically the weighed inventory method, are generally considered the most accurate measures as they involve participants recording what they have eaten. In addition to the weighed inventory method there is also the estimated food diary. The weighed inventory method involves weighing all the food on scales. The estimated food diary uses standard household measures. Although the weighted inventory method is considered the most accurate it has a number of drawbacks. It is time consuming, impractical, invasive, requires close supervision and may lead to false representation due to altered eating habits. Estimated food diaries are simpler although sufficiently accurate compared to weighed records. However, estimated diaries are subject to participant bias, miscalculation of food portions and over and under-reporting.

Observational methods can remove recall errors but they are very time consuming and expensive. In addition the act of observing participant behaviour may be sufficient to alter the behaviour which is being studied.

The 24 hour recall and seven day recall methods were both used in this thesis. The aim of this thesis was to consider frequency of consumption as opposed to the specific amount consumed. Therefore no further advantage would have been gained

from the prospective or observational methods. However due to a lack of strong scientific research it is hard to say with any certainty which is the best methodology to use. Consideration of the methodologies used to examine the relationship between breakfast and health may be beneficial as this relationship has been explored to a greater extent than the relationship between snack consumption and health. Both 24 hour and 7 day recall methodologies have been used within the area of breakfast research. They also have the added benefits of being efficient, inexpensive and non-invasive. This is addressed in the first study which is reported in Chapter 2.

1.8   Breakfast

Breakfast is regarded as the most important meal of the day as it 'breaks the fast' after sleep and therefore provides the refuelling required to start the day. However it is the also the meal most likely to be missed and is generally the smallest in size. Breakfast is especially important for children. Children have generally fasted for 16 hours (since dinner the previous evening) and therefore have very low glucose levels. Breakfast provides children with the glucose and subsequent energy required to function efficiently, particularly at school. However, there has been a decline in breakfast consumption in children and adolescents. Up to 17% of British school children leave home in the morning without anything to eat (United Kingdom Consumption Study, 1998). Adolescents reported eating breakfast on 4-5 days during the week, however this decreased to 3 days per week in young adulthood (Niemeier, Raynor, Lloyd-Richardson, Rogers & Wing 2006). Approximately 25% of US adults report rarely or never consuming breakfast (Haines, Guilkey & Popkin, 1996).

Research has found breakfast consumption to be associated with a range of outcomes, including mood, health, behaviour and academic performance. Each of these is discussed in more detail in subsequent sections. First it is important to consider the effects of food in general on mood and health.

1.9   Nutrition, mood and mental health

Nutrition plays an important role in health. The western world is currently experiencing very high levels of obesity and related disorders. In the United States children are twice as likely to be overweight compared to 20 years ago and adolescents are three times more likely (National Centre for Health Statistics, 2000).

Childhood obesity is one of the biggest risk factors for obesity, diabetes and cardiovascular problems in adulthood. Although these statistics are worrying it is not just physical health status which is a cause for concern in today's society.

Depression is a common and disabling illness. Major depressive disorder is increasingly seen as chronic and relapsing, and can result in high levels of personal disability and loss quality of life for patients. In 2000 one in six adults in Great Britain had a neurotic disorder, such as anxiety and depression (Office for National Statistics, 2000). In 2004 one in ten children in Great Britain aged 5-16 had a clinically recognisable mental disorder (Office of National Statistics, 2004). By 2020 it is predicted that depression will be second after cardiovascular disease in terms of the world's disabling diseases (Murray & Lopez, 1996). It is important to try and identify modifiable risk factors. Physical activity and nutrition are two important factors in reducing this problem. This had lead to considerable research in the field of diet, weight and physical health. However, there is considerably less research examining diet and mental health.

Mental health and well-being are now receiving more interest. Well-being is the ability to function well (both physically and mentally) and to have a positive mood state (Smith, 2005). In addition the World Health Organisation (WHO) defines health as a "state of complete physical, mental and social well-being, and not merely the absence of disease and infirmity" (Belloc & Breslow, 1972).

There are established links between food and depression. The evidence supports a two way association between well-being and nutrition. Food choice can change mood and mood can affect food choice. For example, skipping breakfast may be a manifestation of depression or it may exacerbate it. There is considerably less data for nutrition and well-being than for other health behaviours (Greeno & Wing, 1994). Of the research which has been conducted the majority has focused on carbohydrate, chocolate and glucose consumption. This research is of interest as distinctions between cereal based and confectionary snacks is an area which this thesis aims to investigate. This is addressed in more detail in the studies reported in Chapters 3 and 4.

1.10 Acute effects

1.10.1 Carbohydrate and mood

Comparisons of a protein-rich (86 % energy as protein, trace carbohydrate) and carbohydrate-rich (80 % carbohydrate, protein-free) snacks revealed a tendency for more sleepiness and calmness after the carbohydrate snack than after the protein-rich one (Spring, Waller, Wurtman, Digman & Gozolino, 1983). The most popular assumption is that carbohydrate intake enhances serotonin synthesis by increasing tryptophan (TRP) uptake in the brain. This increase in sleepiness and calmness is compatible with an increase in serotonin function after consumption of a carbohydrate-rich, protein-free meal.

It has been suggested that that the raising of TRP following consumption of a high carbohydrate, low protein meal may protect stress prone individuals from the mood lowering effects of an uncontrollable stressor (Markus *et al.*, 1998, 1999, 2000*a*). Stress is known to increase the release of 5-HT (Wright *et al.* 1992), it is possible that those with poor stress coping abilities are susceptible to a functional deficit in 5-HT synthesis and that a dietary increase in TRP may alleviate this (Markus *et al.*, 1998). Participants were classified as high or low in the neuroticism scale and this was used as an indicator of stress proneness. On one day participants received a high carbohydrate, low protein breakfast, snack and lunch and on another day a low carbohydrate, high protein breakfast, snack and lunch. On both occasions stress was induced and the participants then completed measures of mood. Ratings of depression and vigour increased and decreased respectively after stress induction, except when neurotic (stress prone) participants had eaten the high-carbohydrate–protein-poor diet (which clearly elevated plasma TRP). In this case, no change in depression or vigour occurred (Markus *et al.*, 1998). This was the only situation where cortisol levels did not increase after stress. These dietary effects on depression and cortisol in stress-prone subjects were essentially replicated by Markus *et al.* (2000*b*).

Another study which compared high protein and low protein lunches found increased release of cortisol after the high protein meal (Gibson et al., 1999). In addition the high protein meal also prevented the post lunch decline seen for positive affect. There was no clear correlation between meal induced cortisol release and mood

changes but cortisol secretion was associated with poorer overall psychological well-being (measures using the General Health Questionnaire). These findings suggest a complex interaction between psychological wellbeing, nutritional status and corticosteroid reactivity. This hormonal response provides a possible alternative mechanism for differences in mood, and perhaps performance, after high-carbohydrate–protein-poor and low-carbohydrate–protein-rich meals (Gibson & Green, 2002).

Carbohydrate has been found to relieve depression in people with carbohydrate craving obesity, premenstrual syndrome and seasonal affective disorder (Wurtman & Wurtman, 1989). Higher intake of carbohydrate was also found to be associated with less depression and more energy in healthy participants (De Castro, 1987). All dimensions of mood were improved following 25g cornflakes consumed mid-morning (Benton, Slater & Donohoe, 2001). An intervention study found that participants made to eat a low carbohydrate diet for one week reported increased anger, depression and tension (Keith, O'Keefe, Blessing & Wilson, 1991). Another study found increased anger following consumption of a low carbohydrate / high protein breakfast for 3 weeks (Deijen, Heemstra & Orlebeke, 1989). In contrast Prusaczyk, Dishman & Cureton (1992) found no differences when comparing low and high carbohydrate diets for 3 days.

Breakfast studies have shown that alertness was found to increase after a high-carbohydrate meal versus a high-fat meal (Holt, Delargy, Lawton & Blundell 1999). Smith found that subjects were happier after a cooked breakfast as compared to a high-carbohydrate breakfast (Smith, Kendrick, Maben & Salmon 1994a). Consumption of breakfast, specifically cereal has a positive impact on macronutrient and micronutrient intake in adults (Morgan, Zabik & Stampley 1986; Nicklas, Farris, Myers & Berenson 1995; Galvin, Kiely & Flynn 2003) and children (Rampersaud, Pereira, Girard, Adams & Metzl 2005).

Although it is generally accepted that carbohydrate intake is related to improved mood, the exact mechanism remains unclear. Please refer to Section 1.16.2 for a more detailed discussion.

1.10.2 Chocolate and mood

The relationship between chocolate and mood is rather different. It is generally believed that chocolate is eaten in response to emotional distress, negative mood (Benton & Donohoe, 1999) or stress. Eating is used as an emotion regulation strategy against negative emotions (Macht & Simons, 2000). Individuals identified as emotional eaters consume more sweet, high-fat foods in response to emotional stress (Oliver, Wardle & Gibson, 2000; Wallis & Hetherington, 2004). The literature suggests a reciprocal and interactive relationship between carbohydrate consumption and emotional distress (Christensen, 2001). Research suggests that emotional eaters are more likely to experience mood disturbances and will seek comfort from food in these circumstances (Gibson, 2006). Cravings for sweet carbohydrate / fat-rich snacks are induced by emotional distress. Consumption of these snacks has a positive reinforcing effect which enhances mood. This enhancement is only temporary and declines leading to increased emotional distress. Despite this the evidence surrounding emotional eating theory is inconclusive. Although stressed emotional eaters ate more sweet, high fat foods (chocolate and cake) than unstressed emotional eaters and both stressed and unstressed non-emotional eaters (Oliver et al., 2000) there is a lack of convincing evidence that eating sweet, high-fat foods, such as chocolate, actually reduces stress. Only one study was found which examined the effects of chocolate consumption on everyday mood in healthy adults (Macht & Dettmer, 2006). Chocolate consumption was compared with eating an apple or nothing. Chocolate consumption increased mood, joy and activation, and reduced tiredness. Reductions in feelings of hunger were significantly greater following chocolate consumption and desire to eat was significantly lower up to 90 minutes post consumption. However chocolate consumption also elicited feelings of guilt, possible due to negative thoughts surrounding body weight (Macht, Gerer & Ellgring, 2003). It is suggested that positive emotions are experienced during and immediately following consumption, however feelings of guilt intensify thereafter.

1.10.3 Glucose and mood

Snacking on candy decreased tiredness in the afternoon (Thayer, 1987). Consumption of a glucose drink in the afternoon decreased the irritable behaviour of children who were frustrated (Benton, Brett & Brain, 1987). The limited data

available supports the view that a snack improves mood. However, the literature regarding the effects of glucose drinks on mood is not consistent. Thayer (1987) found a change in mood following a sugar snack where there was a feeling of increased energy up to one hour following the snack. This was followed by increased tiredness and decreased energy. Owens, Parker and Benton (1997) reported an association between falling blood glucose following a glucose challenge and feeling less energetic. Benton (2002) suggested that although there are different results regarding the effects of glucose drinks on mood, they are consistent with the idea that there is an increase in subjective energy (or energetic arousal) initially but by two hours after ingestion the opposite is true (and that this pattern follows the rise and fall of blood glucose post ingestion). However, recent findings do not concur. Wesnes, Pincock, Richardson, Helm & Hails (2003) found alertness was higher 90 minutes after a glucose drink and Martino and Morris (2003) found hedonic tone higher 120 minutes after a glucose drink. The findings appear to be mixed where effects are found, while others have found no effect of blood glucose on mood (e.g. Winder & Borrill, 1998).

Overall the effect of eating meals and / or snacks regularly on mood and mental health has received far less attention than specific nutritional factors.

The research examining the effects of carbohydrate and chocolate on mood and mental health has provided some interesting insight into the potential effects that specific snacks may exhibit and to a certain degree the possible mechanisms underlying these differences. The results of these studies offer further support for the notion that consideration of the type of snack consumed may prove to be a better indicator than snacking frequency per se of mental health and well-being. This thesis considered the effects of different types of snacks on mood, health and well-being. These potential differences are addressed in the studies reported in Chapters 3 and 4.

1.11 Lifestyle and good health practice

Lifestyle factors have been found to be associated with physical and mental health status, measured using the General Health Questionnaire (GHQ) or SF-36, in adults (Belloc & Breslow, 1972; Segovia, Bartlett & Edwards, 1991; Ezoe & Morimoto, 1994). Seven health practices have been identified as being associated with physical health status. These are smoking, alcohol consumption, sleep, breakfast,

snacking, weight and exercise (Belloc & Breslow, 1972; Belloc, 1973). All these health practices were found to have a cumulative effect on health. Belloc and Breslow (1972) found that participants who reported seven positive health practices had better physical health than those who only reported six.

Following from these studies researchers examined the effects of these seven health practices on mental health status, especially depression (Wetzler & Ursano, 1988; Frederick, Frerichs & Clark 1988). Simonsick (1991) found significant associations between poor health habits and depressed mood and "nervous breakdown." Total number of good habits was a good predictor of depression after controlling for prior depression and gender (Frederick et al.). Good health practices both individually and collectively were found to be associated with better mental health in factory workers (Ezoe & Morimoto, 1994). A study of industrial workers found that reduction of health practices was related to negative mental health, as measured by GHQ (Irie, Miyata, Nagata, Mishima, Ikeda & Hirayama 1997).

1.11.1 Acute effects of habitual snack consumption

1.11.1.1 Mood

A study conducted by Benton and colleagues (2001) examined the effects of different breakfast and mid-morning snack combinations on mood in a sample of adults. Those that consumed the mid-morning snack were more agreeable, confident and energetic later in the day.

Student participants who consumed a cereal bar for breakfast felt more alert, happy and sociable and less anxious (Smith & Wilds, submitted for publication). The consumption of a cereal bar as a mid morning snack increased alertness and hedonic tone particularly in the group which received no breakfast. In those participants who received no breakfast but later received a mid morning snack their anxiety decreased after consumption of the snack

1.11.1.2 Mental health

Very few studies report the individual effects of snacking, all the studies reported here were conducted with adults. Eating between meals was always included as a negative health practice. A study by Frederick et al. (1988) reported that prevalence of depression was higher for six of the seven poor health habits when compared with good health habits. This was because infrequent snacking (considered

a positive health habit) was found to be associated with a higher prevalence of depression, although this difference was not significant. Eating snacks at most twice a week was inversely and weakly associated with depression in overseas workers and depression, mental instability and neurosis in the whole sample, overseas workers and their spouses (Tuekpe, Todoriki, Zheng, Kouadio & Ariizumi 2006). Depressive symptoms in women were associated with not eating fruit on a daily basis (Allgower, Wardle & Steptoe, 2001). Men and women reporting poor mental health were less likely to eat fruit on a daily basis than their healthier counterparts (Sarlio-Lahteenkorva, Lahelma & Roos, 2004).

Smith (submitted for publication) examined the effect of snacking frequency on a variety of measures of mental health, while controlling for smoking and alcohol consumption. Increased snacking frequency was associated with less stress, emotional distress, depression and anxiety; however these differences did not reach significance.

1.11.2 Acute effects of habitual breakfast consumption

1.11.2.1 Mood

Consumption of breakfast has been found to improve mood in adults. Being happy and sociable (hedonic tone) is increased following consumption of breakfast (Smith, 1998). In one study people who ate a cereal breakfast each day were also found to be calmer following the completion of a series of performance tasks, suggesting that the consumption of breakfast cereal had an effect on anxiety (Smith, 1998).

It has been suggested that meals which facilitate a moderate, sustained elevation in blood glucose for example a high fibre carbohydrate rich meal (cereal and toast) may enhance alertness (Holt et al., 1999). In this study participants who consumed breakfast had an immediate increase in alertness. Similar findings have been reported by Lloyd, Rogers & Hedderley (1996). Following the consumption of a low fat, high carbohydrate breakfast participants reported an improvement in mood, including a decline in fatigue/dysphoria. The macronutrient content of the breakfast, regardless of the energy value and oro-sensory qualities, displayed small but reliable effects on subsequent mood. It was suggested that a relative decline in mood state are

found when participants deviate from their habitual meal composition. Omitting breakfast had no detrimental effect on mood.

Findings from another study showed that following a high-fat morning meal participants reported feeling more dreamy and fatigued and less vigorous compared to a high-carbohydrate meal (Wells & Read, 1996). Similarly, volunteers have reported feeling more sleepy and less awake 2-3 hours following a high fat, low carbohydrate meal, and ratings of fatigue were also significantly greater (Wells, Read, Uvnas-Moberg & Alster 1997).

1.11.2.2 Mental health

Most studies of health practices conducted with adults used a cumulative score to assess their relationship with physical and mental health. Some however considered the individual effects of each health practice. One measure of good health practice is regular breakfast consumption (Belloc & Breslow, 1972). Irie et al (1997) found a reduction of good health practices was related to increased negative mental health as measured by the GHQ; specifically reduced breakfast consumption was associated with negative mental health. Depression was significantly associated with skipping breakfast, regardless of social support, age and gender (Allgower, et al., 2001). Kimura, Ogushi, Haruki & Okada (2000) identified breakfast consumption as an important factor with regard to mental health status as measured by the SF-36.

Poor mental health was found to be associated with not eating cereal or porridge at least 5 times per week in women although this did not remain statistically significant in the final adjusted model (Sarlio-Lahteenkorva et al., 2004). Eating breakfast everyday was significantly associated with decreased total GHQ, anxiety-insomnia and social dysfunction in male factory workers (Ezoe & Morimoto, 1994). Breakfast consumption was found to be inversely associated with depression and neurosis in male overseas workers, however this association was weak (Tuekpe et al., 2006).

The relationship between nutrition and mental health is not as straightforward as some of the other factors. Some researchers have failed to find any effect of eating behaviour on mental health (Milligan, Burke, Beilin, Richards, Dunbar, Spencer, Balde & Gracey 1997). In addition Simonsick (1991) found that healthy eating was associated with mental health problems and that attempts to follow a healthy diet was associated with being close to a nervous breakdown in men and emotional

disturbances in women.

Participants were found to be less depressed, less emotionally distressed and had lower levels of perceived stress than those who did not eat breakfast each day (Smith, 1998b). Breakfast consumption is also linked with reduced stress and a lowering of cortisol activity (Smith, 2002), improved sleep quality and bowel function (Smith, 2005; Tanaka, Taira, Arakawa, Masuda, Yamamoto, Komoda, Kadegaru & Shirakawa 2002) and reductions in fatigue (Smith, Bazzoni, Beale, Elliott-Smith & Tiley 2001) all of which are also related to mental health. The link between breakfast and reduced fatigue has been suggested as the most important factor leading to improved mental health (Chen, Sekine, Hamanishi, Wang, Gaina, Yamagami & Kagamimori 2005).

Previous research has considered the effects of breakfast on mood and mental health and the vast majority support the notion that breakfast is a positive health behaviour. There are a number of possible explanations for this. Consumption of breakfast, specifically cereal, has a positive impact on macronutrient and micronutrient intake in adults (Morgan et al., 1986; Nicklas et al., 1995; Galvin et al., 2003) and children (Rampersaud et al., 2005). However the explanation which has received the most interest is an increase in glucose following consumption of breakfast.

1.12 Energy load and mood

Michaud, Musse, Nicolas and Majean (1991) found that meal size had no effect on mood in adolescents. However, higher levels of hedonic tone were reported after eating the higher energy breakfast (in 10-11 year olds) in the study conducted by Wyon, Abrahmasson, Järtelius and Fletcher (1997). Two studies using adult samples have also considered energy load. With respect to lunch Smith, Ralph and McNeill (1991) reported no effect of meal size on mood. Smith, Kendrick, Maben and Salmon (1994) found higher levels of sociability following consumption of a larger meal. The evidence presented above does not allow any strong conclusions to be made about the effects of meal size on mood.

1.13 Occupational factors

When considering health another important consideration in today's society is

working life. Previous research has considered the effects of some lifestyle factors on accidents and injuries. These have predominantly considered smoking, alcohol and sleep disorders (for example: Sacks & Nelson, 1994; Wadsworth, Simpson, Moss & Smith 2003). Smoking is considered one of the most significant, yet controllable, risk factors for accidents and injuries at work (Sacks & Nelson, 1994). Research has shown current smokers to be 2-3 times more likely to be injured than non-smokers (Oleckno, 1987; Wadsworth et al., 2003; Wen, Tsai, Cheng, Chan, Chung & Chen 2005; Wong, 1994). Alcohol has been identified as a significant risk factor. The leading causes of alcohol-related injuries are violence, road traffic accidents, accidental falls and fire/burns (Macdonald, Cherpitel, DeSouza, Stockwell, Borges & Giesbrecht 2006). Two literature reviews conclude that alcohol was involved in less than 11% of work injuries (Stallones & Kraus, 1993; Webb, Redman, Hennrikus, Kelman, Gibberd & Sanson-Fisher 1994). Two further important considerations are age and gender. Young men report higher levels of occupational injuries (Bhattacherjee, Chau, Sierra, Legras, Benamghar, Michaely, Ghosh, Guillemin, Ravaud, Mur & Lorhandicap Group 2003).

Another factor related to performance is cognitive failures. These are slips of memory, attention or action and lead to cognitive based errors on tasks which are simple and should be completed easily and without fault. Cognitive failures are considered human error, which is associated with accidents (Larson & Merritt; 1991; Larson, Alderton, Neideffer & Underhill, 1997). Accidents have been found to be associated with distractibility, poor selective attention and mental error, in other words cognitive failures (Hansen, 1989; Arthur, Barrett & Alexander, 1991). In addition they occur far more frequently than accidents, however only in certain situations do they lead to accidents.

There is a strong association between occupation and health (Marmot & Wilkinson, 2001) however this relationship is not understood very well. It is important to consider accidents, injuries and cognitive failures at work. The number of work-related accidents is increasing across the world (Nakata, Ikeda, Takahashi, Haratani, Hojou, Fujioka & Araki 2006), with 270 million being reported each year (International Labour Organisation, 2005). Unintentional injuries are in the top ten causes of death and disability worldwide (World Health Organisation, 2002a). Very little is known about non-fatal injuries and associated risk factors (Begg, Langley &

Williams, 1999).

Consideration of other outcomes can help to create a broader understanding about the effects of breakfast and snacking. A greater the level of understanding about breakfast and the snacking means more confidence about the implications of possible dietary based interventions. The associations between lifestyle factors, work stress and accidents, injuries and cognitive failures were addressed in the study reported in Chapter 3.

1.14 Children, lifestyle and dietary factors

Most of the lifestyle research discussed previously has focused on adults. However, dietary patterns and other lifestyle factors develop during childhood and these persist into adult life. Childhood is a time of rapid growth where nutrient intake should reflect the increasing demand for energy, vitamin and minerals as these are the building blocks for muscular and bone growth. It is therefore apparent that breakfast is an especially important meal, both in terms of re-fuelling in the morning and ensuring an adequate intake of nutrients.

Breakfast skipping is becoming an increasing problem in children and adolescents. Children from poor economic backgrounds are more likely to skip breakfast (Höglund, Samuelson & Mark, 1998; O'Dea & Caputi, 2001; Keski-Rahkonen, Kaprio, Rissanen, Virkkunen & Rose, 2003).However, this group is particularly at risk to suffer from health problems (Brooks-Gunn, 1997; Aber, 1997; Roberts, 1997; Reading, 1997). This led to a government initiative to provide breakfast at school and breakfast clubs were opened in deprived areas of the UK. In addition to the positive relationship with health, breakfast has been found to be associated with academic performance and behaviour in school.

Breakfast clubs were proposed to boost children's academic performance because a less hungry child is more likely to concentrate and learn and by reducing the rates of school absenteeism (Ball, 1998). A longitudinal study looked at school breakfast participants (SBP) versus non school breakfast participants (NSBP) (Meyers, Sampson, Weitzman, Rogers & Kayne 1989). Participation in the SBP decreased lateness and absenteeism. Researchers are concerned with how school breakfast will affect behaviour; attendance and how this will effect overall school achievement. In fact many outcomes have been improved by breakfast consumption at

school.

An evaluation of breakfast clubs who won awards in the 2000 UK-wide Breakfast Clubs Award Scheme looked at the effects of breakfast clubs on improving education (Harrop & Palmer, 2002). Improvements were found for attendance, punctuality, concentration and academic performance. Three quarters felt that the club had helped to improve attendance at the school, and one in five said that the club had contributed to significant improvements. In addition three quarters also felt that the club had helped improve punctuality of which a quarter thought that the club had contributed to significant improvements. Four in five schools felt that the club had helped improve concentration in morning lessons, although few reported significant improvements. Half felt that the club had helped improve academic performance in morning lessons. However, few reported significant improvements and one third said they were unable to give an opinion.

The Community Childhood Hunger Identification Project (CCHIP) in the U.S has shown that hunger is associated with poor behavioural and psychosocial behaviour in children (Kleinman, Murphy, Little, Pagano, Wehler, Regal & Jellinek 1998; Murphy, Wehler, Pagano, Little, Kleinman & Jellinek 1998). Few studies, however, have looked at the effect of different types of breakfast on behaviour in children. Two exceptions to this are studies by Murphy et al. (1998) and Worobey and Worobey (1999) who have shown that children who eat a school breakfast show better behaviour than children who eat breakfast at home.

The majority of research which has examined breakfast consumption / skipping in children has links to academic performance or physical health and obesity. Very little research has examined mental health and well-being. Based on the results from adult data it would appear that the relationships between breakfast, snacking and health are of interest and are likely to be just as important, if not more so in children. Research in children is beneficial for a number of reasons. This research could help to identify when these relationships develop and indicate when interventions may be their most effective. In addition there are fewer other lifestyle factors to be considered. The associations between breakfast, snacking and health are examined in the study reported in Chapter 4.

1.15 Associations between breakfast and snacking

A significant minority of children in the U.K are arriving at school either having nothing for breakfast or having eaten, crisps confectionery and fizzy drinks (Street 1999). A separate but related issue arises here, that of what actually defines breakfast. Most children eat something in the morning however, should any food or drink consumed in the morning breakfast be considered breakfast or should breakfast provide a minimum amount of calories and nutrients? Advice given by health professionals in the United Kingdom is that a breakfast should constitute 20% of the Recommended Nutrient Intake (RNI) of energy, macronutrients and micronutrients (Gibson & O'Sullivan, 1995). It is also recommended that a healthy breakfast should be high in carbohydrate and low in fat (Street 1999).

As children become more and more independent other types of food are consumed at breakfast. The likelihood of purchasing a 'breakfast' on the way to school has increased and this breakfast could be anything from a bacon or sausage roll purchased from outside the home to crisps, chocolate, fizzy drinks and sweets (traditionally considered to be snack foods). This is further compounded by the lack of a definition about what constitutes breakfast and what constitutes a snack. For the studies reported below breakfast was defined as anything eaten before school or on the way to school and a snack was anything eaten at break-time (but not lunchtime) or on the way home from school.

Eating breakfast was associated with reduced impulsive snacking (Schlundt, Hill, Sbrocco, Pope-Cordle & Sharp, 1992) and eating snacks which are lower in fat (Resnicow, 1991). Individuals who frequently skip breakfast generally do not consume healthy foods (Shimai, Kawabata, Nishioka & Haruki, 2000). Children who skip breakfast are more likely to snack between meals (Sjöberg, Hallberg, Höglund & Hulthén (2003) and these snacks are more likely to be unhealthy snack foods, e.g. chocolate, sweets and soft drinks (Utter, Scragg, Mhurchu & Schaaf 2007), bought from outside the home.

Breakfast skipping may cause greater levels of hunger later in the day resulting in overeating or lead to consumption of higher energy dense foods resulting in greater overall intake (Wyatt, Grunwald, Mosca, Klem, Wing & Hill 2002). Therefore unhealthy snacking could modify the relationship between breakfast consumption at home and body mass index (Utter et al., 2007). People who snack

frequently eat more in general (Gatenby, 1997). Other explanations are that breakfast consumers are more likely to perform other healthy behaviours.

The vast majority of research has considered the effects of breakfast and snack consumption independently. This however only provides a limited account of these effects. It is important that the interactions between breakfast and snacking are examined. The evidence described above suggested that skipping breakfast is strongly associated with consumption of unhealthy snacks. What is not known is whether a negative effect of snacking may actually represent a negative effect of not consuming breakfast. This is examined in the study reported in Chapter 4.

1.16 Mechanisms

A number of explanations have been offered to explain the effects of breakfast. However the explanation which has received the most interest is an increase in glucose following consumption of breakfast. These explanations could equally be used to explain the effects of snacking. If snacking is examined in the same way as breakfast, but with differing results this may help to elicit any underlying mechanisms. Below is a discussion of the mechanisms by which breakfast and / or a snack may affect behaviour.

1.16.1 Glucose

It has been suggested that breakfast is associated with improved mood due to increased availability of glucose to the brain. There is a tendency for those with lower blood glucose, when performing cognitively demanding tasks, to report poorer mood. In a range of situations an association between a tendency for blood glucose levels to fall rapidly, and irritability, has been found. It has been suggested that meals which facilitate a moderate, sustained elevation in blood glucose may enhance alertness (Holt et al., 1999). Glucose is the primary source of energy for the brain and is essential for the normal functioning of the central nervous system (Sieber and Traystman 1992). The fact that glucose is able to cross the blood-brain barrier by the process of active transport is an important clue in understanding how it might affect performance. Exactly how glucose effect mental performance remains debated. The fact that glucose crosses the blood-brain barrier by active transport (Wenk 1989) and that it is used in a huge number of biochemical processes is of key importance.

Glucose levels influence the activity level of, and are influenced by other neurotransmitters; including dopamine, serotonin, norepinephrine and it is a key substrate for acetylcholine (Benton, Owens & Parker 1994, Messier and White 1987, Wenk 1989, Ragazzino & Gold 1994).

1.16.2 Carbohydrate

Brain sertonergic (5-hydroxytrptamin, 5-HT) function on mood and behaviour is the most extensively tested idea looking at the relationship of food and mood (Rogers 1995). Increased carbohydrate consumption has been found to increase tryptophan (TRP) uptake in the brain, which is a precursor for serotonin synthesis (Fernstrom & Wurtman, 1972). It is proposed that a high carbohydrate meal increases the ratio of the plasma concentration of TRP relative to the other 'large neutral amino acids' (LNAA). Since TRP and the other LNAA compete for entry into the brain and the rate limiting enzyme for serotonin production (tryptophan hydroxylase) is not fully saturated with substrate under normal conditions, an increase in plasma TRP:LNAA concentration leads to an increase in brain serotonin synthesis and in turn, to increased serotonergic neurotransmission. This is thought to produce changes in the neurotransmitters systems that are know to be related to mood (Fernstrom & Wurtman, 1972).

Carbohydrate has been found to reduce depression in people with carbohydrate craving obesity, premenstrual syndrome and seasonal affective disorder (Wurtman & Wurtman, 1989). The majority of these studies are cross-sectional and of a correlational nature. This makes the findings harder to interpret. Over a nine day period, higher intake of carbohydrate was found to be associated with less depression and more energy in healthy participants (De Castro, 1987). The amount of carbohydrate consumed over a seven-day period has been found to be associated with positive mood in a group of control subjects (Jansen, van den Hout & Griez 1989). Conversely an intervention study found that participants made to eat a low carbohydrate diet for one week reported increased anger, depression and tension (Keith et al., 1991). Another study found increased anger following consumption of a low carbohydrate / high protein breakfast for 3 weeks (Deijen et al., 1989). In contrast Prusaczyk et al. (1992) found no differences when comparing low and high carbohydrate diets for 3 days. In many individuals, poor mood stimulates the eating of

palatable high carbohydrate/high fat foods that stimulate the release of endorphins. A review by Benton, (2002) identified a series of studies which reported that a high carbohydrate meal, or diets high in carbohydrate, are associated with feeling less energetic.

1.16.3 Carbohydrate versus protein

Foods with different proportions of protein and carbohydrate can influence mood and performance by changes in serotonergic function. In contrast to the positive effect of carbohydrate on serotonin synthesis, consumption of a meal high in protein can be expected to have the opposite effect, primarily because most dietary proteins contain little tryptophan (Wurtman, Wurtman, Growdon & Henry 1981).When a high carbohydrate, low protein diet was consumed, stress prone individuals did not show the stress-induced rise in depression, decline in vigour and cortisol elevation that they showed after the high protein, low carbohydrate diet (Markus, Panhuysen, Tuiten, Koppeschaar, Fekkes & Peters 1998). An improvement in mood, including a decline in fatigue/dysphoria, was observed in those consuming a low fat, high carbohydrate breakfast (Lloyd *et al.*, 1996).

A number of researchers have shown that a food or drink containing a high proportion of simple carbohydrate such as sugars or simple starches which are readily metabolised to glucose will lead to a drowsy, unaroused state (Spring, Maller, Wurtman, Digman & Gozolino 1983; Lieberman, Spring & Garfield 1986; Thayer, 1987; Pivonka & Grunewald, 1990). This contradicts the popular perception that carbohydrate, especially sugar, will have an energising or even hyperactive effect. A previous study showed that there was greater drowsiness, sleepiness and calmness after carbohydrate-rich meals compared with protein rich meals (Spring, Chiodo & Bowen 1987), although this was not found to be consistent across all groups. A sugar sweetened drink was found to increase sleepiness and decrease alertness when compared to a drink sweetened with aspartame (Pivonka & Grunewald, 1990). Although some studies have not found this effect (Brody and Wolitsky 1983, Reid and Hammersley, 1994, 1995; Wells, Read & Craig 1995).

Other studies in the late 1980s and early 1990s however failed to show any definite carbohydrate versus protein effects on mood, despite confirmation of the significant effects on TRP: LNAA (Deijen *et al.*, 1989; Christensen & Redig., 1993).

The influence of dietary changes on plasma tryptophan: LNAA ratio is probably too small to produce any significant changes in brain sertoninergic function (Young, 1991).

1.16.4 Carbohydrate versus fat

Overall, high-fat meals have been shown to increase fatigue and reduce alertness. There was however inconsistencies in these findings, e.g. feelings of drowsiness, confusion and uncertainty were seen to increase after low- and high-fat lunches but not after a medium-fat lunch (Lloyd, Green & Rogers 1994). Another study by Lloyd and colleagues looked at different amounts of fat in the breakfast meal on mood. The participants reported reduced 'fatigue-dysphoria' after a low-fat / high-carbohydrate breakfast (Lloyd *et al.,* 1996). This could be due to the fact that mood may be affected by meals that differ substantially in macronutrient composition from habitual ones (Rogers & Lloyd, 1994; Dye, Lluch & Blundell 2000), i.e. participants were habitually eating a low-fat breakfast and the change from a low-fat to a different breakfast may change their mood rather than high- or low-fat *per se.*

Mood differences were seen in the Lloyd studies after only 30 minutes (Lloyd *et al.,* 1994, 1996) however there is evidence to show that increases in fatigue because of fat ingestion are not likely to occur until the arrival of substantial amounts of fat into the duodenum 2-3 h later (Wells *et al.,* 1995, 1997; Wells and Read, 1996). It is possible therefore in Lloyd's studies that the effects of mood may have resulted from discrepancies between subjects' expectations of post-ingestive effects, and the actual effects that resulted from neurohormonal responses to detection of specific nutrients in the duodenum and liver (Gibson & Green, 2002).

Wells and Read showed that half an hour after ingestion of low- or high-fat meals, alertness increased and sleepiness declined. Arousal declined to the highest extent 2.5-3h after a high-fat meal (Wells *et al.,* 1995, 1997; Wells and Read, 1996). If lipid was infused directly into the duodenum, alertness declined much earlier. There was a increase in fatigue and reduction in vigour by 30-90 minutes after a high fat-meal when eaten mid morning but not at lunch time (Wells *et al.,* 1995; Wells and Read, 1996).

The mechanisms underlying fat effects on mood are thought to be via the action of metabolic and gastrointestinal hormones. Cholecystokinin (CCK) which is a

gastric regulatory hormone is affected by the breakdown of dietary fat which leads to increases in duodenal non-esterified fatty acids (Schwizer, Asal, Kreiss, Mettraux, Borovicka, Rémy, Güzelhan, Hartmann & Fried 1997). CCK can reduce arousal (Stacher, 1985). Plasma CCK level and somatostatin increase to a great extent after a high-fat, low –carbohydrate than after a low fat, high- carbohydrate equi-energtic meal (Wells et al., 1997). The reverse was true for insulin and glucose. There was an increase in gastrin in equal amounts after both meals. Associations between levels of hormones were investigated by multiple regression. Fatigue was positively correlated with levels of CCK and negatively with gastrin whilst sleepiness was positively related to insulin and negatively to gastrin. However there were no interactions between meal types in the regression analyses, and changes in gastrin were unrelated to meal type.

1.16.5 Micronutrients

As most breakfast cereals are high in carbohydrate, this may offer one reason why breakfast consumption has been associated with an improved mood. It has also been suggested that micronutrient supplementation can improve mood (Benton, Haller & Fordy, 1995). A number of studies have associated thiamine with mood and feelings of well being. Poor thiamine status has been associated with introversion, inactivity, fatigue, decreased self-confidence and a generally poorer mood (Heseker, Kubler, Pudel & Westenhoffer 1992). When these individuals received supplementation of thiamine for two months there was an increase in sociability and sensitivity.

Similar findings have been found in a number of other studies. In Irish females with poor thiamine status supplementation of 10mg of thiamine over a six week period was associated with greater feelings of well being and less fatigue (Smidt, Cremin, Grivetti & Clifford 1991). The poor thiamine status in these women may reflect the lack of fortification of food in Ireland. In individuals with marginal thiamine status, supplementation of thiamine and improvement in thiamine status has been associated with improved mood, and being more clearheaded, composed and energetic (Benton et al., 1995; Benton, Haller & Fordy 1997). An improvement in mood has also been associated with improved riboflavin and vitamin B6 in women (Benton et al., 1995).

There is also evidence from clinical observations and biochemical studies which suggest that folate may be involved in the regulation of mood, in particular depression. "Evidence has been steadily mounting over the past several decades implicating folate in processes thought to underlie the regulation of mood and the mediation of anti-depressant drug effects" (Alpert & Fava, 1997). Folate deficiency has been associated with insomnia, irritability, fatigue and forgetfulness (Herbert, 1962). Depressed patients have consistently been found to have lower serum or RBC folate concentrations compared to normal patients (Abou-Saleh & Coppen, 1989; Carney, Chary, Laundy, Bottiglieri, Chanarin, Reynolds & Toone 1990, Ghadirian, Ananth & Engelsmann 1980). Improvements in mood have been observed in folate-deficiency, depressed patients following folate replacement (Reynolds, 1967; Botez, Young, Bachevalier & Gauthier 1979; Carney & Sheffield, 1970). The biochemical mechanisms through which folate exerts an influence on mood and behaviour are likely to involve the one-carbon cycle, which is essential to many transmethylation reactions within the central nervous system, including the metabolism of neurotransmitters (Alpert & Fava, 1997). The above findings supports the association between breakfast cereals and improved mood as many breakfast cereals are fortified with vitamins, including thiamine and folate, and minerals.

1.17   Summary of the chapter

It is not always possible to consume breakfast every morning and therefore consumption of an appropriate mid-morning snack may be beneficial. It is necessary to try and identify what an appropriate snack may be. There are concerns that if snacking on unsuitable foods become an established habit in children; this may lead to increased snacking with potential consequences for the development of obesity.

Previous research has controlled for a number of lifestyle factors including smoking behaviour, alcohol consumption, weight and level of exercise. It is important that future studies also consider these factors. Research is needed to clarify whether the associations between breakfast, snacking and health are independent of other lifestyle factors. This has important implications for potential interventions. The studies in this thesis controlled for a number of lifestyle factors. The aim was to replicate previous findings and extend this area by considering other outcomes.

The UK is currently experiencing very high levels of health problems, both

physical and mental (ONS 2000, Goldberg & Huxley, 1992). Not only do these problems have a negative effect on individuals and families they are a huge finical burden for the economy and health service. Getting people to change their lifestyle habits may help to alleviate some of these problems. Breakfast has long been considered a positive health behaviour and it significantly contribute to the diet at a macro- and micro-nutrient level. On the other hand snacking has generally been perceived as a negative pattern of eating which should be avoided. Knowledge of the effects of snack consumption is inconsistent and in some cases completely absent. However both breakfast skipping and snacking are increasing and examination of their effects of breakfast and snacking may provide important insight both in terms of implications and interventions.

Reviewing the current literature has identified a number of gaps in the research and a lack of understanding in other areas. Based on this there are an infinite number of directions which this thesis could have taken. The focus of this thesis is:

- Replicate the previous benefits found for breakfast consumption and subjective health and extend this research to consider other outcomes
- Expand the current snacking research using the breakfast research as a benchmark.
- Examine the role of other lifestyle and demographic factors on the relationship between dietary intake and health
- Investigate the relationship between breakfast and snacking
- Try and identify a psychosocial profile of breakfast and snacking
- Consider these effects in a range of samples

The first study in this thesis addressed prevalence of snacking, measurement of dietary intake and use of appropriate methodologies and associations between breakfast and snacking frequency and health and well-being.

CHAPTER TWO

THE RELATIONSHIP BETWEEN SNACKING HABITS, SNACKING PERCEPTIONS, SNACKING FREQUENCY, BREAKFAST FREQUENCY, AND HEALTH AND WELL-BEING IN MEMBERS OF THE GENERAL PUBLIC

2.1 Aims of the study

This study is an exploratory study. The first aim was to examine snacking habits, perceptions of snacking and definitions of snacking within the general population. The second aim of this study was to find out whether the breakfast methodology could be applied to snacking research. The final aim of the study was to investigate the effects of breakfast and snacking frequency on self-reported health and well-being. A cross-sectional survey methodology was used.

The outcome measures used in this study were well established scales. These scales were used to measure health related behaviours (e.g. smoking behaviour, alcohol consumption), physical (common physical complaints reported by individuals for example fatigue, muscle aches, pain etc) and mental (e.g. depression, anxiety) health. A full description of these and the other measures used in this study are given in the method section.

2.2 Introduction

2.2.1 Snacking

The previous chapter highlighted and discussed a number of important reasons for studying the effects of snacking, these included weight gain / obesity, nutritional intake, physical health, mental health and well-being. Researcher knowledge of snacking and its associations with health and well-being is very limited.

Nutrition and behaviour is receiving increased interest, particularly within public health, and it is therefore important that more research is conducted to investigate snacking as thoroughly as other areas of eating behaviour. There are a number of problems associated with studying eating patterns and behavior for example defining eating occasions and measurement of intake. Please refer to Section 1.7 for more detail. For this reason a large amount of demographic information is

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required from a variety of different samples in order gain a clearer picture of snacking behaviour. It is important to establish whether people are snacking and if so what they are eating.

One issue which needs to be addressed before examining any effects of snacking on behaviour is measuring food intake. Due to the limited amount of research there is as yet no established methodology for snacking research. Other areas, for example breakfast consumption, have received much greater interest. Using the breakfast methodology to examine the effects of snacking would appear to be a logical step. The inclusion of breakfast in the study as a positive control would allow for this methodology to be tested with snacking.

2.2.2 Breakfast, snacking and health outcomes

Research found that regular breakfast cereal consumption was associated with less stress, depression, emotional distress, fewer physical symptoms (Smith, 1999; 2003) and less fatigue (Nakao & Yano, 2006). Those who ate breakfast on an almost daily basis reported significantly better physical health than those who skipped breakfast (Belloc and Breslow, 1972). Another study found daily breakfast consumption was associated with lower depression, although this failed to reach statistical significance (Frederick, Frerichs & Clark, 1988).

With respect to snacking the current literature has mainly considered the relationship between snacking frequency and physical outcomes such as body weight and obesity. Those who rarely ate between main meals reported significantly better physical health than those who ate between meals (Belloc and Breslow, 1972). Erratic eating was associated with poorer health than eating regular meals. One other study has considered snacking and mental health (Smith, submitted). Participants who consumed at least one snack everyday scored lower on all measures of mental health (stress, depression, emotional distress and anxiety) than those participants who reported never snacking, however none of these differences were found to be significant. This result was found in four samples: one from the general population (aged 20-60); one from late teens living at home; one from a student population (aged 18-30) and one from an elderly sample (aged 65+). Although no significant benefits of snacking were found no negative effects of snacking were identified which suggests that snacking should not be avoided.

2.2.3 Methodological issues

Numerous studies have been conducted examining the effects of breakfast on mental health. Breakfast is commonly consumed and widely researched and therefore it can provide a realistic benchmark for snacking research. Previous studies conducted on breakfast have used a single item to measure breakfast (How often do you eat breakfast?) and responses were given on 5 point Likert scale ranging from never to everyday (Smith, 1998; 1999; 2003).

All of these studies were conducted using self-report survey measures and were cross-sectional in nature. Cross-sectional studies are used to measure the prevalence of both health outcomes and determinants of health within a sub-group of the population at one point in time and they are particularly useful when the study is descriptive in nature.

There are however a number of disadvantages of using cross-sectional data which need to be noted. They do not allow for any assumptions to be made regarding causality as both the determinants of health and health outcomes are measured at the same time. As a result differing results may be found if another time-frame is considered. Biased response is also a concern. An individual may be more likely to respond if they have a particular characteristic or set of characteristics. A biased response occurs if these characteristics are linked to the outcomes variable(s). For example, those interested in diet and health would be more likely to complete a dietary questionnaire. They are also more likely to be aware of their diet and health and this would bias the results found.

These studies are very time and cost efficient and can provide important background information about the current situation. They are especially useful when very little is known, as with the field of snacking, as they can indicate whether an area warrants further and more detailed study and help generate hypotheses.

In order to establish whether this design is appropriate for snacking research it was important that the previous associations found between breakfast consumption and health outcomes were replicated.

2.2.4 Summary

The focus of the current study is to establish prevalence of snacking and other eating habits, in addition to peoples' perceptions and definitions surrounding

snacking, determine whether the methodology used for breakfast research is appropriate for snacking research and investigate any associations between breakfast, snacking and health and well-being.

2.2.5 Questions to be addressed in study 1

On the basis of previous literature the following questions were addressed:

2.2.5.1 Characteristics of snacking and snacking habits

1. How often do participants eat snacks?
2. When during the day do they eat snacks?
3. How many meals do participants eat per day?
4. What do they usually eat for these meals?
5. What is the psychosocial profile associated with snacking?

2.2.5.2 Perceptions and definitions of snacking

6. Which qualities do participants rate as being important in a snack food?
7. What are peoples' beliefs about a snacking pattern of eating and snack foods and specifically do people perceive snacking and snack foods as being unhealthy.
8. What definition of snacking do participants prefer?
9. Which foods do participants perceive to be healthy snacks?
10. What food and drink items do participants consider to be snacks?
11. What do participants actually eat as a snack?
12. Are any differences seen based on age groups?
13. Are any differences seen based on gender?

2.2.5.3 Relationship between breakfast frequency, snacking frequency and health and well-being

14. Is breakfast frequency a good indicator of health outcomes (both mental and physical)?
15. Is snacking frequency a good indicator of health outcomes (both mental and physical)?

2.3   Method

2.3.1   Participants

A total of 136 participants were recruited from members of the general population. The participants consisted of 96 females and 40 males, ranging in age from 17-80 years (mean age was 37 years). The purpose of the study was to examine snacking habits and their associations with health related behaviours, psychosocial factors and health outcomes. The participants were informed about the purpose of the study. Participants were either recruited through poster advertisements or contacted via a participant database. They were sent the material to complete through the post. All participants were paid for participating in this study. Participants were told that the aim of the study was to examine health related behaviours and general health status per se. All of the participants were debriefed following the study and it was explained that the primary aim of the study was to investigate associations between dietary intake and mental health and well-being. Ethical approval was given by the Cardiff University, School of Psychology ethics committee.

2.3.2   Procedure

Participants recruited from the databases were sent a letter and information sheet detailing the study and a consent form. Participants were requested to complete the consent form and a variety of psychosocial questionnaires in addition to a food frequency questionnaire and to return them in the freepost envelope provided. Participants recruited through the poster campaign came to the laboratory and were given the same information sheet detailing the study and consent form. Participants completed the questionnaires in the laboratory.

2.3.3   Materials and measurement

Data were collected about food frequency, demographics and health related behaviours (see below). In addition a number of psychosocial and health outcomes measures were used in this initial study. The majority of these are widely used and are valid and reliable.

2.3.4   Food frequency questionnaire

The food frequency questionnaire was developed to investigate participants'

beliefs about snacking, their definition of snacking and their snacking habits (full questionnaire can be found in Appendix A1). The questionnaire used Likert scales to measure breakfast frequency, snacking frequency, beliefs about snacking and important properties of snack foods. Information was also collected about definition of snacking, which foods were considered snacks, which foods participants ate as snacks and which they considered to be healthy snacks.

2.3.5 *Health Related Behaviours*

This is a questionnaire (based on Cohen, Tyrrell & Smith, 1993) which measures a number of factors such as exercise, alcohol consumption and smoking (full questionnaire can be found in Appendix A1).

2.3.6 *Psychosocial factors*

A number of standardized measures were used to examine psychosocial factors. Table 2.1 shows the complete list of questionnaires completed by participants (for complete versions of these questionnaires see Appendix A1). Those measures of particular interest are described in more detail below. A full description of the remaining questionnaires can be found in Appendix A1. Reliability analysis was conducted for all of the questionnaires used in this study. Alpha coefficients are given in Appendix A2 and any values of interest are reported in the results section.

Table 2.1: Psychosocial questionnaires used in the present study

Measure	Reference
1. Personality	
State-Trait Anxiety Inventory	Spielberger, Gorsuch, & Lushene, 1971
Neuroticism & Introversion	Eysenck & Eysenck, 1968
Self-esteem	Fleming & Watts, 1980
2. Stress measures	
Life events	Henderson, Bryne & Duncan-Jones, 1981
Hassles	Kanner, Coyne, Schaefer & Lazarus, 1981
Perceived stress	Cohen, Kamarack & Mermelstein, 1983
Positive and Negative Mood States	Zevon & Tellegen, 1982
3. Social Support	
Interpersonal Support Evaluation List	Cohen & Hobermann, 1983
University of California Loneliness Scale	Russell, Peplau, & Ferguson, 1982
Social Network Index	Berkman, 1984
4. Locus of control	
Social reaction Inventory	Paulhus, 1983
5. Health beliefs	
Health promotion scale	Bausell, 1986
Health orientation scale	Snell, Johnson, Lloyd & Hoover, 1991

2.3.6.1 Personality measures

State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch & Lushene, 1970)

Self report measures of individual's current level of anxiety (state anxiety) as well as their general level of anxiety (trait anxiety). Both scales consist of 20 statements, trait anxiety statements asked how one generally feels for example, "I am happy" and "I feel like crying". The statements were rated on a 4 point likert scale which ranged from (1) almost never to (4) almost always. The state anxiety statements were similar but asked about how one felt at that moment such as, "I am content" and "I am upset". These were also rated on a 4 point likert scale however this one ranged from (1) not at all to (4) very much so. The scores for positive items, on both scales, were reversed so

that a higher score is indicative of higher anxiety.

Eysenck Personality Inventory (EPI) – (Eysenck & Eysenck, 1968)

The neuroticism and introversion scales of the EPI were used. Participants responded either 'yes' or 'no' as to how they usually felt or behaved. A single score was calculated for neuroticism and introversion.

Self-esteem (Fleming & Watts, 1980)

This is a measure of reactions to and opinions about a number of situations. There are 14 items which are rated on a 6 point Likert scale from (1) I agree very much to (6) I disagree very much. A single score was derived from the questionnaire which was calculated by summing the all the responses. Higher scores indicate higher levels of self-esteem.

2.3.6.2 Stress Measures

Life Events (based on Cohen et al., 1991)

This is a measure of specific stressful events such as bereavement, divorce, unemployment, which occurred within a set time frame. The scale consists of 24 items. Participants are asked to indicate whether they have experienced any of these events in the past 12 months. The participants were required to answer either 'yes' if the event had occurred or 'no' if it had not. If participants responded with 'yes' they were asked whether it was a 'good' or 'bad' experience. The following scores were derived from the scale:

Negative life events – total number of negative events experienced by participants

Positive life events – total number of positive events experienced by participant

Total life events – summation of negative and positive life events.

Perceived Stress Scale (PSS; Cohen et al., 1983)

This is a 14 item measure of the degree to which situations in one's life are appraised as stressful. It focuses on three components unpredictability, uncontrollability and overloading, which are seen as central to the experience of stress. Items are also included which ask about current levels of experienced stress. A single score of stress is derived from this scale.

Negative and positive affect (Zevon & Tellegen, 1982)

Independent scales of negative and positive affect (10 items each) were derived from Zevon and Tellegen's (1982) factor analysis of 57 affect adjectives. The two scales are relatively independent and have differential predictability. Participants were presented with a list of adjectives in the question 'how (angry, proud, annoyed etc) have you felt this week'. Responses were given on a 5 point likert scale (0= not at all, 1= a little, 2= moderately, 3= quite a bit and 4= extremely). The scores on items for positive mood were added as were those for negative mood.

2.3.6.3 Social Support Measures

Interpersonal Support Evaluation List (ISEL; Cohen & Hoberman, 1983)

The general population version of the ISEL is a measure of perceived availability of social support. The scale consists of 40 items and 4 sub-scales of relatively independent kinds of social resources which are responsive to stressful events: Tangible – perceived availability of material aid, Appraisal – perceived availability of someone to talk to about ones problems, Self-esteem – perceived availability of a positive comparison when comparing ones self to others and Belonging – perceived availability of people one can do things with. Responses were given on a 4 point likert scale (1= definitely false, 2= probably false, 3= probably true, 4= definitely true).

2.3.6.4 Locus of Control

Social Reaction Inventory (SRI; Paulhus, 1983)

The SRI consists of 20 items and 2 subscales: personal efficiency, control over the non-social environment as in personal achievement and interpersonal control, control over other people in groups and dyads. Participants are asked to indicate how much they agree or disagree with the 20 statements using a 6 point scale ranging from (0) I disagree very much to (5) I agree very much. The total scores for each subscale are calculated by summing the responses from the corresponding statements.

2.3.6.5 Health beliefs and attitudes

Health Orientation Scale (HOS; Snell et al., 1991)

The HOS consists of 50 items and 10 sub-scales (5 items each) measuring people's beliefs about health and well-being. The 10 sub-scales are labelled: health consciousness, health monitoring, health anxiety, health esteem-confidence,

motivation to unhealthiness, motivation for health, health internal and health external locus of control, health expectations and optimism and health status. Responses were given on a 5 point likert scale (1= not at all characteristic of me, 2= slightly characteristic of me, 3= somewhat characteristic of me, 4= moderately characteristic of me and 5= very characteristic of me).

2.3.7 Health Outcomes

These are measures of common physical and mental symptoms. They have shown high correlations with psychosocial factors. The measures included are listed in Table 2.2 (the full versions of these measures are in Appendix A1). Those measures of particular interest are described in more detail below. A full description of the remaining questionnaires can be found in Appendix A1. Reliability analysis was run for all of the health outcome questionnaires used in this study. Alpha co-efficients are given in Appendix A2, with any values of interest are reported in the results section.

Table 2.2: Health outcomes measures used in the current study

Measure	Reference
Hospital Anxiety and Depression Scale	Zigmond & Snaith, 1983
General Health Questionnaire	Goldberg, 1992
Cohen-Hoberman Index of Physical Symptoms	Cohen & Hoberman, 1983
Profile of Fatigue Related States	Ray, Weir, Phillips & Cullen, 1992
Symptom Checklist	Smith, Johal, Wadsworth, Davey Smith & Peters, 2000
Revised Middlesex Hospital Questionnaire	Broadbent & Gath, 1979
Cognitive Failures Questionnaire	Broadbent Cooper, Fitzgerald & Parkes, 1982

Hospital Anxiety and Depression Scale (HAD) – (Zigmond & Snaith, 1983)

The HADS is a 14 item self report measure which is easy and quick to administer. The HADS incorporates depression and anxiety subscales and items are scored from

0-3. The corresponding items are summed to calculate totals for each subscale. A score of 10 or greater on either scale indicates the presence of clinical anxiety or depression. This scale avoids asking about ambiguous somatic symptoms such as dizziness and lethargy.

General Health Questionnaire (GHQ) – (Goldberg, 1992)

The GHQ screens for minor psychiatric disorders and is a self-administered questionnaire which focuses on two major areas – the inability to carry out normal functions and the appearance of new and distressing psychological phenomena. The shortened 12 item version was used in the current study. Participants were asked about how they have been feeling in the last few months and responded using a 4 point Likert scale ranging from (0) not at all to (3) much more than usual.

The Profile of Fatigue Related Symptoms (PFRS) – (Ray et al., 1991)

This was developed for use in patients with Chronic Fatigue Syndrome (CFS). The PFRS consists of 54 items and 4 subscales: emotional distress, cognitive difficulty, fatigue and somatic symptoms. Participants rated whether they had experienced the symptoms within the past week on a 7 point scale ranging from (1) not at all to (7) extremely. The items assigned to each subscale were summed (range from 1 to 77). Higher scores indicate greater levels of physical and mental symptoms.

2.3.8 *Statistical Analysis*

The data was analysed using SPSS for Windows v.14. Chi-Square analysis was used to examine associations between snacking behaviours, demographic information and health related behaviours. One way Analysis of Covariance was used to investigate the effects of breakfast and snacking frequency on the psychosocial and health outcomes measures.

2.4 Results

2.4.1 Demographic information:

Demographic information was collected from participants. A summary of this information can be seen in Table 2.3.

Table 2.3: Demographic information of the participants who completed the study

Sample Size	136
Mean age (s.e.) in years	37.3 (1.5)
Number of females	96
Number of males	40
Breakfast frequency: Never	7 (5.3%)
Less than once a week	1 (0.8%)
Once or twice a week	11 (8.4%)
Most days (3-6)	30 (22.9%)
Everyday	82 (62.6%)
Snacking frequency: Never	5 (3.8%)
Less than once a week	10 (7.6%)
Once or twice a week	26 (19.8%)
Most days (3-6)	48 (36.6%)
Everyday	42 (32.1%)
Smokers (%): Yes	17 (13)
No	114 (87)
Alcohol: Non drinker	13 (10)
Very occasional	29 (22)
Occasional	51 (39)
Regular	38 (29)

2.4.2 Eating habits

Nearly two thirds of the sample reported eating 3 meals a day (64%). Participants generally ate cereal for breakfast, a sandwich with fruit/crisps/yoghurt for lunch and a large cooked evening meal. The majority of participants ate 1-2 snacks a

day, with 80% of participants reporting at least one snack per day. The participants in this sample were eating approximately 4-5 times a day. The majority of snacks were eaten mid-afternoon (61%), followed by mid morning (59%) and then during the evening (52%).

2.4.3 Properties of snacks

Properties of snacks were given on a likert scale. The mode for each property is reported here. All of the values are given in tables in Appendix A2. Being "a healthy option / good for me" was considered to be a very important property of snack foods. Participants thought that "easy to carry", "very tasty", "fills me up" and "easy to eat on the go" were all quite important. Being "easy to share around" and having a "recognized brand name" were not considered to be important.

2.4.4 Perceptions about snacking

Perceptions of snacking were given on likert scales. The mode for each statement is reported here. All of the values are given in tables in Appendix A2. The participants agreed with the following statements: a grazing pattern of eating is less healthy than eating three meals a day; snack foods are generally less healthy and that increased snacking by the population is a major contributor to the current rise in obesity. However they disagreed with the following statements: I depend on snacks as I do not have enough time to prepare meals; some snacks are healthy but these are not tasty. Most participants were neutral about the statement I avoid snack foods as I think they are unhealthy.

2.4.5 Definition of snacking

When asked how best to define snacking the majority of participants (72%) agreed on the following definition, "food or drink eaten between main meals". When the sample was split for gender and age no differences were found in the definition. However when the sample was split based on ethnicity differences were found. Non-white participants equally agreed with food/drink eaten on the move, food or drink eaten between meals and food that is quick to eat (25%). Due to the small number of non-white participants in the current study it was not possible to explore ethnic differences for any of the subsequent analyses.

2.4.6 Perceptions of snacks

Data was collected about which snacks participants considered to be healthy. Table 2.4 shows how many participants thought each item was healthy. Not surprisingly fruit was the item which showed the most agreement. Everyone agreed that fruit was healthy (15 people did not complete this question). At the other end of the scale only 3 people considered a pot noddle to be healthy. There does appear to be some items which people are split over. These are cereal bars, cheese, crackers, peanuts and digestive biscuits. It is possible that these items are much harder to categorise due to there being considerable differences depending on the variety consumed.

Table 2.4: N (%) reporting that these items are healthy snack foods

N = 121	N (%)
Fruit	121 (92.4)
Low fat yoghurt	96 (73.3)
Breakfast cereal	94 (71.8)
Cereal bar	52 (39.7)
Cheese	38 (29.0)
Crackers	33 (25.2)
Peanuts	30 (22.9)
Digestive biscuit	27 (20.6)
Crisps	10 (7.6)
Chocolate	7 (5.3)
Pot noodle	3 (2.3)

The same process was used to examine which foods participants considered to be snacks. The number of participants who agreed each item is a snack food is listed in Table 2.5. Although there are high levels of agreement for some items, for example crisps and bananas, there are some items which split the participants, for example breakfast cereal and a can of coke.

Table 2.5: N (%) reporting that these items are snack foods

N = 130	N (%)
Crisps	123 (93.9)
Banana	113 (86.3)
Mars bar	113 (86.3)
Nuts	108 (82.4)
Can of coke	56 (42.7)
Breakfast cereal	49 (37.4)
Slice of pizza	46 (35.1)
Pot noodle	41 (31.3)
Sandwich	35 (26.7)
Chips	30 (22.9)
Bacon sandwich	22 (16.8)
Cheese burger	20 (15.3)
Pizza	8 (6.1)
Big mac	6 (4.6)

Data was collected about the foods participants reported eating as snacks. Frequency of consumption of each item is shown in Table 2.6. All of the items were reported as being eaten on a daily basis by some participants. Generally speaking those items considered to be healthy were eaten more frequently than those considered unhealthy.

Table 2.6: Frequency of consumption of snack items

N=128	Not at all	Once a week	3-4 times a week	5-6 times a week	once a day	2-3 times a day	4 or more times a day
fruit	20 (15.3)	23 (17.6)	29 (22.1)	14 (10.7)	25 (19.1)	12 (9.2)	5 (3.8)
fruit juice	63 (48.1)	18 (13.7)	14 (10.7)	11 (8.4)	14 (10.7)	7 (5.3)	1 (0.8)
dry fruit	85 (64.9)	23 (17.6)	14 (10.7)	3 (2.3)	3 (2.3)	0	0
packet crisps	49 (37.4)	41 (31.3)	24 (18.3)	7 (5.3)	5 (3.8)	2 (1.5)	0
chocolate	33 (25.2)	35 (26.7)	39 (29.8)	13 (9.9)	4 (3.1)	3 (2.3)	1 (0.8)
nuts	81 (61.8)	27 (20.6)	13 (9.9)	2 (1.5)	4 (3.1)	1 (0.8)	0
cheese	61 (46.6)	34 (26.0)	22 (16.8)	6 (4.6)	4 (3.1)	1 (0.8)	0
yoghurt	67 (51.1)	22 (16.8)	23 (17.6)	5 (3.8)	10 (7.6)	1 (0.8)	0
cereal bar	94 (71.8)	15 (11.5)	10 (7.6)	4 (3.1)	5 (3.8)	0	0
biscuits	49 (37.4)	28 (21.4)	32 (24.4)	7 (5.3)	9 (6.9)	3 (2.3)	0
cakes	78 (59.5)	23 (17.6)	22 (16.8)	3 (2.3)	2 (1.5)	0	0
toast	45 (34.4)	23 (17.6)	27 (20.6)	16 (12.2)	15 (11.5)	2 (1.5)	0
breakfast cereal	76 (58.0)	18 (13.7)	14 (10.7)	6 (4.6)	14 (10.7)	0	0
soft drink	87 (66.4)	17 (13.0)	9 (6.9)	9 (6.9)	4 (3.1)	2 (1.5)	0
hot drink	31 (23.7)	5 (3.8)	12 (9.2)	19 (14.5)	15 (11.5)	34 (26.0)	12 (9.2)
glass of milk	82 (62.6)	19 (14.5)	10 (7.6)	1 (0.8)	7 (5.3)	4 (3.1)	5 (3.8)

2.4.7 Is the same pattern of results found when looking at sub-samples?

2.4.7.1 Gender effects

Due to smaller numbers of male participants it was decided to split the sample and to examine the 2 groups separately in order to investigate any differences. Total scores were calculated based on the factors identified for "snacks participants had eaten within the last week". Means were compared for each of these scores. The male participants consumed more "teatime snacks" (biscuits and hot drinks) than the females (13.6 v. 10.7). The females ate more "healthy snacks" (fruit, nuts and yoghurt) (9 v. 7.1) and "other snacks" (fruit juice, cheese and toast) than the males (7.4 v. 6.5). No differences were found for "unhealthy snacks" (crisps, cake and chocolate). These results suggest that overall males and females do eat similar groups of snacks however there are some differences within these groups.

2.4.7.2. Age effects

The same process was used to look at age effects. Based on a histogram (see Appendix A2) a bimodal distribution of age was identified. The sample was therefore split into 2 groups: 17-40 years (low age group) and 41-80 years (high age group). Those participants in the lower age group ate more "other snacks" (8 v. 5.9) and "unhealthy snacks" (6.4 v. 4.3) than the older age group. Those participants in the high age group ate more "teatime snacks" (15.2 v. 9) and "healthy snacks" (9.4 v. 7.9) than the younger age group.

These analyses indicate that there are differences between males and females and younger and older participants with regard to type of snack foods consumed. Age and gender are therefore included as covariates in all subsequent analyses.

2.4.8 Associations with psychosocial measures and health outcome

Overall 2% of the sample scores above the clinical cut off for depression, 11% for anxiety and 13% for psychological distress (GHQ). The results obtained from 2 large scale community studies found 8% reported clinical levels of depression, 23% reported clinical levels for anxiety and 30% reported clinical levels for psychological distress (Smith, Wadsworth, Moss & Simpson, 2004a; 2004b; Smith, Jonal, Wadsworth, Davey Smith & Peters, 2000).

2.4.8.1 Snacking frequency

Significant results are described below. The complete set of results is given in Appendix A2. Significant differences were found on the appraisal subscale of the Interpersonal Support Evaluation List (ISEL), self-esteem subscale of the ISEL, belonging subscale of the ISEL, total ISEL, health esteem confidence, motivation to avoid unhealthiness, motivation for health, health status, General Health Questionnaire, positive mood and depression subscale of the HADS. Table 2.7 shows the mean scores for the 2 groups. Those who reported snacking everyday reported higher levels of social support, health esteem confidence, motivation to avoid unhealthiness, motivation for health, health status and positive mood than those who reported never snacking. Participants who snacked everyday scored lower on the General Health Questionnaire and the depression subscale of the HADS than those who never snacked. The effects of snacking on GHQ, depression and positive mood remained significant when social support was controlled for.

Table 2.7: Mean (s.e.) scores for snacking frequency on psychosocial measures and health outcomes

	Occasionally (N=85)	Daily (N=41)
Psychosocial Measures		
Social support – appraisal (ISEL)	32.22	34.68
$F(1,120) = 5.29$, $p<.05$	(0.61)	(0.88)
Social support – self esteem (ISEL)	30.12	31.75
$F(1,122), = 4.82$, $p<.05$	(0.42)	(0.61)
Social support – belonging (ISEL)	31.92	33.99
$F(1,122) = 4.70$, $p<.05$	(0.54)	(0.78)
Total social support (ISEL)	127.37	133.77
$F(1,120) = 4.08$, $p<.05$	(1.79)	(2.60)
Health Esteem Confidence (HOS)	15.95	17.64
$F(2,122) = 6.56$, $p<.05$	(0.37)	(0.54)
Motivation to avoid Unhealthiness	17.25	19.45
(HOS) $F(1,122) = 6.26$, $p<.05$	(0.50)	(0.72)
Motivation for Health (HOS)	17.13	19.67
$F(1,122) = 6.69$, $p<.05$	(0.56)	(0.81)
Health Status (HOS)	16.78	18.72
$F(1,122) = 7.22$, $p<.01$	(0.41)	(0.59)
Positive mood	32.48	36.11
$F(1,122) = 4.33$, $p<.05$	(0.99)	(1.43)
Health Outcomes		
General health (GHQ)	2.05	1.11
$F(1,122) = 4.27$, $p<.05$	(0.26)	(0.38)
Depression (HADS)	3.66	2.14
$F(1,122) = 9.78$, $p<.01$	(0.28)	(0.40)

2.4.8.2 Breakfast frequency and psychosocial measures and health outcomes

Significant results (at $p<.1$) are described below. The complete set of results is given in Appendix A2. Significant differences were found for breakfast frequency on

health esteem confidence, health external locus of control, negative life events, total life events, health promotion, health internal locus of control, trait anxiety and the depression subscale of the Hospital Anxiety and Depression Scale (HADS). Please refer to Table 2.8 for mean scores. Those participants that reported eating breakfast on a daily basis reported higher levels of health esteem confidence, health promotion and health internal locus of control. Conversely they reported lower levels of health external locus of control, number of negative life events, total number of life events and depression. When trait anxiety was included as a covariate breakfast was no longer significantly associated with depression or life events. Including health beliefs had no effect on the associations between breakfast and depression and life events.

Table 2.8: Means (s.e.) for frequency of breakfast consumption on psychosocial measures and health outcomes.

	Occasionally (N=46)	Daily (N=80)
Psychosocial measures:		
Health Esteem Confidence	15.35	17.16
$F(1,122) = 6.95$, p<.01	(0.53)	(0.40)
Health External Locus of Control	12.44	10.62
$F(1,122) = 3.90$, p=.05	(0.71)	(0.53)
Negative Life Events	2.73	1.47
$F(1,97) = 10.78$, p<.01	(0.31)	(0.21)
Total Life Events	3.76	2.66
$F(1,97) = 5.55$, p<.05	(0.38)	(0.25)
Health promotion	13.15	14.22
$F(1,122) = 3.05$, p=.083	(0.47)	(0.35)
Health internal locus of control	18.12	19.78
$F(1,122) = 3.27$, p=. 073	(0.71)	(0.53)
Trait anxiety	40.35	37.47
$F(1,121) = 2.84$, p=.095	(1.33)	(0.98)
Depression (HADS)	3.76	2.83
$F(1,122) = 3.22$, p=.075	(0.41)	(0.30)

2.5 Discussion

2.5.1 Purpose of the study

Previous research has suggested that snacking is a negative health behaviour, however due to a lack of research it is hard to draw any firm conclusions about the effects of snacking. Before exploring this and the potential implications it was first considered important to try and identify the prevalence of snacking and the characteristics of those people who report snacking. The current study aimed to examine eating habits, perceptions and definitions of snacking in a general public sample and to use the breakfast methodology to see whether it could be applied to snacking research. Associations between breakfast and snacking frequency, and health and well-being were considered.

2.5.2 Prevalence of snacking

The results revealed that although people do snack in addition to eating 3 meals a day, the total number of eating occasions per day was lower than suggested by previous research (British Nutrition Foundation, 1984). In the current study people reported eating 4-5 times per day. Previous research has also found the number of eating episodes to be lower than expected, with adults reporting eating 4.9 times daily (Gatenby et al., 1995). There are a number of explanations for these differences including age, geographical location and what is considered a snack and / or a snacking occasion. There is currently a lack of agreement concerning what constitutes a snack and specifically whether drinks consumed without food are snacks. In the current study drinks consumed in isolation were not reported nor included as snacks and / or snacking occasions. Gatenby et al. (1995) identified that adults consumed an average of 2.55 drinks per days in isolation of meals or snacks. It is possible that this is sufficient to account for the observed difference. It is also possible that this decrease in snacking is associated with increased awareness surrounding diet, obesity and health. The majority of snack foods available are high energy-load and high in fat and sugar, even some of the supposed reduced fat varieties. This explanation is supported by the findings in the current study that snacking was perceived as being less healthy than eating 3 meals per day and a contributor to the current rise in obesity in the UK. Previous research has concluded that high unhealthy snacking is

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contributing to increased levels of obesity and that healthy snack food choices should be emphasised (Jahns et al., 2001; Zizza et al., 2001).

2.5.3 Eating habits and characteristics of people who snack

Regardless of this the results from the current study confirm that the majority of people report snacking on a daily basis as 80% of the current sample reported consuming at least one snack a day. It was therefore important to explore eating habits in general. No significant differences were found for gender or age with respect to frequency of consumption, type of snack consumed or definition of snacking.

Snacks were consumed mid-morning, mid-afternoon and during the evening. Snacks were consumed by 59% of participants between breakfast and lunch, 61% between lunch and evening meal and 52% following the evening meal. These values are different to previous research in girls. McCoy et al. (1986) found that 56% had a mid-morning snack, 91% a mid-afternoon snack and 80% an evening snack. The participants in the current study were predominantly female so it seems unlikely that gender differences can fully account for these differences. Snacking was also found to be most common in the afternoon and least common in the morning in students (Cross, Babicz & Cushman, 1994). It would appear more likely that eating patterns have altered over the last 20 years.

Overall people reported eating a variety of foods, both as part of meals and as snacks. A healthy sub-group was identified when participants were asked to indicate which items they considered snacks and which they actually ate as snacks. When they were explicitly asked to identify healthy snacks the items could be distinguished into 3 different groups; healthy, unhealthy and other (those items where differing varieties may be healthy or unhealthy). These results provide strong evidence that people are able to distinguish between differing types of snacks, even when they were not requested to do so. In addition people disagreed that healthy snack foods are not tasty. These results suggest that the type of snacks people consume may provide a useful insight and this may be a better indicator of health than snacking frequency per se. This will be explored further in the next chapter.

2.5.4 Breakfast effects

Those participants who reported eating breakfast on a daily basis were

significantly more motivated to ensure they were healthy, to take responsibility for their own health and to positively evaluate themselves as being healthy and in good physical and mental shape. In addition daily breakfast consumption was associated with fewer major life events, especially negative ones, lower depression and trait anxiety. The significant association replicated previous findings. However the inclusion of trait anxiety in the model led to the association between breakfast and depression becoming non-significant. As measures of trait anxiety were not collected in previous studies it is not possible to say whether trait anxiety can fully account for the associations between regular breakfast and decreased depression.

This study has extended previous research by including measures not previously investigated. Previous research has generally focused on general health, as measured by the GHQ and depression (for example Belloc & Breslow, 1972; Ezoe & Morimoto, 1994). The current results suggest that breakfast is associated with fewer life events, especially negative life events. It is possible that those people experiencing a major negative life event have high stress levels. Previous research has identified an association between skipping breakfast and stress (Smith, 1998). It is important to investigate as many different types of outcomes as possible in order to build a clear picture of any effects. The pattern of the effects found may also help to elucidate the underlying mechanisms.

The strong positive associations found between breakfast consumption and health beliefs may be indicative that breakfast consumption is a marker for a healthier lifestyle per se. Previous research has found that regular breakfast consumers are less likely to smoke and drink less alcohol than non-consumers (Smith, 1998). It is therefore important that research is conducted to identify whether any potential effects of breakfast can be attributed to breakfast or whether they are associated with a healthier lifestyle in general. This shall be explored in the next chapter.

2.5.5 Snacking effects

Those participants who reported eating snacks on a daily basis were significantly more motivated to ensure they were healthy, to positively evaluate themselves as being healthy and be in good physical and mental shape, have someone they could talk to about their problems and have a positive mood. In addition they were less depressed and had fewer minor psychiatric symptoms. All of these effects

remained when social support was included as a covariate. Their positive beliefs about their health could not account for the positive associations found between snacking frequency and health outcomes.

These results indicate that regular snacking has a positive association with psychosocial factors and health outcomes. The positive association found between snacking frequency and health beliefs suggests that snacking frequency may also be marker for a healthier lifestyle. These results contradict previous studies which have included regular snacking as a negative health behaviour. Previous studies have differed in their definition of both snacks and snacking occasions and it is possible that this can account for this difference. However results from both the current study and other research suggest that the type of snack food consumed may be a more important consideration than snacking frequency.

No information has been collected to examine whether frequent healthy and frequent unhealthy snack consumers differ from one another with regard to health and well-being. A negative association between snacking frequency and health may indicate that the majority of individuals in the sample were consuming unhealthy snacks. Conversely it is possible that the majority of the people in the current sample were frequent healthy snack consumers. This is addressed in the next study.

2.5.6 Methodological issues

The results concerning breakfast consumption replicated the previous positive associations found between breakfast consumption and depression. This indicates that the measures used in the current sample were sensitive enough to identify any differences and makes the associations found between snacking and health more reliable. A number of novel questionnaires were also used however the relatively high Chronbach Alpha values obtained for the sub-scales calculated in this study are encouraging. Overall it appears that Likert scales are a suitable measure of frequency of consumption over the previous 7 days. They have been used to assess breakfast and snack intake in a number of studies examining associations with health and lifestyle outcomes.

2.5.7 Limitations of the study

All these results need to be treated with caution as causal inferences cannot be

made due to the cross-sectional design of this study. It is not possible to say whether breakfast and / or snack consumption causes psychosocial problems or whether people who consume breakfast and / or snacks regularly as a result of psychosocial problems. This will be addressed in a later intervention study.

The sample used in the present study was reasonable small. There were also considerably fewer people in the occasional breakfast group and daily snack group than the daily breakfast group and the occasional snack group. A larger sample would increase the likelihood of having more equal groups.

There was also a very high female to male ratio. A number of studies have identified an association between gender and mental health specifically depression (Bebbington, 1988; Coryell et al., 1992; Maier et al., 1992; Weissman et al., 1993). It is possible that the effects found in the current study are due to the high number of female participants.

2.5.8 Implications of the study

The results from the current study suggest that both breakfast and snacking are positively associated with health and well-being.

This implies that from a mental health perspective there are no reasons to avoid snacking. More research would be needed, which replicated these findings, before any firm conclusions could be drawn.

2.5.9 Future direction

Three important questions have arisen from the results of the current study. The first of these is whether the associations found between breakfast and snacking, and health and well-being are indicative of a healthier lifestyle per se. Secondly whether the type of snack consumed is more important than snacking frequency. The final issue is to consider other outcomes which may help to identify the underlying mechanisms. These three questions formed the basis of the next study.

CHAPTER THREE

THE RELATIONSHIP BETWEEN BREAKFAST, SNACKING, AND OTHER HEALTH RELATED BEHAVIOURS AND THEIR EFFECTS ON HEALTH AND WELL-BEING WITHIN A SAMPLE OF EMPLOYED NURSES

3.1   Aims of the study

The results from the previous chapter suggest that snacking is a common occurrence within the general population and therefore warrants further investigation. People were found to snack on a regular basis despite believing that snacking was unhealthy. In contrast to this regular snacking was found to be associated with improved health and well-being. As expected, based on previous research, breakfast was found to be a positive indicator of health and well-being. The breakfast methodology proved to be appropriate for snacking research. Three areas of particular interest were identified based on these results. These were (1) whether leading a healthier lifestyle per se could account for the associations between breakfast, snacking and health; (2) whether snacking type is a stronger indicator of health than snacking frequency and (3) whether the previous findings can be extended to other outcomes. These three questions form the basis of this study.

3.2   Introduction

Research has examined the effects of seven health practices (smoking, alcohol consumption, sleep, breakfast, snacking, weight and exercise) on both physical (Belloc & Breslow, 1972) and mental health (Frederick et al., 1988; Wetzler & Ursano, 1988; Simonsick, 1991). For a detailed discussion of the literature please refer to Chapter 1. The overall consensus from these studies was that: breakfast consumption is a good independent indicator of good health; snacking has a much smaller effect, which can be either positive or negative; there is a strong cumulative effect of the seven health practices.

3.2.1   Lifestyle factors

Unhealthy eating habits are conceptually different from other health risk

behaviours (van Kooten, de Ridder, Vollebergh & van Dorsselaer, 2007). It is important to examine the effects of breakfast and snacking over and above those of a healthy / unhealthy lifestyle.

Although positive effects of breakfast have been identified with regard to health and well-being researchers have failed to extend this area of research any further. It is possible that the positive effects of breakfast identified in these studies are found because regular breakfast consumption is a major contributor to a healthy lifestyle and health status (Siega-Riz, Popkin & Carson, 2000). Skipping breakfast is associated with increased smoking and alcohol consumption (Keski-Rahkonen, Kaprio, Rissanen, Virkkunen & Rose, 2003). A healthy lifestyle has been found to be associated with a decreased susceptibility to disease and increased longevity (Hubert, Bloch, Oehlert & Fries, 2000).

Some previous studies have included other measures of lifestyle and have reported controlling for these other factors. Smith (1998) found that breakfast was still associated with reduced stress, depression and emotional distress after controlling for smoking and alcohol consumption. From a public health perspective it is important to determine whether breakfast is exhibiting a positive association which is independent of other lifestyle factors and could potentially be used as an intervention or whether regular breakfast consumers are healthier in general and therefore complete lifestyle changes are required.

With regard to the associations between snacking and health the relationship appears much more complicated. Research is needed controlling for the effects of other lifestyle factors in order to elicit the specific effects of snacking, if there are any. Inconsistent results have been found in previous studies, with snacking having a beneficial effect in some studies and a negative effect in others. It is not clear whether regular snacking is indicative of a healthy lifestyle, an unhealthy lifestyle or in fact both.

3.2.2 Type of snack consumed

The majority of studies merely consider the effect of snacking frequency on health. No research to date has examined whether the type of snack consumed is a stronger and more consistent indicator of health status. Snack foods are often perceived to be high in energy, fat and sugar, for example chocolate, crisps and

biscuits, and are therefore considered to be unhealthy. People are becoming more health conscious and it is possible that they are choosing healthier snacks, for example fruit, nuts and yoghurt. The negative effects previously reported could be an indication that the majority of people were frequently snacking on unhealthy snack foods. In contrast snacking may display a positive association if people regularly snack on healthy snack foods. If this is the case then this could have important implications for potential interventions.

Inconsistencies have been found for snacking on general mental health status. These measures are easily administered and are a good indicator of health. However consideration of outcomes may provide useful insight into this relationship. Working life is playing a more prominent role in everyday life. Previous research has found associations between breakfast, snacking and stress. It appears a logical step to extend previous research to include measures of working life and stress. This association may be particularly apparent in shift workers whose daily lives are greatly disrupted.

3.2.3   Occupational factors

More people are working irregular hours or nights, between 16-20% of work now takes place outside normal daytime working hours 07.00 -17.00 (Persson & Martensson, 2006). Accidents which are caused by a lack of concentration or fatigue are more common at night (Rajaratnam & Arendt, 2001). In addition irregular working hours disrupt regular eating patterns (Geliebter, Gluck, Tanowitz, Aronoff & Zammit, 2000) and result in decreased intake of energy and nutrients compared to those who work during daytime hours. Previous research found that for nurses working night shifts work related situations were almost twice as likely to have a negative influence on their diet (Persson & Martensson, 2006). However the majority had healthy eating habits. Other studies have also found that nurses generally adopt a healthier lifestyle than the general population (Barrett, Norton, Busam, Boyd, Maron & Slovis, 2000; Jaarsma, Stewart, De Geest, Fridlund, Heikkilä, Mårtensson, Moons, Op Reimer, Smith, Strömberg & Thompson, 2004; UNITE Study Group, 2002).

It is also important to extend these studies beyond the health effects which have been considered so far. As discussed in Chapter 1 accidents and injuries are a leading cause of death and disability within the world. Workplace accidents and injuries are associated with great costs to the individual, the family and the economy.

Cognitive failures are considered to be a risk factor for and associated with accidents and minor injuries. Cognitive failures are an important factor as they are a more common occurrence than accidents. The majority of previous studies examining accidents have focused on fatal accidents as opposed to minor injuries or cognitive failures.

Although research has considered the effects of alcohol and smoking on accidents and injuries, it has not looked at the potential effects of food intake and eating habits. The research into work stress and accidents and injuries provides evidence of an area where factors cannot be considered in isolation. Other important factors which have been found to be associated with accidents and injuries at work and need to be controlled for are neuroticism, total negative job characteristics, age, alcohol and smoking (Wadsworth et al., 2003).

3.2.4 Summary

It is important to elicit the specific effects of breakfast and snacking over and above those of other lifestyle factors. It has been suggested that breakfast is a marker for a healthier lifestyle in general. Snacking frequency has produced contrasting results to date. It is possible this can be explained by the type of snack consumed as opposed to frequency per se. These are both important considerations for potential interventions. In order for any interventions or advice to be beneficial it is important that they can be applied to as many different aspects of life as possible. It is therefore important to look at work based outcomes in addition to measures of health and well-being.

3.2.5 Questions addresses in the present study

1. Whether type of snack food consumed will show a stronger association with health and well-being than snacking frequency per se.

2. Whether healthy snacking is indicative of a healthy lifestyle and whether it is associated with better mental health even after controlling for other lifestyle and demographic factors.

3. Whether unhealthy snacking is a negative health behaviours and whether it is associated with worse mental health even after controlling for other lifestyle and demographic factors.

4. Whether other snacking is a negative health behaviours and whether it is associated with worse mental health after controlling for other lifestyle and demographic factors.

5. Whether breakfast consumption is a positive health behaviours and is it still associated with better mental health (especially depression) after controlling for other lifestyle and demographic factors.

6. Total number of positive behaviours should show a positive linear relationship with health

3.2.6 Questions replicated from previous study

3.2.6.1 Eating habits

7. How often do participants eat snacks?
8. When during the day do they eat snacks?
9. How many meals do participants eat per day?
10. What do they usually eat for these meals?
11. What is the psychosocial profile associated with snacking?

3.2.6.2 Perceptions and definitions of snacking

12. Which qualities do participants rate as being important in a snack food?
13. What are peoples' beliefs about a snacking pattern of eating and snack foods and specifically do people perceive snacking and snack foods as being unhealthy.
14. What definition of snacking do participants prefer?

3.3   Method

3.3.1   Participants

In total 870 people participated in the survey. The participants consisted of 790 females and 75 males. The mean age was 45 years (age range was 22-67 years). People were invited to participate in an advert placed in issue 129 (22nd June - 5th July 2005) of the Royal College of Nursing (RCN) Bulletin. Letters were also sent to a random selection of 5,000 people registered with the RCN and living in the South West of England. An information sheet was sent out with the questionnaires. This included a description about the aims of the project. Ethical approval was given by the Cardiff University, School of Psychology ethics committee.

3.3.2   Procedure

Letters were sent out with a blank address label. Participants were asked to write their address on the label and return it to the researchers in the freepost envelope provided. This label was used to post the questionnaire and no personal details were kept. People who responded to the advert in the RCN Bulletin were asked to phone and leave their address or e-mail with their address. The questionnaires were returned anonymously with no identifiers attached therefore no reminders or follow ups were completed.

3.3.3   Materials

The questionnaire (32 pages; see Appendix A1) was designed to examine health and health-related behaviours. It is also examined other factors which were not considered in the previous chapter. It comprised the following sections:

3.3.3.1 General Well-being

This section contained the Hospital Anxiety and Depression Scale (Zigmond & Snaith, 1983), The Eysenck Personality Inventory Neuroticism Scale (Eysenck, 1968) and symptom checklists (referring to symptoms of ill-health having ever been diagnosed, occurring in the last 12 months and 14 days respectively). Single items measuring sick leave, work-stress, life stress and general health in the last 12 months

are also included in this section.[1] Single measures of work-stress, life stress and health were used as opposed to the longer measures that have already been developed. These single measures have been proven as comparable measures (Smith et al., 2000). If the full length versions of the questionnaires had been included this would have been prohibitive.

3.3.3.2 Accidents and Injuries

This section consisted of single items referring to accidents, minor injuries and cognitive failures (in and outside of work) in the last 12 months (Smith et al., 2000).

3.3.3.3 Lifestyle

This section contains information on health-related behaviours: smoking, prevalence and quantity of alcohol consumption, and breakfast and snacking habits.

3.3.3.4 The Work Environment

This section contained a number of standardised measures. Data from these questionnaires was collected as previous research has shown them to be strongly correlated with work outcomes (Smith, McNamara & Wellens, 2004). The scores from these questionnaire were combined to from a negative job characteristics variable which was included as a covariate in all analyses involving work related outcomes (work stress; accidents at work; minor injuries at work and cognitive failures at work):

- Exposure to physical hazards and working hours (Smith et al; 2000)
- Demand-Control-Support (Karasek, Brisson, Kawakami, Houtman, Bongers & Amick, 1979)
- Effort-Reward Imbalance (Siegrist, Starke, Chandola, Godin, Marmot, Niedhammer & Peter, 1996)

3.3.3.5 Demographics

Items referring to age, gender, education, ethnicity and salary were included in this section.

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[1] All symptom and medication checklist are taken from Smith et al. (2000).

3.3.4 Statistical analysis

One way ANOVAs and Pearson chi-square were used to analyse data at a univariate level. Backward step binary logistic regression and ANCOVAs were used to analyse the data including covariates. Binary logistic regression was used for those outcomes which were categorical in nature. Regression models were used in order to examine whether breakfast, snacking, healthy snacking, unhealthy snacking and other snacking exhibit any effects on health outcomes when other health related behaviours and demographics are taken into consideration. A list of all the covariates included in the models is given in Table 3.1. Goodness of fit statistics were examined (Hosmer-Lemeshow, Cox & Snell and Nagelkerke) along with standardised residuals (Cooks, Leverance and DFBetas). Linear regression was also used to test for evidence of collinearity. Unless otherwise stated all of these values were normal and did not warrant any further exploration.

Table 3.1: Variables included in the regression models

Variable	Description
Alcohol Consumption	Less than 21 units per week for men / 14 units per week for women compared with greater than 21 units per week for men / 14 units per week for women.
Smoking	Current cigarette smokers were compared to those who did not currently smoke cigarettes.
Difficulty sleeping	Those currently suffering from difficulties sleeping were compared to those having no difficulties sleeping
Gender	Males and females were compared
Age	Age was compared based on a median split (22-45 yrs compared to 46-67 yrs)
Neuroticism	Median split (score of 10 or less was compared to a score of more than 10)
Total negative score	Median split (score of 17 or less was compared to a score of more than 17)
Breakfast consumption	Non-daily consumption of breakfast was compared to daily consumption of breakfast
Snack consumption	Never, less than once a week, once or twice a week was compared with most days (3-6) and everyday
Healthy snack consumption (fruit, dry fruit and nuts)	Median split (8 or less portions per week was compared to more than 8 portions per week)
Unhealthy snack consumption (chocolate, crisps and biscuits)	Median split (3 or less portions per week was compared to more than 3 portions per week)
Other snack consumption	Median split (1 or less portions per week was compared to more than 1 portion per week)

The same variables were used in ANCOVAs for continuous outcomes. These were run twice, firstly with the covariates entered as continuous variables and secondly as dichotomous variables. This was to ensure that any differences were not attributable to the coding of the variables. All of the results presented are those where the covariates were entered as continuous variables.

3.4 Results

3.4.1 Demographics

Demographic information was collected about the participants. This is shown in Table 3.2.

Table 3.2: Demographic data of the participants who completed the stud

N=870		N (%)
Mean age (s.e.) in years		44.82 (0.3)
Number of females		790 (90.8)
Number of males		75 (8.6)
Smoke	Yes	116 (13.3)
	No	749 (86.1)
Alcohol	Yes	684 (78.6)
	No	179 (20.6)
Breakfast frequency:	Never	42 (4.8)
	Less than once a week	46 (5.3)
	Once or twice a week	65 (7.5)
	Most days (3-6)	149 (17.2)
	Everyday	562 (65)
Snacking frequency:	Never	47 (5.4)
	Less than once a week	105 (12.1)
	Once or twice a week	227 (26.1)
	Most days (3-6)	327 (37.6)
	Everyday	160 (18.4)

3.4.2 Eating habits

Over half of the participants (62%) reported eating 3 meals a day. Participants generally ate cereal for breakfast, a sandwich for lunch and either a small or large cooked evening meal. The majority of participants ate 1-2 snacks per day, with 78%

of participants eating at least 1 snack per day. Therefore the participants were generally eating 4-5 times per day.

3.4.3 Perceptions about snacking

The complete results are shown in Appendix B. Participants agreed with the following statements: a grazing pattern is less healthy than eating 3 meals per day, snack foods are less healthy and increased snacking by the population is a major contributor to the current rise in obesity. Conversely they disagreed with the following statements: I depend on snacks as I do not have time to prepare meals and some snacks are healthy but these are not tasty. They neither agreed nor disagreed with: I avoid snack foods as I think they are unhealthy.

3.4.4 Definition of snacking

The majority of participants (73%) agreed that snacking was best defined as "food or drink eaten between main meals". No differences were found between males and females or younger and older participants.

3.4.5 Snacking frequency and outcome measures

ANCOVA revealed a significant difference for number of symptoms in the last 14 days, regular snacking was associated with increased number of symptoms. Table 3.3 gives the details.

Table 3.3: Mean (s.e.) number of symptoms experienced during the previous 14 days based on snacking frequency

	Occasional (non-daily) snacking (N=379)	Daily snacking (N=487)
Symptoms last 14 days	3.23	3.69
$F_{(1,749)} = 7.36, p<.01$	(0.13)	(0.12)

Snacking frequency was found to be significant in the final model for the following outcomes: accidents at work, minor injuries at work, cognitive failures at work, cognitive failures outside work and depression. Regular snacking was

positively associated with all of the outcomes. Table 3.4 gives the details. The final model is shown in Appendix B.

Table 3.4: Summary table of the logistic regression results for snacking frequency

Outcome N = 861	Model $\chi^{2\,a}$	Goodness of fit [b]	Odds ratio	95% confidence intervals	P value
Accident at work	$\chi^2(4) = 27.79$	$X^2(6) = 1.46$	1.82	1.04-3.18	.035
Minor injury at work	$\chi^2(3) = 43.81$	$X^2(6) = 4.43$	1.43	1.05-1.96	.025
Cognitive failures at work	$\chi^2(5) = 49.99$	$X^2(8) = 5.98$	1.54	1.13-2.12	.007
Cognitive failures outside work	$\chi^2(4) = 52.74$	$X^2(8) = 5.75$	1.87	1.34-2.61	.000

[a] $p<.001$ [b] $p>.05$

3.4.6 Healthy snacking

ANCOVA revealed no significant differences for healthy snacking. Healthy snacking was found to be significant in the final model for the following outcomes: minor injuries at work, work stress and life stress. Regular healthy snacking was associated with fewer minor injuries at work but greater levels of work stress. Table 3.5 gives the details relating to healthy snacking. The final model is shown in Appendix B.

Table 3.5: Summary table of logistic regression results for frequency of healthy snacking (N for low healthy snacking =422, N for high healthy snacking = 428)

Outcome N=826	Model χ^2 [a]	Goodness of fit [b]	Odds ratio	95% confidence intervals	P value
Minor injury at work	$\chi^2(3) =$ 50.71	$\chi^2(6) = 3.71$	0.64	0.47-0.89	.007
Work stress	$\chi^2(5) =$ 96.02	$\chi^2(8) = 4.76$	1.53	1.09-2.14	.014

[a] $p<.001$ [b] $p>.05$

3.4.7 Unhealthy snacking

ANCOVA revealed significant differences for anxiety, depression and number of symptoms in the last 14 days. Increased unhealthy snacking was associated with scores on all of these outcomes.

Table 3.6: Mean (s.e.) scores for outcomes which significantly differed based on frequency of unhealthy snacking

	Low unhealthy (N=408)	High unhealthy (N=421)
Anxiety	7.65	8.25
$F(1,706) = 4.54, p<.05$	(0.20)	(0.20)
Depression	4.56	5.16
$F(1,708) = 6.38, p<.05$	(0.17)	(0.17)
Symptoms last 14 days	3.13	3.85
$F(1,719) = 17.25, p<.001$	(0.12)	(0.12)

[a] $p<.001$ [b] $p>.05$

Unhealthy snacking was found to be significant in the final model for the following outcomes: accidents at work, minor injuries at work, minor injuries outside work, cognitive failures at work, cognitive failures outside work, health in general and life stress. Table 3.7 gives the details relating to unhealthy snacking. The final model

is shown in Appendix B. Unhealthy snacking was associated with more accidents and minor injuries at work, more minor injuries and cognitive failures outside work, more concerns about health and more life stress.

Table 3.7: Summary table of logistic regression results for frequency of unhealthy snacking

Outcome N=825	Model χ^2 [a]	Goodness of fit [b]	Odds ratio	95% confidence intervals	P value
Accident at work	$\chi^2(3) = 22.23$	$\chi^2(6) = 5.55$	1.78	1.02-3.11	.042
Minor injury at work	$\chi^2(3) = 60.08$	$\chi^2(6) = 3.78$	2.06	1.49-2.85	.000
Minor injury outside work	$\chi^2(4) = 32.25$	$\chi^2(7) = 3.89$	1.53	1.14-2.07	.005
Cognitive failures outside work	$\chi^2(4) = 45.53$	$\chi^2(8) = 15.22$	1.52	1.08-2.13	.016
Health in general	$\chi^2(4) = 73.69$	$\chi^2(7) = 2.13$	1.38	1.01-1.90	.044
Life stress	$\chi^2(3) = 98.33$	$\chi^2(6) = 1.21$	1.59	1.16-2.18	.004

[a] $p<.001$ [b] $p>.05$

3.4.8 Other snacking

ANCOVA revealed no significant differences for other snacking. Other snacking was found to be significant in the final model for the following outcomes: accidents at work, accidents outside work, minor injuries at work and depression. Table 3.8 gives the details relating to other snacking. The final model is shown in Appendix B. Other snacking was associated with more accidents and minor injuries at work.

Table 3.8: Summary table of logistic regression results for frequency of other snacking (N for low other snacking =416, N for high other snacking = 406)

Outcome N=818	Model χ^2 [a]	Goodness of fit [b]	Odds ratio	95% confidence intervals	P value
Accidents at work	$\chi^2(3)$ = 22.54	$\chi^2(6)$ = 0.54	1.81	1.04-3.16	.037
Minor injury at work	$\chi^2(3)$ = 43.36	$\chi^2(6)$ = 1.94	1.40	1.02-1.93	.038

[a] $p<.001$ [b] $p>.05$

3.4.9 Breakfast, psychosocial measures and health outcomes

ANCOVA revealed significant effects of breakfast frequency for anxiety, depression and number of symptoms in the last 14 days. Daily breakfast consumption was associated with lower depression and fewer symptoms.

Table 3.9: Mean (s.e.) scores of those outcomes which showed a significant difference based on frequency of breakfast consumption

	Occasional (non-daily) breakfast (N=302)	Daily breakfast (N=562)
Depression F(1,738) = 3.32, p=.06	5.18 (0.20)	4.71 (0.15)
Symptoms last 14 days F(1,748) = 3.71, p=.055	3.71 (0.15)	3.36 (0.11)

Breakfast consumption was found to be significant in the final model for the following outcomes: accidents at work, accidents outside work, minor injuries at work, cognitive failures at work, work stress, health in general and number of symptoms in last 14 days. Table 3.10 gives the details relating to breakfast

consumption. The final model is shown in Appendix B. Daily breakfast consumption was associated with a reduced risk of an accident, minor injury or cognitive failure at work and lower work stress.

Table 3.10: Summary table of logistic regression results for breakfast frequency

Outcome N=859	Model χ^2 [a]	Goodness of fit [b]	Odds ratio	95% confidence intervals	P value
Accident at work	$\chi^2(3) = 26.63$	$\chi^2(5) = 1.05$	0.54	0.32-0.91	.022
Minor injury at work	$\chi^2(3) = 50.59$	$\chi^2(6) = 7.68$	0.56	0.42-0.79	.001
Cognitive failures at work	$\chi^2(5) = 47.61$	$\chi^2(8) = 7.63$	0.71	0.50-0.99	.046
Work stress	$\chi^2(6) = 102.96$	$\chi^2(8) = 5.87$	0.63	0.45-0.90	.010

[a] $p<.001$ [b] $p>.05$

3.4.10 Associations between breakfast and unhealthy snacking

Daily breakfast was associated with frequent snack consumption however this was not significant. A significant association was seen between daily breakfast consumption and low unhealthy snacking χ^2 (1) = 17.62, p<.001 and daily breakfast consumption and high healthy snacking χ^2 (1) = 26.11, p<.001.

3.4.10.1 Breakfast and unhealthy snacking

As in previous study breakfast and unhealthy snack consumption showed the greatest effects. Firstly breakfast and unhealthy snacking were included along with all of the covariates. The same results were found as reported above with 2 exceptions: breakfast was no longer significant for accidents outside work and symptoms in the last 14 days.

3.4.10.2 Breakfast, healthy snacking and unhealthy snacking

Breakfast, healthy snacking and unhealthy snacking were all included along with the covariates. ANCOVA revealed significant effect of unhealthy snacking for number of symptoms in last 14 days, anxiety and depression (see Table 3.11).

Table 3.11: Mean (s.e.) scores for those outcomes which showed a significant difference based on frequency of unhealthy snacking when breakfast, healthy snacking and unhealthy snacking were included in the regression model

N=809	Unhealthy snacking	
	Low	**High**
Symptoms in last 14 days	3.16 (0.14)	3.87 (0.13)
$F(1,716) = 13.72$, $p<.001$		
Anxiety	7.66 (0.23)	8.32 (0.21)
$F(1,691) = 4.57$, $p<.05$		
Depression	4.60 (0.19)	5.25 (0.17)
$F(1,69) = 6.37$, $p<.05$		

When all 3 variables were included in the logistic regression the following results were found. Healthy snacking remained significant for minor injuries at work. Breakfast was significant for accidents at work, minor injuries at work, cognitive failures at work, work stress and health in general. Unhealthy snacking was significant for minor injuries at work, minor injuries outside work, cognitive failures outside work, work stress and life stress. Table 3.12 shows the full details.

Table 3.12: Summary table of logistic regression results when breakfast frequency, frequency of healthy snacking and frequency of unhealthy snacking were included in the model

Outcome (N=809)	Covariate	Model χ^{2} [a]	Goodness of fit [b]	Odds ratio	95% confidence limits	P value
Accident at work	Breakfast	$\chi^2(3) =$ 23.18**	$\chi^2(5) =$ 2.19	0.45	0.26-0.78	.005
Minor injury at work	Breakfast	$\chi^2(5) =$ 73.37**	$\chi^2(8) =$ 3.77	0.66	0.47-0.92	.015
	Healthy snacking			0.70	0.50-0.98	.036
	Unhealthy snacking			1.95	1.40-2.71	.000
Minor injury outside work	Unhealthy snacking	$\chi^2(4) =$ 31.99**	$\chi^2(8) =$ 4.01	1.54	1.14-2.09	.005
Cognitive failures at work	Breakfast	$\chi^2(4) =$ 46.25**	$\chi^2(7) =$ 9.16	0.68	0.48-0.96	.026
Cognitive failures outside work	Unhealthy snacking	$\chi^2(4) =$ 43.20**	$\chi^2(8) =$ 16.81	1.51	1.07-2.12	.018
Work stress	Breakfast	$\chi^2(6) =$ 101.46**	$\chi^2(8) =$ 5.72	0.56	0.39-0.81	.002
	Unhealthy snacking			1.61	1.13-2.29	.008
Life in general	Unhealthy snacking	$\chi^2(3) =$ 98.50**	$\chi^2(6) =$ 1.63	1.57	1.15-2.16	.005

[a] $p<.00$ [b] $p>.05$

3.4.11 Health related behaviours

A total positive health-related behaviours score was calculated by summing the number of positive behaviours. A score of 1 was given if participants were in the high group for breakfast and healthy snacking, and in the low group for smoking, alcohol consumption and unhealthy snacking. For the regression 0-3 positive behaviours were compared to 4-5. The total positive score was associated with minor injuries at work, minor injuries outside work, cognitive failures at work, cognitive failures outside work, health in general and depression. Table 3.13 gives full details for depression. Table 3.14 gives the full details for the regression models.

Table 3.13: Mean (s.e.) depression scores based on number of positive health behaviours

	0-2 positive health behaviours (N=183)	3 positive health behaviours (N=226)	4 positive health behaviours (N=217)	5 positive health behaviours (N=108)
Depression	5.46	5.15	4.39	4.20
$F_{(1,697)} = 4.43$, $p<.01$	(0.27)	(0.22)	(0.22)	(0.32)

Table 3.14: Summary table of logistic regression results for number of positive health behaviours (N for 3 or less positive behaviours=409, N for 4 or 5 positive behaviours= 325)

Outcome N=732	Model χ^2 [a]	Goodness of fit [b]	Odds ratio	95% confidence intervals	P value
Minor injury at work	$\chi^2(4) = 63.03$	$X^2(7) = 9.40$	0.44	0.31-0.62	.000
Minor injury outside work	$\chi^2(3) = 27.12$	$X^2(6) = 1.74$	0.69	0.51-0.94	.018
Cognitive failures at work	$\chi^2(3) = 43.04$	$X^2(6) = 7.46$	0.68	0.49-.94	.020
Health in general	$\chi^2(3) = 71.57$	$X^2(6) = 1.36$	0.66	0.48-0.92	.013

[a] $p<.001$ [b] $p>.05$

No difference was found when any one of the behaviours was removed from the model. The results suggest that at least 4 positive health behaviours are required for optimal scores.

3.5   Discussion

3.5.1   Purpose of the study

The results from the previous chapter identified that people snack 1-2 times per day in addition to eating 3 meals. However, a range of different items were reported as being consumed as snacks. Snacking frequency was found to be positively associated with health and well-being. Previous research had identified regular snacking as a negative health behaviour. The first aim of this study was to try and replicate these previous findings and investigate whether the type of snack consumed was a stronger indicator of health.

The positive effects of breakfast were replicated in the previous study. It has been suggested that breakfast is a marker for a healthy lifestyle and therefore any positive associations found with breakfast are actually a result of having a healthier lifestyle in general. The second aim of this study was to examine whether the associations found between breakfast, snacking and health and well-being could be fully accounted for by health related behaviours.

In addition the current literature has predominantly focused on depression and general health when examining the effects of breakfast and snacking. The third aim of this study was to extend this area of research and look at accidents, minor injuries and cognitive failures, specifically at work.

3.5.2   Type of snack

The nurses in the current study reported eating 5 unhealthy snacks per week and 10 healthy snacks per week. Previous research has identified that working night shifts is associated with poor eating habits (Persson & Martensson, 2006) and lower energy and nutrient intake (Geliebter et al., 2000). Based on this nurses were expected to report high levels of unhealthy snacking. Conversely nurses have actually been found to report following a healthy diet and have adopted healthier lifestyle than the general population (Barrett et al., 2000; Jaarsman et al., 2004). The results from the current study support the notion that nurses generally follow a healthy diet. In the current sample 50% of the nurses reported working shifts regularly however only 18% worked nights, average shift length was found to be 8 hours. It therefore appears unlikely that their eating habits would be significantly different from other working

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populations. This is further supported by the eating habits data, which showed nurses reported eating very similar foods in the same amount as the general population sample in the previous chapter.

Although the results of the current study identified that the type of snack is an important consideration, frequent snacking on healthy items showed very little association with any of the outcomes included in the current study. Frequency of unhealthy snack consumption was found to be the strongest indicator of health. The sample was very similar with regard to frequency of low and high healthy snacking and low and high unhealthy snacking. The lack of an effect of healthy snacking cannot be attributed to unequal groups.

It is possible that frequent consumption of healthy snacks is the opposite end of a continuum with unhealthy snacks consumption. If this was the case then healthy snacking should have shown associations with the same outcomes at unhealthy snacking but in the opposite direction. This was not found and therefore it appears likely that consuming healthy snacks is different to not eating unhealthy snacks. This is addressed in the next study.

Unhealthy snacking was found to be associated with very similar outcomes as breakfast, except in the opposite direction. It is possible that people who frequently snack on unhealthy snacks are less likely to eat breakfast. Therefore any effect of unhealthy snacking may not be an effect of snacking but could in fact be the negative effect of not consuming breakfast. This will be investigated further in the next study.

3.5.3 Lifestyle factors

All of these results were found while controlling for demographic factors and health related behaviours. Gender, age, smoking, alcohol consumption and difficulty sleeping were included for all of the analyses. These results imply that the positive associations between breakfast and health outcomes are not simply a reflection of the positive effects of a healthy lifestyle. Unhealthy snacking was negatively associated with health and well-being in the current sample. It also appears that unhealthy snacking is not just an indicator of an unhealthy lifestyle per se.

The majority of participants in the current study did not smoke or consume high levels of alcohol. It is possible that the relationship between breakfast, unhealthy snacking and health and well-being would have been influenced by other health

related behaviours if the sample had included more smokers and heavy drinkers. Only a limited number of factors were considered in the current study. Belloc & Breslow (1972) identified 7 health practices which were associated with physical and mental health. Five of these (smoking, alcohol consumption, sleep, breakfast consumption and snack consumption) were considered in the current study. Due to the large number of potential covariates it was not possible to consider all of them within the current study. Subsequent research should also include measures of physical activity and weight.

The cumulative effects of positive health behaviours revealed a linear relationship with health outcomes. A significant difference was found between 0-3 and 4/5 behaviours. This implies that performing up to 4 positive health behaviours is associated with better health. However no differences were seen when any behaviour was excluded which implies that there is very little additional benefit of performing all 5 positive behaviours.

3.5.4 Occupational factors

Breakfast, snacking frequency, healthy snacking and unhealthy snacking all showed significant associations with accidents, minor injuries and cognitive failures at work. Previous research identified smoking, alcohol consumption, sleep problems, age and gender to be associated with accidents and injuries. Dietary factors, particularly breakfast and unhealthy snacking, were still strongly associated with accidents, injuries and cognitive failures while controlling for these other variables. Regular breakfast consumers were half as likely to have a minor injury at work as irregular breakfast consumers. High consumption of unhealthy snacks was associated with twice the likelihood of having a minor injury at work.

Increasing breakfast consumption and reducing unhealthy snack consumption could be used as the basis of a simple and cost effective intervention for health and safety in the workplace. Only a few of the potential confounders were controlled for in the current study and more research is needed to explore the associations between breakfast and unhealthy snacking.

It is not possible to draw any conclusions about the mechanisms by which breakfast and snacking may influence accidents and injuries. One possible explanation is that high fat meals have been found to increase fatigue and decrease alertness.

Unhealthy snacks are generally high in fat, while most breakfast cereals are low in fat. In addition breakfast cereal and toast have been found to be associated with increased alertness (Holt et al., 1999). Other factors which have been shown to be associated with accidents and injuries also need to be taken into consideration for example stress and fatigue levels. Cognitive failures are lapses in concentration and attention and may also be affected by fatigue and alertness. Some research has been conducted examining the associations between breakfast, snacking and cognitive functioning, including underlying mechanisms. This is discussed in more detail in Chapter 6 and is examined in Chapter 7.

Although it is not clear how breakfast and unhealthy snacking affect accidents, injuries and cognitive failures, it is a relationship which warrants further attention and investigation.

3.5.5   Limitations of the study

Due to the cross-sectional nature of the study it is not possible to make any conclusions about causation and directionality. However it is unlikely that having an accident influences dietary intake. Intervention studies are required to properly explore the relationships between breakfast frequency, snacking frequency and snacking type, and health and well-being.

The current sample only considered working health professionals, predominantly nurses and therefore was homogenous. The vast majority of the individuals in this sample were white females who did not smoke and only consumed small to moderate amounts of alcohol. Therefore the conclusions drawn from the current study cannot be generalised to other groups. The associations between snacking type and health and well-being need to be replicated in a general public sample. In addition vulnerable groups, for example children and the elderly should be considered as they may receive the most benefit from any interventions.

3.5.6   Implications of the study

Breakfast and unhealthy snack food consumption exhibit strong associations with health and well-being. This was still found to be the case when controlling for other lifestyle and demographic factors which are associated with health outcomes. These associations are also found for accidents, minor injuries and cognitive failures

in the workplace. Increasing breakfast consumption and decreasing unhealthy snack consumption may be the basis of an intervention programme to improve health.

3.5.7 Future studies

The results from the current study suggest that breakfast and unhealthy snacking are both strongly associated with health and well-being. Research is needed to investigate whether these are 2 separate measures of whether unhealthy snacking is effectively measuring the same as breakfast skipping. This formed the basis for the next study. These results have been found in members of the general population, students and nurses. Some sub-groups of the population are more at risk than others and the results from such studies would potentially have the greatest impact. One sub-group which is particularly at risk are children. The second aim of the next study is to consider the relationship between dietary intake and health and well-being in primary-school children.

CHAPTER FOUR

THE EFFECTS OF BREAKFAST AND SNACKING ON HEALTH AND WELL-BEING IN FAMILIES WITH PRIMARY SCHOOL AGED CHILDREN: A INVESTIGATION OF THE RELATIONSHIPS BETWEEN BREAKFAST AND SNACKING

4.1 Aims of the study

The results of the previous chapter showed that type of snack consumed needs to be considered when examining any associations between snacking and health and well-being. In particular unhealthy snacking displayed strong associations with a number of health outcomes. Inclusion of other lifestyle factors could not solely account for these associations. However it is possible that breakfast and snacking are closely related to one another and therefore snacking and breakfast are in fact measures of the same underlying factor. This is investigated in the current study.

The previous study extended the current knowledge about breakfast and snacking by looking at other outcomes, for example accidents, injuries and cognitive failures at work. However other sub-groups warrant specific attention due to the potential implications of this research. One sub-group which is experiencing high levels of health problems but would benefit the most from interventions are children. This study examined the relationship between breakfast, snacking and health in primary school children.

The first aim of the present study was to identify the prevalence of breakfast skipping and snacking in a sample of primary school children. Associations between breakfast and snack consumption, and health outcomes were also examined. The second aim of this study was to focus specifically on the relationship between breakfast and snacking, particularly unhealthy snacking, on a limited number of health outcomes to establish whether they are independent of one another.

4.2 Introduction

The results of the previous chapter showed that type of snack consumed needs

to be considered when examining any associations between snacking and health and well-being. In particular unhealthy snacking displayed strong associations with a number of health outcomes. Other lifestyle factors cannot account for the relationships between breakfast consumption, snack consumption and health outcomes, which imply these associations, are not merely indicative of a healthy / unhealthy lifestyle per se. Finally breakfast and unhealthy snacking showed strong associations with other types of outcomes e.g. accidents, minor injuries and cognitive failures. Although the results revealed that lifestyle factors could not account for the associations found between dietary intake and health it is important to examine the relationships between breakfast and snack consumption.

These findings have provided important information about the effects of breakfast and snacking and their potential for interventions in adults. The greatest benefit of any interventions would have the greatest benefit in children. By examining families it is possible to look at extend the previous research to consider another age group, the data from the adults will allow for the previous results to be replicated. The relationships between breakfast and snacking, and health and well-being needs to be explored in a sample of children. These two issues are the focus of the current study.

4.2.1 Effects of breakfast and snacking on health in children

Breakfast skipping is highly prevalent amongst children and adolescents. This is associated with a number of negative outcomes. Children who skip breakfast report reduced micronutrient intake and these shortfalls are not compensated for at subsequent eating occasions (Nicklas, Bao, Webber & Berenson, 1993; Ruxton & Kirk, 1997; Sjoberg et al., 2003).

Childhood obesity is one of the biggest risk factors for obesity, diabetes and cardiovascular problems in adults. Physical inactivity and diet are two important modifiable risk factors for obesity. Eating junk food at age 3 was found to be associated with obesity at age 7 (Reilly, Armstrong, Dorosty, Emmett, Ness, Rogers, Steer & Sherriff 2005).Obesity in children under the age of 11 has risen from 9.9% in 1995 to 13.7% in 2003 (Health Survey for England, 1995-2003). A number of risk factors have been identified for childhood obesity. These include parental influences, availability and type of food and social class.

In addition to the aforementioned increase in obesity mental health problems

are increasing in children. In 2004 one in ten children in Great Britain aged 5-16 had a clinically recognisable mental disorder (Office for National Statistics, 2004). Lifestyle factors are associated with both physical and mental health status in adults (Belloc & Breslow, 1972; Segovia et al., 1991; Ezoe & Morimoto, 1994). Dietary factors are a risk factor for obesity and are associated with mental health problems in adults. Considerable research has addressed the links between diet and obesity during childhood however very little research has examined the relationship between lifestyle factors and mental health.

Positive relationships have been found between good health practices (for example good nutrition) and mental health practices, depression, anger and loneliness in children and adolescents (Mahon, Yarcheski & Yarcheski, 2001; McDermott, Hawkins & Duncan, 1987).

Irregular eating habits were identified as a prominent factor for poor quality of life in 12-13 year old children (Chen et al., 2005). Skipping breakfast was associated with impaired quality of life in the domains of physical fitness, daily activities, social activities, social support and overall health. Snack food consumption was found to be associated with negative feelings, decreased daily activities, increased pain and decreased quality of life in 12-13 year old children (Chen et al.).

Dietary behaviours and other lifestyle patterns develop during childhood (Cunnane, 1993). It is important to determine if there is an association between dietary patterns and mental health outcomes in children. If an association is found it is imperative to establish when this association develops as this could have important implications for interventions.

4.2.2 Associations between breakfast and snacking

Previous research has identified that people snack in addition to eating meals. However the majority of the literature has considered either the effects of breakfast or of snacking. The exception to this is the literature looking at health practices which considered the cumulative effects of 7 health practices (please refer to Chapter 1 for a detailed discussion of the literature). Virtually no research could be found which has examined the interactions between breakfast and snack consumption and their combined effects on health status.

As noted before, breakfast skipping is associated with negative health and

academic outcomes and poor nutrition. For those people who skip breakfast a mid-morning snack, for example fortified cereal bars may be an ideal way to raise glucose levels and improve their nutritional intake. Conversely skipping breakfast has also been associated with increased unhealthy snack consumption.

Children who skip breakfast are more likely to snack between meals (Box & Landman, 1994; Sjoberg et al., 2003) and these snacks are more likely to be unhealthy snack foods, e.g. chocolate, sweets and soft drinks (Utter et al., 2007), bought from outside the home. Individuals who frequently skip breakfast generally do not consume healthy foods (Shimai, Kawabata, Nishioka & Haruki, 2000). Unhealthy snacking could modify the relationship between breakfast consumption at home and body mass index (Utter et al., 2007).

No differences were found between breakfast and non breakfast consumers for frequency of consumption of snacks on the journey to school, arrival at school and during morning break time. Fizzy drink consumption was the most frequently consumed snack at lunch and afternoon break time. Consumption was higher in the breakfast consumers than the non breakfast consumers (New & Livingstone, 2003). Overall no differences were identified between breakfast and non breakfast consumers for frequency of confectionary consumed although there was a trend for higher confectionary consumption in breakfast eaters.

Children who eat confectionary and other sweet based snack foods have been found to consume more food in general. However they also chose a wider variety of foods and therefore have a more balanced intake of nutrients.

4.2.3 Questions addressed in the current study

4.2.3.1 Children

1. What is the prevalence of breakfast skipping and snack consumption in primary school children?
2. Is consumption of snacks associated with improved mood?
3. Is type of snack food an important consideration when examining effects of snacking of health, mood and well-being?
4. Is skipping breakfast associated with poor mental health and well-being?
5. Is skipping breakfast associated with increased unhealthy snack consumption and decreased healthy food consumption?

4.2.3.2 The following questions were investigated using adult data

6. Is increased breakfast consumption associated with decreased unhealthy snack consumption? Is this sufficient to account for the pattern of results found?

7. Is there an association between breakfast and unhealthy snacking, and mental health, mood and well-being?

8. Does changing just one of these behaviours show any improvement / decline?

9. Is the same pattern seen for healthy snacking and unhealthy snacking?

10. Is the same pattern seen for breakfast and healthy snacking?

11. Is there an association between breakfast, healthy snacking and unhealthy snacking, and mental health, mood and well-being?

12. Is type of breakfast consumed an important consideration?

4.2.3.3 Based on the previous study it was hypothesised that

13. Healthy snacking will show a positive effect on health mood and well-being.

14. Unhealthy snacking will have a negative effect on health, mood and well-being

15. Breakfast will have a positive effect on health, mood and well-being

4.3 Method

4.3.1 Participants

The volunteers were recruited from schools in the Cardiff area. The Head teacher from each school was contacted personally and their permission to access pupils, via their parents, requested. The Head teacher was asked for informed consent before any approach to parents was made. Parents were invited to make contact if they wish to be considered for the study. The aim was to recruit approximately 400 parent and child volunteers. Recruitment was in the form of an advertisement for volunteers in the School Newsletter.

Participants received payment at a rate of £50 per individual taking part, and each participating school also received a single payment of £150. Recruitment continued until the study had the required number of participants. Consent was given by each Head teacher who agreed to take part before any parents were approached. Consent was obtained from each adult from each family on their own behalf, and from one adult from each family on behalf of their child or children before commencement of the study. An information sheet was included with the questionnaires. This provided a description about the aims of the project. The study was approved by the Cardiff University, School of Psychology ethics committee.

4.3.2 Procedure

Adult participants rated their own and their child or children's well-being by completing questionnaires. Following initial telephone conversation meetings were arranged with families at their convenience. Any concerns or questions were addressed. Information sheets were not provided to children because of the wide age range of these participants. Any questions they had were answered by the researcher in the presence of their parents.

4.3.3 Materials and measurement

Adapted versions of the food frequency questionnaire and health related behaviours were included. The following questions were not included in the food frequency questionnaire: when do you eat snacks, which foods do you perceive to be snacks, what snacks so you consider to be healthy snacks and which properties are

important. A new question was included asking participants whether they thought drinks could be considered a snack (a revised version of the food frequency questionnaire is in Appendix A1). New measures included were social class and working status (these questions are in Appendix A1). A description of how the healthy, unhealthy and other snack measures were developed is in Appendix C.

4.3.3.1 Psychosocial factors

A number of standardized measures were used to examine psychosocial factors. Table 4.1 shows the complete list of questionnaires completed by participants. Only one new measure was used in this study, this was a bowel functioning questionnaire (for a complete version of this questionnaire see Appendix A1). The remainder of the measures used in the current study were used in the previous study (full details about these measures can be found in Chapter 2).

Table 4.1: Questionnaires completed by participants in the present study

Questionnaire	Reference
Positive and negative affect	Zevon & Tellegen, 1982
Hospital Anxiety & Depression Scale	Zigmond & Snaith, 1983
Profile of Fatigue Related Symptoms	Ray et al., 1991
Symptom checklist	Smith et al., 2000
Bowel Functioning	Smith et al., 2000

4.3.3.2 Lifestyle factors and demographics

Age and gender were included as co-variates for all the analyses conducted with the data from the children.

4.3.4 Statistical analysis

The data was analysed using SPSS for Windows v.14. Principle components factor analyses of correlation matrices were conducted in order to classify empirically derived sets of subscales for the novel measures. The factor structure was rotated using the orthogonal method and was set to converge in 25 iterations. Factor loadings

greater than or equal to .40 were considered significant for inclusion in the subscales.

Chi-Square analysis was used to examine associations between snacking behaviours, demographic information and health related behaviours. One way Analysis of Covariance was used to investigate the effects of breakfast and snacking frequency on the psychosocial and health outcomes measures. Age and gender were included as covariates for of the analyses regarding children. Age, gender, smoking and alcohol consumption were included as covariates for all of the analyses conducted on the adult data.

4.4 Children results

4.4.1 Demographics

Demographic information was collected about the participants. This is displayed in Table 4.2.

Table 4.2: Demographic information about the children in the current study

Sample Size	213
Mean age (s.e.) in years	8.11 (0.14)
Number of females	108
Number of males	105
Breakfast frequency (%): Never	11 (5.2)
Less than once a week	5 (2.3)
Once or twice a week	11 (5.2)
Most days (3-6)	30 (14.1)
Everyday	154 (72.3)
Snacking frequency (%): Never	1 (0.5)
Less than once a week	3 (1.4)
Once or twice a week	12 (5.6)
Most days (3-6)	83 (39.0)
Everyday	113 (53.1)

4.4.2 Eating habits

The vast majority of the children (79%) ate 3 meals a day. The children generally ate cereal for breakfast, a sandwich with yoghurt/fruit/crisps for lunch and a small cooked evening meal with a dessert. The majority of participants ate 2 snacks per day, 93% of participants reported eating at least 1 snack on the previous day. Therefore the participants were generally eating 5 times per day.

4.4.3 Snack, psychosocial measures and health outcomes

Significant results are described below. The complete set of results is given in Appendix C. A significant difference was found for cognitive difficulties. Table 4.3 shows the mean scores for the 2 groups. Daily snacking was associated with more cognitive failures although given the number of analyses conducted this could have been a chance effect.

Table 4.3: Mean (s.e.) scores for cognitive difficulties split based on snacking frequency

	Occasional (non-daily) snacking (N=99)	Daily snacking (N=113)
Cognitive difficulties	18.51	21.26
$F(1, 207) = 4.23, p<.05$	(0.98)	(0.92)

4.4.4 Healthy snacking

Significant results are described below. The complete set of results is given in Appendix C. A significant difference was found for positive mood. Table 4.4 shows the mean scores for the 2 groups. Frequent healthy snacking was associated with greater positive mood, however this could be a chance effect.

Table 4.4: Mean (s.e.) scores for positive mood split based on frequency of healthy snack consumption

	Low healthy snacking (N=113)	High healthy snacking (N=(99)
Positive mood	43.34	46.29
$F(1,199) = 7.72, p<.01$	(0.76)	(0.74)

4.4.5 Unhealthy snacking

Significant results are described below. The complete set of results is given in

Appendix C. Significant differences were found for depression, total number of symptoms and bowel functioning. Table 4.5 shows the mean scores for the 2 groups. High unhealthy snacking was associated with increased depression, number of symptoms and bowel problems.

Table 4.5: Mean (s.e.) scores for those outcomes which showed significant differences based on frequency of unhealthy snack consumption

	Low unhealthy (N=107)	High unhealthy (N=105)
Depression	0.67	1.34
$F(1, 209) = 8.92 \ p<.01$	(0.16)	(0.15)
Total number of symptoms	0.93	1.49
$F(1,208) = 5.61, \ p<.05$	(0.17)	(0.16)
Bowel function	1.50	2.54
$F(1, 208) = 9.15, \ p<.01$	(0.25)	(0.24)

4.4.6 Other snacking

Significant results are described below. The complete set of results is given in Appendix C. Significant differences were found for depression and bowel function. Table 4.6 shows the mean scores for the 2 groups. Frequent other snacking was associated with increased depression and bowel problems.

Table 4.6: Mean (s.e.) scores for those outcomes which showed significant differences based on frequency of other snack consumption

	Low other (N=102)	High other (N=110)
Depression	0.74	1.29
$F(1,209) = 6.05, \ p<.05$	(0.16)	(0.16)
Bowel function	1.63	2.44
$F(1,208) = 5.48, \ p<.05$	(0.25)	(0.24)

4.4.7 Breakfast, psychosocial measures and health outcomes

Significant results are described below. The complete set of results is given in Appendix C. Significant differences were found for anxiety, depression, fatigue, positive mood, negative mood and bowel functioning. Table 4.7 shows the mean scores for the 2 groups. Daily breakfast consumers were perceived as having lower anxiety, depression, fatigue and negative mood and a higher positive mood. They also had fewer bowel problems than non-daily consumers.

Table 4.7: Mean (s.e.) scores for those outcomes which showed significant differences based on breakfast consumption

	Occasional (non-daily) breakfast (N=57)	Daily breakfast (N=154)
Anxiety	4.04	2.81
$F_{(1, 206)} = 9.25$, p<.01	(0.34)	(0.21)
Depression	1.77	0.74
$F_{(1, 207)} = 17.21$, p<.001	(0.21)	(0.13)
Positive mood	41.35	46.13
$F_{(1, 197)} = 16.06$, p<.001	(1.02)	(0.61)
Negative mood	13.08	9.64
$F_{(1, 205)} = 8.98$, p<.01	(0.98)	(0.59)
Bowel function	2.71	1.79
$F_{(1, 206)} = 5.48$, p<.05	(0.34)	(0.20)

4.4.8 Associations between breakfast and snacking

Chi-square analysis was used to examine any associations between breakfast consumption and snacking. Significant associations were found between breakfast and snacking frequency (χ^2 (1) = 6.58, p=.01) and breakfast and unhealthy snack consumption (χ^2 (1) = 5.11, p<.05). Daily breakfast consumption was associated with greater snacking but decreased unhealthy snack consumption. Daily breakfast was associated with frequent healthy and other snack consumption however neither of these was significant.

4.5   Adult data

4.5.1   Demographics

Demographic information was collected about the participants. This is shown for males in Table 4.8a and for females in Table 4.8b.

Table 4.8a: Demographic information about male participants

Sample Size = 104	
Mean age (s.e.) in years	39.95 (0.64)
Social Class: I	19 (18.3)
II	38 (36.5)
IIINM	12 (11.5)
IIIM	20 (19.2)
IV	10 (9.6)
V	0
Breakfast frequency (%): Never	11 (10.6)
Less than once a week	7 (6.7)
Once or twice a week	12 (11.5)
Most days (3-6)	18 (17.3)
Everyday	54 (51.9)
Snacking frequency (%): Never	3 (2.9)
Less than once a week	11 (10.6)
Once or twice a week	18 (17.3)
Most days (3-6)	42 (40.4)
Everyday	30 (28.8)
Smoker (%): Yes	21 (20.2)
No	83 (79.8)
Alcohol (%): Yes	89 (85.6)
No	15 (14.4)

Table 4.8b: Demographic information about female participants

Sample Size = 136	
Mean age (s.e.) in years	37.49 (0.54)
Social Class: I	10 (7.4)
II	35 (25.7)
IIINM	31 (22.8)
IIIM	4 (2.9)
IV	12 (8.8)
V	2 (1.5)
Breakfast frequency (%): Never	15 (11.0)
Less than once a week	7 (5.1)
Once or twice a week	17 (12.5)
Most days (3-6)	27 (19.9)
Everyday	70 (51.5)
Snacking frequency (%): Never	1 (0.7)
Less than once a week	7 (5.1)
Once or twice a week	27 (19.9)
Most days (3-6)	60 (44.1)
Everyday	41 (30.1)
Smoker (%): Yes	31 (22.8)
No	105 (77.2)
Alcohol (%): Yes	107 (78.7)
No	29 (21.3)

The first part of these results looks to extend the findings from the end of the previous chapter, specifically the associations between unhealthy snacking, breakfast and mental health.

4.5.2 Snacking frequency, psychosocial measures and health outcomes

No significant differences were found for any of the psychosocial measures or health outcomes.

4.5.3 Healthy snacking

Females reported eating more healthy snacks than males (7.66 v. 5.49 times per week respectively). Non-smokers ate more healthy snacks than smokers (7.50 v. 3.91 times per week respectively). Significant results are described below. The complete set of results is given in Appendix C. Table 4.9 shows the mean scores for the 2 groups. High healthy snacking was associated with better scores than low healthy snacking.

Table 4.9: Mean (s.e.) scores for those outcomes which showed significant differences based on frequency of healthy snack consumption

	Low healthy [a] (N=123)	High healthy [a] (N=114)
Positive mood	34.78	37.84
$F_{(1,231)} = 5.09$, p<.05	(0.92)	(0.95)
Anxiety	6.80	5.16
$F_{(1,231)} = 8.97$, p<.01	(0.37)	(0.38)
Depression	5.20	3.48
$F_{(1,232)} = 10.85$, p<.01	(0.35)	(0.37)
Cognitive difficulties	26.81	22.81
$F_{(1,227)} = 5.92$, p<.05	(1.11)	(1.16)
Fatigue	32.30	26.22
$F_{(1,230)} = 9.96$, p<.01	(1.31)	(1.35)
Somatic symptoms	27.25	24.11
$F_{(1,228)} = 4.03$, p<.05	(1.06)	(1.10)
Total number of symptoms	4.67	3.41
$F_{(1,233)} = 6.85$, p<.01	(0.33)	(0.34)

[a] low healthy = 6 or less healthy snacks per week, high healthy = more than 6 healthy snacks per week

4.5.4 Unhealthy snacking

Significant results are described below. The complete set of results is given in Appendix C. Table 4.10 shows the mean scores for the 2 groups. High unhealthy snacking was associated with poor scores.

Table 4.10: Mean (s.e.) scores for those outcomes which showed significant differences based on frequency of unhealthy snack consumption

	Low unhealthy [a] (N=114)	High unhealthy [a] (N=123)
Positive mood	38.62	34.09
$F(1,231) = 12.48$, p<.001	(0.92)	(0.88)
Negative mood	14.86	18.42
$F(1,231) = 6.41$, p=.01	(1.01)	(0.97)
Anxiety	5.41	6.57
$F(1,231) = 4.83$, p<.05	(0.38)	(0.37)
Depression	3.48	5.19
$F(1,232) = 11.67$, p<.001	(0.36)	(0.35)
Emotional distress	35.95	42.43
$F(1,221) = 6.72$, p<.01	(1.80)	(1.71)
Cognitive difficulties	22.37	27.14
$F(1,227) = 9.20$, p<.01	(1.14)	(1.08)
Fatigue	26.44	32.10
$F(1,230) = 9.29$, p<.01	(1.33)	(1.28)
Somatic symptoms	23.83	27.55
$F(1,228) = 6.22$, p<.05	(1.06)	(1.03)
Symptom score	3.25	4.81
$F(1,233) = 11.50$, p<.001	(0.33)	(0.32)
Bowel function	4.38	5.62
$F(1,231) = 4.51$, p<.05	(0.42)	(0.40)

[a] low unhealthy = 3 or less unhealthy snacks per week, high unhealthy = more than 3 unhealthy snacks per week.

4.5.5 Breakfast, psychosocial measures and health outcomes

Smoking was included as a covariate for all analyses involving breakfast. Significant results are described below. The complete set of results is given in Appendix C. Table 4.11 shows the mean scores for the 2 groups. Daily breakfast consumers reported better scores than non-daily consumers.

Table 4.11: Mean (s.e.) scores for those outcomes which showed significant differences based on breakfast consumption

	Low breakfast [a] (N=114)	High breakfast [a] (N=124)
Positive mood	34.26	38.14
$F_{(1,229)} = 8.86$, p<.01	(0.93)	(0.90)
Negative mood	18.01	15.49
$F_{(1,229)} = 3.11$, p=.079	(1.02)	(0.98)
Depression	5.01	3.69
$F_{(1,230)} = 6.69$, p=.01	(0.37)	(0.35)
Cognitive difficulties	26.70	22.97
$F_{(1,225)} = 5.50$, p<.05	(1.14)	(1.10)
Fatigue	32.54	26.40
$F_{(1,228)} = 10.82$, p=.001	(1.34)	(1.28)
Somatic symptoms	28.02	23.77
$F_{(1,226)} = 7.99$, p<.01	(1.08)	(1.03)
Number of symptoms	4.79	3.35
$F_{(1,231)} = 9.59$, p<.01	(0.33)	(0.32)
Bowel	5.92	4.19
$F_{(1,229)} = 8.80$, p<.01	(0.42)	(0.40)

[a] Low breakfast = non daily breakfast consumption; high breakfast = daily breakfast consumption

4.5.6 Breakfast and snacking

Chi square analysis was used to examine the relationships between breakfast and snacking. Increased breakfast consumption was associated with increased snack consumption χ^2 (1) = 3.95, p<.05. Increased breakfast consumption was associated with increased healthy snacking χ^2 (1) = 16.32, p<.001. No association was found between breakfast consumption and unhealthy snacking χ^2 (1) = 0.64, p>.05. Therefore is not the case that high unhealthy snack consumers are more likely to skip breakfast.

4.5.6.1 Breakfast and unhealthy snacking

Sub-groups of breakfast and unhealthy snacking were created. Significant differences are reported in Table 4.12. Post hoc tests revealed a significant difference between the low breakfast / high unhealthy snack (LBHU) and the high breakfast / low unhealthy snack (HBLU) groups for all the outcomes (full details in Appendix C). Those in the HBLU group scored significantly better on all of the outcomes than those in the LBHU group. Table 4.12 shows the mean scores for the 4 groups.

Table 4.12: Mean (s.e.) scores for those outcomes which showed significant differences based on subgroups of breakfast and unhealthy consumption

	LBLU N=58	LBHU N=56	HBLU N=62	HBHU N=62
Depression	4.16	5.74	2.73	4.64
$F(3, 228) = 6.60$, p<.001	(0.53)	(0.48)	(0.49)	(0.49)
Emotional distress	35.36	44.48	36.02	40.11
$F(3, 217) = 2.86$, p<.05	(2.73)	(2.41)	(2.41)	(2.45)
Cognitive difficulties	23.08	29.57	21.71	24.26
$F(3, 223) = 5.17$, p<.01	(1.66)	(1.49)	(1.53)	(1.52)
Fatigue	30.23	34.50	23.16	29.72
$F(3, 226) = 6.86$, p<.001	(1.95)	(1.79)	(1.77)	(1.80)
Somatic symptoms	25.65	30.05	22.51	25.09
$F(3, 224) = 4.63$, p<.01	(1.58)	(1.46)	(1.43)	(1.45)
Positive mood	35.61	33.09	41.27	35.11
$F(3, 227) = 7.88$, p<.001	(1.34)	(1.23)	(1.25)	(1.24)
Negative mood	15.49	20.09	14.34	16.62
$F(3, 227) = 3.26$, p<.05	(1.50)	(1.36)	(1.37)	(1.37)
Total number of symptoms	4.06	5.42	2.52	4.18
$F(3, 229) = 7.08$, p<.001	(0.48)	(0.44)	(0.44)	(0.45)
Bowel function	5.16	6.62	3.61	4.70
$F(3, 227) = 4.77$, p<.01	(0.61)	(0.57)	(0.57)	(0.57)

LBLU – low breakfast / low unhealthy; LBHU – low breakfast / high unhealthy; HBLU – high breakfast / low unhealthy; HBHU – high breakfast / high unhealthy

In those groups where one positive and one negative behaviour was performed (LBLU and HBHU) the results appear to be very similar which would suggest that changing either behaviour is positive. As a result of this these two groups were merged and the means for the 3 groups (LBHU; LBLU/HBHU; HBLU) were plotted on bar graphs. All of the outcome measures showed a linear effect. Figure 4.1 shows some examples of the graphs, the remainder are in Appendix C.

Figure 4.1: Mean (s.e.) scores for depression and total number of symptoms experienced within the last 14 days based on frequency of consumption of breakfast and unhealthy snacks
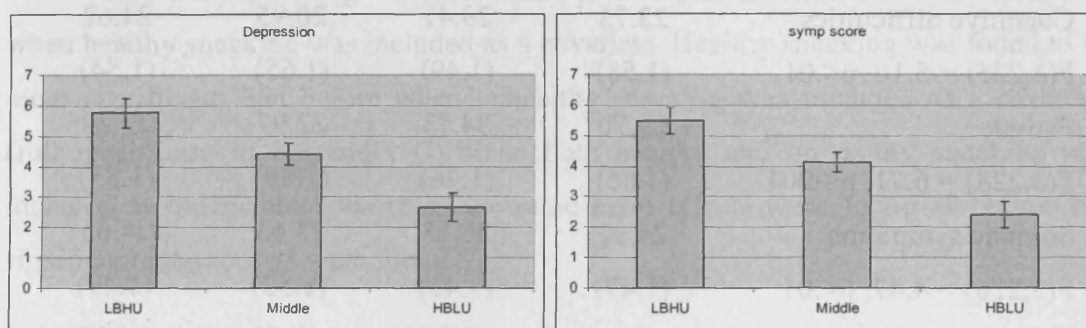
Unhealthy snacking was still found to be significant for all of the outcome measures after breakfast was included as a covariate. Breakfast was still found to be significant for the same outcomes as before when unhealthy snacking was included as a covariate. In addition when both breakfast and unhealthy snacking were included as independent variables the same main effects were found as before (the full results are in Appendix C). No significant interactions were seen for any of the outcome measures.

4.5.6.2 Healthy snacking and unhealthy snacking

A summary of the results is reported here, the full results are in Appendix C. Significant differences were found between the low healthy / high unhealthy (LHHU) group and the high healthy / low unhealthy (HHLU) group. Those in the HHLU group scored better for all the outcome measures. Table 4.13 shows the mean scores for the 4 groups.

Table 4.13: Mean (s.e.) scores for those outcomes which showed significant differences based on subgroups of healthy and unhealthy snack consumption

	LHLU (N=59)	LHHU (N=64)	HHLU (N=55)	HHHU (N=59)
Anxiety	6.15	7.43	4.57	5.69
F(3,229) = 4.93, p<.01	(0.53)	(0.50)	(0.55)	(0.52)
Depression	4.38	5.98	2.46	4.39
F(3,320) = 8.14, p<.001	(0.50)	(0.48)	(0.52)	(0.49)
Emotional distress	38.26	44.44	33.68	40.21
F(3,219) = 3.27, p<.05	(2.61)	(2.35)	(2.53)	(2.51)
Cognitive difficulties	23.75	29.41	20.95	24.62
F(3,225) = 5.10, p<.01	(1.58)	(1.49)	(1.65)	(1.54)
Fatigue	29.70	34.73	22.97	29.29
F(3,228) = 6.71, p<.001	(1.85)	(1.76)	(1.89)	(1.83)
Somatic symptoms	24.01	30.18	23.63	24.65
F(3,226) = 4.47, p<.01	(1.49)	(1.43)	(1.53)	(1.49)
Positive mood	36.76	32.85	40.72	35.35
F(3,229) = 6.37, p<.001	(1.28)	(1.22)	(1.35)	(1.26)
Negative mood	16.01	19.60	13.63	17.18
F(3,229) = 3.06, p<.05	(1.43)	(1.35)	(1.47)	(1.38)
Total number of	3.58	5.68	2.87	3.90
symptoms	(0.46)	(0.44)	(0.47)	(0.45)
F(3,231) = 6.95, p<.001				
Bowel function	4.41	6.36	4.24	4.91
F(3,229) = 2.79, p<.05	(0.59)	(0.56)	(0.61)	(0.58)

LHLU – low healthy / low unhealthy; LHHU – low healthy / high unhealthy; HHLU – high healthy / low unhealthy; HHHU – high healthy / high unhealthy

Figure 4.2 shows two examples of the differences between the groups (the complete set of graphs are in Appendix C).

Figure 4.2: Mean (s.e.) scores for depression and total number of symptoms experienced within the last 14 days based on frequency of healthy and unhealthy snacks
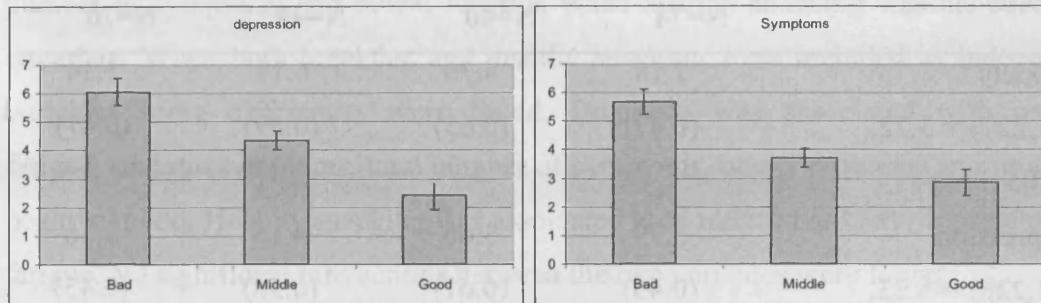
Unhealthy snacking was still found to be significant for all of the outcomes when healthy snacking was included as a covariate. Healthy snacking was found to be more significant than before when unhealthy snacking was included as a covariate (full results are in Appendix C). When both healthy and unhealthy snacking was included as independent variables the same main effects were found as before. No significant interactions were found.

4.5.6.3 Breakfast and healthy snacking

The same analyses were repeated for breakfast and healthy snacking. Post hoc analysis revealed a significant difference between low breakfast / low healthy (LBLH) and high breakfast / high healthy (HBHH) for all of the outcomes. Table 4.14 shows the mean scores for the 4 groups.

Table 4.14: Mean (s.e.) scores for those outcomes which showed significant differences based on subgroups of breakfast and healthy snack consumption

	LBLH N=74	LBHH N=40	HBLH N=48	HBHH N=76
Anxiety F(3,227) = 3.72, p<.05	7.18 (0.47)	4.76 (0.65)	6.14 (0.59)	5.34 (0.47)
Depression F(3,228) = 5.23, p<.01	5.79 (0.45)	3.66 (0.61)	4.15 (0.56)	3.36 (0.45)
Cognitive difficulties F(3,223) = 3.00, p<.05	28.22 (1.42)	24.01 (1.89)	23.99 (1.74)	22.29 (1.42)
Fatigue F(3,226) = 6.07, p<.001	35.08 (1.67)	28.03 (2.26)	28.03 (2.05)	25.25 (1.64)
Somatic symptoms F(3,224) = 4.29, p<.01	29.80 (1.35)	24.76 (1.84)	23.65 (1.64)	23.79 (1.32)
Positive mood F(3,227) = 4.37, p<.01	32.84 (1.17)	36.73 (1.57)	37.68 (1.44)	38.53 (1.17)
Total number of symptoms F(3,229) = 5.00, p<.01	5.36 (0.42)	3.80 (0.56)	3.55 (0.52)	3.19 (0.41)
Bowel function F(3,227) = 3.27, p<.05	5.99 (0.53)	5.87 (0.72)	4.54 (0.65)	3.91 (0.52)

LBLH – low breakfast / low healthy; LBHH – low breakfast / high healthy; HBLH – high breakfast / low healthy; HBHH – high breakfast / high healthy

Including the other variable as a covariate had an effect. Healthy snacking was

only associated with depression, anxiety, fatigue and total number of symptoms when breakfast was included as a covariate. However breakfast was associated with depression, cognitive difficulties, fatigue, somatic symptoms, positive mood, total number of symptoms and bowel function when healthy snacking was included as a covariate. When both breakfast and healthy snacking were included as independent variables some differences were found. Breakfast was associated with reduced fatigue, somatic symptoms, total number of symptoms, bowel problems and improved positive mood. Healthy snacking was associated with reduced anxiety, depression and fatigue. No significant interactions between the two variables were found.

4.5.6.4 Breakfast, healthy snacking and unhealthy snacking

Finally the analyses were rerun with breakfast, healthy snacking and unhealthy snacking included as independent variables. No significant interactions were found. Bowel function was associated with breakfast consumption $(F_{(1,226)} = 7.89, p<.01)$. Emotional distress, cognitive difficulties and negative mood were associated with unhealthy snacking $(F_{(1,216)} = 6.08, p<.05; F_{(1,222)} = 6.36, p<.05; F_{(1,226)} = 6.79, p=.01)$. Anxiety and depression were associated with healthy snacking $(F_{(1,226)} = 7.83, p<.01; F_{(1,227)} = 8.01, p<.01)$ and unhealthy snacking $(F_{(1,226)} = 4.56, p<.05; F_{(1,227)} = 16.23, p<.001)$. Positive mood, somatic symptoms and total number of symptoms were associated with breakfast $(F_{(1,226)} = 6.23, p<.05; F_{(1,223)} = 5.3, p<.05; F_{(1,228)} = 6.42, p<.05)$ and unhealthy snacking $(F_{(1,226)} = 14.67, p<.001; F_{(1,223)} = 3.83, p=.05; F_{(1,228)} = 10.37, p=.001)$. Fatigue was associated with breakfast $(F_{(1,225)} = 6.36, p<.05)$, healthy snacking $(F_{(1,225)} = 6.08, p<.05)$ and unhealthy snacking $(F_{(1,225)} = 8.19, p<.01)$. Table 4.15 shows the mean scores for the different groups (significant differences are in bold).

Table 4.15: Mean (s.e.) scores when breakfast, healthy and unhealthy snack consumption were all included as independent variables. Significant differences are shown in bold.

	Breakfast		Healthy		Unhealthy	
	Low N=114	High N=124	Low N=123	High N=114	Low N=114	High N=123
Anxiety	5.92	5.71	**6.60**	**5.03**	**5.24**	**6.39**
	(0.40)	(0.37)	**(0.37)**	**(0.40)**	**(0.39)**	**(0.37)**
Depression	4.61	3.73	**4.92**	**3.43**	**3.15**	**5.19**
	(0.37)	(0.35)	**(0.35)**	**(0.38)**	**(0.37)**	**(0.35)**
Emotional distress	38.87	37.97	40.41	36.43	**35.24**	**41.59**
	(1.89)	(1.75)	(1.80)	(1.90)	**(1.88)**	**(1.76)**
Cognitive difficulties	25.78	23.06	25.88	22.96	**22.42**	**26.42**
	(1.16)	(1.09)	(1.11)	(1.18)	**(1.16)**	**(1.09)**
Fatigue	**31.34**	**26.62**	**31.37**	**26.58**	**26.31**	**31.64**
	(1.37)	**(1.27)**	**(1.30)**	**(1.39)**	**(1.35)**	**(1.28)**
Somatic symptoms	**27.17**	**23.68**	26.56	24.29	**23.95**	**26.91**
	(1.11)	**(1.02)**	(1.05)	(1.13)	**(1.09)**	**(1.05)**
Positive mood	**34.98**	**38.24**	35.45	37.78	**39.10**	**34.13**
	(0.95)	**(0.89)**	(0.91)	(0.97)	**(0.95)**	**(0.89)**
Negative mood	17.23	15.36	17.28	15.31	**14.40**	**18.18**
	(1.06)	(0.99)	(1.02)	(1.09)	**(1.06)**	**(0.99)**
Total symptoms	**4.53**	**3.35**	4.39	3.49	**3.19**	**4.67**
	(0.34)	**(0.32)**	(0.32)	(0.35)	**(0.34)**	**(0.32)**
Bowel function	**5.87**	**4.19**	5.20	4.88	4.47	5.61
	(0.44)	**(0.41)**	(0.42)	(0.45)	(0.43)	(0.41)

These results show that unhealthy and breakfast in particular still show strong associations when all 3 dietary variables are included. However these results do not allow for any conclusions to be drawn about the relationship between the different factors.

In order to explore these findings further graphs were produced based on the 8 combinations of breakfast, healthy snacking and unhealthy snacking. Means scores from the ANOVA three way interaction decriptives table were plotted on bar graphs (Please refer to Appendix C for table). Figure 4.3 shows the graph for depression. This was chosen as an example as it showed strong effects of both positive and negative behaviours. The complete set of graphs is in Appendix C.

Figure 4.3: Mean (s.e.) scores for depression based on subgroups of breakfast, healthy and unhealthy snack consumption (the best and worst combinations are indicated).
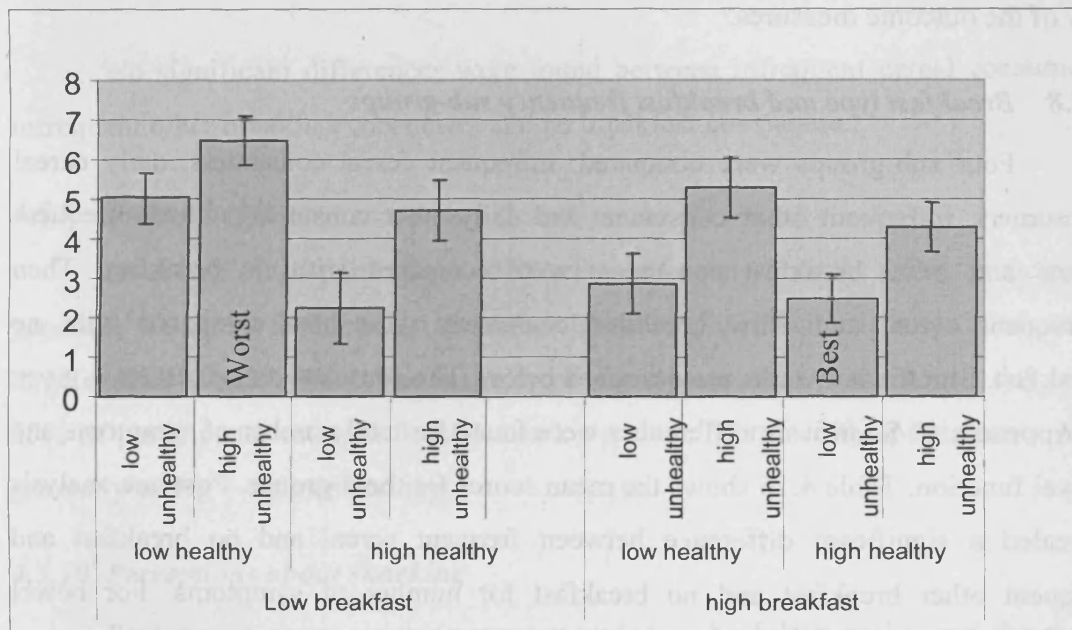
A significant effect of unhealthy snacking for found in all 4 sub-groups (low breakfast, high breakfast, low healthy snacking and high healthy snacking). The groups of particular interest are low breakfast and low unhealthy snacking as these results suggest that unhealthy snacking is not a reflection of low breakfast or healthy snack consumption. In support of this significant differences were also found for breakfast and healthy snacking in the low unhealthy snack group. The results for healthy snacking and breakfast suggest that both of them may be measuring an underlying healthiness factor. No effect of healthy snacking was seen for high breakfast consumers and vice versa.

4.5.7 Breakfast type, health related behaviours, psychosocial factors and health outcomes

These analyses addressed the question of whether type of breakfast was important. Breakfast was split into no breakfast, cereal breakfast and other breakfast. A significant difference was found for smoking χ^2 (2) = 8.56, p<.05. Those participants who reported eating cereal for breakfast were less likely to smoke than those in the no breakfast group. A significant difference was found for total number of symptoms F(2,236) = 3.86, p<.05. Those in the no breakfast group reported more symptoms (5.6) than cereal (3.9) and other breakfast (3.7) consumers. No significant differences were found between cereal consumers and other breakfast consumers for any of the outcome measures.

4.5.8 Breakfast type and breakfast frequency sub-groups

Four sub-groups were compared: infrequent cereal consumers, daily cereal consumers, infrequent other consumers and daily other consumers. Firstly frequent cereal and other breakfast consumers were compared with no breakfast. Then infrequent cereal and other breakfast consumers were also compared with no breakfast. Significant results are described below. The complete set of results is given in Appendix C. Significant differences were found for total number of symptoms and bowel function. Table 4.16 shows the mean scores for the 4 groups. Post hoc analysis revealed a significant difference between frequent cereal and no breakfast and frequent other breakfast and no breakfast for number of symptoms. For bowel function the significant difference was found between frequent cereal and no breakfast.

Table 4.16: Mean (s.e.) scores for those outcomes which showed significant differences within frequent breakfast consumers based on the type of breakfast consumed

	Frequent cereal N=49	Frequent other N=75	No breakfast N=114
Number of symptoms	3.47	3.15	5.61
$F_{(2,152)} = 5.48$, p<.01	(0.44)	(0.44)	(0.62)
Bowel function	4.03	4.20	6.35
$F_{(2,151)} = 3.44$, p<.05	(0.53)	(0.54)	(0.76)

No significant differences were found between infrequent cereal consumers, infrequent other breakfast consumers and no breakfast consumers.

4.5.9 Eating habits

Over half of the participants (57%) reported eating 3 meals a day. Participants generally ate cereal for breakfast, a sandwich with yoghurt/fruit/crisps for lunch and a large cooked evening meal. The majority of participants ate 1-2 snacks per day, with 85% of participants eating at least 1 snack per day. Therefore the participants were generally eating 4-5 times per day.

4.5.10 Perceptions about snacking

Perceptions about snacking were recorded using Likert scales and the mode answers are reported here. The complete results are in Appendix C. Participants agreed with the following statements: (1) a grazing pattern is less healthy than eating 3 meals per day, (2) snack foods are less healthy and (3) increased snacking by the population is a major contributor to the current rise in obesity. Conversely they disagreed with the following statements: (1) I depend on snacks as I do not have time to prepare meals, (2) some snacks are healthy but these are not tasty and (3) I avoid snack foods as I think they are unhealthy.

4.5.11 Definition of snacking

The majority of participants (70%) agreed that snacking was best defined as

"food or drink eaten between main meals". No differences were found between males and females or younger and older participants.

4.6 Discussion

The results from the previous studies have shown that snacking is a common occurrence and that unhealthy snacking in particular is strongly and negatively associated with health and well-being. In contrast regular breakfast consumption is strongly and positively associated with health and well-being. The effects cannot be solely accounted for by other lifestyle factors (smoking and alcohol consumption) or demographic factors (age and gender). These findings were based on results from a samples of nurses and the general population. This research was extended in two ways in the current study. Firstly the current study examined dietary factors and health status in primary school children. Secondly it explored any potential associations between breakfast and snack consumption.

4.6.1 Lifestyle, dietary factors and health status in children

4.6.1.1 Demographics

The data from the children provided some interesting results. Parents reported that the average number of eating occasions per day was 5. This was higher than the results obtained from adults, although lower than found in the literature (Livingstone, 1991). A typical day consisted of cereal for breakfast, sandwich with fruit/crisps/yoghurt for lunch and a small cooked evening meal with a dessert. This was consistent across all ages and gender. It was found that children either eat a particular snack frequently or they do not eat it at all. For example dried fruit, cereal bars, cake and nuts were generally not eaten as snacks. However, most children ate fruit, yoghurt, crisps, biscuits and chocolate once a day.

4.6.1.2 Lifestyle and risk factors for mental health problems and poor well-being

Previous studies found that lifestyle factors, including dietary patterns, develop during childhood. The current sample looked at children ranging from 3-11 years old. The majority of children were both "high healthy" and "unhealthy snack food" consumers. Regular snacking was significantly associated with both frequent healthy and unhealthy snacking. The results support the notion that increased snacking in children is associated with increased food consumption in general (Gatenby, 1997).This would also support the idea that children who eat more tend to

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consume a greater range of foods and are more nutritionally balanced.

4.6.1.3 Health status and well-being

Frequent snacking was associated with increased cognitive difficulties. Healthy snacking was associated with positive mood and other snacking was associated with reduced depression and bowel problems. Unhealthy snack consumption showed the expected negative associations with health status and well-being. Unhealthy snacking was associated with increased depression, number of symptoms and bowel problems. Breakfast showed the strongest positive association with health status. Breakfast was associated with mood (both positive and negative), anxiety, depression and bowel function. This supports the notion that breakfast consumption is important for children. One result of particular interest was the different findings for other snacking and breakfast consumption. Other snacking was measured using breakfast cereal and toast consumption. Although these are traditionally breakfast foods they are also convenient snacks. The vast majority of children ate cereal or toast for breakfast. When cereal and toast were consumed as snacks they were associated with increased depression and bowel problems. However, when consumed at breakfast they were positively associated with both outcomes. This supports the view that effects of food depend on when it is consumed. One possible explanation is that those children snacking on cereal toast did not consume breakfast and the negative associations with health and well-being reflect a negative effect of skipping breakfast. However this issue can only be properly understood by using intervention studies which measure both acute and long term changes in well-being can provide more insight into the possible role of habitual breakfast intake.

4.6.2 Associations between breakfast and snack consumption

The results from both the previous study and the current study suggest that breakfast and unhealthy snacking are strongly associated with health and well-being. Regular breakfast consumption is associated with better nutrition intake and decreased consumption of snack foods which are high in fat and sugar. It is therefore possible that the negative effects of unhealthy snacking were in fact negative effects of skipping breakfast.

Breakfast and unhealthy snacking showed strong but opposing effects on

health and well-being. These effects remained when both behaviours were considered together and when they were included as covariates for one another. No significant interactions were found suggesting that these effects are independent of one another. The greatest difference was identified between "regular breakfast / low unhealthy snacking" and "occasional breakfast / high unhealthy snacking". However it is not possible to say whether the positive effects seen for the high breakfast / low unhealthy snack group reflect the presence of breakfast, the absence of unhealthy snacking or most likely a combination of the two.

No association was found between breakfast consumption and unhealthy snacking. Adults who were frequent consumers of unhealthy snacks were equally likely to be regular or occasional breakfast consumers. It is therefore unlikely that the differences are because frequent unhealthy snack consumers are also skipping breakfast.

Further exploration revealed that both breakfast and unhealthy snacking were important and although a difference was found after changing one behaviour, a significant difference was found when both behaviours were changed. Examining subgroups revealed a significant effect of unhealthy snacking for occasional breakfast consumers for depression, emotional distress, cognitive difficulties, somatic symptoms, negative mood and total number of symptoms. An effect of breakfast was found in low unhealthy snack consumers for depression, fatigue, positive mood and total number of symptoms. These results support the view that unhealthy snacking and breakfast are two independent behaviours. The same effect, although weaker, was also seen for healthy and unhealthy snacking suggesting that unhealthy and healthy snacking are also independent behaviours.

Daily breakfast consumers were more likely to be frequent healthy snack consumers. This would suggest that they might be measuring the same underlying factor. Including breakfast as a covariate in the healthy snacking analyses resulted in a number of significant associations disappearing. The same was not true for breakfast, the inclusion of healthy snacking was found to have little to no effect. The only exception to this was anxiety and depression. Healthy snacking, but not breakfast, remained significantly associated with reduced anxiety and depression, both measures of mental health. In contrast breakfast was found to be associated with symptomatic outcomes (somatic symptoms, positive mood, total number of symptoms and bowel

problems). Examining subgroups of behaviour supports the notion that breakfast and healthy snacking are closely to related to one another and may be measuring the same underlying factor of "healthiness".

Due to the cross-sectional nature of this study it is not possible to say with any certainty that breakfast and unhealthy snacking are completely independent of one another or that healthy snacking and breakfast are closely related to one another. This does however appear to be the best explanation of the current results.

4.6.3   Limitations of the current study

These results need to be treated with caution. When the prevalence rates of the mental health and well-being factors for the children in the current study were examined they were found to be very low. Average anxiety and depression scores were 3.15 and 1.02 respectively, with only 0.5% being above the clinical cut-off for anxiety and none being above the clinical cut-off for depression. However, the data about the children were based on parental reports. Previous research is mixed concerning the correlation between parent and child responses. Parents have been found to be accurate at reporting symptoms that are overt and easily observable (Sprangers & Aaronson, 1992; Herjanic & Reich, 1997). However, the correlations are lower for emotional symptoms (Kazdin, French, Unis & Esveldt-Dawson, 1983).

In addition the same measures were used for both adults and children in the current study. Measurement of mental health problems in children is problematic. It is possible that the measures used in the current study were unsuitable for assessing health and well-being in children. More research is needed looking at the associations between breakfast and snack consumption, and health and well-being. Responses should be taken from the children where possible and by other adults, for example teachers to get more accurate results.

The vast majority of children reported eating breakfast everyday. This resulted in uneven groups for the breakfast comparisons. The current study needs to be replicated with more children who did not usually consume breakfast.

4.6.4   Implications of the study

Dietary intake is an important consideration in primary school children. The children in the current sample frequently consumed both healthy and unhealthy

snacks. Although snacking in young children can improve nutritional intake by increasing variety into the diet, the dietary patterns developed in childhood are a strong indicator of dietary habits in adulthood. It is important that children are encouraged to consume healthy snacks.

Breakfast, unhealthy snacking and healthy snacking appear to be independent of one another. This is important when considering possible interventions. Although changing one behaviour was sufficient to improve health, greater improvement was found when all 3 behaviours were positive (regular breakfast and healthy snack consumption and low unhealthy snack consumption).

4.6.5 Future studies

The studies conducted to date have produced some interesting results however they are limited due to the methodology used. Cross-sectional studies are useful for exploring new areas of research to highlight which areas should be examined using intervention studies. The results from the studies done to date have provided a number of possible areas for an intervention study. Although there was a temptation to try and examine as much as possible in order to support previous findings the limitations of running an intervention study as part of a thesis prevented this. The next study reported in this thesis is an intervention which aims to investigate the effects of consuming breakfast or a mid-morning snack for 2 weeks on subjective health and well-being.

CHAPTER FIVE

A 2-WEEK INTERVENTION STUDY EXAMINING THE EFFECTS OF BREAKFAST OR A MID-MORNING SNACK ON HEALTH AND WELL-BEING

5.1   Aims of the study

The results from the previous chapter revealed that children snack more frequently than adults on both healthy and unhealthy foods. Some associations were found between breakfast frequency, snack type and health and well-being, however these results need to be treated with caution due to a number of methodological problems.

Analysis of the data collected from the adults found that breakfast, healthy snack and unhealthy snack frequency were related with one another. However, the results from the previous study suggest that despite this association with each other they exert independent effects of health and well-being.

The results from the previous studies have revealed that breakfast is positively associated and unhealthy snacking is negatively associated with health and well-being. These results are found regardless of other lifestyle and demographic factors in different samples. The conclusions which can be drawn from this study and those preceding it were limited by the cross-sectional methodologies used. The main feature of the present study was a change in methodology and the use of an intervention study.

5.2   Introduction

5.2.1   Methodological issues

A recurring limitation of the previous studies has been that they were cross-sectional in nature. Although this type of methodology is useful when exploring a relatively new area of research such as snacking it does not allow for any conclusions to be made with regard to directionality and causation. Consistent associations have been found for both breakfast and unhealthy snacking and health and well-being. There is now very little that can be gained from further cross sectional studies. One way of expanding understanding about the relationships between meals, snacks and

health and well-being is using intervention studies. These have been used within both breakfast and snacking research.

5.2.2 Long-term effects of breakfast on health and well-being

The majority of intervention studies which have been conducted with breakfast intake have focused on school breakfast programmes. Psychosocial function was found to improve in children whose participation in the school breakfast programme increased (Murphy et al., 1998). In addition measures of child depression and hyperactivity were improved in those whose participation increased. However, it should be noted that these results were based on parental observations. Other studies have found a positive effect of breakfast on different aspects of mood in children, including alertness (Wesnes et al., 2003; Wyon et al., 1997) and contentment (Wesnes et al., 2003). Conversely no significant effects were found in adolescents for tranquillity (Michaud et al., 1991) or anxiety (Cromer, Tarnowski, Stein, Harton & Thornton 1990).

One study on adults by Smith and colleagues (2001) examined the effects of 3 cereals which differed in fibre content (2 high fibre – 29% and 15% and 1 low fibre – 3%) on digestive symptoms and fatigue. The number of digestive symptoms increased during the first week of high fibre consumption, however this substantially decreased in the second week. Ratings of fatigue were found to be significantly lower in both weeks following consumption of the high fibre cereal. This result was found in individuals with both high and low fibre intake at baseline.

5.2.3 Long term effects of snacks on health and well-being

The only intervention studies which could be found examining snacking behaviour considered their effects on diet and energy intake or cognition. Increased consumption of low fat snacks compared to high fat snacks, in habitual snackers, was found to significantly reduce fat intake without increasing total daily energy intake (Lawton, Delargy, Smith, Hamilton & Blundell 1998).

Intervention studies with children have found positive effects of mid-morning and mid-afternoon snacks on various aspects of cognition; including memory and attention and academic performance (Busch, Taylor, Kanarek & Holcomb 2002; Mahoney, Taylor & Kanarek, 2005; Muthayya, Thomas, Srinivasan, Rao, Kurpad,

van Klinken, Owen & de Bruin 2007). No studies could be found which have considered longer term effects of snacking on mental health, well-being and mood. Based on the previous findings from this thesis it is important to consider the possible effects of snack consumption on health and well-being.

5.2.4 Possible mechanisms for the positive effects of breakfast and snack consumption

Two explanations have received the most interest with regard to the mechanisms surrounding breakfast, snacking and performance and mood. These are an increase in blood glucose following consumption of food and increased carbohydrate intake associated with breakfast and some mid-morning snacks.

Individuals were asked to keep food diaries over 9 days and the proportion of energy consumed from carbohydrates was calculated (de Castro, 1987). A significant negative association was found between proportion of energy consumed from carbohydrates and depression. Those individuals who reported greater carbohydrate intake felt more energetic. However these associations were not seen between meals and subsequent mood, instead the impact was found to be cumulative.

In another study students consumed low, medium or high levels of carbohydrate over one week (Keith et al., 1991). Consumption of a low carbohydrate diet was associated with anger, depression and tension. This is supported by findings that eating a low carbohydrate (25g) / high protein (70g) breakfast for 3 weeks resulted in increased levels of anger (Deijen et al., 1989).

No studies were found examining the long-term effects of carbohydrate or glucose on health and well-being.

5.2.5 Summary

An intervention study is needed to further examine the effects of breakfast and snacking on health and well-being. As this study is the first to examine these associations using an intervention study it is important to consider 3 groups; a control group consuming nothing throughout the morning, a group who consume breakfast and no snack and a group who consume a mid-morning snack but no breakfast. This will allow for any independent effects of breakfast and snacking to be identified. Breakfast cereal has been found to affect health and it is a commonly consumed

breakfast. With regard to a mid-morning snack a cereal based snack bar was chosen. There is considerable evidence that carbohydrate can positively influence mood and well-being. It is beyond the scope of this thesis to investigate macronutrient effects. However it has been suggested that if the positive effects of breakfast are due to increased carbohydrate consumption. The same should be found with a cereal based snack bar which is nutritionally very similar to breakfast cereal.

5.4 Results

5.4.1 Participant demographics

Table 5.3 describes the demographic information for the 151 participants who completed the study.

Table 5.3: Demographic data for the study participants. Data are represented as a percentage (number) with the exception of age which is group means (s.e.).

	No breakfast (N=46)	Breakfast (N=53)	Mid-morning snack (N=52)
Gender			
Male	34.8 (16)	34.0 (18)	34.6 (18)
Female	65.2 (30)	66.0 (35)	65.4 (34)
Age in years	28.1 (1.4)	25.3 (1.0)	23.5 (1.1)
Habitual breakfast consumers	29 (63)	34 (64)	35 (67)
Smokers	6.4 (3)	9.4 (5)	7.7 (4)
Drank alcohol	87.2 (41)	94.3 (50)	88.5 (46)
Units per week			
Never	12.8 (6)	5.7 (3)	7.7 (4)
1-10 units per week	41.3 (19)	30.2 (16)	44.2 (23)
11-20 units per week	15.2 (7)	30.2 (16)	28.8 (15)
21-30 units per week	4.3 (2)	9.4 (5)	15.4 (8)

One significant difference was found between the three groups with respect to demographic information. The participants in the mid-morning snack condition were significantly younger than those in the no-breakfast condition $F(2,148) = 3.72$, $p<.05$ (mean age for snack = 23.5 years, mean age for no breakfast = 28.1 years).

5.4.2 Baseline questionnaire measures

Table 5.4 shows the baseline scores for the participants. Two significant differences was found between the conditions, these were cognitive difficulties and negative mood. Post hoc analysis revealed the participants in the snack condition reported significantly fewer cognitive difficulties than the breakfast group. Those in the breakfast group reported significantly higher levels of negative mood than those in the snack group.

Table 5.4: Baseline questionnaire scores. Scores are the means with s.e. in parenthesis.

	Nothing N=46	Breakfast N=53	Snack N=52
Emotional distress	36.40	40.00	32.62
	(2.44)	(2.30)	(2.32)
Fatigue	29.15	31.17	27.31
	(1.95)	(1.84)	(1.85)
Cognitive Difficulties	29.60	*33.40*	*24.17*
$F(2,149) = 7.00, p<.01$	(1.85)	*(1.74)*	*(1.76)*
Somatic Symptoms	28.17	28.96	27.25
	(1.52)	(1.43)	(1.44)
Positive Mood	32.98	33.19	34.89
	(1.27)	(1.20)	(1.21)
Negative Mood	17.26	*20.15*	*15.31*
$F(2,149) = 3.16, p<.05$	(1.45)	*(1.37)*	*(1.38)*
Total Symptom Scores	4.36	4.81	4.50
	(0.53)	(0.50)	(0.50)
Anxiety	5.06	6.26	5.62
	(0.54)	(0.51)	(0.51)
Depression	3.13	3.42	3.65
	(0.43)	(0.41)	(0.41)
Bowel function	4.17	5.30	6.04
	(0.76)	(0.71)	(0.72)

5.4.3 Between group effects

5.4.3.1 Differences at day 7

Significant differences were found for positive mood and total number of symptoms. Table 5.5 shows mean (s.e.) scores. Post hoc analysis revealed those in the no food group reported significantly lower positive mood than those in the breakfast and snack groups. Those in the no food group reported more symptoms than those in the breakfast condition.

Table 5.5: Mean (s.e.) scores for those outcomes which showed significant differences at Day 7.

N=151	Nothing	Breakfast	Snack
Positive mood	28.74	32.90	33.77
F(2,147) = 4.85, p<.01	(1.25)	(1.16)	(1.17)
Symptom score	5.23	3.58	4.59
F(2,147) = 3.30, p<.05	(0.48)	(0.44)	(0.45)

5.4.3.2 Differences at day 14

Significant differences were found for emotional distress, fatigue, cognitive difficulties, positive mood and total number of symptoms. Table 5.6 shows the mean (s.e.) scores. Post hoc analyses revealed significant differences between the no food group and the breakfast group for emotional distress, positive mood, total number of symptoms and bowel function. Significant differences were between no food group and breakfast and snack groups for fatigue and cognitive difficulties. The significant difference was between the breakfast and the snack group for bowel function.

Table 5.6: Mean (s.e.) scores for those outcomes which showed significant differences at Day 14.

N=151	Nothing	Breakfast	Snack
Emotional distress	36.65	29.70	32.22
$F(2,145) = 3.23$, p<.05	(2.00)	(1.91)	(1.89)
Fatigue	29.74	23.68	23.14
$F(2,146) = 4.36$, p<.05	(1.79)	(1.69)	(1.69)
Cognitive difficulties	30.06	23.55	24.89
$F(2,146) = 5.84$, p<.01	(1.45)	(1.39)	(1.40)
Positive mood	28.13	34.02	31.21
$F(2,148) = 5.71$, p<.01	(1.27)	(1.19)	(1.21)
Symptom score	5.68	3.87	4.65
$F(2,148) = 3.77$, p<.05	(0.48)	(0.45)	(0.46)
Bowel function	6.50	4.06	6.60
$F(2,148) = 4.13$, p<.05	(0.75)	(0.70)	(0.71)

5.4.4 Within group effects

5.4.4.1 Differences between baseline and day 7

Nothing group: One significant difference was found between baseline and day 7 which was a decease in positive mood $F(1, 45) = 9.93$, p<.01. Positive mood was 32.76 (1.26) at baseline this dropped to 28.35 (1.38) by day 7.

Breakfast group: Significant differences were found for emotional distress, fatigue, cognitive difficulties and somatic symptoms. Table 5.7 shows mean (s.e.) scores. Breakfast consumption had a positive effect on all outcomes.

Table 5.7: Mean (s.e.) scores at baseline and Day 7 for participants in the breakfast condition

N=53	Baseline	Day 7
Emotional distress	40.00 (2.40)	34.40 (2.06)
$F_{(1,52)} = 4.78$, p<.05		
Fatigue	31.17 (1.82)	26.02 (1.45)
$F_{(1,52)} = 4.74$, p<.05		
Cognitive difficulties	33.40 (1.66)	26.94(1.45)
$F_{(1,52)} = 9.13$, p<.01		
Somatic symptoms	28.96 (1.40)	24.76 (1.14)
$F_{(1,52)} = 5.31$, p<.05		
Symptom score	4.81	3.72
$F_{(1,52)} = 4.35$, p<.05	(0.46)	(0.41)

Mid-morning snack group: A significant reduction was found for anxiety $F_{(1,51)} = 4.18$, p<.05. Baseline anxiety levels were 5.62 (0.52) this reduced to 4.81 (0.51) by day 7.

5.4.4.2 Differences between baseline and day 14

Nothing group: A significant difference was found for positive mood and bowel function. Table 5.8 shows mean (s.e.) scores. Other snacking had a negative effect on both outcomes.

Table 5.8: Mean (s.e.) scores at baseline and Day 14 for participants in the no food condition

N=46	Baseline	Day 14
Positive mood	32.98 (1.25)	27.77 (1.28)
$F_{(1,46)} = 12.25$, p=.001		
Bowel function	4.17	5.92
$F_{(1,46)} = 4.29$, p<.05	(0.67)	(0.91)

Breakfast group: Significant differences were found for emotional distress,

fatigue, cognitive difficulties, somatic symptoms, negative mood and bowel function. Table 5.9 shows mean (s.e.) scores. Breakfast consumption had a positive effect on all of the outcomes.

Table 5.9: Mean (s.e.) scores at baseline and Day 14 for participants in the breakfast condition

N=53	Baseline	Day 14
Emotional distress	39.51	31.41
$F(1,50) = 21.52$, p<.001	(2.42)	(1.90)
Fatigue	31.29	24.37
$F(1,51) = 11.06$, p<.001	(1.86)	(1.75)
Cognitive difficulties	33.39	26.23
$F(1,51) = 25.94$, p<.001	(1.69)	(1.55)
Somatic symptoms	28.85	25.06
$F(1,51) = 9.02$, p<.01	(1.42)	(1.19)
Negative mood	20.15	16.57
$F(1,51) = 10.76$, p<.01	(1.40)	(1.22)
Bowel function	5.30	4.11
$F(1,52) = 5.56$, p<.05	(0.64)	(0.59)

Mid-morning snack group: Significant differences were found for fatigue, somatic symptoms and positive mood. Table 5.10 shows mean (s.e.) scores. Mid-morning consumption was associated with decreased fatigue, number of somatic symptoms and positive mood.

Table 5.10: Mean (s.e.) scores at baseline and Day 14 for participants in the mid-morning snack condition

N=52	Baseline	Day 14
Fatigue	27.31	22.50
F(1,51) = 7.50, p<.01	(1.72)	(1.52)
Somatic symptoms	27.25	24.71
F(1,51) = 4.13, p<.05	(1.19)	(1.40)
Positive mood	34.89	31.81
F(1,51) = 5.20, p<.05	(1.28)	(1.49)

5.4.4.3 Differences between day 7 and day 14 (baseline measure included as covariate)

Nothing group: No significant differences were found for any of the outcome measures.

Breakfast group: Significant differences were found for fatigue, cognitive difficulties, somatic symptoms, negative mood, anxiety and bowel function. Table 5.11 displays all of the mean (s.e.) scores. Breakfast had a positive effect for all outcomes except somatic symptoms.

Table 5.11: Mean (s.e.) scores at Day 7 and Day 14 for participants in the breakfast condition

N=53	Day 7	Day 14
Fatigue	26.12	24.85
$F(1,50) = 4.22, p<.05$	(1.50)	(1.65)
Cognitive difficulties	26.83	26.71
$F(1,50) = 9.99, p<.01$	(1.45)	(1.30)
Somatic symptoms	25.02	25.54
$F(1,50) = 10.26, p<.01$	(1.22)	(1.01)
Negative mood	17.68	17.08
$F(1,50) = 5.80, p<.05$	(1.10)	(0.94)
Anxiety	6.19	5.74
$F(1,50) = 6.99, p<.05$	(0.47)	(0.42)
Bowel function	5.06	4.34
$F(1,50) = 7.49, p<.01$	(0.67)	(0.46)

Snacking group: No significant differences were found for any of the outcome variables.

5.5 Discussion

The studies to date, although being cross-sectional in nature, have found consistent benefits of breakfast on health and well-being. In contrast unhealthy snacking has shown strong negative associations with the same outcomes. The results regarding snacking per se are more inconsistent. The previous chapter identified a relationship between breakfast and snacking although their effects on health and well-being appear to be independent of one another. These studies have only considered associations between food and health at one point in time and therefore need to be treated with caution.

In order to further understand the relationship between breakfast and snacking, and health and well-being it is important to conduct an intervention study. Very little research has examined the long term effects of breakfast on health and no research has been identified which has considered the effects of snacking. The aim of this study was to investigate whether regular consumption of breakfast or a mid-morning snack over 14 days would lead to changes in reported levels of health and well-being.

5.5.1 Long-term effects of breakfast

A number of positive effects of regular breakfast consumption were found. Those in the breakfast group reported improved positive mood and decreased number of symptoms after 7 days compared to those in the no food group. By day 14 those in the breakfast condition reported lower levels of emotional distress, fatigue, cognitive difficulties, bowel problems, number of symptoms and increased positive mood, compared to those in the nothing condition.

Within the breakfast group similar effects were seen. After 7 days improvements were found for all subscales of the PFRS (emotional distress, fatigue, cognitive difficulties and somatic symptoms) and total number of symptoms. After 14 days differences were reported for all subscales of the PFRS, negative mood and bowel function.

The current results are supported by previous cross sectional studies which have found positive associations between regular breakfast consumption and improved mood (Smith, 1999; Benton, Slater & Donohoe, 2001) and decreased emotional distress (Smith, 1998). In addition a previous intervention study found a

significant positive effect of high fibre breakfast cereal on fatigue (Smith et al., 2001).

5.5.2 Long-term effects of snack

Those in the mid-morning snack group reported significantly higher positive mood than those in the nothing group at day 7. By day 14 significant differences were seen between those in the mid-morning snack group and those in the nothing group for fatigue and cognitive difficulties. Consumption of a mid-morning snack was associated with decreased fatigue and cognitive difficulties. Conversely those in the mid-morning snack group reported significantly more bowel problems than those in the breakfast group. No other differences were found between those in the snacking condition and those in the breakfast condition. Consumption of mid-morning cereal based snack did show a similar pattern of effects as breakfast although these effects were less pronounced than those found following breakfast.

Regular mid-morning snack consumption was found to be associated with decreased anxiety after 7 days and lower levels of positive mood, fatigue and somatic symptoms at day 14. It is possible that the low levels of positive mood reported at day 14 are associated with the high levels of bowel problems. It is not possible to say based on the current study why consumption of cereal based snack bars led to increased bowel problems, compared to breakfast cereal.

Overall regular consumption of a cereal based mid-morning snack was generally found to be better than consuming no food in the morning and produced similar, although weaker, effects to breakfast. However, this is an area of research which has not been previously explored and more research is needed to further explore these effects. Future research also needs to consider the combined effects of breakfast and snacking, and the effects of different snacks on health and well-being.

5.5.3 Mechanisms

The literature surrounding breakfast, and to some extent snacking, and health and well-being has focused on increased carbohydrate consumption and the subsequent increase in serotonin secretion as the most likely mechanism underlying these associations.

Consumption of both the mid-morning snack and breakfast used in the present study increased carbohydrate intake. In general the pattern of results found for

breakfast and snack consumption was found to be very similar. It is therefore possible that increased carbohydrate intake and subsequent serotonin levels can account for the observed benefits in the present study. However, both of these foods also contained enough protein to block increased uptake of tryptophan compared to other long neural amino acids and so it seems unlikely that this is the cause of the effects found. This was not addressed in this study and therefore it is not possible to draw any firm conclusions about the underlying mechanisms. A series of specific studies are the only way to fully address these issues. This is a debate that has remained in the literature for decades and it seems unlikely that any consensus will be reached in the near future.

5.5.4   Limitations of the current study

The current study only considered the effects of a cereal based snack bar on health and well-being. The results from the previous cross-sectional studies in this thesis have identified that consumption of unhealthy snacks are strong negative indicators of health. Based on these results it is important that this research is replicated comparing the effects of different types of snacks. In addition comparisons of the effects of different types of snacks may help to elucidate the most likely underlying physiological mechanism.

No conclusions could be drawn about whether either intervention had an effect on dietary habits as measures of eating behaviours were only taken at the start of the study. Future research should consider whether changing one aspect of the diet is sufficient to alter dietary patterns. This would also provide more information about the associations between breakfast and snacking, particularly unhealthy snack consumption.

The individuals in the current study were screened before participating and heavy drinkers and smokers were excluded. The sample used was therefore relatively healthy. It is important that these results are replicated in a broader sample. If the same results are found then breakfast and / or mid-morning snack consumption could be used as a relatively simple intervention to improve health and well-being. It would also be of interest whether different types of snacks would exhibit different effects depending on whether individuals were generally healthy or unhealthy to begin with.

5.5.5 *Implications of the present study*

The results from the present study suggest that regular consumption of breakfast has a continued positive effect on health and well-being. This supports the view that regular breakfast is a marker of a healthy lifestyle. Those who consumed the mid-morning snack reported improved health, with the exception of bowel problems, than those in the no food group. However, their scores were generally not significantly different to those in the no food group or the breakfast group. Although mental health was not found to significantly improve following consumption of the snack they did not deteriorate either, suggesting that snacking should not be avoided. Consumption of breakfast in particular may be a simple method of improving mood and decreasing fatigue.

The results of this study have raised a number of questions which should be considered when conducting future research:

1.   Is a breakfast intervention sufficient to change other dietary patterns and lifestyle behaviours?

- If so are the positive effects seen as a result of a healthier lifestyle change?
- How long do these effects persist?
- What is the effect of breakfast when other behaviours remain the same?

2.   Are any additional benefits or differences seen for mid-morning snacking?

- Are there other outcomes not affected by breakfast which may be affected by snack consumption?

3.   Do the benefits of breakfast / snack consumption extend to physical health outcomes, for example common colds and weight?

5.6 General summary of the dietary intake and health chapters

The studies reported in this part of the thesis have examined the associations between breakfast frequency, snacking frequency, type of snack consumed, and health and well-being. Overall these studies have identified a positive association between regular breakfast consumption and health and a negative association between frequent unhealthy snacking and health. Although breakfast and

unhealthy snacking are associated with one another as well as other health related behaviours (e.g. smoking and alcohol consumption) it would appear that their opposing effects are independent of one another. The effects of lifestyle factors, breakfast and snacking were found to be cumulative. This reinforces the notion that these behaviours are acting independently of one another as performing subsequent positive health behaviours leads to further improvements in reported health. The results of the current intervention study revealed that regular breakfast consumption has a positive effect on mental health, well-being and mood. Consumption of a cereal based snack bar which was very similar to the breakfast cereal used in the study displayed similar although weaker associations with health.

As is the case during the course of a thesis for every research question that is addressed significantly more are generated. The 4 studies reported here have provided some interesting results which if extended could have wide ranging implications. The research which is still required and its potential implications are presented below:

5.6.1   *Measurement of snacking*

As discussed previously snacking is a relatively new area of research however it is limited by the same methodological issues as other areas of food research, for example accurate measurement of intake. The studies conducted in this thesis are unique in examining the associations between type of snack consumed and health. These have raised a number of novel questions including:

a.   How do you define healthy and unhealthy snacks?

b.   How do you define frequent (or infrequent) healthy / unhealthy snacking?

c.   Are these the same for adults and children?

Diet is an important lifestyle factor which is associated with a number of health problems for example high blood pressure, which are themselves risk factors for more serious health problems, for example diabetes and heart disease. The associations between other lifestyle factors and health are fairly robust and these behaviours are considerably easier to measure. Accurate measurement of snacking would help to develop a psychosocial profile of lifestyle factors. Being able to add accurate information concerning both breakfast and snack consumption to this profile would help in designing interventions to change individual's behaviour, whether it is

smoking, alcohol consumption or diet.

Interventions developed on the basis of these profiles could be varied for different sub-groups of the population. Interventions in older people may focus more on cures or at least stabilising their current situation. Dietary interventions could for example help to decrease blood pressure or cholesterol levels. For those with chronic conditions such as diabetes where a cure is not possible changing snacking habits could help manage blood glucose levels and stabilise the condition. In addition to the health benefits changing dietary behaviour is associated with other factors such as increased energy. Small changes for example being able to walk to the shops may help to significantly improve quality of life which may be particularly beneficial to an elderly population.

For younger people these lifestyle changes could form the basis of important preventative strategies to reduce levels of obesity. Levels of obesity are growing exponentially and need to be addressed as the health implications both for the individual and society as a whole with continue to grow as these children continue into adulthood. Programmes need to be developed which are aimed specifically at children. These should not only focus on reducing unhealthy behaviours, for example playing computer games all evening, but proactively promote healthy living. Reducing unhealthy practices is separate to performing healthy behaviours. The effects of these interventions have long lasting effects into adulthood. In addition health problems such as obesity are strongly influenced by family history. If children are taught positive health practices at a young age this might not only prevent them becoming obese but also their children and future generations. Breakfast has also been shown to improve concentration and alertness in children which may be also be beneficial with respect to performance at school and learning.

5.6.2   What is snacking measuring?

The question needs to be asked whether the "snacking" measures used in this thesis were actually measuring snacking behaviour or another underlying factor. The following questions need to be addressed:

a. Is snacking behaviour a marker for something else?

b. If so does it matter what the underlying factor is?

c. Can snacking behaviour be viewed along a healthy / unhealthy

continuum?

Frequent snacking has been shown to be associated with poor dietary intake for example skipping breakfast. It would also seem plausible that snacking is associated with other negative health behaviours including higher alcohol consumption and sedentary behaviour and that is lifestyle per se which is associated with health outcomes. The results from the studies in this thesis suggest that the relationship is slightly more complicated than this. Fully understanding the associations between breakfast, healthy snacking and unhealthy snacking has important implications for interventions. Both breakfast and healthy snacking appear to be independent of unhealthy snacking. This suggests that a lack of performing positive behaviour does not necessarily imply the performance of a negative behaviour. This has obvious implications for interventions. Interventions need to discourage unhealthy behaviours, such as smoking but also promote healthy behaviours for example breakfast consumption in order for optimal benefits to be seen.

What is not clear from these results is whether the questions used in this thesis are actually just measuring breakfast and snacking consumption or are these behaviours markers for another underlying factor. The study reported in Chapter 3 suggests that this underlying factor is not healthiness per se. However other explanations have not been addressed. One way of gaining a greater understanding about this would be to ask individuals about their motivation for eating and their beliefs about the relationship between diet and health. Another question which should be asked is, if breakfast and snacking are markers for an underlying factor does it matter what the underlying factor is?

5.6.3 Combined effects

Further analysis of the relationship between breakfast and snacking is required and there are a number of questions which this research should address:

a.   Do breakfast, snacking and other lifestyle factors show a dose – response relationship?

b.   Is there a plateau after which no additional benefits are found?

The studies in this thesis are the first to explore how breakfast, snacking type and other lifestyle factors might combine in terms of their effects on health. This is an area of research with enormous potential for interventions. Combined effect research has been conducted in a wide range of disciplines. This approach has been used to investigate the effects of psychosocial workplace stressors on work stress (Smith, McNamara & Wellens, 2004). Similar results have also been found for psychosocial stressors and myocardial infarction (Peter, Siegrist, Hallqvist, Reuterwall & Theorell, 2002) and accidents at work (Luz, Melamed, Najenson, Bar & Green, 1990). Interventions in the work place could lead to improve health and safety at an individual level. In some industries this would also translate into improved safety for co-workers and therefore benefit the company. Breakfast clubs have been introduced to try and improve health status and cognitive performance of children. There is scope for a similar intervention to be introduced to the work place.

With respect to interventions it is crucial to consider the respective importance of each of the lifestyle factors. Dietary and behaviour change interventions are time consuming. There is a question of how important is a healthy diet in comparison to other lifestyle factors and how much should individuals be encouraged to do.

5.6.4 Future direction

One original aim of this thesis was to examine the effects of breakfast and snacking on a variety of outcome measures. Although further examination of these questions is of interest they are peripheral to the central aims of this thesis and therefore they must remain for future research to address.

The focus of the second part of this thesis is the influence of breakfast and snacking on other aspects of behaviour, specifically cognitive functioning. The results of the study reported in Chapter 3 showed an association between dietary intake and cognitive failures at work. Lapses in concentration both at school and in the work place can have a large impact on health and performance. A multitude of research has examined the effects of breakfast on cognition. Only a couple of studies have investigated the effects of snacks. The literature on breakfast, snacking and cognition is reviewed in Chapter 6.

CHAPTER SIX

REVIEW OF THE LITERATURE EXAMINING THE EFFECTS OF BREAKFAST AND SNACKING ON MOOD AND COGNITIVE PERFORMANCE

6.1   Aims of this chapter

The first part of this thesis has focused on the associations between breakfast and snack consumption and health and well-being. This has been examined in a range of samples and using a variety of different outcome measures. One consistent result appears to be that breakfast and snacking is associated with positive and negative affect. In addition the results from Chapter 3 found significant associations between breakfast and snacking, and accidents, minor injuries and cognitive failures. The remainder of the thesis this is going to examine the effects of breakfast and snacks on various aspects of mood and performance.

The aim of this chapter is to review the literature surrounding breakfast, snacking and cognition. Chapter 7 reports a study which examined the effects of different mid-morning snacks in mood and cognitive functioning. Chapter 8 describes a study of hazard perception while driving.

6.2   Introduction

6.2.1   Mood

Research reviewed in Chapter 1 demonstrated that mood is associated with breakfast and snack consumption. Overall food has been found to have a positive effect on mood. Breakfast consumption was found to be associated with improved positive mood, sociability (hedonic tone), increased levels of energy and decreased anxiety (Smith, 1998). Consumption of a mid-morning snack has also been found to be associated with mood. Participants who consumed a mid-morning snack were found to be more agreeable, confident and energetic later in the day (Benton et al., 2001).

A number of possible underlying mechanisms were also discussed. The

possible roles of carbohydrate, protein, fat, glucose and micronutrient status were reviewed. The evidence for each mechanism is mixed and no one can solely account for the differences observed. The majority of studies examining the effects of breakfast and snacking on mood also examined measures of cognitive performance. Examination of the associations between breakfast, snacking and cognition may help to elucidate the role of macro- and micro-nutrients and glucose.

Over the past 20 years the notion that short term changes in nutritional intake can affect neural functions, such as memory, information processing and learning, has been generally accepted although this was previously based on anecdotal assumptions. Within the last decade scientific research has been conducted which has confirmed a relationship between nutritional intake and cognitive behaviour.

6.2.2 Early studies of the effects of breakfast

A series of studies conducted during the 1940s and 1950s collectively known as the Iowa Breakfast studies (Tuttle et al, 1949, 1950, 1952, 1954) were the first to look at breakfast and measures of mental performance. These studies were predominantly used to investigate the effects of varying breakfast regimens on physiological performance however they also looked at mental performance mainly in the form of reaction times. The first set of studies compared 4 different breakfast regimens (a heavy breakfast of 800 kcal, a light breakfast of 400 kcal, no breakfast and coffee only, 60 kcal) on simple and choice reaction time (Tuttle, Wilson & Daum, 1949). The participants were six females aged 22-27 years who completed the study on 2 occasions. On the first occasion there was a tendency in the no breakfast condition for slower reaction times. On the second occasion five out of the six and three out of the six showed a significant increase in simple reaction and in choice reaction time respectively in the no-breakfast condition. These results need to be treated with caution due to the small sample size.

The second set of studies (Tuttle, Daum, Myers & Martin, 1950) examined 10 males aged 21-28 years 3 hours after either a 750kcal breakfast or no breakfast. These results again were conflicting. Most of the participants (N=6) showed no change in reaction time, 3 participants displayed increased reaction time in the no breakfast condition and 1 showed an improvement in reaction time in the no breakfast condition. Again there was an issue of the small sample size. In the 1952 studies

Tuttle, Daum, Imig, Randall and Schumacher found no effect of 3 different breakfasts (bacon, egg and milk breakfast, no breakfast and a cereal and milk breakfast) on reaction time. The participants were 10 men aged 60-83 years. For 5 weeks participants consumed the bacon, egg and milk breakfast, followed by 4 weeks having no breakfast and then 4 weeks on the cereal and milk breakfast. During the course of the study no differences were found for reaction time in 7 out of 8 participants. Although this study examined the long term effects of breakfast it was still conducted with small subject numbers and had a poor experimental design.

The last set of studies (Tuttle, Daum, Larsen, Salzano & Roloff, 1954) examined school achievement and the attitudes of schoolboys aged 12–14 years. Subjective assessments made by schoolmasters suggested that consumption of a cereal and milk breakfast had a positive effect on attitude and school performance. Choice reaction time was not altered by missing breakfast.

Although these studies ignited an interest in breakfast research close examination of the results revealed that omission of breakfast had very little effect and any changes found were inconsistent. The studies have been criticised for a number of reasons. All of the studies had very small samples sizes which limits the reliability of the statistical tests used and restricts the generalization of these results to the wider population. The inconsistent findings of the experiments further question the validity and reliability of the results (Dickie & Bender, 1982). All of the studies used subjective reports especially the final study looking at scholastic performance. As mentioned previously only a small number of performance measures were used and the majority of these were reaction time tasks.

An abundance of research has since been carried out looking at the acute effects of breakfast omission, breakfast consumption, macronutrients and glucose administration on cognitive performance. The findings of the Iowa Breakfast Studies have been replicated in these more recent studies.

6.2.3 Acute effects of skipping breakfast on cognitive performance

Breakfast skipping has been identified in children from as young as 5 years (Box and Landman, 1994; Gardner and Merchant, 1996; Gardner and Merchant, 1998). Up to 17% of British school children leave home in the morning without having anything to eat (United Kingdom Consumption Study, 1998). A more recent

study of 15-year olds found that 23% of boys and 14% girls skipped breakfast (Nicklas, Reger, Myers & O'Neil, 2000).

Skipping breakfast leads to a decline in cognitive performance in children and young adults. Fairly robust effects have been found with respect to several aspects of memory functioning including immediate and delayed recall (Smith et al., 1992; 1994a; Vaisman, Voet, Akivis & Vakil, 1996; Benton & Parker, 1998; Smith, Clark & Gallagher, 1999), recognition memory (Smith, Kendrick & Maben, 1992), episodic memory (Wesnes et al., 2003), short term memory (Pollitt, Leibel & Greenfield, 1981; Michaud et al., 1991), long term memory (Chandler, Walker, Connolly & Grantham-McGregor, 1995) and spatial memory (Benton & Sargent, 1992; Mahoney et al, 2005). Despite the consistent results reported above other researchers have failed to find any negative effects of breakfast omission on memory (Dickie & Bender, 1982; Cromer et al., 1990; Lopez, de Andraca, Perales, Heresi, Castillo & Colombo, 1993; Chandler et al., 1995; Jacoby, Cueto & Pollitt, 1996).

Acute effects of breakfast have been found with respect to attention and concentration (Conners & Blouin, 1983; Michaud et al., 1991; Wesnes et al., 2003; Mahoney et al, 2005), problem solving (Conners & Blouin; Simeon & Grantham-McGregor, 1989; Wyon et al, 1997), visual discrimination (Pollitt, Cueto, & Jacoby, 1998 and Simeon, 1998), verbal fluency test (Simeon 1998; Grantham-McGregor, Chang & Walker, 1998), tasks of arithmetic, continuous visual stimulus (Conners & Blouin), stimulus discrimination (Pollitt *et al.,* 1981) and test grades (Rampersaud et al., 2005).

However these studies used different measures and are therefore not directly comparable to each other. The data is less supportive on these processes as numerous studies have failed to find any effect of breakfast on attention (Pollitt et al., 1981; Dickie & Bender, 1982; Pollitt, Lewis, Garza, & Shulman, 1983; Simeon & Grantham-McGregor, 1989; Cromer et al., 1990; Lopez et al., 1993; Chandler et al., 1995) and problem solving (Dickie & Bender, 1982; Simeon & Grantham-McGregor; Lopez et al., 1993; Jacoby et al., 1996; Cueto, Jacoby, & Pollitt, 1998; López-Sobaler, Ortega, Quintas, Navia & Requejo, 2003). In addition no effects have been found for tasks requiring sustained attention (Smith et al., 1992; 1994) or speed of general knowledge retrieval (Simeon, 1989; Smith et al.,1992).

6.2.4 Breakfast cereal and cognitive performance

Breakfast cereal has been found to have an acute effect on memory (Smith et al., 1994; Smith et al., 1999; Benton & Sargent, 1992; Benton & Parker, 1998). This effect is specifically found with free recall, delayed recognition and spatial memory tasks. Eating carbohydrates (breakfast cereal) was found to eliminate shortfalls in certain areas of memory (free word recall) and reduce a deficit in attention by more than half (Wesnes et al., 2003).

In contrast breakfast cereal seems to have little effect on tasks requiring sustained attention (Smith et al., 1994; Smith et al., 1999). It has been proposed that the increased availability of glucose to the brain after eating breakfast cereals enhances memory performance. Glucose is the main source of fuel used by the brain, along with oxygen. Lund-Anderson (1979) stated that under resting conditions an equilibrium develops between blood and brain glucose levels. Increases in blood glucose would therefore represent an increase in brain glucose levels and an improvement in performance on cognitive tasks.

6.2.5 Snacking and cognitive performance

There are a number of reasons to examine the effects of snacking on cognitive performance. Firstly breakfast is seldom eaten in isolation. It has been suggested that a mid-morning snack helps to maintain blood glucose levels and is therefore beneficial to cognitive performance. In addition cereal bars are nutritionally similar to breakfast cereal. Consistent results have been found for cereal therefore it is of interest whether a snack, specifically a cereal bar produces the same results.

The majority of snacks have been found to contain a high proportion of carbohydrate (Bellisle et al., 2003). For this reason it is of interest whether they have similar effects on cognitive functioning as breakfast cereal and if so whether this is the result of increased availability of glucose.

As with studies looking at breakfast cereals, associations have been found between snacks and mental health, mood and cognitive functioning.

Benton et al. (2001) looked at the effects of a snack or no snack after fasting for breakfast, eating 10-g carbohydrate breakfast or a 50-g carbohydrate breakfast. The snack provided was 25-g carbohydrate cereal. The study also measured blood glucose levels. A significant improvement was found for memory 20 minutes after

snack consumption. Their blood glucose levels did not predict memory. No effect of snack was found for memory after 60 minutes. However, in those who received just a snack or a 50g carbohydrate breakfast followed by a snack low blood glucose levels were associated with better memory. The opposite relationship was found in those who consumed a 10g breakfast followed by a snack. It would appear that the effect may depend on the nature of the previous meal.

The association between low blood glucose levels and improved mood and memory may be explained by glucose tolerance. Better glucose tolerance is associated with increased insulin sensitivity and a consequent reduction in insulin secretion which influences numerous neural sites including those in the hippocampus which is associated with memory. Glucose tolerance is poorer later in the day and for this reason generalizations of the effects of snacks eaten in the morning to those eaten later in the day should be made with caution (Benton et al., 2001). Those studies which considered the effects of snacks during the morning are reported first followed by those conducted in the late afternoon.

Smith and Wilds, (submitted for publication) randomly allocated participants into one of four groups based on combinations of breakfast (cereal bar vs no breakfast) and snack (cereal bar vs no snack). Participants were asked to rate their mood and complete four memory tasks; free recall, recognition memory, a verbal reasoning task and a semantic perceiving task. Participants who consumed a cereal bar for breakfast felt more alert, happy and sociable and less anxious. The participants in this group also recalled more words in the free recall task. The consumption of a cereal bar as a mid morning snack increased alertness and hedonic tone particularly in the group which received no breakfast. In those participants who received no breakfast but later received a mid morning snack their anxiety decreased after consumption of the snack and their recall on the free recall test improved. An extension of the Smith and Wilds study considered potential associations between habitual snacking and cognition. No significant differences were found for snacking frequency on the cognitive performance scores.

Busch et al. (2002) considered the effects of a confectionary snack on attention in young boys (9-12 years). Participants were given either 25g confectionary snack (predominantly simple carbohydrates) or half a cup of an aspartame drink in week 1 and the other in week 2. Parents were required not to give their children anything to

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eat after 10pm on the evening prior to testing and not to give them anything for breakfast on the morning of testing. Participants completed an array of cognitive tasks to measure attention, spatial memory, verbal memory, visual perception and short-term memory span. Significant differences between the confectionary snack and placebo were only evident with respect to attention. After eating the confectionary snack participants had higher hit rates, fewer misses and fewer false alarms in a continuous performance task.

Kanarek and Swinney (1990) conducted two studies considering the effects of lunch and afternoon snacks on a range of cognitive tasks. In the first study participants either had lunch or no lunch, followed by either a caloric snack (confectionary) or a non-caloric snack (diet soft drink). Memory was tested using forward and backward digit span tests, attention was measured using a continuous performance task (participants had to spot when a consonant was followed by a number greater than 25). Arithmetic reasoning was measured using arithmetic word problems and reading speed was also tested. Consumption of the confectionary snack was associated with improved recall on the backward digit span test and faster detection of targets on the continuous performance task.

Study 2 was identical but a fruit flavoured yoghurt was used as a caloric snack instead of the confectionary. In the second study those who consumed the caloric snack (yoghurt) performed significantly better on all of the tasks than those who had a non-caloric snack. This was regardless of whether participants had been given lunch except on the reading speed task where those that had eaten lunch were significantly faster. There was no interaction effect. Kanarek and Swinney conclude that mid-afternoon snacks can have a positive effect on cognitive performance.

These results do need to be treated with caution as the studies involved very small sample sizes (10 and 8) respectively and were conducted with males. For a discussion of methodological issues refer to Section 6.2.9.

6.2.6 Macronutrients and cognitive performance

6.2.6.1 Protein : carbohydrate ratio and performance

Considerable research has been prompted by the notion that variations in carbohydrate (CHO) and protein may influence performance via changes in brain

serotoninergic function (Young, 1991). A number of predictions have been made about the effects of differing amounts of CHO and protein but the evidence is in fact quite weak.

Whether mood affects behaviour and therefore performance remains debated i.e. whether feeling tired or less aroused 'causes' reduced activity, or whether reduced activity 'causes' the changes in mood. In addition another problem is the 'inverted-U' association between arousal and performance. Foods that reduce arousal may impair performance if arousal was previously medium to low, but improve it if arousal was high.

A high–CHO meal can also impair performance. Spring *et al.* (1983) looked at performance on sustained selective attention 2hrs after subjects ate CHO or protein meals. Older people have shown a reduction in performance after a CHO meal. The results of studies by Lieberman and colleagues (1986) found adverse effects of unbalanced CHO meals on performance tasks involving sustained attention and speed.

6.2.6.2 Fat and cognitive performance

Little research has been carried out regarding the effect of diet fat on performance (Bellisle, Blundell, Dye, Fantino, Fern, Fletcher, et al.,1998). However, examination of the effects of pure macronutrient ingestion on cognitive performance found that the best performance was observed after fat ingestion (Fisher et al, 2001). Overall, there appears to be only a small effect on cognitive performance as compared to high carbohydrate-low-fat meals. On balance, high-fat meals appear to have little effect on cognitive performance, relative to high-CHO-low-fat meals.

6.2.7 Limitations of the carbohydrate hypothesis

Although research has found positive effects following ingestion of 100% CHO, adding as little as 4% of protein to the meal can abolish the tryptophan effect (Teff, Young, Marchand & Botez, 1989). It is therefore very unlikely that this can account for the positive effects of CHO on mood and performance. The infrequency of consumption of meals and snacks that contain very low levels of protein raises considerable doubt as to the importance of this mechanism. The majority of meals and snacks used in the current research would still contain enough protein in the high CHO condition to prevent the necessary increase in TRP. Even consumption of 100%

CHO, for example boiled sweets, cola or lemonade, would only be sufficient to increase serotonin if they were taken exclusively and long enough after the previous meal that protein no longer remained in the gut. A high CHO meal is likely to produce variable effects in performance, depending on the presence of some protein with the CHO.

An alternative hypotheses has argued that reactions to stress can increase the release of serotonin and that those prone to stress may be serotonin depleted. Research has provided evidence that a high CHO meal benefited those prone to stress but only when they had experienced stress (Markus et al., 1998; Markus, Panhuysen, Tuiten & Koppeschaar, 2000). The breakfasts consumed in the study were very large (1200-1300 kcal) and therefore it is unclear whether these findings will generalise to normal sized meals. These findings do however suggest that individual differences need to be explored. Performance improvements following a simple-sugar load are probably due to an increase in blood glucose.

6.2.8 Glucose and cognitive performance

Following consumption of a meal blood glucose levels rise for approximately half an hour before returning to near baseline levels within 2 hours. Consumption of carbohydrate, in particular simple sugars, shows an energising effect which ties in with increasing plasma glucose levels. Peak plasma glucose times are reported to be 20-30 minutes (Benton, Owens & Parker, 1994; Foster, Lidder & Sunram, 1998; Kennedy & Scholey, 2000). Consumption of a carbohydrate supplement containing glucose was found to enhance the power of three brain waves frequencies (theta, alpha and beta) which are known to be associated with attention and arousal 30 minutes after consumption (Wang, Szabo & Dykman, 2004). Owens et al. (1997) reported an association between falling blood glucose following a glucose challenge and feeling less energetic. Benton (2002) suggested that although there are different results regarding the effects of glucose drinks on mood, they are consistent with the idea that there is an increase in subjective energy (or energetic arousal) initially but by two hours after ingestion the opposite is true (and that this pattern follows the rise and fall of blood glucose post ingestion).

A considerable number of studies have found positive effects of glucose on performance (Lapp, 1981; Hall, Gonder-Frederick, Chewning, Silveira & Gold,1989;

Benton & Owens, 1993; Benton et al., 1994). After consumption of a glucose drink blood glucose levels were correlated with improved decision time in a reaction time task (Benton & Owens, 1993). Raising levels of blood glucose are associated with better recall than falling levels. A glucose induced improvement was found across a variety of baseline glucose levels and was therefore not the product of hypoglycaemia. Higher levels of blood glucose, following consumption of a glucose drink, were correlated with faster information processing, better word recall and improvements on the Stroop test (Benton et al., 1994).

Previous research suggests that increased neural activity is associated with increased use of glucose by the brain (Haier, Siegel, MacLachlan, Soderling, Lottenberg, & Buchsbaum, 1992a; Jonides, Schumacher, Smith, Lauber, Awh, Satoshi & Koeppe, 1997). Cognitive demand seems to be associated with increased glucose metabolism in localised brain areas (Benton, Parker, & Donohoe, 1996; Kennedy & Scholey, 2000). This is consistent with the notion that cognitively demanding situations can deplete the brain of glucose.

There is evidence that as opposed to increasing arousal blood glucose prevents a decline in arousal which occurs when individuals perform cognitively demanding tasks (Owens et al., 1997).

Overall the scientific literature appears to support the view that under specific circumstances certain foods or food constitutes can influence cognitive and affective process which drive human behaviour. There are however a variety of other factors which also need to be considered.

6.2.9 Factors influencing the effects of meals and macronutrients on mental performance

It is possible that methodological issues for example the lack of control of confounding factors, the tasks used and food consumed can account for not finding any differences between breakfast and no breakfast conditions. There are a number of possible explanations as to why significant results are found in some studies but not others. This is most likely due to the variety of different methodologies used. The vast majority of scientific investigations only provide a momentary picture of the effects of breakfast on cognitive performance, as it is only tested once in each nutritional condition.

In the studies reviewed there are many methodological differences and various factors which may have a moderating effect on performance have not always been considered. Age, body weight, gender, activity levels, usual patterns of intake, marginal nutritional deficiencies and social economic status may modify the relationship between nutritional intake and cognitive functioning (Waldstein, Manuck, Ryan & Muldoon, 1991). These factors are discussed below.

6.2.10 Meal size and cognitive performance

The literature surrounding the effects of meal size on performance provides a mixed account. Comparisons of a habitual breakfast and a higher energy breakfast (163% of habitual size) revealed the higher energy breakfast to be associated with poorer performance on an attention task but improved performance on a short-term memory task (Michaud et al., 1991). Energy intake at breakfast was positively correlated with speed of performance on a checking task (attention task) and negatively correlated with number of errors on another test of attention, the addition task (Wyon et al., 1997). A similar pattern is found when lunch effects are considered. Smith et al. (1991) compared three lunches differing in size. Normal lunch consisted of 117% habitual intake, large lunch consisted of 206% habitual intake and the small lunch consisted of 78% habitual intake. The large lunch was seen to be associated with a higher number of errors in a choice reaction time task. A comparison of a large (approx 1300 kcal) and a small (approx 850 kcal) lunch found no effect of meal size on vigilance (Smith et al., 1994). An effect of accuracy was found on the focused attention task where the large lunch was associated with a greater susceptibility to distractions when the distracters were close to the target. Similarly in the categoric search task those participants who had eaten the larger lunch were less accurate when the targets were presented in the periphery as opposed to the centre.

6.2.11 Type of cognitive performance task

Another factor to take into consideration is the type of task used in the testing. A large number of mental or cognitive tasks are potentially able to demonstrate the effects of foods on performance. In practice however, a limited number of tests have been used. Some of the more frequently used ones are selected below (see table 6.1).

Table 6.1: The Type of Functions assessed by cognitive tests

Function	Example of Tests	Common component of task
Vigilance / sustained attention	Search tests, e.g. categoric search, focused attention, repeated digits	Detection of stimulus items from particular categories
Reaction time (decision and movement time)	Simple or choice	Stimulus appears and participants must make a single response, usually by depressing a key; in the choice reaction-time test, one of a number of stimuli make appear and the subject must make one of two responses (e.g. left or right hand)
Working memory (short-term memory)	Spatial memory Word recognition	Participants must recognize rather than recall the stimuli
Immediate memory	Free recall	Participants must remember (recall) series of items or words
Reasoning	Logical	Participants must process and indicate whether stimulus is true or false
Visuospatial motor task	Simulator or driving task	

The nature of the task is crucial. Sustained attention tasks were found to be the most sensitive to lunch effects (Smith *et al.*, 1992). Some studies have shown attention to be a sensitive measure and others reaction time. Many of the tasks used actually involve detecting a signal and therefore could be considered attention tasks, even though the dependable variable is reaction time. Few cognitive tasks in this field allow separation of detection and response time. A lack of effect on some tasks could be from a subtle effect of a micronutrient on only one component of the task. Many studies have administered "off-the-shelf" tests in a test battery. The selection of tests

requires careful consideration of the cognitive faculties that the tests measure and the specific functions they involve need to be taken into consideration (Dye *et al.*, 2000). Cognitive tests employed in studies of this kind are often too short in duration. It is not possible to determine whether cognitive functions are enhanced following food consumption. Improved performance may simply reflect a better ability to sustain performance or attention on the selected tasks.

6.2.12 Time of day and circadian rhythms

Performance on cognitive tasks is affected by time of day and circadian rhythms. Irrespective of food consumption performance, specifically performance on tasks requiring sustained attention is impaired in the early afternoon (Smith & Miles, 1986). Controlling for the effects of and interactions with circadian rhythms requires a level of methodological complexity. Alertness naturally increases throughout the morning and this needs to be acknowledged when investigating the effects of breakfast. This is particularly relevant to carbohydrate. Lloyd *et al.* (1996) found no differences in performance following breakfasts with low-, medium-, or high- CHO content. However, consumption of the high-CHO breakfast reduced fatigue and dysphoria. In contrast, high-CHO lunches produced greater impairment of performance on attention and reaction-time tasks than did standard high-fat meals (Simonson, Brozek & Keys, 1948), high-protein meals (Spring et al., 1983) or no lunch at all (Smith & Miles, 1986). A review of 6 studies examining circadian rhythms in mental performance (Monk & Folkard, 1985) reported evidence of a deficit in performance in the early afternoon. Greater glucose responses indicating a poorer meal tolerance occur in the evening rather than the morning. Fasting blood glucose shows an opposite diurnal variation with higher levels in the morning rather than the evening. This could contribute to the effects of energy observed early in the day.

6.2.13 Future direction

The results surrounding breakfast and cognition are fairly robust and a consensus has been reached about those tasks with are affected by breakfast (memory) and those which are not (sustained attention). The effects of snack consumption have only been considered in a handful of studies. These have generally used two types of

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snack (cereal based or confectionary). Based on the results of the studies reported in Chapters 3 and 4 which showed that type of snack consumed was an important consideration for health outcomes research needs to address whether the same applies to mood and cognition. This formed the basis of the study reported in Chapter 7.

CHAPTER SEVEN

ACUTE EFFECTS OF DIFFERENT MID-MORNING SNACKS ON

COGNITIVE FUNCTIONING AND MOOD

7.1   Aims of the study

The previous section used cross-sectional survey studies and an intervention study to examine associations between breakfast and snacking, and health and well-being. Overall the previous studies have found that breakfast has a positive effect and unhealthy snack consumption has a negative effect.

The majority of the literature reviewed in the previous chapter has considered the effects of breakfast or snack and other meal combinations on cognition. Based on the results from earlier in this thesis it is important to consider whether different types of snacks exhibit differing effects on cognitive functioning. Some research has been conducted looking at cereal based snacks and confectionary snacks and these are discussed below. However, this is the first study which has directly compared the effects of different types of snacks on cognitive functioning.

7.2   Introduction

7.2.1   Breakfast and cognitive functioning

The studies looking at breakfast have found very strong evidence that breakfast consumption is associated with improved performance on some cognitive tasks specifically memory tasks, alertness and mood (Pollitt & Mathews, 1998; Smith et al., 1999). The effects have been identified following consumption of a variety of different types of breakfast, including cereal, toast, cooked breakfast and protein drinks (Benton & Sargent, 1992; Smith et al., 1994). A generally accepted mechanism for the benefit of breakfast on memory is the increased availability of glucose to the brain following consumption of breakfast (Benton & Sargent, 1992; Benton & Owens, 1994). This is in part due to the high carbohydrate content of most breakfasts. Most of the studies of breakfast cereal on cognition and mood were conducted with breakfast cereal. It is of interest whether a cereal based snack bar will produce the same results

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as breakfast cereal.

Cereal snack bars are generally marketed as an alternative for those people who do not have time to eat breakfast in the morning. Therefore it is even more appropriate to examine whether these bars can demonstrate the same positive effects of breakfast.

7.2.2 Snacking and cognition

Research has now started to consider whether snacking also shows benefits on cognitive performance and if the same effects are found following consumption of a cereal based snack bar as opposed to breakfast cereal.

To date only 5 studies have been conducted looking at the effects of snacking on cognitive performance. These studies have considered different types of snacks and aspects of cognitive performance over differing time frames. Two studies have considered confectionary snacks versus diet soda (Kanarek & Swinney, 1990; Busch et al., 2002) and three have considered cereal based snack bars (Benton et al., 2001; Benton & Jarvis, 2007; Smith & Wilds, submitted for publication).

Having a confectionary snack was found to improve performance on a sustained attention task when eaten instead of breakfast (Busch et al., 2002) and in the late afternoon, regardless of whether lunch had been consumed (Kanarek & Swinney, 1990).

When a confectionary snack was eaten instead of breakfast it was found to decrease false alarm rates as a function of time demonstrating that enhanced performance occurred over an extended period of time. No effect was found for confectionary snacks on tests of digit span, verbal memory, spatial learning and visual perception. In contrast when the confectionary snack was consumed mid-afternoon significant effects were found with respect to backwards digit span test, arithmetic problems and reading speed in addition to improved performance on sustained attention (Kanarek & Swinney, 1990). There are a number of reasons for these inconsistencies for example type of snack consumed and circadian rhythms. For example these results could reflect not a benefit of a confectionary snack consumed in the mid-afternoon but a reversal of the post lunch dip. More research is needed to further investigate the effects of a confectionary snack on other aspects of cognitive performance and at other times of the day.

The effects of a cereal based snack on cognitive performance have been found to differ from those of a confectionary snack. Consumption of a cereal based snack has been found to significantly improve mood and memory, specifically recall memory (Benton et al., 2001; Smith & Wilds, submitted for publication). These studies have been conducted looking at various breakfast and mid-morning snack combinations. A significant difference was seen for all mood dimensions with participants who consumed a mid-morning snack reporting better mood. In addition consumption of a mid-morning snack was found to improve recall 20 minutes but not 60 minutes after consumption (Benton et al., 2001). Measures of blood glucose indicate that after consuming a mid-morning snack in isolation low blood glucose levels were significantly associated with better memory both 60 and 105 minutes later. Consumption of a muesli bar was found to reverse the adverse effects of a small breakfast (average 61 kcal) on concentration in school children (Benton & Jarvis, 2007).

The aim of the current study was to examine the acute of a mid-morning snack on mood and cognitive functioning. The study investigated whether different types of snacks show any differences on a range of cognitive tasks.

7.2.3 *Research questions*

1. To replicate the previous different findings of cereal and a confectionary snack on cognitive functioning.
2. Is a cereal based snack bar an appropriate replacement for breakfast?
3. Are the effects of a confectionary snacks specific or are they found with other unhealthy snacks?

7.3.4 Procedure

Participants completed the cognitive tasks on three occasions. The tests were completed in the following order; first mood rating, immediate free recall, logical reasoning, spatial memory, reaction time, semantic memory, focused attention, categoric search, repeated digits, delayed free recall, recognition memory and finally the end mood rating (details about each test are given below). The tasks were completed in this order at all 3 testing occasions.

On the day prior to testing participants completed a familiarisation session. This lasted approximately half an hour and contained a few examples of each test. The aim of the familiarisation session was to eliminate any practice effects from the test; it also gave participants a chance to ask any questions about the tasks used in the study. At the end of this session participants were reminded that they were not allowed to eat anything from 10.00pm that evening, that they were to consume no more than 3 units of alcohol and that they were only to drink water in the morning.

At 10.00am the following morning participants came to the lab and completed the baseline measure. This session lasted approximately 45 minutes. When the participants finished the baseline session they were either given a snack to eat or they were asked to sit quietly for a couple of minutes. Participants performed the test session 45 minutes after consumption. This session lasted approximately 45 minutes.

7.3.5 Materials

The snacks used in the study were a cereal bar, a chocolate bar and a packet of crisps. The nutritional content of each is shown in Table 7.1. A questionnaire was used to collect demographic information was about all the participants.

7.3 Method

7.3.1 Participants

The participants consisted of 40 members of the general public and 56 students. The members of the general population were from South Wales and were recruited from a general public research panel. The students were recruited from Cardiff University. All participants received payment for completing the study. The participants consisted of 67 females and 29 males with an average age of 34 years (ranging from 17-80 years). An information sheet was provided at the start of the study. This included a description about the aims of the project. Ethical approval was given by the Cardiff University, School of Psychology ethics committee.

7.3.2 Exclusions

Participants were excluded from the study if they had eaten anything on the day of testing other than a snack provided by the experimenter or consumed any caffeine. Participant's baseline data was screened before the testing session. Data was checked to see if participants made more than 50 errors on either the focused attention or the categoric search task, if they detected fewer than 2 targets in one minute of the repeated digits task or if they made more than 20 false hits. This resulted in 8 participants being excluded from the study (3 males and 5 females). Following these exclusions there remained 21 participants in the Nutri-Grain group and 22 in each of the other groups.

7.3.3 Design

The design of the study was between subjects with participants randomly allocated to one of the four conditions, cereal bar, chocolate, crisps or no snack. Counterbalancing of the number of members from the general public and students within each condition occurred. In the crisp and no snack conditions there were 9 members of the general public and 13 students. In the chocolate condition there were 10 members of the general public and 12 students. In the cereal bar condition there was 10 members of the general public and 11 students.

Table 7.1: Nutritional values of the snacks used in the current study.

		Cereal bar (37g)	Crisps (34.5g)	Chocolate bar (49g)
Energy	kj	550	752	1073
Energy	kcal	140	181	257
Protein	g	1.5	2.2	3.7
Carbohydrate	g	26	17.3	27.6
Of which sugar	g	12	0.2	
Of which starch	g	12		
Fat	g	3.5	11.4	14.6
Saturates	g	0.6	5.2	Not available
Fibre	g	1	1.4	Not available
Sodium	g	0.1	0.2	Not available

7.3.6 Mood

This was measured using 18 bi-polar visual analogue scales (e.g. Drowsy-Alert, Tense-Calm; after Herbert, Johns and Dore, 1976), which were presented before and after the performance tasks. These scales yield three factors: alertness, hedonic tone and anxiety.

7.3.7 Performance Tasks

7.3.7.1 Immediate free recall task

A list of 20 words was presented on the screen at a rate of one every 2 seconds. At the end of the list participants had 2 minutes to write down as many words as possible, in any order.

7.3.7.2 Delayed free recall task

At the end of the test session the participants were given 2 minutes to write down as many words as possible from the list presented at the start of the session.

7.3.7.3 Delayed recognition memory

At the end of the test session participants were presented with a list of 40

words which consisted of the 20 original words (presented at the start of the session) and 20 distracters. The participants were asked whether the word was in the original list and had to respond as quickly as possible by pressing either true or false.

7.3.7.4 Logical reasoning task

Participants were presented with statements about the order of the letters A and B followed by the letters AB or BA (for example A precedes B, AB). Participants had to decide whether the statement was a true description of the order of the letters. Participants responded by pressing either True or False on a response box. The sentences ranged in syntactic complexity from simple active to passive negative (for example A is not followed by B). This task lasted 3 minutes.

7.3.7.5 Spatial memory task

This task was developed to investigate the visuo-spatial scratchpad as described by Baddely in his working memory model. Participants are shown 6 boxes on the screen, 5 form a pentagon and the sixth is in the middle. The squares light up in a randomised sequence. Participants were asked to watch the sequence and memorise the sequence. Having observed the sequence they were asked to reproduce it by pressing the appropriate buttons on the keyboard. This was repeated four times.

7.3.7.6 Semantic processing task

The aim of this test is to examine speed of retrieval of information from general knowledge. Participants were presented with sentences and were required to decide whether the sentences were true (e.g. canaries have wings) or false (e.g. dogs have wings). The number completed in 3 minutes was recorded.

7.3.7.7 Simple reaction time tasks

Participants were required to complete two simple reaction time tasks. In one task the fore-period was variable (1-8 seconds), in the other the time between the warning signal and the presentation of the target was fixed (2 seconds). In both of the tasks a box was presented on the screen and this was followed by a square (the target) which was presented in the middle of the box. Participants were required to press a key as soon as the square was detected. Once this had been done a new trial began and another box appeared. Each of these tasks lasted 3 minutes.

7.3.7.8 Categoric search task

This task was developed by Broadbent et al to measure selective attention and choice reaction time. At the beginning of each trial two crosses appear in the positions 2.04 or 5.20 degrees apart. The participants do not know which cross will be followed by the target (a letter A or B). On half of the trials the letter A or B was presented alone, on the other half it was presented with a digit [1-7]. The number of near/far stimuli, A versus B responses and digit/blank responses were controlled. Half the trials produced a compatible response (the letter A was presented on the left of the screen, or the letter B was presented on the right of the screen), the other half were incompatible. Participants completed 10 practice trials followed by three blocks of 64 trials. This test lasted approximately 6 minutes. The focus is on responses that were either the same (repetitions) or different (alternations) from the previous one.

7.3.7.9 Focused attention task

This task was developed by Broadbent et al. (1986, 1989) to measure selective attention and choice reaction times. At the beginning of each trial three crosses appeared on the screen. The outside crosses were separated from the middle cross by either 1.02 or 2.60 degrees. The target (a letter A or B) was always presented at the middle cross. The central letter was either accompanied by 1) nothing, 2) asterisks, 3) letters that were the same as the target or 4) letters which differed from the target. The two distracters presented were always identical. Participants completed 10 practice trials followed by three blocks of 64 trials. The focus of this test was on mean reaction time and percentage of correct responses when the target was presented alone or when distracters were present.

7.3.7.10 Repeated-digits vigilance task

This is a measure of sustained attention. Three-digit numbers were presented on the screen at a rate of 100 per minute. Each was usually different from the preceding one but occasionally (8 times a minute) the same number was presented on successive trials. Participants were required to detect these repetitions and respond as quickly as possible. The number of hits, reaction time for hits, and false alarms were recorded. The task lasted for 3 minutes.

7.3.8 Statistical analysis

Descriptive statistics were examined to ensure that there were no outliers before the data was analysed. One way ANCOVAs were used to analyse any differences between the different snack and no snack conditions. Baseline measures were included as a covariate.

7.4 Results

7.4.1 Demographic and baseline measures

No differences were found between the 4 groups for any of the demographic factors (see Table 7.2). In addition no differences were found between the 4 groups for any of the mood or cognitive performance measures at baseline.

Table 7.2: Demographic information of the participants split based on condition

	Nothing N=22	Cereal bar N=21	Chocolate N=22	Crisps N=22
Gender:				
Male	8 (38.1)	4 (21.1)	7 (33.3)	5 (22.7)
Female	13 (61.9)	15 (78.9)	14 (66.7)	17 (77.3)
Age	44.84 (3.68)	42.76 (3.78)	43.95 (3.40)	48.95 (2.91)
Smokers	3 (14.3)	4 (21.1)	3 (14.3)	2 (9.1)
Alcohol	13 (61.9)	11 (57.9)	10 (47.6)	14 (63.6)
Breakfast				
Never	0 (0)	2 (10.5)	0 (0)	1 (4.5)
Once week	0 (0)	0 (0)	1 (4.8)	0 (0)
3-4 week	3 (14.3)	2 (10.5)	3 (14.3)	2 (9.1)
Most days	6 (28.6)	5 (26.3)	3 (14.3)	7 (31.8)
Everyday	12 (57.1)	10 (52.6)	13 (61.9)	12 (54.5)
Snack				
Never	0 (0)	3 (15.8)	0 (0)	0 (0)
Once a week	1 (4.8)	2 (10.5)	2 (9.5)	1 (4.5)
3-4 a week	4 (19.0)	2 (10.5)	3 (14.3)	7 (31.8)
Most days	7 (33.3)	8 (42.1)	5 (23.8)	7 (31.8)
Everyday	9 (42.9)	4 (21.1)	10 (47.6)	7 (31.8)

7.4.2 Mood

When the four groups were compared significant differences were found for

alertness at the beginning of the session, hedonic tone at the beginning of the session, hedonic tone at the end of the session and calmness at the end of the session. Those in the chocolate and crisp groups scored higher on all of the outcomes. Post-hoc analysis revealed significant differences between these and nothing group for all the outcomes except calmness at the end of the session; for this outcome the significant difference was between the unhealthy and cereal bar groups. Table 7.3 shows adjusted mean (s.e) scores.

Table 7.3: Mean (s.e) scores for mood ratings split based on condition

	Cereal bar N=21	Chocolate N=22	Crisps N=22	Nothing N=22
Alertness start of session	219.98	249.89	220.22	213.28
$F_{(3,78)} = 2.79$, p<.05	(10.26)	(9.75)	(9.57)	(9.71)
Alertness end of session	198.16	236.41	202.34	198.05
$F_{(3,78)} = 2.53$, p=.06	(12.10)	(11.61)	(11.29)	(11.54)
Hedonic tone start of session	181.03	192.05	181.95	168.97
$F_{(3,78)} = 2.04$, p>.05	(7.01)	(6.57)	(6.42)	(6.64)
Hedonic tone end of session	172.15	189.49	176.81	166.57
$F_{(3,78)} = 2.39$, p=.07	(6.62)	(6.29)	(6.13)	(6.32)
Calmness start of session	83.70	87.79	90.59	88.68
$F_{(3,78)} = 0.89$, p>.05	(3.13)	(2.93)	(2.89)	(2.93)
Calmness end of session	81.23	89.50	88.72	82.44
$F_{(3,78)} = 2.87$, p<.05	(2.60)	(2.49)	(2.44)	(2.47)

7.4.3 Cognitive functioning

7.4.3.1 Memory

A trend was seen for number of incorrect answers on the delayed recall test. Table 7.4 shows mean (s.e.) scores. Those in the cereal bar condition made more mistakes than the other groups particularly those in the crisp condition. No differences were found between the conditions for any of the other memory tasks. No differences

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were found between the conditions for logical reasoning.

Table 7.4: Mean (s.e) scores for memory tasks split based on condition

	Cereal bar N=21	Chocolate N=22	Crisps N=22	Nothing N=22
Immediate recall				
Number recalled	10.30	10.32	9.54	10.32
	(0.53)	(0.50)	(0.49)	(0.50)
Number wrong	1.00	0.56	0.56	0.51
	(0.20)	(0.19)	(0.19)	(0.19)
Delayed recall				
Number recalled	7.43	8.04	6.92	7.75
	(0.61)	(0.58)	(0.56)	(0.58)
Number wrong	2.38	1.52	1.22	1.39
$F_{(3,78)} = 5.23$, $p=.08$	(0.34)	(0.33)	(0.32)	(0.33)
Recognition memory				
Total target correct	15.42	15.60	14.26	13.27
	(0.85)	(0.79)	(0.78)	(0.81)
Mean RT when target correct	928.79	992.04	791.34	888.49
	(119.76)	(113.34)	(110.24)	(112.81)
Semantic memory				
Number answered	70.08	69.24	69.18	70.64
	(0.92)	(0.88)	(0.85)	(0.88)
Number wrong	2.38	2.58	2.90	2.89
	(0.44)	(0.43)	(0.41)	(0.42)
Logical reasoning				
Percentage wrong	19.36	15.17	17.28	17.50
	(2.01)	(1.89)	(1.83)	(1.86)

7.4.3.2 Attention

A trend was found for number of errors on the categoric search task. Table 7.5 shows mean (s.e.) scores. Those in the crisp condition made more errors than the other groups particularly those in the cereal bar condition. A different pattern was found for

number of errors on the focused attention task. Those in the chocolate condition made more errors than the other groups particularly those in the nothing condition. In addition those in the chocolate condition were also found to record more false hits on the repeated digits task than those in the crisp condition.

Table 7.5: Mean (s.e) scores for attention tasks split based on condition

	Cereal bar N=21	Chocolate N=22	Crisps N=22	Nothing N=22
Categoric search task				
Speed of encoding	11.28	9.83	4.33	10.66
	(5.51)	(5.26)	(5.13)	(5.32)
Number of errors	6.52	9.17	10.78	8.83
$F_{(3,78)} = 2.49$, p=.066	(1.15)	(1.07)	(1.04)	(1.07)
Mean reaction time	528.37	523.25	521.79	526.43
	7.36)	(7.01)	(6.82)	(6.98)
Focused attention				
Speed of encoding	25.60	24.32	20.18	23.65
	(6.44)	(6.18)	(5.97)	(6.12)
Number of errors	9.38	10.01	7.68	6.90
$F_{(3,77)} = 2.16$, p=.099	(1.02)	(1.00)	(0.95)	(0.97)
Mean reaction time	407.57	409.01	407.89	419.53
	(14.92)	(14.32)	(13.84)	(14.18)
Repeated digits				
Number of false hits	17.89	18.14	13.31	13.77
$F_{(3,77)} = 2.28$, p=.086	(1.78)	(1.71)	(1.65)	(1.74)
Number of hits	16.21	17.18	16.98	16.65
	(0.69)	(0.66)	(0.64)	(0.68)
Mean reaction time	690.57	698.99	694.43	684.26
	(14.96)	(14.00)	(13.68)	(14.49)

7.4.3.3 Reaction time

No differences were found between the conditions for reaction time. Table 7.6

shows mean (s.e.) scores.

Table 7.6: Mean (s.e) scores for reaction time split based on condition

	Cereal bar N=21	Chocolate N=22	Crisps N=22	Nothing N=22
Mean RT	241.02 (7.09)	240.14 (6.74)	245.26 (6.57)	259.10 (6.76)

7.5 Discussion

7.5.1 Purpose of this study

Previous research has established that breakfast consumption is associated with improved cognitive performance especially with regard to mood and memory. Benefits have also been found following consumption of snacks. Positive effects of snacking have generally been seen for mood and tasks of attention. However, the research surrounding snacking is mixed and inconsistent. Research considering the effects of snacking have been conducted using different snacks (e.g. cereal bars, confectionary, yogurts), at different times of the day (breakfast replacement, mid-morning or mid-afternoon) and in combination with other meals (breakfast and / or lunch). The current study aimed to consider the effects of different snack foods eaten in isolation during the mid-morning.

In contrast to the benefits of snacking described above the results from the cross-sectional study described in chapter 3 revealed that snacking frequency was associated with increased cognitive failures, these are defined as lapses in memory and / or attention. This was especially apparent in those who were regular unhealthy snack consumers. The two most popular unhealthy snacks that were reported being consumed by individuals in the cross-sectional studies were chocolate and crisps. These were compared to a cereal based snack bar and a no snack condition was included as a control group.

7.5.2 Breakfast and cereal snack

Anxiety levels were higher in the cereal bar group than the other groups. Based on previous studies of snacking and mood, consumption of a cereal based snack bar was expected to be associated with improved mood. Benton et al (2001) found a mid-morning snack was associated with a more positive mood in general and improved feelings of. Another study by Smith & Wilds (submitted for publication) also found higher levels of mood following consumption of a cereal based snack eaten mid-morning, regardless of whether individuals had consumed breakfast.

Consumption of a cereal bar led to poorer performance on the delayed recall task. This is in contrast to previous research which has found a positive effect of a mid-morning snack on memory. It has been suggested that cereal snack bars may have

a beneficial effect due to their nutritional similarity to breakfast cereal. Previous studies of the acute effects of breakfast have found a positive of breakfast on memory (Smith et al., 1992;1994;1999; Benton & Parker, 1998). In addition Benton et al. (2001) found recall was improved 20 minutes following consumption of a cereal based snack consumed mid-morning. However, this benefit was no longer apparent after 60 minutes.

Cereal based snack bars have been marketed as a breakfast replacement. Although this can be supported with regard to nutritional intake, the results with respect to cognitive functioning are inconclusive. Based on the results of the current study it would appear that consumption of a cereal based snack bar mid-morning is not a suitable replacement for breakfast with respect to mood and cognition. It should however be noted that those who consumed the cereal bar performed better than those who did not receive a snack. There was no evidence that consuming a cereal bar as a mid-morning snack should be avoided.

7.5.3 Confectionary vs. cereal snack

It was predicted that confectionary and cereal based snacks would produce different patterns of results. In the current study consumption of chocolate was found to be associated with more errors on the categoric search task and increased number of false hits on the repeated digits task, both measures of attention. This is in contrast to the results of previous research. Consumption of a confectionary snack instead of breakfast was found to improve performance on a sustained attention task (Busch et al., 2002). A study by Kanarek and Swinney (1990) found decreased false alarm rates as a function of time when a confectionary snack was eaten instead of breakfast. Performance was found to be enhanced over an extended period of time.

Although confectionary and cereal based snacks were founds to produce different effects they were found to be in the opposite direction than expected.

Both of the studies reported above considered the effects of a confectionary snack which was eaten instead of breakfast. Although individuals in the current study did not consume breakfast the snack was not consumed until mid-morning.

7.5.4 Unhealthy snacking

No differences were seen between chocolate and crisp consumption. Research

has identified that individuals prefer foods which are sweet and high in fat. This suggests that palatability is an important component of eating behaviour. Research examining palatability has found that cravings are increased during low mood or high stress situations. Consumption of palatable foods induces the release of endorphins. However, although chocolate is considered a palatable food crisps are not sweet enough. It would therefore seem unlikely that palatability can account for the similar results found for chocolate and crisps. Another possibility is acceptability.

Those in the cereal bar group reported increased levels of anxiety. Participants may also have felt that that the cereal bars was not acceptable when they knew that they could have had chocolate or crisps instead. Levels of acceptability were not measured in the current study however this may be an important factor to consider in future research. It is also possible that the individuals in the cereal bar condition had the highest anxiety levels due to the unfamiliarity of the snack. The majority of participants reported eating chocolate or crisps as a snack. In total 65% of participants reported never eating cereal bars as a snack compared with 25% (chocolate) and 38% (crisps).

7.5.5 Limitations of the current study

These effects were not as strong and do not appear to be as consistent as the breakfast effects previously observed. Breakfast was not included in this study due to the fact that these effects have been examined many times previously using the same tests with consistent results. In retrospect it might have been beneficial to have included a breakfast control group. However this would have required more participants and time which was limited.

There are a number of problems associated with studies of dietary intake and cognitive performance. A number of factors are possible cofounders. These include prior food consumption, timing of intake, timing between consumption and testing, individual differences and type of tasks used. It is not possible to control for all of these factors in the current study. In addition as this is still a relatively new area of research a number of variables remain unknown. There is no consensus surrounding timing of intake or testing. A series of robust scientific studies are required in order to further examine the extent of the influence these timings have. This may also help to identify potential mechanisms.

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7.5.6 Implications of the current study

The results from the current study suggest that confectionary snacks are associated with improved mood, however their effects on cognition is mixed. Conversely a cereal bar was found to improve performance in some tasks and impair others. These results were the opposite of what was expected based on previous research. The results from this study reinforce the notion that more research is needed examining the effects of a mid-morning snacks on mood and cognitive performance. However future studies should consider the effects of different types of snacks and whether their effects vary depending on time of day of consumption.

7.5.7 Future directions

Laboratory based studies only provide a limited amount of information about cognitive performance. Different facets of cognition are measured independently. However this is rarely encountered in day to day life as most tasks require a complex combination of these different functions. It is important to consider the effects of breakfast and snacking on real life activities, for example driving. The effects of breakfast and a mid-morning snack combinations on hazard perception while driving was the focus of the next study.

CHAPTER EIGHT

ACUUTE EFFECTS OF BREAKFAST AND MID-MORNING SNACK COMBINATIONS ON HAZARD PERCEPTION WHILE DRIVING

8.1 Aims of this study

The results from the previous chapter found that a mid-morning snack was associated with improved mood; including alertness, hedonic tone and calm. A few differences were found with respect to cognition (number of errors on tasks of attention (the categoric search task, focused attention and repeated digits task), delayed recall and simple reaction time) although these effects were not significant.

The results from an earlier study found that breakfast and snacking were associated with cognitive failures at work. Cognitive failures are defined as temporary lapses in attention and memory. Consideration of a real life activity was the focus for this Chapter. Lapses in attention can have potentially disastrous consequences while driving. The first part of this Chapter introduces situational awareness and reviews the literature to identify cognitive, psychological and demographic factors associated with hazard perception while driving. The present study investigated breakfast and mid-morning snack combinations on hazard perception while driving.

8.2 Introduction

The vast majority of studies looking at associations between eating behaviour and cognitive functioning have been conducted using laboratory based tasks which measure a single aspect of cognition. Many real life tasks involve numerous combinations of these cognitive processes and it is therefore difficult to draw any real life implications from these laboratory studies. It is currently unclear whether the improved performance observed in the laboratory after eating breakfast and / or a mid-morning snack is transferable to real life activities such as driving.

8.2.1 Road accident and injury rates

The United Kingdom had the lowest road death rate in the EU in 2001, at 6.1 per 100,000 population (Office of National Statistics, 2001). In 2006 there were

258,404 road casualties in Great Britain and 31,845 people were killed or seriously injured. These figures are however decreasing, road casualties are 5% lower than 2005 and 1% fewer were killed or seriously injured (Department of Transport, 2007). The government announced a new road safety strategy in 2000 and set new targets for reducing casualties by 2010. These targets include a 40% reduction in the number of people killed or seriously injured; 50% reduction in the number of children killed or seriously injured; a 10% reduction in the slight casualty rate compared with the average for 1994-8. In 2006, the number of people killed or seriously injured was 33 per cent below; the number of children killed was 52 per cent below; and the slight casualty rate was 26 per cent below the 1994-8 average.

8.2.2 Situational awareness

A key component of driving is remaining aware of a dynamic and uncertain situation. It is essential for the driver to know where they are, the speed and position of not only their own vehicle but others as well and road conditions. In addition drivers need to be aware of how these variables could change and make decisions about their navigation and manoeuvring based on these potential changes. This ability of maintaining a complex set of information is known as "Situational Awareness" (SA). This is a key skill for driving as a lack of SA has been found to be associated with accidents and crashes (Treat, Tumbas, McDonald, Shinar, Hume, Mayer, Stansifer & Castellan, 1979; Gugerty, 1997).

Driving ability has been found to be associated with a variety of cognitive, psychological and demographic factors. Studies have attempted to address why younger drivers have a much higher crash frequency. One explanation is they have poorer perception of risks and hazards (Quimby & Watts, 1981; Bragg & Finn, 1982). Another is that different factors are responsible for crashes at different ages with older drivers being more likely to crash due to visual acuity and visual inattention (Owsley, 1986) whereas younger drivers tend to adopt more risky driving styles.

Men are twice as likely to be involved in a fatal car crash as women (Department of Transport, 2007) with different causes of accidents being identified between males and females. Males were found to be more likely to crash because of violations (e.g. speeding, drinking and unwarranted risk taking) while females were more likely to be involved in crashes due to perceptual or judgemental errors (Storie,

1977).

Although the majority of previous research has been conducted using driving simulators researchers have started to explore new ways of measuring driver performance. This can be split into driving skill and driving style. Driving skill can be improved with practice or training, driving style focuses on how people choose to drive or driving habits which have developed over time. One part of SA, which specifically relates to driving is hazard perception latency, how long it takes for a person to react to a potential hazard, this can be expected to improve over time with experience and training. It has been claimed that about 90% of road traffic crashes are caused by driver error (Lewin, 1982).

Hazard perception is one source of individual difference in road accidents (Elander, West & French, 1993). Hazard perception is the process of identifying hazardous objects and events in the traffic system and quantifying their dangerous potential (Brown & Groeger, 1988). Drivers need to be not only aware of their current location, the speed and position of their vehicle and road conditions but also other vehicles on the road and how any of these factors may change in the near future. The hazard perception test was introduced into the driving theory test in November 2002 to help reduce the number of people killed and seriously injured on Britain's roads by 40% by 2010 (Driving Standards Agency).

8.2.3   Factors associated with hazard perception

Research into the causes of traffic accidents has found improper lookout and inattention were the two leading causes of accidents. Driving safely is a complex skill which involves various cognitive processes including perception, attention and motor control. Studies of driving performance and safety have examined a number of important components. Driving ability has been found to be associated with a variety of cognitive, psychological and demographic factors.

8.2.4   Cognitive performance

Driving safely is a complex skill which involves various cognitive processes including perception, working memory, attention and motor control. Research has considered the effects of numerous aspects of cognition on driving performance.

8.2.4.1 Simple reaction time

No relationship has been identified between simple reaction times and crash frequency (Goldstein, 1961; Quimby, Maycock, Carter, Dixon & Wall, 1986). This is not surprisingly given that younger drivers are more likely to be involved in crashes but they also have faster reaction times than older drivers (Cox, Baxter, Buckle, Fenner, Golding, Gore, et al., 1987).

8.2.4.2 Working memory

Driving requires the use of dynamic spatial working memory. Within working memory new information must be combined with existing knowledge for a composite picture of the current situation. Formulating and selecting appropriate responses and carrying out the subsequent actions imposes a huge demand on working memory. Based on Baddley's model of working memory the visuo-spatial sketch pad plays a significant role. This is particularly true during heavy traffic. During these periods when working memory becomes overloaded individuals need to constantly switch their attention (Gugerty, 1997).

8.2.4.3 Sustained attention

Focusing on only certain aspects of the situation can result in a lack of situation awareness, with potentially fatal consequences. Attention can be enhanced by physiological arousal mechanisms (Kahneman, 1973). Sustained and focused attention is negatively associated with driving. Focusing on only certain aspects of the situation can impact on hazard perception.

8.2.4.4 Attention switching

On the other hand attention switching abilities can provide relief when there is a large demand on attention, i.e. driving in heavy traffic. It is argued that an ability to rapidly switch attention to relevant stimuli is a crucial component of safe driving (Kahneman, Ben-Ishai & Lotan, 1976). Most of the early research of attentions switching has used an auditory task, the Dichotic Listening Task (DLT; Gopher & Kahneman, 1971). However the visual modality is considered dominant in information processing tasks (Pick, Warren & Hay, 1969) and a visual test of selective attention was developed based on the DLT (Avolio, Alexander, Barrett & Sterns,

1981). In a study of company drivers errors on both auditory and visual tests of attention were associated with crash rates. The strongest results were found with switching errors (Avolio, Kroeck & Penek 1985).

8.2.5 *Psychological factors*

Alertness and fatigue are two opposing elements which are crucial to safe driving. Fatigue is thought to have a negative effect on driving performance. Impairments have been found with respect to psychomotor skills (Dureman & Boden, 1972) and perception (Brown, 1967). Considerable research has examined the effects of energy drinks and caffeine and the subsequent increases in alertness / decreases in fatigue on accident and crash rates (for example: Brice & Smith, 2001; Horne & Reyner, 2001). However some individuals appear to be more susceptible to the effects of fatigue than others (Elander et al., 1993).

8.2.6 *Demographics*

Age and the associated increase in experience is an accepted risk factor for crash frequency and accident rate. Slower detection of hazards on a driving simulator is associated with higher crash rates, independently of age and mileage (Quimby et al., 1986). People under the age of 25 years and those over 55 years were slower to react to potential hazards on a driving simulator than those of intermittent ages (Quimby & Watts, 1981). However the younger group recorded the fastest reaction times and therefore it was concluded that the effect was due to their failure to recognise the situation as hazardous. Other research has found no difference between young novice drivers and older experienced drivers for the detection of near hazards but the younger drivers were slower at detecting distant hazards (Brown, 1982). Younger drivers were found to be more likely to rate potential hazards as being less dangerous and be slower to respond to them.

Gender differences have also been consistently found. Although men are twice as likely to be involved in a fatal car crash than women (Department of Transport, 1990) difference have been identified with respect to the causes of these accidents. Men are more likely to crash because of driving violations, e.g. speeding and drink driving, whereas women are more likely to crash due to perceptual or judgemental errors (Storie, 1977).

8.2.7 Breakfast, snacking and cognition

The effects of breakfast and snacking on cognition were discussed in more detail in the previous chapter, however there are a few important findings which relate to those facets identified above which have been found to impact performance on a driving task.

8.2.7.1 Breakfast

Consumption of breakfast leads to increased ratings of alertness and other aspects of mood and improved performance on various aspects of memory (Smith et al., 1999; Benton et al., 2001). Despite these positive effects on subjective alertness there is very little evidence that breakfast is associated with functions linked to increased alertness, for example sustained attention. Benefits have also been found for a variety of aspects of memory although very few have specifically looked at working memory and memory load. A literature search found no studies which consider the effects of breakfast on performance on a driving simulator. All of this suggests that breakfast may enhance performance on the hazard perception test.

8.2.7.2 Snacking

Consumption of a snack has also been found to increase alertness (Benton et al., 2001). Although benefits have been found with regard to recall memory no research could be found which has considered the effects of a snack on aspects of working memory. The main difference between breakfast and snacking appears to be the positive effects of snack consumption on attention. Consumption of a mid-morning snack has been found to improve attention and concentration in schoolchildren (Wesnes et al., 2003). However the results from snacking research has overall been more inconsistent and therefore it is harder to make any predictions about their possible effects on hazard perception while driving. In contrast to the breakfast research one study has examined the effects of snacks on driving performance. Consumption of chocolate bar led to fewer track collisions than no snack or an equicaloric snack of cheese and biscuits (Smith & Rich, 1998). This result suggests that improvements of driving performance cannot be attributed to consumption of food per se and therefore different foods may elicit different results.

8.2.8 Hazard perception

The majority of previous research examining driving behaviour has been conducted using driving simulators however researchers have started to explore new ways of measuring driver performance. One source of individual differences in road accidents is hazard perception (Elander et al., 1993). Hazard perception is the process of identifying hazardous objects and events in the traffic system and quantifying their dangerous potential (Brown & Groeger, 1988). The hazard perception test was introduced into the driving theory test in November 2002 to help meet the new targets set by the government in 2000 (Driving Standards Agency).

8.2.9 Aims of the current study

Examination of driving provides a more realistic picture of the effects of food consumption on cognitive functioning. Laboratory based tasks can e used to measure individual facets of cognition however they are not accurately able to examine the complex interaction of these different processes which are used for everyday activities.

The aim of the current study was to provide preliminary information on the effects of breakfast and / or a mid-morning snack on hazard perception in driving.

8.3 Method

8.3.1 Participants

A total of 60 participants were recruited for the study. Fifty-one participants completed the study; the other 9 were unable to attend due to work commitments. The participants consisted of 18 males and 33 females with a mean age of 23.67 (range from 18 to 43). In the final database there were 12 participants in the nothing condition (no breakfast and no mid-morning snack) and 13 participants in each of the remaining conditions; breakfast only; snack only and both breakfast and a snack. The participants consisted of students and members of the general public. Students were recruited through a poster advertisement at Cardiff University. Members of the general public were recruited from a general public participant database. All participants were paid for taking part in the study. An information sheet was provided at the start of the study. This included a description about the aims of the project. The study was approved by the Cardiff University, School of Psychology ethics committee.

8.3.2 Exclusion criteria

Exclusion from the study was determined as; (a) Participants with an existing disease or long term medication; (b) Those who were heavy smokers (i.e. >10 cigarettes a day) or alcohol consumption above 20 units a week (females) and > 30 units a week (males), (c) relevant food allergies.

8.3.3 Design

The study was a between subjects design with participants randomly allocated to one of the four conditions. The study consisted of a baseline session, post breakfast session and a post snack session. All 60 participants were randomised by SPSS (version 11) taking gender into consideration.

8.3.4 Materials ·

8.3.4.1 Mood

Mood was assessed both pre- and post – performance using 18 visual analogue mood rating scales (after Herbert et al., 1976). Each bi-polar scale consisted of a pair

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of adjectives, e.g. drowsy – alert. Participants were asked to mark a cross on the line based on their current mood. A measure of alertness was derived from these ratings with a high score meaning greater alertness (maximum score of 408).

8.3.4.2 Hazard Perception Test

Hazard perception was measured using 2 commercially available CDs for learner drivers. Measurement of performance in the Hazard Perception Test (HPT) was based on the report produced by the software at the end of the test. Full details and examples of this report are given in Appendix E.

Participants were required to click the left mouse button as soon as they detected a potential hazard. A mark out of 5 was awarded for each hazard, based on their reaction time. The earlier a hazard was identified the higher the score. If the programme detected any rhythmical clicking patterns then the participants were told that they had cheated on that clip and therefore received a score of "0". The test consisted of 14 clips, 13 contained 1 developing hazard and 1 contained 2.

At the end of each test a record screen was bought up on the screen. This gave a mark out 5 for each clip (mark out of 10 for one clip), whether the participant had passed or failed and their total score out of 75. Scoring "0" on a clip, when no cheating had been detected, was recorded as an error as the participant had failed to recognise the hazard. Scoring "1" on a clip was recorded as a long response as they only just managed to identify the hazard in time.

8.3.5 Procedure

Participants had to abstain from eating and drinking caffeinated products from 10.00pm the previous evening. Participants came into the unit at 8.00am and were given an information sheet detailing the study and written consent was obtained. In addition demographic information was collected which included a question about previous driving experience (in years) and whether they had done a hazard perception test when they took their driving task. Both of these were included as covariates for all of the hazard perception analyses. Participants completed 3 practice trials and were provided with feedback about their performance. They then completed the baseline session, which consisted of 14 clips. The baseline session lasted approximately 15 minutes. Participants were then taken to another room where magazines / newspapers

were available. Those in the breakfast condition were given a cereal bar at 8.30am. All of the participants completed the first test session between 9.15-9.30am. Participants returned to the other room and those in the snack condition were given a cereal bar at 10.00am. The second test session was completed by all the participants between 10.45-11.00am. Participants remained in the unit while they weren't completing the tests. Participants were allowed to drink water during the course of the study.

8.3.6 Analysis

A series of 2x2 between subjects ANOVAs were used to assess the effects of breakfast and / or a mid-morning snack on mood ratings, score on the hazard perception test, number of errors, number of long responses and number of times participants were detected as cheating. A series of repeated measure ANOVAs were used to look at any differences across the two test sessions (post breakfast and post snack) with baseline measures (pre breakfast) included as a covariate.

8.4 Results

8.4.1 Participant demographics

Demographic information was collected about the participants. This is displayed in Table 8.1. There were no significant differences between the groups with respect to the demographic information.

Table 8.1: Demographic information of the 51 participants who completed the study. Data is represented as a percentage (number) or group means (s.e.m) and split by condition.

	Nothing N=12	Breakfast N=13	Snack N=13	Both N=13
Gender:				
Male	33.3 (4)	30.8 (4)	38.5 (5)	46.2 (6)
Female	66.7 (8)	69.2 (9)	61.5 (8)	53.8 (7)
Age	25.2 (2.3)	21.4 (1.2)	24.8 (2.2)	23.5 (1.6)
Smokers	25.0 (3)	0 (0)	15.4 (2)	0 (0)
Alcohol units:				
None	16.7 (2)	7.7 (1)	7.7 (1)	23.1 (3)
1-10 per week	58.3 (7)	38.5 (5)	30.8 (4)	30.8 (4)
11-20 per week	8.3 (1)	23.1 (3)	38.5 (5)	38.5 (5)
21-30 per week	16.7 (2)	30.8 (4)	23.1 (3)	7.7 (1)

8.4.2 Chi-Square analysis

A chi-square analysis of how many people passed the test at baseline was significant (χ^2 = 5.12, p<.05). In total 33 passed the baseline session and 17 people failed. There was missing data for one individual.

However this significant difference remained throughout the test sessions. For test 1 33 people passed and 18 people failed and for the second test session 33 people passed and 18 people failed. It was not the same 18 people failing each time. It was not the case that people were improving on the task over time as a result of practice /

exposure to the task.

8.4.3 Mood ratings

No significant differences were seen for mood between the breakfast and no breakfast and the snack and no snack groups at baseline. Table 8.2 shows the mean (s.e.) scores.

Table 8.2: Mean (s.e) scores for mood ratings split based on condition

	No Breakfast N=12	Breakfast N=13	No snack N=13	Snack N=13
Pre session alertness	218.75	202.76	214.50	206.84
	(14.1)	(13.8)	(14.1)	(13.9)
Pre session hedonic tone	202.63	200.96	194.02	209.22
	(7.8)	(7.7)	(7.7)	(7.5)
Pre session calm	101.63	107.52	101.23	107.9
	(4.1)	(4.0)	(4.1)	(4.0)
Post session alertness	206.48	206.08	214.69	198.20
	(16.0)	(15.7)	(15.9)	(15.6)
Post session hedonic tone	191.92	195.80	193.08	194.68
	(8.3)	(8.1)	(8.3)	(8.1)
Post session calm	94.40	99.60	95.73	98.32
	(4.6)	(4.5)	(4.6)	(4.5)

8.4.3.1 Post breakfast session (session 1)

A significant main effect of breakfast was found for alertness at the beginning of the session ($F_{(1, 44)} = 8.14$, $p<.01$) with participants who ate breakfast reporting higher levels of alertness. All of the data analysed is included in Table 8.3.

Table 8.3: Mean (s.e) scores for session 1 mood ratings split based on breakfast consumption

	No Breakfast N=25	Breakfast N=26
*Pre session 1 alertness***	*215.65*	*259.23*
	(10.6)	*(10.4)*
*Pre session 1 hedonic tone**	*189.98*	*206.04*
	(6.2)	*(6.1)*
Pre session 1 calm	98.71	95.36
	(3.1)	(3.0)
Post session 1 alertness	221.21	222.84
	(11.5)	(11.3)
Post session 1 hedonic tone	181.72	190.29
	(9.2)	(9.0)
Post session 1 calm	94.79	97.63
	(3.9)	(3.9)

* significant at p<0.1

** significant at p<0.05

8.4.3.2 Post snack session (session 2)

A significant main effect of snack was found for alertness at the end of the session F $(1, 43) = 4.09$, p<.05 with participants who ate the snack reporting greater levels of alertness. All of the data analysed is included in Table 8.4.

Table 8.4: Mean (s.e) scores for session 2 mood ratings split based on snack consumption

	No snack N=25	Snack N=26
Pre session 2 alertness	215.06	241.58
	(11.8)	(11.5)
Pre session 2 hedonic tone	193.13	196.82
	(7.1)	(6.9)
Pre session 2 calm	94.34	98.12
	(3.7)	(3.6)
*Post session 2 alertness***	*194.31*	*237.6*
	(13.4)	*(13.2)*
Post session 2 hedonic tone	185.17	197.68
	(6.6)	(6.5)
Post session 2 calm	93.47	100.43
	(3.8)	(3.7)

** significant at $p<0.05$

8.4.3.3 Within session baseline effects

Within subjects analyses were conducted to examine any differences between pre and post session scores. A significant main effect of session was found for calm during the baseline session. Calm significantly decreased during the session (meaning that anxiety levels increased).

Table 8.5: Mean (s.e.) calm scores at baseline

N=51	Pre baseline session	Post baseline session
Calm	104.63	97.05
$F_{(1,48)} = 10.29, p<.01$	(2.88)	(3.20)

Significant differences were found for breakfast between pre and post session scores for alertness. There was a significant main effect of time and an interaction

between breakfast condition and time. Overall alertness decreased during the test (237.54 vs 222.03). However alertness levels remained very similar within the no breakfast group but decreased within the breakfast group.

Table 8.6: Mean (s.e.) scores for pre and post session 1 alertness based on breakfast consumption.

N=51	No breakfast		Breakfast	
	Pre session 1	Post session 1	Pre session 1	Post session 1
Alertness	220.44	221.31	254.64	222.74
$F_{(1,47)} = 5.11, p<.05$	(13.32)	(13.92)	(13.05)	(13.64)

8.4.3.4 Within subjects test effects

A significant interaction was found between breakfast and session for pre-session alertness. Pre-session alertness increased between session 1 and session 2 in the no breakfast group whereas it decreased in the breakfast group.

Table 8.7: Mean (s.e.) scores for pre session 1 and pre session 2 alertness based on breakfast consumption.

N=51	No breakfast		Breakfast	
	Pre session 1	Pre session 2	Pre session 1	Pre session 2
Alertness	215.65	230.79	259.23	226.48
$F_{(1,46)} = 10.94, p<.01$	(10.61)	(12.10)	(10.39)	(11.86)

A repeated measures ANOVA was used with time and session included as within subject variables and breakfast and snack consumption as between subject variables. Significant main effects of time and session were found for alertness. Pre-session alertness was higher than post-session alertness (225.28 vs. 214.50). Overall alertness increased between baseline and session 1 and declined between session 1 and session 2 (208.20; 229.42; 222.04 respectively). A significant interactions were found for breakfast and session (refer to Table 8.8).

Table 8.8: Mean (s.e.) scores for alertness based on breakfast consumption.

N=51	No breakfast			Breakfast		
	Baseline	Session 1	Session 2	Baseline	Session 1	Session 2
Alertness	212.62	220.88	221.51	203.79	237.96	222.56
	(13.63)	(12.42)	(13.02)	(13.36)	(12.28)	(12.77)

Significant interactions were also found for breakfast by time and session (refer to figure 8.1) and breakfast and snack consumption. Consumption of a mid-morning snack decreased alertness in those in the no breakfast group (229.75 vs. 206.92) but increased alertness for those in the breakfast group (202.71 vs. 240.17).

Figure 8.1: Mean alertness scores by breakfast, time and session
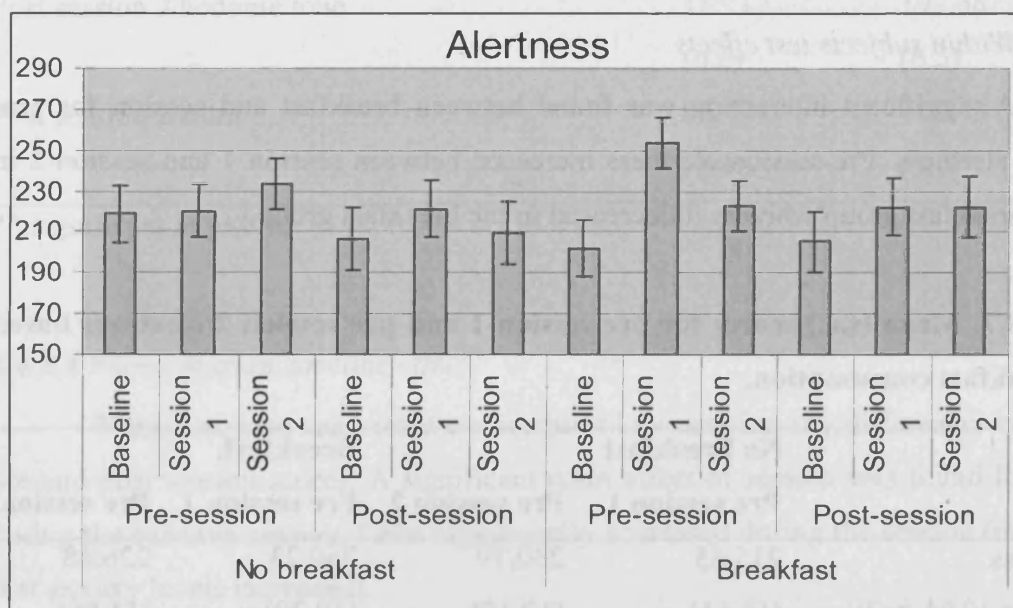
8.4.4 *Performance on the Hazard Perception Task*

Table 8.9 shows the baseline scores for the participants. Comparisons were made between no breakfast and breakfast conditions and the snack and no snack conditions.

Table 8.9: Baseline measures on the Hazard Perception Test split based on breakfast and snack consumption. Values are either N (%) or mean (s.e.)

	No breakfast N=25	Breakfast N=26	No Snack N=25	Snack N=26
Number who passed	14	19	19	14
	(56)	(73)	(76)	(54)
Mean total score (out of 75)	43.21	42.85	45.08	41.12
	(2.4)	(2.3)	(2.4)	(2.3)
Mean number of errors	1.46	1.81	1.58	1.69
	(0.4)	(0.4)	(0.4)	(0.4)
Mean number of long responses	1.42	1.00	1.13	1.27
	(0.3)	(0.3)	(0.3)	(0.3)

No significant differences were found for number of errors, number of long responses and number of times participants were detected as cheating in either test session. Therefore no further analyses were conducted. For all subsequent analyses previous driving experience was included as a covariate.

8.4.5 Breakfast effects

No significant differences were found between the breakfast and no breakfast groups for any of the outcomes. Mean scores (s.e.) are displayed in Table 8.10.

Table 8.10: Acute effects of breakfast (or no breakfast) on the Hazard Perception Test. Values are either N (%) or mean (s.e.)

N=51	No breakfast	Breakfast
Number who passed	19	14
	(76)	(54)
Mean total score (out of 75)	43.80	40.34
	(1.8)	(1.7)
Mean number of errors	1.82	2.54
	(0.4)	(0.4)
Mean number of long responses	0.76	0.99
	(0.2)	(0.2)

8.4.6 Snacking effects

A significant difference was found for total score. Those in the mid-morning snack group scored higher on the test than those in the no snack group. Means (s.e.) for all of the outcomes are shown in table 8.11.

Table 8.11: Acute effects of a snack (or no snack) on the Hazard Perception Test. Values are either N (%) or mean (s.e.)

N=51	No Snack	Snack
Number of people who passed	16	17
	(64)	(65)
*Mean total score (out of 75)***	*40.68*	*46.25*
F(1,46) = 5.51, p<.05	*(1.7)*	*(1.6)*
Mean number of errors	2.31	1.75
	(0.4)	(0.4)
Mean number of long responses	1.01	0.76
	(0.2)	(0.2)

** significant at p<0.05

Consumption of the snack was associated with higher test scores. When the breakfast

and no breakfast groups were compared a significant effect of snacking was found within the breakfast group $F_{(1,23)} = 4.69$, $p < .05$ but not within the no breakfast group $F_{(1,21)} = 1.15$, $p > .05$, although the same pattern of results was identified.

Table 8.12: Mean (s.e.) total score on the Hazard Perception Test split based on breakfast and snack consumption

N=51	No breakfast		Breakfast	
	No snack	Snack	No snack	Snack
Total score	40.59 (2.63)	44.88 (2.41)	40.85 (2.35)	47.54 (2.33)

8.5 Discussion

8.5.1 Purpose of the study

The primary aim of this study was to provide some preliminary information about the effects of breakfast and / or a mid-morning snack on hazard perception while driving. Breakfast has been found to show positive effects on alertness and other facets of cognition; however the exact pattern of effects remains unclear. One aim of this study was to try and replicate the positive effects of breakfast and snacking on mood. It was also of interest whether breakfast would also be beneficial on a driving task which involved a complex interaction of different aspects of cognitive functioning. The same also applies to snacking.

Another point of interest was whether consuming the same item for both breakfast and a mid-morning snack will produce different effects. Previous research has found that breakfast cereal consumed at various times of the day produces different effects. As cereal based bars as marketed as a breakfast replacement bar it was of interest whether they produce the same positive effects of breakfast cereal when eaten as breakfast.

8.5.2 Mood

The findings of the present study showed that consumption of breakfast led to increased alertness levels after 45 minutes. Breakfast consumption also increased levels of hedonic tone. These findings are consistent with previous research looking at the effects of breakfast (Smith et al., 1999). The results from the previous study found increased alertness one hour after consumption of a mid-morning snack. Those participants who consumed breakfast reported very high alertness levels before starting the first test session (mean =259). These levels fell off very sharply over the course of the first session. By the end of the session the alertness levels of those in the breakfast condition was the same as those in the no breakfast condition (mean = 220).

Alertness levels also fell during the test in the snack group, however alertness levels before the test were lower (mean = 241) and they decreased by a considerably lesser extent by the end of the test (mean = 237). The high pre test levels of alertness in the breakfast group may reflect a diurnal effect of natural increases in alertness associated with circadian rhythms and the additional increases seen after breakfast

consumption. Due to short duration of the test session it is very unlikely the sharp decrease found is the result of circadian rhythms. One possible explanation is reported glucose depletion following cognitively demanding tasks. This however would appear unlikely as the same effect was not found in the snack group. This is discussed in more detail later in this chapter.

8.5.3 Hazard perception

8.5.3.1 Breakfast effect

One interesting result of the study was that consumption of breakfast led to poorer performance on the hazard perception task than no breakfast although this was not significant. This supports the notion that although breakfast improves ratings of alertness it does not influence tasks which are affected by alertness such as sustained attention (Smith et al., 1992). Other factors which influence hazard perception are reaction time and attention. Previous research has failed to find any effects of breakfast in laboratory studies of reaction time and the findings relating to sustained attention have been inconsistent. Although the current results taken with previous research might suggest that breakfast does not have any effect on hazard perception there are other factors which need to be considered.

The breakfast provided in the current study was a cereal based snack bar. One possible explanation is that cereal based bars are not a suitable replacement for breakfast. This is smaller than the majority of participants reported eating for breakfast. It is possible that having a considerably smaller breakfast than usual produces more negative effects on cognitive functioning (Mahoney et al., 2005). It would be of interest to examine whether the negative effects of breakfast would be replicated if individuals consumed a breakfast which was similar to their usual breakfast.

8.5.3.2 Snacking effects

The present study showed a benefit of consuming a cereal based mid-morning snack on hazard perception. Participants who received a mid-morning snack scored significantly higher on the test than those who did not. When previous consumption of breakfast was taken into consideration this effect remained significant. Further analysis revealed that consumption of the mid-morning snack reversed the negative

effects of consuming breakfast.

Previous research found that consumption of a chocolate bar was associated with improved performance on a driving simulator when eaten either mid-morning or mid-afternoon (Smith & Rich, 1998). The researchers concluded that one possible explanation for this effect was the high carbohydrate composition of the chocolate bar. The cereal based snack bar used in the current study was very similar in carbohydrate composition to the chocolate bar (cereal bar 65g per 100g; chocolate bar 69g per 100g). It would appear that a high carbohydrate snack eaten during the mid-morning could potentially improve driving performance. However further research is required to test this view.

8.5.4 Possible role of glucose

The literature reviewed in Chapter 6 found that blood glucose levels increased following consumption of a high carbohydrate breakfast. Changes in blood glucose levels are one possible mechanism via which breakfast and / or snacking may influence mood and cognition. This is supported by early studies of nutrition and driving ability which found glucose consumption was associated with increased concentration and faster reaction times (Keul, Huber, Lehmann, Berg, Jacob, 1982; Moser, Plum & Buckmann, 1983) although the beneficial effects of glucose on a driving simulator task only became apparent after long distance: 70-110km (Keul et al.). Overall the studies of glucose suggest that tasks which require rapid responses are susceptible to the facilitating effects of glucose and these are specifically observed during prolonged testing sessions. The hazard perception task required rapid responses to particular situations as opposed to continuous rapid responses. In addition the task duration was only 15 minutes, which was considerably shorter than previous studies which have tested participants over a period of 70 minutes (e.g. Keul et al., 1982). It appears unlikely that the task used in the current study would be affected by increased blood glucose levels.

The only way to resolve this is for future studies to include measures of blood glucose in order to examine whether it is associated with performance on the hazard perception test. The majority of studies examining glucose and cognition have tended to use an interval of 20 minutes between consumption and testing, while glucose levels are still rising, as opposed to the 45 minutes used in the current study. This

should be considered in future studies of glucose levels and hazard perception while driving.

8.5.5 Limitations of the current study

The results of this study need to be treated with caution as the hazard perception test is a novel measure which has not been previously used for this type of research. Its inclusion in the driving theory test would suggest it is a reliable measure of situational awareness, this does not mean however that it is sensitive enough to identify differences in performance associated with dietary intake.

Age has been previously identified as an important factor associated with hazard perception and was controlled for in this study. However due to the age of the students who participated in the present study some of them had recently taken their theory tests including the hazard perception test. This was also controlled for in the present study but it might explain why the majority of participants passed all of the sessions. The results do suggest that there may be a ceiling effect. Due to the limitations of the software used it was not possible to modify the difficulty of the clips or the test in general. Future studies should examine ways in which the degree of difficulty could be altered and measure participant's perceived levels of difficulty.

Motivation is another factor which needs to be addressed in future studies. Those who did not receive breakfast and / or a snack may have been less motivated to perform well on the task. Another component of the test which it would be useful to modify is feedback and outcomes. With the present software participants are passive observers of the situation and their decision to detect hazards and the speed of their response has no influence on the outcome. This is not realistic. The development of a task where the outcome changed if participants did not respond within the given time frame may provide a more realistic study of driving performance.

With regard to breakfast future research may wish to use breakfast cereal or other commonly consumed breakfast items as opposed to a cereal bar. This would provide a better indication of the effects of a standard breakfast on performance. In addition measures of habitual breakfast intake should be taken and controlled for.

8.5.6 Implications of the current study

Despite the limitations described above this study is the first to consider the

effects of breakfast and mid-morning snack combinations on hazard perception while driving and has raised some interesting questions.

Is breakfast and / or snack consumption sufficient to alter performance on complex everyday tasks for example driving?

Those who consumed a mid-morning snack in the present study scored significantly higher on a test of situational awareness while driving. Previous research found that consumption of a confectionary snack was associated with fewer collisions of a driving simulator task. Therefore the results from both the present study and previous research suggest that consumption of a high carbohydrate snack may improve awareness while driving and therefore may be subsequently associated with fewer crashes and collisions.

The effects of breakfast are not as clear. No previous research could be found which has investigated the effects of breakfast consumption on driving or performance on a driving simulator. The results from the present study suggest that although alertness may be improved following consumption of breakfast, this does not translate into improvements in other aspects of cognition.

This is a question which cannot be answered yet. However it remains an important question which should to be addressed in future research.

Should studies of breakfast and snacking continue to examine cognition at an individual level?

Examination of the results from previous studies of breakfast on cognition suggested that the pattern of effects was similar to those required for improved situational awareness. The current study was unable to prove or disprove this suggestion. It does however appear that performance on tasks, such as driving, which require a complex set of differing cognitive facets cannot be predicted based on performance on each facet at an individual level. The effects of breakfast on cognition have been exhaustively examined and the question needs to be asked how much more can we learn from these studies. Research should now be extended to look at the broader picture and consider the potential effects of dietary intake on more real life activities, whether this is driving, sports performance or occupational factors (for example air traffic control).

However a lot of debate still remains about the underlying mechanisms and it may be argued that these studies are required in order to investigate this further. Research of breakfast and cognition has spanned 50 years and the perceived effects of glucose and macronutrients has been the focus of research since the 80s. It appears unlikely that more studies in this area will resolve this issue.

8.5.7 Generally summary of the cognitive based studies

The two studies reported in the second part of this thesis have examined cognitive performance and a driving skills test. The results from the cognitive performance study identified significant differences for alertness, sociability (hedonic tone) and anxiety. A benefit of consuming a mid-morning snack was found when compared to no food. Some differences were found between cereal based and confectionary snacks on memory and attention tasks however the majority of these were not found to be significant. Based on these results it is not possible to draw any firm conclusions about whether different types of snacks produce different effects on cognition.

The results from the study of hazard perception while driving identified that consumption of a high carbohydrate snack mid-morning was associated with improved scores on the test. No effects of breakfast were identified. The pattern of results suggested a possible negative effect of breakfast consumption which was unexpected. However, this study was an exploratory study as it is the first to use the hazard perception test as a measure of driving skill. These results suggest that understanding the effects of breakfast and snacking on individual cognitive performance tasks is not sufficient to predict their influence on more real life activities which involve complex sets of these functions.

8.5.8 Future directions

Work based interventions are increasing in popularity. Fatigue at work can be detrimental in some occupations, however in others it can lead to far more serious consequences including fatality. Signs on the motorway advising drivers to take regular breaks are now a common occurrence. Energy / caffeine containing drinks are marketed to increase alertness / reduce fatigue. All of the research conducted to date including those reported in the this thesis suggests that consumption of breakfast and /

or a mid-morning snack would also improve alertness. For a number of professions employees are required to answer a range of questions before they start work in order to establish whether it is safe for them to work. Inclusion of a question asking what they have had to eat before starting work in combination with other measure may prove to be an extremely simple but effective measure of alertness. Breakfast provisions at work could also be an effective intervention. This could be as basic as having breakfast cereals available.

The mechanism underlying this effect which has received the most interest is increased availability of glucose. Studies of glucose have suggested that this positive effect may be especially apparent during tasks which require rapid responses over an extended period of time. Safety critical jobs such as air traffic control, sea faring watch keepers and transport drivers are all involve high stress and high demand. In addition lapses in attention within these occupations are associated with risk for not only the individual involved but also their work colleagues and sometimes members of the public. Research should be extended to examine the potential role of breakfast and snack consumption in these high risk groups.

8.5.9 Summary

The studies reported in this thesis have investigated a wide range of outcomes, variables and associations. The results of each study have been discussed however Chapter 9 considers the results of these studies in relation to the original aims of this thesis. In addition the limitations of these studies are described. The final part of this chapter suggests areas of research which future studies should address and the potential implications of these findings.

CHAPTER NINE

GENERAL CONCLUSIONS AND DISCUSSION OF RESULTS

9.1   Aims of the thesis

This thesis aimed to further explore the effects of breakfast and snack consumption on a wide range of outcome measures, including health (both mental and physical), mood, cognitive functioning and hazard perception while driving. The perceived impact of nutritional intake has extended beyond the scope of weight and obesity, although these remain crucial areas of research. It is important that as many of the potential effects of food intake as possible are considered before advising individuals on dietary changes.

In today's culture healthy lifestyle practices are increasing in popularity. There are already numerous dietary guidelines which individuals are advised to follow, for example eating 5 fruit and vegetables a day, decreasing salt intake to less than 6g per day. Another belief which is specifically held with regard to children but also adults is the notion that breakfast is considered to be the most important meal of the day. From a nutrition perspective this does appear to be true. Individuals who regularly eat breakfast report higher fibre, carbohydrate, vitamin and mineral intake and decreased fat intake (Ruxton & Kirk, 1997). The nutritional benefits extend beyond the breakfast eating occasion with decreased energy and fat intake being reported at subsequent meals. However associations between breakfast consumption and other outcomes have received considerably less attention than nutrient intake and obesity.

The assumption that breakfast is the most important meal of the day is based on a considerable amount of scientific research. There are a number of studies which support the view that breakfast is important meal with respect to health (Barton et al., 2005; Berkey, Rockett, Gillman, Field & Colditz, 2003; Ma, Bertone, Stanek, Reed, Herbert & Cohen, 2003). Based on the research that has been done it would appear that regular breakfast consumption may be beneficial for mood and learning, especially in nutritionally disadvantaged children. It was of interest whether benefits could also be found in normal weight, healthy individuals following both acute and longer term consumption of breakfast.

In line with society's increased awareness of the current obesity problem in the Western world, increased snacking has received considerable negative press. Snacking has been labelled as a negative health behaviour as it is commonly associated with "snack foods" which are generally high in fat, sugar and provide "empty" calories. However, individuals are becoming more health conscious and healthy snack foods are increasing in popularity; this is supported by the large increase in juice and smoothie bars. Snacking research has received far less attention than breakfast, with the possible exception of links with obesity. Overall, empirical studies have generally found a positive association between increased eating frequency and lower body weight. Relatively little is known about the relationship between regular snacking and other outcome measures. In addition no research has explicitly examined the links between snack food choice and health outcomes. Given the obvious differences between healthy and unhealthy snacks on weight it is important that type of snack is differentiated in all aspects of snacking research.

The studies in the current thesis aimed to re-examine and replicate the findings from previous studies which considered the wider effects of breakfast and snack consumption. A number of novel questions were also addressed. The key areas of interest were as follows: (1) to consider a broader range of outcomes, including measures of mental health, well-being, mood, work related outcomes, cognitive performance and hazard perception while driving; (2) to examine the associations between breakfast and snacking, and health and well-being in a range of different samples to establish the generalisability of the findings; (3) to compare different measures of breakfast and snack consumption, specifically frequency of consumption vs. type of food consumed; (4) to examine the relationship between breakfast and snacking and (5) to investigate the role of other demographic and lifestyle factors on the relationships between breakfast, snacking and the outcome measures. General limitations of the studies used in this thesis are discussed at the end of this chapter. In addition suggestions are made about the direction that future research should take in order to expand the results found in thesis.

9.2 Types of outcomes considered

9.2.1 Health and well-being

Early studies generally only considered general health and depression. More recent studies have also considered stress, fatigue and emotional distress. However, this is only a small selection of the measures available to measure a variety of aspects of health, mood and well-being. The studies in this thesis examined the associations between breakfast and snacking and a range of outcomes including those studied previously. The primary aim of the first study was consider a range of different outcomes. Overall only a few facets were found to be significantly associated with breakfast and snack consumption. These were stress, measured using life events, health beliefs, measured using the health orientation scale, positive mood and depression. The results from this study confirmed the previous results although different measures were used (except for depression). This offers further support that breakfast consumption is associated with lower stress and depression. In a study of parents with primary school aged children breakfast was both strongly and negatively associated with depression, fatigue, cognitive difficulties, symptoms and bowel problems and positively associated with mood. It is possible that the improvements in digestive function seen following breakfast consumption result in the lower fatigue scores. This in turn may account for the increase in mood. It should also be noted that the questionnaire used to measure number of symptoms included digestive symptoms. It is possible that this is effectively the same measure of the bowel problems questionnaire.

The mechanism by which breakfast improves digestive function is not yet understood. It appears likely that breakfast, especially cereal, increases fibre consumption and that this leads to decreased feelings of bloatedness, constipation and pain in bowels, for example.

9.2.2 Accidents, minor injuries and cognitive failures

As discussed above breakfast consumption has been found to be associated with decreased fatigue and cognitive difficulties. In addition positive associations have been identified for alertness. Although these results are of interest, they suggest that the effects of breakfast may be much more widespread than psychological well-

being and mood.

Accidents in the workplace are increasing worldwide (Nakata, 2006) with 270 million being reported each year (International Labour Organisation, 2005). Unintentional injuries are a top ten cause of death and disability across the world (WHO, 2002a). Accidents and injuries occurring at work account for several million working days lost each year in the UK (Wadsworth et al., 2003). Over 1 million injuries are experienced by workers each year. Around 40 million working days are lost to business and over 25 000 individuals are forced to give up work because of injury or ill health (HSE). In 1994 the worldwide average estimated fatal occupational accident rate was 14.0 per 100,000 workers, a rate higher than that previously estimated. In comparison, the rate of fatal injury to workers in the UK, 2002/03 was 0.79 deaths per 100,000 (National Statistics, 2003).

Although fatal accidents are decreasing it is much harder to accurately describe the effects of minor injuries and cognitive failures. There are high levels of underreporting associated with minor injuries. Regular breakfast consumers were found to report fewer accidents, minor injuries and cognitive failures at work than irregular breakfast consumers. This is the first time that this association has been examined and it is has important implications for work place interventions. These results need to be replicated before any firm conclusions can be drawn. In addition intervention studies would be the only way to examine cause and effect. It does however appear plausible that breakfast increases alertness and decreased fatigue which leads to increased vigilance at work and therefore fewer accidents and injuries. Introduction of workplace breakfasts, similar to the breakfast club initiative started in schools, may have a positive effect on workplace safety.

In addition the type and availability of mid-morning snacks may also provide another opportunity to maintain high levels of vigilance throughout the morning. Regular consumption of unhealthy snacks was found to be associated with increased accidents, injuries and cognitive failures at work. Those who regularly consumed unhealthy snacks were twice as likely to report a minor injury at work as those who rarely ate unhealthy snacks. Those who regularly ate healthy snacks were half as likely to report a minor injury.

These results do need to be treated with caution. The accident rates at work were very low and therefore limit the reliability of these results. Only further large

scale studies will be able to determine whether this effect is generalisable to the wider working population. In addition these results were based on nurses, this is a very specific sub-group and the results need to be replicate in a number of different occupational group. This has the potential to be a very interesting area of research which has far reaching implications for the individual, workplace and society as a whole.

9.2.3   Cognition

The effects of breakfast on cognition have been extensively researched in recent years. The research can be separated into 4 different areas; (1) the effect of breakfast clubs, (2) acute effects of breakfast consumption, (3) longer term intervention studies of breakfast and (4) composition of breakfast. In contrast relatively little research has considered the effects of snacks. Of the research which is available the majority has considered the effects of confectionary or caloric snacks in children and adolescents. A smaller number of studies have considered the effects of a cereal based snack on performance in adults. The study in this thesis aimed to directly compare the effects of different mid-morning snacks on cognition. Overall confectionary and cereal based snacks showed different pattern of results, however these differences were relatively small. The results in the current study were the opposite of what was expected based on previous research. It is not clear why this was the case. However there were a number of methodological differences between this study and previous research as well as between previous research. This is discussed in more detail in a subsequent section.

Another important consideration is the acceptability and familiarity of the snacks provided. Those in the chocolate and crisps groups reported the highest levels of hedonic tone, alertness and calmness. Those in the cereal group reported the highest levels of anxiety. Due to the nature of the study individuals were aware of the snacks being used in the study. Therefore those who received a cereal bar as a snack knew they could have been given a bar of chocolate or a packet of crisps. The individuals in the current study reported frequently consuming chocolate and / or crisps as a snack. In contrast only a few reported eating cereal bars as a snack.

Previous research has also examined the effects of palatability on mood. Foods high in carbohydrate, such as chocolate, were thought to increase mood via increased

tytrophan which stimulates the release of serotonin. However, this has largely been discredited as it is very unlikely to occur for the majority of high carbohydrate foods including chocolate. Consuming even small amounts of protein is enough to block this mechanism and stop the subsequent increase in serotonin.

Researchers now argue that increased palatability of foods is associated with improved mood. Palatability is defined by the hedonic or affective response to the taste, flavour, aroma and texture of food (Rogers, 1990). Palatability is determined by innate responses such as inborn taste preference for sweets, fat and salt but a dislike for bitter tastes, and by learning (for example, effects on mood). Chocolate provides preferred tastes and texture that have innate appeal and the combinations increase the hedonic rating. The opioid system may play a role in the palatability of preferred foods (Si et al., 1986), endogenous opioid peptides (EOPs) such as beta-endorphins are released as food is eaten. It is thought that EOPs are involved in the rewarding aspects of eating, for example palatability, which could enhance the pleasure of eating and lead to increased intake (Reid & Hunter, 1984; Olson, Olson & Kastin, 1889a; Mercer & Holder, 1997).

Only further investigation of these foods will allow for any conclusions to be made about the underlying mechanisms. However this is an area of research which has been investigated over a number of decades and it seems unlikely that any definitive answer will be found. The interest relating to the findings of the study in this thesis is that caloric and cereal based snacks consumed during the mid-morning are associated with differing patterns of results.

9.2.4 Hazard Perception

The final outcome considered in this thesis was hazard perception. The previous studies of breakfast, snacking and cognition have identified a number of differences. Breakfast is generally accepted to improve mood, especially alertness, and improve memory, specifically recall memory. Cereal based snack bars have been found to show similar results to breakfast although benefits have also been found for attention and concentration. The main problem with these studies is that they examine each facet of cognition separately. Many of the day to day activities performed by people involve complex sets of these cognitive functions. The final study in this thesis aimed to address this by examining the effects of breakfast and a mid-morning snack

on hazard perception while driving.

Driving is a real life activity which is performed by individuals numerous times per day. It is also a potential dangerous behaviour and human error can have potentially fatal consequences. As discussed previously breakfast and snacking have been found to be associated with accident and injury rates in the workplace. It is also possible that they might influence road traffic accidents and crashes. The hazard perception test which is now a compulsory part of the driving theory test was used to examine awareness while driving in a sample predominantly made up of students. The results of this study showed that those who consumed breakfast scored lower on the test than those who did not consume breakfast. Possible explanations for this are discussed below. Conversely consumption of a mid-morning snack led to significantly higher test scores.

The results from this study would suggest that although breakfast may be associated with improved performance on a number of cognitive functions, it does not show the same benefit when a task involves a complex set of cognitive functions. Breakfast is associated with increased alertness but not those tasks associated with it for example sustained attention. Conversely based on the cross-sectional data of accidents, injury and cognitive failure rates breakfast would be expected to improve concentration and therefore awareness while driving. This is the first study to consider this effect and therefore the results need to be treated with a certain degree of caution. Future studies should include different types of breakfast. The breakfast consumed in the current study was a cereal based snack bar. Although these have been marketed as breakfast replacements it is possible that a positive effect of breakfast may have been found if a more traditional breakfast had been consumed, for example a bowl of cereal. In addition any future studies should consider whether the timings between consumption and testing are important. The alertness levels recorded in this study suggest that alertness levels peaked at the start of the test session. Future research needs to clarify whether performance was worse because alertness levels had peaked and were starting decline or whether the task was significantly demanding enough to decrease alertness levels. Research has found that cognitively demanding tasks decrease stores of glucose more rapidly. Glucose consumption is associated with improved performance when tasks are more demanding. Future studies could also measure blood glucose levels however this was neither practical nor possible within

the current thesis. However, only a small decrease in alertness was found in the snacking groups suggesting that the task itself was not too demanding.

The positive effect of a mid-morning snack on awareness while driving was expected based on previous research. A study by Smith and Rich (1998) found improved performance on a driving simulator task following consumption of a confectionary snack. No improvement was seen after an equicaloric snack of cheese and biscuits or no snack. This result suggests that the positive effect could not be attributed to food consumption per se and the researchers concluded that a high carbohydrate may improve driving performance. The cereal bar used in the current study was also high in carbohydrate content and this may help explain the better test scores. There was however a ceiling effect problem with the hazard perception task. The majority of participant passed the test on at all three sessions. Future studies may need to include video clips with varying degree of difficulty. It should be noted that although the cheese and biscuits snack was equicaloric there are other explanations for the differences observed. One plausible explanation is that the confectionary snack was more palatable than the cheese and biscuits. This is discussed in more detail in section 9.3.2. Another consideration is hunger levels. It is possible that the cheese and biscuits were not considered filling enough by participants and the resulting hunger lead to poorer performance on the test as opposed to the confectionary snack improving performance.

The type of task used in the hazard perception task may also be a contributing factor. In the previous driving simulator study participants were actively involved in the task. However in the hazard perception task participants are passive observers and are required to respond to a video clip. The decision made by participants had no effect on the outcome of the clip. Introduction of a feedback mechanism may provide more information and lead to improved performance.

This task remains relatively new and future research needs to consider the limitations of the software available in addition to other methodological issues associated with running studies concerning the acute effects of breakfast and snacking. However the finding that a mid-morning snack improves performance on the hazard perception task is very interesting and warrants further investigation due to its potential implications for road safety especially amongst young adults.

9.3 Other factors which need to be considered with relation to these findings

9.3.1 *Emotional eating*

There are established links between food and depression. The evidence supports a two way association; food choice can change mood and mood can affect food choice. For example, skipping breakfast may be a manifestation of depression or it may exacerbate it. The area which has received considerable attention is the relationship between chocolate and mood. It is generally believed that chocolate is eaten in response to emotional distress, negative mood (Benton & Donohoe, 1999) or stress. Emotional eaters consume more sweet, high-fat foods in response to emotional stress than non-stressed emotional eaters and both stressed and non-stressed non-emotional eaters (Oliver, Wardle & Gibson, 2000). Despite the evidence for emotional eating there is a lack of convincing evidence that eating sweet, high-fat foods actually reduces stress. Three studies have reported reduced negative emotions (Agras & Telch, 1998; Herman & Polivy, 1975; Pines & Gal, 1977) after eating. However, two studies found no changes of emotional state after eating (Abramson & Wunderlich, 1972; McKenna, 1972). One study which examined the effects of chocolate consumption on everyday mood in adults found that although participants reported increased mood, joy and activation, and reduced tiredness they also experienced higher levels of guilt than those individuals consuming an apple or nothing (Macht & Dettmer, 2006).

A second problem with emotional eating theory is the mechanisms underlying food induced improvements are unclear. The mood effects of foods have generally been explained by nutrient dependent changes in neurotransmitter systems, for example increased brain serotonin after consumption of carbohydrate-rich, protein-poor meals (Markus, Panhuysen, & Tuiten, 1998). However these nutrient dependent changes can only occur after a delay, i.e. after nutrient absorption. Nutrient-dependent mood changes have been found to occur 1–2 h after consumption (Markus et al., 1998; Smit, Gaffan, & Rogers, 2004). In addition a greater amount of cocoa is required, for the active ingredients such as caffeine and theobromine, to obtain such effects (Mumford et al., 1996). This would not be an effective way to cope with negative emotions which arise everyday from unpredictable stimuli.

It is possible that the associations seen between unhealthy snack consumption

and negative well-being, particularly depression are the result of emotional eating. However it seems unlikely that emotional eating could account for all of the results found in this thesis from a variety of different samples. This is something which needs to be addressed in future research.

9.3.2 Palatability

Many external factors can influence food intake one of which is the palatability of foods (Pliner & Mann, 2004). Palatability is defined by the hedonic or affective response to the taste, flavour, aroma and texture of food (Rogers, 1990). During periods of stress it has been suggested that over eating occurs (Greeno & Wing, 1994) and studies report an increased intake of both fat and carbohydrate (Liberman, Wurtman & Chew, 1986; Vlitos &. Davies, 1996; Wurtman, Brzezinzki, Wurtman & Laferrere, 1989). This combination of fat and carbohydrate implies that palatability may be a crucial factor with respect to mood. Research has identified that individuals prefer foods which are sweet and high in fat. Research examining palatability has found that cravings are increased during low mood or high stress situations.

Research into cravings has identified that cravings are selective and that chocolate is by far the most commonly craved item (Hill, Weaver & Blundell, 1991; Rozin, Levine & Stoess, 1991; Schuman, Gitlin & Fairbanks, 1987; Weingarten & Elston, 1991). Data from Canadian adults showed that 97% of women and 68% of men experienced food cravings (Weingarten & Elston, 1991). It has been suggested that "drug-like" substances in chocolate improve mood (Benton , 1999). These "drug-like" constitutes include caffeine, theobromine, magnesium, anadamides and phenylethylamine and are found in cocoa powder. Research found that consumption of cocoa powder was insufficient to satisfy chocolate cravings (Michener & Rozin, 1994). The critical factors were found to be taste and mouth feel. In addition the level of the "drug-like" constitutes in chocolate are insufficient to produce a pharmacological effect (Benton , 1999).

It is well established that opioid mechanisms influence food intake. Opioid agonists generally enhance and antagonists generally decrease eating (Levine, Morley, Gosnell, Billington & Bartness, 1985; Mercer & Holder, 1997) and importantly opiates increase food reward or palatability. Much research has been conducted in rats

however, in humans opioid antagonists decreased thinking about food, feelings of hunger (Spiegel, Stunkard, Shrager, O'Brien & Morrison, 1987; Wolkowitz, Doran, Cohen, Cohen, Wise & Pickar, 1988) and food intake (Trenchard & Silverstone, 1982). Opioid antagonists such as naloxone have been found to influence the eating of pleasant tasting food such as chocolate in humans (Drewowski, Gosnell, Krahn & Canum, 1989; Spiegel, Stunkard, Shrager, O'Brien & Morrison, 1987; Trenchard & Silverstone, 1982; Wolkowitz, Doran, Cohen, Cohen, Wise & Pickar, 1988; Yeomans & Gray, 1996; Yeomans & Gray, 1997; Yeomans, Wright, Macleod & Critchley, 1990).

A release of endorphins following food consumption could reduce stress as endogenous opiates modulate responses to pain and pleasure. From that it is equally likely that stress would induce the release of endorphins which would lead to an increase in palatable food intake. It is thought that eating palatable foods is associated with the release of endorphins and that blocking these endorphins, by using drugs like naloxone or naltrexone, decreases the intake of palatable foods, e.g. those high in fat and carbohydrate.

9.3 Comparison of different measures of breakfast and snack consumption, specifically frequency of consumption vs. type of food consumed

9.3.1 Breakfast

All of the previous studies of breakfast and health status have used a measure of breakfast frequency. Participants were generally asked to record how often they consume breakfast in a week. This has consistently been found to correlate with health outcomes and provide an accurate measure of breakfast consumption. Studies concerning the acute effects of breakfast have examined the effects of different types of breakfast. However, the majority have just examined the effects of a breakfast compared to no breakfast as opposed to directly comparing the effects of different breakfasts. Overall it would appear there is very little difference between different types of breakfast. Consuming breakfast regularly is more important than what is consumed at breakfast. The results from the studies in this thesis support this view. No difference was seen between those who were frequent cereal or other breakfast

consumers. In addition no differences were seen between infrequent cereal and other breakfast consumers.

Following an overnight fast it is important that the body and brain receives the food required to function effectively. For this reason it is not surprisingly that very few differences are seen between different types of breakfast. From a nutritional perspective a cereal based breakfast may be recommended as it may be beneficial with respect to the high levels of fortification. Micronutrient intake has shown positive but small effects on mood. However this would be neglible in the amounts contained in most commercially available cereals.

9.3.2 Snacking

In contrast to breakfast the type of snack food consumed by an individual may be associated with different patterns of behaviour. The most notable example of this is comfort or emotional eating. Foods, and specifically snack foods, are chosen for a number of different reasons. Although some snacking occasions are motivated by hunger they are much more likely to be motivated by emotions. Many people reporting snacking when bored. Consumption of high fat and sweet snacks are often consumed to increase mood.

However snacking can be beneficial for the diet and healthy snacking can help to increase intake of fruit and other essential vitamins and minerals. Given the obvious nutritional and health differences between different types of snacks it is surprisingly that no research has directly examined the effects of different types of snacks on health status. Two studies in this thesis compared the effects of regular (and irregular) healthy and unhealthy snack consumption on reported health and well-being. Frequency of unhealthy snack consumption was found to be a very strong negative predictor of health status. This is not surprising as these are the type of snacks which are generally perceived to supply both empty and extra calories.

Frequent healthy snacking was positively associated with health outcomes however this was not as strong or as consistent as the unhealthy snack results. It is important to note that no negative effects of healthy snacking were found. This suggests that people should not avoid snacking per se but they should be conscious of the types of food they are snacking on. Replacing a chocolate bar with an apple may not improve psychological health but it will not produce any negative effects either.

Taken with the positive effects of healthy snacks on physical health status consumption of healthy snacks can be encouraged.

With respect to dietary interventions many individuals may find it hard to change their pattern of eating dramatically, for example reducing their number of eating occasions from 6 to 3 times per day. However if they are still able to eat when the usually would but change the foods this might help to maintain the dietary intervention. This will not work for everyone, however it may be an important step for some individuals and people should be made aware that snacking per se is not a negative health behaviour. In addition to future research examining the effects of frequent healthy and unhealthy snack consumption it should also consider people's understanding about snack foods.

An intervention study comparing the effects of healthy and unhealthy snacking would offer the best support for the cross-sectional results seen here. This would need to be carefully planned due to potential methodological and ethical issues. For example would it be ethical to have a group who would have to frequently consume unhealthy snacks over an extended period of time? A better way of addressing this area would be to increase healthy snack consumption and record whether individual's diets also changed over time. Follow up data would also be required in order to investigate how long any changes were maintained for.

This could have very important implications for future interventions. The results from the studies in this thesis imply that either reducing unhealthy snacking or to a lesser extent increasing healthy snacking may reduce psychological distress and improve mood, energy levels and digestive function.

It is important that these results are treated with a certain degree of caution due to the cross-sectional nature of the studies and other methodological limitations. These are addressed in the next section.

9.4 Associations between breakfast and snacking, and health and well-being and the generalisability of the findings to other samples

9.4.1 Health outcomes

Interest in lifestyle factors (including breakfast and snacking) and their association with mental health and psychological well-being has fluctuated over the

years. This area first gained popularity in the early 1970s. Another spate of research was conducted in the late 1980s / early 1990s and it has increased in popularity again during the last 7 years.

9.4.1.1 Cross-cultural

The majority of these studies were conducted in either the United States (Belloc & Breslow, 1972; Belloc, 1973; Frederick et al., 1988; Wetzler & Ursano, 1988; Simonsick, 1991) or Japan (Ezoe & Morimoto, 1994; Irie et al., 1997; Kimura et al., 2000; Nakao & Yano, 2006; Tuekpe et al., 2006). Although the United States in particular is experiencing the same high levels of obesity and health problems as the UK these studies need to be replicated in studies based in the UK. It should be noted that those studies in the United States were conducted in the 70s, 80s and very early 90s. This limits how much attention should be given to them today. Changes in eating behaviour occur over time and so it is important that researchers are aware of this and continually look to review the data and run new studies when possible. These changes will also vary from one culture to another. Cultural norms also play an important role in eating behaviour. These can influence everything from defining meals and snacks, influencing frequency of eating occasions, importance of food and the types of food consumed. This makes it harder for results to be generalised across nations.

Comparison of cross-cultural data would provide more reliable information about the potential differences or similarities between countries. One study has included more than one country (Allgöwer, Wardle & Steptoe, 2001). Data was collected from 5,529 students in 16 European countries, including England and Scotland. Unfortunately the data was analysed as one sample and no results were reported for individual countries. This study can form the basis of future studies which can help to extend knowledge of cultural differences.

Ideally this thesis would have considered cross-cultural differences however it was not possible within the timeframe and other limitations of a thesis. The primary aim was instead to replicate and extend the few studies which have been conducted in the UK. Only 4 studies were identified which were done in the UK. Three studies by Smith and colleagues (1998; 1999; 2003) have examined the associations between breakfast and subjective reports of health and one study has considered the effects of snacking on health status (Smith, submitted for publication). This thesis has both

confirmed the results of these studies and extended them by considering other samples, outcomes and measurement of breakfast and snacking.

9.4.1.2 Cross-sectional

All of the research within this area has been cross-sectional in nature, including those in this thesis. There are a number of disadvantages associated with cross-sectional designs, for example issues of causality and directionality. However these studies are particularly important when the area of research is relatively new. Intervention studies are time consuming and can be costly. Results from cross-sectional studies can be used to guide intervention studies. Based on the results of the studies from this thesis it has become apparent that a number of intervention studies are required to further examine the effects of dietary intake in children, investigate the effects of breakfast and unhealthy snacking on health and well-being and the relationship between breakfast, snacking and complex cognitive functioning, e.g. driving.

9.4.1.3 Measurement of dietary intake

Another criticism of food research is the measurement of dietary intake. The majority of studies use self report questionnaires. All of the studies in this thesis used self report questionnaires to measure both breakfast and snacking frequency. Research which has criticised self-report measures for being unreliable has focused on the amount of food and energy consumed. Another problem with self-report measures is under-reporting and this is particularly found for unhealthy items. For the current studies breakfast and snacking frequency were both measured on a weekly basis using Likert scales. One of the aims of this thesis was to consider other measurements of breakfast and snacking. This included looking at the type of snack consumed in addition to frequency of consumption. Self report likert scales were used to assess this as the main focus was still to establish frequency of consumption of these items as opposed to specific amounts. Other methods, for example observation and providing standardised amounts and weighing leftovers have been developed to examine amounts consumed more accurately. It is not practical to measure frequency of consumption in these ways. Diary studies are the next logical step in this research where individuals are required to record each day what they have consumed and the

type of eating occasion (i.e. meal or snack). This method has been used to examine dietary intake and, physical health and mood and it could be equally beneficial for studies of other measures of mental health and psychological well-being. However, diary studies are time consuming. Although they would have provided significantly more detailed information about the amounts of foods consumed this was not the focus of the current thesis and they would not have been a time or cost effective. Now that this research has identified a link between type of snacking and health outcomes they are pivotal for future research in this area. Using self-report questionnaires to measure frequency of consumption is fairly standard and appears to be common practice within previous research however it is hard to be certain due to a lack of information provided in published papers.

9.4.1.4 Availability of information about previous studies

At the start of the thesis all of the previous studies were reviewed. The original aim was to identify demographic factors including gender and age, how breakfast and snacking were measured, other confounders considered and the outcome measures used. However this sometimes proved problematic and highlighted a lack of information available. This makes it harder for these studies to be replicated. The current studies have tried to replicate these studies to allow for comparisons to be made while also expanding knowledge within this area.

9.4.1.5 Sample size

One advantage of the previous studies is that the majority were community based studies which had large sample sizes. There are a number of benefits associated with larger sample sizes including more power, results are more likely to be normally distributed, smaller standard errors and they are likely to be more representative of the population. The sample sizes in the present studies were considerably smaller than these other studies however the current results supported those of the larger scale studies. Smaller scale studies are sufficient to identify significant differences and are considerably easier to conduct than large community based studies. Being able to run smaller studies means that studies can be quickly and inexpensively replicated in various samples.. Although sample sizes are one consideration when designing studies there are other considerations which need to be taken into account.

9.4.1.6 Other confounding variables

Other factors for example social economic status, income, education level and marital status, are associated with health outcomes. Education level and marital status were recorded in all of the studies in this thesis. Income and social economic status were each considered in studies (income in the study of nurses; socio-economic status in the family study). Although no direct link was found between any of the factors and health status in the current studies it does not mean that they should not be included in future studies. It is possible that they are having a moderating / mediating effect. SES and income have a large impact on diet. In turn education level is significantly associated with income level. Families of lower SES are more likely to miss breakfast and have a poorer diet than those of higher status. They are also more likely to smoke and make unhealthier lifestyle choices. This is especially relevant as the results from this thesis showed that lifestyle factors have a cumulative effect on health and well-being.

9.4.1.7 Gender

Another important consideration is gender. One disadvantage of the studies in this thesis is they have been predominantly female, with the exception of the family study (Chapter 4). One study was conducted with nurses which remains a female dominated job. However it was important that other factors associated with nursing were examined, for example night work, shift work and increased knowledge of health. The majority of students recruited for the current studies were psychology undergraduates. This is also a female dominated course. Although this is not ideal gender was included as a covariate in all of the current studies in order to limit the impact. The one study which did include an equal number of males and females found no differences on the basis of gender. Depression, in particular, is reported to be far more prevalent in women although this was not replicated in any of the current studies. However it is important that men and women are either considered separately or gender is controlled for depending on the aims of the study. Some caution is required with regard to generalising these findings however they have increased understanding of these relationships in women. Future studies need to examine whether the same results are found in male dominated and mixed samples.

9.4.1.8 Age

As a result of these community samples a broad range of ages have been considered, generally including adults of a working age (18-65years). This was the case for 3 of the 4 studies in this thesis. The exception was the family study where the adults were generally younger as they were required to have primary school aged children in order to participate in the study. Results from both the current and previous studies have found no differences between different age groups.

9.4.1.9 Children

All of the previous studies were conducted with adults, the majority of which included individuals aged 18 or over. Previous research has examined a variety of adult samples. Two previous studies considered industrial factory workers (Ezoe & Morimoto, 1994; Irie et al., 1997), others examined students (Allgöwer, Wardle & Steptoe, 2001; Smith, 1998) and one staff at a university (Nakao & Yano, 2006). The studies within the current thesis tried to extend knowledge of lifestyle and psychological well-being by considering the relationships in a variety of different samples. It is important that future research in this area is conducted using as many different samples as possible in order to extend the generalisability of the findings. Breakfast and snacking were found to be associated with well-being in samples of students, general population, nurses and children. This is the first study which has considered potential associations between dietary intake and health and well-being in children.

Children are an important sub-group of the population. Childhood is a period of huge growth, both physically and mentally. Many adult habits and behaviours are established during childhood, including eating behaviour. Simple interventions with children, for example encouraging breakfast consumption and increasing awareness about healthy and unhealthy foods, may produce significant changes in behaviour that last into adulthood. As well as eating habits and other lifestyle factors being established during childhood, those who develop psychological and mental health problems during childhood are far more likely to continue experiencing them in adulthood. These studies could provide new information about the relationship between food intake and health and well-being and help to guide new initiatives to improve the health of the children. Although changing these behaviours are unlikely

to cure the current obesity problem they may help prevent future generations from obesity and the associated risks. Considerably more research is needed within this area. The results of the study in this thesis were found to be very significant. However there are a number of methodological problems which need to be addressed in future research. The current studies need to be replicated in a more controlled manner to ensure that the results are reliable. Although challenging from a methodological perspective it is crucial that this research is further examined in children as they are the group at the largest risk.

9.4.2 Cognitive outcomes

Some of the issues surrounding cognitive studies have been addressed in the previous section; for example sample size and a lack of information provided in publications. However there are a number of specific factors associated with research of food and cognitive functioning.

9.4.2.1 Cultural differences

Although this was addressed in the previous section looking at health the cultural differences are more extreme within cognitive research. Previous research of breakfast and cognition has generally considered the effectiveness of school breakfast programmes and been conducted with children, especially those which are nutritionally disadvantaged. Examination of these populations can provide important information about the potential benefits of breakfast and can also inform crucial interventions for this extreme sub-group of the population. However in order for these findings to be applied to the population in general it is important that they are also conducted in healthy well nourished adults and children. As discussed in the previous section cross-cultural differences and the associated differences in social economic status are important considerations within food research. This is especially true for studies of performance and learning research. Although it is very likely that breakfast improves attention, attendance and verbal fluency, for example, in children who are nutritionally disadvantaged there are a number of other confounders which need to be considered. In addition to the fact that these children are living in very poor countries their environment and culture influence both the type of food available and which foods are considered appropriate as breakfast foods.

9.4.2.2 Methodology

The majority of studies examining the effects of both breakfast and snacking on cognition have generally used a very similar methodology. As the focus of this research was examining the effects of breakfast and snacking in healthy individuals only these studies will be discussed in any more detail here. Those studies which were conducted with children used both between and within subject designs; however most used within. All of the studies which examined university students or adults used between subjects design. This was the method adopted for the study in this thesis. Although within subject designs allow you to control for individual differences there is also the possibility of practice / exposure effects. The purpose of the current study was predominantly exploratory. It was of interest whether differences could be found between different types of snacks. It is generally much harder to find any differences within groups of foods than between groups of food. Using a between subjects design was an efficient way to measure any differences. The participants were all students and no differences were found between the groups with respect to demographic factors.

9.4.2.3 Tasks used

The studies of cognition can be split into 5 areas; (1) the effect of breakfast clubs, (2) breakfast vs. fasting, (3) acute effects of breakfast consumption, (4) longer term intervention studies of breakfast and (5) composition of breakfast. Depending on the aim of the study different tasks have been used to measure cognition. A large number of mental or cognitive tasks are potentially able to demonstrate the effects of foods on performance. In practice however, a limited number of tests have been used. Many of the cognitive tasks used actually involve time to detect a signal and therefore could be considered tasks of attention, although the dependent variable is reaction time. Few of the cognitive tasks frequently used in this field allow separation of detection and response time. A lack of effect found on some tasks could be from a subtle effect of food intake on only one component of the task. Many studies have administered "off-the-shelf" tests in a test battery. In the selection of tests careful consideration of the cognitive and neuropsychological faculties that the tests measure and the specific functions they unravel need to be taken into consideration (Dye et al., 2000). Many of the tests used are short in duration. It is not possible to determine whether functions

are enhanced or whether better performance simply reflects an increase in the ability to sustain performance or attention on indiscriminately selected test batteries. All of the tasks used in the study in this thesis have been used in previous studies of food intake and cognition. This is something which needs to be considered when designing future studies

9.4.2.4 Type of foods consumed

In addition to the use of different tasks to measure cognitive performance different foods have been administered as breakfast and snacks. This makes it harder to compare the results of these studies due to the increase in potential confounding variables. Studies of breakfast have examined standardised school breakfasts (which vary according to culture), habitual breakfast (which is not always reported) and energy containing drinks. Different types of food may elicit different effects for a variety of reasons. Changing from habitual breakfast intake has been identified to influence performance and mood (Rogers & Lloyd, 1994; Dye et al., 2000). In conjuction with this hunger may also account for the differences seen. If the test food is perceived as being smaller or less filling than habitual intake this could have deleterious effects on both mood and cognitive performance.

The macronutrient content of the breakfast is another important consideration. Some studies have identified impaired performance following consumption of a high carbohydrate (CHO) meal (Spring et al., 1983; Connors et al., 1986; Lieberman et al., 1986). However performance improves following a simple sugar load. The effect of CHO on performance will produce variable effects in performance depending on the amount of protein present. Other researchers have suggested that stress may play a mediating role between CHO and performance (Markus et al., 1998; 2000). However individual differences need to be explored further. High fat meals are hypothesised to increase subsequent fatigue and reduce alertness compared to low fat-high carbohydrate meals (Lloyd et al., 2006). However little decisive research has been carried out regarding the effects of dietary fat on performance (Bellisle et al., 1998). Glucose has been found to be associated with improved performance in a number of studies (Lapp, 1981; Hall et al., 1989; Benton & Owens, 1993; Benton et al., 1994). Another important factor which needs to be controlled for is caffeine intake. This commonly consumed at breakfast time and has a strong positive effect on alertness

and cognition.

For the study in this thesis the aim of the study was to examine the effects of different snacks. Foods were chosen which as well as addressing the research questions were foods which are consumed as snacks. Due to the nature of the study it was not possible to control for macronutrient content. It was of specific interest which snacks showed different / similar effects and whether the pattern of results made it possible to determine underlying mechanisms. Participants in the study for this thesis were told to drink only water on the morning of testing and to consume no food. Although participants were asked when they arrived whether they had adhered to these directions it is not possible to say for certain that they had. Ideally saliva samples would have been collected in order to exclude anyone who had not followed these instructions however this was not possible for this study due to a lack of experience, time and money.

9.5 The role of other demographic and lifestyle factors on the relationships between breakfast, snacking and the outcome measures

One of the key questions investigated in this thesis is whether diet and food consumption is a marker for a healthier lifestyle in general and if so whether any positive or negative effects can be fully explained by other lifestyle practices.

The previous section of this chapter considered the samples used in these studies and some methodological issues. The first part of this section will highlight a number of important issues which need to be considered. The second part of this section aims to discuss the results from this thesis in relation to the results of these studies.

9.5.1 Which lifestyle factors should be included?

People who regularly eat breakfast are less likely to smoke and consume less alcohol than irregular breakfast consumers. It is therefore possible that the positive effects of breakfast reflect a positive effect of not smoking or of drinking less. For this reason it is important that research of breakfast and snacking also considers and controls for other lifestyle factors. These studies should also investigate whether other lifestyle factors are more important than breakfast or snack consumption per se and consider the relationships between them.

Breslow and Belloc (1972) identified 7 health practices which they found were related to physical health. These were smoking, alcohol consumption, exercise, weight, sleep, breakfast and eating between meals. These studies have been replicated a number of times and extended to consider their effects on mental as well as physical health. The studies in this thesis considered the effects of breakfast while controlling for smoking, alcohol, sleep and snacking. Previous studies have also controlled for weight and exercise.

In retrospect it would have been beneficial to have included a measure of exercise in the studies in this thesis. Including a measure of weight however would have been very problematic. There are a number of different methods used for example hip to waist ratio and body mass index. No consensus has been reached with regard to the most accurate measure to use. In addition for the results to be reliable it would have meant individuals coming to the laboratory to be weighed. This would not have been possible for the largest study examining this issue in the thesis as it involved nurses from across the South West of England.

The associations between dietary intake, weight, other lifestyle factors and health are complex and need to be addressed in a series of dedicated studies. Weight and obesity was not the main focus of this thesis and for a number of practical and methodological reasons it was not included at all. The studies from this thesis would need to be replicated while controlling for weight. Previous research of lifestyle factors has measured weight and the positive effects of breakfast have still been identified. This suggests that although weight may be an important consideration it cannot sufficiently explain the associations between other lifestyle behaviours and health outcomes.

The results from these studies may help to inform the direction which interventions should take. The previous research has identified that a number of different lifestyle factors are all associated with health outcomes. It is important to ascertain whether changing one of these behaviours is sufficient to change reported health outcomes. The cross-sectional survey in this thesis conducted with nurses can provide the basis for the intervention studies needed to properly explore this.

9.5.2 Demographic factors

As discussed previously there are a number of demographic factors which

have been shown to be associated with health outcomes. These include gender, age, marital status, education level, ethnicity, social economic status and income. Increasing age is associated with decreasing mental health (Lehtinen et al., 1990; Mirowsky & Ross, 1992). Females report more mental health problems, including depression, than males. Education level has been found to be negatively associated with health status in both males and females (FSA, 2007). These factors were included in all of the studies in this thesis. Social economic status and income were each included in one study.

Social economic status was included in the final cross-sectional study in order to examine whether it was able to account for any of the associations found between breakfast, snacking and health. However, the differences between social classes in terms of smoking behaviour, amount of alcohol consumed, exercise rates and healthy dietary behaviour can explain some of the class differences found for health and mortality (Chandola & Jenkinson, 2000). It was concluded that differences in age and health behaviours were both important predictors of physical and mental health. More recent research has found no difference between low economic status families and the general population with respect to dietary intake (FSA, 2007). The researchers suggest that the gap between the social classes in closing. However, the population as a whole was not eating as healthily as it should be. Therefore this closing of the gap between the social classes may be the result of the higher classes not being as healthy as expected, as opposed to the lower classes improving their diet. No differences were identified for social class in the one study it was measured. Although social economic status may remain an important consideration for a number of reasons it does not account for the associations found between breakfast, snacking and health outcomes.

With respect to the study reported in Chapter 3 conducted with nurses it would be expected that they would all have the same level knowledge about the benefits of eating healthily. Is income therefore a contributing factor to why some do not eat as healthily as others?

9.5.3 Breakfast and snacking effects

On an individual level the majority of research has focused on smoking and alcohol consumption as they are directly associated with health. However a number of studies report the individual effects of the lifestyle factors included as well as their

cumulative effects on health. Breakfast was consistently found to show a positive association with health outcomes. This was replicated in this thesis. Regular breakfast consumption (eating breakfast everyday) was negatively associated with depression, number of symptoms, fatigue and cognitive difficulties and positively associated with mood. These results remained when other lifestyle and demographic factors were controlled for, including snack consumption.

Breakfast consumption is not just a marker for a healthier lifestyle per se. The associations seen between breakfast and health outcomes cannot be explained by the increased likelihood for regular breakfast consumers to perform other positive health behaviours.

Overall the results for snacking frequency were found to be more inconsistent. In previous studies snacking was generally found to be associated with poor mental health status (Allgöwer et al., 2001; Sarlio-Lahteenkorva, Lahelma & Roos, 2004; Tuekpe et al., 2006). One study found a positive trend between snacking frequency and depression but this was not significant. The results have been equally mixed for snacking frequency in this thesis. A much more consistent pattern was found for type of snack consumed. Healthy snacking is positively but weakly associated with health, conversely unhealthy snacking is very strongly and negatively associated with health. All of these results remained significant when all demographic and other lifestyle factors were controlled for, including breakfast consumption.

These results suggest that although dietary intake may prove to be a reasonably strong predictor of whether individuals lead healthier lifestyles their effects on health outcomes are independent of these other lifestyle factors.

9.5.4 Cumulative effects

The majority of the previous studies of lifestyle factors have considered their cumulative effects on health. Data was collected about 5 lifestyle factors in this thesis; smoking, alcohol consumption, numbers of hours sleep, breakfast and unhealthy snack consumption. Total number of positive behaviours showed a positive linear relationship with health. Significant differences were seen at all stages except between performing 4 and 5 positive health behaviours. Changing one behaviour is enough for a significant change to be reported. This has important implications for interventions. Individuals may be more willing and find it easier to alter one behaviour. If this is

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successful it could encourage them to change more which may also lead to changes in health.

In addition to considering the cumulative effects of all of these health behaviours it was of interest to determine whether any one behaviour exerted a greater influence than another. Removing one behaviour from the final model had no effect on the outcomes. This suggests that none of the behaviours are more important than another. This is also a positive finding with respect to possible interventions. Individuals only need to change any one behaviour in order to improve their health. This would improve the likelihood of individuals persisting with making a life change.

This could be extended to obesity research as lifestyle factors are very strong predictors of weight. It would seem much more likely that certain lifestyle factors would be more important than others with regard to obesity. Therefore it may be important to encourage people to tackle these first as they will also impact on psychological well-being. If people are feeling better mentally they are far more likely to be motivated to tackle other problems for example weight.

Although these studies have provided some important insight into the associations between various lifestyle practices and health outcomes, the focus of this thesis is breakfast and snack consumption. The results from the current studies have found a positive effect of breakfast and a negative effect of unhealthy snacking on a variety of outcome measures. However the relationship between breakfast and snack consumption also needs to be examined in more detail.

9.6   The relationship between breakfast and snacking

The results from the studies in this thesis have replicated some previous findings and extended a number of areas of research. A particularly interesting result was that the type of snack consumed, specifically the frequency of unhealthy snack consumption is a strong predictor of psychological health and well-being. The positive effects of breakfast found in previous research have been replicated and extended to a broader range of outcomes. A positive effect of breakfast was found for very similar outcomes as unhealthy snacking. It was, therefore, important to try and ascertain whether unhealthy snacking and breakfast consumption were opposite ends of a healthy eating continuum or separate from one another.

As discussed previously individuals who regularly eat breakfast have been found to lead healthier lifestyles in general. They are also more likely to consume a healthier diet, and subsequently are much less likely to snack on unhealthy foods. Children who skip breakfast are more likely to snack between meals (Sjöberg, Hallberg, Höglund & Hulthén (2003) and these snacks are more likely to be unhealthy snack foods (Utter, Scragg, Mhurchu & Schaaf 2007) bought from outside the home.

In one study in this thesis those participants who regularly consumed breakfast reported rarely consuming unhealthy snacks. In the other study no association was seen between breakfast and unhealthy snack consumption. Regular breakfast consumers were equally likely to snack on healthy foods as irregular breakfast consumers.

A number of different methodologies were used to examine the relationship between breakfast and unhealthy snacking. Strong effects were found for both while controlling for the other. Negative effects of unhealthy snacking were found for both regular and irregular breakfast consumers, conversely positive effects of breakfast were seen in both regular and irregular unhealthy snack consumers. The results from the two cross-sectional studies in this thesis support the notion that breakfast and unhealthy snacking are separate from one another.

When subgroups of breakfast and unhealthy snack consumption were compared a linear relationship was found between healthy eating and health outcomes. Increasing breakfast consumption or decreasing unhealthy snack consumption was sufficient to change reported levels of health. Changing both behaviours was found to show a significant difference from changing just one. This offers further support for the notion that these two behaviours are separate from one another.

Dietary interventions need to ensure that individuals are encouraged to change both aspects of their diet in order to achieve optimum results. Although significant improvements may be seen after changing one behaviour, these can be improved considerably more if the other behaviour is also changed. The same pattern of results is also seen between healthy and unhealthy snacking. Frequent healthy snack consumers are not necessarily infrequent unhealthy snack consumers and vice versa. The relationship between breakfast and healthy snacking however is not as straightforward. Many of the effects of healthy snacking are no longer found when

breakfast consumption is controlled for. Two exceptions to this were reduced anxiety and depression which remained significantly associated with healthy snack consumption but not breakfast consumption.

Due to the cross-sectional nature of the studies used to explore the relationships between breakfast and snacking it is not possible to draw any definitive conclusions. This is an area which has not been considered in previous research and these cross-sectional studies were required in order to determine whether this is an area which warrants further attention. The results obtained suggest that this is an area of research which could provide some important information about dietary interventions and could expand knowledge about the complex relationship between breakfast, snacking, and health and well-being.

9.7   General limitations

9.7.1   General problems associated with food research

Measuring dietary intake accurately has been addressed numerous times in research. And it has been suggested that the measurement of the habitual food intake of an individual must be among the most difficult task a physiologist can undertake (Garrow, 1974). However accurate assessments of dietary intake are important for assessing the relationship betweens food intake and health. Even when an appropriate methodology has been decided upon it remains subject to random and / or systematic errors during data collection (Livingstone, 1995). Individuals admit that they would change their behaviour if asked to complete dietary records (Mela & Aaron, 1997).

9.7.1.1.   Underreporting of dietary intake

Underreporting of dietary intake needs to be taken into account when looking at any self report measure, including dietary recall, food frequency questionnaires and dietary histories. A European study of 10 countries found that 13.8% of women and 10.3% of men were extreme underreporters (Ferrari et al., 2002). It is well reported that overweight young people are more likely to underreport dietary intake than their leaner counterparts (Bandini, Schoeller, Cyr & Dietz, 1990; Perks, Roemmich, Sandow-Pajewski et al., 2000). Bandini et al. (1990) found that accuracy of food records kept by adolescents over 2 weeks was 20% for the obese adolescents than among non-obese adolescents. With respect to adults individuals who are obese,

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dieting, less educated, from low socio-economic backgrounds, females or current smokers are more likely to underreport energy intake (Klesges, Eck & Ray, 1995; Briefel, Sempos, McDowell, Chein & Alaimo, 1997; Pryer, Vrijheid, Nichols, Kiggins & Elliott, 1997; Stallone, Brunner, Bingham & Marmot, 1997; Braam, Ocke, Beueno-de-Mesquita & Seidell, 1998; Johnson, Soultanakis & Matthews, 1998; Kretsch, Fong & Green, 1999). However it should be noted that this phenomena is not limited to energy intake, selective reporting of macronutrient intake has also been observed (Heitmann & Lissner, 1995; Johansson, Solvoll, Bjorneboe & Drevon, 1998; Voss, Kroke, Klipstein-Grobusch & Boeing, 1998)).

It is not just frequency and magnitude of underreporting which needs to be accounted for. Research suggests that individuals are more likely to underreport certain types of foods. One study analysed the effects of continuous food recording on eating patterns and found participants significantly reduced the number of snacks and amounts of food consumed (Rebro, Patterson, Kristal & Cheney, 1998). Another study also identified a tendency to under-report snack foods, specifically foods considered "unhealthy" or "fattening" (Lafay, Mennen, Basdevant, Charles, Borys, Eschwège, Romon, 2000). Conversely consumption of foods considered "healthy" made be over-reported (Becker & Welten, 2001). This is a major issue in dietary research and is not easily overcome (Bellisle, McDevitt & Prentice, 1997; Chiva, 1997) it can also distort the interpretation of results from dietary surveys (Stallone, Brunner, Bingham & Marmot, 1997; Johansson, Akesson, Berglund, Nermell & Vahter 1998).

There is no easy solution to this problem. It is recommended that energy intake data is validated with published cut-off points for energy intake in relation to estimated basal metabolic rates (Black, Tanaka, Leiter & Anderson, 1991; Goldberg, Black, Jebb, Cole, Murgatroyd, Coward & Prentice, 1991). It was beyond the scope of this thesis to examine the extent of under- or over-reporting dietary intake. The primary aim of the thesis was to examine the effects of frequency of consumption as opposed to nutritional intake. The same measures of breakfast and snack intake were used throughout the thesis for consistency and to allow for comparisons to be made.

The definition of food intake may significantly influence the outcome and interpretation of studies. A study by McBride, Wise, McNeill & James, (1990) found that a significant relationship was only found between eating frequency and energy

intake when meals were defined as providing more than 375 kJ. Snack and meal consumption in this thesis were based on participants definitions. The results from all of the studies reported in this thesis were very similar both when participants were explicitly asked about definitions and the data concerning frequency of consumption. It would appear unlikely that this could account for any differences found between these studies. However, this could account for difference seen between the studies in this thesis and previous research. This is an area which cannot easily be resolved and will remain a limitation of all snacking research in particular.

9.7.1.2. Compliance with intervention studies

One major problem with dietary intervention studies is the issue of ensuring compliance. In order to increase number of participants it is necessary to keep disruption to a minimum, therefore generally it is not practical to make participants come into the laboratory to eat. One method of ensuring compliance is to collect physiological data such as saliva samples. However, this requires a lot of time, money and a high level of expertise as well as specific equipment and facilities and was not practical for this thesis. A dietary diary is often the main measure of food intake when examining dietary compliance. This is usually followed up when the participants attend the laboratory. It is not possible to know whether the participants in the intervention study complied with the dietary guidelines they were provided with. Participants were asked to keep a record, on a daily basis, of which flavour bar (or how many bowls of cereal) they had eaten and they were also asked to rate how acceptable this was. However as noted above self reported dietary reports are subject to bias themselves. For the cognitive and hazard perception studies participants were asked to rate their levels of hunger when arriving at the laboratory. They were also asked whether they had consumed any food or drink (except water) that morning.

Compliance presents huge difficulties to dietary studies and it is not something which is easily overcome. If the results from this thesis were replicated this may suggest that a more detailed intervention study, using physiological markers for example, should be conducted.

9.7.2 Use of parental self-report measures for children's data

However, the data about the children were based on parental reports. Previous

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research is mixed concerning the correlation between parent and child responses. Several studies have reported on levels of disagreement between responses from children and parent proxies (Erling, Wiklund & Albertsson-Wikland, 1994; Epkins, 1996). However, more recent research has shown that proxy ratings are more accurate when the information required is concrete, visible and less subjective (Sprangers & Aaronson, 1992; Herjanic & Reich, 1997). Parents have been found to be accurate at reporting symptoms that are overt and easily observable. However, the correlations are lower for emotional symptoms such as depression.

Childhood depression has been a challenge for researchers for many decades although there is now a generally accepted view that it does exist, even in young school children (Puura, Almqvist, Tamminen, Piha, Kumpulainen, Räsänen, Moilanen & Koivisto, 1998). The majority of studies have found that parents report fewer depressive symptoms than the children themselves (Angold, Weissman, John, Merikangas, Prusoff, Wickramaratne, Gammon & Warner, 1987; Barrett, Berney, Bhate, Famuyiwa, Fundudis, Kolvin & Tyrer, 1991). However others have found the opposite concluding that children underestimate the severity of their symptoms (Kazdin, French, Unis & Esveldt-Dawson, 1983; Ivens & Rehm, 1988). Parents are sensitive to behaviour which they have to react to but they are fairly insensitive to the inner experiences and emotions of their children as indicated by the findings of Kazdin et al. (1983). Most symptoms of depression are highly subjective feelings and experiences, for example feeling unhappy, guilt or a loss on concentration ability. Despite these criticisms the reliability of children under 10 or 12 years old to report the onset and duration of symptoms is limited (Kovacs, Brent, Steinberg, Paulauskas & Reid, 1986). As the majority of the children included in the present study were under the age of 12 parental reports were considered to be the most reliable method of data collection. Parents were requested to complete the questionnaires with their children and to ask them how they felt. However no information was collected afterwards about whether parents followed this suggestion.

The measures used in the current study were identical to those for the parents. It is possible that these measures were unsuitable for use in children. Future research needs to consider the measures used and should try and collect information from both parents and children.

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9.7.3 Use of breakfast as a positive control

Breakfast was included as a positive control for the majority of the studies in this thesis. Breakfast was chosen as both the research questions and methodological limitations associated with breakfast research are equally relevant and transferable to snacking research. The previous research from breakfast can therefore provide an important benchmark for the more recent snacking research.

The role of breakfast on cognition had been extensively researched and a general consensus has been reached for particular functions, for example memory. The methodologies adopted in these studies remain reasonably similar to one another and can be effectively used to examine snacking. This is especially evident in the few studies which have considered the effects of breakfast and subsequent snacks on performance.

In contrast breakfast and its associations with health is an area which remains relatively small in comparison to other lifestyle factors and is still being investigated. Considerably more research has been conducted examining smoking, alcohol consumption as risk factors for physical health and obesity. The vast majority of the literature examining mental health has focused on socio-demographic factors and family history as risk factors.

Although there are areas of inconsistency which limit the use of breakfast as a positive control, it remains the most researched area of food and health.

9.7.4 Statistical Power and effect size

This thesis has produced some interesting results. However it should be noted that the generalisability of these results are limited by the sample sizes and associated power of the various studies. The studies conducted for this thesis were exploratory in nature and for the vast majority there was little or no pre-existing data. This meant that it was not possible to calculate priori power or determine an appropriate sample size to achieve adequate power.

Factors such as sample size were predominantly limited due to pragmatic reasons, such as number of responses collected, participants available. Although ideal, it was not viable to conduct long term intervention studies with large sample sizes as PhD research. However, these studies have revealed some results which warrant further investigation and the results from the studies reported here could be used as a

benchmark for future research. In particular the odds ratios reported in Chapter 3 show some quite large effect sizes. Using this data as a benchmark would allow for stronger conclusions to be made about clinical and practical significance.

9.8 Summary of key findings

9.8.1 Consideration of a broader range of outcomes

A similar pattern of results was found for all of the health based outcomes and safety indicators with regular breakfast being positively associated with health status and safety and frequent unhealthy snacking being negatively associated with the same outcomes. Different effects were found with respect to snacking type and cognitive performance. Consumption of confectionary snacks and cereal based snacks showed opposite effects on tasks of attention and memory, although these were not found to be significant. Finally performance on a more real life activity was investigated. Consumption of a snack which is high in carbohydrate may be beneficial to driving performance if consumed during the mid-morning.

9.8.2 Frequency of consumption vs. type of food consumed

Extending the snacking research has revealed that snacking type is strongly associated with health. Frequency of unhealthy snack food showed stronger associations than snacking frequency per se. This suggests that both the type of snack consumed and frequency needs to be taken into consideration. In contrast breakfast frequency showed stronger associations with health than type of food consumed.

9.8.3 Examination of the relationship between breakfast and snacking

Breakfast and unhealthy snacking show strong opposite effects on similar outcomes. Although regular breakfast consumers were less likely to be frequent unhealthy snack consumers, their effects appeared to be independent from one another. Changing one dietary behaviour was associated with improved reports of health however changing both behaviours were associated with optimal reports of health.

9.8.4 Investigation of the role of other demographic and lifestyle factors on the relationships between breakfast, snacking and the outcome measures

The results from the studies reported in this thesis cannot be explained by other lifestyle, health behaviours and demographic factors. Number of positive health behaviours was found to have a cumulative effect on health outcomes. These results suggest that although changing behaviour was associated with reports of improved health the more behaviours which are changed the greater the effect.

9.9   Future directions

Based on the results from this thesis a number of areas have been identified which warrant further attention. Studies examining associations between dietary intake and health need to replicate the current findings, ideally in large samples which are representative of the population in general. A greater use of intervention studies is also crucial to develop greater understanding about these associations and underlying mechanisms and to further explore the relationship between breakfast and snacking. The results of these studies could have important and far reaching implications for health especially in children. More scientific research which addresses the methodological problems discussed in this thesis is required to investigate the effects of dietary intake in children.

Within the field of nutrition and cognition research should consider the potential effects of dietary intake in more real life activities. This should involve extensions of the hazard perception study reported in this thesis and consideration of other tasks. Based on the results of dietary intake and safety indicators there is scope to extend this research to specific occupations where there are high levels of cognitive demand. Finally future studies should try and establish the underlying mechanisms.

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Appendices

Appendix A – Description of remaining questionnaires used in Chapter 2

Eysenck Personality Inventory (EPI) – (Eysenck & Eysenck, 1968)
The neuroticism and introversion scales of the EPI were used. Participants responded either 'yes' or 'no' as to how they usually felt or behaved. A single score was calculated for neuroticism and introversion.

Self-esteem (Fleming & Watts, 1980)
This is a measure of reactions to and opinions about a number of situations. There are 14 items which are rated on a 6 point Likert scale from (1) I agree very much to (6) I disagree very much. A single score was derived from the questionnaire which was calculated by summing the all the responses. Higher scores indicate higher levels of self-esteem.

Hassles Scale (Kanner, Coyne, Schaefer & Lazarus, 1981)
This is a measure of stress based on everyday minor stressors or 'hassles'. Participants are given a list of 117 potential hassles which they are asked to rate on a 3 point likert scale (1=somewhat severe, 2= moderately severe and 3= extremely severe). A number of different areas were considered such as family, health, work and finances. Participants responded based on those hassles they had experienced within the last month. Three scores were derived from the hassles scale;
Frequency – adding the number of items which were endorsed by the participants (range from 0 to 117).
Cumulative severity – This is the sum of the 3 point severity rating (range from 0 to 351, 3 x 117).
Intensity – This is calculated by dividing the cumulative severity by frequency (range from 0 to 3).

University of California Loneliness Scale (UCLA) – (Russel, Peplau & Cutrona, 1978)
This is a subjective measure of perceived loneliness and the adequacy of interpersonal relationships. The scale consists of 20 items and a single score is calculated. The scale has good internal and test-retest reliability as well as discriminative and construct validity.

Social Network Index (SNI) – (Berkman, 1984)
This is a measure of the degree of social integration. The questionnaire has 4 components: marital status, contact with family and friends, church membership and group membership. The relative importance of these components are integrated into a summary measure which ranges from 0 to 4. Intimate relations (marital status, family, friends) are given 2x the weight of church membership and 4x the weight of group membership.

Health Seeking Behaviours (HSB) – (Bausell, 1986)
The HSB is a checklist of 20 items looking at health habits. Participants could either respond yes (1) if they usually complied with the behaviour or no (0) if they did not.

The questionnaire contains 7 items about dietary behaviour, 4 about automotive and household practices, 2 health monitoring items and 7 general lifestyle items. Higher score = higher levels of health promotion.

Cohen-Hoberman Inventory of Physical Symptoms (CHIPS) – (Cohen & Hoberman, 1983)

Common physical symptoms are assessed on this 12 item measure. Excluded symptoms which are psychological in nature (e.g. nervous, depressed), does include physical symptoms which have traditionally been seen as psychosomatic (headache, weight loss). Participants were asked to indicate how much these symptoms had bothered or distressed them during the past 24 hours. Reponses were given on a 5 point Likert scale which ranged from (0) not at all to (4) extremely. A single score was derived by summing the frequency responses across all the items (range = 0 to 48).

The Revised Middlesex Hospital Questionnaire (MHQ) – (Broadbent & Gath, 1979)

The MHQ was developed as a self report inventory of 48 items which measured 6 distinct and clinically recognised psycho-neurotic states. These 6 scales were labelled designated anxiety, phobic anxiety, obsessional symptoms, somatic symptoms, depressive symptoms and hysterical symptoms.

The version of the MHQ used in the present study as modified by Broadbent and Gath (1979). The adapted version consists of 25 items and 4 subscales: anxiety, obsessional symptoms, somatic symptoms and depression. Participants were asked to rate whether they had been bothered, distressed or annoyed by any of the symptoms within the past 6 weeks. A 3 point scale was used from (0) never to (2) often. Responses to items corresponding to each subscale were added to obtain the total score for each subscale. On all scales higher scores indicate higher physical and mental symptoms.

Cognitive Failures Questionnaire (CFQ) – (Broadbent et al., 1982)

The CFQ was developed to measure frequency of lapses in 3 areas: memory, perception and motor functioning. The scale consists of 25 items and participants responded on a 5 point Likert scale ranging from (0) never to (4) very often. Scores from all of the items were summed to calculate the total score. A higher score indicates higher number of cognitive failures.

Personal Details

Date of Birth: 19

Sex: . . . . M (1)   F (2)

Ethnicity:

	tick box	
White		1
Black African		2
Black Caribbean		3
Indian		4
Chinese		5
Bangladeshi		6
Other		7

If Other, please specify	

Education

Education Completed:

	tick one box	
No schooling.		0
Primary education only.		1
Some secondary education but left school before 16.		2
Secondary education: Completed CSE's / 'O' levels / GCSE's.		3
Secondary education: Completed 'A' levels.		4
At least one year of university but no degree.		5
University graduate, BA or BSc.		6
Masters degree, MA or MSc.		7
Higher degree, Ph.D., MD or other.		8

Other education received but not listed above	

Employment (Public):

		Tick one box
1	Full time	
2	Part time	
3	Unemployed	
4	Retired	
5	Student	
6	Other	

If Other, please specify	

Your Occupation

If you are retired, please tell us what you used to do. If you are unemployed, please tell us what you usually do. If you have two jobs, please tell us about your main employment

What is you Occupation?	

In which area do you work?	

Current Study Details (Students):

Course Title:	
Course Duration:	
Year Started:	
Year Ends:	
Current Year:	
Department Name:	
Department Address	

Health Related Behaviours

Do you SMOKE? . . . . Yes (1)　　No (0)

	tick one box	
Every Day		4
Most Days		3
Some Days		2
Hardly Ever		1

If you smoke regularly (Every Day or Most Days)

Quantity per day	please indicate **when** you smoke your cigarettes	
	Quantity during daytime	Quantity during evening

Or if you only smoke occasionally (Some Days or Hardly Ever)

Quantity per week	please indicate **when** you smoke your cigarettes	
	Quantity during the day	Quantity during evenings

Do you consume ALCOHOL ? . . . . Yes (1)　　No (0)

	tick one box	
Every Week		4
Most Weeks		3
Some Weeks		2
Hardly Ever		1

(REMEMBER - One unit = half a pint of beer or one pub measure of wine or spirits)

If you drink alcohol regularly (Every Week or Most Weeks)

Units per week	please indicate **when** you drink your alcohol

	Units during the week	Units during weekend

Or if you only drink alcohol occasionally (Some Weeks or Hardly Ever)

Units per month	please indicate **when** you drink your alcohol	
	Units during the week	Units during weekends

What drinks do you drink ?   (try to indicate the breakdown of a typical weeks drinking)

			Units
♦ Only complete this section if you drink every week or most weeks.	1	Beer / Lager	
♦ REMEMBER - One unit = half a pint of	2	Wine	
beer or one pub measure of wine or spirits	3	Spirits	
♦ please **specify** which other drinks	4	Other	
♦ Does this Total tally with the value in **UNITS PER WEEK ?** (above)		**Total**	

Health Related Behaviours - Breakfast

Do you usually have breakfast ?

	tick one box	
No		0
Sometimes		1
Yes		2

What do you usually eat for breakfast ?

	tick one box	
Nothing		0
Toast		1
Cereal		2
Toast and Cereal		3
Muesli/Porridge		4
Fruit		5
Cooked Breakfast		6
Other		7
Combination		8

What do you usually drink for breakfast ?

	tick one box	
Nothing		0
Non-Caffeinated (fruit juice, water, milk)		1
Coffee		2
Tea		3
Coffee & Tea		4
Combination of Caff. and Non Caff. Drinks		5
Other		6

If you eat cereal regularly, which cereal do you regularly eat ? (one only)

Which other types of cereal do you occasionally eat?

1	
2	
3	

How would you describe your usual breakfast ?

	tick one box	
Light		1
Medium		2
Heavy		3

Health Related Behaviours – Other meals

Do you usually have LUNCH ? . . . . Yes (1)   No (0)

What do you usually eat for lunch ?

	tick one box	
Nothing		0
Fruit/yoghurt/cereal		1
Sandwich		2
Sandwich + crisps/ fruit/ yoghurt		3
Cooked Lunch		4
Other		5

What do you usually drink for lunch ?

	tick one box	
Nothing		0
Non-Caffeinated (fruit juice, water, milk)		1
Coffee		2
Tea		3
Coffee & Tea		4
Combination of Caff. and Non Caff. Drinks		5
Other		6

How would you describe your usual lunch ?

	tick one box	
Light		1
Medium		2
Heavy		3

Do you usually have an EVENING MEAL ? . . . Yes (1)   No (0)

What do you usually eat for your evening meal ?

	tick one box	
Nothing		0
Fruit		1
Light Cooked		2
Light Cooked + dessert		3
Heavy Cooked		4
Heavy cooked + dessert		5
Combination		6
Other		7

What do you usually drink with an evening meal ?

	tick one box	
Nothing		0
Non-Caffeinated (fruit juice, water, milk)		1
Coffee		2
Tea		3
Coffee & Tea		4
Combination of Caff. and Non Caff. Drinks		5
Other		6

How would you describe your usual evening meal ?

	tick one box	
Light		1
Medium		2
Heavy		3

Your Sleep

USUALLY

1. I go to bed at....................(time)   2. I fall asleep at......................

3. I get up at..............

	Not Applicable	Never	Sometimes	Often	Always
4. I am satisfied with my sleep		☐0	☐1	☐2	☐3
5. My partner complains that I twitch or move a lot during my sleep.	☐9	☐0	☐1	☐2	☐3
6. I dream a lot		☐0	☐1	☐2	☐3
7. I wake a lot during the night		☐0	☐1	☐2	☐3
8. My partner complains that I snore loudly	☐9	☐0	☐1	☐2	☐3
9. I am restless during the night		☐0	☐1	☐2	☐3
10. I have very unpleasant or frightening dreams		☐0	☐1	☐2	☐3
11. I take a long time to go off to sleep at night		☐0	☐1	☐2	☐3
12. I wake up terrified, without knowing why		☐0	☐1	☐2	☐3
13. I feel very tired in the morning		☐0	☐1	☐2	☐3
14. When I wake up in the night I can't get off to sleep again		☐0	☐1	☐2	☐3
15. I wake up very easily in the morning		☐0	☐1	☐2	☐3
16. When I get up I feel groggy and muzzy-headed		☐0	☐1	☐2	☐3
17. My sleep is refreshing		☐0	☐1	☐2	☐3

	0	1	2	3
18. I feel very tired during the day	$\square$0	$\square$1	$\square$2	$\square$3
19. I walk in my sleep	$\square$0	$\square$1	$\square$2	$\square$3
20. I keep dropping off to sleep during the day	$\square$0	$\square$1	$\square$2	$\square$3
21. I take tablets to help me sleep	$\square$0	$\square$1	$\square$2	$\square$3
22. I have a nap during the day	$\square$0	$\square$1	$\square$2	$\square$3
23. I wake up very early in the morning and can't get off to sleep again	$\square$0	$\square$1	$\square$2	$\square$3
24. I take tablets or medicine during the day.	$\square$0	$\square$1	$\square$2	$\square$3

Name of tablets/medicine if known. ....

....

Do you have any children under 5? $\square$ Yes (1) $\square$ No (0)

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Your eating habits

INSTRUCTIONS: Please circle the appropriate answer for each question

1.   Are you on a special diet of any sort for health reasons?
No (0)   Yes (1)

If yes: What are the reasons?
                 What is the special diet?

2. Would you say that you usually eat the right amount of food for you?
No (0)   Yes (1)

2.a If no: Do you eat too much or too little?
                    1 = too much   2 = too little

3.   How often do you eat breakfast?

Every day	Most days (3-6)	Once or twice a week	Less than once a week	Never
(4)	(3)	(2)	(1)	(0)

4. Apart from breakfast, how many main or cooked meals (i.e. a meal that has a main course with one or more vegetables) do you usually have during the day? _____

5.   Apart from breakfast, how many lighter meals do you usually have during the day? _____

6. How often do you have a snack or something to eat between meals or before going to bed?

Every day	Most days (3-6)	Once or twice a week	Less than once a week	Never
(4)	(3)	(2)	(1)	(0)

6.a   If every day: How often ?

1= once or twice   2 = 3 or 4   3 = 4+

7.   Do you eat regularly; i.e. have the same number of meals and snacks at roughly the same time each day?

No (0)   Yes (1)

8. How often do you eat fried foods (don't count chips)?

Every day	Most days (3-6)	Once or twice a week	less than once a week	Never
(4)	(3)	(2)	(1)	(0)

9a. How many cups of caffeinated coffee do you usually drink in a day?

None	1 or 2	3 or 4	5 or 6	6+
(0)	(1)	(3)	(5)	(6)

9b. How many cups of tea do you usually drink in a day?

None	1 or 2	3 or 4	5 or 6	6+
(0)	(1)	(3)	(5)	(6)

10. There will now follow a list of foods. Please indicate, by circling the appropriate answer, how often you eat each of them.

		More than once a day	Once a day	Most days (3-6)	Once or twice a week	Less than once a week	Nev
A	Fresh fruit	6	5	4	3	2	1
B	Salads or raw veg.	6	5	4	3	2	1
C	Tinned fruit	6	5	4	3	2	1
D	Chips	6	5	4	3	2	1
E	Potatoes (**NOT CHIPS**)	6	5	4	3	2	1
F	Root vegetables like carrots, turnips and parsnips	6	5	4	3	2	1
G	Peas and beans (all kinds)	6	5	4	3	2	1
H	Green vegetables	6	5	4	3	2	1
I	Other cooked vegetables, inc. mushrooms and onions	6	5	4	3	2	1
J	Nuts	6	5	4	3	2	1
K	Potato crisps/similar snacks	6	5	4	3	2	1

		More than once a day	Once a day	Most days (3-6)	Once or twice a week	Less than once a week	Never
L	Sweets, chocolates	6	5	4	3	2	1
M	Pasta and rice	6	5	4	3	2	1
N	Breakfast cereal	6	5	4	3	2	1
O	Biscuits	6	5	4	3	2	1
P	Cakes of all kinds	6	5	4	3	2	1
Q	Sweets or puddings, fruit pies, and flans and tarts	6	5	4	3	2	1
R	Ice cream, mousse, yoghurt, milk puddings	6	5	4	3	2	1
S	Soft drinks; e.g. colas	6	5	4	3	2	1
T	Pure fruit juice	6	5	4	3	2	1
U	Jam/Marmalade/Honey	6	5	4	3	2	1
V	Cheese	6	5	4	3	2	1
W	Eggs	6	5	4	3	2	1
X	Cream	6	5	4	3	2	1
Y	Fish	6	5	4	3	2	1
Z	Poultry	6	5	4	3	2	1
	Sausages/Tinned meat/ Pâté, meat pies/pasties, etc.	6	5	4	3	2	1
	Beef/lamb/pork/ham/ bacon	6	5	4	3	2	1

Can you think of any other sorts of food which you eat regularly? (Specify)

	More than once a day	Once a day	Most days (3-6)	Once or twice a week	Less than once a week	Never
a. _____	6	5	4	3	2	1
b. _____	6	5	4	3	2	1
c. _____	6	5	4	3	2	1
d. _____	6	5	4	3	2	1

The following questions are about your <u>drinking habits</u>.

11. Would you say that you are: 0 = a non drinker
                                        1 = a very occasional drinker
                                        2 = an occasional drinker
                                        3 = a regular drinker

12. Would you say that you are: 0 = a light drinker

                                        1 = a moderate drinker
                                        2 = a heavy drinker

13.   On how many days have you had an alcoholic drink in the last week?

     0   1   2   3   4   5   6   7

14.   We would like to know what you had to drink last week:

Please indicate:

                  the number of 1/2 pints of beer in the last week
....

                  the number of spirits in the last week
....

                  the number of glasses of wine that you had
....

15.   Was last week's drinking: 0 = reasonably typical of your usual pattern
                                          1= rather less than usual
                                          2= rather more than usual

The following questions are about cigarette smoking.

16.   Do you smoke at least one cigarette a day?

     No   (0)   Yes (1)

<u>If yes:</u>
17.   On average, how many cigarettes do you smoke each day? _____
               (Number of cigarettes; if less than 1 put 1)

The following questions concern activities and exercise.

18. How often do you take walks, runs or jogs in good weather?
    0 = never or very infrequently
    1 = sometimes
    2 = frequently

19. How often do you swim or do aerobic exercise?
    0 = never or very infrequently
    1 = sometimes
    2 = frequently

20. How often do you do physical work around the house or flat?
    0 = never or very infrequently
    1 = sometimes
    2 = frequently

21. How often do you participate in sports like an active ball game (not including sports like golf, bowling, pool or snooker)?
    0 = never or very infrequently
    1 = sometimes
    2 = frequently

22. How often do you take part in sports like golf, bowling or snooker?
    0 = never or very infrequently
    1 = sometimes
    2 = frequently

23. How often do you watch television?
    0 = once a week or less
    1 = several times
    2 = daily, less than two hours
    3 = 2 to 4 hours
    4 = more than four hours per day

Interpersonal Support Evaluation List

INSTRUCTIONS: This scale is made up of a list of statements, each of which may or may not be true about you. For each statement circle 'definitely true' if you are sure it is true about you and 'probably true' if you think it is true but are not absolutely certain. Similarly, you should tick 'definitely false' if you are sure the statement is false and 'probably false' if you think it is false but are not absolutely certain.

1.   **There are several people I trust to help solve my problem.**

4 = definitely true   3 = probably true   2 = probably false   1 = definitely false

2. **If I need help mending something, (e.g. an appliance, car, clothes, furniture), there is someone who would help me.**

4 = definitely true   3 = probably true   2 = probably false   1 = definitely false

3.   **Most of my friends are more interesting than I am.**

4 = definitely true   3 = probably true   2 = probably false   1 = definitely false

4.   **There is someone who takes pride in my accomplishments.**

4 = definitely true   3 = probably true   2 = probably false   1 = definitely false

5.   **When I feel lonely, there are several people I can talk to.**

4 = definitely true   3 = probably true   2 = probably false   1 = definitely false

6. **There is no one that I feel comfortable talking to about intimate personal problems.**

4 = definitely true   3 = probably true   2 = probably false   1 = definitely false

7.   **I often meet or talk with family or friends.**

4 = definitely true   3 = probably true   2 = probably false   1 = definitely false

8.   **Most people I know think highly of me.**

4 = definitely true   3 = probably true   2 = probably false   1 = definitely false

9. **If I need a lift very early in the morning (e.g. to the tube station, train station, or airport), I would have a hard time finding anyone to take me.**

4 = definitely true   3 = probably true   2 = probably false   1 = definitely false

10.   **I feel like I'm not always included in my circle of friends.**

4 = definitely true   3 = probably true   2 = probably false   1 = definitely false

11. **There is really no one who can give me an objective view of how I'm handling my problems.**

4 = definitely true   3 = probably true   2 = probably false   1 = definitely false

12. **There are several different people I enjoy spending time with.**

4 = definitely true   3 = probably true   2 = probably false   1 = definitely false

13. **I think that my friends feel that I'm not very good at helping them solve their problems.**

4 = definitely true   3 = probably true   2 = probably false   1 = definitely false

14. **If I were ill and needed someone (friend, family member, or acquaintance) to take me to the doctor, I would have trouble finding someone.**

4 = definitely true   3 = probably true   2 = probably false   1 = definitely false

15. **If I wanted to go on a trip or outing for a day (e.g. to the seaside or countryside), I would have a hard time finding someone to go with me.**

4 = definitely true   3 = probably true   2 = probably false   1 = definitely false

16. **If I needed a place to stay for a week because of an emergency (e.g. water or electricity not working in my flat or house), I could easily find someone who would put me up.**

4 = definitely true   3 = probably true   2 = probably false   1 = definitely false

17. **I feel there is no one I can share my most private worries and fears with.**

4 = definitely true   3 = probably true   2 = probably false   1 = definitely false

18. **If I were ill, I could easily find someone to help me with my daily chores.**

4 = definitely true   3 = probably true   2 = probably false   1 = definitely false

19. **There is someone I can turn to for advice about handling problems with my family.**

4 = definitely true   3 = probably true   2 = probably false   1 = definitely false

20. **I'm as good at doing things as most people are.**

4 = definitely true   3 = probably true   2 = probably false   1 = definitely false

21. **If I decide one afternoon that I would like to go out (e.g. to the cinema) that evening, I could find someone to go with me.**

4 = definitely true   3 = probably true   2 = probably false   1 = definitely false

22. **When I need suggestions on how to deal with a personal problem , I know someone I can turn to.**

4 = definitely true   3 = probably true   2 = probably false   1 = definitely false

23. **If I needed an emergency loan of £100, there is someone (friend, relative or acquaintance) I could get it from.**

4 = definitely true   3 = probably true   2 = probably false   1 = definitely false

24. **In general, people do not have much confidence in me.**

4 = definitely true   3 = probably true   2 = probably false   1 = definitely false

25. **Most people I know do not enjoy the same things that I do.**

4 = definitely true   3 = probably true   2 = probably false   1 = definitely false

26. **There is someone I could turn to for advice about making career plans or about changing my job.**

4 = definitely true   3 = probably true   2 = probably false   1 = definitely false

27. **I don't get invited to do things with others.**

4 = definitely true   3 = probably true   2 = probably false   1 = definitely false

28. **Most of my friends are more successful at making changes in their lives than I am.**

4 = definitely true   3 = probably true   2 = probably false   1 = definitely false

29. **If I had to go away from home for a few weeks, there is someone I know who would look after my house or flat (the plants, pets, garden, etc.).**

4 = definitely true   3 = probably true   2 = probably false   1 = definitely false

30. **There is really no one I can trust to give me good financial advice.**

4 = definitely true   3 = probably true   2 = probably false   1 = definitely false

31. **If I wanted to have lunch with someone, I could easily find someone to join me.**

4 = definitely true   3 = probably true   2 = probably false   1 = definitely false

32.   **I am more satisfied with my life than most people are with theirs.**

4 = definitely true   3 = probably true   2 = probably false   1 = definitely false

33. **If I was stranded 10 miles from home, there is someone I could call who would come and collect me.**

4 = definitely true   3 = probably true   2 = probably false   1 = definitely false

34.   **No one I know would throw a birthday party for me.**

4 = definitely true   3 = probably true   2 = probably false   1 = definitely false

35. **It would be difficult to find someone who would lend me their car for a few hours. (If you don't drive, assume for the purpose of this question that you have someone to drive you, but no car).**

4 = definitely true   3 = probably true   2 = probably false   1 = definitely false

36. **If a family crisis arose, it would be difficult to find someone who could give me good advice about how to handle it.**

4 = definitely true   3 = probably true   2 = probably false   1 = definitely false

37.   **I am closer to my friends than most people are to theirs.**

4 = definitely true   3 = probably true   2 = probably false   1 = definitely false

38.   **There is at least one person I know whose advice I really trust.**

4 = definitely true   3 = probably true   2 = probably false   1 = definitely false

39. **If I needed some help in moving to a new house or flat, I would have a hard time finding someone to help me.**

4 = definitely true   3 = probably true   2 = probably false   1 = definitely false

40.   **I have a hard time keeping pace with my friends.**

4 = definitely true   3 = probably true   2 = probably false   1 = definitely false

Social Network Index

INSTRUCTIONS: Please circle the answer appropriate response.

1.   **Marital status:**

   a.   **Have you ever been married?**   yes (1)   no (0)

   b.   **Are you now single, married, separated, divorced, widowed?**

single	married	separated	divorced	widowed
(1)	(2)	(3)	(4)	(5)

2.   **Friends and relatives:**

   a: **How many close friends do you have?**

none	1 or 2	3 to 5	6 to 9	10 or more
(0)	(1)	(2)	(3)	(4)

   b.   **How many relatives do you have that you feel close to?**

none	1 or 2	3 to 5	6 to 9	10 or more
(0)	(1)	(2)	(3)	(4)

   c.   **How many of these friends do you see at least once a month?**

none	1 or 2	3 to 5	6 to 9	10 or more
(0)	(1)	(2)	(3)	(4)

   d.   **How many of these relatives do you see at least once a month?**

none	1 or 2	3 to 5	6 to 9	10 or more
(0)	(1)	(2)	(3)	(4)

3.   **Church and group membership:**

   Do you belong to any of these types of groups? if so please circle the appropriate letter.

a.	A social or recreational group?	(1)
b.	A labour union, commercial group, professional organisation?	(2)
c	Church group?	(3)
d.	A group concerned with children (PTA, boy scout)?	(4)
e.	A group concerned with community betterment, charity or service?	(5)
f.	Any other group?	(6)
	Please give details _____	

University of California Loneliness Scale

INSTRUCTIONS: Please indicate by circling one of the numbers **how often** you feel the way described in each of the statements.

1.   **How often have you felt in harmony with people around you?**

0 = never   1 = almost never   2 = sometimes   3 = fairly often   4 = very often

2.   **How often do you feel as though you lack companionship?**

0 = never   1 = almost never   2 = sometimes   3 = fairly often   4 = very often

3.   **How often do you feel that there is no one you can turn to?**

0 = never   1 = almost never   2 = sometimes   3 = fairly often   4 = very often

4.   **How often do you feel alone?**

0 = never   1 = almost never   2 = sometimes   3 = fairly often   4 = very often

5.   **How often do you feel part of a group?**

0 = never   1 = almost never   2 = sometimes   3 = fairly often   4 = very often

6.   **How often do you feel that you have a lot in common with the people around you?**

0 = never   1 = almost never   2 = sometimes   3 = fairly often   4 = very often

7.   **How often do you feel that you are no longer close to anyone?**

0 = never   1 = almost never   2 = sometimes   3 = fairly often   4 = very often

8.   How often do you feel that your interests and ideas are not shared by those around you?

0 = never   1 = almost never   2 = sometimes   3 = fairly often   4 = very often

9.   **How often do you feel that you are an outgoing person?**

0 = never   1 = almost never   2 = sometimes   3 = fairly often   4 = very often

10.   **How often do you feel that there are people you feel close to?**

0 = never   1 = almost never   2 = sometimes   3 = fairly often   4 = very often

11.   How often do you feel left out?

0 = never   1 = almost never   2 = sometimes   3 = fairly often   4 = very often

12.   How often do you feel that your social relationships are superficial?

0 = never   1 = almost never   2 = sometimes   3 = fairly often   4 = very often

13.   How often do you feel that nobody really knows you?

0 = never   1 = almost never   2 = sometimes   3 = fairly often   4 = very often

14.   How often do you feel isolated from other people?

0 = never   1 = almost never   2 = sometimes   3 = fairly often   4 = very often

15.   How often do you feel that you find companionship when you want it?

0 = never   1 = almost never   2 = sometimes   3 = fairly often   4 = very often

16.   How often do you feel that there are people who really understand you?

0 = never   1 = almost never   2 = sometimes   3 = fairly often   4 = very often

17.   How often do you feel unhappy because of being so withdrawn?

0 = never   1 = almost never   2 = sometimes   3 = fairly often   4 = very often

18.   How often do you feel that people are around you but not with you?

0 = never   1 = almost never   2 = sometimes   3 = fairly often   4 = very often

19.   How often do you feel that there are people you can talk to?

0 = never   1 = almost never   2 = sometimes   3 = fairly often   4 = very often

20.   How often do you feel that there are people you can turn to?

0 = never   1 = almost never   2 = sometimes   3 = fairly often   4 = very often

Self Esteem

INSTRUCTIONS: The next group of questions has to do with your reactions and opinions about a number of situations. We would like to know how much you agree or disagree with each of the statements listed below. Please mark the number which expresses your answer, with numbers 1 and 6 being the extreme answers. We have covered many different points of view. You may find yourself agreeing strongly with some, disagreeing just as strongly with others, and perhaps uncertain about others.

We want to learn about your responses to these situations, so it is important that each response reflects your own feelings.

1. **I worry about how well I get along with people.**

   I agree very much   1   2   3   4   5   6   I disagree very much

2. **I often dislike myself.**

   I agree very much   1   2   3   4   5   6   I disagree very much

3. **I often feel very self-conscious.**

   I agree very much   1   2   3   4   5   6   I disagree very much

4. **I often feel inferior to most of the people I know.**

   I agree very much   1   2   3   4   5   6   I disagree very much

5. **I feel confident that some day the people I know will look up to me and respect me.**

   I agree very much   1   2   3   4   5   6   I disagree very much

6. **I feel afraid or anxious when I am going into a room by myself where other people have already gathered and are talking.**

   I agree very much   1   2   3   4   5   6   I disagree very much

7. **I often have the feeling that there is nothing I can do well.**

   I agree very much   1   2   3   4   5   6   I disagree very much

8. **I worry about whether other people like to be with me.**

   I agree very much   1   2   3   4   5   6   I disagree very much

9. **I am often troubled with shyness.**

   I agree very much   1   2   3   4   5   6   I disagree very much

10. **I think that I am a worthless individual.**

I agree very much   1   2   3   4   5   6   I disagree very much

11. **I am worried that some of my friends may not have a good opinion of me.**

I agree very much   1   2   3   4   5   6   I disagree very much

12. **I am confident about my abilities.**

I agree very much   1   2   3   4   5   6   I disagree very much

13. **I sometimes feel so discouraged with myself that I wonder whether anything is worth while.**

I agree very much   1   2   3   4   5   6   I disagree very much

14. **I feel worried or bothered about what other people think about me.**

I agree very much   1   2   3   4   5   6   I disagree very much

Social Reaction Inventory

INSTRUCTIONS: The next set of questions has to do with your reactions and opinions about a number of situations. Please indicate by circling the appropriate answer how much you agree or disagree with the statements below. You may find yourself agreeing strongly with some, disagreeing as strongly with others, and perhaps uncertain with others.

We want to learn about your responses to these situations so it is important that your response reflects your feelings.

1. **When I get what I want it's usually because I have worked hard for it.**

   I agree very much (5)   I mainly agree (4)   I slightly agree (3)
   I disagree very much (0)   I mainly disagree (1) I slightly disagree (2)

2. **Even when I'm feeling self-confident about most things, I still seem to lack the ability to control social situations.**

   I agree very much (5)   I mainly agree (4)   I slightly agree (3)
   I disagree very much (0)   I mainly disagree (1) I slightly disagree (2)

3. **I have no trouble making and keeping friends.**

   I agree very much (5)   I mainly agree (4)   I slightly agree (3)
   I disagree very much (0)   I mainly disagree (1) I slightly disagree (2)

4. **When I make plans I am almost certain to make them work.**

   I agree very much (5)   I mainly agree (4)   I slightly agree (3)
   I disagree very much (0)   I mainly disagree (1) I slightly disagree (2)

5. **I am not good at guiding the course of a conversation with several others.**

   I agree very much (5)   I mainly agree (4)   I slightly agree (3)
   I disagree very much (0)   I mainly disagree (1) I slightly disagree (2)

6. **I prefer games requiring some luck over games requiring pure skill.**

   I agree very much (5)   I mainly agree (4)   I slightly agree (3)
   I disagree very much (0)   I mainly disagree (1) I slightly disagree (2)

7. **I can learn almost anything if I set my mind to it.**

   I agree very much (5)   I mainly agree (4)   I slightly agree (3)
   I disagree very much (0)   I mainly disagree (1) I slightly disagree (2)

8. **I can usually establish a close personal relationship with someone I find attractive.**

I agree very much (5)   I mainly agree (4)   I slightly agree (3)
I disagree very much (0)   I mainly disagree (1)   I slightly disagree (2)

9. **My major accomplishments are entirely due to my hard work and skill.**

I agree very much (5)   I mainly agree (4)   I slightly agree (3)
I disagree very much (0)   I mainly disagree (1)   I slightly disagree (2)

10. **I usually don't set goals because I have a hard time following them through.**

I agree very much (5)   I mainly agree (4)   I slightly agree (3)
I disagree very much (0)   I mainly disagree (1)   I slightly disagree (2)

11. **When talking with another person, I can usually steer the person toward the topic I want to talk about and away from those I wish to avoid.**

I agree very much (5)   I mainly agree (4)   I slightly agree (3)
I disagree very much (0)   I mainly disagree (1)   I slightly disagree (2)

12. **Competition discourages excellence.**

I agree very much (5)   I mainly agree (4)   I slightly agree (3)
I disagree very much (0)   I mainly disagree (1)   I slightly disagree (2)

13. **Often people get ahead just by being lucky.**

I agree very much (5)   I mainly agree (4)   I slightly agree (3)
I disagree very much (0)   I mainly disagree (1)   I slightly disagree (2)

14. **If I need help in carrying off a plan of mine, it's usually difficult to get others to help.**

I agree very much (5)   I mainly agree (4)   I slightly agree (3)
I disagree very much (0)   I mainly disagree (1)   I slightly disagree (2)

15. **If there is someone I want to meet, I can usually arrange it.**

I agree very much (5)   I mainly agree (4)   I slightly agree (3)
I disagree very much (0)   I mainly disagree (1)   I slightly disagree (2)

16. **I often find it hard to get my point of view across to others.**

I agree very much (5)   I mainly agree (4)   I slightly agree (3)
I disagree very much (0)   I mainly disagree (1)   I slightly disagree (2)

17. **On any sort of competition (for example, an exam, board game, or athletic contest) I like to know how well I do relative to everybody else.**

I agree very much (5)   I mainly agree (4)   I slightly agree (3)
I disagree very much (0)   I mainly disagree (1)   I slightly disagree (2)

18. **It is pointless to keep working on something that's too difficult for me.**

I agree very much (5)   I mainly agree (4)   I slightly agree (3)
I disagree very much (0)   I mainly disagree (1)   I slightly disagree (2)

19. **In attempting to smooth over a disagreement, I usually make it worse.**

I agree very much (5)   I mainly agree (4)   I slightly agree (3)
I disagree very much (0)   I mainly disagree (1)   I slightly disagree (2)

20. **I find it easy to play an important part in most group situations.**

I agree very much (5)   I mainly agree (4)   I slightly agree (3)
I disagree very much (0)   I mainly disagree (1)   I slightly disagree (2)

Life Events

INSTRUCTIONS: Below are questions about a number of events that commonly happen in people's lives.   Each question is concerned with whether the event has happened to you in the last **12 months**.   Please tick **YES** if the event happened and **NO** if it didn't.

If you have responded **YES**, please indicate whether this was a good or a bad experience by placing a tick in the appropriate column.

		No (0)	**Yes**	**Good** (1)	**Bad** (2)
1.	Have you moved during the last 12 months?	___	___	___	___
2.	Have you broken off an engagement to be married or ended an intimate relationship during the last 12 months?	___	___	___	___
3.	Did you get married during the last 12 months?	___	___	___	___
4.	Did someone close to you die in the last 12 months?	___	___	___	___
5.	Were you separated or divorced during the last 12 months?	___	___	___	___
6.	Did you break up with a close friend during the last 6 months?	___	___	___	___
7.	Has an important relationship (e.g. with a family member or friend) changed during the last 12 months?	___	___	___	___
8.	Have you (or your spouse/ partner) had or adopted a baby during the last 12 months?	___	___	___	___

		No (0)	Yes	Good (1)	Bad (2)
9.	Have you or a close friend or family member had a serious accident during the last 12 months?	____	____	____	____
10.	Have you or a close friend or family member had a serious illness during the last 12 months?	____	____	____	____
11.	Have you (or your spouse/partner) been pregnant during the last 12 months?	____	____	____	____
12.	Have you (or your wife) had an abortion or miscarriage during the last 12 months?	____	____	____	____
13.	Have you lost or changed jobs during the last 12 months?	____	____	____	____
14.	Have you been involuntarily unemployed during the last 12 months?	____	____	____	____
15.	Have you suffered serious financial hardship during the last 12 months?	____	____	____	____
16.	Have you had any serious problems or disappointment in work or an educational course during the last 12 months?	____	____	____	____
17.	Have you had a significant success in work or an educational course during the last 12 months?	____	____	____	____
18.	Has your house been broken into or burgled during the last 12 months?	____	____	____	____

	No (0)	Yes	Good (1)	Bad (2)
19. Have you, your wife or other member of your family been assaulted or mugged during the last 12 months?	___	___	___	___
20. Has the behaviour of any member of your family or close friends been a significant problem for you during the last 12 months?	___	___	___	___
21. Have you appeared in court during the last 12 months?	___	___	___	___
22. Have you had a pet die or disappear during the last 12 months?	___	___	___	___
23 Have you (or your spouse/ partner) suffered a significant business or investment loss or had a business you own fail?	___	___	___	___
24. If there have been other events that you consider to be important during the last 12 months please list the three most significant below and note whether they were good or bad experiences:				
Event 1:	___	___	___	___
Event 2:	___	___	___	___
Event 3:	___	___	___	___

Health Promotion Scale

INSTRUCTIONS: The items below assess your health-related behaviours. Please answer ALL questions by circling either 'YES' or 'NO' to describe your behaviour. Your answer will be kept confidential.

		(1)	(0)
1.	Have you had your blood pressure read at least once in the past 6 months? (do NOT include readings taken in this unit)	YES	NO
2.	Have you visited the dentist for treatment or check-up at least once in the past 6 months?	YES	NO
3.	Do you try a lot to avoid eating too much salt?	YES	NO
4.	Do you try a lot to avoid eating too much fat?	YES	NO
5.	Do you try to eat sufficient fibre in your diet?	YES	NO
6.	Do you try to avoid eating too much cholesterol?	YES	NO
7.	Do you try to consume enough vitamins and minerals?	YES	NO
8.	Do you try to avoid eating too much sugar?	YES	NO
9.	Do you try to consume enough calcium?	YES	NO
10.	Do you try to keep your weight within the prescribed range for your age?	YES	NO
11.	Do you exercise at least three times a week so that you breathe heavily and your pulse is accelerated for at least 20 minutes?	YES	NO
12.	Do you smoke?	YES	NO
13.	Do you take steps to reduce stress?	YES	NO
14.	Do you socialise at least once a week with close friends or relatives?	YES	NO
15.	Do you usually sleep from 7 to 8 hours per night?	YES	NO
16.	Do you wear a seat belt when in the front seat of a car?	YES	NO
17.	Do you have a smoke detector?	YES	NO
18.	Do you smoke in bed or live with someone who smokes in bed?	YES	NO
19.	Do you take special precautions to avoid accidents in the home?	YES	NO

Health Orientation Scale

INSTRUCTIONS: The items listed below refer to people's health, both physical and mental. Please read each item carefully and decide to what extent it is characteristic of you. Give each item a rating of how it applies to you by using the following:

1 = Not at all characteristic of me
2 = Slightly characteristic of me
3 = Somewhat characteristic of me
4 = Moderately characteristic of me
5 = Very characteristic of me

Please circle the appropriate number.

<u>NOTE</u>: Remember to respond to all items, even if you are not completely sure. Your answers will be kept in the strictest confidence. Also, please be honest in responding to these statements.

1.	I am very aware of how healthy I feel	1	2	3	4	5
2.	I sometimes wonder what others think of my health	1	2	3	4	5
3.	I feel anxious when I think about my health	1	2	3	4	5
4.	I feel confident about the condition of my health	1	2	3	4	5
5.	I do things that keep me from becoming unhealthy	1	2	3	4	5
6.	I'm very motivated to be healthy	1	2	3	4	5
7.	I feel like my health is something that I myself am in charge of	1	2	3	4	5
8.	My health is determined mostly by chance happenings	1	2	3	4	5
9.	I expect that my health will be excellent in the future	1	2	3	4	5
10.	I am in good health	1	2	3	4	5
11.	I notice immediately when I feel unhealthy	1	2	3	4	5
12.	I'm very concerned with how others evaluate my health	1	2	3	4	5
13.	I'm worried about my health	1	2	3	4	5
14.	I rarely become discouraged about my health	1	2	3	4	5
15.	I am motivated to keep myself from becoming unhealthy	1	2	3	4	5

16.	I'm strongly motivated to devote time and effort to my health	1	2	3	4	5
17.	My health is something I alone am responsible for	1	2	3	4	5
18.	The condition of my health is controlled by accidental happenings	1	2	3	4	5
19.	I believe that the future of my health will be positive	1	2	3	4	5
20.	My health is good	1	2	3	4	5
21.	I'm sensitive to internal cues about my health	1	2	3	4	5
22.	I'm very aware of what others think of my health	1	2	3	4	5
23.	Thinking about my health leaves me with an uneasy feeling	1	2	3	4	5
24.	I am pleased with how well and healthy I feel	1	2	3	4	5
25.	I try to avoid engaging in behaviours that undermine my health	1	2	3	4	5
26.	I have a strong desire to keep myself healthy	1	2	3	4	5
27.	My health is determined largely by what I do (and don't do)	1	2	3	4	5
28.	Being in good health is just a matter of luck	1	2	3	4	5
29.	I do expect to suffer health problems in the future	1	2	3	4	5
30.	I am a well exercised person	1	2	3	4	5
31.	I know immediately when I'm not in great health	1	2	3	4	5
32.	I'm concerned about how my health appears to others	1	2	3	4	5
33.	I usually worry about whether I am in good health	1	2	3	4	5
34.	I have positive feelings about my health	1	2	3	4	5
35.	I really want to prevent myself from being unhealthy	1	2	3	4	5
36.	It's really important to me that I keep myself in proper health	1	2	3	4	5

37.	What happens to my health is my responsibility	1	2	3	4	5
38.	Being healthy has nothing to do with luck	1	2	3	4	5
39.	I will probably experience a number of health problems in the future	1	2	3	4	5
40.	My health needs a lot of attention to be in excellent condition	1	2	3	4	5
41.	I'm very aware of changes in my health	1	2	3	4	5
42.	I'm concerned about what other people think of my health	1	2	3	4	5
43.	I feel nervous when I think about the state of my health	1	2	3	4	5
44.	I feel that I have handled my health very well	1	2	3	4	5
45.	I am really motivated to avoid being in bad health	1	2	3	4	5
46.	I strive to keep myself in the most healthy condition	1	2	3	4	5
47.	Being in good health is a matter of my own ability and effort	1	2	3	4	5
48.	I don't believe that chance or luck play a role in my health	1	2	3	4	5
49.	I anticipate that my health will deteriorate in the future	1	2	3	4	5
50.	My health is in need of attention	1	2	3	4	5

Cognitive Failures Questionnaire

INSTRUCTIONS: The following questions are about minor mistakes which everyone makes from time to time, but some of which happen more often than others. We want to know how often these things have happened to you in the last **six months.** Please circle the appropriate number for **each** item.

		very often	quite often	occas- ionally	very rarely	never
1.	Do you read something and find you haven't been thinking about it and must read it again?	4	3	2	1	0
2.	Do you forget why you went from one part of the house to the other?	4	3	2	1	0
3.	Do you fail to notice signposts on the road?	4	3	2	1	0
4.	Do you find you confuse right and left when giving directions?	4	3	2	1	0
5.	Do you bump into people?	4	3	2	1	0
6.	Do you find that you forget whether you've turned off a light or a fire or locked the door?	4	3	2	1	0
7.	Do you fail to listen to people's names when you are meeting them?	4	3	2	1	0
8.	Do you say something and realise afterwards that it might be taken as insulting?	4	3	2	1	0
9.	Do you fail to hear people speaking to you when you are doing something else?	4	3	2	1	0
10.	Do you lose your temper and regret it?	4	3	2	1	0
11.	Do you leave important letters unanswered for days?	4	3	2	1	0
12.	Do you find you forget which way to turn on a road you know well but rarely use?	4	3	2	1	0

		very often	quite often	occas-ionally	very rarely	never
13.	Do you fail to see what you want in a supermarket (although it's there)?	4	3	2	1	0
14.	Do you find yourself suddenly wondering whether you've used a word correctly?	4	3	2	1	0
15.	Do you have trouble making up your mind ?	4	3	2	1	0
16.	Do you forget appointments?	4	3	2	1	0
17.	Do you forget where you put something like a newspaper or a book?	4	3	2	1	0
18.	Do you find you accidentally throw away the thing you want and keep what you meant to throw away – as in the example of throwing away the matchbox and putting the used match in your pocket?	4	3	2	1	0
19.	Do you daydream when you ought to be listening to something?	4	3	2	1	0
20.	Do you find you forget people's names?	4	3	2	1	0
21.	Do you start doing one thing at home and get distracted into doing something else (unintentionally)?	4	3	2	1	0
22.	Do you find you can't quite remember something although it's 'on the tip of your tongue'?	4	3	2	1	0
23.	Do you find that you forget what you came to the shops to buy?	4	3	2	1	0
24.	Do you drop things?	4	3	2	1	0
25.	Do you find you can't think of anything to say?	4	3	2	1	0

Revised Middlesex Hospital Questionnaire

INSTRUCTIONS: The next few questions ask about the way you personally feel; lots of them may have no application to you at all, but we are asking all kinds of people and want the results for comparison.   Please circle the appropriate answer for **each** item.

During the past six weeks

		(0)	**(1)**	**(2)**
	Have you felt upset for no obvious reason?	Never	Sometimes	Often
1.	Have you been troubled by dizziness or shortness of breath?	Never	Sometimes	Often
2.	Have you been able to think as quickly as you used to?	Yes	Rather less quickly	Much less quickly
3.	Have you felt as though you might faint?	Never	Sometimes	Often
4.	Have you felt sick or had indigestion?	Never	Sometimes	Often
5.	Have you felt that life is too much effort?	Never	Sometimes	Often
6.	Have you felt uneasy and restless?	Never	Sometimes	Often
7.	Have you found that silly or unreasonable thoughts kept recurring in your mind?	Never	Sometimes	Often
8.	Have you felt tickling or prickling sensations in your body, arms or legs?	Never	Sometimes	Often
9.	Have you regretted much of your past?	No	Moderately	Very much
10.	Have you felt really panicky?	Never	Sometimes	Often
11.	Has your appetite been poor?	No	Moderately poor	Very poor
13.	Have you woken unusually early in the mornings?	Never	Sometimes	Often
14.	Have you felt 'strung up' inside?	Never	Sometimes	Often
15.	Have you had to check things you do to an unnecessary extent?	Never	Sometimes	Often
16.	Have you been able to get off to sleep all right?	Never not	Sometimes not	Often not

		(0)	(1)	(2)
17.	Have you had to make a special effort to face up to things (i.e. every day problems)?	Not more than anyone else	Moderately so	Very much so
18.	Have you had the feeling you are 'going to pieces'?	Never	Sometimes	Often
19.	Has it irritated you if your normal routine was disturbed?	Not at all	A little	Greatly
20.	Have you suffered from excessive sweating or fluttering of the heart?	Never	Sometimes	Often
21.	Have you experienced periods of sadness (more than half a day)?	Never	Sometimes	Often
22.	Have you had dreams which upset you when you woke up?	Never	Sometimes	Often
23.	Have you found yourself worrying about things that do not really matter?	Never	Sometimes	Often
24.	Have you felt unduly tired and exhausted?	Never	Sometimes	Often
25.	Have you been able to feel warmth and affection for other people?	Yes	Not much	Very little

In general:

26.	Do people say that you are too conscientious?	Never (0)	Sometimes (1)	Often (2)
27.	Do you think that 'cleanliness is next to godliness'?	Not at all (0)	To a degree (1)	Definitely (2)
28.	Are you a perfectionist?	No (0)	To a degree (1)	Very much so (2)

Hassles

INSTRUCTIONS: Hassles are irritants that can range from minor annoyances to fairly major pressures, problems or difficulties. They can occur a few or many times.

Listed on the following pages are a number of ways in which a person can feel hassled. Indicate by circling a 0, 1, 2 or 3 how **SEVERE** each of the hassles has been for you **in the past month.**

HASSLES   SEVERITY

0 = hassle did not occur
1 = somewhat severe
2 = moderately severe
3 = Extremely severe

1.	Misplacing or losing things	0	1	2	3
2.	Troublesome neighbours	0	1	2	3
3.	Social obligations	0	1	2	3
4.	Inconsiderate smokers	0	1	2	3
5.	Troubling thoughts about your future	0	1	2	3
6.	Thoughts about death	0	1	2	3
7.	Health of a family member	0	1	2	3
8.	Not enough money for clothing	0	1	2	3
9.	Not enough money for housing	0	1	2	3
10.	Concerns about owing money	0	1	2	3
11.	Concerns about getting credit	0	1	2	3
12.	Concerns about money emergencies	0	1	2	3
13.	Someone owes you money	0	1	2	3
14.	Financial responsibility for someone who doesn't live with you	0	1	2	3
15.	Cutting down on electricity, water, etc.	0	1	2	3
16.	Smoking too much	0	1	2	3
17.	Use of alcohol	0	1	2	3
18.	Personal use of drugs	0	1	2	3
19.	Too many responsibilities	0	1	2	3
20.	Decisions about having children	0	1	2	3
21.	Non- family members living in your home.	0	1	2	3
22.	Care for pet.	0	1	2	3

	HASSLES	SEVERITY

0 = hassle did not occur
1 = somewhat severe
2 = moderately severe
3 = Extremely severe

23.	Planning meals	0	1	2	3
24.	Concerned about the meaning of life	0	1	2	3
25.	Trouble relaxing	0	1	2	3
26	Trouble making decisions	0	1	2	3
27	Problems getting along with fellow workers	0	1	2	3
28	Customers or clients give you a hard time	0	1	2	3
29	Home maintenance (inside)	0	1	2	3
30	Concerns about job security	0	1	2	3
31.	Concerns about retirement	0	1	2	3
32.	Laid- off or out of work	0	1	2	3
33.	Don't like current work or duties	0	1	2	3
34.	Don't like fellow workers	0	1	2	3
35.	Not enough money for basic necessities	0	1	2	3
36.	Not enough money for food	0	1	2	3
37.	Too many interruptions	0	1	2	3
38.	Unexpected company	0	1	2	3
39.	Too much time on hands	0	1	2	3
40.	Having to wait	0	1	2	3
41.	Concerns about accidents	0	1	2	3
42.	Being lonely	0	1	2	3
43.	Not enough money for health care	0	1	2	3
44.	Fear of confrontation	0	1	2	3
45.	Financial security	0	1	2	3
46.	Silly practical mistakes	0	1	2	3
47.	Inability to express yourself	0	1	2	3
48.	Physical illness	0	1	2	3
49.	Side effects of medication	0	1	2	3
50.	Concerns about medical treatment	0	1	2	3
51.	Physical appearance	0	1	2	3

	HASSLES	SEVERITY			

SEVERITY
0 = hassle did not occur
1 = somewhat severe
2 = moderately severe
3 = Extremely severe

52.	Fear of rejection	0	1	2	3
53.	Difficulties with getting pregnant	0	1	2	3
54.	Sexual problems that result from physical problems	0	1	2	3
55.	Sexual problems other than those resulting from physical problems.	0	1	2	3
56.	Concerns about health in general	0	1	2	3
57.	Not seeing enough people	0	1	2	3
58.	Friends or relatives too far away	0	1	2	3
59.	Preparing meals	0	1	2	3
60.	Wasting time	0	1	2	3
61.	Auto maintenance	0	1	2	3
62.	Filling out forms	0	1	2	3
63.	Neighbourhood deterioration	0	1	2	3
64.	Financing children's education	0	1	2	3
65.	Problems with employees	0	1	2	3
66.	Problems on job due to being a woman or man	0	1	2	3
67.	Declining physical abilities	0	1	2	3
68.	Being exploited	0	1	2	3
69.	Concerns about bodily functions	0	1	2	3
70.	Rising prices of common goods	0	1	2	3
71.	Not getting enough rest	0	1	2	3
72.	Not getting enough sleep	0	1	2	3
73.	Problems with ageing parents	0	1	2	3
74.	Problems with your children	0	1	2	3
75.	Problems with persons younger than yourself	0	1	2	3
76.	Problems with your lover	0	1	2	3
77.	Difficulties seeing or hearing	0	1	2	3
78.	Overloaded with family responsibilities	0	1	2	3
79.	Too many things to do	0	1	2	3

HASSLES

SEVERITY
0 = hassle did not occur
1 = somewhat severe
2 = moderately severe
3 = Extremely severe

80.	Unchallenging work	0	1	2	3
81.	Concerns about meeting high standards	0	1	2	3
82.	Financial dealings with friends or acquaintances	0	1	2	3
83.	Job dissatisfactions	0	1	2	3
84.	Worries about decisions to change jobs	0	1	2	3
85.	Trouble with reading, writing or spelling abilities	0	1	2	3
86.	Too many meetings	0	1	2	3
87.	Problems with divorce or separation	0	1	2	3
88.	Trouble with arithmetic skills	0	1	2	3
89.	Gossip	0	1	2	3
90.	Legal problems	0	1	2	3
91.	Concerns about weight	0	1	2	3
92.	Not enough time to do the things you need to do	0	1	2	3
93.	Television	0	1	2	3
94.	Not enough personal energy	0	1	2	3
95.	Concerns about inner conflicts	0	1	2	3
96.	Feel conflicted over what to do	0	1	2	3
97.	Regrets over past decisions	0	1	2	3
98.	Menstrual (period) problems	0	1	2	3
99.	The weather	0	1	2	3
100.	Nightmares	0	1	2	3
101.	Concerns about getting ahead	0	1	2	3
102.	Hassles from boss or supervisor	0	1	2	3
103.	Difficulties with friends	0	1	2	3
104.	Not enough time for family	0	1	2	3
105.	Transportation problems	0	1	2	3
106.	Not enough money for transportation	0	1	2	3
107.	Not enough money for entertainment and recreation	0	1	2	3
108.	Shopping	0	1	2	3

		SEVERITY			
HASSLES		0 = hassle did not occur 1 = somewhat severe 2 = moderately severe 3 = Extremely severe			
109.	Prejudice and discrimination from others	0	1	2	3
110.	Property, investments or taxes	0	1	2	3
111.	Not enough time for entertainment and recreation	0	1	2	3
112.	Yardwork or outside home maintenance	0	1	2	3
113.	Concerns about news events	0	1	2	3
114.	Noise	0	1	2	3
115.	Crime	0	1	2	3
116.	Traffic	0	1	2	3
117.	Pollution	0	1	2	3

Have we missed any of your hassles ? If so write them in below:

118. _____   1   2   3

One more thing: Has there been a change in your life that has affected how you answered this scale?   If so, tell us what it was.

_____

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Perceived Stress Scale

INSTRUCTIONS: The questions in this scale ask you about your feelings and thoughts during the **last month**. In each case, please indicate by circling a number how often you felt or thought a certain way.

1.   **In the last month, how often have you been upset because of something that happened unexpectedly?**

0 = never   1 = almost never   2 = sometimes   3 = fairly often   4 = very often

2.   **In the last month, how often have you felt that you were unable to control the important things in your life?**

0 = never   1 = almost never   2 = sometimes   3 = fairly often   4 = very often

3.   **In the last month, how often have you felt nervous and 'stressed'?**

0 = never   1 = almost never   2 = sometimes   3 = fairly often   4 = very often

4.   **In the last month, how often have you dealt successfully with day to day problems and annoyances?**

0 = never   1 = almost never   2 = sometimes   3 = fairly often   4 = very often

5.   **In the last month, how often have you felt that you were effectively coping with important changes that were occurring in your life?**

0 = never   1 = almost never   2 = sometimes   3 = fairly often   4 = very often

6.   **In the last month, how often have you felt confident about your ability to handle your personal problems?**

0 = never   1 = almost never   2 = sometimes   3 = fairly often   4 = very often

7.   **In the last month, how often have you felt that things were going your way?**

0 = never   1 = almost never   2 = sometimes   3 = fairly often   4 = very often

8.   **In the last month, how often have you felt that you could not cope with all the things that you had to do?**

0 = never   1 = almost never   2 = sometimes   3 = fairly often   4 = very often

9.   **In the last month, how often have you been able to control irritations in your life?**

0 = never   1 = almost never   2 = sometimes   3 = fairly often   4 = very often

10.   In the last month, how often have you felt that you were on top of things?

0 = never   1 = almost never   2 = sometimes   3 = fairly often   4 = very often

11.   In the last month, how often have you been angered because of things that were outside your control?

0 = never   1 = almost never   2 = sometimes   3 = fairly often   4 = very often

12.   In the last month, how often have you found yourself thinking about things that you have to accomplish?

0 = never   1 = almost never   2 = sometimes   3 = fairly often   4 = very often

13.   In the last month, how often have you been able to control the way you spend your time?

0 = never   1 = almost never   2 = sometimes   3 = fairly often   4 = very often

14.   In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?

0 = never   1 = almost never   2 = sometimes   3 = fairly often   4 = very often

General Health Questionnaire

The following questions are about how you have been feeling **in the last few months**. Please try to answer **ALL** the questions.

Have you recently:		1	2	3	4
a)	Been able to concentrate on whatever you're doing?	☐Better than usual	☐Same as usual	☐Less than usual	☐Much less than usual
b)	Lost much sleep over worry?	☐Not at all	☐Same as usual	☐Rather more than usual	☐Much more than usual
c)	Felt that you are playing a useful part in things?	☐More so than usual	☐Same as usual	☐Rather more than usual	☐Much more than usual
d)	Felt capable of making decisions about things?	☐More so than usual	☐Same as usual	☐Less useful than usual	☐Much less useful
e)	Felt constantly under strain?	☐Not at all	☐No more than usual	☐Rather more than usual	☐Much more than usual
f)	Felt you couldn't overcome your difficulties?	☐Not at all	☐No more than usual	☐Rather more than usual	☐Much more than usual
g)	Been able to enjoy your normal day-to-day activities?	☐More so than usual	☐Same as usual	☐Less so than usual	☐Much less than usual
h)	Been able to face up to your problems?	☐More so than usual	☐Same as usual	☐Less able than usual	☐Much less able
i)	Been feeling unhappy and depressed?	☐Not at all	☐No more than usual	☐Rather more than usual	☐Much more than usual
j)	Been losing confidence in yourself?	☐Not at all	☐No more than usual	☐Rather more than usual	☐Much more than usual
k)	Been thinking of yourself as a worthless person?	☐Not at all	☐No more than usual	☐Rather more than usual	☐Much more than usual
l)	Been feeling reasonably happy, all things considered?	☐More so than usual	☐Same as usual	☐Less so than usual	☐Much less than usual

Cohen-Hoberman Index of Physical Symptoms

INSTRUCTIONS: Using this scale, we'd like to ask you about some physical symptoms that people often experience. For each symptom we would like you to indicate how much that problem has bothered or distressed you **in the last 24 hours**. For each, we'd like you to answer by circling 'not at all', 'a little bit', 'moderately', 'quite a bit' or 'extremely'.

In the past 24 hours how often were you bothered by:

1.   Dizziness

0 = not at all   1 = a little bit   2 = moderately   3 = quite a bit   4 = extremely

2.   Faintness

0 = not at all   1 = a little bit   2 = moderately   3 = quite a bit   4 = extremely

3.   Constant fatigue

0 = not at all   1 = a little bit   2 = moderately   3 = quite a bit   4 = extremely

4.   Nausea and/or vomiting

0 = not at all   1 = a little bit   2 = moderately   3 = quite a bit   4 = extremely

5.   Stomach pains (e.g. cramps)

0 = not at all   1 = a little bit   2 = moderately   3 = quite a bit   4 = extremely

6.   Hot or cold spells

0 = not at all   1 = a little bit   2 = moderately   3 = quite a bit   4 = extremely

7.   Poor appetite

0 = not at all   1 = a little bit   2 = moderately   3 = quite a bit   4 = extremely

8.   Felt weak all over

0 = not at all   1 = a little bit   2 = moderately   3 = quite a bit   4 = extremely

9.   Feeling low in energy

0 = not at all   1 = a little bit   2 = moderately   3 = quite a bit   4 = extremely

10.   Muscle tension or soreness

0 = not at all   1 = a little bit   2 = moderately   3 = quite a bit   4 = extremely

11.   Muscle cramps

0 = not at all   1 = a little bit   2 = moderately   3 = quite a bit   4 = extremely

12.   Severe aches and pains

0 = not at all   1 = a little bit   2 = moderately   3 = quite a bit   4 = extremely

State-Trait Anxiety Inventory - State

INSTRUCTIONS: A number of statements which people have used to describe themselves are given below. Read each statement carefully and then circle the appropriate number to the right of the statement to indicate **how you feel right now**, that is at this moment. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

1 = Not at all
2 = Somewhat
3 = Moderately so
4 = Very much so

1.	I feel calm.				
		1	2	3	4
2.	I feel secure.				
		1	2	3	4
3.	I am tense.				
		1	2	3	4
4.	I am regretful.				
		1	2	3	4
5.	I feel at ease.				
		1	2	3	4
6.	I feel upset.				
		1	2	3	4
7.	I am worrying over possible misfortunes.	1	2	3	4
8.	I feel rested.				
		1	2	3	4
9.	I feel anxious.				
		1	2	3	4
10.	I feel comfortable.				
		1	2	3	4
11.	I feel self-confident.				
		1	2	3	4
12.	I feel nervous.				
		1	2	3	4
13.	I am jittery.				
		1	2	3	4
14.	I feel "highly strung".				
		1	2	3	4
15.	I am relaxed.				
		1	2	3	4
16.	I feel content.				
		1	2	3	4
17.	I am worried.				
		1	2	3	4
18.	I feel over-excited and "rattled".				
		1	2	3	4

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19. I feel joyful.

1 2 3 4

20. I feel pleasant.

1 2 3 4

State-Trait Anxiety Inventory - Trait

A number of statements which people have used to describe themselves are given below. There are no right or wrong answers. Do not spend too much time on any one statement. Give the answer which seems to describe how you <u>generally</u> feel. Do not give two answers to the same question, choose one or the other. Make sure you answer all the questions.

		1	2	3	4
		Almost never	Some times	Often	Almost always
1	I feel pleasant				
2	I tire quickly				
3	I feel like crying				
4	I wish I could be as happy as others seem to be				
5	I am losing out on things because I can't make up my mind soon enough				
6	I feel rested				
7	I am "cool, calm and collected"				
8	I feel that difficulties are piling up so that I cannot overcome them				
9	I worry too much over something that really doesn't matter				
10	I am happy				
11	I am inclined to take things hard				
12	I lack self-confidence				
13	I feel secure				
14	I try to avoid facing a crisis or difficulty				
15	I feel blue				
16	I am content				
17	Some unimportant thought runs through my mind and bothers me				
18	I take disappointments so keenly that I can't put them out of my mind				
19	I am a steady person				
20	I get in a state of tension or turmoil as I think over my recent concerns and interests				

Eynseck Personality Inventory – Introversion

A number of questions regarding the way you behave are given below. There are no right or wrong answers. Do not spend too much time on any one statement. Give the answer which seems to describe how you usually feel or behave. Do not give two answers to the same question, choose one or the other. Make sure you answer all the questions.

		1	0
		Yes	No
1	Do you often long for excitement ?		
2	Are you usually carefree ?		
3	Do you stop and think over things before doing anything ?		
4	Do you generally do and say things quickly without stopping to think ?		
5	Would you do almost anything for a dare ?		
6	Do you often do things on the spur of the moment ?		
7	Generally , do you prefer reading to meeting people ?		
8	Do you like going out a lot ?		
9	Do you prefer to have few but special friends ?		
10	When people shout at you, do you shout back ?		
11	Can you usually let yourself go and enjoy yourself a lot at a lively party ?		
12	Do other people think of you as being very lively ?		
13	Are you mostly quiet when you are with other people ?		
14	If there is something you want to know about, would you rather look it up in a book than talk to someone about it ?		
15	Do you like the kind of work that you need to pay close attention to ?		
16	Do you hate being with a crowd who play jokes on one another ?		
17	Do you like doing things in which you have to act quickly ?		
18	Are you slow and unhurried in the way you move ?		
19	Do you like talking to people so much that you never miss a chance of talking to a stranger ?		
20	Would you be very unhappy if you could not see lots of people most of the time ?		
21	Would you say that you were fairly self-confident ?		
22	Do you find it hard to really enjoy yourself at a lively party ?		
23	Can you easily get some life into a rather dull party ?		
24	Do you like playing pranks on others ?		

Positive and Negative Mood States (chapters 2,4&5)

INSTRUCTIONS: Below are a list of words that describes feelings people have. We would like to know to what degree each word **describes how you have been feeling during the past week.** Please circle the number which you feel most applies to you for **each** item.

1.   **How attentive have you felt this week?**
     0= Not at all   1= A little   2= Moderately   3= Quite a bit   4= Extremely

2.   **How distressed have you felt this week?**
     0= Not at all   1= A little   2= Moderately   3= Quite a bit   4= Extremely

3.   **How proud?**
     0= Not at all   1= A little   2= Moderately   3= Quite a bit   4= Extremely

4.   **How nervous?**
     0= Not at all   1= A little   2= Moderately   3= Quite a bit   4= Extremely

5.   **How sad have you felt this week?**
     0= Not at all   1= A little   2= Moderately   3= Quite a bit   4= Extremely

6.   **How active?**
     0= Not at all   1= A little   2= Moderately   3= Quite a bit   4= Extremely

7.   **How friendly?**
     0= Not at all   1= A little   2= Moderately   3= Quite a bit   4= Extremely

8.   **How angry have you felt this week?**
     0= Not at all   1= A little   2= Moderately   3= Quite a bit   4= Extremely

9.   **How dissatisfied with yourself?**
     0= Not at all   1= A little   2= Moderately   3= Quite a bit   4= Extremely

10. **How tired?**
     0= Not at all   1= A little   2= Moderately   3= Quite a bit   4= Extremely

11. **How healthy have you felt this week:**
     0= Not at all   1= A little   2= Moderately   3= Quite a bit   4= Extremely

12. **How calm?**
     0= Not at all   1= A little   2= Moderately   3= Quite a bit   4= Extremely

13. **How guilty have you felt this week?**
     0= Not at all   1= A little   2= Moderately   3= Quite a bit   4= Extremely

14. **How scared have you felt this week?**
     0= Not at all   1= A little   2= Moderately   3= Quite a bit   4= Extremely

15. **How happy?**
0= Not at all   1= A little   2= Moderately   3= Quite a bit   4= Extremely

16. **How emotionally strong have you felt this week?**
0= Not at all   1= A little   2= Moderately   3= Quite a bit   4= Extremely

17. **How confident have you felt this week?**
0= Not at all   1= A little   2= Moderately   3= Quite a bit   4= Extremely

18. **How angry at yourself?**
0= Not at all   1= A little   2= Moderately   3= Quite a bit   4= Extremely

19. **How upset?**
0= Not at all   1= A little   2= Moderately   3= Quite a bit   4= Extremely

20. **How alert have you felt this week?**
0= Not at all   1= A little   2= Moderately   3= Quite a bit   4= Extremely

21. **How irritated?**
0= Not at all   1= A little   2= Moderately   3= Quite a bit   4= Extremely

22. **How depressed?**
0= Not at all   1= A little   2= Moderately   3= Quite a bit   4= Extremely

23. **How enthusiastic have you felt this week?**
0= Not at all   1= A little   2= Moderately   3= Quite a bit   4= Extremely

24. **How sleepy?**
0= Not at all   1= A little   2= Moderately   3= Quite a bit   4= Extremely

25. **How warmhearted have you felt this week?**
0= Not at all   1= A little   2= Moderately   3= Quite a bit   4= Extremely

26. **How excited have you felt this week?**
0= Not at all   1= A little   2= Moderately   3= Quite a bit   4= Extremely

27. **How hostile?**
0= Not at all   1= A little   2= Moderately   3= Quite a bit   4= Extremely

28. **How shaky?**
0= Not at all   1= A little   2= Moderately   3= Quite a bit   4= Extremely

29. **How determined have you felt this week?**
0= Not at all   1= A little   2= Moderately   3= Quite a bit   4= Extremely

30. **How content?**
0= Not at all   1= A little   2= Moderately   3= Quite a bit   4= Extremely

Hospital Anxiety and Depression Scale (chapters 2,3,4&5)

INSTRUCTIONS: In this section, we'd like to find out about how you have been feeling lately. The questions are about your general well-being and feelings of stress.

Please read each item and then tick the box next to the reply which comes closest to how you have been feeling **in the past week**. Try to give your first reaction. This will probably be more accurate than spending a long time thinking about an answer.

Please answer all questions, and tick only **ONE BOX** per question.

a) I feel tense or wound up
Most of the time ☐(1)
A lot of the time ☐(2)
From time to time, occasionally ☐(3)
Not at all ☐(4)

b) I feel as if I am slowed down
Nearly all the time ☐(1)
Very often ☐(2)
Sometimes ☐(3)
Not at all ☐(4)

c) I still enjoy the things I used to enjoy
Definitely as much ☐(1)
Not quite so much ☐(2)
Only a little ☐(3)
Hardly at all ☐(4)

d) I get a sort of frightened feeling like "butterflies" in the stomach
Not at all ☐(1)
Occasionally ☐(2)
Quite often ☐(3)
Very often ☐(4)

e) I get a sort of frightened feeling as if something awful is about to happen
Very definitely and quite badly ☐(1)
Yes, but not too badly ☐(2)
A little, but it doesn't worry me ☐(3)
Not at all ☐(4)

f) I have lost interest in my appearance
Definitely ☐(1)
I don't take as much care as I should ☐(2)
I may not take quite as much care ☐(3)
I take just as much care as ever ☐(4)

g) I can laugh and see the funny side of things
As much as I always could ☐(1)
Not quite so much now ☐(2)
Definitely not so much now ☐(3)
Not at all ☐(4)

h) I feel restless as if I have to be on the move
Very much indeed ☐(1)
Quite a lot ☐(2)
Not very much ☐(3)
Not at all ☐(4)

i) Worrying thoughts go through my head
A great deal of the time ☐(1)
A lot of the time ☐(2)
From time to time but not too often ☐(3)
Only occasionally ☐(4)

j) I look forward with enjoyment to things
As much as I ever did ☐(1)
Rather less than I used to ☐(2)
Definitely less than I used to ☐(3)
Hardly at all ☐(4)

k) I feel cheerful

Not at all ☐(1)
Not often ☐(2)
Sometimes ☐(3)
Most of the time ☐(4)

l) I get sudden feelings of panic

Very often indeed ☐(1)
Quite often ☐(2)
Not very often ☐(3)
Not at all ☐(4)

m) I can sit at ease and feel relaxed

Definitely ☐(1)
Usually ☐(2)
Not often ☐(3)
Not at all ☐(4)

n) I can enjoy a good book or radio or TV programme

Often ☐(1)
Sometimes ☐(2)
Not often ☐(3)
Very seldom ☐(4)

Profile of Fatigue Related Symptoms (chapters 2,4&5)

INSTRUCTIONS: Below is a list of problems which may or may not apply to you. For each problem, please say to what extent you have experienced this during the **PAST WEEK, including today.** Do not think for too long before answering but give your immediate reaction. Remember, we are talking about the **past week and not in general.** Give your answer by circling any number from 1 to 7 to the right of the item, where:

1 = **not at all**
4 = **moderately**
7 = **extremely**

Please be careful not to miss out any of the items

1.	Feeling physically tired even when taking things easy	1	2	3	4	5	6	7
2.	Your limbs feeling heavy	1	2	3	4	5	6	7
3.	Getting easily upset by things	1	2	3	4	5	6	7
4.	Difficulty concentrating	1	2	3	4	5	6	7
5.	Stomach pain	1	2	3	4	5	6	7
6.	Not having the physical energy to do anything	1	2	3	4	5	6	7
7.	Difficulty standing for long	1	2	3	4	5	6	7
8.	Losing your temper easily	1	2	3	4	5	6	7
9.	Difficulty remembering things	1	2	3	4	5	6	7
10.	Muscles feel weak even after resting	1	2	3	4	5	6	7
11.	Feeling depressed	1	2	3	4	5	6	7
12.	Muscles tender to the touch	1	2	3	4	5	6	7
13.	Slowness of thought	1	2	3	4	5	6	7
14.	Tremor or twitching	1	2	3	4	5	6	7
15.	The slightest exercise making you physically tired	1	2	3	4	5	6	7
16.	Being irritable	1	2	3	4	5	6	7
17.	Difficulty reasoning things out	1	2	3	4	5	6	7

		1	2	3	4	5	6	7
18.	Burning, tingling or crawling sensations	1	2	3	4	5	6	7
19.	Numbness in some part of your body	1	2	3	4	5	6	7
20.	Back pain	1	2	3	4	5	6	7
21.	Feeling anxious	1	2	3	4	5	6	7
22.	A feeling of confusion ('mental fog')	1	2	3	4	5	6	7
23.	Bouts of sweating (day or night)	1	2	3	4	5	6	7
24.	Feeling physically drained	1	2	3	4	5	6	7
25.	Dizziness or giddiness	1	2	3	4	5	6	7
26.	Absent-mindedness	1	2	3	4	5	6	7
27.	Worrying about things that do not matter	1	2	3	4	5	6	7
28.	Feeling physically tired even after a good night's sleep	1	2	3	4	5	6	7
29.	Difficulty understanding; e.g. what someone was saying to you	1	2	3	4	5	6	7
30.	Feeling pessimistic about the future	1	2	3	4	5	6	7
31.	Cold hands or feet	1	2	3	4	5	6	7
32.	Having to stop doing something, that was easy in itself, because it made you tired	1	2	3	4	5	6	7
33.	Muscles feeling weak after slight exercise	1	2	3	4	5	6	7
34.	Difficulty following things; e.g. a simple plot on TV	1	2	3	4	5	6	7
35.	Hot or cold spells	1	2	3	4	5	6	7
36.	Feeling tense	1	2	3	4	5	6	7
37.	Feeling faint	1	2	3	4	5	6	7
38.	Difficulty finding the right word	1	2	3	4	5	6	7
39.	Feeling chilled or shivery	1	2	3	4	5	6	7
40.	Tearfulness	1	2	3	4	5	6	7

		1	2	3	4	5	6	7
41.	Irregular or rapid heartbeats	1	2	3	4	5	6	7
42.	Feeling worthless	1	2	3	4	5	6	7
43.	Forgetting what you were trying to say	1	2	3	4	5	6	7
44.	Being easily angered when things went wrong	1	2	3	4	5	6	7
45.	Feeling mentally tired even after a good night's sleep	1	2	3	4	5	6	7
46.	Diarrhoea or constipation	1	2	3	4	5	6	7
47.	Feeling nervous	1	2	3	4	5	6	7
48.	Feeling sad	1	2	3	4	5	6	7
49.	The slightest effort making you mentally tired	1	2	3	4	5	6	7
50.	Feeling like you had a temperature	1	2	3	4	5	6	7
51.	Other people annoying you	1	2	3	4	5	6	7
52.	A sore throat	1	2	3	4	5	6	7
53.	Feelings of resentment	1	2	3	4	5	6	7
54.	Being slow to react	1	2	3	4	5	6	7

SYMPTOM CHECK LIST (chapters 2,3,4&5)

INSTRUCTIONS: Please tick the boxes which describe any symptoms you are currently experiencing.

Tick here

1	Physical weakness	
2	Excessive fatigue	
3	Legs feeling heavy	
4	Muscle pain in back, arms or legs	
5	Pain in chest	
6	Painful joints	
7	Nausea	
8	Indigestion	
9	Bloated stomach	
10	Wind	
11	Sore throat	
12	Headache	
13	Earache	
14	Sore eyes	
15	Sensitive to noise	
16	Sensitive to light	
17	Feeling hot/cold	
18	Sweating	
19	Shivering	
20	Swollen glands	
21	Racing heart	
22	Insomnia	
23	Depression	
24	Anxiety/Panic feelings	
25	Loss of concentration	
26	Loss of memory	
27	Allergies	
28	Other (please specify):	

What medications are you taking at the moment?

Prescribed drugs: _____

Multivitamins etc.: _____

Eysenck Personality Inventory – Neuroticism (chapters 2&3)

INSTRUCTIONS: The following questions regard the way you usually feel or act. Please tick either yes or no. Work quickly and please answer all questions.

	YES (1)	NO (0)
1. Do you often need understanding friends to cheer you up?	☐	☐
2. Do you find it very hard to take no for an answer?	☐	☐
3. Does your mood go up and down?	☐	☐
4. Do you ever feel just miserable for no good reason?	☐	☐
5. Do you feel suddenly shy when you want to talk to an attractive stranger?	☐	☐
6. Do you often worry about things you should not have done or said?	☐	☐
7. Are your feelings rather easily hurt?	☐	☐
8. Are you sometimes bubbling over with energy and sometimes sluggish?	☐	☐
9. Do you daydream a lot?	☐	☐
10. Are you troubled about feelings of guilt?	☐	☐
11. Would you call yourself 'tense' or 'highly-strung'?	☐	☐
12. After you have done something important, do you often come away feeling you could have done better?	☐	☐
13. Do ideas run through your head so that you cannot sleep?	☐	☐
14. Do you get palpitations or thumping in your heart?	☐	☐
15. Do you get attacks of shaking and trembling?	☐	☐
16. Are you an irritable person?	☐	☐
17. Do you worry about awful things that might happen?	☐	☐
18. Do you have many nightmares?	☐	☐

	YES (1)	NO (0)
19. Are you troubled by aches and pains?	☐	☐
20. Would you call yourself a nervous person?	☐	☐
21. Are you easily hurt when people find fault with your work?	☐	☐
22. Are you troubled with feelings of inferiority?	☐	☐
23. Do you worry about your health?	☐	☐
24. Do you suffer from sleeplessness?	☐	☐

Bowel problems (Chapters 4&5)

Using this scale, we'd like to ask you about some physical symptoms that people often experience. For each symptom we would like you to indicate how much that problem has bothered or distressed you during the past seven days, including today. For each, we'd like you to answer by circling:
'not at all', 'a little bit', 'moderately', 'quite a bit' or 'extremely'.

In the past <u>seven days</u> how often were you bothered by :

1. **Constipation**

0 = not at all	2 = moderately	4 = extremely
1 = a little bit	3 = quite a bit	

2. **Diarrhoea**

0 = not at all	2 = moderately	4 = extremely
1 = a little bit	3 = quite a bit	

3. **Indigestion**

0 = not at all	2 = moderately	4 = extremely
1 = a little bit	3 = quite a bit	

4. **Nausea and/or vomiting**

0 = not at all	2 = moderately	4 = extremely
1 = a little bit	3 = quite a bit	

5. **Stomach pains (e.g. cramps)**

0 = not at all	2 = moderately	4 = extremely
1 = a little bit	3 = quite a bit	

6. **Wind**

0 = not at all	2 = moderately	4 = extremely
1 = a little bit	3 = quite a bit	

7. **Poor appetite**

   0 = not at all   2 = moderately   4 = extremely

   1 = a little bit   3 = quite a bit

8. **Weight loss/feeling slimmer**

   0 = not at all   2 = moderately   4 = extremely

   1 = a little bit   3 = quite a bit

9. **Pain in Bowels**

   0 = not at all   2 = moderately   4 = extremely

   1 = a little bit   3 = quite a bit

10. **Incomplete evacualtion of bowels**

   0 = not at all   2 = moderately   4 = extremely

   1 = a little bit   3 = quite a bit

11. **Bloatedness**

   0 = not at all   2 = moderately   4 = extremely

   1 = a little bit   3 = quite a bit

Demographics

Age: .... **yrs**

Sex: 0   1
          M   **F**

Current Status: (Please tick one box only)

Single	0	**Separated**	3
Living with partner	1	**Divorced**	4
Married	2	**Widowed**	5

Education Completed: (Please tick one box only)

None	0	**City & Guilds/national diploma**	3
GCSE/ 'O' Level	1	**BA/BSc**	4
AS Level/SCE Higher/Matriculation	2	**Higher degree/professional qualification**	5

How would you describe yourself?

White	0	Black Caribbean	1
Black African	2	Black neither Caribbean or African	3
Indian	4	Pakistani	5
Bangladeshi	6	Chinese	7
		None of these (Please specify)	8

_____

What is the total current yearly amount you receive from your wage, pension, benefit allowance or annual salary (before tax is deducted)? Please indicate one category.

less than £2,500	0	£2,500-£4,999	1	£5,000-£9,999	2
£10,000-£15,999	3	£16,000-£19,999	4	£20,000-£24,999	5
£25,000-£29,999	6	£30,000-39,999	7	£40,000-49,999	8
£50,000 or more	9				

Health Related Behaviours

Do you smoke cigarettes now (i.e. NOT cigars/pipe)?

     Yes   1   No   0

How many cigarettes do you smoke per day?

Manufactured   Handrolled

_____   _____

**On average how often do you drink during the week, that is weekdays.
Please tick ONE BOX only.**

    Never   1 - 2 Days   3 Days   4 Days

     0   1   2   3

How many units do you drink during an average week? _____ units
(1 unit = half a pint of beer/glass of wine/1 measure of spirits)

On average how often do you drink at the weekends. Please tick ONE BOX only.

    Never   1 - 2 Days   All 3 Days

     0   1   2

How many units do you drink on an average weekend? _____ units

SNACKING QUESTIONNAIRE

This questionnaire sets out to discover attitudes to snacks and snacking amongst the general population as well as individual snacking habits and preferences for different snack foods.

How often do you eat breakfast ?

Every day	Most days (3-6)	Once or twice a week	Less than once a week	Never
$\square_4$	$\square_3$	$\square_2$	$\square_1$	$\square_0$

What do you normally eat for breakfast (please tick ONE box)?

Nothing	$\square_0$	Fruit	$\square_4$
Toast	$\square_1$	Cooked Breakfast	$\square_5$
Cereal	$\square_2$	Combination	$\square_6$
Muesli/Porridge	$\square_3$	Other	$\square_7$

What do you usually eat for lunch (please tick ONE box)?

Nothing	$\square_0$	Sandwich + crisps/ fruit/ yoghurt	$\square_3$
Fruit/yoghurt/cereal	$\square_1$	Cooked Lunch	$\square_4$
Sandwich	$\square_2$	Other	$\square_5$

What do you usually eat for your evening meal (please tick ONE box)?

Nothing	$\square_0$	Heavy Cooked	$\square_4$
Fruit	$\square_1$	Heavy cooked + dessert	$\square_5$
Light Cooked	$\square_2$	Combination	$\square_6$
Light Cooked + dessert	$\square_3$	Other	$\square_7$

How often do you have a snack or something to eat between meals or before going to bed?

Every day	Most days (3-6)	Once or twice a week	Less than once a week	Never
$\square_4$	$\square_3$	$\square_2$	$\square_1$	$\square_0$

How many meals did you eat yesterday? ....

How many times did you have snack yesterday? ....

Which of the following definitions do you think best describes a snack?

	Tick one box
Food or drink eaten on the move	$\square_1$
Food or drink eaten between main meals	$\square_2$
Small quantities of food (5 mouthfuls or less)	$\square_3$
Food eaten more than once a day	$\square_4$
Food that is quick to eat	$\square_5$
Food that is easy to eat	$\square_6$
Food that doesn't fill you up	$\square_7$
Food or drink eaten after the evening meal	$\square_8$
Food accompanying a hot drink	$\square_9$

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Which of the following foods have you eaten in the last week <u>as a snack</u>?

	Twice or more a day	Once a day	5-6 times a week	3-4 times a week	Twice a week	Once a week	Not at all
Fresh fruit	$\square_1$	$\square_2$	$\square_3$	$\square_4$	$\square_5$	$\square_6$	$\square_7$
Crisps	$\square_1$	$\square_2$	$\square_3$	$\square_4$	$\square_5$	$\square_6$	$\square_7$
Chocolate confectionary	$\square_1$	$\square_2$	$\square_3$	$\square_4$	$\square_5$	$\square_6$	$\square_7$
Yoghurt	$\square_1$	$\square_2$	$\square_3$	$\square_4$	$\square_5$	$\square_6$	$\square_7$
Dried fruit	$\square_1$	$\square_2$	$\square_3$	$\square_4$	$\square_5$	$\square_6$	$\square_7$
Cereal bar	$\square_1$	$\square_2$	$\square_3$	$\square_4$	$\square_5$	$\square_6$	$\square_7$
Biscuits	$\square_1$	$\square_2$	$\square_3$	$\square_4$	$\square_5$	$\square_6$	$\square_7$
Breakfast cereal	$\square_1$	$\square_2$	$\square_3$	$\square_4$	$\square_5$	$\square_6$	$\square_7$
Nuts	$\square_1$	$\square_2$	$\square_3$	$\square_4$	$\square_5$	$\square_6$	$\square_7$
Cake / cake bars	$\square_1$	$\square_2$	$\square_3$	$\square_4$	$\square_5$	$\square_6$	$\square_7$
Toast / bread with spread	$\square_1$	$\square_2$	$\square_3$	$\square_4$	$\square_5$	$\square_6$	$\square_7$

Please indicate using the following scale how much you agree/disagree with the statements listed below.

1 – Strongly agree;   2 – Agree;   3 – Neither agree or disagree;

4 – Disagree;   5 – Strongly disagree.

A grazing (snacking) pattern of eating is less healthy than eating three meals a day.........

Snack foods are generally less healthy foods.   ....

Increased snacking by the population in general is a major contributor to the current increase in obesity in the UK.   ....

I avoid eating snack foods because I think they are unhealthy.   ....

I depend a lot on snack foods because I have a busy lifestyle and don't have time to prepare meals.   ....

Some snack foods are healthy but these are not tasty.   ....

Over the past 12 months, how would you say your health in general has been?

Very good	Good	Fair	Bad	Very bad
0	1	2	3	4

In general, how do you find your job?

Not at all stressful	Mildly stressful	Moderately stressful	Very stressful	Extremely stressful
0	1	2	3	4

How do you find life in general? Please tick one box only.

Not at all stressful	Mildly stressful	Moderately stressful	Very stressful	Extremely stressful
0	1	2	3	4

Have you ever been told by the doctor that you have, or have had any of the following? Please tick Yes or No for EACH of the categories in the following list.

	Yes	No
Angina	1	0
High cholesterol level	1	0
Diabetes	1	0
Stroke	1	0
Heart attack (coronary thrombosis, myocardial infarction)	1	0
High blood pressure	1	0
Nervous trouble or depression	1	0
Asthma	1	0
Emphysema	1	0
Bronchitis	1	0
Breast cancer	1	0
Other cancer	1	0

There are some kinds of health problems that keep recurring and some that people have all the time. In the last 12 months have you suffered from any of the following health problems?

Please tick Yes or No for EACH of the categories in the following list.

	Yes	No
Bronchitis	1	0
Arthritis or rheumatism	1	0
Sciatica, lumbago or recurring backache	1	0
Persistent skin trouble (e.g. eczema)	1	0
Asthma	1	0
Hay fever	1	0
Recurring stomach trouble or indigestion	1	0
Being constipated all or most of the time	1	0
Piles	1	0
Persistent foot trouble (e.g. bunions, in-growing toenails)	1	0
Trouble with varicose veins	1	0
Nervous trouble or persistent depression	1	0
Persistent trouble with your gums or mouth	1	0
Any other recurring health problem *Please specify*⬇	1	0

Have you had any of the following symptoms in the last 14 days?
Please tick Yes or No for EACH of the categories in the following list.

	Yes	No
A cough, catarrh or phlegm	1	0
Diarrhoea	1	0
Heartburn, wind or indigestion	1	0
Shortness of breath	1	0
Dizziness or giddiness	1	0
Earache or discomfort in the ears	1	0
Swollen ankles	1	0
Nervy, tense or depressed	1	0
A cold or flu	1	0
A sore throat	1	0
Difficulty sleeping	1	0
Pains in the chest	1	0
Backache or pains in the back	1	0
Nausea or vomiting	1	0
Feeling tired for no apparent reason	1	0
Rashes, itches or other skin trouble	1	0
Blocked or runny nose	1	0
Headache	1	0
Wheeziness	1	0
Toothache or trouble with gums	1	0
Any other complaints in the last 14 days?	1	0

Thinking about the last 12 months, have you had any accidents WHILE YOU WERE WORKING that required medical attention from someone else (e.g. a first aider, GP, nurse or hospital doctor)?

None	1	2	3	4	5	6	More than 6
0	1	2	3	4	5	6	7 Please specify

How many accidents requiring medical attention have you had OUTSIDE work in the last 12 months?

None	1	2	3	4	5	6	More than 6
0	1	2	3	4	5	6	7 Please specify

In the last 12 months how frequently have you had minor injuries (e.g. cuts and bruises) that did not require medical attention?

a)   at work

Not at all	Rarely	Occasionally	Quite frequently	Very frequently
0	1	2	3	4

b)   outside of work

Not at all	Rarely	Occasionally	Quite frequently	Very frequently
0	1	2	3	4

How frequently do you find that you have problems of memory (e.g. forgetting where you put things), attention (e.g. failures of concentration), or action (e.g. doing the wrong thing)?

a)   at work

Not at all	Rarely	Occasionally	Quite frequently	Very frequently
0	1	2	3	4

b)   outside of work

Not at all	Rarely	Occasionally	Quite frequently	Very frequently
0	1	2	3	4

Job demand, control support and Effort Reward Imbalance.

(Used to calculate total negative job characteristics)

Now we would like to ask you about where you work. For each question please tick ONE answer that best describes your work.

		Often	Some-times	Seldom	Never/ almost never
a)	Do you work at night?	0	1	2	3
b)	Do you do shift work?	0	1	2	3
c)	Do you have to work long or unsociable hours?	0	1	2	3
d)	Do you have to be "on call" for work?	0	1	2	3
e)	Do you have unpredictable working hours?	0	1	2	3
f)	Does your job ever expose you to breathing fumes, dusts or other potentially harmful substances?	0	1	2	3
g)	Does your job ever require you to handle or touch potentially harmful substances or materials?	0	1	2	3
h)	Do you ever have work tasks that leave you with a ringing in your ears or a temporary feeling of deafness?	0	1	2	3
i)	Do you work in an environment where the level of background noise disturbs your concentration?	0	1	2	3

Now we'd like to ask you about your work and the sorts of things you have to do. For each question please tick the answer that best describes your job or the way you deal with problems at work.

		Often	Some-times	Seldom	Never/ almost never	Not appli-cable
a)	Do you have to work very fast?	0	1	2	3	4
b)	Do you have to work very intensively?	0	1	2	3	4
c)	Do you have enough time to do everything?	0	1	2	3	4
d)	Are your tasks such that others can help you if you do not have enough time?	0	1	2	3	4
e)	Do you have the possibility of learning new things through your work?	0	1	2	3	4
f)	Does your work demand a high level of skill or expertise?	0	1	2	3	4
g)	Does your job require you to take the initiative?	0	1	2	3	4
h)	Do you have to do the same thing over and over again?	0	1	2	3	4
i)	Do you have a choice in deciding HOW you do your work?	0	1	2	3	4
j)	Do you have a choice in deciding WHAT you do at work?	0	1	2	3	4

This section is about your position at work - how often do the following statements apply? Please tick ONE box only.

		Often	Some-times	Seldom	Never/ almost never	Not appli-cable
a)	Others take decisions concerning my work.	0	1	2	3	4
b)	I have a great deal of say in decisions about work.	0	1	2	3	4
c)	I have a say in my work speed.	0	1	2	3	4
d)	My working time can be flexible.	0	1	2	3	4
e)	I can decide when to take a break.	0	1	2	3	4
f)	I can take my holidays more or less when I wish.	0	1	2	3	4
g)	I have a say in choosing who I work with.	0	1	2	3	4
h)	I have a great deal of say in planning my work environment.	0	1	2	3	4

This section is about consistency and clarity at work - how often do the following statements apply? Please tick ONE box only.

		Often	Some-times	Seldom	Never/ almost never	Not appli-cable
a)	Do different groups at work demand things from you that you think are hard to combine?	0	1	2	3	4
b)	Do you get sufficient information from line management (your superiors)?	0	1	2	3	4
c)	Do you get consistent information from line management (your superiors)?	0	1	2	3	4

These questions are about your job involvement. Please tick ONE box only.

		Often	Some-times	Seldom	Never/ almost never	Not appli-cable
a)	Does your job provide you with a variety of interesting things to do?	0	1	2	3	4
b)	Is your job boring?	0	1	2	3	4

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Now we would like to ask you about when you are having difficulties at work. Please tick ONE box only.

		Often	Some-times	Seldom	Never/ almost never	Not appli-cable
a)	How often do you get help and support from your colleagues?	0	1	2	3	4
b)	How often are your colleagues willing to listen to your work related problems?	0	1	2	3	4
c)	How often do you get help and support from your immediate superior?	0	1	2	3	4
d)	How often is your immediate superior willing to listen to your problems?	0	1	2	3	4

Do you agree or disagree with the following statements about your work?

		Agree	Some-what agree	Some-what disagree	Disagree
a)	If a task has to be done well I'd better take care of it myself.	0	1	2	3
b)	I can get very upset when someone hinders me in my duties.	0	1	2	3
c)	As soon as I get up in the morning, I start thinking about work problems.	0	1	2	3
d)	When I come home, I can easily relax and 'switch off' from work.	0	1	2	3
e)	People close to me say I sacrifice too much for my job.	0	1	2	3
f)	For me, family or private life comes first, then work.	0	1	2	3
g)	Work rarely lets me go, it is still on my mind when I go to bed.	0	1	2	3
h)	Every once in a while I like it when others hold me back from working.	0	1	2	3
i)	If I postpone something that I was supposed to do today, I will have trouble sleeping at night.	0	1	2	3

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In these next questions we would like to know whether or not you agree with some statements about your work. If you DON'T agree with a statement tick the box marked No, as in this example. Then move on to the next statement.

If you <u>agree</u>, to what extent are you distressed by it?

EXAMPLE : Don't agree

				Not at all	Some- what	Rather	Very dis- tressed
a)	I have constant time pressure due to a heavy workload.	No ✔	Yes				

If you DO agree with a statement tick the box marked Yes AND tick one box to show how much it distresses you, as in this example. Then move on to the next statement.

If you <u>agree</u>, to what extent are you distressed by it?

EXAMPLE : Agree

				Not at ⇨all	Some- what	Rather	Very dis- tressed
a)	I have constant time pressure due to a heavy workload.	No	Yes ✔			✔	

Do you agree with the following statements?
If you <u>agree</u>, to what extent are you distressed by it?

				Not at all	Some- what	Rather	Very dis- tressed
a)	I have constant time pressure due to a heavy workload.	No 0	Yes 1	0	1	2	3
b)	I have many interruptions and disturbances in my job.	No 0	Yes 1	0	1	2	3
c)	I have a lot of responsibility in my job.	No 0	Yes 1	0	1	2	3
d)	I am often under pressure to work overtime.	No 0	Yes 1	0	1	2	3

					Not at all	Some-what	Rather	Very dis-tressed
e)	I have experienced or expect to experience an undesirable change in my work situation.	No	Yes		0	1	2	3
		0	1					
f)	My job promotion prospects are poor.	No	Yes		0	1	2	3
		0	1					
g)	My job security is poor.	No	Yes		0	1	2	3
		0	1					
h)	I am treated unfairly at work.	No	Yes		0	1	2	3
		0	1					

In these next questions we would again like to know whether or not you agree with some statements about your work. This time, though, the order of 'Yes' and 'No' is changed. So, if you DO agree with a statement tick the box marked Yes. Then move on to the next statement. If you DON'T agree with a statement tick the box marked No AND tick one box to show how much it distresses you. Then move on to the next statement.

Do you agree with the following statements?
(Please note the order of 'Yes', 'No' is changed)

If you <u>disagree</u>, to what extent are you distressed by it?

		Yes	No	Not at all	Some-what	Rather	Very dis-tressed
a)	Considering all my efforts and achievements, my work prospects are adequate.	1	0	0	1	2	3
b)	I receive the respect I deserve from my superiors and colleagues.	1	0	0	1	2	3
c)	I experience adequate support in difficult situations.	1	0	0	1	2	3
d)	Considering all my efforts and achievements, I receive the respect and prestige I deserve at work.	1	0	0	1	2	3

Appendix B: Complete regression models for Chapter 3

Snacking frequency

B1 - Accidents at work

	B	S.E	Wald	df	Sig.	Exp(B)	Lower 95% CI	Upper 95% CI
Smoke	.567	.328	2.991	1	.084	1.763	.927	3.351
Neuroticism	.737	.304	5.874	1	.015	2.090	1.151	3.794
Snack	.599	.284	4.446	1	.035	1.821	1.043	3.178
Sleep	.779	.299	6.812	1	.009	2.180	1.214	3.914
Constant	-3.759	.360	109.008	1	.000	.023		

B2 - Minor injuries at work

	B	S.E	Wald	df	Sig.	Exp(B)	Lower 95% CI	Upper 95% CI
Neuroticism	.665	.166	16.005	1	.000	1.944	1.404	2.692
Snack	.360	.160	5.039	1	.025	1.434	1.047	1.963
Sleep	.542	.165	10.851	1	.001	1.720	1.246	2.376
Constant	-1.483	.169	76.531	1	.000	.227		

B3 - Cognitive failures at work

	B	S.E	Wald	df	Sig.	Exp(B)	Lower 95% CI	Upper 95% CI
Alcohol	.468	.209	4.982	1	.026	1.596	1.059	2.406
Age	.339	.160	4.490	1	.034	1.404	1.026	1.922
Neuroticism	.734	.166	19.458	1	.000	2.083	1.503	2.885
Snack	.434	.161	7.303	1	.007	1.544	1.127	2.116
Sleep	.331	.165	4.002	1	.045	1.392	1.007	1.925
Constant	-.407	.176	5.352	1	.021	.666		

B4 - Cognitive failures outside work

	B	S.E	Wald	df	Sig.	Exp(B)	Lower 95% CI	Upper 95% CI
Age	.344	.171	4.033	1	.045	1.411	1.008	1.973
Neuroticism	.798	.179	19.955	1	.000	2.221	1.565	3.151
Snack	.624	.170	13.456	1	.000	1.867	1.337	2.605
Sleep	.411	.178	5.351	1	.021	1.508	1.065	2.137
Constant	-.078	.175	.196	1	.658	.925		

Healthy snacking:

B5 - Minor injuries at work

	B	S.E	Wald	df	Sig.	Exp(B)	Lower 95% CI	Upper 95% CI
Neuroticism	.704	.171	16.958	1	.000	2.022	1.446	2.826
Healthy	-.440	.164	7.232	1	.007	.644	.467	.888
Sleep	.588	.169	12.076	1	.001	1.801	1.292	2.510
Constant	-1.147	.165	48.505	1	.000	.318		

B6 - Work stress

	B	S.E	Wald	df	Sig.	Exp(B)	Lower 95% CI	Upper 95% CI
Gender	-.724	.302	5.743	1	.017	.485	.268	.876
Alcohol	.381	.205	3.442	1	.064	1.464	.979	2.190
Neuroticism	1.244	.183	46.379	1	.000	3.471	2.426	4.966
Negative job	.744	.174	18.196	1	.000	2.103	1.495	2.960
Healthy	.424	.173	6.041	1	.014	1.528	1.090	2.143
Constant	-1.494	.320	21.726	1	.000	.225		

Unhealthy snacking

B7 - Accidents at work

	B	S.E	Wald	df	Sig.	Exp(B)	Lower 95% CI	Upper 95% CI
Neuroticism	.658	.308	4.558	1	.033	1.932	1.055	3.535
Unhealthy	.577	.284	4.124	1	.042	1.781	1.020	3.107
Sleep	.801	.307	6.784	1	.009	2.228	1.219	4.070
Constant	-3.606	.344	109.698	1	.000	.027		

B8 - Minor injuries at work

	B	S.E	Wald	df	Sig.	Exp(B)	Lower 95% CI	Upper 95% CI
Neuroticism	.686	.172	15.907	1	.000	1.986	1.418	2.783
Unhealthy	.724	.165	19.196	1	.000	2.064	1.492	2.854
Sleep	.555	.171	10.590	1	.001	1.742	1.247	2.433
Constant	-1.702	.174	95.148	1	.000	.182		

B9 - Minor injuries outside work

	B	S.E	Wald	df	Sig.	Exp(B)	Lower 95% CI	Upper 95% CI
Alcohol	.327	.192	2.910	1	.088	1.387	.953	2.018
Neuroticism	.333	.160	4.357	1	.037	1.395	1.021	1.908
Unhealthy	.427	.153	7.781	1	.005	1.532	1.135	2.068
Sleep	.493	.158	9.719	1	.002	1.638	1.201	2.233
Constant	-.855	.152	31.614	1	.000	.425		

B10 - Cognitive failures outside work

	B	S.E	Wald	df	Sig.	Exp(B)	Lower 95% CI	Upper 95% CI
Age	.367	.174	4.455	1	.035	1.443	1.027	2.029
Neuroticism	.774	.180	18.469	1	.000	2.169	1.524	3.088
Unhealthy	.416	.173	5.777	1	.016	1.516	1.080	2.129
Sleep	.463	.179	6.680	1	.010	1.589	1.118	2.258
Constant	.005	.175	.001	1	.977	1.005		

B11 - Health in general

	B	S.E	Wald	df	Sig.	Exp(B)	Lower 95% CI	Upper 95% CI
Alcohol	.399	.198	4.061	1	.044	1.490	1.011	2.197
Neuroticism	1.012	.169	35.926	1	.000	2.751	1.976	3.830
Unhealthy	.325	.161	4.069	1	.044	1.384	1.009	1.899
Sleep	.484	.166	8.519	1	.004	1.622	1.172	2.245
Constant	-1.527	.170	80.452	1	.000	.217		

B12 - Life stress

	B	S.E	Wald	df	Sig.	Exp(B)	Lower 95% CI	Upper 95% CI
Age	-.374	.160	5.452	1	.020	.688	.502	.942
Neuroticism	1.378	.161	73.486	1	.000	3.966	2.894	5.434
Unhealthy	.463	.160	8.343	1	.004	1.589	1.161	2.176
Constant	-.955	.169	32.002	1	.000	.385		

Other snacking:

B13 - Accidents at work

	B	S.E	Wald	df	Sig.	Exp(B)	Lower 95% CI	Upper 95% CI
Neuroticism	.640	.308	4.327	1	.038	1.897	1.038	3.467
Other	.592	.284	4.344	1	.037	1.808	1.036	3.157
Sleep	.814	.307	7.052	1	.008	2.257	1.238	4.117
Constant	-3.609	.344	109.937	1	.000	.027		

B14 - Minor injury at work

	B	S.E	Wald	df	Sig.	Exp(B)	Lower 95% CI	Upper 95% CI
Neuroticism	.666	.170	15.320	1	.000	1.946	1.394	2.716
Other	.337	.162	4.297	1	.038	1.400	1.018	1.925
Sleep	.553	.168	10.844	1	.001	1.739	1.251	2.418
Constant	-1.462	.166	78.037	1	.000	.232		

Breakfast:

B15 - Accidents at work

	B	S.E	Wald	df	Sig.	Exp(B)	Lower 95% CI	Upper 95% CI
Neuroticism	.762	.305	6.239	1	.012	2.142	1.178	3.894
Breakfast	-.615	.268	5.283	1	.022	.540	.320	.913
Sleep	.711	.302	5.533	1	.019	2.036	1.126	3.681
Constant	-2.916	.337	74.758	1	.000	.054		

B16 - Minor injuries at work

	B	S.E	Wald	df	Sig.	Exp(B)	Lower 95% CI	Upper 95% CI
Neuroticism	.659	.167	15.546	1	.000	1.933	1.393	2.682
Breakfast	-.553	.163	11.447	1	.001	.575	.418	.793
Sleep	.468	.167	7.858	1	.005	1.597	1.151	2.215
Constant	-.890	.179	24.782	1	.000	.411		

B17 - Cognitive failures at work

	B	S.E	Wald	df	Sig.	Exp(B)	Lower 95% CI	Upper 95% CI
Alcohol	.365	.208	3.098	1	.078	1.441	.959	2.165
Age	.378	.163	5.407	1	.020	1.460	1.061	2.008
Neuroticism	.753	.166	20.568	1	.000	2.123	1.533	2.940
Breakfast	-.346	.173	3.986	1	.046	.708	.504	.994
Sleep	.291	.167	3.043	1	.081	1.338	.965	1.855
Constant	.071	.187	.145	1	.703	1.074		

B18 - Work stress

	B	S.E	Wald	df	Sig.	Exp(B)	Lower 95% CI	Upper 95% CI
Gender	-.596	.292	4.155	1	.042	.551	.311	.977
Alcohol	.340	.201	2.867	1	.090	1.404	.948	2.081
Age	.323	.173	3.492	1	.062	1.382	.984	1.939
Neuroticism	1.244	.180	47.611	1	.000	3.470	2.437	4.941
Negative job	.690	.173	15.926	1	.000	1.993	1.420	2.796
Breakfast	-.456	.176	6.703	1	.010	.634	.449	.895
Constant	-1.268	.331	14.637	1	.000	.281		

Breakfast, healthy snacking and unhealthy snacking

B19 - Accidents at work

	B	S.E	Wald	df	Sig.	Exp(B)	Lower 95% CI	Upper 95% CI
Breakfast	-.806	.285	8.026	1	.005	.447	.256	.780
Neuroticism	.604	.313	3.723	1	.054	1.829	.991	3.376
Sleep	.623	.315	3.913	1	.048	1.865	1.006	3.458
Constant	-2.732	.338	65.331	1	.000	.065		

B20 - Minor injury at work

	B	S.E	Wald	df	Sig.	Exp(B)	Lower 95% CI	Upper 95% CI
Breakfast	-.423	.174	5.906	1	.015	.655	.466	.921
Health	-.358	.170	4.420	1	.036	.699	.500	.976
Unhealthy	.667	.169	15.537	1	.000	1.947	1.398	2.713
Neuroticism	.658	.175	14.120	1	.000	1.931	1.370	2.721
Sleep	.516	.175	8.674	1	.003	1.675	1.188	2.361
Constant	-1.217	.224	29.460	1	.000	.296		

B21 - Minor injury outside work

	B	S.E	Wald	df	Sig.	Exp(B)	Lower 95% CI	Upper 95% CI
Unhealthy	.434	.154	7.980	1	.005	1.544	1.142	2.087
Alcohol	.339	.193	3.093	1	.079	1.404	.962	2.048
Neuroticism	.312	.160	3.793	1	.051	1.367	.998	1.871
Sleep	.508	.159	10.198	1	.001	1.662	1.217	2.270
Constant	-.854	.153	31.375	1	.000	.426		

B22 - Cognitive failures at work

	B	S.E	Wald	df	Sig.	Exp(B)	Lower 95% CI	Upper 95% CI
Breakfast	-.388	.175	4.924	1	.026	.678	.481	.956
Alcohol	.368	.214	2.950	1	.086	1.445	.949	2.200
Age	.415	.167	6.195	1	.013	1.515	1.092	2.100
Neuroticism	.881	.164	28.823	1	.000	2.413	1.750	3.329
Constant	.140	.176	.636	1	.425	1.150		

B23 - Cognitive failures outside work

	B	S.E	Wald	df	Sig.	Exp(B)	Lower 95% CI	Upper 95% CI
Unhealthy	.411	.174	5.601	1	.018	1.509	1.073	2.121
Age	.373	.175	4.561	1	.033	1.452	1.031	2.044
Neuroticism	.761	.181	17.742	1	.000	2.140	1.502	3.050
Sleep	.444	.180	6.110	1	.013	1.559	1.096	2.217
Constant	.016	.176	.008	1	.928	1.016		

B24 - Job stress

	B	S.E	Wald	df	Sig.	Exp(B)	Lower 95% CI	Upper 95% CI
Breakfast	-.573	.185	9.613	1	.002	.564	.393	.810
Healthy	.476	.179	7.053	1	.008	1.610	1.133	2.288
Gender	-.838	.304	7.601	1	.006	.432	.238	.785
Age	.407	.179	5.176	1	.023	1.503	1.058	2.134
Negative job	.711	.178	16.002	1	.000	2.036	1.437	2.884
Neuroticism	1.238	.186	44.488	1	.000	3.450	2.398	4.965
Constant	-1.174	.337	12.159	1	.000	.309		

B25 - Life stress

	B	S.E	Wald	df	Sig.	Exp(B)	Lower 95% CI	Upper 95% CI
Unhealthy	.454	.161	7.893	1	.005	1.574	1.147	2.160
Age	-.410	.162	6.440	1	.011	.664	.484	.911
Neuroticism	1.381	.162	72.896	1	.000	3.978	2.897	5.462
Constant	-.938	.169	30.645	1	.000	.392		

Positive health behaviours

B26 - Minor injuries at work

	B	S.E	Wald	df	Sig.	Exp(B)	Lower 95% CI	Upper 95% CI
Alcohol	-.421	.216	3.802	1	.051	.656	.430	1.002
Neuroticism	.654	.175	13.908	1	.000	1.922	1.364	2.710
Positive health	-.828	.182	20.782	1	.000	.437	.306	.624
Sleep	.502	.172	8.472	1	.004	1.652	1.178	2.316
Constant	-.844	.179	22.118	1	.000	.430		

B27 - Minor injuries outside work

	B	S.E	Wald	df	Sig.	Exp(B)	Lower 95% CI	Upper 95% CI
Neuroticism	.317	.160	3.917	1	.048	1.373	1.003	1.879
Positive health	-.370	.156	5.601	1	.018	.691	.508	.938
Sleep	.464	.159	8.516	1	.004	1.590	1.165	2.172
Constant	-.381	.153	6.217	1	.013	.683		

B28 - Cognitive failures at work

	B	S.E	Wald	df	Sig.	Exp(B)	Lower 95% CI	Upper 95% CI
Age	.404	.165	6.040	1	.014	1.498	1.085	2.069
Neuroticism	.873	.165	28.012	1	.000	2.393	1.732	3.306
Positive health	-.387	.166	5.430	1	.020	.679	.491	.940
Constant	.146	.159	.846	1	.358	1.157		

B29 - Health in general

	B	S.E	Wald	df	Sig.	Exp(B)	Lower 95% CI	Upper 95% CI
Neuroticism	1.028	.170	36.703	1	.000	2.795	2.004	3.898
Positive health	-.411	.166	6.150	1	.013	.663	.479	.917
Sleep	.417	.167	6.222	1	.013	1.517	1.093	2.104
Constant	-1.074	.167	41.152	1	.000	.341		

B30 - grazing less healthy

	Frequency (%)
strongly agree	232 (26.7)
Agree	295 (33.9)
neither	173 (19.9)
disagree	137 (15.7)
strongly disagree	30 (3.4)

B31 - snack foods less healthy

	Frequency (%)
strongly agree	149 (17.1)
Agree	375 (43.1)
neither	159 (18.3)
disagree	141 (16.2)
strongly disagree	39 (4.5)

B32 - increased snacking obesity

	Frequency (%)
strongly agree	315 (36.2)
Agree	376 (43.2)
neither	90 (10.3)
disagree	56 (6.4)
strongly disagree	29 (3.3)

B33 - avoidance unhealthy

	Frequency (%)
strongly agree	65 (7.5)
Agree	172 (19.8)
neither	285 (32.8)
disagree	274 (31.5)
strongly disagree	69 (7.9)

B34 -busy lifestyle

	Frequency (%)
strongly agree	33 (3.8)
Agree	124 (14.3)
Neither	134 (15.4)
Disagree	339 (39.0)
strongly disagree	235 (27.0)

B35 - healthy not tasty

	Frequency (%)
strongly agree	29 (3.3)
Agree	129 (14.8)
neither	203 (23.3)
disagree	332 (38.2)
strongly disagree	173 (19.9)

Children's data

C1 – Snacking frequency

	Occasional snacking	Daily snacking
Positive mood	43.97 (0.78)	45.64 (0.74)
Negative mood	10.235 (0.74)	10.83 (0.70)
Anxiety	3.02 (0.26)	3.26 (0.25)
Depression	1.08 (0.17)	0.96 (0.16)
Emotional distress	28.63 (1.18)	29.91 (1.12)
Fatigue	16.01 (0.57)	15.96 (0.53)
Somatic symptoms	17.61 (0.41)	16.91 (0.38)
Total symptoms	1.11 (0.17)	1.32 (0.16)
Bowel problems	2.26 (0.25)	1.85 (0.24)

C2 – Healthy snacking

	Low healthy snacking	High healthy snacking
Negative mood	10.91 (0.73)	10.21 (0.71)
Anxiety	3.29 (0.26)	3.01 (0.25)
Depression	0.92 (0.16)	1.11 (0.16)
Emotional distress	29.97 (1.17)	28.69 (1.13)
Cognitive difficulties	19.36 (0.96)	20.57 (0.95)
Fatigue	16.28 (0.55)	15.70 (0.55)
Somatic symptoms	17.74 (0.40)	16.76 (0.39)
Total symptoms	1.22 (0.17)	1.22 (0.17)
Bowel problems	2.17 (0.25)	1.93 (0.25)

C3 – Unhealthy snacking

	Low unhealthy snacking	High unhealthy snacking
Positive mood	45.26 (0.79)	44.48 (0.75)
Negative mood	10.55 (0.74)	10.56 (0.70)
Anxiety	2.82 (0.26)	3.45 (0.25)
Emotional distress	29.05 (1.19)	29.53 (1.12)
Cognitive difficulties	19.45 (0.97)	20.45 (0.93)
Fatigue	16.08 (0.57)	15.90 (0.54)
Somatic symptoms	17.28 (0.40)	17.19 (0.39)

C4 – Other snacking

	Low other snacking	High other snacking
Positive mood	44.63 (0.78)	45.06 (0.75)
Negative mood	10.67 (0.73)	10.44 (0.71)
Anxiety	2.85 (0.25)	3.44 (0.25)
Emotional distress	29.01 (1.14)	29.61 (1.16)
Cognitive difficulties	18.80 (0.95)	21.11 (0.94)
Fatigue	16.08 (0.56)	15.90 (0.55)
Somatic symptoms	17.11 (0.40)	17.36 (0.39)
Total symptoms	1.05 (0.17)	1.39 (0.17)

C5 - Breakfast

	Low breakfast	High breakfast
Emotional distress	31.63 (1.59)	28.56 (0.95)
Cognitive difficulties	19.47 (1.33)	20.21 (0.79)
Fatigue	17.16 (0.76)	15.58 (0.46)
Somatic symptoms	17.62 (0.54)	17.08 (0.33)
Total symptoms	1.41 (0.23)	1.14 (0.14)

Measures of healthy and unhealthy snacking

A median split was used to examine the effects of those snacks considered healthy (fruit, dried fruit, yoghurt and nuts), unhealthy (crisps, chocolate, biscuits and cakes) and other snacks (breakfast cereal, cereal bars and toast) individually. Fruit and yoghurt were found to be the optimal measure of healthy snacking; the majority of children did not eat dried fruit (78%) or nuts (85%) as snacks. Crisps, chocolate and biscuits were the optimal measure of unhealthy snacking. Breakfast cereal and toast were optimal for other snacking. Frequency of consumption of these items was summed and a median split was conducted. These were used for all subsequent analyses.

Adults

C6 – Snacking frequency

	Low snacking	High snacking
Positive mood	36.06 (0.78)	36.70 (1.19)
Negative mood	17.08 (0.84)	15.86 (1.30)
Anxiety	6.27 (0.32)	5.42 (0.48)
Depression	4.52 (0.30)	4.01 (0.47)
Emotional distress	39.60 (1.51)	38.78 (2.25)
Cognitive difficulties	24.71 (0.94)	25.32 (1.48)
Fatigue	29.97 (1.12)	27.97 (1.71)
Somatic symptoms	25.76 (0.90)	25.68 (1.36)
Total symptoms	4.09 (0.28)	3.99 (0.43)
Bowel problems	4.92 (0.35)	5.27 (0.54)

C7 – Healthy snacking

	Low healthy snacking	High healthy snacking
Negative mood	17.90 (1.00)	15.47 (1.03)
Emotional distress	41.60 (1.78)	36.99 (1.82)
Bowel problems	5.41 (0.41)	4.60 (0.43)

C8 - Breakfast

	Low breakfast	High breakfast
Anxiety	6.31 (0.38)	5.68 (0.37)
Emotional distress	40.45 (1.83)	38.05 (1.74)

C9 – Subgroups of breakfast and unhealthy snacking

	LBLU	LBHU	HBLU	HBHU
Anxiety	5.68 (0.56)	6.86 (0.52)	5.13 (0.52)	6.22 (0.52)

LBLU – low breakfast / low unhealthy, LBHU – low breakfast / high unhealthy, HBLU – high breakfast / low unhealthy, HBHU – high breakfast / high unhealthy

C10 – Subgroups of breakfast and healthy snacking

	LBLH	LBHH	HBLH	HBHH
Emotional distress	43.14 (2.29)	35.77(3.07)	38.56 (2.81)	37.63 (2.23)
Negative mood	19.26 (1.29)	15.84 (1.72)	15.67 (1.58)	15.30 (1.268)

C11 - grazing less healthy

	Frequency (%)
Strongly agree	62 (25.8)
Agree	**84 (35.0)**
Neither agree or disagree	49 (20.4)
Disagree	36 (15.0)
Strongly disagree	9 (3.8)

C12 - snack foods less healthy

	Frequency (%)
Strongly agree	43 (17.9)
Agree	**101 (42.1)**
Neither agree or disagree	41 (17.1)
Disagree	49 (20.4)
Strongly disagree	6 (2.5)

C13 - increased snacking obesity

	Frequency (%)
Strongly agree	78 (32.5)
Agree	**114 (47.5)**
Neither agree or disagree	29 (12.1)
Disagree	12 (5.0)
Strongly disagree	7 (2.9)

C14 - avoidance unhealthy

	Frequency (%)
Strongly agree	6 (2.5)
Agree	43 (17.9)
Neither agree or disagree	69 (28.8)
Disagree	**100 (41.7)**
Strongly disagree	22 (9.2)

C15 - busy lifestyle

	Frequency (%)
Strongly agree	11 (4.6)
Agree	35 (14.6)
Neither agree or disagree	37 (15.4)
Disagree	**94 (39.2)**
Strongly disagree	63 (26.3)

C16 - healthy not tasty

	Frequency (%)
Strongly agree	12 (5.0)
Agree	53 (22.1)
Neither agree or disagree	54 (22.5)
Disagree	**87 (36.3)**
Strongly disagree	34 (14.2)

Measures of healthy, unhealthy and other snacking:

Healthy snacking:

Healthy snacking was calculated by summing fruit and dry fruit consumption.

C17 - Fruit

	Low fruit	**High fruit**
Anxiety	6.72 (0.38)	5.36 (0.36)
Depression	5.23 (0.37)	3.59 (0.35)
Cognitive difficulties	26.49 (1.16)	23.39 (1.08)
Fatigue	32.81 (1.33)	26.24 (1.25)
Positive mood	34.64 (0.94)	37.78 (0.89)
Total number of symptoms	4.64 (0.34)	3.52 (0.32)

C18 - Dry fruit

	Low dry fruit	**High dry fruit**
Anxiety	6.32 (0.29)	4.78 (0.57)
Depression	4.77 (0.28)	2.76 (0.55)
Somatic symptoms	26.50 (0.84)	22.63 (1.64)
Positive mood	35.23 (0.71)	40.56 (1.42)
Negative mood	17.33 (0.78)	14.02 (1.54)

C19 - Yoghurt

	Low yoghurt	**High yoghurt**
Depression	5.16 (0.36)	3.60 (0.35)
Positive mood	34.86 (0.93)	37.66 (0.90)

Nuts: No significant differences were found for any of the outcome measures.

Unhealthy snacking:

This was calculated by summing crisp and chocolate consumption.

C20 - Crisps

	Low crisp consumption	**High crisp consumption**
Anxiety	5.53 (0.34)	6.67 (0.41)
Depression	3.77 (0.33)	5.19 (0.39)
Cognitive difficulties	23.46 (1.03)	26.74 (1.21)
Fatigue	27.58 (1.23)	31.78 (1.46)
Positive mood	38.14 (0.84)	33.78 (0.99)
Total number of symptoms	3.65 (0.31)	4.59 (0.36)

C21 - Chocolate

	Low chocolate	**High chocolate**
Anxiety	5.46 (0.38)	6.46 (0.36)
Depression	3.56 (0.37)	5.05 (0.34)
Cognitive difficulties	23.21 (1.16)	26.18 (1.06)
Positive mood	37.71 (0.95)	35.10 (0.88)
Negative mood	15.14 (1.03)	17.95 (0.95)
Total number of symptoms	3.54 (0.34)	4.47 (0.32)

C22 - Biscuit

	Low biscuit consumption	**High biscuit consumption**
Emotional distress	36.97 (1.69)	41.85 (1.82)
Total number of symptoms	3.37 (0.31)	4.80 (0.33)

C23 - Cake

	Low cake consumption	**High cake consumption**
Cognitive difficulties	23.23 (1.09)	26.52 (1.12)
Total number of symptoms	3.59 (0.32)	4.55 (0.33)

C24 – Mean scores (s.e.) based on sub-groups of breakfast, healthy snack and unhealthy snack consumption

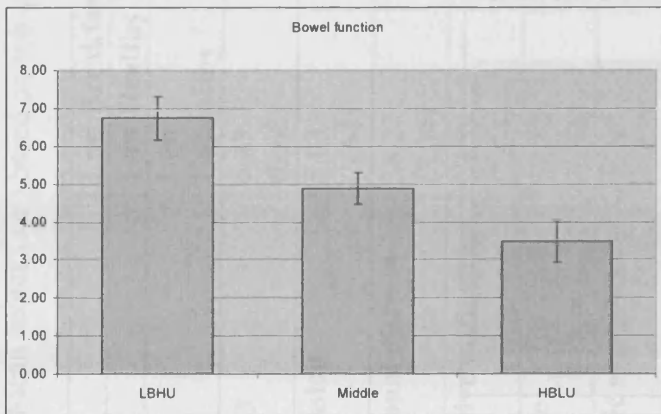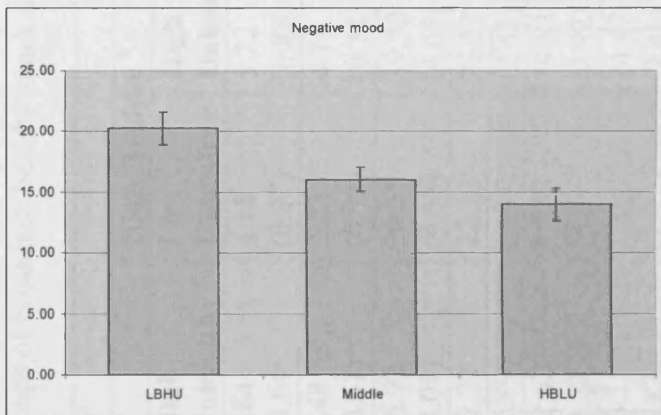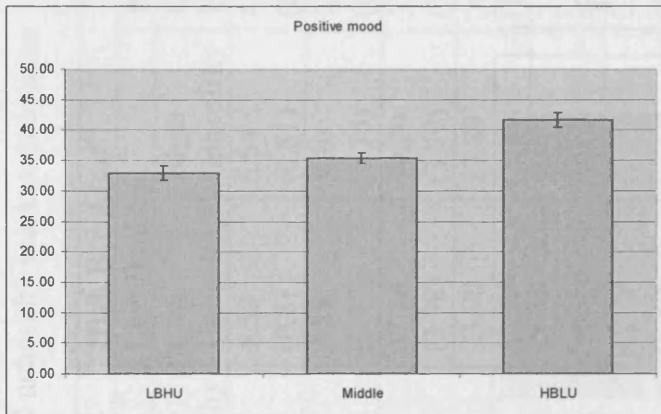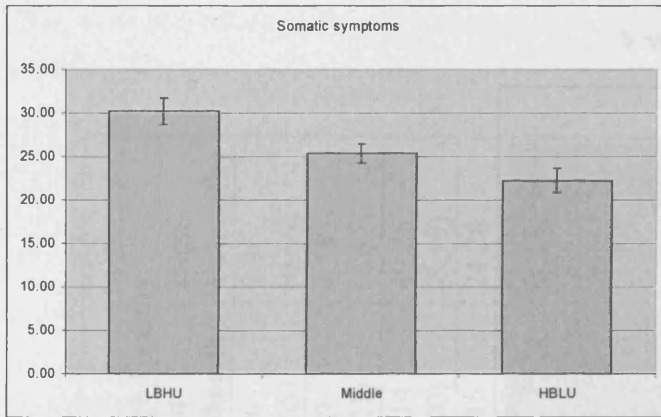| | Low Breakfast [a] | | | | High Breakfast [a] | | | |
| | Low Healthy [b] | | High Healthy [b] | | Low Healthy | | High Healthy | |
	Low Unhealthy [c]	High Unhealthy [c]	Low Unhealthy	High Unhealthy	Low Unhealthy	High Unhealthy	Low Unhealthy	High Unhealthy
Anxiety	6.43 (0.68)	7.84 (0.64)	4.18 (0.97)	5.22 (0.85)	5.58 (0.81)	6.54 (0.81)	4.76 (0.65)	5.96 (0.66)
Depression	5.03 (0.64)	6.48 (0.61)	2.23 (0.92)	4.71 (0.78)	2.86 (0.77)	5.30 (0.76)	2.49 (0.61)	4.28 (0.62)
Emotional distress	38.27 (3.34)	46.92 (3.01)	30.31 (4.55)	39.90 (4.05)	37.26 (3.98)	39.20 (3.79)	35.14 (3.00)	40.26 (3.19)
Cognitive difficulties	23.39 (2.04)	32.32 (1.89)	22.22 (2.86)	25.17 (2.43)	23.90 (2.39)	23.89 (2.38)	20.15 (1.96)	24.28 (1.95)
Fatigue	32.32 (2.37)	37.52 (2.22)	25.98 (3.36)	29.53 (2.92)	25.32 (2.81)	30.33 (2.80)	21.62 (2.22)	29.19 (2.29)
Somatic symptoms	25.98 (1.91)	33.15 (1.82)	25.08 (2.71)	24.47 (2.41)	21.75 (2.26)	25.37 (2.25)	22.98 (1.79)	24.63 (1.85)
Positive mood	33.89 (1.64)	31.88 (1.55)	39.33 (2.35)	34.83 (2.00)	41.76 (1.96)	34.26 (1.95)	41.42 (1.60)	35.53 (1.58)
Negative mood	17.10 (1.86)	21.14 (1.73)	12.20 (2.62)	18.45 (2.23)	14.14 (2.19)	16.73 (2.18)	14.17 (1.76)	16.40 (1.77)
Total symptoms	4.26 (0.59)	6.34 (0.56)	3.61 (0.84)	3.92 (0.72)	2.38 (0.70)	4.57 (0.70)	2.53 (0.56)	3.91 (0.57)
Bowel functioning	4.87 (0.75)	6.97 (0.71)	5.76 (1.08)	5.94 (0.94)	3.69 (0.90)	5.26 (0.90)	3.56 (0.72)	4.28 (0.73)

[a] Low breakfast = non daily breakfast consumption; high breakfast = daily breakfast consumption

[b] low healthy = 6 or less healthy snacks per week, high healthy = more than 6 healthy snacks per week
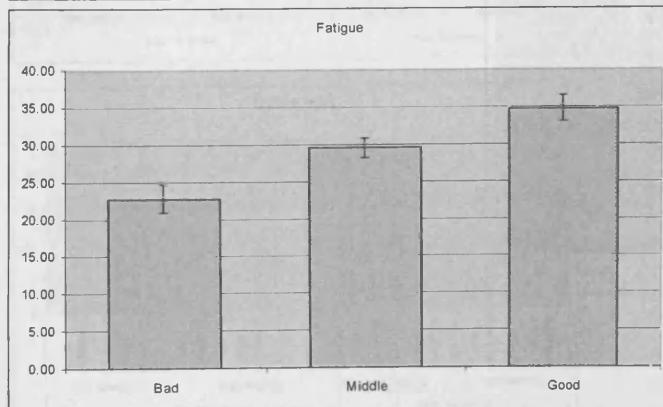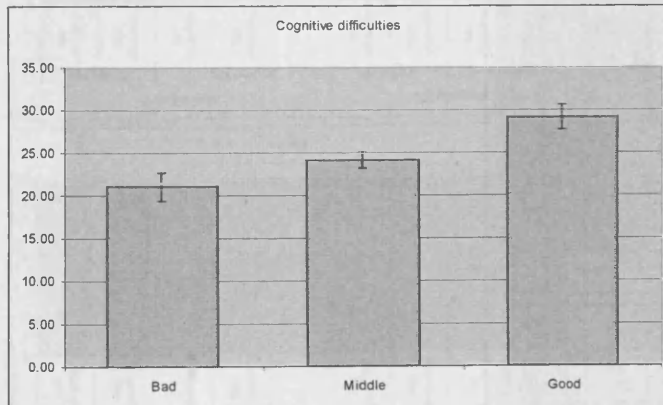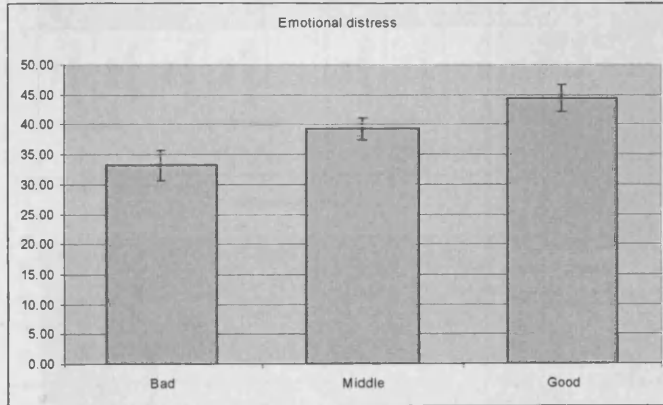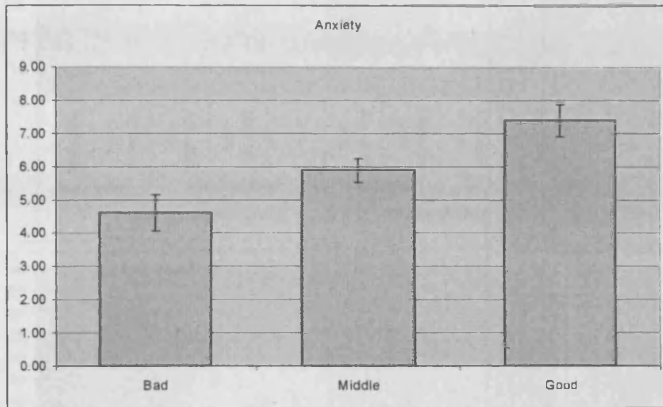
[c] low unhealthy = 3 or less unhealthy snacks per week, high unhealthy = more than 3 unhealthy snacks per week.
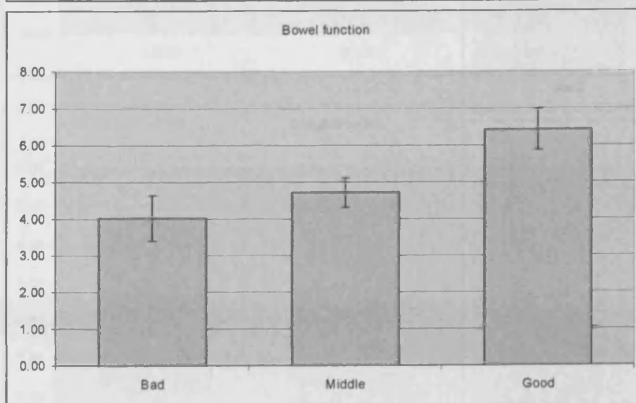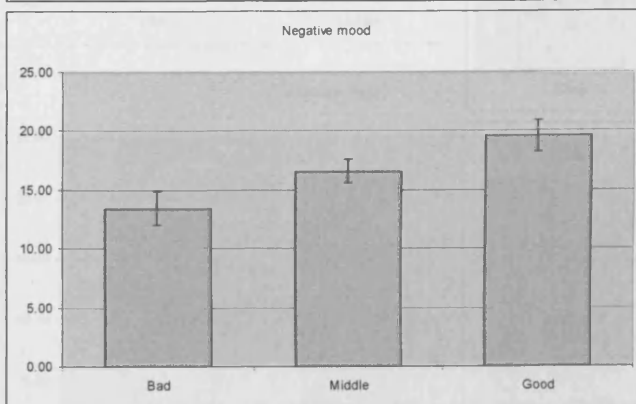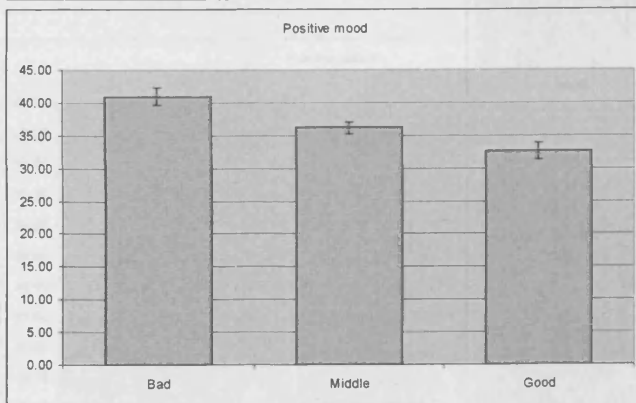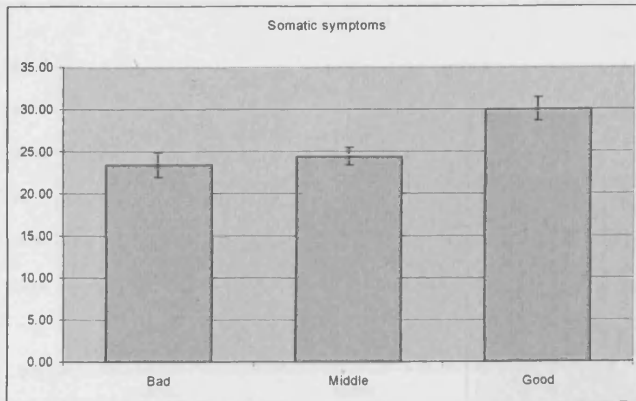
Appendix C – Graphs from Chapter 4

Anxiety

Emotional distress

Cognitive difficulties

Fatigue

Somatic symptoms

Positive mood

Negative mood

Bowel function

Healthy and unhealthy

Anxiety

Emotional distress

Cognitive difficulties

Fatigue

Somatic symptoms

Positive mood

Negative mood

Bowel function
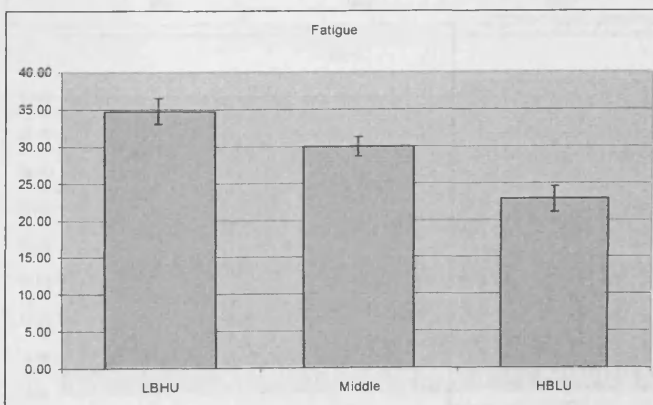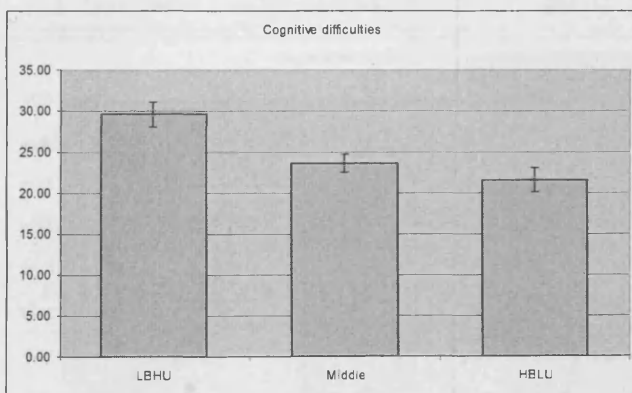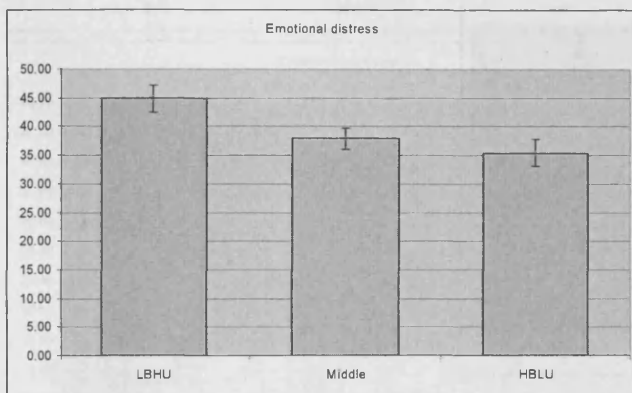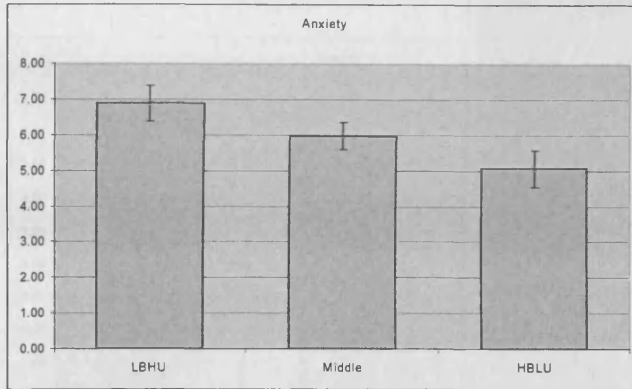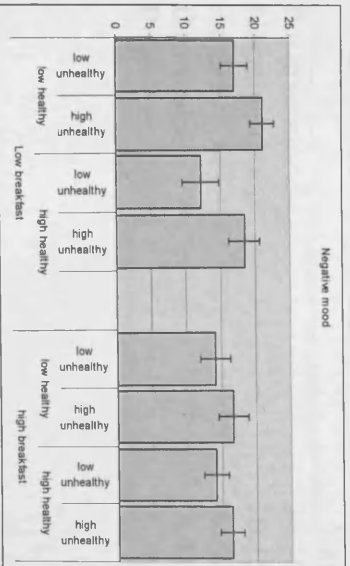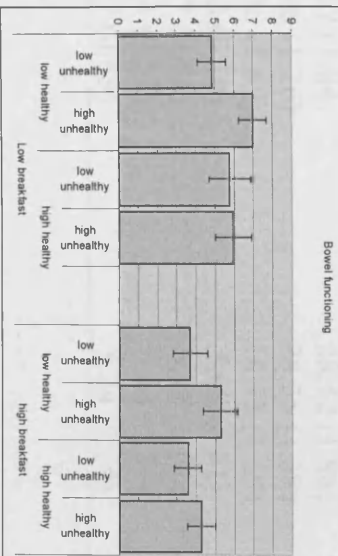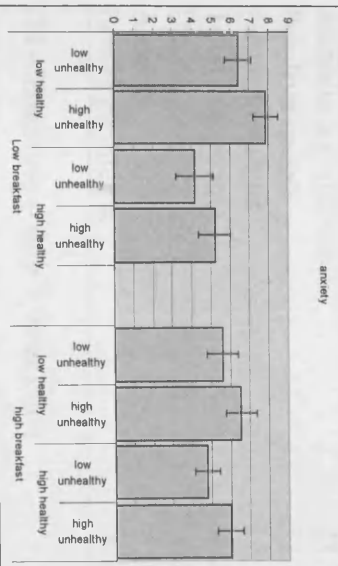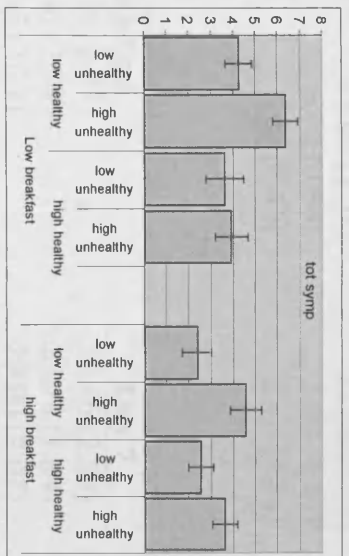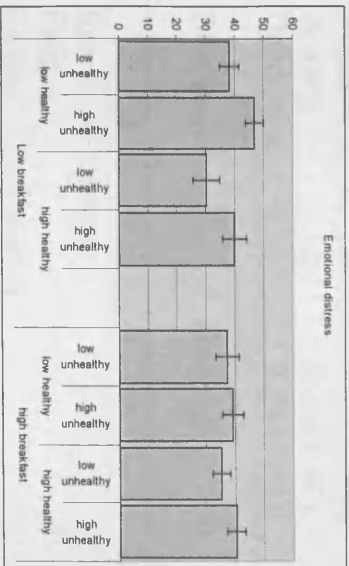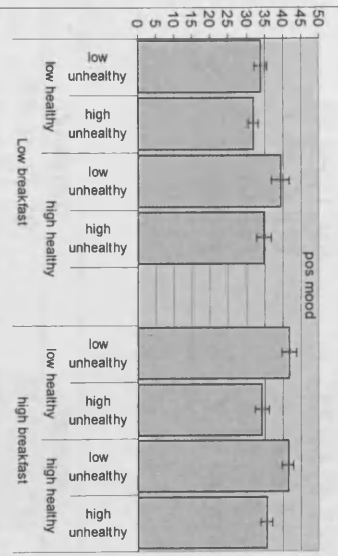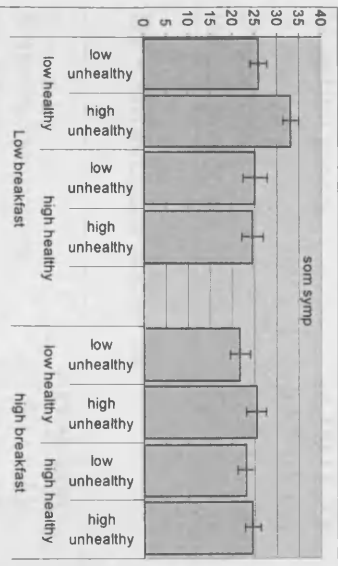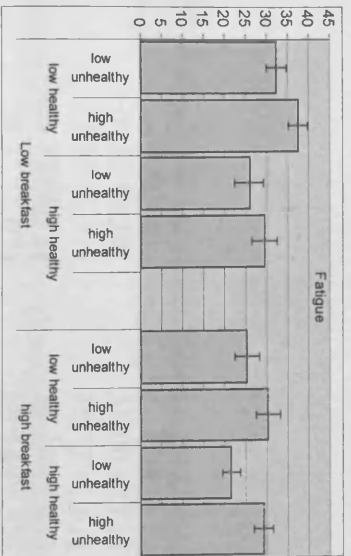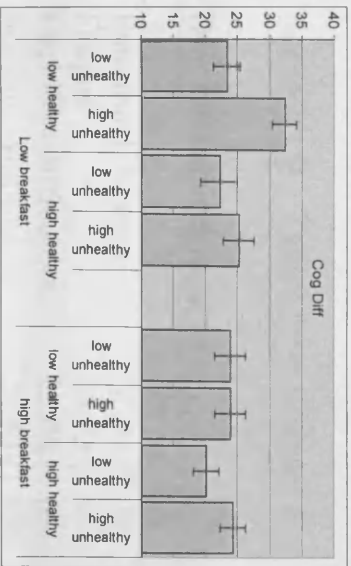
Appendix D – Tables from Chapter 5

D1 – Differences at day 7

	Breakfast	Nothing	Snack
Emotional distress	32.71 (2.06)	36.32 (2.20)	33.00 (2.09)
Fatigue	25.53 (1.60)	27.75 (1.71)	25.72 (1.61)
Cognitive difficulties	25.08 (1.65)	28.75 (1.73)	28.19 (1.67)
Somatic symptoms	24.43 (1.55)	28.51 (1.67)	29.14 (1.57)
Negative mood	16.99 (1.22)	18.95 (1.30)	15.44 (1.23)
Anxiety	5.83 (0.43)	5.66 (0.47)	4.84 (0.44)
Depression	3.33 (0.43)	3.98 (0.45)	3.10 (0.42)
Bowel problems	4.92 (0.71)	5.53 (0.77)	7.11 (0.72)

D2 – Differences at day 14

	Breakfast	Nothing	Snack
Somatic symptoms	24.60 (1.31)	28.46 (1.39)	25.17 (1.31)
Negative mood	15.25 (1.21)	19.03 (1.28)	17.20 (1.23)
Anxiety	5.20 (0.47)	6.10 (0.50)	5.79 (0.47)
Depression	2.94 (0.43)	4.20 (0.46)	3.46 (0.44)

D3 – Baseline – day 7, nothing

	Baseline	Day 7
Emotional Distress	36.76 (2.77)	36.46 (2.89)
Fatigue	29.46 (2.13)	27.78 (1.84)
Cognitive Difficulties	29.65 (2.21)	29.00 (2.07)
Somatic Symptoms	28.17 (1.84)	28.52 (1.88)
Positive mood	32.76 (1.26)	28.35 (1.38)
Negative mood	17.26 (1.69)	18.83 (1.65)
Total symptoms	4.22 (0.59)	5.09 (0.61)
Depression	3.07 (0.44)	3.87 (0.51)
Anxiety	5.04 (0.57)	5.33 (0.57)
Bowel problems	4.17 (0.69)	5.24 (0.74)

D4 – Baseline – day 7, breakfast

	Baseline	Day 7
Positive mood	33.19 (1.13)	32.70 (1.19)
Negative mood	20.15 (1.40)	17.89 (1.17)
Anxiety	6.26 (0.49)	6.15 (0.49)
Depression	3.42 (0.42)	3.34 (0.40)
Bowel problems	5.30 (0.64)	4.94 (0.68)

D5 - Baseline – day 7, snack

	Baseline	Day 7
Emotional Distress	32.62 (1.90)	31.15 (2.22)
Fatigue	27.31 (1.72)	25.19 (1.82)
Cognitive Difficulties	24.17 (1.53)	26.08 (1.96)
Somatic Symptoms	27.25 (1.19)	28.79 (1.98)
Positive mood	34.89 (1.28)	34.33 (1.36)
Negative mood	15.31 (1.14)	14.64 (1.20)
Total symptoms	4.50 (0.48)	4.58 (0.52)
Depression	3.65 (0.40)	3.19 (0.45)
Anxiety	5.62 (0.52)	4.81 (0.51)
Bowel problems	6.04 (0.85)	7.35 (0.83)

D6 - Baseline – day 14, nothing

	Baseline	Day 14
Emotional Distress	36.22 (2.79)	36.72 (2.76)
Fatigue	29.11 (2.16)	29.70 (2.22)
Cognitive Difficulties	29.46 (2.21)	30.35 (2.18)
Somatic Symptoms	28.04 (1.83)	28.46 (2.12)
Negative mood	17.26 (1.65)	18.85 (1.68)
Total symptoms	4.36 (0.59)	5.57 (0.70)
Depression	3.13 (0.44)	4.04 (0.52)
Anxiety	5.06 (0.56)	5.72 (0.62)

D7 - Baseline – day 14, breakfast

	Baseline	Day 14
Positive mood	33.19 (1.13)	33.76 (1.30)
Total symptoms	4.81 (0.46)	4.00 (0.38)
Depression	3.42 (0.42)	2.94 (0.42)
Anxiety	6.26 (0.49)	5.57 (0.54)

D8 - Baseline – day 14, snack

	Baseline		Day 14	
Emotional Distress	32.62	1.90	30.48	2.11
Cognitive Difficulties	24.17	1.53	21.96	1.60
Negative mood	15.31	1.14	16.02	1.37
Total symptoms	4.50	0.48	4.62	0.52
Depression	3.65	0.40	3.60	0.54
Anxiety	5.62	0.52	5.75	0.57
Bowel problems	6.04	0.85	7.08	0.96

D9 - Day 7 – day 14, nothing

	Baseline	**Day 14**
Emotional Distress	36.31 (2.46)	35.87 (2.29)
Fatigue	27.58 (1.75)	28.91 (1.98)
Cognitive Difficulties	28.78 (1.74)	29.93 (1.69)
Somatic Symptoms	28.20 (1.66)	27.82 (1.73)
Positive mood	28.35 (1.25)	27.98 (1.22)
Negative mood	18.83 (1.55)	18.41 (1.48)
Total symptoms	5.09 (0.52)	5.39 (0.60)
Depression	3.87 (0.49)	3.83 (0.45)
Anxiety	5.33 (0.47)	5.59 (0.56)
Bowel problems	5.24 (0.74)	5.80 (0.82)

D10 - Day 7 – day 14, breakfast

	Baseline	**Day 14**
Positive mood	32.70 (1.15)	33.76 (1.15)
Total symptoms	3.72 (0.40)	4.00 (0.36)

D11 - Day 7 – day 14, snack

	Baseline	**Day 14**
Emotional Distress	31.15 (1.94)	30.48 (1.91)
Fatigue	25.19 (1.60)	22.50 (1.39)
Cognitive Difficulties	26.08 (1.63)	21.96 (1.29)
Somatic Symptoms	28.79 (1.77)	24.71 (1.19)
Positive mood	34.33 (1.18)	31.81 (1.27)
Negative mood	14.64 (1.05)	16.02 (1.26)
Total symptoms	4.58 (0.44)	4.62 (0.42)
Depression	3.19 (0.37)	3.60 (0.45)
Anxiety	4.81 (0.36)	5.75 (0.45)
Bowel problems	7.35 (0.76)	7.08 (0.86)

Appendix E – Mood rating and sample score sheeet For The Hazard Perception Test

MOOD RATING		
DAY 1		**DATE:** __ / __ / __
Name:	**Time completed:**	
On each of the following lines please draw a cross between the two extremes which best represents how you have been feeling today.		
Drowsy	--	Alert
Relaxed	--	Excited
Strong	--	Feeble
Muzzy	--	Clear-headed
Co-ordinated	--	Clumsy
Lethargic	--	Energetic
Contented	--	Discontented
Troubled	--	Tranquil
Mentally-slow	--	Quick-witted
Tense	--	Calm
Attentive	--	Dreamy
Incompetent	--	Proficient
Happy	--	Sad
Antagonistic	--	Friendly
Interested	--	Bored
Withdrawn	--	Sociable
Depressed	--	Elated
Self-centred	--	Outward-going

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Sample score sheet

Clip 1. Countryside Town Roundabout

    Hazard(s)
    Hazard 1. Milk Float Parked Near Roundabout

Score = 5

Clip 2. Countryside Town On A Foggy Day

    Hazard(s)
    Hazard 1. Car Stopped In Fog Near Roundabout

Score = 4

Clip 3. Countryside Road In The Morning.

    Hazard(s)
    Hazard 1. Wide Lorry Stopped At Roadside

Score = 5

Clip 4. Countryside Town 1

    Hazard(s)
    Hazard 1. Cyclist, Without Reflective Clothing.

Score = 4

Clip 5. Motorway Near Cardiff

    Hazard(s)
    Hazard 1. Car Pulling Into Your Lane

Score = 5

Clip 6. Motorway Near Swansea

    Hazard(s)
    Hazard 1. Car Brakes Suddenly On Motorway.

Score = 4
Your mark has been reduced to 0, as you were detected clicking rhythmically

Clip 7. Countryside Town On A Foggy Morning

    Hazard(s)
    Hazard 1. Vehicle Stopped In Fog

Score = 3

Clip 8. Countryside Town 4

Hazard(s)
Hazard 1. Bus Parked In Bus Stop.

Score = 5

Clip 9. Dual Carriageway At Sunset.

Hazard(s)
Hazard 1. Lorry Joining Carriageway.

Score = 0

Clip 10. Dual Carriage On A Misty Day

Hazard(s)
Hazard 1. Cyclist At Roundabout

Score = 5

Clip 11. Countryside Lane 2

Hazard(s)
Hazard 1. Car In Narrow Lane

Score = 4

Clip 12. Countryside Parish

Hazard(s)
Hazard 1. Road Blocked By Parked Cars
Hazard 2. Car Parking

Score = 10

Clip 13. Countryside Town Center

Hazard(s)
Hazard 1. Oncoming Car

Score = 0

Clip 14. Dual Carriageway Roundabout 1

Hazard(s)
Hazard 1. Car On Roundabout

Score = 4

Test Passed!
You achieved a total of 54 marks out of 75 - The pass mark is 53% (40 Marks).