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Associations between Health-Related Behaviours, Well-Being, and Academic Performance of Secondary School Students with Special Educational Need: A Secondary Analysis

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Abstract

Health-related behaviours (HRBs) have been considered one of the most critical public health issues, especially for those with special educational needs (SEN). Previous research suggests that health-related behaviours are highly likely to impact well-being and academic achievement. Diet is a crucial health-related behaviour that needs to be investigated along with factors such as sleep and exercise. The present study used data from the Cornish Academies Project, and secondary analyses were conducted to investigate associations between health-related behaviour and well-being and academic performance of secondary students with SEN. The current study sample was 308 students with SEN (mean age, 13.5 years, SD 1.44 years). The study was longitudinal, with time points 6 months apart, and a multivariate design with data from three academies in Cornwall, United Kingdom. The Diet and Behaviour Scale (DABS) measured diet and lifestyle (physical activity, sleep, and general health). Logistic regressions on the time one data showed a significant relationship between good general health and long sleep, eating healthy foods, and avoiding junk food. High exercise and high

attendance decreased the likelihood of low attainment. Long sleep was associated with better conduct at time one and time two. There was a significant association between high consumption of healthy foods and good general health and better educational attainment at time two. Longitudinal cross-lagged analyses showed that high tea and high total weekly caffeine consumption at time one were associated with anxiety at time two. In addition, high cola consumption at time one was associated with high depression at time two. Findings from the current study increase our knowledge regarding associations between HRB and well-being, and academic performance in secondary school pupils with SEN, though the results need to be explored further to determine the precise nature of the relationship.

Keywords
Diet; health-related behaviours; well-being; academic performance; secondary students; special educational need; secondary analyses

1. Introduction

Health-related behaviours (HRBs) have been considered one of the most critical public health issues, especially for those with special educational needs (SEN). A large body of research confirms that health-related behaviours are highly likely to impact well-being [1] and academic achievement [2, 3]. Less is known about how different health behaviours contribute to healthy lifestyles in adolescents with SEN and how these lifestyles relate to health outcomes in adulthood [4]. Therefore, examining HRB in the early years of life is critical because the effects can persist into adulthood [4]. Thus, this study aimed to examine the relationship between health-related behaviours, well-being, conduct and academic performance of secondary students with special educational needs (SEN). Diet is a central health-related behaviour that needs to be investigated along with factors such as sleep and exercise. The following section reviews studies which have examined diet in educational settings.

1.1 Health-Related Behaviours

Positive and health-promoting behavioural patterns include physical activity and healthy nutrition behaviours such as drinking water [5], eating fruit and vegetables [6, 7], and breakfast consumption [8, 9]. Such behaviours protect the individual from disease and promote health [2]. An individual could be exposed to several physical or mental problems through unhealthy behaviours such as smoking [10] and energy drinks [11]. Adolescents often engage in behaviours threatening their health and well-being, such as excessive sugar consumption and lack of exercise. Studies have shown that practising health behaviours helps reduce the risks of these diseases and increases an individual's well-being [12].

1.2 Diet

The existing literature confirms the strong direct relationship between the dietary behaviours practised and quality of life [13, 14]. A person's diet can also determine their level of well-being [15].

In addition, it has been found that people who follow a diet of high amounts of fried foods [16], crisps and chocolate [6] have a reduced sense of well-being [17]. Moreover, it is necessary to investigate the relationship between caffeine, such as coffee, tea, and energy drinks, and their effects on behaviour and academic performance. Since coffee and tea consumption has become one of the most common dietary patterns, they may have a long-term effect on behaviour and cognitive performance [18, 19]. The following section shows that sleep and exercise also influence children's behaviours.

1.3 Effect of Exercise and Sleep on Behaviour

Physical activity is one of the essential activities that can help increase the well-being of young people. Previous studies have confirmed that exercise greatly benefits young people's physical and mental health [20-22]. Moreover, recent studies indicate that moderate-to-vigorous physical activity has a more significant impact on adolescent health than light physical activity [23, 24], and it is also associated with positive well-being [21, 25]. However, most of these studies were cross-sectional or used univariate methods. For example, they examined one variable of health-related behaviour in isolation from the other variables.

The association between sleep and the well-being of children and young people is also well established, with the general conclusion being that good sleep patterns lead to improved well-being, enhanced mental health, and more beneficial health-related behaviours [26]. In addition, sleep disturbance may cause a decrease in psychological well-being [27].

1.4 The Cornwall Academies Study

Richards et al. [19] developed the Diet and Behaviour Scale (DABS) to assess the frequency and quantity of food consumption and its effects on behaviours and psychological variables. The scale was developed as an alternative to other existing dietary scales consisting of up to 131 items, which posed a problem in its use with specific populations, such as children or individuals with SEN, who might be expected to have problems maintaining attention for extended periods [19, 28]. The assessment of DABS was conducted as part of a large longitudinal study, the Cornish Academies Project. The project aimed to establish DABS as a measure of food and beverage consumption in a population of adolescents and young adults and to investigate associations between diet, mental health, school performance, and problem behaviour. Students from three academies in the South West of England participated in the project. Testing was conducted on two occasions six months apart. The sample for the first test consisted of 2610 secondary school students. The second test involved 2307 students. The results indicated that behaviour problems were associated with high coffee consumption and lack of sleep. Low attainment was associated with high consumption of energy drinks, lack of physical activity, and low attendance. Similar results were found in longitudinal analyses. There was a positive association between weekly total caffeine consumption (i.e., total consumption of energy drinks, cola, tea, and coffee) and anxiety and depression. Results were also observed with caffeine consumed specifically from coffee [28-31]. Although the Cornwall project considered SEN status as a predictor, no analyses were conducted to determine the impact of HRB factors on this population. Previous research suggests that HRBs significantly impact students with SEN, and this will be discussed in the next section.

1.5 SEN and Diet

Many students with special educational needs have poor academic achievement [32]. The difficulties they encounter influence their academic performance. Previous studies have confirmed that students with special education needs, especially students with ADHD, have an apparent weakness in reading and mathematics skills. They also consistently suffer behavioural and academic problems that can lead to dropping out or repeating the school year [33]. Kim et al. [34] examined HRBs and obesity among children with ADHD. Their findings suggest that this category of children was more sedentary and had an increased risk of obesity compared to the non-clinical population. Park et al. [16] aimed to explore a broader range of dietary behaviours among nearly 1,000 children with learning disabilities. Their findings confirmed the association between fried food, high consumption of sweets and behaviours and cognitive problems. The study was based on a cross-sectional design; for this reason, it is not possible to identify causal relationships. In addition, children with ADHD and autistic students often experience sleep disturbances. Maladaptive sleep patterns cause daytime sleepiness and fatigue due to increased sleep deficiency and a greater tendency to disordered eating. A study by Barnett et al. [35] confirmed this view and found that the association was not dependent on anxiety or depression [35]. However, these studies did not examine other types of SEN nor the possible relationship between these variables and educational outcomes. Moreover, as mentioned earlier in the exercise section, physical activity, particularly moderate-to-intense exercise, is beneficial for children and adolescents; similar results have been found in children and adolescents with ADHD [36, 37]. This study examined the relationship between HRB and the well-being and academic performance of secondary students with SEN to address these research gaps.

2. Materials and Methods

This article presents secondary analyses of the Cornish Academies Project [19, 28-31], a longitudinal study with time points six months apart, investigating the relationship between health-related behaviours and well-being and educational outcomes for secondary students with SEN [38]. The students were classified as having SEN based on information from the School Information Management System (SIMS), but there was no further information on the type of SEN. Information from the teachers suggested that the types of SEN represented in the sample were mainly autism, ADHD and mental health problems.

2.1 Participants

A sample of 308 students with SEN participated in the study, and their demographic characteristics are shown in Table 1.

Table 1 Demographic information of the sample.

Variables	Type	N (%)
Gender	**Male**	203 (65.9%)
	Female	105 (34.1%)
School Year	**7**	72 (23.4%)

	8	64 (20.8%)		
	9	67 (21.8%)		
	10	59 (19.9%)		
	11	46 (14.9%)		
Free school meals	**Yes**	56 (18.2%)		
	No	252 (81.8%)		
Ethnicity	**White**	303 (98.4%)		
	Not white	5 (1.6%)		
Age	**Max.**	**Min.**	**Mean**	**SD**
	16	11	13.5	1.44

2.2 Materials

The Diet and Behaviour Scale (DABS) [19] was used at both time points to record the frequency and quantity of food and drink consumption. In addition to the dietary questions, five questions were asked to measure specific aspects of lifestyle. Three questions were used to assess the frequency of physical activity of the subjects (light, moderate and vigorous), with responses given on a four-point scale (1 = three times per week or more, 2 = once or twice per week, 3 = about once to three times per month, 4 = never/hardly ever). At time two, three additional questions were asked related to mental health (anxiety, depression, and stress) with responses on a five-point scale. These mental health questions were taken from the Well-being Process Questionnaire [11]. Finally, participants were asked two questions, the first to indicate how many hours per night they typically slept and the second to indicate how well they rated their overall health over the past six months (1 = very good, 2 = good, 3 = fair, 4 = poor, 5 = very poor) [38].

2.3 Procedure

Demographic variables such as gender, age, year in school, academy, attendance, eligibility for free school meals (FSM), and ethnicity were included because the information from demographic variables influences outcomes and correlates with well-being, education and general health [39]. Demographic information, academic performance, detention/behavioural sanctions, and attendance were collected using the School Information Management System (SIMS) [11].

The study included certain independent variables such as junk food, healthy food, coffee, tea, energy drinks, cola, exercise, and sleep, and three dependent variables: school attainment, general health, and detention behavioural sanctions. Furthermore, anxiety, depression, and stress were also included as additional dependent variables at the second time point.

2.4 Statistical Analyses

Two factor analyses were performed for the diet and behaviour scale (DABS) items. The first factor analysis included food items, and the second included caffeinated drinks. The factor analysis was based on the basic component method with variable rotation of the factor (varimax rotation) to extract the factors whose item loadings $\geqslant$0.4 as the minimum degree of saturation of the item on the factor.

Univariate analyses were also performed, the variables were cross-tabulated, and the significance of the association between them was tested using the chi-square statistic. Then multivariate analyses were performed, and separate regression models were constructed, each with one dependent variable and the predictor variables for time one. Binary logistic regressions were performed to determine the effects of demographic (sex, school year, attendance and FSM) and health-related behaviours variables (junk food, healthy food, total weekly caffeine, sleep, attendance, coffee, tea, energy drinks, and cola) on general health, attainment, and detention/behavioural sanctions at time one. The same step was performed for the dependent variables and the predictors from time two to test the model's goodness of fit and to determine the significant effect of each independent variable on the dependent variables. Three regressions were also carried out for anxiety, stress and depression at time two. The predictor variables in the general health regression at time two were healthy food, exercise, energy drinks, sleep, sex, FSM, attendance, and cola. While the predictors in the attainment model at time two were healthy food, exercise, sleep, FSM, tea, total weekly caffeine, junk food, and school year measured at time two. The predictors of poor behaviour for time two were exercise, sleep, FSM, total weekly caffeine, junk food, sex, energy drinks and coffee measured at time two. The significance of each test was based on the fact that the respective p-values were below the significance level ($p < 0.05$). In order to conduct longitudinal analyses, each dependent variable at time two was cross-lagged with the predictor variables at time one and the dependent variables at time one to examine whether the predictors and the dependent variable at time one predicted the dependent variable at time two. SPSS version 26 was used for the statistical analyses. The research was carried out with the approval of the School of Psychology, Cardiff University Ethics Committee, and the informed consent of the participants.

3. Results

3.1 DABS Factor Analyses

Factor analysis was performed for the food, drink, and exercise questions separately for time points 1 and 2. Two factors were extracted for the food items, namely junk food and healthy food. The items that loaded on junk food Time 1 were Q2 chocolate, Q3 crisps, Q9 gum, Q10 sweets, Q11 fast food, Q12 takeaways, Q13 pies or pasties, Q14 processed meat, and Q17 Chips. Similar factors loaded on junk food at Time 2, namely Q2 chocolate, Q3 crisps, Q9 gum, Q10 sweets, Q11 fast food, Q12 takeaway, Q13 pies or pasties, Q:26 Burgers and hotdogs, and Q:17-24 crisps. All items in these factors had loadings above 0.4. The healthy food at both times had three items which were: Q: Fruit or Vegetable, Q:28 Fruit, Q29: Vegetable in addition to oily fish and beans and peas only at T2. All items in the healthy food factor had loadings above 0.4 (see Table 2). Factor analysis was conducted for the drinks questions with an eigenvalue of 1.00. It resulted in 4 factors being extracted: energy drinks, coffee, tea and cola. Each factor had two items with loadings above 0.7 at both times (Table 3).

Table 2 Exploratory factor analysis of food items from Time 1 and 2.

Items	Junk food T1	Healthy Food T1	Junk food T2	Healthy Food T2
Q:10 Sweets	**0.644**	-0.129	**0.648**	0.027
Q:12 Takeaway food	**0.604**	0.053	**0.418**	0.090
Q:11 Fast food	**0.596**	0.005	**0.446**	-0.073
Q:13 Pies or pasties	**0.560**	0.196	**0.286**	0.390
Q:2 Chocolate	**0.545**	-0.377	**0.636**	-0.101
Q:17 Chips	**0.538**	-0.109	**0.587**	0.088
Q:3 Crisps	**0.488**	-0.422	**0.590**	-0.110
Q:9 Gum	**0.476**	-0.073	**0.402**	0.258
Q:14 Processed meat	**0.431**	0.103	0.283	0.161
Q:26Burgersand hotdogs	0.392	0.111	**0.467**	0.081
Q:15 Fried fish	0.363	0.244	0.302	0.383
Q:27 Gum	0.332	0.051	0.308	0.319
Q:28 Fruit	0.103	**0.645**	-0.091	**0.636**
Q:4 fruit or veg	0.073	**0.632**	-0.152	**0.633**
Q:29 Vegetables	0.086	**0.575**	-0.068	**0.600**
Q:24 Crisps	0.379	-0.480	**0.556**	-0.165
Q:25 Chocolate	0.364	-0.409	**0.617**	-0.185
Q:16 Oily Fish	0.277	0.394	0.158	**0.431**
Q:18 Beans or peas	0.234	0.387	-0.022	**0.540**
Q:1 Breakfast	-0.120	0.235	-0.032	0.066
Initial eigenvalue	3.57	2.33	3.38	2.24
Cumulative Variance %	17.88	11.66	16.91	11.20

Table 3 Exploratory factor analysis of drinks items from Time 1 and 2.

Items	Coffee		Tea		Energy drinks		Cola	
	T1	T2	T1	T2	T1	T2	T1	T2
Q.5 Coffee	**0.916**	**0.916**	0.041	0.062	0.108	0.008	0.053	0.012
Q.22 Coffee	**0.915**	**0.904**	0.063	0.090	0.124	0.074	0.061	0.058
Q.6 Tea	0.009	0.087	**0.885**	**0.896**	0.000	0.047	0.066	0.069
Q.23 Tea	0.089	0.065	**0.877**	**0.894**	0.069	0.086	-0.008	0.080
Q.8 Energy Drinks	0.053	0.070	0.033	0.076	**0.855**	**0.914**	0.183	0.138
Q.19 Energy Drinks	0.173	0.016	0.036	0.061	**0.846**	**0.917**	0.065	0.084
Q.7 Cola	-0.024	0.040	-0.045	0.065	0.037	0.010	**0.887**	**0.894**
Q. 21 Cola	0.153	0.030	0.122	0.085	0.237	0.225	**0.790**	**0.845**
Initial eigenvalue	2.436	1.60	1.490	1.341	1.375	2.453	1.013	1.207
Cumulative Variance %	30.44	20.05	49.07	16.76	66.25	30.66	78.92	15.08

3.2 Univariate Analyses

A cross-tabulation analysis was conducted to examine whether there were associations between health-related behaviours and general health, attainment, and detention/behavioural sanctions at time one (T1) and time two (T2) (see Table 4). The variables were dichotomised into high and low groups. The health-related behaviour predictor variables were healthy food, junk food, coffee, tea, energy drink, cola, total weekly caffeine, sleep, and exercise. These variables also were dichotomised into high and low groups. The demographic predictors were gender, ethnicity, free school meals (FSM), school year, and attendance. The outcomes of interest were general health status, attainment and detention/behavioural sanctions at times one and two, and anxiety, depression, and stress only at time two. A chi-square test showed that poor general health at times one and two was associated with low consumption of healthy foods. There was a significant association between gender, short sleep and poor general health at Time 1. Females were more likely to have poor general health than males at time one. Low attainment was associated with high consumption of cola, energy drinks, and junk food at time one only. In addition, low attendance was associated with low academic performance at time one. Moreover, low physical activity levels were associated with low attainment and poor general health at times one and two. Gender and sleep were associated with detention and behavioural sanctions (poor conduct) at times one and two. In addition, there was an association between poor behaviour and school year at times one and two, and at time two, there was a significant association between high weekly consumption of caffeine and energy drinks and poor behaviour. A cross-tabulation analysis was conducted to examine whether there were associations between health-related behaviours and anxiety, depression, and stress at time two (see Table 5). The Chi-square test showed that high anxiety and stress were associated with short sleep. There was also a significant association with gender; females were more likely to report high anxiety, depression and stress than males.

Table 4 Cross-tabulation between demographics, lifestyle, and HRB variables and the outcomes in Time 1 and 2. (The results in bold have a significant association $p < 0.05$).

Predictors		Poor General Health				Low Attainment				Poor Behaviours			
		T1		T2		T1		T2		T1		T2	
		Row%	χ2, (p)	Row%	χ2, (p)	Row%	χ2, (p)	Row%	χ2, (p)	Row%	χ2, (p)	Row%	χ2, (p)
Exercise	Low	36.2%	7.03,	45.0%	5.49,	82.4%	5.36,	81.0%	4.49,	27.7%	0.44,	29.5%	3.42, 0.064
	High	21.9%	**(0.008)**	31.7%	**(0.019)**	71.3%	**(0.021)**	70.4%	**(0.034)**	24.4%	(0.50)	39.3%	
Gender	Male	23.8%	5.57,	34.1%	1.98,	76.8%	0.01,	75.1%	0.005,	33.0%	15.30,	39.0%	4.93,
	Female	37.0%	**(0.018)**	42.7%	(0.15)	76.2%	(0.89)	74.8%	(0.94)	12.4%	**(<0.001)**	26.0%	**(0.026)**
Sleep	short	38.9%	12.46,	42.7%	1.91,	73.3%	1.80,	76.2%	0.80,	32.8%	7.50,	43.2%	12.40,
	long	19.4%	**(<0.001)**	34.4%	(0.16)	80.8%	(0.17)	71.4%	(0.37)	18.7%	**(0.006)**	23.1%	**(<0.001)**
School year	7	21.9%	3.11, (0.53)	38.5%	0.09, (0.99)	86.1%	6.018, (0.19)	87.5%	8.97, (0.62)	11.1%	13.36, **(0.010)**	11.1%	13.36, **(0.010)**
	8	35.6%		38.7%		78.1%		76.2%		25.0%		25.0%	
	9	28.6%		37.1%		73.1%		70.8%		31.3%		31.3%	
	10	30.4%		37.3%		69.5%		66.7%		37.3%		37.3%	
	11	25.6%		36.4%		73.9%		72.7%		28.3%		28.3%	
Attendance	Low	27.3%	0.186,	40.3%	0.87,	83.7%	8.40,	23%	0.40,	24.8%	0.20,	35.5%	0.07,
	High	29.6%	(0.66)	35.0%	(0.35)	69.7%	**(0.004)**	26.2%	(0.52)	27.1%	(0.65)	34.0%	(0.78)
Healthy food	Low	34.9%	6.24,	45.6%	7.88,	77.9%	0.29,	79.9%	3.15,	28.6%	1.08,	36.4%	0.35,
	High	21.6%	**(0.013)**	29.7%	**(0.005)**	75.3%	(0.59)	71.1%	(0.076)	23.4%	(0.29)	33.1	(0.55)
Junk food	Low	24.7%	2.08,	36.7%	0.11,	70.8%	5.87,	72.8%	1.07,	28.6%	1.08,	29.2%	4.13,
	High	32.4%	(0.14)	38.6%	(0.73)	82.5%	**(0.015)**	78.0%	(0.29)	23.4%	(0.29)	40.3%	(0.42)
Total weekly caffeine	Low	28.6%	0.084,	39.4%	0.70,	76.2%	0.05,	72.5%	1.30,	25.2%	0.001,	27.5%	6.14,
	High	27.0%	(0.77)	34.5%	(0.40)	77.3%	(0.81)	78.3%	(0.25)	25.3%	(0.97)	41.4%	**(0.013)**
Energy drinks	Low	27.9%	0.042,	40.9%	1.38,	70.6%	6.18,	74.5%	0.13,	22.9%	1.51,	26.6%	8.95,
	High	29.0%	(0.83)	34.3%	(0.23)	82.6%	**(0.013)**	76.3%	(0.714)	29.0%	(0.21)	42.9%	**(0.003)**
Cola	Low	26.4%		34.9%		70.8%		73.8%		25.3%		33.1%	

	High	30.5%	0.591, (0.44)	40.6%	0.99, (0.31)	82.5%	5.87, **(0.015)**	77.0%	0.40, (0.526)	26.6%	0.06, (0.79)	36.4%	0.33, (0.55)

Table 5 Cross-tabulation between demographics, lifestyle, HRB variables, and stress, anxiety, and depression in Time 2. (The results in bold have a significant association $p < 0.05$).

Predictors		High Anxiety		High depression		High stress	
		Row%	χ2, (p)	Row%	χ2, (p)	Row%	χ2, (p)
Exercise	Low	50.0%	2.57, (0.11)	46.2%	1.72, (0.18)	67.9%	0.006,
	High	40.6%		38.5%		67.5%	(0.93)
Gender	Male	36.6%	8.91, **(0.003)**	31.1%	15.43, **(<0.001)**	63.2%	3.86,
	Female	55.3%		55.3%		74.8%	**(0.05)**
sleep	short	50.0%	4.47, **(0.034)**	42.0%	0.005, (0.94)	73.4%	3.93,
	long	37.1%		42.4%		62.1%	**(0.047)**

3.3 Multivariate Analyses

Binary logistic regressions were performed to determine the effects of demographic and health-related behaviours variables on general health, attainment, and detention/behavioural sanctions at time one. The predictors included in the general health, attainment and poor behaviour regressions at time one were sex, school year, FSM, junk food, healthy food, total weekly caffeine, sleep, attendance, coffee, tea, energy drink, and cola measured at time one. The results of binary logistic regressions showed that the models for poor general health, attainment, and detention/behavioural sanctions time one were statistically significant (chi-square (square (12) = 32.28 $p < 0.001$, chi-square (12) = 32.25 $p < 0.001$, chi-square (12) = 33.16 $p < 0.001$ respectively). The models explained about 16% of the variance in general health status, attainment, and detentions/behavioural sanctions at time one. Females were more likely to have poor general health than males (OR = 1.87, CI [1.05, 3.32], $p \leq 0.05$), and greater junk food consumption led to an increase in the likelihood of poor general health (OR = 2.35, CI [1.22, 4.52] $p = 0.010$). Coffee, tea, cola, and energy drinks were not associated with poor general health. Longer sleep was associated with a decrease in the likelihood of poor health at time one (OR = 0.42 CI [0.24, 0.73] $p < 0.05$). Greater healthy food consumption was associated with a decrease in the likelihood of poor health (OR = 0.56 CI [0.32, 0.99] $p < 0.05$). There was a significant association between high exercise, high attendance and a decreased likelihood of low attainment at time one (OR = 0.50 CI 0.28, 0.89 $p < 0.05$, OR = 0.40 CI 0.23, 0.71 $p < 0.005$ respectively). The results also suggested that high-energy drink consumption increased the likelihood of low attainment at time one (OR = 1.81 CI 1.02, 3.22 $p < 0.05$). The results showed that being male increased the likelihood of having poor behaviours at time one (OR = 0.263 CI [0.12, 0.54] $p < 0.001$). There was a significant association between the school year and low detention/behaviour sanctions at time one (OR = 1.39 CI [1.114, 1.74] $p < 0.005$). There was a significant association between long sleep and reduced poor behaviour at time one (OR = 0.439 CI [0.239, 0,805] $p < 0.008$).

At time two, the binary logistic regression models of general health, attainment and detention/behavioural sanctions were significant (chi-square (8) = 15.84 $p = 0.045$, chi-square (8) = 22.62 $p = 0.004$, chi-square (8) = 29.94 $p < 0.001$ respectively). The predictor variables in the general health regression at time two were healthy food, exercise, energy drinks, sleep, sex, FSM, attendance, and cola. The predictors in the attainment model at time two were healthy food,

exercise, sleep, FSM, tea, total weekly caffeine, junk food, and school year measured at time two. The predictors of poor behaviour at time two were exercise, sleep, FSM, total weekly caffeine, junk food, sex, energy drinks and coffee measured at time two. The models explained 8.4% of the variance in general health status, 12.3% of the variance of attainment, and 16.1% of the variance of detentions/behavioural sanctions at time two. The only variable that was related to general health at time two was healthy food, with decreased healthy food consumption being associated with poor health (OR = 0.54 CI [0.31, 0.93] $p < 0.05$). The results showed that high consumption of healthy food and high exercise decreased the likelihood of low attainment at time two (OR = 0.45 CI 0.24, 0.85 $p < 0.05$, OR = 0.47 CI 0.25, 0.89 $p < 0.05$ respectively). There was a significant association between longer sleep and better behaviour at time two (OR = 0.34 CI [0.18, 0.6] $p < 0.001$). High consumption of coffee increased the likelihood of poor behaviour at time two (OR = 1.86 CI 1.02, 3.38 $p < 0.05$).

The predictor variables of anxiety and depression models of time two were (sex, sleep, exercise, FSM, total weekly caffeine, and junk food). The binary logistic regression models of anxiety and depression were statistically significant, chi-square (6) = 19.90 $p = 0.003$, chi-square (6) = 14.11 $p = 0.028$ respectively) at time two. In contrast, the logistic regression model of stress was not statistically significant. Females reported significantly higher high anxiety and depression than males (OR = 2.56 CI 1.43, 4.56 $p < 0.001$, OR = 2.50 CI 2.40, 4.50 $p = 0.002$ respectively). In addition, a long sleep score was associated with a decreased odds ratio for high anxiety at time 2 (OR = 0.48 CI 0.28, 0.83 $p = 0.009$).

3.4 Longitudinal Analysis

Cross-lagged models were used to examine the longitudinal effects of HRB predictors at time one on general health, attainment, poor behaviour, anxiety, and depression at time two. The five cross-lag models were significant. Poor general health at T2 was associated with poor health and low attendance at T1 (Table 6). Low attainment at T2 was predicted by high junk food at T1 and low attainment at T1 (Table 7).

Table 6 Cross-lag poor general health Time 2 and predictors Time 1.

Variables	Exp(B)	CI 95%	Sig.
Female – sex T1	1.588	(0.884, 2.854)	0.122
School YearT1	0.971	(0.786, 1.199)	0.783
Not take-FSMT1	1.425	(0.676, 3.003)	0.352
High Junk food T1	0.795	(0.426, 1.485)	0.472
High Healthy food T1	0.621	(0.345, 1.116)	0.111
High Total Weekly Caffeine T1	1.123	(0.552, 2.284)	0.750
Long Sleep T1	1.017	(0.568, 1.821)	0.955
Exercise T1	0.762	(0.431, 1.349)	0.352
High Attendance T1	0.512	(0.289, 0.907)	**0.022**
High coffee T1	1.115	(0.621, 2.001)	0.716
High Tea T1	1.555	(0.846, 2.858)	0.156
High energy drinks T1	1.021	(0.551, 1.891)	0.948
High cola T1	0.786	(0.434, 1.422)	0.426

Poor General Health T1	3.445	(1.832, 6.478)	**0.000**
Model coefficient	χ^2 (14) = 32.499 p < 0.003. R^2 = 0.163		

Table 7 Cross-lag low Attainment Time 2 and predictors Time 1.

Variables	Exp(B)	CI 95%	Sig.
Female- Sex T1	0.973	(0.494, 1.914)	0.936
School Year T1	0.872	(0.685, 1.110)	0.266
Not take FSM T1	1.571	(0.692, 3.566)	0.280
Exercise T1	0.844	(0.438, 1.642)	0.611
High junk food T1	0.477	(0.234, 0.970)	**0.041**
High healthy food T1	1.215	(0.629, 2.350)	0.562
High total Weekly Caffeine T1	0.812	(0.378, 1.744)	0.593
Long sleep T1	0.797	(0.418, 1.521)	0.491
High attendance T1	0.677	(0.351, 1.306)	0.245
High coffee T1	1.418	(0.725, 2.774)	0.308
High tea T1	1.490	(0.753, 2.947)	0.252
High energy drinks T1	0.727	(0.355, 1.492)	0.385
High cola T1	1.285	(0.652, 2.535)	0.469
low attainment T1	9.695	(4.634, 20.285)	**0.000**
Model coefficient	χ2 (14) = 55.071 p < 0.001. R^2 = 0.270		

The cross-lag model of poor behaviours was significant (χ2 (14) = 112.049 p < 0.001. R2 = 0.453), though there were no significant predictors in the cross-lag analysis other than poor behaviours at time one (OR = 23.61, CI [10.71, 52.02] p < 0.001). High stress at T2 was associated with short sleep and low exercise at T1. High tea consumption and low total caffeine at time one were associated with high anxiety in the cross-lag analyses. The higher anxiety and depression reported by females at time one were also found at time two. An association between cola consumption at time one and high depression was demonstrated in cross-lag analysis (see Table 8).

Table 8 Cross-lag high anxiety and high depression Time 2 and predictors Time 1.

Variables	*High anxiety T2*			*High depression T2*		
	Exp(B)	CI 95%	Sig.	Exp(B)	CI 95%	Sig.
High exercise T1	1.158	(0.675, 1.985)	0.595	0.699	(0.405, 1.205)	0.197
Female-gender T1	2.515	(1.436, 4.403)	**0.001**	2.853	(1.631, 4.994)	**0.000**
School year T1	1.107	(0.905, 1.353)	0.324	1.153	(0.939, 1.416)	0.173
No Free School Meals T1	1.659	(0.810, 3.398)	0.167	1.466	(0.704, 3.053)	0.306
High junk food factor T1	1.149	(0.647, 2.041)	0.636	1.551	(0.859, 2.802)	0.146
High healthy food T1	0.758	(0.437, 1.314)	0.323	0.913	(0.523, 1.593)	0.748
High Total Weekly Caffeine T1	0.410	(0.209, 0.807)	**0.010**	0.576	(0.294, 1.130)	0.109
Ethnicity – white T1	0.763	(0.109, 5.342)	0.786	0.875	(0.122, 6.277)	0.894
Long Sleep T1	0.731	(0.421, 1.269)	0.266	0.771	(0.444, 1.339)	0.356

High attendanceT1	0.872	(0.511, 1.489)	0.616	0.866	(0.503, 1.491)	0.603
High coffee T1	1.733	(0.984, 3.052)	0.057	1.443	(0.818, 2.547)	0.206
High tea T1	1.805	(1.002, 3.251)	**0.049**	1.637	(0.906, 2.958)	0.102
High energy drinks T1	0.905	(0.505, 1.622)	0.738	0.959	(0.529, 1.738)	0.890
High cola T1	0.987	(0.564, 1.727)	0.964	0.518	(0.293, 0.916)	**0.024**
Model coefficient	$\chi2$ (14) = 28.18 p = 0.013. R^2 = 0.139			$\chi2$ (14) = 34.82 p = 0.002. R^2 = 0.169		

4. Discussion

The present analyses examined the relationship between HRBs and the well-being and academic performance of a sample of secondary school students with SEN. The prediction of general health was one aim of the research. Gender, sleep, and healthy food consumption were significant predictors of general health in the univariate analyses and remained significant at the multivariate level at time one. In contrast, there was no association between junk foods and general health in the univariate analyses at time one. However, the associations emerged in the multivariate analyses, with high junk food consumption associated with poor general health at time one. The model predicted general health status at time two, but only the healthy food predictor was significant. There was, therefore, some evidence of the impact of diet on health, but only the benefit of a healthy diet appeared robust. Further studies on the variation in the effect of junk food need to be conducted on this population.

The prediction of academic attainment was another aim. Attendance, exercise, and energy drinks appeared significant at time one, but only exercise remained significant in the univariate analyses at time two. However, the multivariate analyses confirmed that high junk food consumption was associated with lower attainment at time two. This effect remained significant even when time one attainment was included in the model.

A third aim of the study was to investigate the effects of HRB on students' conduct. The regression model of HRB and poor behaviour at time one was significant. The school year, gender and sleep were significant in multivariate analyses. Short sleep was associated with poor behaviours at time two in students with SEN. Also, coffee consumption was significantly associated with poor behaviours, with increased coffee consumption being associated with poor behaviours at time two for students with SEN. The results are consistent with the original data findings from the complete sample in the Cornish Academies project [40].

Mental health problems were associated with the consumption of caffeinated drinks. For example, tea consumption was associated with high anxiety and depression. However, as stress, anxiety and depression were only measured at time two, these results must be treated with caution. Also, it is likely that these results reflect reverse causality. Those with mental health problems may drink tea rather than beverages with a high caffeine content. Those with low anxiety may consume more caffeine which accounts for the association between energy drink consumption and low anxiety. The results also show that different aspects of diet and other health-related behaviours have selective effects depending on the outcomes. These results suggest a holistic approach to health-related behaviours rather than focusing on one component, such as diet. The limitation of the study is that the data were secondary analyses, and the study could not include family background characteristics, such as parental education and family income. In addition, it did not consider the categories of SEN (for example, ADHD and autism). The dependent variables of anxiety,

depression, and stress were included only at the second time point, so the effects of lagged values of these outcome variables cannot be measured. Future research must conduct interventions with SEN samples to determine whether a healthy diet, better sleep and increased exercise improve the learning and attention of SEN students. Their general health and well-being must also be addressed, and the present results show that many aspects of their health-related behaviours are relevant [30, 35].

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Author Contributions

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Competing Interests

The authors have declared that no competing interests exist.

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