

USE OF WEB-BASED EPIDEMIOLOGY IN THE INVESTIGATION OF  
RISK FACTORS FOR COMMON MENTAL DISORDER

THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR  
THE DEGREE OF PhD

BY

LYNN SHERREE JESSOP

COCHRANE INSTITUTE OF PRIMARY CARE AND PUBLIC HEALTH  
SCHOOL OF MEDICINE  
CARDIFF UNIVERSITY

JANUARY 2015

## DECLARATION

This work has not been submitted in substance for any other degree or award at this or any other university or place of learning, nor is being submitted concurrently in candidature for any degree or other award.

Signed ..... (Lynn Jessop) Date: 31.01.15

### STATEMENT 1

This thesis is being submitted in partial fulfilment of the requirements for the degree of PhD.

Signed ..... (Lynn Jessop) Date: 31.01.15

### STATEMENT 2

This thesis is the result of my own independent work/investigation, except where otherwise stated. Other sources are acknowledged by explicit references. The views expressed are my own.

Signed ..... (Lynn Jessop) Date: 31.01.15

### STATEMENT 3

I hereby give consent for my thesis, if accepted, to be available online in the University's Open Access repository and for inter-library loan, and for the title and summary to be made available to outside organisations.

Signed ..... (Lynn Jessop) Date: 31.01.15

### STATEMENT 4: PREVIOUSLY APPROVED BAR ON ACCESS

I hereby give consent for my thesis, if accepted, to be available online in the University's Open Access repository and for inter-library loans after expiry of a bar on access previously approved by the Academic Standards & Quality Committee.

Signed ..... (Lynn Jessop) Date: 31.01.15



## SUMMARY

The common mental disorders of anxiety and depression (CMD) impose a substantial burden on individuals and society. A current limitation for research into risk factors for CMD is that the Mental Health Inventory-5 (MHI-5), a brief but widely used scale to measure anxiety and depression was designed without a cut-point to identify cases of CMD. This thesis designed a web-based epidemiological study, Changes in Well-being, to gather data from the MHI-5 and the Clinical Interview Schedule – Revised (CIS-R), representing the ‘gold standard’ for CMD case classification. From a random sample of 10,000 people aged 18 to 74 years living in Caerphilly county borough, Wales, a total of 616 participants were recruited. Of these, 82 (13.4%) were classified as CMD ‘non-severe’ (CMD-NS) using a CIS-R score of 12-17, and 129 (20.9%) were classified as a case of CMD ‘severe’ (CMD-S) with a CIS-R score of 18 and over. In an analysis of paired CIS-R and MHI-5 scores, the corresponding cut-points on the MHI-5 scale of 0-100 were  $\leq 60$  and  $\leq 45$  respectively. These cut-points were applied to baseline and follow-up survey MHI-5 scores in the Caerphilly Health and Social Needs Longitudinal Study dataset to classify cases. Logistic regression analysis showed the importance of younger age, a range of major adverse life events, and living in the most deprived areas as risk factors for the onset of CMD. Adverse employment transitions, moving to non-owner-occupation and becoming widowed were more strongly associated with the onset of CMD-S than CMD-NS. Recovery from CMD was associated with older age groups and living in areas of high social cohesion. This thesis has shown the utility of web-based epidemiological studies in population mental health, determined cut-points on the MHI-5 scale and demonstrated the importance of a wide-range of risk factors for change in CMD case status.

## ACKNOWLEDGMENTS

Akin to a leading actress Oscar winner's speech I have a number of people to thank.

Professor Glyn Lewis, who gave his permission for the web-adaptation, and use of the CIS-R in the CWB website. Professor John Gallacher for resourcing the development of the CWB website, giving access to the web platform, and his generous, wide ranging, support throughout. Professors David Fone, and Frank Dunstan, my supervisors, whose expertise, brilliance, and exacting standards pushed me to strive to deliver a thesis of quality that was worthy of the subject matter and results. Clive Mitchell for his technical expertise, patience and willingness to look beyond the technical issues and grasp the purpose and philosophy adopted for the CWB website. Professor Lesley Jones, for her priceless support, wisdom, and unwavering belief that this thesis would be submitted.

Carl Phillips and the South East Wales Research Ethics Committee team who were always enthusiastic and helpful. The pilot testing reviewers, who made such an important contribution to the development of the CWB website, and its functionality. The Participant Resource Centre for setting up and manning the CWB study's free phone helpline. Angela Watkins, who helped with formal design items for the Participant Information Pack, and countless queries. Dr Daniel Farewell, for providing ad hoc statistical 'tuition' with such generosity of spirit and humility. Gareth Davies Student Support Services for assistance above and beyond the call of duty: for this '*Tommy*' the war is over! Aled Holt PGR Office Manager for handling the submission process so attentively. The many Cardiff University staff that provided the required assistance along the way. The MRC and Cardiff University for funding this research. The Samaritans Cardiff who gave permission for the inclusion of their contact details on the CWB website. The participants for taking part in the CWB study and engaging with the research, though some were clearly not experiencing optimal mental health and well-being. And finally Laura Harding who generously, with such good humour, resolved the formatting issues of this thesis making submission possible. You are a true star.

## TABLE OF CONTENTS

DECLARATION	I
SUMMARY	II
ACKNOWLEDGMENTS	III
TABLE OF CONTENTS	IV
LIST OF TABLES	X
LIST OF FIGURES	XIII
LIST OF ABBREVIATIONS	XV
CHAPTER 1	1
CHAPTER 1: INTRODUCTION TO THESIS	2
1.1 Mental disorders a global problem	4
1.2 Common Mental Disorders	5
1.3 Measuring mental health status and defining cases	7
1.4 The five-item Mental Health Inventory (MHI-5)	7
1.5 The Clinical Interview Schedule – Revised (CIS-R)	10
1.6 The adoption of web-based methods in epidemiological research	10
1.7 Growth of the Internet and usage	12
1.8 Assessing change in mental health status	16
1.9 Caerphilly Health and Social Needs Longitudinal Study (CHSNS)	17
1.10 The research questions and specific objectives of this thesis	17
1.11 Structure of thesis	20
CHAPTER 2	24
CHAPTER 2: LITERATURE REVIEW I - MEASURING MENTAL HEALTH	25
2.1 Chapter objectives	25
2.2 The importance of detecting common mental disorders	25
2.3 Defining mental health and mental disorders	26
2.4 Measuring instruments	36
2.4.1 General Health Questionnaire (GHQ)	39
2.4.2 Clinical Interview Schedule	45
2.5 The measuring instruments utilised in this thesis	47
2.5.1 Clinical Interview Schedule - Revised (CIS-R)	48
2.5.2 Programmable Questionnaire System (PROQSY)	52
2.5.3 The five-item Mental Health Inventory (Version 2)	55

2.6 Determination of a cut-point on the five-item Mental Health Inventory	61
2.7 Conclusions	65
<b>CHAPTER 3</b>	<b>68</b>
<b>CHAPTER 3: LITERATURE REVIEW II</b>	<b>69</b>
3.1 Chapter objectives	69
3.2 Part I: Case prevalence rate for common mental disorder	70
3.3 Part II: Risk factors for mental health case status	74
3.3.1 Individual transitions	75
3.3.2 Marital transitions	82
3.3.3 Socio-economic status	84
3.3.4 Area factors	91
3.3.5 Social cohesion	94
3.4 Part III: Web-based research: challenges and practical issues	97
3.4.1 Internet usage and health information seeking	98
3.4.2 Web-based research	99
3.4.3 Epidemiology and web-based research	100
3.4.4 Internet Mediated Research	101
3.4.5 Mental health related web-based studies	102
3.4.6 Critique of web-based studies	102
3.5 Concluding summary	103
<b>CHAPTER 4</b>	<b>105</b>
<b>CHAPTER 4: THE CHANGES IN WELL-BEING WEB-BASED STUDY</b>	<b>106</b>
4.1 Chapter objectives and overview of the CWB study	106
4.1.1 Components of the CWB study	107
4.1.2 Title for web-based use	109
4.1.3 Harm to participants - Risk assessment	109
4.2 CWB study Design and Methodology	109
4.2.1 Participant recruitment using the Welsh Demographic Service (WDS)	110
4.2.2 The CWB study sample size estimation	111
4.2.3 Web-based studies - secure IT environment	112
4.3 The CWB study DEVELOPMENT work	113
4.4 Measurement instruments	113
4.4.1 Instrument adaptation	113
4.5 The CWB study Website development	115
4.6 Participant information pack development	117
4.7 Participation in the CWB study and free-phone helpline	120

4.8 Consent	121
4.9 The CWB study Questionnaires	122
4.10 Ethical Approval	126
4.11 Pre-pilot testing stage	130
4.11.1 Purpose	130
4.11.2 Method	131
4.11.3 Results	131
4.12 Functionality testing	131
4.13 The Pilot testing	134
4.13.1 Reviewer profiles	134
4.13.2 Selection of reviewers	135
4.14 Phase 1 pilot testing	136
4.14.1 Purpose	136
4.14.2 Method	136
4.14.3 Results	137
4.15 Phase 2 pilot testing	138
4.15.1 Purpose	138
4.15.2 Method	138
4.15.3 Results	138
4.16 Phase 3 pilot testing	138
4.16.1 Purpose	138
4.16.2 Method	139
4.16.3 Results	139
4.17 Pilot testing data collected	139
4.18 Summary of action taken and changes to CWB website	139
4.18.1 Functionality changes	140
4.18.2 The website and documentation content	140
4.19 Ethical approval of study amendments	140
4.20 Data collection – testing the different modes of the CIS-R	141
4.21 CWB website data collection testing	142
4.22 Final website pre-launch activities	142
4.23 CIS-R web-adapted version instrument validity	142
4.24 Discussion	144
4.24.1 The potential of web-based studies in epidemiology	144
4.24.2 Technological challenges	146
4.25 Conclusions	148
<b>CHAPTER 5</b>	<b>149</b>

<b>CHAPTER 5: THE DETERMINATION OF CUT-POINTS ON THE FIVE-ITEM MENTAL HEALTH INVENTORY FOR A CASE OF COMMON MENTAL DISORDER AND COMMON MENTAL DISORDER - SEVERE</b>	<b>150</b>
5.1 Chapter objectives	150
5.2 The data collection study	150
5.3 Characteristics of the sample	152
5.3.1. Sex of participants	152
5.3.2 Age of participants	152
5.3.3 Social deprivation status of participants	153
5.3.4 WIMD quintiles by sex	154
5.3.5 WIMD quintiles by age group	155
5.4 MHI-5 results	155
5.4.1 Mean MHI-5 scores by sex	156
5.4.2 MHI-5 mean scores by age group	157
5.4.3 MHI-5 mean scores by WIMD quintile	157
5.5 CIS-R results	157
5.5.1 CIS-R group by sex	158
5.5.2 CIS-R by age group	159
5.5.3 CIS-R groups by deprivation	159
5.6 Relationship between MHI-5 and CIS-R	160
5.6.1 Preliminary evaluation of the relationship between the instruments	160
5.7 Statistical Methods - identifying two cut-points on the MHI-5	162
5.7.1 Sensitivity and Specificity	162
5.7.2 Receiver Operating Curves (ROC)	163
5.7.3 Optimisation criteria	163
5.7.4 Youden Index ( <i>J</i> )	165
5.7.5 Shortest distance to upper left corner (0, 1)	165
5.7.6 Misclassification rate	166
5.7.7 Minimax criterion	166
5.7.8 Prevalence matching	166
5.8 The CWB dataset: ROC curve plot and optimisation criteria applied	167
5.9 ROC curve plot for CMD-S	172
5.10 MHI-5 cut-points identified in earlier studies	177
5.11 Optimisation criteria - suitability for CWB study	180
5.12 Selecting the cut-points - further considerations	182
5.13 Strengths and limitations	185
5.14 Concluding summary	187
<b>CHAPTER 6</b>	<b>189</b>

<b>CHAPTER 6: CHANGE IN MENTAL HEALTH CASE STATUS: ASSOCIATION WITH INDIVIDUAL SOCIAL AND ECONOMIC TRANSITIONS AND AREA FACTORS</b>	<b>190</b>
6.1 The structure of the analysis	191
6.2 The Caerphilly health and Social Needs Longitudinal Study data set	192
6.3 Characteristics of the sample	192
6.3.1 Sex	192
6.3.2 Age	193
6.3.3 Registrar General Social class	193
6.3.4 Marital status	195
6.3.5 Employment status	196
6.3.6 SF-36 Physical component summary (PCS)	197
6.3.7 Household Tenure	200
6.3.8 Gross Household Income	201
6.4 Small Area level	203
6.4.1 Social deprivation: Townsend Index	203
6.4.2 Social Cohesion	204
6.4.3 Area classification by Rural/Urban category	205
6.5 Five-item Mental Health Inventory scores	206
6.5.1 Five-item Mental Health Inventory mean scores by age group	207
6.5.2 Five-item Mental Health Inventory by Townsend Index	208
6.5.3 Five-item Mental Health Inventory results at follow-up	208
6.6 Overview of the analysis of factors associated with baseline case status and change in case status at follow-up	209
6.7 Model 1 Common mental disorder case status at Baseline	210
6.7.1 Baseline case status and descriptive table for study variables	211
6.7.2 Unadjusted and adjusted odds ratios for the baseline Model 1	213
6.8 Model 2 Onset of Common mental disorder case status	216
6.8.1 Onset of CMD case status and descriptive table for study variables	216
6.8.2 Unadjusted and adjusted odds ratios for Onset of CMD Model 2	219
6.9 Model 3 Recovery from being a case of Common mental disorder	222
6.9.1 Recovery from CMD case status and descriptive table for study variables	222
6.9.2 Unadjusted and adjusted odds ratios for Recovery from CMD Model 3	225
6.10 Analysis of Onset of Common mental disorder-Not severe and Common mental disorder-Severe Models 4 and 5	228
6.11. Analysis of Models 4 and 5: Onset of case of Common mental disorder (Not Severe) and Common mental disorder – Severe	231
6.12 Discussion of the results of the five models	234
6.13 Strengths	238
6.14 Limitations	239

6.15 Conclusions	240
<b>CHAPTER 7</b>	<b>241</b>
<b>CHAPTER 7: SYNTHESIS OF FINDINGS AND FUTURE RESEARCH</b>	<b>242</b>
7.1 The research questions and revisiting the answers found	243
7.2 Review of the thesis objectives and demonstration of how met	248
7.3 Discussion of the strengths and limitations of this thesis	249
7.4 Discussion of the contributions made to knowledge and results	257
7.4.1 Contributions to methodological knowledge	257
7.4.2 Contributions to existing knowledge	258
7.4.3 Discovery of new knowledge	259
7.5 Examination of the implications for researchers	260
7.6 Identification of future research to extend the findings made	261
7.7 Concluding comment	262
<b>REFERENCES</b>	<b>263</b>
<b>APPENDIX</b>	<b>284</b>



## LIST OF TABLES

<b>CHAPTER 1</b>	<b>1</b>
Table 1.1 World Internet usage (reduced continents form)	12
<b>CHAPTER 2</b>	<b>24</b>
Table 2.1 Example of GHQ-12 questions and scoring methods	41
Table 2.2 MHI-5 reverse-coded and final question values	57
Table 2.3 Formulae for Scoring and Transforming Scales	57
<b>CHAPTER 3</b>	<b>68</b>
Table 3.1 Comparison of case prevalence for CMD and CMD-S in the general population	70
<b>CHAPTER 4</b>	<b>105</b>
Table 4.1 Human ageing and web use	133
Table 4.2 CWB Pilot testing reviewer profiles	135
<b>CHAPTER 5</b>	<b>149</b>
Table 5.1 Participants by age group and sex	153
Table 5.2 Distribution of participants by WIMD quintile	154
Table 5.3 WIMD quintiles by sex	155
Table 5.4 WIMD quintiles by age group	155
Table 5.5 MHI-5 mean scores by age group	157
Table 5.6 MHI-5 mean score by WIMD quintile	157
Table 5.7 CIS-R group by sex	158
Table 5.8 CIS-R group by age group	159
Table 5.9 CIS-R group by WIMD quintile	159
Table 5.10 ROC curve results and cut-points with selected optimisation criteria calculations for case of common mental disorder on the MHI-5 for both sexes	168
Table 5.11 ROC curve results and cut-points with selected optimisation criteria calculations for common mental disorder by reference to sex: (1) Male	169
Table 5.12 ROC curve results and cut-points with selected optimisation criteria calculations for common mental disorder by reference to sex: (2) Female	170
Table 5.13 Summary of the cut-points for a case of CMD	171
Table 5.14 ROC curve results and cut-points with key optimisation criteria calculations for CMD-S the sexes combined	172
Table 5.15 Summary of selected cut-points for CMD-S with classification rates	173

Table 5.16 Difference in value between selected cut-points for a case of CMD-S	173
Table 5.17 ROC curve results and cut-points with selected optimisation criteria calculations for CMD-S by reference to sex: (1) Male	175
Table 5.18 ROC curve results and cut-points with selected optimisation criteria calculations for CMD-S by reference to sex: (2) Female	176
Table 5.19 Summary of MHI-5 cut-point scores identified by the five optimisation criteria for a case of CMD-S	176
Table 5.20 Summary of MHI-5 cut-point scores identified in earlier studies with optimisation criteria used	178
Table 5.21 Summary of MHI-5 cut-point scores identified by the five optimisation criteria with selections made	182
<b>CHAPTER 6</b>	<b>189</b>
Table 6.1 Age group at baseline	193
Table 6.2 Baseline Registrar General Social class	194
Table 6.3 Marital status at baseline	195
Table 6.4 Marital status transitions	196
Table 6.5 Employment status at baseline	196
Table 6.6 Employment status transitions	197
Table 6.7 SF-36 PCS at baseline	199
Table 6.8 SF-36 PCS transitions	199
Table 6.9 Household tenure at baseline	200
Table 6.10 Household tenure transitions	200
Table 6.11 Gross Household Income at baseline	202
Table 6.12 Gross Household Income transitions	202
Table 6.13 Townsend Index	204
Table 6.14 Social Cohesion in thirds at baseline	205
Table 6.15 Rural/Urban categories at baseline	206
Table 6.16 MHI-5 Mean (SD) scores by age group at baseline	207
Table 6.17 MHI-5 mean score by the Townsend Index	208
Table 6.18 Change in CMD case status between baseline and follow-up	209
Table 6.19 Analysis strategy	210
Table 6.20 Number (%) of participants classified into CMD and Not a case at baseline	211
Table 6.21 Description of the study variables by Common mental disorder case status at baseline	211
Table 6.22 Unadjusted and adjusted odds ratios for a case of CMD at baseline	213
Table 6.23 Transitions in Common mental disorder case status between baseline and follow-up	217

Table 6.24 Description of the study variables for onset of Common mental disorder case status	217
Table 6.25 MODEL 2: Onset of CMD Unadjusted and Adjusted Odds ratios	219
Table 6.26 Description of the study variables by recovery status from being a case of Common mental disorder	222
Table 6.27 Model 3: Recovery from being a case of CMD Unadjusted and Adjusted Odds ratios	225
Table 6.28 Description of the sample by study variables with Onset of Common mental disorder-NS and Common mental disorder-S case status	228
Table 6.29 MODELS 4 AND 5: Fully adjusted odds ratio results for Onset of Common mental disorder (NOT SEVERE) AND Common mental disorder – Severe	231
Table 6.30 Statistically significant Odds ratios for Onset of CMD-NS and CMD-S	237
<b>CHAPTER 7</b>	<b>241</b>
Table 7.1 Case prevalence for common mental disorder and common mental disorder-severe	253

## LIST OF FIGURES

<b>CHAPTER 1</b>	<b>1</b>
Figure 1.1 Devices used to view websites in 2011 for the age range 16 to 65 years and over	13
Figure 1.2 Websites receiving traffic from mental health search terms	15
<b>CHAPTER 2</b>	<b>24</b>
Figure 2.1 Formula and example for transformation of raw scale scores to 0-100 scale scores	58
<b>CHAPTER 4</b>	<b>105</b>
Figure 4.2 The CWB website home page	116
Figure 4.3 Extract from the web browser address bars information sheet	117
Figure 4.4 Screen shot of CWB website login webpage	120
Figure 4.5 Participant instructions on how to use the CIS-R PC format	121
Figure 4.6 Consent web-page of the CWB website	122
Figure 4.7 CWB webpage with an overview of the MHI-5 instructions and two of the questions	123
Figure 4.8 Screen shot of a webpage with information and instructions written for the web-adapted format of the CIS-R	124
Figure 4.9 Screen shot of the webpage notifying the end of interview and to proceed to the Guidance notes	125
Figure 4.10 Final page of the CIS-R PC format	125
Figure 4.11 CWB website Guidance notes webpage	125
Figure 4.12 CWB website request to participate in future research	126
Figure 4.13 Two CWB webpages with the linked webpage in order of appearance	129
Figure 4.14 Two CIS-R via PROQSY program 'pages' in order of appearance	130
Figure 4.15 CWB website webpage advising of a final task and the consent to further contact webpage	148
<b>CHAPTER 5</b>	<b>149</b>
Figure 5.1 Participant recruitment rate for the CWB study website	151
Figure 5.2 CWB website site closed webpage	151
Figure 5.3 Welsh Index of Multiple Deprivation domains	153
Figure 5.4 Histogram of MHI-5 scores	156
Figure 5.5 Distributions of MHI-5 scores by sex	156

Figure 5.6 Distribution of CIS-R scores	158
Figure 5.8 Histograms of MHI-5 scores for the CIS-R groups	162
Figure 5.9 ROC curve for MHI-5 scores	168
<b>CHAPTER 6</b>	<b>189</b>
Figure 6.1 SF-36 Scales Measure of Physical and Mental Components of health with variance estimates	198
Figure 6.2 Histogram of transformed MHI-5 baseline score	207
Figure 6.3 Histogram of MHI-5 scores at follow-up	208

## LIST OF ABBREVIATIONS

Acronyms and abbreviations have been kept to a minimum in the main body of the text, although they do feature extensively in tables and figures. Acronyms and abbreviations are defined where the relevant terms are first introduced, at the foot of tables, and where it may assist recall in later chapters. For ease of reference a comprehensive list appears here.

APA: American Psychiatric Association

APMS: Adult Psychiatric Morbidity Survey (2007)

AWFG: Age Well Feel Good study

BHPS: British Household Panel Survey

CES-D: Center for Epidemiological Studies – Depression Scale

CHSNS: Caerphilly Health and Social Needs Study (the survey)

CIDI: World Health Organisation Composite International Diagnostic Interview

CIS: Clinical Interview Schedule

CIS-R: Clinical Interview Schedule – Revised

CIS-R via PROQSY: The CIS-R written as a PROQSY compatible computer script

CIS-R web-adapted: The CIS-R computerised script adapted for web-based use

CMD: Common Mental Disorder (all)

CMD-NS: Common Mental Disorder- Not Severe

CMD-S: Common Mental Disorder-Severe

CWB: Changes in Well-Being study

DALY: Disability-Adjusted-Life-Year

DSM: Diagnostic and Statistical Manual of Mental Disorders all versions;  
predominantly III-R, IV, IV-TR and V

GBD: Global Burden of Disease

GHQ: General Health Questionnaire (12, 18, 30 and 60)

HADS: Hospital Anxiety and Depression Scale

ICD-10: International Classification of Diseases 10th Revision

IMR: Internet Mediated Research

The Institute: Institute of Primary Care and Public Health, in the School of  
Medicine, Cardiff University

IOS: IOS Ltd an NHS approved external supplier  
 M-CIDI: Munich-Composite International Diagnostic Interview  
 MADD: Mixed Anxiety and Depression Disorder  
 MDE: Major Depressive Episode  
 MHI-5: Five item Mental Health Inventory (versions 2 and 1 as stated)  
 MINI MAX: Minimax method  
 MISCL RATE: Misclassification rate  
 MR: Misclassification rate (*tables*)  
 MX: Minimax method (*tables*)  
 NICE: National Institute for Health and Care Excellence  
 NMH: Normal Mental Health – Not a case  
 NMH-II: Normal Mental Health – Never a case  
 NWIS: NHS Welsh Informatics Services  
 PHQ-9: Patient Health Questionnaire Depression Scale  
 PM: Prevalence matching  
 PMAPH: Psychiatric Morbidity among Adults living in Private Households (England)  
 PRC:UK Biobank National Participant Resource Centre  
 PREV.MATCH: Prevalence Matching  
 PROQSY: Programmable Questionnaire System  
 ROC: Receiver Operating Curves  
 S: Shortest distance to the upper left corner, co-ordinates (0,1) (*tables*)  
 SEW REC: South East Wales Research Ethics Committee  
 SF-36: Short Form Health Survey 36  
 SHORT 0, 1: Shortest distance to the upper left corner, co-ordinates (0,1)  
 University: Cardiff University  
 WDS: Welsh Demographic Service  
 WHO: World Health Organisation  
 WHS: Welsh Health Survey  
 WIMD: The Welsh Index of Multiple Deprivation  
 Y: Youden Index  
 The Harvard Style is used for citing and referencing

## CHAPTER 1



## CHAPTER 1: INTRODUCTION TO THESIS

*'No health without mental health'*

### Mental health and well-being: the public health challenge

Mental health is a fundamental public health issue; without good mental health and well-being the ability to manage life's normal stressors is diminished and quality of life is reduced. The effects of poor mental health are far reaching and can last a lifetime (*Department of Health 2011*). Whether measured by financial or human cost, the burden placed upon society and individuals by poor mental health is considerable. In consequence, reducing the scale of the problem has become a pressing item on the public health agenda for all those involved in public health, including researchers, clinicians, public health practitioners and policy makers.

Poor mental health is indicated by the presence of specific symptoms associated with mental disorders. Mental disorders encompass a continuum from mild sub-clinical symptoms to severe clinically diagnosed mental illnesses. In the UK depression and anxiety are the most frequently occurring mental disorders in the general population. These common mental disorders, of depression and anxiety form the central focus of this thesis. Despite their prevalence and burden, common mental disorders are frequently, undetected, or misdiagnosed as physical illness, and left untreated. This pivotal issue is succinctly expressed by Kessler;

*Detection is important because it is a precondition of treatment; treatment, however excellent, can only be delivered to those whose disorder has been detected.*

*(Kessler, D. 2003, p.62)*

Ascertaining the mental health status of the general population, and identifying changing trends, is an important area of public health research because it provides a significant indicator of overall health. Outside of large scale national surveys such as the Adult Psychiatric Morbidity Survey of England,

(APMS 2007), where standardised clinical interviews are used, researchers have customarily measured mental health status and common mental disorders (different types of depression and anxiety) by means of self-report instruments. These remain popular despite questions of validity and other limitations e.g. length and absence of a cut-point for caseness. The requirement exists for a convenient and valid method of identifying a case of common mental disorder. Specifically, a measure is required that has been validated by the 'gold standard' of a standardised clinical interview. This should be robust, short, easy to administer, and with a defined cut-point or threshold for determining a case of common mental disorder.

Throughout this thesis, reference is made to identifying a case of common mental disorder, but this term does not describe a specific diagnosable disorder. Rather, it is a label used for different types of depression and anxiety that are the most common mental disorders in the community. Although widely used it is not universally adopted, and as the literature confirms, there is a variety of different terminology in use that is not always defined or identical in meaning.

The public health challenges posed by common mental disorders extend beyond the ability to identify cases. It is also necessary to understand the factors associated with change in mental health case status, which are of increasing significance. This includes individuals' mental health status moving from 'at risk' to case status, recovery, or progression to more severe symptoms. As will be shown, studies which examine risk factors and their association with changes in mental health case status, for example, individual transitions relating to life events, socio-economic status, or area factors, generally focus on a small number of factors within a specific field of interest. Another limitation found in a significant number of these studies is the inability to assess change due to the use of cross-sectional analysis. Examination of a small number of risk factors, though useful, can only provide limited insights. In order to understand the aetiology of common mental disorders, and the effects on mental health case status of multiple risk factors to which individuals may be exposed simultaneously (e.g. ill- health, debt, marriage breakdown, unemployment, deprived neighbourhood

with poor social cohesion) the broader scope provided by large scale longitudinal studies is required.

In the next section a more detailed commentary on the initial topics discussed is provided to give context to the central focus of this thesis.

### 1.1 MENTAL DISORDERS A GLOBAL PROBLEM

The global burden of mental illness is such that it is no longer considered a lower priority to physical illness. The World Health Organisation (WHO) 2001 Report focused on mental health, well-being and the growing global burden of mental disorders. The WHO estimated that around 25% of all people would at some time during their lives be affected by neuropsychiatric conditions, with around 20% of all patients seen in primary health care having one or more mental disorders.

The WHO suggested that depression is the leading cause of disability across the world affecting some 121 million people. In its 2004 report the WHO estimated that by 2020, depression will be the second highest contributor (after heart disease) to the global burden of disease. By 2030, it is expected to be the first (WHO 2004). In a cross-cultural study across 15 sites, the UK (Manchester) ranked second highest for prevalence of depression at 16.9%, (Goldberg and Lecrubier 1995). In the 2012 Health Survey of England (a yearly survey held since 1991 that monitors the nation's health)(<http://data.gov.uk>) the prevalence of probable mental ill-health, noted as a score  $\geq 4$  on the GHQ-12 (Goldberg and Williams 1988), (the General Health Questionnaire-12) was 15% (1094) of a population sample of 7257. Turning to Wales, the Welsh Health Survey (WHS) (an annual survey carried out in Wales which collects information on a range of individuals' health behaviours and other characteristics such as social class)(<http://data.gov.uk>) in its 2010 report states that 10 % of respondents reported being treated for mental illness. In the WHS 2013 Initial Headline Results ([www.hscic.gov.uk](http://www.hscic.gov.uk)) this figure is 12%. It is likely that the true prevalence rate is higher due to reporting errors, and non-participation of individuals who were receiving treatment or otherwise unable to take part. Comparing the prevalence

rates of mental disorders found in the literature is problematic due to a number of factors such as the measures used, the disorders of interest, location and timing of surveys and the period over which prevalence is measured. In consequence a wide variation in prevalence rates exists, and explanations or theories for unusual prevalence rates are not always provided.

## 1.2 COMMON MENTAL DISORDERS

The term common mental disorder does not have the benefit of a universally accepted definition. Given common mental disorders are central to this thesis, the following general definitions are helpful.

Goldberg and Huxley (1992), in their seminal work on common mental disorders, defined them as:

*...disorders which are commonly encountered in community settings, and whose occurrence signals a breakdown in normal functioning.*

*(Goldberg and Huxley 1992, pp.7-8)*

The authors noted that, in general terms, these comprise depressive illnesses and anxiety-related disorders.

The APMS (2007, p.27) defines common mental disorders as follows:

*Common mental disorders, also known as neurotic disorders, are mental conditions that cause marked emotional distress and interfere with daily function, but do not usually affect insight or cognition. Common mental disorders comprise different types of depression and anxiety.*

Although common mental disorders are easily distinguishable from more severe mental disorders, Goldberg and Huxley (1992) note that absence of severity does not imply that the disorders which are common in the community can be described as 'mild', or do not cause enormous suffering and potential long term disability. Common mental disorders encompass a range of conditions including phobias and obsessive compulsive disorder, but unless otherwise

indicated, reference to common mental disorders in this thesis refers to depression and anxiety.

As noted in the opening comments, the common mental disorders of anxiety and depression (often comorbid) are the most common cause of psychological distress in the community, and reducing their scale is a key public health challenge (Goldberg and Huxley 1992). Common mental disorders have a population prevalence of 15–30%, depending on the definition used (Goldberg and Huxley 1992; Meltzer *et al.* 1995; Weich and Lewis 1998) and constitute a major public health burden of reduced physical and social functioning, higher mortality, and lost productivity, (Murphy *et al.* 1987; Wells 1988; Lloyd *et al.* 1996). Common mental disorders account for one in five consultations with general practitioners (Williams *et al.* 1986) and one-fifth of days lost at work in Britain, (APMS 2007). Despite this, and their prevalence in the community, it is known that cases of common mental disorder are not always diagnosed and treated in primary care (Paykel and Priest 1992; Kessler, D. 2003). Recognising depression is made more difficult by the regularity of presentations with somatic symptoms, and of depression related to physical disorders (Paykel and Priest 1992). The significance of case detection is the potential to assist individuals to recover more quickly than would be the case if they did not receive treatment (Goldberg and Huxley 1992). Without treatment, symptoms will take longer to resolve (Freeling *et al.* 1985), can increase in severity, and may result in progression to clinical disease, increasing further the already considerable cost to individuals and society. Mental disorders can also be risk factors for numerous physical health problems, or the consequences of them.

Mental and physical illnesses are frequently associated with common risk factors and disentangling the two is problematic, (Churchill 2010). Together they often exacerbate and intensify the experience of physical symptoms, increase functional impairment, impede recovery and adherence to treatment, worsen prognosis and reduce life expectancy; a costly and vicious cycle of poor physical and mental health results (Churchill 2010; NICE 91, 2009). The non-detection of depression and anxiety in the physically ill increases the demand for effective

case identification methods and integrated services (Goldberg and Huxley 1992; Chew-Graham 2002).

It is apparent that identifying and separating mental disorders from physical conditions is far from simple, and where self-report measures are used it is likely that reporting errors will occur further complicating detection.

### 1.3 MEASURING MENTAL HEALTH STATUS AND DEFINING CASES

Self-report survey questionnaires are commonly used in large epidemiological studies to ascertain the mental health status of individuals in the general population, and to identify changing prevalence and other trends. These instruments provide a convenient option as they are often short and self-explanatory. Although they lack the sensitivity and specificity of a standardised clinical interview, they remain popular amongst researchers as an economical and effective method of identifying psychologically distressed individuals in the general population (Means-Christensen et al. 2005).

Where greater sensitivity and specificity are required, the standardised clinical interview is the 'gold standard'. However, these interviews are usually conducted by trained interviewers or psychiatrists, and take considerably longer to complete. This makes them an unsuitable and unaffordable option for use in many general population studies. A compromise solution for case finding in population-based studies is to use a self-report questionnaire that has been validated for determining cases against a standardised clinical interview. Although this approach may not provide the differential 'diagnosis' available from a standardised clinical interview, it does offer an instrument with a valid facility to define cases.

### 1.4 THE FIVE-ITEM MENTAL HEALTH INVENTORY (MHI-5)

The Mental Health Inventory 5 (MHI-5) is the mental health scale used in the Short Form Health Survey (SF-36). The SF-36 covers eight health concepts (Ware and Gandek 1998) and includes four major mental health dimensions (anxiety,

depression, loss of behavioural/emotional control, and psychological well-being). The MHI-5 is useful in the screening of psychiatric disorders, (Berwick *et al.* 1991; Ware *et al.* 1995; Jenkinson *et al.* 1999) and is in widespread use both globally e.g. Denmark (Thorsen *et al.* 2013) Croatia (Rukavinia *et al.* 2012) the Netherlands (Cuijpers *et al.* 2009) and locally e.g. the Welsh Health Survey and the Caerphilly Health and Social Needs Longitudinal Study (CHSNS) (Fone *et al.* 2007; 2013). Although self-report questionnaires such as the MHI-5 are imperfect, as Berwick and colleagues (1991) have observed, a screening measure of less power that is actually used might be of greater benefit than a 'gold standard' instrument that was not used due to its length.

The MHI-5 is discussed in detail in Chapter 2; comment here is confined to the main points of interest. The MHI-5 is a brief measure of mood disorders (McCabe *et al.* 1996; Ware and Gandek 1998; Ware *et al.* 2000) and its validity and reliability are well established. It was developed specifically to measure mental health in the general population. Studies have shown it to be an equally valid measure of mental health status as the 12-item GHQ-12 (Berwick *et al.* 1991; McCabe *et al.* 1996). As a measure of continuously distributed mental health, the MHI-5 was not designed with cut-points to define a case of common mental disorder or clinical disease, but instead was developed as a discrete scale (Ware and Gandek 1998). There are two versions of the MHI-5; in this thesis version two is used. The differences between the versions are discussed in Chapter 2.

A number of studies have been conducted to establish a cut-point for a case of common mental disorder on the MHI-5 scale, and the primary studies (Winston and Smith 2000; Hoeymans *et al.* 2004; Kelly *et al.* 2008) are discussed in Chapters 2 and 5. As a precursor to those chapters, two of these studies identified cut-points that were not validated due to the use of an alternative to a 'gold standard' standardised clinical interview. The findings are further complicated by the differing criteria and cut-point used for determining a case e.g. what constitutes a case of common mental disorder in one study may be an indicator of major depression and anxiety disorder in another. This variation encapsulates the problem and demonstrates why determination of a cut-point is

best achieved by use of a standardised clinical interview, designed to measure common mental disorders. However, the study which did use a suitable gold standard instrument to determine a cut-point for a case of common mental disorder had other significant limitations (*Winston and Smith 2000*).

There are other studies (*Rumpf et al. 2001; Hoeymans et al. 2004; Cuijpers et al. 2009*) that have identified cut-points on the MHI-5 scale by using a selection of measures as the gold standard. A further problem exists as the threshold determined is for depression of differing severity and not a case of common mental disorder. This has resulted in a range of thresholds and non-comparable results. These issues explain why the MHI-5 still lacks a widely used or useful cut-point to determine cases of common mental disorder.

In addition to determining a cut-point for a case of common mental disorder, there is value in determining a cut-point for more severe disorder. The APMS (2007) notes that a score of 18 and above on the CIS-R identifies more severe neurotic symptomatology that is likely to require treatment. This score can be used for the necessary analysis to determine a second cut-point. Such a cut-point will enable identification of the extent of scale scores between a case of common mental disorder and a disorder of increased severity that is likely to require treatment. It will also provide the opportunity to investigate whether the MHI-5 has sufficient sensitivity to discriminate between differing levels of severity of mental disorder. In this thesis, a new categorisation of 'severe common mental disorder' (CMD-S) is introduced to distinguish the severity of disorder measured.

At this point it is pertinent to note that notwithstanding questions of validity and the different status attaching to thresholds, it is not known how these thresholds relate to vulnerability to developing more severe mental illness. None of the measures used, or studies to-date, afford an insight into this matter.



## 1.5 THE CLINICAL INTERVIEW SCHEDULE – REVISED (CIS-R)

The CIS-R is a clinically validated standardised interview developed to measure common mental disorders in the general population (Lewis *et al.* 1992). It defines sub-threshold neurotic mental disorders and neurotic symptoms of a severity likely to require treatment (APMS 2007, p.25). The CIS-R is available in a computerised format

The flexibility of administration and reliability of the CIS-R have resulted in its widespread use and inclusion in UK national population surveys such as the APMS (2007). The specific development of the CIS-R for measuring common mental disorders, and its capacity to identify probable clinical disease, makes it a suitable choice to determine cut-points on the MHI-5. It is therefore the standardised clinical interview used to establish cut-points for a case of common mental disorder, defined by a score  $\geq 12$ , and more severe neurotic symptomatology, in this thesis defined by a score  $\geq 18$  for a case of CMD-S. Symptomatology of this severity may indicate a different classification, though at what score between 18 and 57 this might occur for any diagnosable disorder or group of disorders, is not known.

## 1.6 THE ADOPTION OF WEB-BASED METHODS IN EPIDEMIOLOGICAL RESEARCH

*There was a time when people felt the Internet was another world, but now people realise it's a tool that we use in this world*

*Sir Tim Berners-Lee*

The use of web-based technologies via the Internet in epidemiological research is an exciting and dynamic development. The rapid growth of the Internet, substantial number of users globally, and high level of demand for health-related information, are driving an increasing number of researchers to consider how they can utilise these new technologies. Web-based studies offer several advantages including reduced costs, increased convenience for participants and researchers, and greater confidentiality to participants. The existence of the CIS-R in a computerised format and the prospect of recruiting a larger number of

participants, determined that the possibility of conducting a web-based study had to be explored.

The emergence of web-based research is illustrated in a survey of 750 university Human Research Ethics Boards in the United States. This revealed that internet research protocols involving online or web surveys are the type most often reviewed (94% of respondents), indicating the growing prevalence of this methodology for academic research (*Buchanan and Hvizdak 2009*).

The Institute of Primary Care and Public Health (the Institute) in the School of Medicine, Cardiff University, has in development a bespoke software web-platform (the web-platform) to facilitate web-based research. An increasing number of studies within the Institute are being designed to capitalise on the emerging web-based technologies. The requirement for a separate study to determine cut-points on the MHI-5 and existence of the CIS-R in a computerised format presented a prime opportunity to conduct the cut-point study using web-based methods. Although it was not known if the CIS-R could be adapted for web-based use in the proposed study, if feasible it would provide access to the tremendous research opportunities presented by the Internet and contribute to the further development of the web-platform.

In order to assess whether web-based methods were suitable for the planned research a technical feasibility assessment was conducted by Institute research staff at the author's request. An evaluation of the CIS-R (discussed in Chapter 2) was made. The assessment confirmed that it was possible and feasible to adapt the CIS-R for web-based use. At this point the Principal Investigator in the Institute of the web-based Age Well Feel Good study (AWFG) (*Gallacher et al. 2013*), discussed later in this chapter, whose team are developing the web-platform, agreed to provide the technical expertise and resources required for the cut-point study.

To place the emergence of web-based research in context, and appreciate the potential of using this methodology it is useful to consider the growth in internet usage.

### 1.7 GROWTH OF THE INTERNET AND USAGE

The Internet has changed how we communicate, obtain information, and approach a multitude of activities. Researchers are increasingly examining how the opportunities presented can be exploited. Chapter 3 Part III discusses web-based research and health-related studies; the comments below provide background to the growth of the Internet and why it presents substantial research opportunities.

In 2003 it was estimated that 15 million people accessed the Internet every day and this rate was increasing by around 25% every three months (*Rhodes et al. 2003*). Table 1.1 provides an indication of the scale and use of the Internet at the end of June 2014.

Table 1.1 World Internet usage (reduced continents form)

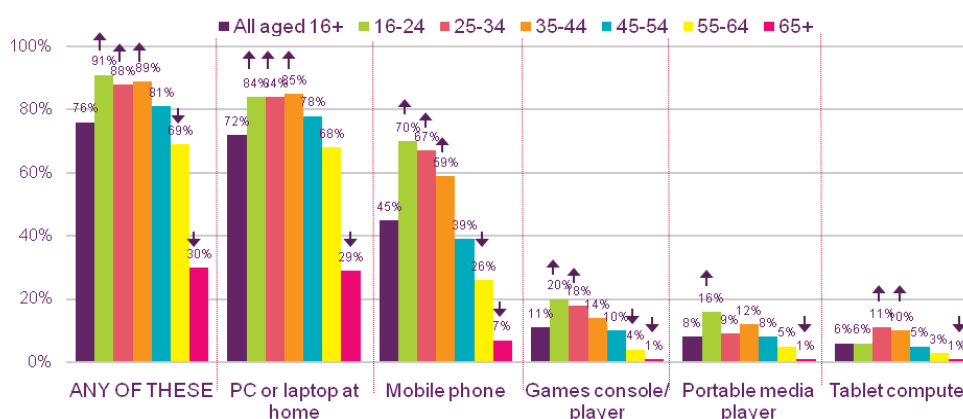
WORLD INTERNET USAGE AND POPULATION STATISTICS JUNE 30, 2014					
WORLD REGIONS	POPULATION (2014 EST.)	INTERNET USERS 31.12.2000	INTERNET USERS LATEST DATA	PENETRATION POPULATION %	GROWTH 2000-2014
EUROPE	825,824,883	105,096,093	582,441,059	70.5 %	454.2 %
NORTH AMERICA	353,860,227	108,096,800	310,322,257	87.7 %	187.1 %
E & NA (TOTAL)	1,179,685,110	213,192,893	892,763,316	-	-
UK FIGURES	63,742,977	15,400,000	57,266,690	89.9%	271.9%
WORLD TOTAL	7,182,406,565	360,985,492	3,035,749,340	42.3 %	741.0 %

(Source: Internet World Stats, Miniwatts Marketing Group, 2014)

In 2013, 21 million households in the UK had an internet connection; this figure represents 83% of households. The Internet was accessed by 36 million

adults (73%) in the UK every day, 20 million more than in 2006. Methods of accessing the Internet are rapidly changing with six out of every 10 adults (61%) using a mobile phone or portable computer to access the Internet 'on-the-go'. People accessed the Internet for news information (55%), to access their bank accounts (50%), and to seek health information (43%), (ONS 2013). In figure 1.1, the devices used to view websites are shown for the age range 16 years and over.

Figure 1.1 Devices used to view websites in 2011 for the age range 16 to 65 years and over



(Source: Communications Market 2012, Ofcom.org.uk)

In a recent study 32% of young people (aged under 30 years) considered the Internet a basic necessity, and one in three university students and young professionals considered the Internet to be as important as air, water, food, and shelter. The study recruited 2,800 participants from 14 countries (the UK was a participating country), 100 university students and 100 young professionals from each country. In the UK results, 64% of university students and 73% of young professionals stated that they could not live without the Internet because it was an integral part of their daily life (Cisco Connected World Technology Report 2011). In the 2014 report, of 2,912 white collar professionals aged between 18 and 51 years, recruited from 15 countries including the UK, 42% would choose internet access rather than their sense of smell (Cisco Connected World Technology Report, 2014).

Increasingly, commercial and public organisations are directing individuals to the Internet to obtain information, complete forms and register interest in countless products and services. The Internet is no longer a novel means of conducting business, obtaining information about public bodies, and leisure activities; rather it has increasingly become the norm.

More pertinent to epidemiological research is the increasing trend of using the Internet to obtain health-related information. The percentage of UK internet users accessing online health-related information increased from 37% in 2005 to 68% in 2009 (*Dutton et al. 2005; 2009*). A 2005 survey of seven European countries found that 71% of all adults used the Internet for health information (*Andreassen et al. 2007*). In the United States this figure was 61% (*Fox et al. 2009*).

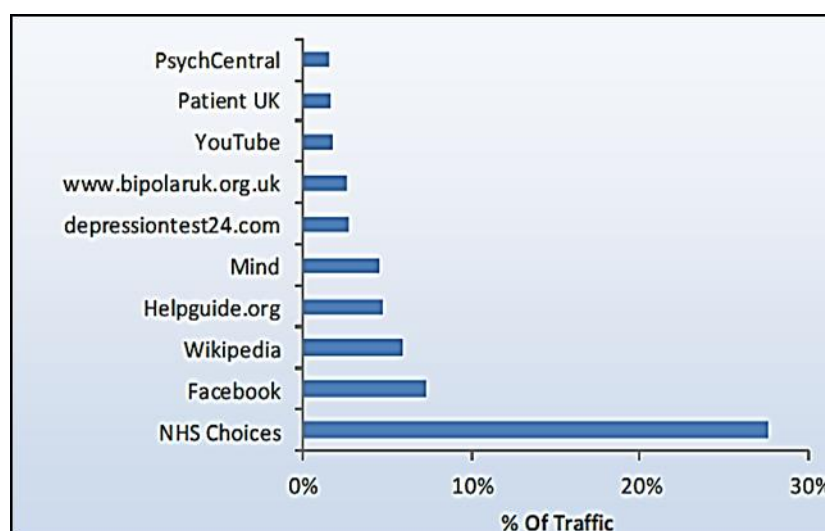
The National Health Service (NHS) Direct website launched in 1999 was the UK's main health advice and information website for patients and the public. In 2009 the website recorded 18 million visits (*NHS Direct 2010*). Health-related internet use is seen as embedded in everyday health practices (*Kivits 2009; Powell et al. 2011*).

The NHS Direct website was decommissioned in March 2014 and replaced by NHS Choices. This new website provides weekly reports on its website traffic. For the period 26 May 2014 to 1 June 2014, the number of visits to nhs.uk totalled 9.39 million, seven million of which were unique visitors. The number of visits recorded saw an increase of 49% compared to the same period in 2013 (*NHS UK, 2014*).

NHS Choices is the most popular health website in Europe and the UK's third biggest government website. Traffic continues to grow with the website receiving 40.6 million visits between August 2013 and 2014. In August 2014 over two million visits were made to the mental health pages and the top three search terms were 'depression' 'anxiety' and 'bipolar', which mirrored the most visited mental health conditions (*NHS Choices Mental Health Content Report August*

2014). Figure 1.2 shows the websites receiving traffic from mental health search terms and indicates the popularity of the NHS Choices website with those seeking information on mental health.

Figure 1.2 Websites receiving traffic from mental health search terms



(Source: NHS Choices Mental Health Content Report August 2014)

The potential for epidemiological research is illustrated by a US web-based ‘Mood Screener’ study examining the prevalence of major depression and depressive symptoms, which used a screening measure for a Major Depressive Episode (MDE). Over 50,000 participants were attracted to the website over the course of the year-long study, with 24,965 people screened for MDE (Leykin *et al.* 2012). Of those screened, 66.6% were assessed positive for an MDE. This was an unexpectedly high rate of depression. The researchers posit that the majority of those seeking information on depression online probably had good reasons for so doing based upon the results of the screening. The findings of this study suggest that web-based studies may not deter individuals with mental health disorders from responding but might in fact attract them.

The AWFG study, previously referred to, is a longitudinal web-based study undertaken by the Institute to examine how people over 50 years of age can remain healthy and happy as they age. The study population was recruited by mail from eligible residents in south Wales. After the invitation mailing of

15,000 prospective participants recruited 660 (4.4%), all subsequent contact and task performance was carried out remotely by use of web-based methods.

An interesting aspect of the study design is the length of participation, which is until the participant dies. Although at an early stage, the AWFG study has the potential to collect data for an extensive period with minimal on-going research costs.

#### 1.8 ASSESSING CHANGE IN MENTAL HEALTH STATUS

In the introductory comments to this chapter, reference was made to the lack of understanding and knowledge regarding the effects of multiple concurrent risk factors associated with changes in mental health case status. In order to understand more fully change in mental health case status and severity in the general population, and the association with commonly occurring risk factors, longitudinal research is required that concurrently examines a range of individual transitions (socio-economic and life events) and small-area factors (such as neighbourhood settlement type and social deprivation). There are a considerable number of studies investigating the effect of individual transitions on mental health status for a wide range of transitions including unemployment (*Thomas et al. 2005; Weich and Lewis 1998*); retirement (*Thomas et al. 2005*); lack of social support (*Pevalin and Goldberg 2003*); and divorce (*Wade and Pevalin 2004*). Many cross-sectional studies are in the literature, but fewer longitudinal studies, have investigated associations between mental health and area or neighbourhood factors, such as area deprivation, and other neighbourhood socio-economic characteristics (*Dalgard and Tambs 1997; McCulloch 2001; Drukker and van Os 2003; Macintyre and Ellaway 2003; Stafford and Marmot 2003; Weich et al. 2003; Chandola et al. 2005; Propper et al. 2005; Skapinakis et al. 2005; Fone et al. 2007; Lofors and Sundquist 2007*); social cohesion (*Fone et al. 2007; Stafford et al. 2011*) and rural and urban living (*Weich et al. 2006*). Most studies are either cross-sectional in design, precluding findings of change, or examine a single or small number of risk factors.

Notwithstanding their general importance and value, longitudinal studies are resource intensive, and results are only obtained after extended periods. These factors serve to reduce the number of studies conducted compared to other designs. Of the longitudinal studies of relevance found (discussed in Chapter 3 Part II) each focused on a small number of risk factors and was therefore unable to consider the wider range of associations which were likely to be operating. No studies have been found where change in mental health case status, multiple individual transitions, and area factors have been investigated at the same time, which is the aim of the analysis of the CHSNS data in this thesis.

#### 1.9 CAERPHILLY HEALTH AND SOCIAL NEEDS LONGITUDINAL STUDY (CHSNS)

The data for the analysis of change in mental health case status will be drawn from the CHSNS. The CHSNS is a community-based longitudinal study of population-based health and social inequalities, examining neighbourhood effects on mental health. Data were collected from a large representative sample of the adult population of Caerphilly county borough in south-east Wales. In 2001, a baseline population questionnaire survey obtained responses from 10 892 (60.6%) respondents aged 18 to 74 years on a wide range of socio-economic, lifestyle, health and housing factors and perceptions of the local neighbourhood, including access to services, social cohesion and neighbourhood quality. The MHI-5 was used as the measure of mental health status. A second wave of the survey was carried out after seven years collecting data from 4558 (50.2%) participants using the same range of questions (*Fone et al. 2012*). The CHSNS dataset contains the scale scores for the MHI-5 for both waves. There is a more detailed discussion of the CHSNS study in Chapter 6.

#### 1.10 THE RESEARCH QUESTIONS AND SPECIFIC OBJECTIVES OF THIS THESIS

The public health importance of mental health and the significance of common mental disorders highlighted in this chapter; the need to determine cut-points on the MHI-5 for CMD and CMD-S together with the limits of current research, provide the rationale for the research questions to be answered in this thesis.



There are three research questions:

1. *Is it feasible to use web-based methods to collect robust data on mental health and well-being from population samples? What are the strengths and limitations of collecting mental health and well-being data using web-based methods?*
2. *What are the cut-points on the MHI-5 scale for a case of common mental disorder and a case of more severe common mental disorder (CMD-S)?*
3. *To what extent is change in mental health case status associated with individual social and economic transitions and small area level factors?*

The research questions will be answered by achieving the following specific objectives:

1. Review the literature (I) - on how mental health is formally defined, measured, and the instruments commonly used which are relevant to this study. (*Chapter 2*).
2. Review the literature (II) - on the case prevalence of common mental disorders and how measured (Part I), the individual and area-based risk factors associated with change in mental health case status (Part II); and web-based research and its application to mental health-based studies, (Part III). (*Chapter 3*).
3. Conduct a web-based study using 'web-adapted' versions of the MHI-5 and CIS-R to collect scores for both instruments to enable the determination of two cut-points on the MHI-5. (*Chapter 4*).
4. Establish cut-points for a case of common mental disorder and CMD-S on the MHI-5 using paired instrument scores from the data collected in the web-based study and applying optimisation criteria. (*Chapter 5*).

5. Apply the MHI-5 cut-points established in the CWB web-based study to the MHI-5 responses in the CHSNS dataset to identify the individual socio-economic transitions, and small area level factors significantly associated with change in mental health case status of two classifications. (*Chapter 6*).

The third objective will be to collect data for the web-adapted MHI-5 and CIS-R using the thesis study website developed entitled 'Changes in Well-Being' (CWB). Participant recruitment will be from a random sample of 10,000 residents of Caerphilly county borough, who have not participated in earlier phases of CHSNS. A new sample frame will be created by the NHS Wales Informatics Service (NWIS). Prospective participants will be contacted using a mailing of a participant information pack in which they are invited to visit the CWB website within four weeks of receiving the invitation, login using a unique participant ID number provided, give consent to participation, and undertake two tasks – completion of the MHI-5 and CIS-R and submit their responses.

The fourth objective will require the data collected to be analysed to determine thresholds for identification of a case of common mental disorder and more severe common mental disorder (CMD-S) on the MHI-5 scale. This will be established using methods to compare the paired MHI-5 and CIS-R scores , and application of optimisation criteria.

The fifth objective will involve applying the defined MHI-5 cut-points to the MHI-5 scores within the CHSNS dataset to determine the mental health case status classifications of the participants, and analyses of:-

- a) The changes in mental health case status between the two waves of data;
- b) The risk factors (individual socio-economic transitions and area factors) within the CHSNS data, identifying those significantly associated with change in mental health case status and in which direction.

In the next section the structure and content of the remaining thesis, Chapters 2-7, is set out.

#### 1.11 STRUCTURE OF THESIS

There are a further six chapters to this thesis. Each chapter has a specific objective that introduces the topics to be covered.

#### CHAPTER 2: LITERATURE REVIEW I - MEASURING MENTAL HEALTH

In this chapter the objective is to examine mental health in the context of how it is formally defined, measured, and the instruments commonly used which are relevant to this study.

Discussion will include why it is important to measure mental health status; how mental health is defined; the formal classification of mental disorders; how mental health is measured; review of a selection of instruments commonly used to measure mental health that are appropriate for the detection of neurotic disorders, which include the most frequently occurring common mental disorders of depression and anxiety. The instruments selected in large part demonstrate the development of the instruments used in this study, and why the need exists to determine a cut-point or threshold for a case of common mental disorder on the MHI-5 scale. The conclusion examines the strengths and limitations of the instruments selected, and issues arising from different classification criteria of mental disorders.

#### CHAPTER 3: LITERATURE REVIEW II

The objective of this chapter is to review the literature pertinent to three specific areas discussed in this thesis: Part I - Case prevalence of common mental disorders and the measures used; Part II - Change in mental health status by associated with individual and area-based risk factors, and; Part III - Web-based research and its application to mental health-based studies.

Part I examines the prevalence of common mental disorders and their measurement.

Part II discusses change in mental health status associated with risk factors including individual transitions (economic, social and life events) and area factors (neighbourhood settlement type, deprivation, and social cohesion) investigated in longitudinal studies. The review will consider the challenges of examining change in mental health status, the pre-requisite of longitudinal research, issues arising from the limited number of longitudinal studies available to review, their limitations, and absence of any studies examining the range of risk factors required to answer the third research question of the thesis.

Part III examines web-based research; the Internet and current global usage; health-related web-based studies; the issues relating to an emerging methodology, design considerations, ethical challenges, and practical issues to be addressed.

#### CHAPTER 4: THE CHANGES IN WELL-BEING WEB-BASED STUDY

The objective in this chapter is to describe and discuss the web-based Changes in Well Being (CWB) study, conducted to collect the data necessary to enable the determination of cut-points for the MHI-5.

The CWB study is discussed from development to the conclusion of the data collection. The topics addressed include the study development, process of translation/adaptation of the measurement instruments; design of participant information pack; ethical approval issues relating to the study; design and method of the pilot testing for the CWB website; incorporating changes to the CWB website; mode testing of instruments, and the data collection method. The conclusion examines the strengths and limitations of the study.

#### CHAPTER 5: THE DETERMINATION OF CUT-POINTS ON THE FIVE-ITEM MENTAL HEALTH INVENTORY FOR A CASE OF COMMON MENTAL DISORDER AND COMMON MENTAL DISORDER-SEVERE

The objective in this chapter is to describe and analyse the data collected by the CWB website, to describe and discuss the analysis carried out to determine cut-points for a case of CMD and CMD-S on the MHI-5. This will include the analysis of optimisation criteria to identify optimal cut-points. The cut-points derived will be compared with those of other studies, the strengths and limitations of the study will be discussed and a conclusion presented.

#### CHAPTER 6: CHANGE IN MENTAL HEALTH CASE STATUS: ASSOCIATION WITH INDIVIDUAL SOCIAL AND ECONOMIC TRANSITIONS AND AREA FACTORS

The objective of this chapter is to apply the cut-points to the CHSNS dataset, ascertain the change in mental health status (e.g. onset of case status and recovery) and identify the risk factors which are significantly associated with change in mental health status of the two classifications.

This chapter will present an overview of the CHSNS longitudinal data set and discussion of the variables selected for analysis and descriptive statistics, the MHI-5 cut-points applied and the main study analysis of significant factors associated with changes in mental health case status. It will incorporate the results from previous chapters to support the analysis discussed.

#### CHAPTER 7: SYNTHESIS OF FINDINGS AND FUTURE RESEARCH

The objective of the final chapter is to synthesise the main findings of the thesis, discuss the application of the findings and suggest topics for future research.

This will include an evaluation of the primary findings of the thesis, the answers to the research questions, and discussion of the practical implications of this research and how far this study addresses outstanding issues relating to the MHI-5. The contributions made to knowledge and methodology will be specifically identified, and further research will be discussed.

As indicated, the next chapter will review the literature relating to the measurement and classification of mental disorders, and the challenge of defining cases.

## CHAPTER 2

## CHAPTER 2: LITERATURE REVIEW I - MEASURING MENTAL HEALTH

This chapter will examine how common mental disorders are defined and measured, and the value of having a cut-point, or threshold, on a measure to determine caseness. As a precursor to investigating these topics it is useful to review in what manner mental health and disorder are described, and how mental disorders are defined in two widely accepted diagnostic and classification manuals.

### 2.1 CHAPTER OBJECTIVES

The objectives of this chapter are to:

- a) Explain the importance of detecting cases of common mental disorder;
- b) Examine how mental disorder is formally defined in two diagnostic and classification systems and the problem of sub-threshold conditions;
- c) Review instruments designed to measure common mental disorders and the difficulty of case detection;
- d) Discuss the instruments selected for the CWB study;
- e) Discuss the studies that have identified a cut-point to define a case of common mental disorder.

### 2.2 THE IMPORTANCE OF DETECTING COMMON MENTAL DISORDERS

The research evidence identifying mental illness as the paramount public health challenge is steadily increasing; mental illness in people aged below 65 years of age accounts for nearly as much morbidity as all physical illnesses combined (CEP 2012). Over 50% of people aged 16 to 64 years who meet the diagnostic criteria for at least one common mental disorder experience comorbid anxiety and depressive disorders (NICE 2011). Many individuals with a 'pure' mental disorder without co-morbidity will later develop other mental disorders (Beard *et*



al. 2008). When assessed as co-morbid health problems the evidence suggests that at least 30% of all people with a long-term physical condition also have a mental health problem (Cimpean and Drake 2011). Yet despite the scale of the problem it is well established that mental disorders are under-diagnosed and untreated (Freeling et al. 1985; Goldberg and Huxley 1992; Bebbington 2004; NICE 2011). Recent studies confirm that in the majority of cases among people with physical illnesses, depression goes undetected and untreated (Katon 2003; Cepoiu et al. 2008). Without effective means of identifying those with mental health disorders, the increasing public health burden cannot be addressed.

As noted in Chapter 1, it is estimated that by 2030 depression will be the leading contributor to the global burden of disease (WHO 2004). The population prevalence of common mental disorders varies depending on the methodology and instrument used, and how cases are determined. There are three pre-requisites to determining population prevalence estimates: first, clarity of definition of the condition under investigation; second a valid method of measurement, and third an appropriate study population and sample from it. The first point is examined in the next section.

## 2.3 DEFINING MENTAL HEALTH AND MENTAL DISORDERS

The terminology used in the literature when referring to mental health and mental disorders can be confusing, particularly where different terms and states are used interchangeably. It is therefore necessary to establish the meanings of terms used in this thesis. Reference to 'mental health' encompasses the entire range of mental health states; 'mental well-being' refers to good mental health, and 'mental disorders' refers to defined states of impaired functioning, both clinical (formal DSM-IV or V / ICD-10 /clinician diagnosed disease) and sub-threshold (conditions not meeting clinical criteria). This latter category provides the central focus of this thesis.

Epidemiology requires the conceptualisation of impaired functions as disorders, together with the identification of these disorders in a valid and

reliable way (Bebbington 2004). Problematically, psychiatric epidemiology lacks a universally accepted definition for common mental disorders. The terms in use are varied and include: minor psychiatric disorders, psychological distress, mild psychiatric disturbances, common mental illnesses, diagnosable psychiatric disorders, and sub-threshold mental disorders. The nomenclature used in this thesis for the most frequently occurring mental disorders in community populations is common mental disorders (CMD).

To understand the nature of common mental disorders and the significant burdens they impose, it is useful to have a definition of what constitutes 'good' health. A widely accepted definition is provided by the World Health Organisation which defines *good health* as follows:

*a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity*

(WHO, 1948, no. 2, p. 100)

with good *mental health* expressed as:

*a state of well-being in which the individual realises his or her own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her community.*

([www.WHO.int/](http://www.WHO.int/))

In contrast, formulating a precise definition for mental disorder proved highly challenging until the introduction of formal classification systems with diagnostic criteria. There are two systems at present with wide acceptance. The first is contained in the fourth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) a diagnostic manual published by the American Psychiatric Association (APA 1994). The DSM is developed primarily by US psychiatrists and is used globally by professionals working in mental health, typically psychiatrists and primary health care providers, to assist with diagnosis and management. The first DSM was published in 1952 as DSM-I, with subsequent editions entitled DSM-II (1968) and DSM-III (1980). The DSM-III edition revealed inconsistencies in the system and occasions where the criteria

lacked sufficient clarity. This led to the production of a revised and corrected version entitled DSM-III-R (1987) (APA [www.psychiatry.org](http://www.psychiatry.org)). The DSM-IV was published in 1994, and in 2000 a text revision version of the DSM-IV known as DSM-IV-TR was published. The revised text updated the extra information provided on each diagnosis, and a number of diagnostic codes to maintain consistency with the International Statistical Classification of Diseases and Related Health Problems (currently 10<sup>th</sup> Revision) (ICD-10). DSM-V was published during the period this thesis was in preparation. Unless otherwise stated, the DSM-IV is the edition referred to in this thesis as the current version.

The issue of defining terms improved but difficulties remained as noted in the DSM-IV-TR (2000, p. xxx) when discussing a definition of ‘mental disorder’.

*... although this manual provides a classification of mental disorders, it must be admitted that no definition adequately specifies precise boundaries for the concept of mental disorder. The concept of mental disorder, like many other concepts in medicine and science, lacks a consistent operational definition that covers all situations... Mental disorders have also been defined by a variety of concepts (e.g. distress, dysfunction, dyscontrol, disadvantage, disability, inflexibility, irrationality, syndromal pattern, etiology, and statistical deviation). Each is a useful indicator for a mental disorder, but none is equivalent to the concept, and different situations call for different definitions.*

The DSM-IV Guidebook also acknowledges the lack of clarity and consistent definition for mental disorder:

*The concept of disorder in the context of psychiatry is like other concepts in medicine and science in failing to have a clear and consistent definition.*

*(DSM-IV-TR Guidebook 2004, p.12)*

The second established classification system was developed by the World Health Organisation (WHO), and is set out in the International Statistical Classification of Diseases and Related Health Problems (currently 10<sup>th</sup> Revision) (ICD-10). ICD-10 is a coding of diseases and signs, symptoms, abnormal findings, complaints, social circumstances and external causes of injury or diseases, as classified by the WHO. ICD-10 is the standard diagnostic tool for epidemiology,

health management and clinical purposes (<http://www.who.int/classifications/icd/en/>). The diagnostic criteria have also been converted into 'diagnostic' algorithms for incorporation into assessment instruments, and have been included in the CIS-R computerised version, (<http://www.who.int-classifications-icd-en-bluebook.pdf>). These algorithms enable the production of ICD-10 classifications alongside those produced by the instrument. The WHO's primary focus for the mental and behavioural disorders classification is to assist in the reduction of the disease burden of mental disorders (<http://www.apa.org/monitor/2009/10/icd-dsm.aspx>).

The section of ICD-10 entitled Mood [affective] disorders (F30-F39) covers the following:

*This block contains disorders in which the fundamental disturbance is a change in affect or mood to depression (with or without associated anxiety) or elation. The mood change is usually accompanied by a change in the overall level of activity; most of the symptoms are either secondary to, or easily understood in the context of, the change in mood and activity. Most of these disorders tend to be recurrent and the onset of individual episodes can often be related to stressful events or situations.*

The ICD-10 clinical descriptions and diagnostic guidelines note the problems of terminology stating:

*"Disorder" is not an exact term, but it is used here to imply the existence of a clinically recognizable set of symptoms or behaviour associated in most cases with distress and with interference with personal functions.*

*(The ICD-10 Classification of Mental and Behavioural Disorders 1992, p.5)*

and further difficulties in respect of the definition of boundaries;

*Reliance on description of emotions, experience and behaviour inevitably means that there are likely to be many problems in defining the boundaries between different disorders, and between mild and severe degrees of the same disorder. The classification of mood (affective) disorders in this and in all other current psychiatric classifications is beset with many problems of this type, the most common instances being the distinction between different grades of severity of depressive states.*

*(Pocket Guide to the ICD-10 1994, p.348)*

It is evident that the ICD-10 and DSM-IV have definitional and disorder boundary uncertainties. These uncertainties impede the identification and management of sub-threshold disorders. In addition, there is increasing concern amongst academics and practitioners regarding the confusion created by the existence and use of two similar, but not completely equivalent, classification systems. In comparing the two systems, Lopez-Ibor (1994) concluded that they were essentially comparable. However, Wacker et al. (1992) identified a small number of differences between ICD-10 and the DSM-III-R for a diagnosis of depressive episode. These were mainly accounted for by the lower threshold in the number of symptoms required in ICD-10. In a study evaluating the performance of the ICD-10 and DSM-IV, high concordance (83%) was found in the classification of people with a depressive episode (Andrews et al. 1999). The value of introducing new categories for sub-threshold disorders, as defined in this thesis, will be reduced if the two classification systems continue to have different diagnostic criteria. However, it has to be acknowledged that formulating a single valid categorisation of disorders not meeting existing clinical criteria, for adoption by different classification systems, is fraught with difficulties.

The DSM-IV-TR Guidebook (2004, p.416) provides an assessment of the DSM-IV Appendix B proposed new diagnostic categories to be included in the fifth edition of the DSM, and notes the following.

*The severity and duration thresholds for Mood and Anxiety Disorders established in the DSM-III and DSM-III-R were necessarily fairly arbitrary and not based on any strong evidence. It is not surprising, therefore, that a number of studies, particularly those performed in primary care and community settings, report that many patients who fall short of the DSM thresholds for the specific Mood and Anxiety Disorders nonetheless exhibit clinically significant impairment, as measured by functional disability and health care utilization. In fact, three different types of sub-threshold presentations have been identified:*

- 1. Minor depressive disorder, which is sub-threshold to Major Depressive Disorder in symptom severity*
- 2. Brief recurrent depressive disorder, which is sub-threshold to Major Depressive Disorder in duration*

*3. Mixed anxiety-depressive disorder for presentations characterized by a mix of mood and anxiety symptoms that do not meet criteria for any specific disorder.*

In their concluding comments, cautionary issues aside, the authors contend that the proposed new categories of disorder for inclusion in DSM-V were likely to have a population prevalence that is at least equal to the existing official DSM-IV-TR Mood and Anxiety Disorders. The inclusion of these sub-threshold disorders will increase the overall prevalence of Mood and Anxiety Disorders, and thereby all mental disorders. The authors suggest that the overriding consideration is that the threshold established for mental disorders does not exclude those with clinically significant impairment, since their inclusion is useful for the purposes of predicting prognosis or directing treatment.

It is inevitable that the introduction of categories designed to identify previously excluded sub-threshold conditions will result in an increase in the over-all prevalence. Correctly identifying individuals who need treatment is of greater importance than concerns over an increase in the prevalence of mental disorders. Lewis and Araya (2001) note that from a public health perspective it is the aggregate disability in a population that is important.

It is helpful at this point to look at the meaning and measurement of the global burden of disease and disability. The WHO conducted the first global burden of disease (GBD) study in 1990, quantifying the health effects of more than 100 diseases and injuries for eight regions of the world. The study generated comprehensive and internally consistent estimates of mortality and morbidity by age, sex and region. A new metric was also introduced– the disability-adjusted life-year (DALY) – as a single measure to quantify the burden of diseases, injuries and risk factors. The DALY is a time-based measure that combines the years of life lost from premature death, and years of life lost due to time lived in less than full health with a disability ([www.who.int/gbd/](http://www.who.int/gbd/)).

Where the aggregate disability of the population is most important, and a greater number of people with mild illness than severe illness exist, the aggregate burden of disability would be significantly affected by those with less severe illness. In consequence, at the population level, the burden of disability associated with depression of mild severity may be greater than the burden of disability associated with the much smaller number of individuals with severe depression. Their observation identifies the crux of the problem:

*Depressed individuals need treatment for their symptoms and associated disability, but this will do nothing to reduce the burden of disease attributable to depressive symptoms that fall below the usual criteria for defining major depression.*

(Lewis and Araya 2001, p.10)

Though it is somewhat counter-intuitive to consider the common mental disorders a greater public health priority than clinically defined depression, the burden of disability may indicate that this change in priorities is necessary.

As Lewis and Araya (2001, p.9) note:

*There are many more people with mild illness than severe illness. As a result, the aggregate burden of disability associated with depression of mild severity may be greater than the disability associated with the smaller number of people with the more severe depressions.*

It is apparent that defining what is meant by mental disorder is problematic, and differs between classification systems. Milder disorders may be cases under one system but not the other. This is of particular importance in epidemiological studies where results are usually reported using one of these systems, which, reduces the comparability of studies. As Bebbington (2004) notes, a substantial percentage of individuals seen in primary care with mental disorder symptoms will fall below the threshold of DSM-IV or not be identified for coding under ICD-10. Where a condition is 'sub-threshold' or does not meet clinical diagnostic criteria, additional problems arise as cases 'slip through the gaps' in the current classificatory system (Das-Munshi et al. 2008).

Notwithstanding the problems of classification systems, a further challenge exists in correctly identifying which disorders are present. Many people with a specific common mental disorder will also satisfy the criteria for one or more of the other common mental disorders, resulting in comorbidity, though undetected (Bebbington 2004). For example, the comorbidity of anxiety and depression may arise as an anxiety state yet can progress into a depressive disorder with the addition of comparatively few symptoms (Parker et al. 1997).

In primary care, the situation is further complicated by the wide range of assessments made by clinicians and the variable accuracy and reliability of self-reporting by patients (Kessler, D. 2003). In the context of epidemiology, aligning the correct instrument and research methodology with the classification system used becomes increasingly important. For example, when looking at a classification system:

F32 of ICD-10 classifies a Depressive episode as follows:

*In typical mild, moderate, or severe depressive episodes, the patient suffers from lowering of mood, reduction of energy, and decrease in activity... Depending upon the number and severity of the symptoms, a depressive episode may be specified as mild, moderate or severe.*

The range of anxiety disorders in ICD-10 is extensive and reference here is limited to the mixed classification which is of greater relevance.

#### *F41.2 Mixed anxiety and depressive disorder*

*This mixed category should be used when symptoms of both anxiety and depression are present, but neither set of symptoms, considered separately, is sufficiently severe to justify a diagnosis. If severe anxiety is present with a lesser degree of depression, one of the other categories for anxiety or phobic disorders should be used. When both depressive and anxiety syndromes are present and severe enough to justify individual diagnoses, both disorders should be recorded and this category should not be used; if, for practical reasons of recording, only one diagnosis can be made, depression should be given precedence. Some autonomic symptoms (tremor, palpitations, dry mouth, stomach churning, etc.) must be present, even if only intermittently; if only worry or over-concern is present, without autonomic symptoms, this category should not be used. If symptoms that fulfil the criteria for this disorder occur in close*



*association with significant life changes or stressful life events, category F43.2, adjustment disorders, should be used. Individuals with this mixture of comparatively mild symptoms are frequently seen in primary care, but many more cases exist among the population at large which never come to medical or psychiatric attention.*

*Includes: anxiety depression (mild or not persistent)*

*(ICD-10 Classification of Mental and Behavioural Disorders, 1994)*

Although the prospect that there may be a clinically relevant disorder outside the specific diagnoses for anxiety and depression has been discussed for some time, the disorder of mixed anxiety and depression is 'sub-definitional', and thereby sub-threshold, for both the ICD-10 and DSM-IV (Katon *et al.* 1991; Kessler, D. 2003; Bebbington 2004; Das-Munshi *et al.* 2008). In addition to diagnostic classification issues, and whether this inhibits case identification and the provision of appropriate management, evidence exists that suggests that a potentially greater problem occurs in the failure to identify cases, particularly where physical complaints are presented (Goldberg and Bridges 1987; Lewis *et al.* 1996; Kessler, D. *et al.* 1999; NICE 123, 2011). It is therefore crucial where screening instruments are used to detect cases that they have good sensitivity, and provide valid, reliable data, this suggests that good specificity is a lower priority for these investigators.

The following studies illustrate effects of non-detection.

A Danish study examined undetected common mental disorders in long term sickness absence, Soegaard (2012). It was found that of the participants who responded, 21% had a previously undetected psychiatric disorder, of whom 14% had depression and 4.4% anxiety. A survey conducted to identify detection rates of depression or anxiety at a general practice in Bristol (Kessler, D. *et al.* 2002) found that of the 49% (n=88) of patients with depression or anxiety measured by the researchers using the GHQ-12 at baseline, 14% (n=12) of these patients at the follow-up study, conducted three years later, still had a clinically severe condition and had not received a diagnosis or treatment by their GP that may have been beneficial to them. Another study, reviewing data provided by 298 UK general practices to the Health Improvement Network (THIN) from January 1996

to March 2006, discovered that the practice of recording symptom codes instead of diagnostic labels reduced the recorded incidence of depression in primary care, and rendered comparisons with epidemiological studies using standardised diagnostic instruments problematic (Rait *et al.* 2009) suggesting the need for symptom based algorithms.

In 2003 it was argued that the next revision of the DSM, DSM-V, should not eliminate the classification of minor mental disorders, despite the high prevalence estimates in epidemiological surveys. It was suggested that there is over-inclusion of what are seen as 'minor' cases (Kessler, R. *et al.* 2003).

The authors noted:

*In developing these rules for mental disorder, consideration should not be given only to current distress and impairment but also to THE RISK OF PROGRESSION FROM A MILD TO A MORE SEVERE DISORDER. (Emphasis added)*

This statement arguably captures the primary issue concerning case identification and classification of minor psychiatric disorders such as common mental disorders: the prevention of progression to more serious disorder, and avoidance of the attendant consequences.

At present a number of studies suggest that there is an uneasy divide between the prevalence rates for common mental disorders identified in epidemiological research using screening instruments and case detection in primary care by health care professionals. If the detection of cases is to improve in primary care, the routine use of screening instruments as a step towards more standardised assessment seems inevitable. As a corollary to this, if the findings in epidemiological research on mental health status are to become more persuasive, the instruments used to screen for cases must be valid and reliable and possess a specific point or score where case identification is achieved. Further, with the time/cost constraints in play, it is necessary that such instruments are short and impose the smallest time/effort burden upon

participants and the health care professionals who must use them (Berwick *et al.* 1991; Cuijpers *et al.* 2009).

Irrespective of classification or other issues, the common mental disorders of depression and anxiety can and need to be treated. It is suggested that their 'sub-threshold' status results in sub-optimal case identification, and consequently inhibits the provision of appropriate management of these disorders. The first step, it is suggested, in addressing the burden imposed by the common mental disorders, and the challenge of easier case detection, is to establish a simple and quick to use valid and reliable measure. Essentially, a screening instrument that can 1) determine what the probable mental health status of an individual is, 2) whether they are a case of common mental disorder, and 3) may require a more detailed medical assessment to ascertain their actual mental health case status.

#### 2.4 MEASURING INSTRUMENTS

The symptoms of mental disorders can be regarded as distributed throughout the population in varying degrees of severity (Goldberg and Williams 1988). Goldberg and Huxley (1992, p 58) further note,

*It would be tedious to enumerate the surveys which have shown that symptoms (of anxiety and depression) are continuously distributed in populations: rather than attempt to do this, we will observe that we are unaware of a single survey that shows anything else.*

The distribution of symptoms in the general population therefore does not evidence a simple dichotomy between 'cases' and 'normals' (Goldberg and Williams 1988). It has been suggested that the imposition of a threshold on a continuum will only lack some of its arbitrariness if it can be demonstrated that there is a naturally occurring 'step-change' in the distribution, (Bebbington 2004). In a Dutch study, Karsten and colleagues (2010) investigated sub-threshold depression on a functional impairment basis and found a linear increase in functional impairment parallel to an increase in depressive symptoms. The gradual increase in functional impairment did not suggest

natural cut-off points to determine normality, sub-threshold depression or DSM-IV Major Depressive Disorder. They contended that this supports the idea that depression is best conceptualised within a continuum from normality to clinical disease. The investigators further posited that while cut-points are arbitrary, functional impairment becomes apparent early on the continuum, and those reporting 'mild' depression experienced greater functional impairment than those within the normal range. It was therefore reasonable to consider the score for mild depression on the Inventory for Depressive Symptomatology-Self Report (used in the study and which measures the severity of depressive symptoms) as the cut-point for clinically relevant sub-threshold depression. The situation is imperfect but it is essential that we develop the best methods we can to address the difficulties.

There are many measures in use by clinicians and researchers to identify the presence of severe mental disorders with a smaller number designed to detect common mental disorders. The following methods are considered in this chapter: rating scale; self-administered questionnaires; and semi- and fully-structured interviews. Although there are various differences and particular emphases, fundamentally they have the same overriding objective of case finding.

Case identification is the basis of epidemiology and has been defined as:

*... the act of finding those members of a population under study who have the disease or disability with which the investigator is concerned.*

*(Blum 1960, p.253)*

The effectiveness of case identification can be affected by a variety of factors, including instrument design, methods used, cultural bias, length, existence and effectiveness of a threshold score or cut-point, and the validity and reliability of classifications. In addition, exactly what is being measured will influence the question design and emphasis. To achieve reliability and internal consistency, together with validity both of content and construct, requires thorough development and testing.

Reliability and validity are not equivalent, though highly connected. Reliability illustrates how consistently a scale measures a construct. There are two types of reliability often investigated: internal and temporal. Internal reliability is assessed by Cronbach's Alpha (Cronbach, 1951), and temporal reliability by test-retest. Validity, in contrast, can be described as the extent to which a scale does in fact measure what it is supposed to measure. The two are connected in the sense that a scale which is unreliable is unlikely to evidence a high level of validity.

Internal consistency of a multiple item scale measures how inter-related the items are. It measures whether several items that propose to measure the same general construct produce closely related scores. Cronbach's alpha, a coefficient of internal consistency, is often used as an estimate of reliability. The range of values of Cronbach's alpha is limited to between zero and one. Interpreting what score constitutes acceptable internal consistency is a matter for debate as authors have differed on this point. Generally, a Cronbach's alpha of  $\geq 0.9$  is considered excellent,  $0.7 \leq$  to  $< 0.9$  good,  $0.6 \leq$  to  $< 0.7$  acceptable,  $0.5 \leq$  to  $< 0.6$  poor, and  $< 0.5$  unacceptable.

Bland and Altman (1997) suggest that values between 0.7 and 0.8 are sufficient for research instruments, though a value of 0.9 is the required minimum for clinical application. In this thesis a score of over 0.7 will be regarded as achieving acceptable internal consistency.

The selection of an instrument requires careful consideration. Different instruments measuring the same constructs cannot necessarily be considered as direct equivalents because they may employ different classification criteria and scoring methods. The different methods of scale construction (with different individual items included) may produce non-comparable results. For example, where a diverse range of symptoms exist and attitudes and affective states are measured, high apparent prevalence rates can arise due to a large percentage of false positives.

Measures designed specifically for depression will not provide the necessary questions to detect anxiety, which is often co-morbid with depression. Dutch researchers have suggested that comorbidity is '*the rule rather than the exception*' (Lamers et al. 2011). Regardless of the correctness of this suggestion, what is not in doubt is the overlap between the symptoms of anxiety and depression (Lewis and Araya 2001) and where the measurement of both is required the instrument used should be designed to detect both. Therefore the instruments reviewed and discussed in this thesis (Chapters 2, 4 and 5) measure the common mental disorders of depression and anxiety. The instruments discussed next have been divided into two groups;

- a) Two instruments used for screening common mental disorders in the general population;
- b) The instruments used in the CWB study (not those in a) above).

The first instrument to be considered is a questionnaire. Questionnaires enable the assessment of an individual's place on an axis from normality to poor health by providing a score. The score produced is ordered, with one limit corresponding to poor mental health and the other limit to good mental health. To identify a case of common mental disorder, a transition point is required so that scores to one side correspond to cases. The transition point for a case is termed variously as threshold, cut-point, or cut-off.

#### 2.4.1 General Health Questionnaire (GHQ)

The General Health Questionnaire (GHQ) was the first instrument of its kind developed by Goldberg, an academic psychiatrist, to detect sub-threshold disorders such as the common mental disorders (Goldberg 1972). As the first of its kind it is arguably the most important measure developed to detect sub-threshold minor psychiatric disorders, and define caseness.

The GHQ was developed as a self-administered screening instrument to detect diagnosable psychiatric disorders present in respondents in community

settings such as primary care (Goldberg 1972). It is concerned with two major groups of phenomena: the inability to carry out normal 'healthy' functions; and the advent of new phenomena distressing in nature (Goldberg and Hillier 1979). It is a pure state measure of 'present' compared to 'usual' state, the latter regarded as 'normal' state as most individuals consider their usual state to be normal (Goldberg and Williams 1988).

The GHQ is in widespread global use, translated into 38 languages, and extensively validated in general and clinical populations.

### *Content*

The GHQ in its original full length version comprises a set of 60 symptoms, and requires any 12 symptoms to be present to identify a probable case (Goldberg and Hiller 1979). The scale was originally validated by the author in a study using the Clinical Interview Schedule, a standardised clinical interview (Goldberg et al. 1970). A scaled-down 28-item version was subsequently developed (Goldberg and Hiller 1979) followed by a 12-item version (GHQ-12) that included a relevant sub set of questions from the larger sets of items, GHQ-28, and GHQ-60 (Goldberg and Williams 1988). The reduction in items did not alter the detection of sub-threshold mental disorders (Goldberg and Williams 1988). Validation studies of the GHQ-12 have been conducted in various settings using a range of techniques, one of which compares the results of the GHQ-60-item version with the results of the GHQ-12 and GHQ-28 item dis-embedded sub-sets. Goldberg and Williams (1988) investigated the reliability and validity testing conducted, and concluded the GHQ-12 was very reliable.

The authors comment that there is an expected trend of a decreasing value for a decreasing number of items. They also note,

*... there is undoubtedly much redundancy in the GHQ-60, and this must explain how versions as short as the GHQ-12 still do a fair job of discriminating between cases and normals.*

*(Goldberg and Williams 1988, p.61)*

The GHQ-12 is the most commonly used version, and is the version assessed in this section unless otherwise stated.

### Scoring

The GHQ-12 comprises twelve questions; six are positively phrased, and six negatively, with four 'more/less than usual' response options (*Shelton and Herrick 2009*). Three scoring methods are in common use: GHQ (original scale); Modified Likert scale; and Simple Likert scale (*Goodchild and Duncan-Jones 1985; Goldberg and Williams 1988*). Table 2.1 illustrates a selection of GHQ-12 questions and scoring methods.

Table 2.1 Example of GHQ-12 questions and scoring methods

GHQ-12 Q. NO.	HAVE YOU RECENTLY	RESPONSES	SCORE- GHQ	SCORE- MODIFIED LIKERT	SCORE- SIMPLE LIKERT
1	been able to concentrate on what you're doing?	better than usual same as usual less than usual much less than usual	0 0 1 1	0 0 1 2	0 1 2 3
2	lost much sleep over worry?	not at all no more than usual rather more than usual much more than usual	0 0 1 1	0 0 1 2	0 1 2 3
8	felt that you are playing a useful part in things?	more so than usual same as usual less so than usual much less than usual	0 0 1 1	0 0 1 2	0 1 2 3

Unless stated, only the GHQ original scale (absence or presence of condition) is referred to here. The maximum score is 12 and Goldberg indicates that defining the 'best threshold' score for cases (the score that gives the best trade-off between sensitivity and specificity) is a matter for investigators to determine by conducting validity studies. Goldberg recommends this approach because the best threshold score varies in different locations. This variation



Goldberg attributes in part to the prevalence of multiple diagnoses. As a rough indicator Goldberg suggests using the mean score from the validity study conducted and referencing this to the author's specified thresholds e.g. a score of  $\geq 3$  for depression (Goldberg et al. 1998).

In consequence a wide range of threshold scores exists. A score  $\geq 3$  is widely accepted as defining a case of common mental disorder in general populations (Lewis et al. 1992; Goldberg et al. 1997; Hardy et al. 1999; Aalto et al. 2012). Where validation studies are not conducted caution needs to be exercised in selecting a threshold score due to the variations found in the threshold for caseness in different settings and populations (Goldberg et al. 1998; Shelton and Herrick 2009).

Another issue is raised in the GHQ Users Guide (Goldberg and Williams 1988) where the authors note that the GHQ does not measure the longstanding attributes of respondents. The threshold value changes when the period reviewed is altered, e.g.  $\geq 3$  for a 12-month period and  $\geq 4$  for the past two weeks, (Aalto et al. 2012).

In evaluating the findings of studies it is necessary to check the scoring method, period reviewed, cut-point used, and population sample.

### *Reliability and validity*

Many validity studies have been conducted globally over the last 30 years to the present day. Overall, they have found that the GHQ correlates well with psychiatric diagnoses of depression (Hardy et al. 1999; Martin and Newell 2005; O'Connor and Parslow 2010; Aalto et al. 2012; Romppel et al. 2013). Using standardised clinical interviews as the gold standard, recorded sensitivities range between 0.55 and 0.95, and specificities between 0.80 and 0.99, determined by the choice of threshold score (Hardy et al. 1999; Baksheev et al. 2011).

Split-half reliability (a measure of reliability in which a test is divided into two parts and an individual's scores on both halves are compared) was assessed during the development of the GHQ-60 on 853 completed questionnaires. The GHQ-12, drawing on the original study, had a split-half reliability of 0.83 compared to 0.95 for the GHQ-60. For test-retest reliability the GHQ-12 had a coefficient of 0.73 in comparison to 0.76 for the GHQ-60 (Goldberg and Williams 1988).

The internal consistency of the GHQ-12 has been reported in a number of studies with Cronbach's alpha ranging from 0.82 to 0.93 (Banks *et al.* 1980; Hardy *et al.* 1999; Martin and Newell 2005; Cornelius *et al.* 2013; Romppel *et al.* 2013). They concluded that  $\geq 4$  has good reliability.

### *Strengths*

The GHQ-12 is a robust screening instrument for a range of psychiatric disorders, including depression and anxiety, found in the general population. It performed well in a cross-cultural validation study, part of the extensive WHO project on mental health conducted in 15 centres worldwide (Goldberg *et al.* 1997). The GHQ-12 has been included in all waves of the British Household Panel Survey since 1991 ([www.iser.essex.ac.uk](http://www.iser.essex.ac.uk)), and as noted earlier has been translated into 38 languages. The extensive use of the measure indicates the high level of confidence held in respect of its reliability and validity. The GHQ-12 has the advantage, as noted above, of a threshold score which defines a case. It is flexible, the threshold score can be adapted for different populations, cultures and locations, and is relatively short in the scaled-down form. The GHQ-12 is an established and well-regarded measure evidenced by its use as a validation instrument in a number of studies (Lewis *et al.* 1992; Gill *et al.* 2007) notwithstanding the fact that it is not a 'gold standard' standardised interview. It has been examined in conjunction with the MHI-5 in a number of studies comparing instrument performance, where close agreement has been found (Berwick *et al.* 1991; McCabe *et al.* 1996; Kelly *et al.* 2008). The GHQ-12 has also been utilised to define cut-points for the MHI-5. These analyses were made

possible by the existence of a threshold for caseness on the GHQ-12 (*Perenboom et al. 2000; Hoeymans et al. 2004; Kelly et al. 2008*). The GHQ-12 is an important part of the development of instruments designed to detect common mental disorders, and is the golden thread that runs from a screening questionnaire to the evolution of a standardised clinical interview, the CIS-R.

### *Limitations*

The GHQ-12 has a number of limitations. Different scoring methods are utilised, which reduces the scope for comparison with other studies. Studies using a clinical interview prior to the GHQ may have sensitised respondents to their mental state, raising their scores (*Hardy et al. 1999*). The GHQ does not specify a period for which symptoms have been present, and as a result participants may report symptoms of fewer than two weeks duration. The duration of symptoms of fewer than two weeks is not considered sufficient to establish a depressive disorder. Goldberg and Williams (1988) acknowledge that the GHQ is sensitive to highly transient disorders that can remit spontaneously. Conversely, the GHQ is non-optimal where an individual is suffering chronic mental health conditions as they may indicate a present state no different from their usual state, which may result in a lower GHQ score (*Hardy et al. 1999; Cornelius et al. 2013*). This issue is acknowledged in the GHQ Users Guide (*Goldberg and Williams 1988*) where, as stated earlier, the authors indicate that the GHQ does not measure the longstanding attributes of respondents. Aalto and colleagues (2012) suggest the threshold value changes when the period reviewed is altered, e.g.  $\geq 3$  for a 12 month period and  $\geq 4$  for the past two weeks. The GHQ is regarded as having inferior psychometric properties compared to selected other instruments (*Kessler Psychological Distress Scale with 10 (K10) or 6 items (K6); Kessler, R. et al. 2002*) i.e. the absence of a specific period for reported symptoms, and the potential inability to discriminate chronic conditions from 'normals' as the 'usual' state may be depressed (*Cornelius et al. 2013*).

The primary limitation of the GHQ-12 is its lack of 'gold standard' status. It cannot therefore be used to determine a valid cut-point on another instrument.

Notwithstanding this lack of status, researchers have utilised the GHQ-12 as an expedient alternative to a 'gold standard' standardised clinical interview. The findings of studies where this approach has been adopted should be treated with caution.

In summary, the generalisability of findings and comparison of studies are restricted by the choice of scoring method, threshold score for caseness, and the different 'gold standard' instruments used. It is apparent from the literature that the GHQ-12 is well used in epidemiological research. The concerns relating to its psychometric properties indicate that it may not be optimal in clinical settings, where other instruments may be a better option. Despite the limitations identified, in particular the absence of 'gold standard' status, the GHQ set the benchmark for instruments screening for common mental disorders, and remains in use over 40 years since its release. It precipitated the development of a standardised interview for psychiatric assessment and the detection of common mental disorders.

#### 2.4.2 Clinical Interview Schedule

The Clinical Interview Schedule (CIS) (Goldberg *et al.* 1970), developed during the late 1960s, is a standardised semi-structured interview specifically designed to assess common mental disorders. It enables a more detailed assessment to be conducted than is possible with a brief self-report questionnaire. It was intended for use in primary care and community settings. Goldberg described the CIS as constructed to secure a psychiatric assessment:

*... made by an experienced psychiatrist in a realistic clinical setting.*

*(Goldberg et al. 1970, p.18)*

His view was that the best method of case identification was obtained by

*... examination by an experienced psychiatrist.*

*(Goldberg et al. 1970, p.19)*

The CIS comprises two sections. The first, entitled Reported Symptoms, instructs the interviewer to make as few ratings as possible based upon his own interpretations. The second entitled Manifest Abnormalities, permits clinical judgments to be made. Anxiety and depression are rated in both sections, making it possible to compare different measurements of the two symptoms in the same patient (*Lewis and Williams 1989*). The CIS was also used in general hospital and occupational studies in the assessment of minor psychiatric disorders, in the form of commonly occurring neurotic symptoms (*Lewis and Williams 1989*), until the development of the CIS-R, a revised version (the next instrument discussed).

Lewis and Williams (1989) conducted an analysis of existing data from seven studies, with sample sizes ranging from 70 to 264, in which the CIS was used. The objective was to examine the value of clinical judgments in defining cases of minor psychiatric disorder. They concluded that, irrespective of whether clinical judgments were valid and reliable, the ratings that required clinical judgment added limited information to the self-report items in evaluating the overall severity of minor psychiatric disorder. Further, these judgments might be less reliable and could lead to a biased assessment of depression and anxiety. The authors argued that systematic observer bias can be eliminated substantially by relying upon a participant's own report. They contended that self-report measures may be valid for certain research uses where the removal of systematic bias, here clinical judgment, is of greater importance than a potential reduction in reporting accuracy (*Lewis and Williams 1989*).

Contrary to Goldberg's views, Lewis and Williams favoured the use of standardised interviews by trained interviewers who do not make clinical judgments. The authors also argued that reliance upon clinical skills suggested that there are aspects of psychiatric disorder that are perceived as being incapable of being explicitly specified. In addition, they stated that, in principle, where an aspect of psychiatric disorder is not currently adequately described in self-report questionnaires it ought to be feasible to do so. This would result in more reliable means of measurement than the use of clinical judgments (*Lewis*

and Williams 1989). This paper focused upon the elimination of observer bias and clinical judgments in a standardised interview. It did not address the issues of defining or including sub-threshold symptomatology, but the suggestion that inadequately described psychiatric disorder ought to be capable of remedy is relevant to the formulation of an explicit specification for sub-threshold disorders.

Although the CIS represented a development in the standardised assessment of common mental disorders, it remained dependent upon the expertise of a psychiatrist to conduct the interview and make clinical judgments. With such unstructured clinical judgments demonstrated as unreliable, (Kreitman 1961; Shephard et al. 1968) their continued use was problematic. The instrument did not achieve an exact 'specification' of the aspects of psychiatric disorder which allowed for the removal of clinical judgment and the attendant uncertainties. It did not achieve 'gold standard' status, and the apparent paucity of relevant literature compared to the GHQ suggests that the CIS was not in such wide use. The requirement of a psychiatrist interviewer all but precluded use of the CIS in large general population samples, and as noted, interviewer bias, which may be of particular significance, remains.

In a move towards developing a standardised interview with a sufficiently exacting specification that could be administered by a lay interviewer, Lewis and colleagues revised the CIS addressing the issues identified in their earlier review. This is discussed in the next section.

## 2.5 THE MEASURING INSTRUMENTS UTILISED IN THIS THESIS

This section discusses the instruments used in the CWB web-based data collection study:

- Clinical Interview Schedule – Revised (CIS-R)
- Computerised script version of the CIS-R using the Programmable Questionnaire System (PROQSY)

- The five-item Mental Health Inventory (MHI-5) ((Version no.2) A subscale of SF-36 Health Survey, (SF-36))

#### 2.5.1 Clinical Interview Schedule - Revised (CIS-R)

The CIS was revised by Lewis et al. (1992), to reflect standardised case definitions with clinical judgments replaced by rules. In a fully structured format, the CIS-R could now be used by lay interviewers in assessing minor psychiatric disorders in a number of settings, securing significant costs savings, reducing observer bias, and achieving greater observance of standardised instructions.

In addition, Lewis and colleagues identified another problem with the CIS, the Manifest Abnormality section. This section required clinical judgments; the rules for coding symptoms were vague in some instances and with the exception of depression and anxiety, the majority of other items were very rare in general practice or community surveys (Lewis et al. 1992).

#### *Content*

A number of changes to the content of the CIS occurred during the revision process. The first change was to eliminate the Manifest Abnormality section of the CIS. Lewis and Williams (1989) contended that this section did not alter the validity of the assessment to any substantial degree. This alteration determined that the new CIS-R was restricted to identifying and detailing the characteristics of non-psychotic disorders.

The next revision concentrated on minimising sources of observer variation. This was done by prescribing many aspects of the interview style, including the exact wording of the majority of questions, and by specifying precise rules for the coding of every symptom. A number of matters rested with the interviewer: 1. ensuring the participant understood the questions; 2. deciding if the participant had answered positively to the mandatory questions; 3. asking supplementary questions if required; 4. revisiting previous sections if it became

evident that earlier responses were inaccurate, and; 5.ensuring that answers could be coded.

The authors allowed understandable distress to be coded by collecting information on psychological symptoms irrespective of cause. This prevented judgments on: 1. the appropriateness of response to current circumstances, and; 2. the incorrect coding of a symptom as absent, precluding examination of the association between the symptom and its possible cause.

Where previously the interviewer was required to make certain judgments the CIS-R leaves this to the participant by extending the scope of questions, for example, to include the suggested origin of symptoms. Separate sections on anxiety and worry were included to overcome the limitations of the original section on worry, which was poorly related to anxiety and autonomic symptoms e.g. fast pulse, palpitations, shallow breathing, sweating, and trembling.

### *Scoring*

The CIS-R covers the symptoms of a range of ICD-10 diagnoses, and ‘elicits’ responses to 14 neurotic symptoms (somatic symptoms, fatigue, concentration and forgetfulness, sleep problems, irritability, worry and physical health, depression, depressive ideas, worry, anxiety, phobias, panic, compulsions and obsessions) to establish their nature and severity. Thirteen sections have a maximum score of four and one section a maximum score of five. The maximum total score is 57. Scores of up to and including 11 are classified as ‘non case’, scores of 12 - 17 as a ‘case’, and scores of 18 and above indicate a severity that is likely to require treatment and suggests the possibility of clinical disease (*Lewis et al. 1992; Lewis 1994*).

Participants follow a self-determined pathway established by the answers given to each question. The number of questions presented, and the length of time required to complete the questionnaire, vary according to the response e.g. a response indicating that a symptom presented is not experienced will close that



branch of questions, while an answer suggesting that a symptom is experienced to a severe degree will generate further questions on the same topic. Therefore, a participant with good mental health will be able to complete the questionnaire more quickly as a smaller number of questions are presented, while a participant with poor mental health will be presented with a larger number of questions.

### *Reliability and validity*

An important change of emphasis regarding the validity of the CIS-R is shown by the replacement of clinical judgements by questions and rules (Lewis *et al.* 1992). The results of two reliability studies conducted (British general practice, 107 participants, and Chilean primary care, 163 participants) revealed no differences in precision or bias between psychiatrists and lay interviewers in administering the CIS-R (Lewis *et al.* 1992). The internal consistency measured by Cronbach's alpha (0.82) (for the Chilean study 0.88) was acceptable. The threshold for caseness was determined using Receiver Operating Characteristics curves generated by two criterion measures, the GHQ-12 and the level of morbidity that would raise concern in a doctor as judged clinically by the psychiatrist interviewers. The threshold indicated for the GHQ-12 criterion using a score of was 10/11 ( $\geq 2$ ) or 11/12 ( $\geq 3$ ), and for the clinical rating was 12/13. The authors elected to use a threshold of 11/12 with those scoring  $\geq 12$  classified as 'cases' (Lewis *et al.* 1992).

### *Strengths*

The CIS-R can be described as a symptom-driven instrument, meaning that after exhaustive review of symptoms and their severity, symptomatic information can be considered to check whether diagnostic criteria have been met. This is helpful when studying common mental disorders as it allows an overall symptom count to be made, which is useful where the distribution of symptoms in the general population is of interest (Bebbington 2004). In addition, because the CIS-R measures symptom severity, it is able to detect those at sub-threshold level with less severe symptoms. Conversely, diagnosis-driven instruments confirm

whether the required diagnostic criteria are met, which is problematic where sub-threshold disorders exist.

The CIS-R is a well-established and widely used instrument, with a cut-point for caseness that is widely accepted by custom and practice. It is used in major British national surveys such as the British Household Survey Panel, Health Survey for England, and the Adult Psychiatric Morbidity Surveys (Meltzer *et al.* 1995; Jenkins *et al.* 1997; Singleton *et al.* 2001). The CIS-R has been translated into other languages and used in overseas studies conducted with UK collaboration including Chile (Araya *et al.* 2001); India, (Patel *et al.* 2008) and Thailand (Silkapit 1997).

The reliance upon a psychiatrist interviewer making clinical judgments has been removed and replaced by rules. The CIS-R can be administered by a lay interviewer and produces three useful mental health status classifications of not-case, case of common mental disorder, and more severe common mental disorder. The CIS-R is now used as a 'gold standard' instrument and can therefore be used to determine cut-points for common mental disorder and more severe common mental disorder on the MHI-5.

### *Limitations*

It is not clear how the score range ( $\geq 18$ ) for more severe disorder was identified. This revised version must still be administered by a suitably trained interviewer, which has cost implications that may restrict use in smaller studies, particularly those in non-clinical settings. Although the requirement for clinical judgments to be made has been removed, the CIS-R allows the lay interviewer to make certain assessments if the answers given create uncertainty. Therefore it is suggested that the authors have not entirely succeeded in eliminating all observer bias. In the pen and paper format there is potential for error in recording scores, the correct selection of sections to be completed fully, and the transfer of results to a data file. With the development of computerised assessments the future of this interviewer dependent and comparatively inflexible format is in doubt.

### 2.5.2 Programmable Questionnaire System (PROQSY)

Alongside the revision of the CIS in 1992, Lewis developed a computerised assessment system called PROQSY (PRO-grammable Questionnaire SYstem), a program which runs questionnaires written in PROQSY compatible computer script. PROQSY can be considered as, broadly, analogous to Windows 7 running a Word document. Existing questionnaires in different formats can be written in the necessary script and run via PROQSY (Lewis *et al.* 1988). The first computer script developed was for the CIS (Goldberg *et al.* 1970), followed by the CIS-R (Lewis *et al.* 1992). PROQSY is a generic questionnaire delivery and data collection platform suitable for use with PC based systems; the computer scripts that it is designed to run are not written in a software language that is compatible with web-based use. Studies have confusingly referred to PROQSY as if it is the name given to the latest version of the CIS-R; this is not technically accurate. PROQSY is a stand-alone system program that runs, and collects data from, questionnaires written in a compatible computer script. The paper version of the CIS-R was re-written in the PROQSY compatible script.

The development of the original version of PROQSY continued and by 1998 the system was able to generate the common ICD-10 diagnoses seen in primary care (Lewis and Lyons 1999) by inclusion of an algorithm based on the ICD-10 version.

#### *Content*

The content of the CIS-R is as noted previously, except the process of re-writing the CIS-R as a PROQSY compatible computer script resulted in a number of format changes. There were the general simplification of branch questions, a reduction in the number of repeated questions, and improvement in the clarity of questions. It seems probable that in the adaptation of the paper version, the opportunity was taken to streamline the questions and remove items specifically included for use by the interviewer when making assessments. In addition, the scoring system for the paper version revealed that a number of questions in the

questionnaire were not scored. The questions adapted or removed are in this category. The fundamental structure and scoring for each of the 14 symptom categories remained unchanged.

### *Reliability and validity*

Lewis (1994) suggested that in the absence of a definitive gold standard it was more helpful to assess whether computerised assessments are useful than valid. In the context of research, he contended, computerised assessments had much to offer. To assess reliability, the CIS-R in PROQSY compatible format was compared with the CIS (discussed previously) but comparing these results with the results of other studies of British standardised interviews, the author noted, was highly problematic due to the differences between studies.

A study using the CIS-R in PROQSY compatible format in a general practice in a deprived inner city area of South London (Lewis *et al.* 1996) found no difference in clinical outcome, or increase in consultations or prescriptions, in the computerised assessment group compared to the groups receiving a non-computerised assessment. The non-computerised assessment groups were either not assessed at all or assessed by the GHQ-12. One unexpected outcome was the increase in physical illness referrals in the computerised assessment group. The authors suggest this may have simply been a chance finding or the more standardised assessment of psychological health served to draw attention to physical problems that required further investigation or treatment. The complex and entangled nature of mental and physical illness (Churchill 2010) suggests that investigation of mental and physical states separately may not provide sufficient information upon which to make an accurate diagnosis. The researchers concluded there was no evidence that use of a computerised assessment was harmful or damaging to participants, and could be regarded as a potential method of assessing common mental disorders in primary care settings. This was a small study with a sample taken from those attending a general practice. It is a particular weakness of the study that the GHQ-12 was used instead of the CIS-R paper version. The validity of the study was therefore limited.

### *Strengths*

There are two factors for consideration here, potential benefits and those realised. Lewis (1992, 1994) contended that, while not without limitations, computerised assessments would enable routine information to be collected, freeing clinicians to use their time more constructively. Improvement in the detection of psychiatric disorder in primary care was possible, together with assistance in the better management of patients with psychiatric morbidity. In addition computerised assessments were economical and comparable to standardised interviews in measuring neurotic disorder. The costs savings for research were apparent by reducing interviewer costs. Although computerised assessments were in their infancy and could not replace the doctor-patient relationship, they could become an effective tool for clinicians in detecting and managing psychiatric disorder.

The development of computerised assessment has attenuated interviewer bias and ensured greater accuracy of the pathway through the interview linked to participant responses that are entered directly. It has facilitated immediate and accurate data transfer direct to a PC for further analysis. Interviews can be conducted more quickly, they rely entirely on participant report, and the cost of collecting data is reduced. The potential to collect sensitive data from individuals who are reluctant to disclose such information to a human interviewer may be greater using this method. In a small study conducted in a general practice in Oxfordshire it was found that where an unsatisfactory relationship existed between a patient and their doctor, 73% (24 of a sample of 33) indicated that it was easier to disclose information using the computerised assessment (Wilkinson and Markus 1989). This study suggests that Lewis' views may have some substance and the potential benefits may extend beyond those he identified. The adoption of the CIS-R in PROQSY compatible format for use in national household and other large scale surveys is an indication of its advantages over the paper version.

### *Limitations*

It is evident from the literature and PROQSY's author that the need for further validation and comparison studies remains unmet. Although computerised assessments are not untried, they are predominantly used as screening tools in epidemiological research, and not in primary care settings by general practitioners. PROQSY's author does not accept this limitation and has conducted studies to examine whether computerised assessments do have a role to play in primary care settings. While this issue does not directly affect the focus of this thesis, it is suggested the more persuasive the evidence and arguments become in support of the use of computerised assessment in primary care settings, the more compelling the arguments will be for the development, and use, of improved web-based methods in psychiatric epidemiology research.

The CIS-R in computer script format does not eliminate researcher involvement completely, and while a lay interviewer is used instead of a more costly psychiatrist, the interviewer is still required to provide guidance on how to start and use the installed software, and participants must either be visited with a PC or attend a suitably equipped venue. This presents a number of challenges with cost implications. Collecting data exclusively using a PC presents a new range of potential risks of data corruption or loss. Research teams will increasingly need to include suitably qualified personnel to operate and develop new technologies, and invest in appropriate equipment. As the complexity of studies increases, establishing the satisfactory performance of the technologies utilised will become of greater importance. This introduces a further level of testing and evaluation, adding a more complex and specialist dimension to establishing the integrity of data collected.

### 2.5.3 The five-item Mental Health Inventory (Version 2)

The SF-36 was published in 1992, with version 2 introduced in 1996. This contained a number of improvements including simpler instructions and questionnaire items, improved layout for questions and answers in the self-administered version, greater comparability with translated and adapted versions, and elimination of one of the response options ("*a good bit of the time*")

from the mental health and vitality items. This change simplified the format of the questionnaire with minimal or no loss of information (Ware 2000).

### *Content*

The MHI-5 is constructed from the five items that gave the best predicted summary score based on the full 38-item Mental Health Inventory (Davies *et al.* 1988), a larger more comprehensive measure of mental health developed separately from the SF-36 in the late 1970's and published in 1983. The MHI-5 includes one or more of the items from each of the four major health dimensions - anxiety, depression, loss of behaviour/emotional control, and psychological well-being - that were confirmed in factor-analytical studies of the full length Mental Health Inventory (Veit and Ware 1983).

### *Scoring*

The MHI-5 subscale comprises of the following five questions:

*In the past four weeks:*

1. *Have you been very nervous?*
2. *Have you felt so down in the dumps that nothing could cheer you up?*
3. *Have you felt calm and peaceful?*
4. *Have you felt downhearted and depressed?*
5. *Have you been happy?*

Each of the five questions has five response categories which are scored from 1 to 5: All of the time = 1. Most of the time = 2. Some of the time = 3. A little of the time = 4 or None of the time = 5. Raw scale scores can range from five to 25 and are transformed to create a scale of 0 – 100. Mental health is measured on this discrete scale, where 100 is optimal mental well-being. There is no scale developers threshold score for a case of common mental disorder, CMD-S or clinical disease.

## Computing the Raw Scale Scores

Due to the use of three questions asking about ‘negative’ symptoms and two questions asking about ‘positive’ symptoms, reverse scoring for the two positive items (three and five) is necessary. The tables below are in adapted form to those in the SF-36 Version 2 scoring manual (Ware *et al.* 2000).

Table 2.2 MHI-5 reverse-coded and final question values

REVERSE-CODED AND FINAL VALUES FOR ITEMS M1 - M5			
ITEMS M1, M2, M4	RESPONSE CHOICES	REVERSE-CODED ITEM VALUE	FINAL ITEM VALUE
	All of the time	1	1
	Most of the time	2	2
	Some of the time	3	3
	A little of the time	4	4
	None of the time	5	5
ITEMS M3 & M5	RESPONSE CHOICES	REVERSE-CODED ITEM VALUE	FINAL ITEM VALUE
	All of the time	1	5
	Most of the time	2	4
	Some of the time	3	3
	A little of the time	4	2
	None of the time	5	1

Table 2.3 Formulae for Scoring and Transforming Scales

SCALE	SUM FINAL ITEM VALUES (AFTER RECODED ITEMS AS IN TABLE 2.2)	LOWEST AND HIGHEST POSSIBLE RAW SCORES	POSSIBLE RAW SCORE RANGE
Mental Health	M1+M2+M3+M4+M5	5, 25	20

Thus the raw scale scores can take a value between 5 and 25. These scores are then range transformed to take a value between zero and 100 (figure.2.1).



Figure 2.1 Formula and example for transformation of raw scale scores to 0-100 scale scores

$$\text{Transformed Scale} = \frac{\text{Score}-5}{20} \times 100$$

This linear transformation converts the lowest and highest achievable scores to zero and 100, respectively, where zero indicates the poorest mental health and 100 the best mental health.

### Reliability and validity

The initial validation study conducted assessed the performance with the MHI-5 scale with the MHI-38 item version. The sum of the 5-item scale, without weighting, correlated 0.95 with the full length 38-item MHI total score in the sample used from the Health Insurance Experiment (HIE) (a social experiment conducted at six sites in the USA which estimated the effects of different health care financing arrangements on patient demand, health status and satisfaction outcomes) (Ware *et al.* 1980). The same sample was also used to derive the short-form scale. On cross-validation using another HIE sample, the scale correlated 0.93 with the MHI-38 total score (Davies *et al.* 1988).

In a 1996 study (McCabe *et al.* 1996) the MHI-5 was compared with the GHQ-12 using standard statistical tests to assess performance. The researchers found considerable evidence of internal consistency of both instruments (Cronbach's alpha 0.84), as well as for construct validity for differentiating between groups with measured mental health differences. The MHI-5 had equivalent psychometric performance to the GHQ-12, and was suitable for the measurement of mental health in defined populations. The MHI-5 was also found to have operational advantages in that it was in the public domain, part of the full SF-36 general health measure, and was shorter.

The validity of the MHI-5 was tested for different DSM-IV (APA 2000) Axis I diagnoses (Common Axis I disorders include depression, anxiety

disorders, bipolar disorder, attention deficit hyperactivity disorder, autism spectrum disorders, anorexia nervosa, bulimia nervosa, and schizophrenia) to determine whether the MHI-5 was less sensitive to disorders other than mood and anxiety. A general population sample (Northern Germany) of 4075 participants recruited from a random sample of the resident registration office files in Lubeck and 46 surrounding communities was used. German nationals are required by law to be registered in these files throughout their residence. A German translation of the MHI-5 in paper form and the M-CIDI (Munich Composite International Diagnostic Interview) for the DSM-IV Axis 1 diagnoses were used in the study. The German translation of the MHI-5 produced slight differences in two items; these differences were adjusted by analysis of the results of another German population survey. The five-point Likert scale version was used. The MHI-5 was found to be less sensitive in 'detecting' disorders other than mood and anxiety. The MHI-5 was found to be more effective in 'detecting' mood than anxiety disorders (*Rumpf et al. 2001*). It is not clear whether the difference in 'detecting' mood disorder is of practical significance in general population studies, particularly in view of the known common co-morbidity of depression and anxiety. The MHI-5 was not designed to 'detect' clinical disease. Instead it measures four major mental health dimensions (anxiety, depression, loss of behaviour/emotional control and psychological well-being) on a scale.

The findings of this study appear to confirm that the MHI-5 measures the most frequent of the common mental disorders for which it was designed more effectively than other Axis I disorders. The MHI-5 is designed to measure the most prevalent forms of psychological distress (anxiety and depression the most common) in general population surveys, satisfying the minimum psychometric standards required for group comparisons (*Ware and Gandek 1998*). It was not designed for use in primary care where the psychometric standards required are considerably higher. The use of a general population sample precludes assessment of how the MHI-5 might perform in primary care settings.

As noted, interestingly, notwithstanding the above, the authors tested the validity of the MHI-5 in the detection of the mental disorders classified as clinical

disease under Axis I of the DSM-IV. The MHI-5 was found to be an effective instrument in detecting mood and anxiety disorders at DSM-IV level. Contrary to the purpose for which it was designed, this study raises the possibility that the MHI-5 is able to 'detect' anxiety and depression at the higher DSM-IV clinical disease level.

A further study (*Hoeymans et al. 2004*) compared the performance of the MHI-5 and the GHQ-12 in the general Dutch population using the Second Dutch National Survey of General Practice, which recruited participants from Dutch National General Practices. Nearly 400,000 patients were listed and a random sample of approximately 5% of all listed patients were contacted. The researchers restricted their analysis of data to participants aged 18 and over, numbering 7539. Both instruments suggested 13% of the participants were likely to have mental disorders, while 70% were without. Of the remaining 17% of the sample were classified as having poor mental health symptoms, but not under the other (GHQ-12=9.8%, MHI-5=7.6%).

Another Dutch study (*Cuijpers et al. 2009*) compared the validity of the MHI-5 in full with the three MHI-5 depression questions, and the two MHI-5 anxiety questions, with the CIDI (Dutch version) used to assess depressive disorders according to DSM III-R criteria. Data collected from 7076 respondents to the Netherlands Mental Health Survey and Incidence Study were used in the analysis. The reliability (Cronbach's alpha) of the MHI-5 for the sample was 0.83; for the MHI three depression questions 0.77, and for the MHI two anxiety questions 0.71; all versions achieving acceptable, though smaller values.

The researchers considered the MHI-5 to be effective in screening for mood disorders in the general population, taking less than one minute per patient to screen for depression. The shorter versions were as effective in screening for the disorders they addressed. The authors highlighted the need for shorter effective instruments to combat short span of attention in particular groups, and willingness to participate in questionnaire completion.

The CIDI was used as the gold standard instrument. This may not be optimal for all disorders, particularly for anxiety disorders (*Komiti et al. 2001; Means-Christensen et al. 2003*). The high degree of concordance between the CIDI and MHI-5 may be attributable, to some degree, to differences in the method. In addition, the MHI-5 was administered after the CIDI which raises the possibility of sequence effects.

## 2.6 DETERMINATION OF A CUT-POINT ON THE FIVE-ITEM MENTAL HEALTH INVENTORY

From the review in this chapter it is apparent that the instruments used to measure common mental disorders have been developing in the direction of self-report, standardised assessment. Where questionnaires are concerned, the brevity of an instrument can be a key factor in participants' task completion (*Berwick et al. 1991*). This is particularly pertinent where self-administered instruments are used. The MHI-5 has performed as well as the GHQ-12 with the added advantage of increased brevity (*MaCabe et al. 1996*).

The MHI-5 is widely used, it is included in the Welsh Government's annual Welsh Health Surveys (<http://data.gov.uk>), and has established validity and reliability. The design of the MHI-5's scoring from 0-100, which is poor mental health to complete mental well-being (*WHO, 1946, 2003*), determines that common mental disorder case status will exist at some point on the MHI-5 scale. Knowing where the threshold exists will extend the usefulness of the MHI-5. It is therefore useful to appraise the previous studies that have identified a cut-point. Where a study has been discussed in earlier sections, further comment is mainly confined to the cut-points identified, while details of the statistical methods used are discussed in Chapter 5.

In the Rumpf (2001) study, noted earlier, the MHI-5 version 2 was found to be more effective in 'detecting' mood and anxiety disorders, and cut-points of 60 for mood disorders and 70 for anxiety disorders were identified. A score of 65 was considered the most appropriate as a single cut-point for all groups (*Rumpf et al. 2001*). As noted earlier this study examined DSM IV Axis I diagnoses, used the

M-CIDI and the MHI-5 German translation. While these considerations must be taken into account in evaluating the application of the results, the MHI-5 was found to be capable of detecting the disorders of interest notwithstanding the use of a clinical instrument and application of DSM IV criteria. This is a more rigorous standard than required to determine a case of common mental disorder.

The authors of the Dutch study (*Hoeymans et al. 2004*) selected a cut-point of  $\leq 72$  for the MHI-5 (version not stated) as this generated the most comparable prevalence of mental disorders to the GHQ-12 cut-point of  $\geq 2$  which was used in the role of a gold standard instrument. A GHQ-12 cut-point of  $\geq 2$  is lower than the accepted cut-point for caseness in general populations as noted previously, and reduces the scope for comparison of findings. The authors highlighted the main disadvantage of the MHI-5 as the absence of a formal cut-point identifying caseness, and recommended that research to determine a valid, internationally comparable cut-point is undertaken. The lack of use a gold standard instrument to determine the cut-point further restricts the application of the findings.

Using data from the British Household Panel Survey (BHPS) wave 9 (*Taylor et al. 2005*) the authors of a 2008 study (*Kelly et al. 2008*) attempted to define a cut-point for a case of common mental disorder on the MHI-5 version 1. The GHQ-12 with a score  $\geq 3$  was used to determine caseness. They concluded a score of  $\leq 76$  (identified by the Youden Index and Short, 01, optimisation criteria) were best for a generalisable cut-point as these criteria were least dependent on the population case prevalence, though additional cut-points of  $\leq 68$  (prevalence matching and minimax criteria) and  $\leq 60$  (misclassification rate criterion) were also identified. The authors suggested that selection of the 'best' cut-point would be determined primarily by the intended application of the cut-point. The use of the GHQ-12 in place of a gold standard clinical interview limits the application of these findings, but the use of five optimisation criteria provided a useful insight into the range of optimal cut-points that can be derived.

An American study (*Holmes 1998*) analysed data of 95 male non-psychiatric patients who were HIV seropositive. The Structured Clinical

Interview for DSM-III-R (SCID-NP-HIV) was used as the gold standard, and a cut-point of  $\leq 52$  was identified for the Axis I disorder of major depression. This clinical disorder is of greater severity and would necessarily have a lower cut-point than one determined for a case of common mental disorder.

Another Dutch study (Cuijpers *et al.* 2009) using the MHI-5 version 1, identified a cut-point of 74 for a case of major depressive disorder. The CIDI was used as the gold standard which is focused on a clinical outcome. There are a number of limitations in this study, including the instruments used according to the criteria of ICD-10 and DSM-IV, not sub-threshold disorders; the cut-point is improbably high, particularly in view of the fact that it was suggested for major depression; the cut-point is not credible, and renders the findings of limited use in detecting sub-threshold disorders.

In a recent Dutch study (Van den Beukel *et al.* 2012) of 133 chronic dialysis patients with a mean age of 62 years, a cut-point of 70 (MHI-5 v.1) was identified using the Beck Depression Inventory as the gold standard. This cut-point was selected as one that would discriminate between those with and those without depressive symptoms. The characteristics of the study population, failure to use a true gold standard instrument and the basis for selection of the cut-point restrict the wider application of the findings.

Finally, one small study (Winston and Smith 2000) used the MHI-5 and CIS-R to determine a cut-point. The study compared four psychiatric case finding instruments using a population sample of 69 adults attending two general practices in South Wales. The aim of the study was to compare the performance of two 'etic' instruments defined as "*foreign, external to the cultural setting*" (GHQ-12 and MHI-5) and two 'emic' instruments defined as "*indigenous, derived from within a culture*" (SRQ and SSQ) using a homogenous group, in what the researchers termed a "trans-cultural comparison" (Winston and Smith 2000, p.570). All instruments were 'calibrated' against the CIS-R, using a score of 11/12 to determine cases. Cut-points for the instruments were derived from the program Arcus Quikstat to provide "*similar sensitivity and specificity values for*

*each instrument*” (Winston and Smith 2000, p.571) that were not defined. The cut-point for the MHI-5 was set at 28/29 raw score, expressed as a score of 71/72 when the scale is transformed.

Winston and Smith (2000) is the only study found that appears to employ the instruments used in this thesis (it is unclear if version 1 or 2 of the MHI-5 was used), though in different format, but meaningful comparisons are problematic due to significant limitations of this study such as a small non-representative sample of participants recruited from two general practices, and an unusually high level of case prevalence of 45% compared to a more typical 15-30%. The aim of the study focused on a ‘reverse’ trans-cultural comparison, for which the accuracy of cut-points was a lesser consideration. The results appear to have limited scope for generalisable application. They do not impact upon this thesis with regard to establishing a valid cut-point for the MHI-5, though it does provide an opportunity to compare the cut-point identified in this thesis with another cut-point determined for the MHI-5 using the CIS-R as the gold standard.

It has been shown the studies that have attempted to establish a cut-point on the MHI-5, without exception, have significant limitations for the purposes of this thesis. This topic is revisited in Chapter 5. Despite researchers acknowledging the need to conduct a study to establish a valid cut-point, none appear to have done so. It is suggested that the cost of such a study may be prohibitive, particularly where the MHI-5 score and mental health status of participants forms a small component only of a larger study with more dominant points of interest. It is important, given the widespread use of the MHI-5, that a valid cut-point is determined.

In addition to the absence of a study which establishes a valid cut-point, for a case of common mental disorder in the general population, or CMD-S, no studies were found where data collection was obtained using web-based methods.

## 2.7 CONCLUSIONS

At the beginning of this chapter five objectives were listed. The main points of each of are summarised to demonstrate that the objectives have been met.

The first objective was to explain the importance of detecting cases of common mental disorder.

This was achieved by reference to NICE publications, the 2004 WHO report and papers from leading academics in the field. They concluded that, despite the increasing necessity to detect and treat cases, under-detection and the consequent lack of treatment remains at a problematic level. The significant number of individuals suffering common mental disorders demands that the scale of non-detection is reduced.

The second objective examined how mental disorder is formally defined in two diagnostic and classification manuals, and the problem of sub-threshold conditions.

This examination revealed problematic definitions for disorder, compounded by the approach to the classification of conditions of mild severity. These permeate the spectrum of mental health care provision, impeding identification and management of mental disorders of mild severity. The apparent arbitrariness of formally determined thresholds for clinical disease, and failure to provide for sub-threshold conditions, has resulted in a substantial number of individuals being 'missed', misdiagnosed and left without treatment. There can be no doubt that sub-threshold conditions pose a significant public health challenge.

The third objective entailed a review of instruments commonly used to measure common mental disorders.

The review examined the evolution of the instruments designed and in common use to measure common mental disorders. Notwithstanding the



development of screening instruments and a standardised clinical interview to measure common mental disorders, the need remains for a short, validated, screening instrument to detect cases of the common mental disorders of depression and anxiety.

Discussion of the instruments selected for the CWB study formed the fourth objective.

The CWB study will use the CIS-R and MHI-5. . A valid cut-point for the MHI-5 will be determined by analysis of the paired scores of both measures. Detailed discussion of this analysis can be found in chapter 5. The structure and scoring method of MHI-5 was described, and studies in which the MHI-5 was compared with the performance of other instruments were evaluated. Although investigators have repeatedly identified the lack of a threshold on the MHI-5 to determine case status as a limitation that needs to be addressed, none have sought to do so by use of a 'gold standard' standardised clinical interview. The CWB study is the first general population-based study known to have determined a cut-point by use of a 'gold standard' standardised clinical interview, the CIS-R, using web-based methods.

The final objective required the discussion of studies that had identified a cut-point to define a case of common mental disorder.

All of the studies discussed had a number of limitations, to the extent that meaningful comparison of results and generalisability of findings was precluded. No study was found that attempted to determine a cut-point on the MHI-5 for a case of common mental disorder in the general population, by use of the CIS-R with a large UK population sample employing web-based methods.

This chapter has given an indication of the complexities involved in detecting cases of common mental disorders, and the need for detection. A perfect or foolproof method does not exist, and resources are finite. Establishing cut-points for the MHI-5 increases its usefulness and could provide a cost-

effective option for assisting the detection of the prevalent common mental disorders of depression and anxiety.

This thesis addresses the MHI-5's longstanding limitation, extends the development of the CIS-R using web-based methods, and facilitates further analysis of existing data sets with MHI-5 scores.

The second part of the literature review is found in the next chapter and covers three sections: Part I Case prevalence rate for common mental disorder; Part II Risk factors for mental health case status, and Part III Web-based research – challenges and practical issues.

## CHAPTER 3

## CHAPTER 3: LITERATURE REVIEW II

In the first chapter of this thesis a brief overview was provided of the considerable burden of mental health disorders, with particular reference to a) the prevalence of the common mental disorders of depression and anxiety; b) individual socio-economic transitions and area-level factors, and c) the growth of the use of the Internet for health information seeking and web-based research. In this chapter these three areas are examined further.

### 3.1 CHAPTER OBJECTIVES

The objectives of this chapter are to critically appraise the relevant published literature for each part of the review, and draw conclusions on the extent to which the current literature addresses the research questions of this thesis.

The literature review in this thesis is in two parts, this chapter and Chapter 2. The search strategy has not previously been discussed and is explained here. The variation in, and nature of, the subject matter relevant to this thesis proved to be challenging as search terms relevant to one part appeared to have limited relevance in another. The search strategy focused on three areas, mental health measures, transitions in mental health case status, and web-based mental health. Initially a wide selection of search terms were used which included, common mental disorder, CMD, MHI-5, cut-point, CIS-R, depress\*, anxi\*, valid\*, life trans\*, longitudinal, web-based, mental, sub-threshold, SF-36, neuro\*, and symptom\*. Literature searches were performed in PsycINFO, MEDLINE, PubMed, Web of Science and Google Scholar databases linked to Cardiff University library. The search results suggested that a broad range of alternative terms existed for the same topic. The single most effective search strategy entailed key author searches, then citation searches and 'snowballing'. In addition to the papers identified a range of additional terms in use that were then used in conjunction with a number of key terms for each of approximately 24 areas of interest covered by the literature review Parts I and II. A more informal approach of asking colleagues and being attuned to serendipitous

discoveries was also adopted following Greenhalgh and Peacock (2005). Searches were carried out periodically throughout the study.

### 3.2 PART I: CASE PREVALENCE RATE FOR COMMON MENTAL DISORDER

As previously noted, epidemiological investigations frequently produce estimates of the disease prevalence within a population. Providing valid and reliable estimates of the prevalence of mental health disorders in the general population has become increasingly important. The estimated general population prevalence for cases of common mental disorder can vary substantially, often as a direct result of the characteristics of the population sample used. As noted in Chapter 2, and by reference to UK national survey data, a typical population prevalence rate for common mental disorder is within the range of 15 to 30% (Weich *et al.* 1998). In view of the difficulties of drawing meaningful comparisons with studies that measure other mental disorders this review is restricted to those measuring common mental disorders, with one contrasting exception (Rukavina *et al.* 2012).

A selection of prevalence rates found in general population sample studies, large scale national studies data, are shown in table 3.1. A number of the studies included are discussed in Part II of this chapter and Chapter 2.

Table 3.1 Comparison of case prevalence for CMD and CMD-S in the general population

SOURCE AND LOCATION	CASE PREVALENCE FOR CMD AND CMD-S			MEASURE OF MENTAL HEALTH
	CMD (ALL)	CMD Score 12-17	CMD-S Score 18+	
Fone <i>et al.</i> (2013) (Wales)	25.5%			MHI-5
Fone <i>et al.</i> (2007) (Wales)	32.0%			MHI-5
Thomas <i>et al.</i> (2007) (Wales)	26.5%			GHQ-12
Kelly <i>et al.</i> (2008) (UK)	25.3%			MHI-5
APMS (2007)** (UK)	15.1%	7.5%	7.5%	CIS-R
Weich <i>et al.</i> (2005) (UK)	24.6%			GHQ-12
Weich <i>et al.</i> (2003) (UK)	24.7%			GHQ-12
Weich <i>et al.</i> (2002) (UK)	38.9%			CES-D

SOURCE AND LOCATION	CASE PREVALENCE FOR CMD AND CMD-S			MEASURE OF MENTAL HEALTH
	CMD (ALL)	CMD Score 12-17	CMD-S Score 18+	
Weich et al. (2001) (UK)	24.6%			GHQ-12
PMAPH (2000)* (England)	15.0%	8%	7%	CIS-R
Weich and Lewis (1998) (UK)	24.6% 26.3%			GHQ-12
Weich et al. (1998) (UK)	26.3%			GHQ-12
Weich et al. (1997) (UK)	30.0%			GHQ-12
Ustun and Sartorius (1995) (UK)	24.8%			GHQ-12
Lewis and Booth (1994) (UK)	33.7% 31.2% 24.8%			GHQ-30
RUKAVINA ET AL. (2012) (CROATIA)			33.75%	MHI-5
Hoeymans et al. (2004) (NED)	21.0%			MHI-5
Araya et al. (2001) (Chile)	26.7%			CIS-R
Reijneveld and Schene (1998) (NL)	32.3%			GHQ-12

\* Psychiatric Morbidity among Adults living in Private Households (England)

\*\* Adult Psychiatric Morbidity Survey

The prevalence rates for common mental disorders in the studies in table 3.1 range from 15.0% to 38.9%. Of particular interest are the prevalence rates found in the Fone et al. (2007;2013) studies. Using a cut-point of  $\leq 60$  for the MHI-5, the prevalence of cases of CMD found in the CHSNS dataset was 32%. In the second study the investigators analysed data from the seven consecutive waves of the Welsh Health Survey (2003/04 to 2010), an annual cross-sectional survey of the adult population resident in Wales. The prevalence rate in the Fone et al (2013) study is based on the seven years' analysed and as such provides a more smooth indicator of the prevalence rate than a single cross sectional study. The 2007 study analysed the dataset used in this thesis to answer the third research question, Chapter 6.

It can also be seen from table 3.1 that there are a number of reported prevalence rates that are close to the CWB study prevalence, and in one case

higher. Summaries of the main points of the studies, for comparative purposes, are noted below.

A Dutch study, Reijneveld and Schene (1998), examined whether all mental disorders occurred more frequently in deprived urban areas, the association with the socioeconomic status of the residents or that an accumulation of issues in deprived areas reinforced their occurrence. Mental disorders were assessed by the GHQ-12 of 4892 residents from a random sample of the Amsterdam municipal population register aged 16 to 65 years and over. A score  $\geq 2$  was used to define a case. The prevalence of mental disorders was 32.3%, and the investigators found that the high prevalence of cases of mental disorders in deprived urban areas was mainly the result of a concentration of low socioeconomic status of the residents.

Lewis and Booth (1994) examined whether living in cities was bad for mental health. Using data collected in the Health and Lifestyle Survey 1984-1985, the GHQ-30 was used to measure the mental health status of 6456 respondents, a score  $\geq 5$  defining caseness. Three categories of residential area were used and prevalence of psychiatric morbidity measured for each; 1. Urban (without open space), 33.7%; 2. Urban (with open space) 31.2%; and 3. Country district 24.8%. The investigators suggested that the increased prevalence of cases in urban areas was likely due to environmental factors in urban environments which cause or prolong case status.

In the 2000 survey of Psychiatric Morbidity among Adults living in Private Households (England), it was found that 15% of the sample had CIS-R scores of 12 and above (threshold for case of common mental disorder) comprising 8% CMD and 7% CMD-S (score of 18 and over ). The APMS 2007 reported a prevalence of common mental disorder of 15.1% for adults (aged 16 to 64) scoring 12 and above, comprising 7.5% for common mental disorder and 7.5% for CMD-S.

Weich and colleagues (2001) used the GHQ-12 with a score  $\geq 3$  to define a case of common mental disorder in the first wave of the BHPS survey with 8191 participants aged 16 to 75. The GHQ-12 as discussed in Chapter 2 is a self-report questionnaire designed to identify cases of common mental disorder but is not a gold standard clinical interview and therefore provides less robust classifications

Weich et al.(2002) also examined mental health and the built environment in a cross-sectional survey of individual and contextual risk factors. Using the CES-D, 1887 individuals aged 16 years and over, residing in two electoral wards in north London, were found to have an overall prevalence of depression of 38.8%. The investigators found the prevalence of depression was associated with independently rated features of the built environment, independent of individuals' socio-economic status and the interior characteristics of residences. They suggested that the CES-D may have overestimated the prevalence of depression.

The effects of place (2003) were investigated by Weich and colleagues (2003) using the first wave of the BHPS. CMD were assessed using the GHQ-12, and the prevalence of CMD found was 24.7%. The researchers suggested the effects of place of residence on mental health was greatest among individuals who were economically inactive, and therefore more likely to be at home.

Mental health and quality of residential environment (2007) was investigated by Thomas et al. (2007). The GHQ-12 was used to measure symptoms of CMD of 1042 individuals aged 16 to 75 years. Overall 26.57 of the sample were scored as cases. The investigators posited that the psychosocial environment was probably more important than the physical environment in relation to CMD.

In contrast, the prevalence of psychological distress was measured in 3229 adults, (1015 male and 2214 female), in the Croatian Adult Cohort Study in 2003 and 2008 as part of a comprehensive survey of community health in Croatia



(Rukavina *et al.* 2012). Psychological distress was defined as a score  $\leq 52$  on the MHI-5 version.2 transformed scale. In 2003 the prevalence found was 31%, increasing to 33.75% in 2008. The investigators adopted a cut-point of  $\leq 52$  citing Holmes (1998) as the primary reference. As noted in Chapter 2, Holmes (1998) measured major depression (DSM III-R) which explains the lower cut-point score. The cut-point score for a case of common mental disorder will be higher due to a lower level of severity, and suggests that the combined prevalence rate (results for both scores combined) for common mental disorder will be particularly high. There must be some doubt that the cut-point  $\leq 52$  is correct, and a lower cut-point seems probable. This study has been included both to provide a contrast here, and as point of reference in Chapter 5.

Comparing prevalence rates for common mental disorders is problematic due to the issues noted in Chapter 1. This review suggests that prevalence rates must be considered carefully, and comparisons made with caution.

### 3.3 PART II: RISK FACTORS FOR MENTAL HEALTH CASE STATUS

This part of the literature review focuses on evidence which addresses the research question components directly, that is studies relevant to individual socio-economic transitions, and area effects on mental health status and common mental disorders. This field of research is complex. It is subject to the non-standard use of definitions and application of key terms, such as 'transitions' (Kralik *et al.* 2006). How place or area is defined is also often unclear (Diez-Roux 2001; Pickett and Pearl 2001) with geographical scale commonly linked to administrative boundaries in ways that are rarely comparable (Pickett and Pearl 2001). Furthermore, the data available to studies, and over what period e.g. secondary data, official and administrative, are often in a prescribed form which is not necessarily ideally suited to the research question (Pickett and Pearl 2001). Although these types of data are extremely useful, it necessarily imposes a number of methodological restrictions and content limitations.

Transitions are a record of events and effects over time. Therefore only longitudinal study designs are relevant to the research question. The selection criteria for this part of the literature search strategy excluded studies not of a longitudinal design. Included studies that examined one or more of the areas of interest covered by the research question and measured an effect on mental health case status. Also excluded was research based on a non-representative sample of the general population. This was done to increase the comparability of the findings from previous studies. Few studies were found which met the criteria. The use of a questionnaire instead of a standardised clinical interview imposes limitations, though this may be ameliorated if the findings are interpreted as being indicative of 'at-risk mental states' which are highly correlated with the common mental disorders of anxiety and depression (van Os 2004). The studies discussed used a number of measures.

### 3.3.1 Individual transitions

In this section, the impact on mental health case status of individual transitions is considered. The scope of individual transitions, also known as life events or life transitions, is broad and covers a wide range of changes in circumstance e.g. housing tenure, employment or life events. As a precursor to discussion of the literature on individual transitions it is apposite to consider whether the dominant research traditions employed to investigate the causes of the differential effect of individual transitions provide adequate explanations. Or is an alternative approach proposed by Wheaton (1990) likely to provide more helpful insights?

Wheaton (1990) notes that major life changes and role transitions are frequently regarded as stressors that create a requirement for adjustment by affected individuals. The effects on mental health arising from such transitions are wide-ranging, and two research traditions or models have evolved to explain the variation. The first relies upon a 'differential vulnerability' contention in which the access to coping resources or strategies for dealing with stressful situations differs. This approach has produced a sizeable 'sub-tradition'

concentrating on the beneficial effects of social support (Cohen and Wills 1985). The second tradition, labelled 'trait' approach, suggests that the stressfulness of events varies due to differences in their attributes, such as uncontrollability, undesirability, unpredictability and event magnitude (Dohrenwend and Dohrenwend 1974; Thoits 1983). It is implicit in this tradition that the importance of events can be identified together with their stress potential (Wheaton 1990).

A third approach, posited by Wheaton, suggests the potential for impact of an event is determined by an individual's accumulated experience in the role that is changed by the transition. He terms this 'role history' prior to the event, such role history providing the fundamental context for the implications of transitions for mental health during the life course. Wheaton indicates that, necessarily, focus is concentrated on the level of chronic and continuing stress in the role which reflects a multiplicity of demands that persist over time in the role domain. A critical distinction is made in this approach between events that are in fact stressful to the individual, and those that are non-problematic or beneficial by providing an escape from a chronically stressful role scenario, where increased stress paradoxically acts as a stress relief. Wheaton contends that if the impact of an event is largely determined by prior role circumstances, it is a 'misspecification' of the problem to search for factors which modify the effect of the 'stressor' when it occurs.

Wheaton defines chronic stress as follows,

*Chronic stress refers to continuous and persistent conditions in the social environment resulting in a problematic level of demand on the individual's capacity to perform adequately in social roles.*

(Wheaton 1990, p.210)

He indicates that chronic role stress, its presence or absence, preceding the event, is likely to be a key factor in understanding the individual differences in the experience and effect of a life event/transition (Wheaton 1990). This approach, it is suggested, provides a logical premise from which to interpret unexpected or difficult to explain findings in the literature and provides a

broader perspective. Throughout this chapter examples of this approach will be given prior to the discussion of each transition to provide a contrasting, and at times confirmatory, viewpoint.

#### *(i) Income*

Wheaton (1990) suggests that when the occurrence of life transitions is in the context of a problematic role history, it is inaccurate to describe the transition event as a 'stressor' because, for example loss of employment of a low paid job, which removes the individual from a difficult situation may be a positive and necessary event.

While the association between low income, poor physical and mental health is well established, most studies have measured income at one point in time. This does not allow for the volatility of income over a life time. Duncan (1996), suggests income reduces for 26-39 per cent of people aged 45-65 years of age, by 50 per cent or more at least once over an 11-year period. Addressing the limitations of a single point in time analysis, the cumulative impact of sustained economic hardship on psychological and other functioning was studied by Lynch and colleagues (1997). Using income data collected in the Alameda County Study, California, a population-based study, for the years 1965, 1974, 1983, and 1994, (n=2730) and the scores for depression measured by the DSM-III R, the researchers found that sustained economic hardship had reduced psychological and other functioning in the 1974 respondents still living. This study has a number of limitations including the absence of a standardised clinical interview, common mental disorder is not measured, potential measurement error, and likelihood of losing participants as deceased, who may have been in the risk group most significantly affected by the associations of interest.

#### *(ii) Employment*

The subject of employment transitions was studied in the context of changes between employment and various forms of non-employment and vice versa on the psychological well-being of men and women in a sample taken from the BHPS

waves 1-8 (n=5092) (Thomas *et al.* 2005). The GHQ-12 was used to measure mental health with a score  $\geq 3$  defining caseness. The authors found that the transition to unemployment, for whatever reason, was associated with increased psychological distress. The strength of association was similar for both sexes. A higher prevalence of GHQ cases existed for those who were unemployed before and after transition measurement. Transitions from unemployment to paid employment were associated with recovery of normal mental health. The effects of transitions on mental health appeared greatest during the first six months of the transition. The main limitation of this study is the use of the GHQ-12 and not a standardised clinical interview. Lack of reporting on those who were economically active and inactive. The strengths are the use of national survey data, and the evidence on the effects of employment transitions on mental health over time, which vary with the type of transition involved and in which direction the transition occurs.

As distinct from studies focusing on the effects of unemployment on depression, Dooley and colleagues (2000), examined employment not as a dichotomy of working or not, but as a continuum of adequate employment to inadequate employment, and unemployment. They studied whether shifts from adequate employment to inadequate increased depression, in the same way that moving to unemployment does, and whether those with prior depression were more likely to experience this adverse change in employment. Panel data from the USA National Longitudinal Survey of Youth (first surveys conducted in 1979) for the years 1992 and 1994 (age range 27 to 37 years) were analysed. Of 5113 participants, the unemployed and inadequately employed groups reported significantly increased levels of depression than those who remained in employment. They found that both types of adverse change in employment resulted in comparable significant increases in depression in both groups. This change persisted despite the inclusion of the potential mediators of positive life events. Psychological functioning was measured by the 20-item Center for Epidemiological Studies – Depression Scale (CES-D) in 1992 and a seven item subset version in 1994. The limited age range and continuous scale design limits generalisability of the findings and does not establish a causal link between

employment status and depression. Yet this is one of the few studies that has measured change in mental health status over time, with objective measurable transitions. Other studies investigating the sequence between unemployment and onset of depression by use of retrospective methods suggest that increased depression follows job loss (*Eales 1988; Montgomery et al. 1999*). Existing research focusing on the effects of unemployment needs to extend to include employment states which have reduced economic benefit and have an adverse effect on mental well-being as a result.

Related to unemployment is job security. Chronic job insecurity and change in job security on psychological functioning was studied using the Whitehall II study data. A prospective cohort study of white collar civil servants in London aged between 35 and 55 years, with a sample of 931 women and 2429 men, ( $n=3685$ ), eligible for inclusion in the study, was taken from Phase 1 (1985), phase 4 (1995/6), phase 5 (1997/99). Psychiatric morbidity was measured using the GHQ-30, for participants of phase 5 who had remained in secure employment (control group), with three exposure groups (Group 1) participants who had lost job security; (Group 2) participants who had gained job security between phases 4 and 5; (Group 3) participants whose jobs were insecure at both time points (chronic insecurity). The findings of greatest note related to psychological function. The GHQ score and depression were highest in the three exposure groups. The group with the smallest observed difference was Group 2, though they experienced residual negative effects of job insecurity. Group 1 was mid-placed, and Group 3 had the highest. The study concluded that job insecurity has adverse effects on psychological and other functioning which are not entirely reversed by removal of the threat, and the greatest increase is associated with chronic exposure to the stressor (*Ferrie et al. 2002*). Occupational cohorts are frequently relatively homogenous groups working in specific fields and the generalisability of the findings is limited. A self-report measure was used instead of a standardised clinical interview. The exposures may have biased effects in this sample due to the historically relative high level of job security of civil servants working in central government. Notwithstanding these limitations this study does measure change in mental health status over time, in respect of

defined transitions, and has a substantial sample. It also suggests that the negative effects of job insecurity persist beyond removal of the threat.

In a 2012 US study, Wight and colleagues (2013) examined the effects of urban neighbourhood unemployment history on existing depressive symptoms and subsequent symptom trajectories of late middle age and older adults who had stable residential status. Data from four waves (2000, 2002, 2004 and 2006) of the US Health and Retirement Study were analysed. Depressive symptoms were measured using the CES-D. The investigators found that, net of individual-level socio-demographic characteristics, high historical average neighbourhood unemployment was harmful to emotional health at baseline, in 2000. However, over time there was no evidence that these negative neighbourhood effects adversely affected emotional health, while individual-level factors did. The absence of accelerated rate of change in depressive symptoms did not however eliminate the initial adverse outcome sustained as a result of the neighbourhood's unemployment history. They concluded that studies needed to review the effects on mental health of previous neighbourhood characteristics in conjunction with current neighbourhood characteristics. Failure to do so could risk under-estimation of the broader impact of urban neighbourhood context on mental health of late middle age and older adults over time. There are a number of limitations to this study, including a limited discussion of other studies that suggest depressive symptoms decline in later life. The use of Census tracts as proxies for neighbourhoods is imperfect and may create artificial boundaries which do not match the residents' subjective definitions of neighbourhood. This could result in mis-estimating neighbourhood effects. The insufficient data regarding treatment for depression is likely to affect the trajectory of an individual's depressive symptoms, distinct from any neighbourhood characteristics.

In keeping with a number of findings in other studies in this review there is an identifiable degree of consensus regarding the importance and potential negative effect of historical transitions, neighbourhood or other factors

associated with unemployment on mental health status which need to be considered by investigators.

### *(iii) Life-events*

In a 1972 longitudinal study conducted in the USA, investigators examined the relationship between life events e.g. divorce, unemployment, bereavement, and change in mental status, using a sample of 720 adults in New Haven, Connecticut. Mental health status was measured using the instrument developed by Macmillan (1957) and modified by Gurin and colleagues (1960) that utilises a list of 20 psychiatric symptoms. The results recorded that 18% of those interviewed in 1967 were classified as 'high symptom level' (very distressed psychologically). By 1969 21% had experienced deterioration in their mental health status. The authors suggested that there is a relationship between the changing incidence of life events experienced and changes in psychiatric symptomatology; the greater the number of changes in life events, the higher the probability that an individual's mental health status will have changed substantially. A net increase in life events is associated with worsened mental health status, and a decrease with improved mental health. The authors contend that these results demonstrate the importance of social and interpersonal factors often external to an individual in influencing psychological status, noting,

*... the tenuous balance between the individual's psychic economy and the social milieu within which he is forced to adapt.*

*(Myers et al. 1972)*

In a longitudinal analysis of the relationships between stressful life events, social support and mental health, researchers found that social support predicts an increase in mental health over time; stressful life events predict a decrease in mental health over time; negative life events and their adverse effects on mental health do not vary with amount of social support. It was found that different measurement approaches to life events and social support found some differences in the results but did not affect the assessment of whether the effects on mental health were additive or interactive. Data were collected from a



sample of 2,234 individuals living in Seattle, Washington who had enrolled in the Rand's Health Insurance Experiment (HIE) a longitudinal social experiment analysing a range of topics including utilisation of health care services and health status. Self-report questionnaires were completed at two time points, approximately 12 months apart. The age range of participants was 14 to 61 years, with a mean age of 31.8 years. Mental health status was measured by the 38-item Mental Health Index (Ware *et al.* 1998; 2000).

### 3.3.2 Marital transitions

Divorce, Wheaton (1990) notes is a different type of transition due to the often, more permanent form it takes, and the potential for involving choice and anticipation (release from stressors). However, it is an unscheduled (not planned or a perceived 'benefit' in marriage) transition and regarded as a major life event.

Hughes and Waite (2009) studied the marital biography of 8,652 individuals who were interviewed in the first wave of the Health and Retirement Study (HRS) in 1992. The HRS is an American nationally representative longitudinal study of persons over the age of 50 years. The investigators found, in respect of mental health, that those who have never married show more depressive symptoms than the married. Getting divorced or becoming widowed, and being divorced or widowed may damage health. Depressive symptoms, unlike chronic health conditions, seemed to respond quickly and strongly to changes in current situation. The authors contend that both current state and prior marital history appear central to understanding the impact of marriage on health, and echoes Wheaton's role history theory.

Wade and Pevalin (2004) analysed waves 1-9 of the BHPS, with the GHQ-12 as the measure of mental health status, to test the following three hypotheses: 1) The rates of poor mental health after the transition will be similar for separated/divorced and widowed as each make adjustments to their new family structure, and will be higher than married persons; 2) The rate of poor mental

health leading up to the transition among respondents who experience a marital disruption will be higher than married persons; 3) The rate of poor mental health leading up to the transition among participants who experienced the death of a spouse will not be higher than married persons.

They found clear evidence of the greater prevalence of mental health problems for the separated, divorced and widowed in comparison to those who were married. Individuals who were divorced/separated or widowed, before the transition, had a higher prevalence of poor mental health, though even those not reporting poor mental health were at a significant risk of poor mental health afterwards. The processes both preceding and after the transition to widowhood differ. An increased prevalence of disorder is linked to the period surrounding the death itself. The investigators concluded that analysing the relationship between marital disruptions and mental health is complex and changes in relation to the time-period observed. Identifying when marital disruptions are caused by poor mental health or are the consequences of poor mental health requires more detailed data. However, the authors do suggest that the situation preceding entering widowhood is quite different. No identifiable patterning of higher levels of poor mental health among the pre-widowed group was found except for the period immediately around the death itself, a reasonably expected occurrence. This study illustrates the potential difficulties of convincingly testing specific hypotheses using data collected for more general purposes.

Bulloch and colleagues (2009) looked at whether the relationship between marital disruption and major depression was bi-directional. Analysing data from the Canadian National Population Health Survey (1994-2004), which comprised 14,713 respondents aged 15 years and above in 1974, the investigators found the high prevalence of major depression in individuals who were separated or divorced was due to an increased risk of marital disorder in those with major depression, and the higher risk of this disorder in those who had divorced or separated marital status. They concluded that a clinically significant relationship exists between major depression and marital status. A number of compromises were adopted in the analysis. Due to insufficient cell sizes, certain individual

transitions were combined. The 'collapsing' of categories such as widowhood and divorced and separated is less than ideal, particularly as the experience of widowhood is quite different from marital disruption. Consequently, this pragmatic and common practice employed by researchers produced some anomalous results. For example, no relationship between poor mental health and becoming widowed was found. The effects the researchers wished to study, they suggested, precluded the adjustment for socio-economic and broader health factors. They explained their reasoning,

*...any risk factor for depression is a confounder in the causation model, and any risk factor for change of marital status is a potential confounder in the selection model. This complicates the analysis considerably.*

*(Bulloch et al. 2009, p.1176)*

Although this study has a number of limitations and focuses on major depression only, it has provided some support for the contention that the relationship between depression and marital disruption is bi-directional. This is an important factor in managing mental health as it suggests that those who experience marital transitions are not only at risk of developing mental disorders, but may already have them.

Tavares and Aassve (2013) questioned whether first union dissolution is less distressing for cohabitantes than those who marry. The investigators used a sample of 577 individuals who were not married, cohabitating or divorced at first interview from the first 18 waves of the BHPS. They found that the average change in psychological distress, measured with the GHQ-12, was approximately double for married individuals compared to cohabitantes.

### 3.3.3 Socio-economic status

Several studies have focused on the impact of socio-economic status on common mental disorders. However, the distinction between individual transitions and socio-economic context is not always clear.

Researchers using BHPS data for 1991 and 1992 investigated the effects of poverty and unemployment on the onset and maintenance of common mental disorder. Two interviews were conducted 12 months apart using the GHQ-12, and only participants who had completed both were included in the analysis, (n=7726). The prevalence of common mental disorder was 24.6% at T1 (first interview) and 26.3% at T2 (second interview 12 months later). The authors concluded that poverty and unemployment increased the prevalence of common mental disorder by maintaining episodes, but did not precipitate their onset, though financial strain was strongly associated with onset and maintenance. Over the 12-month period analysed, poverty and financial strain were associated with significant increases in psychiatric morbidity, but not unemployment (Weich and Lewis 1998). The assessment of common mental disorder was by use of a self-report questionnaire and not a standardised clinical interview. The mechanisms between poverty and unemployment and mental disorder remain unknown. The focus of the study was on onset and maintenance of common mental disorder rather than broader analysis of change.

Data from the UK Psychiatric Morbidity Survey 2000 was used in a 2006 study examining whether low socio-economic position is associated with increased risk of new episodes of common mental disorder or with worsening prognosis. The fieldwork comprised two interviews conducted 18 months apart using the CIS-R to assess psychiatric morbidity, with (n=2406) participants included in the analysis. Two cohorts were created, of case and non-case, at baseline. No significant association was found between an episode of common mental disorder and the socio-economic indicators studied after adjusting for baseline psychiatric morbidity. In the main analysis, significant associations with past financial difficulties (cohort of non-cases) and lower education (cohort of cases), before adjustment for the baseline CIS-R scores, were found. The authors posit that if baseline psychiatric morbidity is on the causal pathway between low socio-economic status and onset or persistence of common mental disorder, (a score  $\geq 12$  CIS-R) the adjustment made may be an over-adjustment. There was also evidence, in the main analysis, that individuals categorised as non-cases at baseline who were experiencing financial difficulties had an

increased risk of common mental disorder episode at follow-up. This association became non-significant after adjustment. The association was also significant for the cohort of cases, suggesting that subjective measures of material standard of living could be as important in the relationship between socio-economic position and common mental disorder compared to income and wealth which are more objective measures. The authors suggest the effects of objective measures of socio-economic status may have been over-estimated, while subjective measures have been under-estimated (*Skapinakis et al. 2006*).

The limited number of measurements of mental health case status, absence of information on individuals history of common mental disorder at baseline, the inability to determine whether onset at follow-up was first onset or recurrence of episode, and restricting the analysis to case or non-case status only introduced measurement bias and precluded a more precise measurement and understanding of the mechanisms of change in mental health status.

Depression and socio-economic risk factors were assessed a 7-year longitudinal population study using data from the Belgian Household Panel Survey (1992-1999) (n=11909) (*Lorant et al. 2007*). Depression was assessed by a modified version of the Global Depression Scale, and socio-economic factors with measures of material standard of living, education, employment status and social relationships. The analyses focused on changes in socio-economic status and changes in depression taking place in the same year. The results indicated that a lowering of material standard of living between the waves of the survey was associated with increases in depressive symptoms and cases of major depression. Life transitions also influenced depression symptomatology in both directions depending on whether the event was negative or positive, though negative effects were stronger than positive ones. The authors concluded that a relationship between worsening socio-economic status and depression existed. Although there was a lack of association between unemployment and depression, this may be explained by the time-periods for data collection and the evidence that suggests the risk of depression increases steadily for the first six months

following unemployment, reaches a plateau and reverses on finding work (Lorant *et al.* 2007).

Although this was a study analysing data from seven years of a longitudinal study, the researchers' restricted the analysis to change in mental health status in a single year where change in socio-economic status and depression both occurred. This precludes analysis of the longitudinal effects of change and reverse cause may be an explanation for the findings.

Taylor and colleagues (2007) analysed the BHPS for the years 1991-2001 to test the hypothesis that unsustainable housing commitments adversely affect the head of household's psychological health in addition to the associated financial pressures. They found that the association varied between men and women. Where the head of the household is male, arrears and housing payment difficulties have significant psychological burdens and they remained after controlling for general financial problems and adverse fiscal events. The investigators found these burdens are higher for arrears than payment difficulties and equivalent in extent to those associated with marital dissolution and unemployment. In contrast, for the female head of the household, it was found that longer term unsustainable commitments imposed psychological burdens. This study has limitations relating to the consequences of potential loss of one partner in marital breakdown, concurrent with unsustainable housing commitments, to subsequent waves of data, and the separate analysis of each gender precluding investigation of the interplay of spouses mental health on each other. However, it does present some evidence that the effects of unsustainable housing costs are comparable to those observed for job loss or in marital breakdown, and can be categorised as major life events in respect of the potential effects on mental health.

Pevalin (2009) in an analysis of 17 waves of BHPS data, found that housing repossession, and the lead up to repossession, significantly increased the risk of poor mental health. Post-repossession, the percentage of those with a common mental illness varied considerably. In contrast, evictions from rented housing

revealed increased levels of mental illness prior to eviction, but no increased risk thereafter. The difference in association may relate to the loss of security of home ownership compared to the frequently transitory nature of the rented housing population.

Beard and colleagues (2008), in a study of 2282 adult residents of New York City, monitored mental health and the changing symptoms of depression occurring after the September 11, 2001 terrorist attacks. Four telephone interviews were conducted at 6, 18 and 30 months after baseline. A list of major life events was used to measure life-stressors supplemented with questions on, major traumatic episodes over the previous 12 months consistent with DSM criterion A. Social support at baseline was measured by the MOS social support survey (Sherbourne and Stewart 1991). Episodes of major depression were assessed using a modified version of the Structured Clinical Interview for Diagnostic and Statistical Manual for Mental Disorders, 3<sup>rd</sup> Ed, Revised (SCID) major depressive disorder subscale. The SCID captures symptoms of major depression consistent with DSM-IV criteria. Respondents were asked about the presence for over two weeks of any of ten symptoms of depression for criterion A major depression in the DSM-IV.

At baseline, the presence of symptoms was assessed at any time in the past, the previous year or since the September 11 attacks. The presence of symptoms following the previous interview were assessed at each follow-up survey wave. A depressive episode was determined by respondents reporting five or more listed symptoms for a period of at least two weeks, one of which had to be depressed mood or loss of pleasure or interest. Of the sample at baseline, 9.4% reported depression in the previous six months and 17.9% reported lifetime depression. Of 605 participants who had an episode of depression at any time in the study period, 339 (61.1%) had an episode at only one interview, with the remaining participants having more than one non-consecutive or consecutive episode. The participants who reported at baseline having an episode, 60.2% had a further episode during the study period.

Low baseline levels of social support was only a significant predictor of having depression at two or more waves (four waves in total), when compared to participants with no history of depression. Recent traumatic and stressful events had higher odds ratios for those individuals with recurring depression, and lifetime stressors were only significant for this outcome (OR = 2.36 for two or more stressors vs. none; 95% CI: 1.02, 5.51).

Over 25% of participants met the criteria for depression at one point in time, and of these, around 40% met the criteria more than once. The risk of later depression was highest for those with a baseline diagnosis. The factors significantly associated with depression were depression at previous interview, a history of symptoms consistent with depression prior to baseline, and life stressors or traumatic events in the 12 months prior to the interview. Poor physical health reported at a previous interview was a significant predictor of the later development of depression, even after adjusting for other factors.

Inadequate income, in this study defined as less than \$50,000 per annum (equivalent to £31,965 at 2013 rates), was found to increase the risk of future development of depressive symptoms. Evidence was also found to suggest the extent of an individual's social networks may be predictive of future mental health. Individuals reporting lower baseline levels of social support were at increased risk of depression.

There are two main limitations of this study. First, the use of a 'bespoke' version of the SCID and, second, the uniqueness of the traumatic event, which is likely to render the findings of limited application to non-disaster contexts.

Green and Benzeval (2010) used data from the Twenty-07 Study to investigate the burden of common mental disorders for key social groups at different ages. The Twenty-07 Study has followed 4510 participants from three cohorts in the West of Scotland for over 20 years. The investigators had valid data for 3846 of the respondents. The Hospital Anxiety and Depression Scale (HADS) provided the measure of psychological distress. They found that the



probability of anxiety remained reasonably stable with no significant class difference until reaching around 45 years of age, where the prevalence declined. This decline was greater for those in non-manual classes. The prevalence for depression increased more rapidly with age for those in manual classes than for those in non-manual classes. This difference became significant around the age of 30 years. The authors noted

*Socio-economic inequalities in the prevalence of CMD increase with age, as does the overall prevalence of the more burdensome disorder of depression, representing a double jeopardy for those who are older and from a manual class.*

*(Green and Benzeval 2010, p.572)*

The HADS is similar to the MHI-5 and GHQ-12 with two subscales of anxiety and depression. It does not provide a diagnosis of depression or anxiety. Consequently although an individual might be classified as a case, specialist treatment may not be required.

Pevalin and Goldberg (2003), using analysed data from the BHPS 1991-1998, looked at social precursors to episodes of, and recovery from, common mental illness measured by the GHQ-12. They found support for previous findings concerning social factors associated with onset and recovery. Low social support increased the chances of onset and decreased the odds ratio for recovery. Social factors such as divorce, and becoming and remaining unemployed acted to decrease the odds ratio for recovery. Severity of disorder was significantly associated with the odds ratio for recovery which decreased as severity increased. Notably, the chances of changing from a state decreased with the number of previous occasions spent in that state. The importance of prior episodes suggests that knowledge of previous states is essential if meaningful findings are to be made regarding the nature of change in mental health status. This study has two problematic limitations. First, the study did not distinguish between episodes of variable duration resulting in very short and long episodes exceeding one year being grouped together. Second, the inclusion of unadjusted 'false positives' associated with higher GHQ scores.

### 3.3.4 Area factors

In this section the effects of area factors on mental health are considered.

In a Swedish study, Dalgard and Tambs (1997) conducted a 10-year follow-up survey re-interviewing 503 adults from an original population sample of 1010, to look into the potential change in the quality of neighbourhoods and how this may be associated with mental health. They restricted the sample to those who continued to live in the same area at baseline. The authors tested two hypotheses, selection and stress. The selection hypothesis states that if the increase in prevalence of mental disorders in a new satellite town is caused by selective migration, then it will remain high irrespective of changes in the social quality of the neighbourhood during the follow-up period. The stress hypothesis suggests that if the increased prevalence of mental disorder is the result of an unsatisfactory social environment, it could be expected that the prevalence would change in parallel with changes in the social environment, e.g. if the environment is improved the prevalence should go down. Respondents were questioned about social support, and social characteristics of the neighbourhood. The mental health measure used was an abbreviated version of Leighton and Danly's (1966) questionnaire including approximately 50 questions primarily about anxiety, depression and somatisation. Additional, independent, information was collected about the neighbourhood from key informants. Of the five types of neighbourhood surveyed only one, initially poorly functioning neighbourhood with poor mental health among residents, revealed marked change in social characteristics over time. This neighbourhood underwent substantial improvement as a part of the further development of the area. In tandem with the improvement in social environment, a significant improvement in the mental health of the residents who had remained living in the same area occurred. The authors contend the findings support the environmental stress hypothesis indicating that the quality of a neighbourhood has an impact on mental health. This study has a number of limitations, namely, the use of an abbreviated form of a measure of mental health, the lack of information

regarding the neighbourhoods and the improvements undertaken which serve to limit the application of the findings.

Propper et al. (2005) examined the effect of local neighbourhood on change in mental health using the first ten waves of the BHPS from 1991 to 2000. The sample size for the five-year changes in mental health of 7047 individuals living in 4377 households. Common mental disorder was measured by the GHQ-12, and analysed in this study as a continuous measure. The researchers found that five neighbourhood attributes were somewhat unimportant in shaping either levels or trajectories of common mental disorder. Of greater importance to poor mental health were an individual's characteristics and their households. They suggested that even if the association was causal, the effect of neighbourhood on mental health status would be limited, except where individual's who were prone to mental disorders sought a move into neighbourhoods which affected mental health positively. The authors concluded that people rather than place were important in determining changes in mental health status. This study has the following limitations; observational designs preclude causal pathway analysis, mental health measurements were not obtained by a standardised clinical interview and the basis for selection of contextual factors and spatial scale was unclear.

The appropriate selection of units of analysis for area level factors was examined by Chandola et al. (2005) using BHPS data (1991 to 1999) to test the effect of area of residence on individuals health referenced to changing residency over time, and clustering of health at the household level. They found that physical and mental health functioning appeared to cluster within households. Taking account of changes in household membership over time increased the estimation of clustering in functioning at the household level. At the electoral ward level, clustering was reduced when taking the household clustering into account the risk factors associated with functioning. This study suggested that when assessing mental health and other functioning by reference to area level factors, changing membership of households and household level must be taken into account in the analysis of area effects. The authors do not provide insight

into how or why changing membership of households effects change in mental health status.

In their first paper from analysis of BHPS data, Weich and colleagues (2005) investigated the geographical variation in rates of common mental disorder, at individual, household and electoral ward levels prospectively. Data from the first two waves of the BHPS were used with a sample size for analysis of 7659 adults aged 16 to 74 years. Mental health was measured by the GHQ-12. The researchers found that ward level socio-economic deprivation had no influence on the onset and maintenance of common mental disorder, while local factors at the individual and household level did. However, they did not explain why this appeared to be so (Weich *et al.* 2005).

In a second paper, the authors examined the differences in the onset and maintenance of episodes of common mental disorder between rural and non-rural areas (Weich *et al.* 2006). Data from the first two waves of the BHPS were used with a sample size for analysis of 7659 adults aged 16 to 74 years. Mental health was measured by the GHQ-12. The authors found population density was significantly associated with the maintenance of common mental disorder episodes, but not onset. The participants living in rural areas experienced better mental health than their non-rural counterparts. This difference most noted by reference to mean GHQ-12 scores, which after adjusting for a number of potential confounders, was approximately 0.5 of one point. Excluding episode maintenance, the clearest gradient of rates of common mental disorder and change in GHQ-12 score between the two waves was observed when rurality was defined using the ONS classification of wards, rather than a simple measure of population density. The authors suggest there was limited geographical patterning in the prevalence of common mental disorder (Weich *et al.* 2006).

Although, as previously stated, the use of a questionnaire instead of a standardised clinical interview limits the application of the results, perhaps of greater significance is the absence of interval data on episode commencement,

duration and method of classification, previous history, whether CMD on-set is first instance or relapse, or if there has been remission between the waves.

### 3.3.5 Social cohesion

Stafford and colleagues (2011) investigated neighbourhood-based social cohesion, stressors and depressive symptoms in mid-life and beyond using longitudinal data from the English Longitudinal Study of Ageing (ELSA). ELSA is a sample of people aged 50 years and over who live in England. The ELSA was drawn for a general population sample of households that responded to the Health Survey for England in 1998, 1999 and 2001, providing a sample population of 11,392. Mental health status was assessed using the CES-D.

The authors defined neighbourhood social cohesion as the norms of trust, solidarity and reciprocity. They found that neighbourhood social cohesion was associated with subsequent depressive symptoms independent of demographic and socio-economic factors, and the depressive symptoms present at baseline. The status of relationships with friends and personal sense of control were strongly associated with neighbourhood social cohesion and fewer depressive symptoms. They suggested socially cohesive environments are regarded as more conducive to supportive social relations, and neighbourhood social cohesion has implications for the individual psychosocial factors and symptoms of depression of residents. Although caution must be exercised when using self-report measures, it was shown that negative aspects of friendships and a reduced sense of personal control, are frequently experienced by individuals' who perceive their neighbourhood to be low in social cohesion. The authors posited that improvements in neighbourhood social cohesion may lead to a reduction in negative social encounters and depression symptomatology. This study uses a sample of older people for whom social cohesion may be of greater significance, the risk of same source bias, personality and other unmeasured traits may have driven the association between neighbourhood environment and depressive symptoms. Where participants' individual perceptions rather than a valid prescribed presentation of what constitutes neighbourhood social cohesion are

questioned, uncertainties are likely to arise as individual participants may have different perceptions of the subject matter resulting in inconsistencies. However, it is reasonable to suggest that the level of neighbourhood social cohesion is associated with the experience of depressive symptoms.

Mair and colleagues (2009) in a US study investigated the associations between neighbourhood social cohesion and stressors with depressive symptoms and atherosclerosis in a longitudinal multi-ethnic study of men and women aged 45-84. Mental health was measured by the CES-D. The investigators found that lower levels of social cohesion together with other stressors were associated with higher mean CES-D scores in men and women. The use of census tracts as proxies for the geographical area relevant to depression is a limitation and the misspecification of the geographical area may have resulted in underestimates of the effects of interest to the investigators. The interactions of neighbourhood characteristics and life events were not examined; therefore the investigators were unable to comment upon the effect of stressful neighbourhood conditions upon depression.

Stafford and colleagues (2008) analysed data from 7834 participants in the longitudinal Whitehall II study of British civil servants aged 35 to 55 years old working in London in 1985. They tested two hypotheses regarding the association of neighbourhood deprivation and social fragmentation, and level of exposure with poorer physical and mental health functioning. They found that residing in a deprived or fragmented neighbourhood was associated with poorer mental health, and that extended exposure to neighbourhood environments of this kind had incremental effects. The Whitehall II study is of a specific population residing in London and the south east which renders the generalizability of findings problematic. Due to the greater affluence, lower deprivation and quality of neighbourhoods overall. However, of note is the finding that the improvement of mental health functioning with age is reduced for those with greater cumulative exposure to deprived or fragmented neighbourhoods.

The hypothesis that high levels of neighbourhood social cohesion modify an adverse association between change in individual mental health and neighbourhood deprivation was tested by Fone and colleagues (2014) in an analysis of longitudinal data of 4426 participants aged 18 to 74 years from the Caerphilly Health and Social Needs Cohort Study. Neighbourhood social cohesion and deprivation were assessed at baseline, and change in mental health status was measured with the MHI-5 between baseline and follow-up. They found a significant association between decline in mental health status and residing in high deprivation neighbourhoods, after adjusting for baseline socio-economic and life event transitions. The medium and high social cohesion neighbourhoods were significantly associated with an improvement in mental health status compared to low social-cohesion neighbourhoods. The adverse association of neighbourhood deprivation with negative change in mental health status, appeared to be significantly attenuated in high social cohesion neighbourhoods. The ability to examine the joint temporal effect of robust measures of neighbourhood social cohesion and deprivation on change in mental health status over a seven-year period is a particular strength of this study. Conversely, the absence of information on when the individual transitions occurred, or whether more than one transition occurred within any category, increases the risk that individuals were incorrectly classified as the true nature and extent of transitions is unknown. The measurement of mental health status is also subject to the same problem, as potential variability of scores, and thereby mental health status, for the intervening years is not known. Change in case status was not investigated, and in keeping with many other studies investigating change in mental health status, there was no differentiation of CMD-NS and CMD-S to allow for different severity of case status. This precludes more precise analysis of the associations of transitions and social deprivation on change in mental health case status. By analysing CMD as a single 'classification' and assuming socio-economic status transitions and social deprivation had the same effect across the whole distribution of MHI-5 scores, important insights were concealed.

The opportunities to examine the case-transitions, onset, maintenance, recovery and CMD-S are not available. Notwithstanding these observations, there is no known longitudinal study that is without limitations that inhibit the findings made on the topics of interest to the study authors and members of the wider research community.

It is evident from this review that the complexities and challenges of investigating the association of individual socio-economic and area factors with change in mental health status are substantial. The methods adopted, different neighbourhood size, varying sample size and the different measures used to assess mental health result in outcomes with reduced comparability and apparently inconsistent findings. The requirement for the formulation of robust theories regarding the causal pathway between neighbourhood characteristics and changes in mental health status appears to have broad support (*Drukker and Os 2003; Weich et al. 2003; Blakely and Woodward 2000; Diez Roux 2001*). Kelly (2008) suggests the creation of prescribed 'formulas' (to unify methodology) will enable investigators to consistently test and examine the same principles to determine whether they are appropriate for the data. The mechanisms by which area characteristics, for example deprivation and the scale of unemployment, and the extent to which they may negatively affect mental health status could then be clarified (*Kelly 2008*).

The nature of longitudinal studies dictates an extended period before results can be published, and this fact when combined with their high cost explains why they are relatively few in number, and as noted above, unlikely to fully resolve many outstanding issues. Consequently, the literature reviewed does not answer the third research question of this thesis.

### 3.4 PART III: WEB-BASED RESEARCH: CHALLENGES AND PRACTICAL ISSUES

This section discusses the impact the Internet has had on communications, the extent of global coverage, information dissemination and seeking on health



related topics; the implications for research using web-based methodologies, with specific reference to practical, ethical and fiscal considerations.

#### 3.4.1 Internet usage and health information seeking

The use of the Internet for health related topics is extensive and has seen a substantial increase in recent years. The percentage of UK Internet users accessing online health related information increased from 37% in 2005 to 68% in 2009, (*Dutton et al. 2005; 2009*). A survey in seven European countries in 2005 found 71% of all adults used the Internet for health information, (*Andreassen et al. 2007*). In the United States this figure is 61%, (*Fox et al. 2009*).

The National Health Service (NHS) Direct website launched in 1999 is the UK's main health advice and information website for patients and the public. In 2009 the website recorded 18 million visits, (*NHS Direct 2010*). This reflects both an increasing demand for health related information and the recognition and trust of the NHS brand in the non-Internet world, (*Eysenbach et al. 2002*). Health-related Internet use is seen as embedded in everyday health practices, (*Kivits et al. 2009; Powell et al. 2011*).

Murray et al. (2011), found that 59% (n=1559) of the participants to an online survey reported using the NHS Choices website. Of these 33% (n=515) recorded a reduced number primary care consultations as a result of using the website. NHS Choices is the public facing website of the NHS, which provides medical, lifestyle information, and online health tools. It is the first national government sponsored web-based information portal within the NHS. In 2008, 24 million unique users accessed the website. The monthly average is seven million visits, (*NHS Choices 2009*).

An internet-based survey conducted in France in 2007, (*Renahy et al. 2010*), assessed the determinants of the frequency of online health information seeking. Researchers found that of the 3720 respondents who had searched for health information during the previous year, a lack of confidence in, and greater

expectations of health care providers, resulted in more frequent use of the Internet for health information.

Data from the 2002 - 2003 HealthStyles surveys (US) (*Bansil et al. 2006*) were analysed to examine health-related information on the Internet, users behaviours, differences between those with and without chronic diseases, and the type of websites visited. Thirty-five per cent of the study population were found to have used the Internet to search for health related information. Internet users with one or more chronic diseases were 1.3 times more likely to seek health related information than internet users with no chronic disease. Respondents with depression were 1.47 times more likely to seek health-related information on the Internet than internet users with no chronic disease. Three types of website were most frequently accessed; health information portals, government agencies, and non-profit organisations.

#### 3.4.2 Web-based research

It is therefore of little surprise that researchers have been exploring the potential of using the Internet in the conduct of research for some years. As well as disseminating information, the Internet and web-based studies are increasingly viewed as a valuable resource for researchers in the fields of health and psychology. An informal search of a leading search engine, Yahoo, identified over 2,000 web-based surveys in 59 areas, (*Kay and Johnson 1999*). This figure is likely to be higher in view of subsequent technological advances, expansion of the availability of the Internet and reduced costs to consumers in recent years.

A US web-based 'Mood Screener' study examined the prevalence of major depression and depressive symptoms, using a screening measure for a Major Depressive Episode (MDE). Over 50,000 participants visited the website over the course of the year-long study, with 24,965 people screened for MDE. Of those screened 66.6% were assessed positive for an MDE. This unexpectedly high rate of depression, the researchers suggest, indicates that the majority of those seeking information on depression online, contrary to suggestions of

'cyberchondria', may be doing so for valid reasons on based on the results of the screening (Leykin *et al.* 2012). Of the participants who consented to participate in the monthly screening study, the largest proportion of the participants were from the UK (n= 384).

### 3.4.3 Epidemiology and web-based research

The potential of Internet based studies outside of the commercial domain remains under-exploited. Although conducting epidemiological studies remotely, via the Internet, was originally mooted by Rothman and colleagues (1997) the systematic development of Internet based methodology has only recently occurred, (Ekman *et al.* 2007; van Gelder *et al.* 2010).

A recent analysis of modes of data collection identified in seven general medical and epidemiological journals published between 2008 and 2009, revealed that of 2,094 articles published on analytical epidemiological research, 1.3% used a web-based method (questionnaire), (van Gelder *et al.* 2010). Web-based questionnaires are frequently used in psychological studies and the following instruments used in psychological, and psychiatric clinical research and assessment, have been validated for administration via the Internet: Edinburgh Depression Scale, Centre for Epidemiological Studies Depression Scale; Kessler Psychological Distress Scale; and the Obsessive Compulsive Inventory, (van Gelder *et al.* 2010).

Notwithstanding the small number of studies, the study designs routinely used in epidemiology have been utilised in web-based research. For example, a longitudinal observational study of a cohort of employees with access to a web-based automated behaviour change system for physical activity and weight management monitoring, (Ware *et al.* 2008); an on-going prospective, longitudinal cohort study of health-related quality of life, in patients with lung disease or lung transplants, using a web-based questionnaire, (Bhinder *et al.* 2010); a prospective cohort study examining the level of use of a web-based intervention by primary care patients with coronary heart disease, (Kerr *et al.*

2010); a cross-sectional study to identify the characteristics and motivations of online health information seekers assessing the NHS Direct website, (Powell *et al.* 2011); an ecological study using a web-based screening tool for depression in the permanent employees of a telecommunications company with UK-based call centres (Harvey *et al.* 2011); a nested case-control study using data collected from cross-sectional internet survey of men who have sex with men, and risk behaviours in relation to bacterial sexually transmitted diseases (Hirshfield *et al.* 2004), and the following randomised controlled trials which studied internet based interventions to promote fitness (Bolier *et al.* 2012), promote weight loss (Funk *et al.* 2010), and promote physical activity (Slootmaker *et al.* 2009).

#### 3.4.4 Internet Mediated Research

In this rapidly developing area of research methodology, there are a growing number of papers where studies have utilised 'Internet Mediated Research'. The term Internet Mediated Research (IMR) covers a wide range of activities from observational surveys to highly structured and well-controlled experiments, (BPS 2013). In reviewing the findings of these studies it is essential that the distinctions noted below are identified both for their relevance to the current study, and to distinguish them from it.

The primary distinctions to be considered:

1. Was recruitment through to submission of data by web-based methods only?
2. How was the target population selected?
3. Were other electronic modes such as email employed?
4. Were traditional (postal) and IMR methods used?
5. Observational, intervention based or other?

### 3.4.5 Mental health related web-based studies

The early adoption of the Internet as a research vehicle by psychologists determines that there are many studies conducted using surveys and interventions in relation to mental health. In addition to adapting existing instruments for web-based use, a number of studies are using the Internet as a platform for which new instruments are specifically designed, and are being tested and validated.

A study conducted on the Internet in 2001 to explore the performance of a web-based screening instrument for depression, used the CES-D, adapted for web-based use. The screening instrument and feedback generated for users was hosted by an existing popular commercial website 'Intelihealth', a large on-line health information portal. Researchers found of 24, 479 completed tests, 58% (n=14,185) screened positive for depression, with fewer than one-half receiving treatment for depression. Older adults and minorities were least represented in the sample. The researchers suggested the Internet provides a platform for the continuous screening of the public for depression, (*Houston et al. 2001*).

A depression and work performance study using a web-based screening tool for depression, the Patient Health Questionnaire depression scale (PHQ-9), which includes nine questions covering symptoms of depression scored from 0 (not at all) to 3 (nearly every day). The maximum total score is 27, with scores of <5 indicating the absence of depressive disorder. Of the completed questionnaires, 623 (54%) had scores of  $\geq 5$ , suggesting at least subclinical levels of depressive symptoms. Those workgroups with higher levels of depressive symptoms had inferior work performance, (*Harvey et al, 2011*).

### 3.4.6 Critique of web-based studies

Web-based methods are still evolving and in addition to the enormous potential of the Internet, new challenges have to be addressed. Where health related web-based studies recruit participants by personal invitation only, the NHS or academic institutions' ethical approval procedures should provide the necessary

participant protection and privacy safeguards which are available to non-web-based studies. Where recruitment of participants is of 'random' web-users other issues need to be considered and agreed standards developed and observed to preserve the integrity of health related research. When evaluating the findings of web-based studies the ethical standards employed are of particular significance.

The use of web-based studies in UK health research, requiring NHS ethical approval, appears to be small. The South East Wales Research Ethics Committee manager appointed to monitor the progress of the CWB study advised that in the last two years (2012-2014) he was aware of only two approved studies that employed web-based research, though he based his assessment on the inclusion of the wording 'web-based' in the study title. It is reasonable to suggest that the number of web-based studies reviewed is relatively few in number, and this contributed to the level of caution expressed by the REC when reviewing the CWB study (see section 4.10 of Chapter 4).

### 3.5 CONCLUDING SUMMARY

The objectives of this chapter have been met as the literature for each part has been discussed and critically appraised.

Part I examined the population prevalence rate for common mental disorders and illustrated the difficulties in comparing prevalence rates.

Part II discussed a range of individual socio-economic transitions and area factors revealing a number of interesting findings not previously investigated due to the limitation of using a single combined classification for CMD. agreement with previous studies and outcomes of interest constrained by the limitations of the studies and the broader scale of the investigation of life transitions and area factors associated with change in mental health status.

Part III reviewed the growth of internet usage, the demand for health related information and development of web-based studies in health related

research. The opportunities and challenges presented by Internet Mediated research were reviewed, and the distinction between participants recruited by invitation and 'random' internet users recruited directly was examined with the latter posing the greatest threat to the maintenance of appropriate ethical standards. Web-based research will enable epidemiologists to conduct the same research (other than face to face interviews) on a broader scale and probable reduced cost.

The next chapter describes the CWB web-based study

## CHAPTER 4



## CHAPTER 4: THE CHANGES IN WELL-BEING WEB-BASED STUDY

This chapter describes the development and conduct of the Changes in Well-Being (CWB) web-based data collection study. The objectives of the CWB study were to enable two research questions to be answered: 1. *Is it feasible to use web-based methods to collect adequate data on mental health and well-being from population samples? What are the strengths and limitations of collecting mental health and well-being data using web-based methods?* 2. *What are the cut-points on the MHI-5 scale for a case of common mental disorder and a case of more severe common mental disorder (CMD-S)?* The first question is answered in this chapter, and the second question in Chapter 5. To achieve these objectives required: 1. The adaptation of two measures for web-based use, the MHI-5 and CIS-R, 2. The development of website to host the two measures and collect data from study participants, and 3. The design and production of a participant information pack, to be mailed, inviting potential participants to take part in the study.

The requirement for a cut-point on a widely used measure of mental health and well-being and the emergence of web-based epidemiological methods were discussed in Chapter 1. Common mental disorder and CMD-S are classifications of forms of mental disorder which are common in the community.

Establishing cut-points on the MHI-5 to determine a case for each of these classifications required the recruitment of participants who would provide a broad range of scores on the MHI-5 scale, including scores indicating a case of common mental disorder and CMD-S. This requirement heavily influenced the design philosophy applied in the development of the CWB study website and participant information pack.

### 4.1 CHAPTER OBJECTIVES AND OVERVIEW OF THE CWB STUDY

The objectives of this chapter are to describe the following:

1. The CWB study design and methodology;

2. Adaptation of two measures of mental health and well-being for web-based use;
3. The design of the CWB website and participant information pack;
4. NHS ethical approval procedure, IRAS, SEWREC panel;
5. Pilot and additional testing.

Many activities were undertaken simultaneously, but the material in this chapter is organised sequentially to simplify the presentation of events.

#### 4.1.1 Components of the CWB study

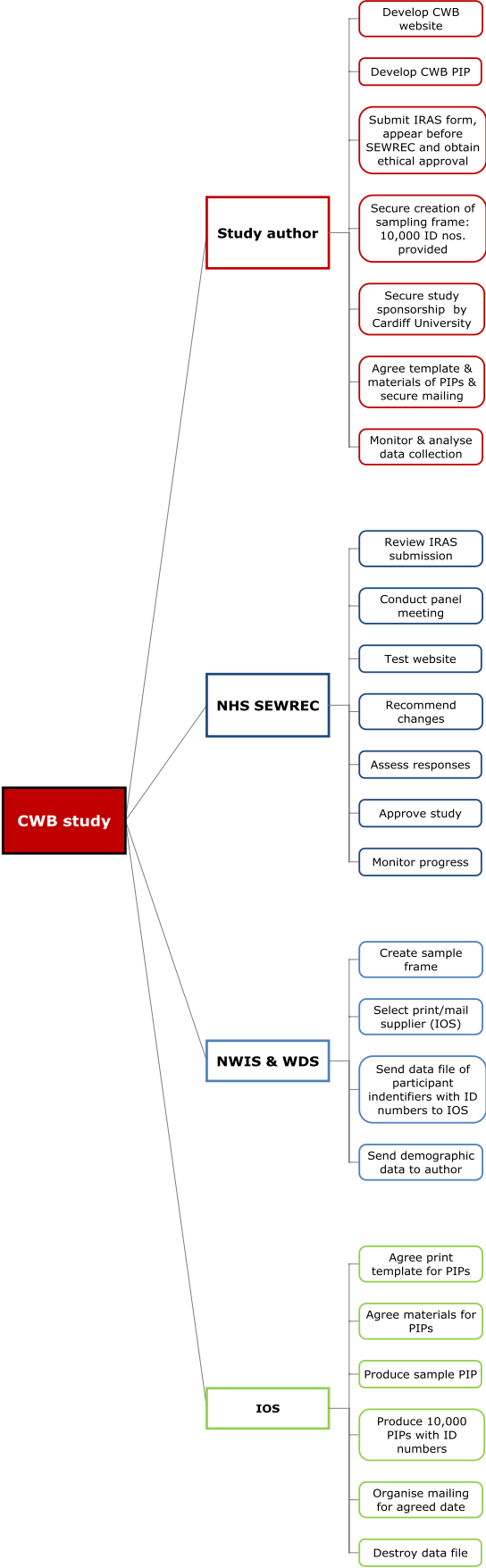
The development of the CWB website and the participant information pack for prospective participant information pack involved the completion of a wide range of tasks, and involved a number of parties. As a useful preview to the content of this chapter, a chart is presented. Figure 4.1, is an overview of the organisational structure of the CWB study and primary responsibilities of each party

In addition to Cardiff University, four organisations are noted in figure 4.1, NHS SEWREC, NWIS, WDS and IOS. As a guide at this point the full title of each is;

1. NHS South East Wales Research Ethics Committee (NHS SEWREC)
2. NHS Wales Informatics Services (NWIS)
3. Welsh Demographic Service (WDS)
4. IOS Limited (IOS) (an NHS approved external supplier)

Discussion of each occurs later in this chapter.

Figure 4.1. CWB study organisational chart with primary activities



#### 4.1.2 Title for web-based use

One of the first matters to be addressed concerned the title of the web-based study. Effective web-based study titles communicate their purpose with brevity; PhD thesis titles are therefore rarely suitable. The CWB study title is a positive, clear, and necessarily short label that could be reproduced easily and frequently in documentation and the website. The title reflects the web-based data collection study, and the over-arching subject of the thesis: change in mental health case status. The CWB title was approved by the Research Ethics Committee and subsequently utilised in the web-based cross-sectional study. The submission of the application for ethical review occurred when the development of the CWB website was at an advanced stage and the prototype version was fully functional. Contact with NWIS and IOS took place after receiving full ethical approval.

#### 4.1.3 Harm to participants - Risk assessment

Before work commenced on the development of the CWB website a risk assessment was conducted. The expert opinion of a consultant psychiatrist was obtained on whether participation in the CWB study posed any potential harm to vulnerable participants with poor mental health. The psychiatrist was of the firm opinion that the vulnerable individuals of concern were unlikely to be willing or capable of participating, and it was doubtful that they would even open the mailed invitation to participate. The CWB study posed no risk of harm to participants in his opinion.

#### 4.2 CWB STUDY DESIGN AND METHODOLOGY

The CWB study used a general population-based cross-sectional survey design to obtain mental health status data of residents of Caerphilly county borough to determine cut-points on the MHI-5 scale. This required the creation of a sample frame of 10,000 randomly selected residents, development of a website to host two web-adapted measures, and development of a participant information pack containing an invitation to participate in the CWB study. The participant

information pack had to be produced and mailed, and the data collected from the web-site monitored and subsequently analysed to determine the cut-points when the data collection period ended. The cut-points determined by the data collected (Chapter 5) were then used to establish the classification of mental health case status of the participants within the CHSNS dataset (Chapter 6).

Web-based data collection is an emerging methodology in epidemiology. The Age Well Feel Good (AWFG) study (referred to in Chapter 1) is at the forefront of web-based data collection methodology in the Institute of Primary Care and Public Health (PCPH). The AWFG study obtained full NHS Research Ethics Committee approval for web-based data collection after a lengthy review process. Therefore, the AWFG methodology was used as a guide for the CWB study, and improved by building on the information gained from the AWFG research team e.g. the inclusion of an information sheet on web browser address bars.

#### 4.2.1 Participant recruitment using the Welsh Demographic Service (WDS)

The predecessor to the WDS had been used in the creation of the sample frame for the CHSNS study in 2001. The WDS had to be used for this study due to the proposed additional population sample from Caerphilly county borough. The WDS is part of a set of services to manage administrative information (demographic data) for NHS patients in Wales. NHS data are subject to numerous privacy protection safeguards including restricted access and approved use. Consequently NHS Research Ethics Committee (REC) approval was required, and NHS Wales Informatics Services (NWIS) would be responsible for creating a new sample frame of residents from Caerphilly county borough drawn from the WDS. NWIS is a national organisation that provides a set of information and technology services for NHS Wales. It is mandated to hold NHS Wales patient personal identity information.

In accordance with the author's instructions, NWIS created a new sample frame comprising 10,000 randomly selected residents registered with a GP in

Caerphilly county borough aged 18 to 74 years, excluding those individuals originally sampled by NWIS in 2001 for the CHSNS study. Additionally, NWIS added 10,000 unique research project ID numbers (participant ID/login number) generated by the CWB website developer to the resulting participant data file. This data file was submitted by NWIS directly to the commercial supplier IOS undertaking the participant information pack production and mailing. The development of the materials used in the mailing is discussed later in this chapter.

#### 4.2.2 The CWB study sample size estimation

In practice sample size is often decided somewhat arbitrarily by researchers (*Malhotra and Indrayan 2010*). Here the sample size estimation was based on a number of factors: the likely response rate, the 4.5% response rate achieved in the AWFG study, the precision with which sensitivity and specificity could be estimated and the resources available to fund the required mailing. Taking these considerations into account the sample size identified was 400, based upon an estimation of a 4% response rate to a mailing of 10,000 people, even though this was possibly pessimistic.

An approximate prevalence rate of common mental disorders in the CHSNS study was estimated by reference to Kelly et al (2008) which suggested around 141 participants of the anticipated 400 recruited would have a common mental disorder. The cut-point (threshold) on the MHI-5 scale for defining cases would be determined from the estimated 141 participants with at least one common mental disorder, and 259 with none. The sensitivity and specificity estimation would be fairly precise. A 95% confidence interval for sensitivity, using the estimate of 80% of the 141 cases, would be of the form  $80\% \pm 7\%$ , a reasonably precise estimate. A 95% confidence interval for the specificity was narrower; this was because it was anticipated there would be approximately twice the number of participants without a common mental disorder.

For establishing a case of CMD-S the sample size for estimating the sensitivity was expected to be considerably smaller, and a 95% confidence interval would be correspondingly wider, around  $\pm 12\%$ . In regard to specificity, the sample size would be narrower, approximately  $\pm 4\%$ .

#### 4.2.3 Web-based studies - secure IT environment

A secure IT environment to maintain participant confidentiality is an essential component in research methodologies when dealing with the personal data of individuals. In the CWB study secure IT operated in respect of:

- personal identifiers (participants' names and addresses), and
- web browser data (data provided by participants).

The personal identifiers were held by NWIS (and temporarily by the mailing company IOS for the purposes of addressing and posting the participant information packs, then deleted), and were not known or made available to the author or Institute staff. Consequently, all analyses were conducted on anonymised datasets. The web browsers used for data collection employed the secure http protocol to transfer information (data) over the Internet.

NWIS also subsequently provided an electronic file of anonymised demographic data for the participants recruited, namely age, sex and WIMD quintiles (The Welsh Index of Multiple Deprivation, the official measure of relative deprivation for small areas in Wales will be discussed in Chapter 5). NWIS did not have access to any data provided by the recruited participants, which was sent direct to and stored on Cardiff University secure IT servers. At no stage did Cardiff University have participant personal identification data. In addition, no party involved in the CWB study possessed both the personal identifiers and data collected.

#### 4.3 THE CWB STUDY DEVELOPMENT WORK

Web-based technologies provide opportunities to collect substantially more data at much lower cost because potential participants are recruited via the Internet, a widespread technology to which many people have access and use. Their use presents new challenges particularly where non web-based designed instruments are utilised because they were developed in an incompatible format or software language. The adaptation of existing complex instruments, here, by 'translation' to a web-based language such as HTML, is a far from simple process. The CWB study required a) the adaptation of two instruments not designed for web-based use, b) the design and development of a website to (i) host the CIS-R and MHI-5, (ii) collect the data generated from them, (iii) provide a self-sufficient resource with everything necessary to inform and guide participants, and c) the development of a paper participant information pack comprising important items that replicated certain webpages of the website. In addition, a rigorous preliminary testing and pilot testing strategy was implemented, and the views and suggestions made by the NHS REC had to be attended to.

#### 4.4 MEASUREMENT INSTRUMENTS

This section describes the process of adapting the CIS-R (via PROQSY) and MHI-5 for web-based use. The CIS-R is a detailed clinical interview schedule originally designed to be administered by a lay assessor, while the MHI-5 is a short form questionnaire of five questions. Detailed discussion of these instruments appeared in Chapter 2.

##### 4.4.1 Instrument adaptation

Adapting the bespoke CIS-R computer script for web-based use presented several programming challenges, primarily due to its complex action branching (section category pathways determined by the users' responses). As noted in Chapter 2, the CIS-R is written in a unique PROQSY compatible script (bespoke computer coding). Therefore, in order to use the CIS-R with the prototype web- platform under development by Institute research staff, the logic of the script



(determinants of pathway and scoring outcomes) and PROQSY (how script commands were actioned and scores computed) had to be mastered by the software and website developer before adaptation occurred. Without this understanding it would not be possible to ensure that correct functionality (scoring mechanisms) with computed results was maintained when the CIS-R script was translated into HTML/JavaScript for web compatibility. Essentially, how each potential individual score is generated by the CIS-R, and delivered via PROQSY to produce the accumulated total score, had to be understood before it could be translated to ensure accurate replication.

Permission was obtained from the instrument's author to adapt the CIS-R PROQSY compatible script for web application. He also provided the source code for PROQSY to assist the translation process. The specialist IT skills required for the development and operation of the CWB website were provided by the developer of the Institute's prototype web-platform, who worked under the direction of the author for the CWB website.

The design of the CIS-R questionnaire, which as noted above contains numerous extended branches of assessment questions linked to the status of answers given, precluded development of the preferred 'save and revert' model. This model would have allowed responses to be saved at each stage submitted and full completion to be achieved over a number of sessions. Instead, participants had to complete the required tasks in one session, or start from the beginning again if they left the website before submission. As a compromise participants were given unlimited opportunities to return to the study website (while it was active) to undertake the required tasks again.

In contrast, the MHI-5 is a simple five item, Likert-type scale instrument with five options for each question. Each question is 'stand-alone' and scored individually by hand; there are no action branches. This paper measure was adapted for web-based use, and included the question scoring scheme in raw form. This enabled the simultaneous collection of individual question scores and automatic calculation of the total score.

#### 4.5 THE CWB STUDY WEBSITE DEVELOPMENT

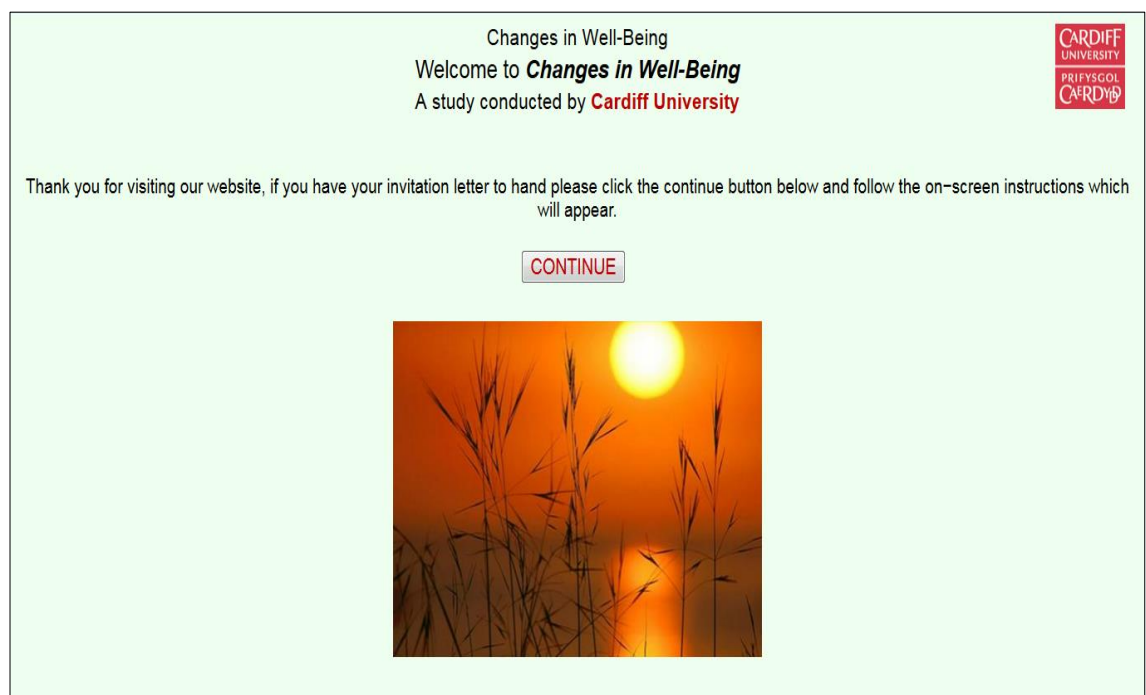
As discussed earlier in this chapter, in order to determine cut-points on the MHI-5 it was necessary to recruit participants with a broad range of MHI-5 scores. This requirement heavily influenced the approach adopted in the development of the CWB study website and participant information pack. A substantial amount of time was invested in identifying the key design considerations. The overriding philosophy throughout was to develop a functionally robust website and accessible participant information pack, using a design and content that would assist those potential participants who may have more severe symptoms. It was decided that a wider level of participation would be secured by achieving the following: development of a clear, uncluttered, concise, easy to use website with seamless continuity of appearance from the home page to last, consistency of functionality and appearance across a variety of internet-enabled devices; and concise, helpful, documentation replicating, so far as possible, the website's appearance and content.

The CIS-R via PROQSY is designed to be used with a researcher in attendance; therefore, further content adaptations were required and improvements made for web-based use. This involved simplifying the login, clarifying the instructions, and removing the necessity for advancing page changes by use of a 'next' button. The CIS-R web-based version became easier to use than the PC based version and the changes made were in keeping with the design criteria.

Although the design priorities for the CWB study website were largely focused on those with potentially poor mental health, the website was also designed to be easy to understand and use by participants with limited computer literacy or advanced age in acknowledgment of the varying range of experience and capabilities likely to exist due to the wide age range (18 to 74 years) of the invited participants.

In comparison with the sophisticated websites routinely found on the Internet, and those developed by other research teams in the Institute e.g. *www.myHeartRisk.co.uk* (no longer active) (Waldron 2012), the CWB website was very elementary in both appearance and function. The uncluttered webpage design, with a single ‘message’ or task per page was intentional for the reasons previously discussed, but also reflected resource constraints. Subsequent studies have supported such an approach (Fan and Yan 2010). Figure 4.2 shows the CWB website home page which was designed to have a calm and quiet visual ‘tone’, and promote trust and confidence by inclusion of the Cardiff University logo, which appeared on the invitation letter and other documents in the participant information pack mailed to prospective participants. The design theme was maintained throughout the entire website to ensure continuity, and reduce the number of changes presented to the participants. Figure 4.2 shows the CWB study website home page.

Figure 4.2 The CWB website home page



#### 4.6 PARTICIPANT INFORMATION PACK DEVELOPMENT

The development of materials for the mailing was a lengthy process due to the dependence on, and relationship with, the website development and overarching design philosophy. Although separate and in different formats i.e. paper and webpages (computer files) written in a web compatible language, a direct link and continuity of style had to be achieved to minimise the cognitive demands posed by changing from one mode to another. If the cognitive demands of moving from the participant information pack to the website were reduced, it was anticipated that participants with less optimal mental health may feel less deterred and more likely to participate. Each format (paper and webpage) imposes limitations and opportunities. The manner in which design improvements arose and were developed in each was different; therefore overall design improvements were driven by the format where the improvement was first made. This approach ensured a greater level of harmonisation of content and appearance between the participant information pack and website, and resulted in improvements which may not have occurred if the design of the formats had been kept separate.

The participant information pack was originally intended to comprise an invitation letter, and Study Information Sheet. This changed after discussion with the CWB website's developer. He advised that during the AWFG study's recruitment phase potential participants' contacted the Participant Resource Centre (PRC) to advise that entering the AWFG web address into the Google search engine had not resulted in connection to the website. It appeared that less experienced internet users did not understand the distinction between web browser address bars and search engines. To assist participants and increase inclusivity an information sheet displaying a screen shot of the CWB website's home page and the address bars of several web browsers featuring the CWB site address was included. An extract from this information sheet is shown in Figure 4.3.

Figure 4.3 Extract from the web browser address bars information sheet

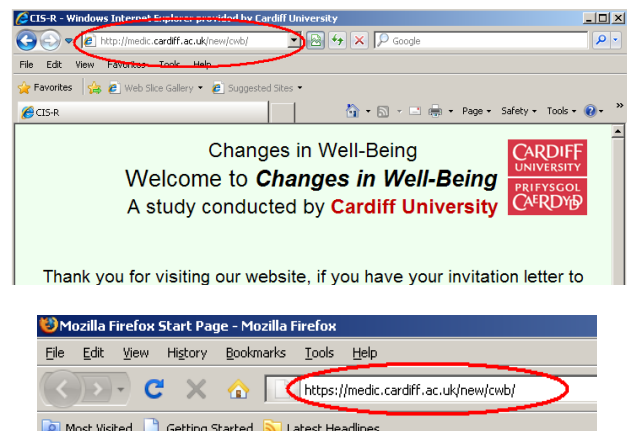
## Web browser address bars

Below are screen shots of the address bars of the more common web browsers in use. If the one you use is not shown, the position and appearance of the address bar will be very similar.

Internet Explorer:

**Website home page**

Mozilla Firefox:



When you open your web browser, highlight the home page address in the address bar and delete it. Then type in <https://medic.cardiff.ac.uk/new/cwb/> and press enter. If the webpage shown above does not appear, check that the address is correctly entered, and if problems persist please contact the free-phone helpline on **0800 0272 194**.

The full version of this document can be seen in the appendix. No contacts were recorded by the PRC for this issue, which suggests the information provided was effective or potential participants took no action if access problems were encountered.

The use of NHS data for participant recruitment restricted the appointment of a commercial supplier to one approved for NHS mandated activities. Therefore no tendering process occurred, and the approved supplier, IOS Ltd (IOS) was selected by NWIS to undertake the Participant information pack production and arrange the mailing.

At the stage IOS was appointed, the design of the participant information pack content to be mailed was complete. Attention was then focused on practical matters. These included producing accurate copies of the originals, accurate reproduction of colours and graphics used, paper quality, and a number of practical items such as inserting the unique User ID/log in numbers.

One new item of work remained to be completed, which was the form and design of the envelope. To avoid concerns and enhance the impression created by

the participant information pack the envelope selected was A4 size, in white, bearing the Cardiff University logo on the front, to distinguish it from 'bills', 'official' letters and 'junk' mail, and a Cardiff University return address on the rear for the CWB study.

The invitation letter in the participant information pack was printed on official Cardiff University headed stationery, the Study Information Sheet was printed in colour to match the CWB website's appearance, and the web-browser information sheet was printed in colour to accurately reproduce the on-screen appearance of various web-browser address bars, and the home page of the CWB website. The participant information pack was printed on high quality paper to ensure the accurate reproduction of the colours and appearance of the CWB website.

In addition to producing the participant information pack in the agreed form, IOS was also required to insert into the invitation letter a participant's name and address, and unique login number from the data file sent directly from NWIS. Each invitation letter included a link to the study website, <https://medic.cardiff.ac.uk/new/CWB>, and a unique research project ID number (participant ID/login number) in a six digit format e.g. 100608, which also served as the login number to join the study. By entering this number when prompted, participants logged into and thereby entered the CWB website where they could join the study by undertaking the required tasks or indicate withdrawal and end participation. The Study Information Sheet also contained contact details for the study. A free-phone number with contact hours was also provided if further information or participant support was required. The content and layout of the Study Information Sheet is identical to the corresponding webpages on the CWB website. (A copy can be found in the appendix). As previously noted this 'duplication' in appearance was intentional to reduce the cognitive effort required to process information presented with the use of dual modes.

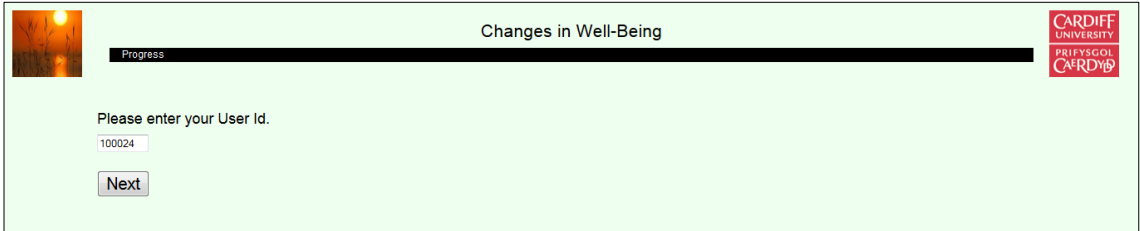
Once a hard copy of the participant information pack had been seen and approved, the timetable for production and mailing was agreed. The participant

information pack production was finished to enable a mailing commencement date of 09.01.12 and completion by 12.01.12. The information packs were posted after the start of the new school term to achieve an end of week/Saturday delivery. This was planned to increase the prospects of participation with potentially greater leisure time available to prospective participants.

#### 4.7 PARTICIPATION IN THE CWB STUDY AND FREE-PHONE HELPLINE

Study participation required visiting the CWB website and entering the user ID number (the unique participant ID number) provided. Figure 4.4 shows a screen shot of this and the simplicity of the 'instructions' on how to proceed. In addition, on entering the ID number the website automatically advanced to the next webpage. The instructions provided throughout the CWB website required no more than the selection of a response option or the 'next' or 'back' onscreen 'buttons'. Participants were also advised when the opportunity to review their responses would end.

Figure 4.4 Screen shot of CWB website login webpage



Changes in Well-Being

Progress

Cardiff University  
Prifysgol Caerdydd

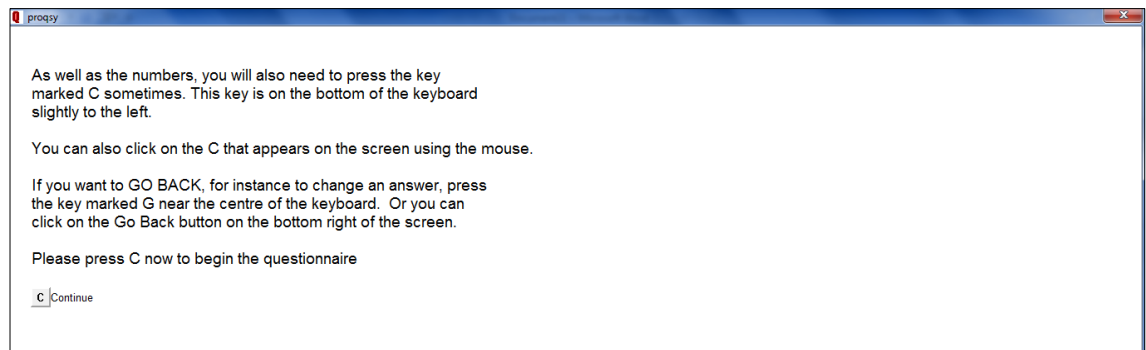
Please enter your User Id.

100024

Next

In contrast, figure 4.5 shows a screenshot of the second page of the CIS-R PC format which contains the user instructions.

Figure 4.5 Participant instructions on how to use the CIS-R PC format



This difference in approach is an example of how the web-adapted format simplified the use of the CIS-R to reduce the demands made of participants, particularly those with poor mental health.

After participants logged in they were required to either confirm they had read the Study Information Sheet, or else be re-directed to the webpage containing them for review. The Study Information Sheet advised potential participants of a further source of information and/or clarification, using a free-phone helpline service provided by the UK Biobank National Participant Resource Centre (PRC) run within the Institute. The PRC is experienced in dealing with participant queries, was specifically briefed for the CWB study, and provided with scripts for frequently asked questions and details of escalation procedures, e.g. stage 1: refer to a PRC Manager.

After submission of confirmation that the Study Information Sheet had been read by the participant, the website automatically advanced to the consent webpages and required the participant to confirm their consent to participate in the study.

#### 4.8 CONSENT

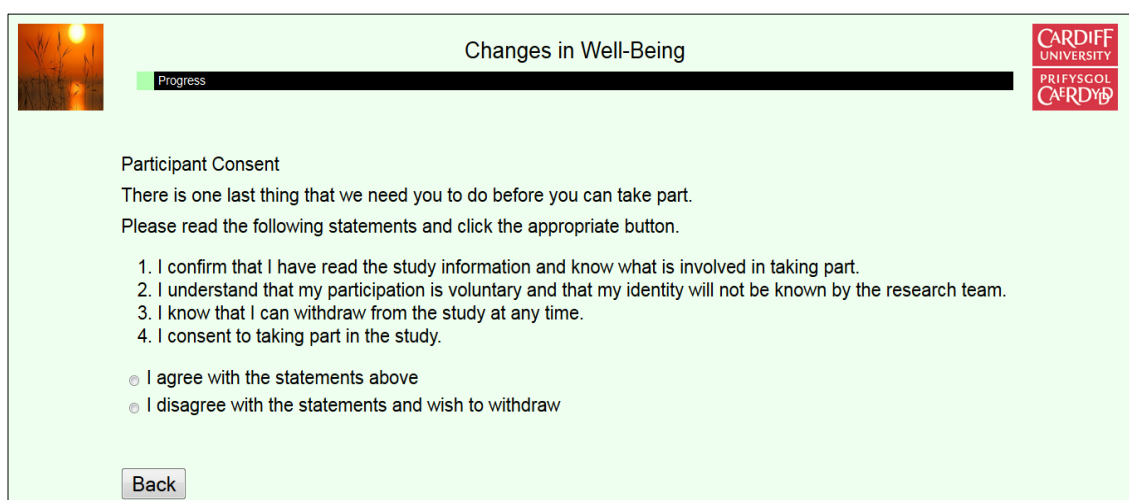
To ensure that the consent section of the CWB website was in accordance with the best current research practice, a number of consent forms with ethical approval, and recently used in other health related studies, were reviewed



before drafting the consent section of the CWB website. The consent section designed was an adaptation of these previous versions.

The use of web-based methods determined that participant consent was obtained remotely i.e. without face-to-face contact with participants. The major disadvantage of this approach was the participant's immediate loss of opportunity to ask questions. The provision of a free-phone helpline sought to address this limitation. However, an advantage to participants of remote contact was the ability to withdraw without any unease. To proceed to the study questionnaires participants had to complete a consent page, where they were invited to give consent by selecting an on-screen 'button' confirming agreement with a number of short statements or disagree and withdraw from the study. A screen shot of the consent webpage of the CWB website is shown in figure 4.6.

Figure 4.6 Consent web-page of the CWB website



Changes in Well-Being

Progress

Participant Consent

There is one last thing that we need you to do before you can take part.  
Please read the following statements and click the appropriate button.

1. I confirm that I have read the study information and know what is involved in taking part.
2. I understand that my participation is voluntary and that my identity will not be known by the research team.
3. I know that I can withdraw from the study at any time.
4. I consent to taking part in the study.

☐ I agree with the statements above

☐ I disagree with the statements and wish to withdraw

Back

Only when participants submitted their consent could they advance to the study questionnaires.

#### 4.9 THE CWB STUDY QUESTIONNAIRES

On reaching the questionnaire completion stage, participants were provided with a brief overview of each questionnaire. The first questionnaire, the Mental Health Inventory-5 (MHI-5), is a short five-question instrument which can be

completed quickly. Figure 4.7 shows the webpage with the MHI-5 overview and instructions and two of the questions.

Figure 4.7 CWB webpage with an overview of the MHI-5 instructions and two of the questions

**Changes in Well-Being**

Progress

CARDIFF UNIVERSITY  
PRIFYSGOL CAERDYDD

PART I

On the next page is the first questionnaire that we would like you to complete. It is short, just five questions, on how you have been feeling over the last four weeks. When you complete the last question all your responses are 'sent' to our secure servers and cannot be reviewed. So if you want to look at your earlier answers you have to do so before answering question five.

If you are ready please press 'Next' below to continue.

Next

**Changes in Well-Being**

Progress

CARDIFF UNIVERSITY  
PRIFYSGOL CAERDYDD

In the past four weeks:  
Have you been very nervous?

- ☐ All of the time
- ☐ Most of the time
- ☐ Some of the time
- ☐ A little of the time
- ☐ None of the time

Back

**Changes in Well-Being**

Progress

CARDIFF UNIVERSITY  
PRIFYSGOL CAERDYDD

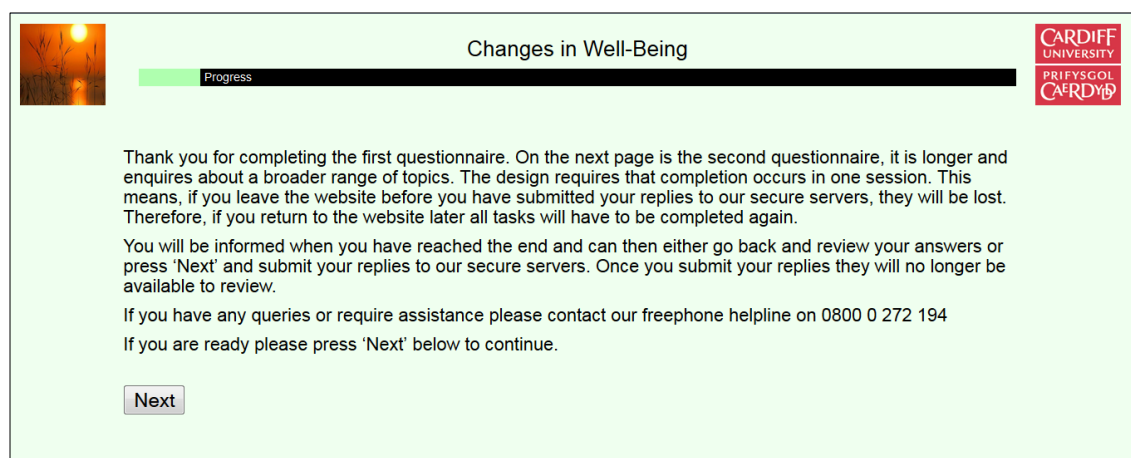
In the past four weeks:  
Have you felt downhearted and depressed?

- ☐ All of the time
- ☐ Most of the time
- ☐ Some of the time
- ☐ A little of the time
- ☐ None of the time

Back

On completion of the MHI-5, the website automatically advanced to information and instructions for the second questionnaire, the Clinical Interview Schedule – Revised (CIS-R) (web-based version). Figure 4.8 shows a screen shot of a webpage from the CWB website with information and instructions written for the web-adapted format of the CIS-R.

Figure 4.8 Screen shot of a webpage with information and instructions written for the web-adapted format of the CIS-R



The content of this webpage reflects the remote method of participation, and was considered necessary by the author to inform and prepare participants for the next questionnaire, and to provide important information about the 'single-session completion' design. The author hoped this information would encourage completion, ensure that the consequences of leaving the website before completion were understood, and reduce the potential loss of 'returning' participants through frustration and disinclination to repeat in full tasks previously commenced. The data collected on the CWB website usage reveals that 13 (2%) participants completed the questionnaires after multiple attempts.

The amount of time required to complete the CIS-R is variable because the total number of questions presented is directly linked to the answers given i.e. a 'no' response will close the topic, while a response indicating severe symptoms will raise further assessment questions along a topic branch. In addition, individual participant speed of progress will vary. The time taken, therefore, can typically range from approximately 20 to 50 minutes.

On completing and submitting their final response to the second questionnaire, the questionnaire ended and participants were advised to proceed to the Guidance notes.

Figure 4.9 Screen shot of the webpage notifying the end of interview and to proceed to the Guidance notes

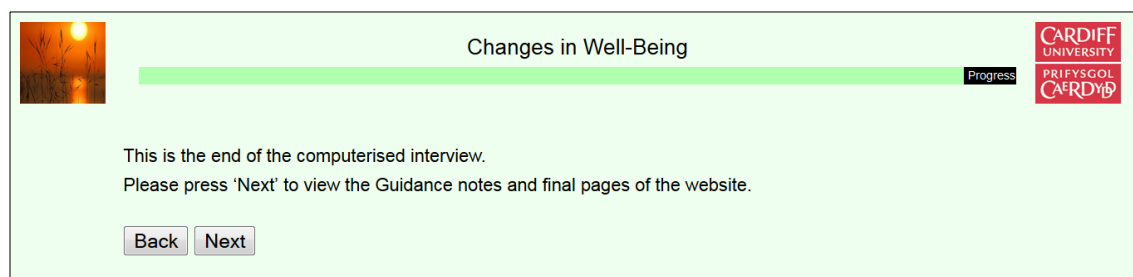


Figure 4.10 shows a screen shot of the equivalent page in the CIS-R PC format which notes the presence of a researcher.

Figure 4.10 Final page of the CIS-R PC format



Figure 4.11 shows a screen shot of the CWB webpage with the Guidance notes.

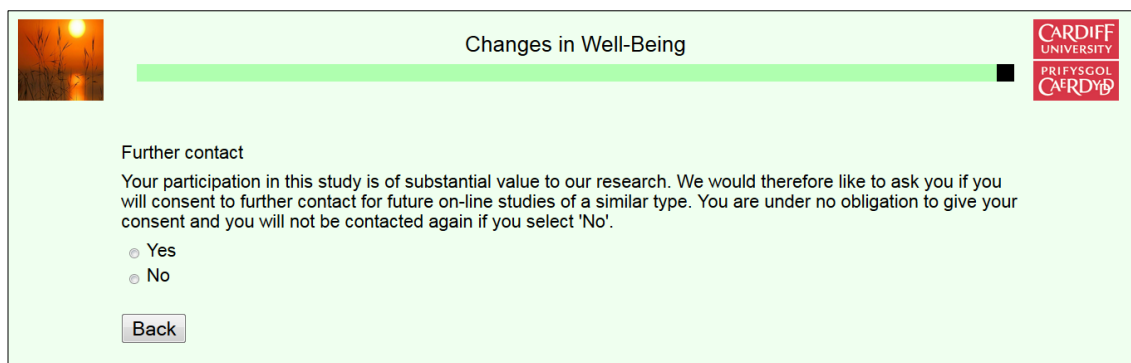
Figure 4.11 CWB website Guidance notes webpage



This webpage was amended to comply with one of the suggestions made by the REC, and is discussed in the next section.

On the next webpage, participants were asked if they would consent to further contact to take part in future on-line studies Figure 4.12 shows the webpage containing this request.

Figure 4.12 CWB website request to participate in future research

The screenshot shows a webpage titled "Changes in Well-Being" with a green header bar. On the left is a small image of a sunset. On the right is the Cardiff University logo. The main content area has a light green background and contains the following text: "Further contact", "Your participation in this study is of substantial value to our research. We would therefore like to ask you if you will consent to further contact for future on-line studies of a similar type. You are under no obligation to give your consent and you will not be contacted again if you select 'No'." Below this text are two radio buttons labeled "Yes" and "No". At the bottom left is a "Back" button.

Of the 616 participants who completed both questionnaires, 558 (90.5%) selected 'yes' consenting to further contact for future on-line studies of a similar type. This suggests that the CWB website achieved a participation experience which did not discourage further participation or remove participant interest in on-line studies.

#### 4.10 ETHICAL APPROVAL

Applications for ethical review are typically made at an early stage in the research process. In this case the application for ethical review could not be made until the website had reached a satisfactory prototype stage which occurred much later. While development work continued, the CWB study website (printed screen shots and active web-link details) and study protocol were submitted with an Integrated Research Application System (IRAS) application form for NHS ethical review by the South East Wales Research Ethics Committee (REC). IRAS is a single on-line system for applying for the permissions and approvals for health and social care/community care research in the UK. At the ethical review meeting the panel were highly engaged with the proposed research but were concerned with the provision of support generally to vulnerable participants, in part due to the 24 hours nature of access to the CWB website. The expression of

such concerns necessitated identification, and discussion, of the possibility that a small number of participants might be faced with a branch of questions relating to suicidal ideation.

The REC required the inclusion of contact details of the Samaritans on the webpage where the issue of suicide first arises, and the addition of ‘comfort wording’ e.g. *“suicide is never the answer; call a friend now”*, primarily to address periods when GP support may be less readily available i.e. until the following day. These requirements posed a number of issues that the author needed to consider. While the REC’s requirements were evaluated, the Chair directed a panel member to assess the CWB website by undertaking the same tasks required of participants. The author therefore provided a User ID login number to enable access to the CWB website.

The first issue raised by the REC to be considered related to the conditions of use stipulated by the instrument’s author when he gave permission for the use of the CIS-R and its development as a web-based instrument. The condition precluded the content of the CIS-R being altered. Second, if changes were permitted these conditions may have affected the instrument’s validity. The instrument’s author gave permission for the inclusion of additional contact details of other agencies but consent was not given for the inclusion of ‘comfort wording’. Such wording could be misinterpreted or misconstrued and do more harm than good, as it was inappropriate to try and second guess the very different reasons why people may wish to harm themselves.

To avoid changing the critical content of the CIS-R, an invisible re-direct link was inserted within the webpage’s coding where suicide is discussed as a serious matter. This resulted in the participant leaving the CIS-R and being re-directed to a separate webpage outside of the CWB website (effectively moving to another single page ‘website’ within the Cardiff University website school of medicine ‘medic’ sub-domain). This webpage retained the same appearance as the CWB website pages. It was possible to return to the CIS-R simply by selecting the ‘next’ button on this external webpage. Participants would not have been

aware of this event as it was seamlessly integrated into the website and did not disturb progress through the questionnaire. The auto advance feature was not included in this external webpage to ensure that participants had to actively choose to continue. In this way the CIS-R's content was not changed; a participant could elect to leave the study from the external single webpage website, but if they returned to the CWB website it would be reasonable to conclude that they felt able to continue with the questionnaire.

In view of the CIS-R author's comments regarding 'comfort wording', and the absence of such wording in other web-based studies focusing specifically on self-harm culminating in suicide e.g. Chu (2011), it was decided to decline the REC's suggestion. The author submitted a written explanation to the Chair. In addition to being opposed by expert psychiatrist opinion, the inclusion of 'comfort wording' could have introduced the risk of potential legal liability and appeared to be excessively cautious given the Chu (2011) web-based study questionnaire.

The other changes suggested by the REC were satisfied by inserting a linked webpage and adding more emergency contact details at the end of the study to the appropriate webpage (figure 4.13). Permission was obtained from Cardiff and District Samaritans prior to including contact details for the organisation. A favourable ethical opinion was then issued.

To afford a better understanding of how the CWB website satisfied the REC's requirements, and to illustrate the difference in appearance of the web-adapted CIS-R and original PC version, the CWB webpage preceding the linked page, the linked page, and subsequent webpage, are shown in three screen shots in figure 4.13. Two screen shots are of the CWB website, and one of the linked 'single webpage website'. For comparison, the two program pages that appear in the same sequence in the original CIS-R via PROQSY program are shown in figure 4.15.

Figure 4.13 Two CWB webpages with the linked webpage in order of appearance

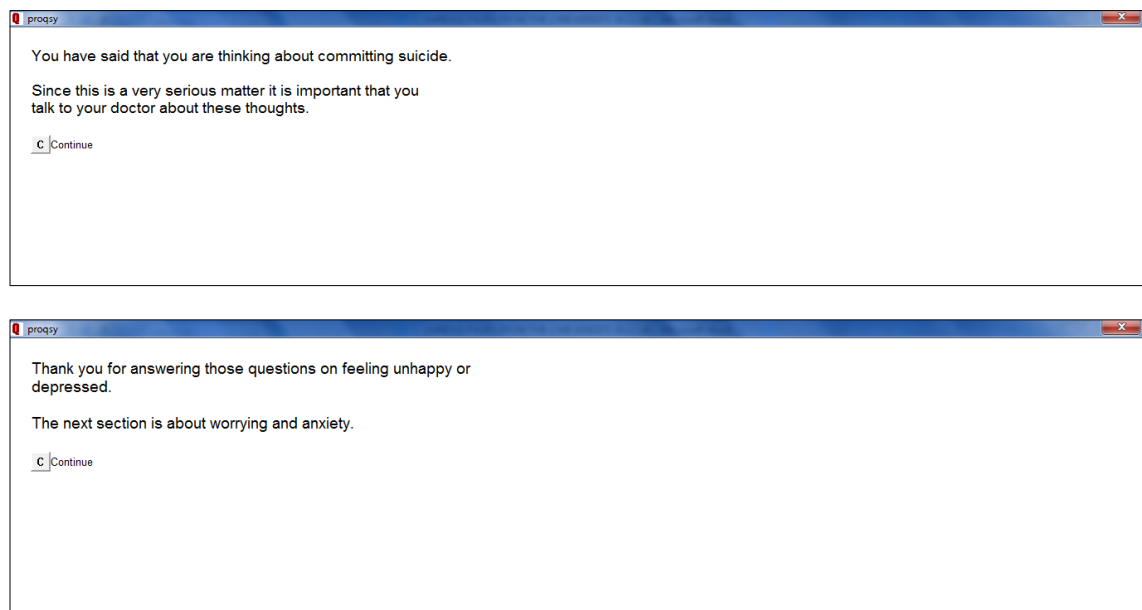


It can be seen from the screen shots that the linked webpage is identical in style and appearance to the CWB webpages, and would not disrupt the continuity of the CIS-R or suggest that participants had been re-directed to another website. By selecting 'next' participants were returned to the CWB website.

In contrast, figure 4.14 shows the same two webpages of the CWB website in the style of the CIS-R via PROQSY PC program.



Figure 4.14 Two CIS-R via PROQSY program 'pages' in order of appearance



As can be seen, the PC format of the CIS-R is more minimalist in appearance in comparison with the CWB web-adapted format, and has a smaller font size.

The concerns over suicide-related questions extended the ethical review process by several months.

#### 4.11 PRE-PILOT TESTING STAGE

In the knowledge that no further changes would be required by the REC it was possible to proceed to more formal testing.

##### 4.11.1 Purpose

Before conducting test exercises with selected pilot reviewers, the CWB website's content and functionality were reviewed and tested by the author and Institute research staff (the review group) who had been involved with the CWB study.

#### 4.11.2 Method

The review group was requested to test the website and its functionality in any way they saw fit and to report their findings. The devices used to connect to the Internet were a standard Cardiff University PC (CUPC) running Windows XP, and Internet Explorer, an ASUS laptop running Windows 7, Opera, Google Chrome, Mozilla-Firefox and Safari for PC, a Blackberry Bold running Blackberry OS and Opera mobile, and an Apple I Pad, running iOS and Safari.

#### 4.11.3 Results

The most significant changes made in this period related to simplification and reduction of the information provided in the webpages which preceded and followed the two questionnaires. The changes made were the provision of a progress bar, the colour scheme used, and log in procedure.

Before devising a pilot testing strategy and progressing to the formal pilot testing stage it was prudent to investigate whether an approach existed that was suitable for the CWB study. Distinct from many web-based studies, the CWB study adapted established measures for web-based use as opposed to designing measures specifically for web-based use. In consequence the review of the instrument's content was not required. The issues of interest focused primarily on website performance or 'functionality', and the effectiveness of the participant information pack.

#### 4.12 FUNCTIONALITY TESTING

While an increasing number of studies on the issues arising from web-based research have appeared in recent years, the topic of pilot testing in the context of functionality or 'usability' has attracted much less attention. The development of website design has been driven by e-commerce, not academia. It was therefore prudent to explore the methods used in this field, and apply more appropriate criteria for research in assessing the validity of strategies employed. This was necessary because academic research by its nature is not focused on generating

or increasing revenue streams as its primary goal, and there are no known peer reviewed journals that examine website functionality as a specific on-going topic.

A range of opinions have been expressed surrounding pilot testing procedures e.g. Lewis, J.R (1994), Virzi (1990, 1992), but the most innovative approach identified is one developed by a web usability expert Dr Jakob Nielsen who holds a PhD in Human-Computer Interaction. Nielsen (2000, p.2) states;

*You want to run multiple tests because the real goal of usability engineering is to improve design and not just to document weaknesses.*

Nielsen (2000) suggested that conducting tests with five users will identify 85% of usability issues, and to identify 100% will require no more than 15 users in total (three tests with five users per test). The Nielsen 'model' comprises three phases. The first phase of testing is expected to identify, as noted, 85% of the usability problems, which are then fixed in re-design and tested. The second phase establishes whether the fixes worked or not, and discovers if the changes made have introduced any new usability issues. Nielsen regards the second phase as the stage where a deeper probe into the usability of the fundamental structure of a website occurs. Issues such as information architecture, task flow, and match to user needs are assessed. These are issues he considers important but often obscured in initial testing because,

*...users are stumped by stupid surface level usability problems that prevent them from really digging into the site.*

*(Nielsen, 2000, p.2)*

This phase of testing, Nielsen suggests, will discover most of the remaining 15% of the original usability problems not discovered in the first phase of testing. These problems are fixed in re-design and a final phase of testing repeats the process. The final phase is believed to identify any remaining issues.

Although the idea of needing to recruit a smaller number of pilot test reviewers is appealing, the key benefit of this approach was increased

effectiveness through multiple stage testing. Multiple stage testing allows for the improvement of design, and testing of re-design (fixes), as an integral part of the development process, as distinct from identification of weaknesses alone which must then be addressed.

The CWB website had a specific, wider and inclusive user design philosophy explained previously in this chapter, and it was improbable that commercial website developers would have needed to consider the issues faced by the CWB website author. However, Nielsen (2013) subsequently produced a report in which he addressed usability in the context of ageing users. Nielsen conducted a small study with participants aged 65 years and over in two stages. In the first ‘round’ in 2002, usability studies were conducted where 17 websites were tested with 44 participants and a control group of 20 users aged 21 to 55 years investigating task completion and time taken. Round two was conducted in 2013 and 29 websites were tested with 31 participants, and as before a control group of 20 users aged 21 to 55 years. Three criteria were measured that indicated a number of changes in a user’s capabilities related to ageing. For vision and dexterity, 100% would indicate no problems using websites. Memory was measured by the percentage of items, introduced at an early stage in the test session, that users could recall correctly at the session’s end. A summary of the findings of the second study are shown in table 4.1.

Table 4.1 Human ageing and web use

CRITERIA TESTED	USERS AGED 65 AND OVER	USERS AGED 21- 55
VISION	82%	95%
DEXTERITY	73%	95%
MEMORY	49%	63%

In another small ‘study’ (Nielsen, 2008) of 61 internet users aged between 25 to 60 years, Nielsen found that people in their forties require larger font sizes, and between the ages of 25 and 60 years he estimated a person’s ability to use websites declines by 0.8% a year, though no details are given on how this decline

was measured. Nielsen suggests that increased time spent on webpages and an increased number of webpages visited to complete a task is an indication of this decline, but a changing pattern of use as people age may also provide an explanation.

Although these studies are small and lack the methodological reporting rigour of peer reviewed papers, they are supportive of the contention that older users have slightly reduced capabilities and website design needs to reflect this. The CWB website design philosophy anticipated the varying requirements of such users and endeavoured to accommodate them.

#### 4.13 THE PILOT TESTING

In addition to the user interface testing, the data collection functions also required testing. Therefore a unique batch of dummy User ID numbers was generated specifically for the pilot testing, and included in the reviewers' invitation letters. These dummy User ID numbers gave access to the actual CWB website as opposed to the test version. In conjunction with the formal pilot testing, the author tested the design 'fixes' at each stage using a university PC running Windows XP and Internet Explorer, an ASUS laptop running Windows 7 and Google Chrome, and a Blackberry smart phone running Blackberry OS and Opera mobile.

##### 4.13.1 Reviewer profiles

To ensure that the full range of question branches in the CIS-R was presented, and to remove any concerns that sensitive data was being collected about them, the reviewers were required to simulate a range of potential participant profiles using the allocated standard profiles in Table 4.2 below. As previously explained, the number of question branches each reviewer is required to complete determines, broadly, how long they will spend on the CWB website, and is likely to affect their experience of it.

Table 4.2 CWB Pilot testing reviewer profiles

No.	CWB PILOT TESTING: STANDARD PROFILES FOR REVIEWERS
1	Male, 20s, in good health with no psychological problems, or concerns.
2	Female, 30s, in reasonable health, but sensitive to, and anxious about, world events.
3	Male, 40s, has significant health concerns, and has recently lost his job as a direct result, his relationships are under strain.
4	Female, 50s, in fair health, but is undergoing tests for a serious illness, and is very anxious.
5	Female, 60s, poor health, in very depressed state, recently widowed after a long marriage, no children and has no desire to live.

The same profiles were used for each phase of pilot testing to reduce variability in the question branches presented, and as an additional means of checking that the reviewers were undertaking the tasks correctly e.g. a reviewer allocated profile no.5 should generate data for the suicide questions.

#### 4.13.2 Selection of reviewers

In assessing the CWB website's functionality four distinct areas needed to be evaluated. The first related to a user's experience of the website's content. The second, concerned the performance (correct operation) of the website, while the third, concentrated on the website's performance when accessed by web browsers other than the market dominant Internet Explorer. The fourth concerned the variety of devices used to connect to the Internet. Therefore, to enhance the value and range of factors which could be tested during the first review stage, it was prudent to select reviewers who were confident users of the Internet. This included wide experience of website functionality (performance), previous use/used or familiarity with a number of web browsers, and access to, and ease of use, with a variety of internet-enabled devices. Knowing that a reviewer met all of these requirements, and could complete the necessary tasks in a strict timeframe, restricted the selection to a convenience sample. Reviewers for the first two phases were therefore recruited exclusively from Institute staff based in the same building. Although it is generally preferable, at some stage, to

include individuals in the pilot test who represent the target population, the model used here was not designed or suited to such an approach.

#### 4.14 PHASE 1 PILOT TESTING

##### 4.14.1 Purpose

In view of the above, the first five reviewers were selected on the basis of their experience, ownership or access to a variety of internet enabled devices, flexible attitude if requested to use an alternative web browser, and availability within a short time frame.

##### 4.14.2 Method

An informal direct approach was made to each individual to save time and to establish their early availability and devices used. A brief overview of what was required was given. Once the required five agreed to be reviewers they were given, by hand, a participant information pack containing copies of the following:

- Reviewer instructions (pilot testing only)
- Invitation letter, with allocated profile details (pilot testing only)
- Study Information Sheet
- Web browser address bar information sheet

Although the reviewer instructions provided a guide to items on which to comment, in order to allow freedom of response and avoid suggestions that reviewers were being restricted, reviewers were advised to comment on anything that interfered with a satisfactory user experience. Reviewers were also informed that the free phone help line number given was not yet active, that they had to rely upon the documents provided alone, and no additional support or assistance would be given. This was to ensure that the reviewers did not benefit from assistance that would be unavailable to the participants.

As previously noted, the first phase reviewers are an extremely important group. Therefore the range of devices used to connect to the Internet, and the web browsers used to access the CWB website, needed to be broad. The devices used were two standard university PCs running Windows XP and Internet Explorer; an Apple I phone running iOS and Safari, an Apple IMac running iOS and Safari, and an HTC Smartphone using Android and an HTC browser.

The comments made by the reviewers covered the participant information pack, website content, website functionality and the questionnaires (content and functionality). The key points that required investigation and subsequent implementation of changes are set out below.

#### 4.14.3 Results

Points actioned:

- *All documentation provided should bear the Cardiff University logo;*
- *speed with which webpages advance is fast and may not be a good idea;*
- *Question/instruction text slightly over-lapped, bottom of some letters cut off;*
- *Radio button selections operate too quickly; suggest specific button to progress to next page;*
- *Line spacing between text is too small in some places;*
- *Progress bar does not reach the end, even by the end of the questionnaire;*
- *Website asks for a Participant number, but invitation letter details a User ID;*
- *At bottom of page a message stating that the participant number is not valid appears, but next button is working and pages can be advanced.*



#### 4.15 PHASE 2 PILOT TESTING

##### 4.15.1 Purpose

The 'fixes' actioned from the results in phase 1 now had to be tested, and the same process of pilot testing was implemented again.

##### 4.15.2 Method

As before a convenience sample was recruited from within the Institute by informal direct approach to each prospective reviewer. After providing a brief overview of what was required, the five new reviewers were given a participant information pack as before. Four university PCs running Windows XP and Internet Explorer and one Apple iMac running iOS and Safari were used. Only comments requiring investigation or action are noted.

##### 4.15.3 Results

###### Points actioned

- *The Samaritans are associated with people who want to commit suicide, while the questionnaire may highlight a lesser problem. The website <http://www.anxietyuk.org.uk/> could be a good addition to the Samaritans information at the end.*
- *I clicked on the Samaritans' web link at the end and was asked if I wanted to leave the website and lose my responses. You might want to ensure that responses are not lost.*

#### 4.16 PHASE 3 PILOT TESTING

##### 4.16.1 Purpose

The 'fixes' actioned from the results in phase 2 now had to be tested, and the same process of pilot testing was implemented again.

#### 4.16.2 Method

Recruitment was as before (a convenience sample of five), with one exception (reviewer no.1), a change made to extend the scope of testing. Reviewer no.1 (who was recruited by informal direct approach by reviewer no.5) received the participant information pack via e-mail and completed the required tasks by accessing the CWB website from Melbourne, Australia.

An Apple iMac running iOS and Safari, two university PCs running Windows XP and Internet Explorer and two Sony laptops running Windows XP and Internet Explorer were used.

#### 4.16.3 Results

Point actioned

- *The Guidance notes at the end of the survey may be improved by making the [www.anxietyuk.org.uk](http://www.anxietyuk.org.uk) link an active hyperlink.*

#### 4.17 PILOT TESTING DATA COLLECTED

The pilot testing was also used to check that data collection had been effective. The extracted results for both MHI-5 and CIS-R confirmed that the required data collection had taken place and gave an insight into the data obtained on user activities e.g. exiting the website before completing tasks, and returning to complete at another time.

#### 4.18 SUMMARY OF ACTION TAKEN AND CHANGES TO CWB WEBSITE

As discussed earlier, the primary purpose of the pilot testing was to allow robust website functionality testing. However, the pilot reviewers' comments did lead to content changes in documentation and the webpages. The following discussion will address changes to functionality first, then content.

#### 4.18.1 Functionality changes

All but one of the functionality issues identified by the reviewers resulted in changes to 'fix' the issues. It can be seen that each time an issue was identified in a phase and fixed, it did not appear in the next phase. The number of genuine functionality items recorded numbered five in the first phase, one in the second phase and none in the third phase. These results suggest that the pilot testing model was effective.

As will be seen in the discussion of the data collection exercise, no functionality issues were reported for the CWB website by participants, further suggesting that functionality issues which may have interfered with task performance were successfully addressed during the pilot testing.

#### 4.18.2 The website and documentation content

The reviewers' comments relating to consistency in appearance, information and terminology mentioned earlier were addressed, and the affected pages in the website and information pack were changed. During the last phase of pilot testing no further comments were made, except a suggestion that led to an improvement by adding an additional contact agency.

On the basis of these pilot studies the final version of the study website was completed.

#### 4.19 ETHICAL APPROVAL OF STUDY AMENDMENTS

The opinion of the study sponsor, Cardiff University, was sought as to whether the changes made to the website constituted a substantial or minor amendment to the protocol or documentation approved by the REC. If the changes were considered a substantial amendment, the study would need to be re-submitted to the REC for further approval. The study sponsor considered the amendments to be minor as they provided further safeguards to potentially vulnerable participants i.e. they did not (negatively) affect to any significant degree the

safety or physical or mental integrity of the subjects of the trial (study), these being the only NRES criteria considered to have application to the proposed amendments. Therefore no further ethical review was sought.

#### 4.20 DATA COLLECTION – TESTING THE DIFFERENT MODES OF THE CIS-R

The final phase of testing required the collection of data using each form of the CIS-R, namely, the original paper version, CIS-R via PROQSY version, and the CWB study's CISR web-adapted version. Repeating the method used in the pilot testing, three profiles were created to ensure that scores were generated for not-case, common mental disorder and CMD-S classifications. The paper version was completed first for each profile and the scores were then calculated, creating test scores to be achieved by the other versions of the CIS-R under test.

Simultaneously, with assistance from other Institute research staff, the questions with answers selected in the CIS-R paper version were read out and the same selections were to be made and entered into the CIS-R via PROQSY, and CIS-R web-adapted version. However, the CIS-R's author made certain content changes from the paper version when the computerised version was developed e.g. different terminology and structure/number of response options, and these changes required the selection of differently numbered responses or those with slightly altered wording to be made in the other CIS-R versions in order to replicate the responses selected in the paper version.

During the process of reconciling these changes a number of human scoring errors were identified in the results for the paper version. These errors were corrected and all three versions now achieved identical total scores. The interviews were completed again for all three profiles to provide a further check, and again the scores across each version were identical, suggesting the CWB web-adapted version of the CIS-R was performing correctly and in accordance with the scoring structure of the original clinically validated instrument. The unplanned additional exercise provided a useful cross-check of each version's scoring.

#### 4.21 CWB WEBSITE DATA COLLECTION TESTING

The CWB website developer conducted a number of technical tests to check the data collection performance of the CWB website and confirmed that completed questionnaire responses were being transferred from the website to the Cardiff University servers as expected.

#### 4.22 FINAL WEBSITE PRE-LAUNCH ACTIVITIES

In preparation for the CWB website's activation online, a series of final tests was conducted to ensure that no technical issues had developed. In addition, the free phone telephone number previously organised by the PRC (set out in the Study Information Sheet and invitation letter), and the facility for participants who required further information or assistance had to become operational. The PRC was advised of the date of the mailing to participants, and thus the date of starting service provision.

#### 4.23 CIS-R WEB-ADAPTED VERSION INSTRUMENT VALIDITY

In Chapter 2 the CIS-R and its various versions were discussed, together with the validation studies conducted. Earlier in this chapter the restrictions imposed by the CIS-R's author to preserve the instrument's integrity were set out. The key restriction related to the prohibition of alterations to the instrument's content. Despite the unavoidable operational and appearance changes, necessitated by conversion of a PC programme language to a web-based one, the CWB web-adapted version of the CIS-R, observed this restriction. The development of the CIS-R for web-based use can be seen as a further evolution of the CIS-R, not of its content, but how it is used. At present the CIS-R web-adapted version has not been the subject of a validation study. This raises questions of instrument validity, and the scientific weight that can be given to the MHI-5 cut-points defined.

These questions were considered throughout the research process and resulted in the adoption of a number of practices: 1) Independent of the author's

conditions of use, no changes would be made to the CIS-R's PC script for PROQSY unless they were essential for the conversion to HTML, 2) Any changes required by the REC would be implemented without changing the CIS-R's content, 3) The cut-points to be determined for the MHI-5 would not be described as 'clinically validated', but established by a clinically validated instrument. Points one and two have already been discussed. This leaves point three, to assess whether the MHI-5 cut-points identified are established by a clinically validated instrument.

Validation studies are generally conducted where there is no existing validation study for an instrument or changes have been made to an instrument which may affect the results obtained, e.g. translating an instrument from English to Italian, or a population for which the instrument was not designed is used. The CIS-R's author conducted validation studies for the CIS-R paper and computerised versions. The CIS-R was a new revised version of the CIS, and therefore required validation. The CIS-R computerised version contained content changes to accommodate a new mode, moving from paper to PC, and this new mode had not been validated. Such changes would warrant validation studies. In this study no changes were made to the CIS-R's content or structure, and administration as a computerised assessment was retained in the form validated. The instrument was developed for use with the general population, and would therefore be appropriate to use with the population in the CWB study.

The conditions stipulated by the author when giving permission for the CIS-R to be adapted for web use concerned the CIS-R's wording and structure. The conditions were observed and it is reasonable to suggest that the author's conditions were to ensure the preservation of the integrity of the instrument which had been validated. Though it must be accepted that there were differences that would be evident to participants i.e. the instrument's background colour, it is contended that these differences were cosmetic in nature and it is difficult to see how they could have an effect on the cut-points determined. It is suggested that there must be substantial or critical changes to an instrument to require re-validation.

#### 4.24 DISCUSSION

There can be no doubt that the phenomenal growth of the Internet has changed the way we communicate, work and conduct many aspects of our lives. The tremendous opportunities presented by the use of web-based technologies are increasingly recognised by epidemiologists as the number of web-based studies continues to grow. Although the Internet and web-based technologies form an emerging research methodology, the papers published for web-based studies focus on the results achieved but make few comments about the challenges posed by this methodology. In this section the strengths, challenges, and limitations of this new methodology are discussed.

##### *Strengths*

#### 4.24.1 The potential of web-based studies in epidemiology

The cost of conducting large-scale epidemiological studies determines that such studies are frequently confined to National surveys or well-funded research projects. The use of internet technologies and overall lower costs will enable a greater number of epidemiological studies to take place with the potential to recruit larger and hard to reach populations. As the number of internet users increases, it is probable that web-based research will be viewed as just another activity that can be performed via the Internet.

The CWB study benefited from the existence of the web-platform. Web-platforms create enormous possibilities for web-based research and can be designed to accommodate specific research requirements. The level of security in operation can be determined by the investigators and is not subject to the constraints of commercial software. This is an important consideration in health research where sensitive data is collected. Each study contributes to the development of the web-platform and capabilities can be increased over time as necessary e.g. in response to an expanding range of internet-enabled devices. The web-platform enabled the streamlined development of a website that could

be viewed with equal quality and functionality by virtually all the popular internet-enabled devices, a wide range of web browsers, and operating systems.

As suggested, the costs of conducting web-based research compare favourably with traditional methods, and in the CWB study the cost per prospective participant (10,000) was estimated at £1, a reasonable sum for the data collected and below the cost of conducting field research, a common method when collecting data by interview.

The flexibility of the web-platform enabled the REC's requirements to be met with a creative solution without compromising the validity of the CIS-R. The ethical review process served to ensure that the design philosophy of the website was met, and a high ethical standard achieved. The satisfaction of challenging ethical conditions demonstrated that it was feasible to conduct a web-based study and maintain research ethics.

The use of a cross-sectional design with a single invitation to participate, and therefore no follow up or reminder to take part, would appear to offer little promise that sufficient or improved participation rates would be achieved. Yet as noted in Chapter 1 and demonstrated in part III of the literature review in Chapter 3, the growth in the use of the Internet for seeking health information (*Buchanan and Hvizdak 2009*) and use of the web-based methods appear to be an effective methodology for the recruitment of individuals with poor mental health (*Leykin et al, 2012*). The CWB study successfully used web-based methods and the responses achieved exceeded expectations. Web-based methods provide an important additional 'tool' for researchers, though a tool that is subject to the same suitability assessment as any other. Web-based methods, and the many connected technological facilities available, are not a total panacea for the issues which face investigators, but offer tremendous possibilities, at a reasonable cost, to resource intensive conventional methods. Web-based methods are therefore, likely to play an important role in future epidemiological research e.g. development of risk assessment tools for serious medical conditions, screening tools for diseases misdiagnosed due to the presentation of symptoms common to



several diseases, and large scale longitudinal data collection of specific populations of interest.

### *Challenges and Limitations*

#### 4.24.2 Technological challenges

The use of computer technologies in research is not new; however, moving from data management and analysis to data collection, particularly the use of web-based technologies, presents quite different challenges. Typically, unless a study requires nothing more sophisticated than the web-based survey software available from commercial websites such as SurveyMonkey or SmartSurvey, specialist technical expertise will be required. Knowing what the correct skillset is, and securing access to it, poses numerous issues. The CWB study benefited from the Institute's existing development of a web-platform for web-based research, without which the CWB study would have been impossible due to the complexities of adapting existing instruments for web-based use.

The use of internet technologies for web-based studies requires collaborative working with individuals who have quite different skills sets and working practices. Initially, there is likely to be a limited level of useful dialogue if there is no prior working relationship. Communication of design requirements and ideas is more a process of 'translation' than immediately understood verbal exchanges. Developing a solid working relationship and an understanding of how a software developer interprets instructions or requests is essential. In the CWB study the most successful approach entailed explaining, face to face, the context for specific design requirements. By providing background information and an overview of the study objectives to the software developer, who knew nothing of the study, he was able to ask questions of relevance to him and gain a sufficient insight to enable the correct interpretation of instructions. The key to success is to identify what will work with the particular individual tasked with producing the necessary software code for the project, and maintain close direct

contact throughout to ensure there are no misunderstandings before tasks are undertaken. This can be an intense and time-consuming process.

Resource constraints and the web-platform determined that virtually all of the author's preparatory visual design aspects of the CWB host website were developed using non-web design software. There were extremely limited opportunities to view the draft design as a formal website using a web browser or to make changes. As a result, and distinct from the more usual practice of evaluation of multiple designs through a web browser, it became necessary to attempt the more demanding development of a near final design website without knowing how it would look in a web browser. This approach can be effective with a lot of preparatory work, but has obvious limitations.

Bespoke web-platforms are complex and require time and resources to develop and maintain them. The technical expertise needed to create them is likely to ensure that few researchers will be able to avoid dependence upon specialist technical staff. This has time and costs implications. The web-platform increased the reliance upon the technical expertise of the platform's developer, and progress was directly linked to his availability to work on the CWB website. This had significant consequences; there was an increased level of cautiousness in design due to the greater need to avoid mistakes and the consequent loss of time spent on corrections, critical design decisions had to be made quickly and often without full appreciation of the consequences, the period for the development of the CWB website could not be controlled and was extended considerably because of the fluctuating availability of a critical member of staff with unique skills.

A conscious decision was made from the outset to limit the burden of participation in the CWB study by restricting the content of the website to essential items only. In consequence, the opportunity to collect additional data of interest was sacrificed. For example, it would have been interesting to obtain participant feedback on the website, the actions required, device, operating system and web-browser used. Gaining an insight into why participants had

decided to take part in the study would also have been useful. The possibility of collecting more data after the study finished, however, was secured by the inclusion of a question regarding consent to further contact, and participation in similar online studies. The question appeared on a webpage after the questionnaires, and could be ignored by the participants who had submitted their responses. Figure 4.15 shows the webpage preceding, and the consent to further contact webpage.

Figure 4.15 CWB website webpage advising of a final task and the consent to further contact webpage

The figure consists of two screenshots of a website interface. Both screenshots have a light green background and a header area with a small image of a lamp on the left, a progress bar titled 'Changes in Well-Being' in the center, and the Cardiff University logo on the right.

The top screenshot shows the following text:
   
Thank you for taking part in this study.
   
The Cardiff University website will contain information about the study's findings once the study has been completed in 2013.
   
On the next page, there is one final task that we would ask you to complete.
   
At the bottom, there are two buttons: 'Back' and 'Next'.

The bottom screenshot shows the following text:
   
Further contact
   
Your participation in this study is of substantial value to our research. We would therefore like to ask you if you will consent to further contact for future on-line studies of a similar type. You are under no obligation to give your consent and you will not be contacted again if you select 'No'.
   
Below this text are two radio buttons: 'Yes' and 'No'.
   
At the bottom, there is a 'Back' button.

#### 4.25 CONCLUSIONS

This chapter has described the design and development undertaken for the CWB study. Two existing instruments were successfully adapted for web-based use and the development of a website and participant information pack in the desired form was achieved. Ethical approval was obtained, and pilot and other testing was completed successfully. The chapter objectives were therefore met.

The data collected by the CWB study is analysed in the next chapter to determine the cut-points for a case of common mental disorder and CMD-S.

## CHAPTER 5

## CHAPTER 5: THE DETERMINATION OF CUT-POINTS ON THE FIVE-ITEM MENTAL HEALTH INVENTORY FOR A CASE OF COMMON MENTAL DISORDER AND COMMON MENTAL DISORDER - SEVERE

This chapter will initially describe the data collected by the CWB study website, the characteristics of the sample and the scores for the MHI-5 and CIS-R. The relationship between the MHI-5 and CIS-R is examined, and a number of statistical methods employed to determine the cut-points for a case of common mental disorder and CMD-S on the MHI-5 are described. The basis for the cut-point selection is discussed, and a concluding summary of the findings presented.

Throughout this chapter reference is made to identifying a case of common mental disorder or of CMD-S, but as noted in Chapter 1, common mental disorder does not describe a specific diagnosable disorder. It is used here as a convenient form of reference for different types of depression and anxiety that are common disorders in the general population.

### 5.1 CHAPTER OBJECTIVES

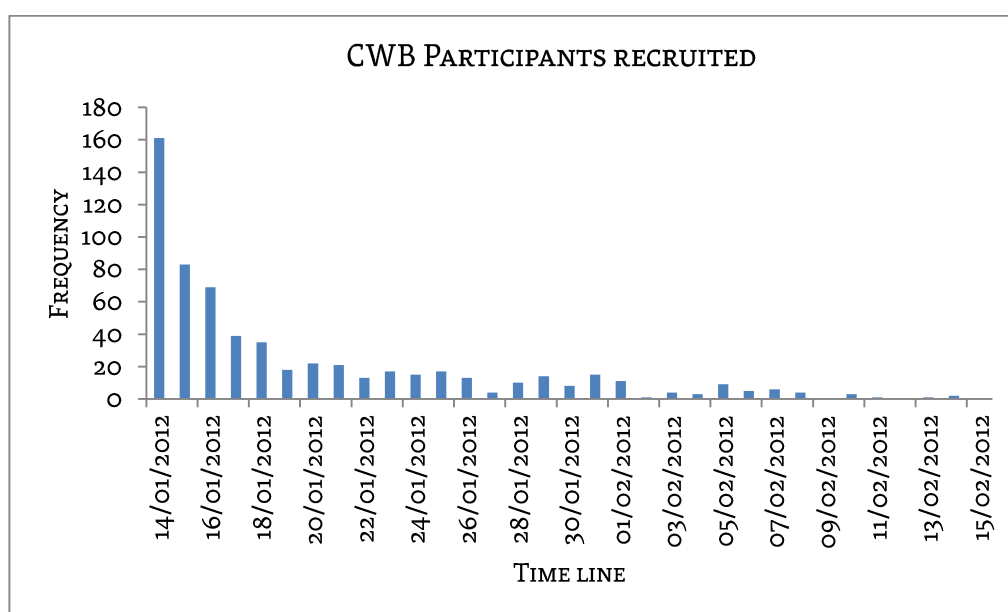
This chapter has the following objectives;

1. Describe the data collected by the CWB study website;
2. Investigate the form of relationship between the MHI-5 and CIS-R;
3. Evaluate the range of cut-points identified for the MHI-5 by selected optimisation criteria;
4. Discuss the findings made, the basis of selection of the chosen cut-points, and the implications of the choices made.

### 5.2 THE DATA COLLECTION STUDY

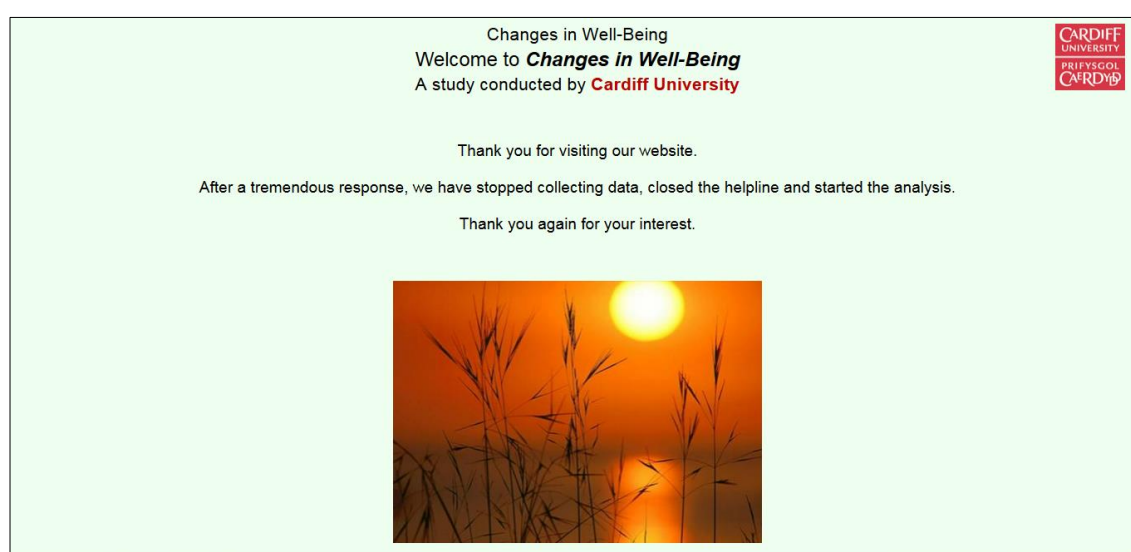
The CWB study website became accessible via the Internet to invited participants on 10 January 2012 (the first day of the mailing) and closed on 15 February 2012 (33 days). Figure 5.1 records the rate of recruitment of participants.

Figure 5.1 Participant recruitment rate for the CWB study website



In keeping with the typical participant response rate, the majority of the participants were recruited shortly after receiving the information pack. In the first three days 313 participants were recruited, and a further 328 over the remaining 30 days. The CWB study website remained live for an additional week from the planned period of one month, after which it was closed. Figure 5.2 shows the website closure home page.

Figure 5.2 CWB website site closed webpage



The Participant Resource Centre (PRC), which provided the free-phone support service, reported the following activities for the data collection period: 37 contacts comprising 31 routine queries; 10 participants requesting to take part by telephone as they had no PC or Internet access; 2 participants reporting the addressee had moved away and volunteering to take part instead. The PRC advised that this was a very low service demand (0.37%) for a mailing of 10,000 people. The absence of complaints was also noted.

The total number of participants recruited ( $n = 641$ ) reduced after the data were cleaned and demographic details obtained from NWIS. Participants were excluded from the study for the following reasons: repeated submissions, incomplete data collected e.g. scores for CIS-R but not MHI-5, missing values, and missing demographic data provided by NWIS after the data collection phase ended. The cleaned CWB data set was analysed using a range of statistical techniques discussed in this chapter.

### 5.3 CHARACTERISTICS OF THE SAMPLE

As previously stated the population of interest is the residents of the Caerphilly county borough aged 18 to 74 years, who had not previously been sampled in the CHSNS. The number of unique participants for whom there was complete data was 616. The following analysis is based on these 616 participants.

#### 5.3.1. Sex of participants

Of the 616 participants, 62.5% ( $n=385$ ) were female and 37.5% ( $n=231$ ) were male.

#### 5.3.2 Age of participants

The age range of participants was 18 to 74 years, with a mean age of 47.2 (SD=15.2) years. Table 5.1 shows the participants by age group and sex.

Table 5.1 Participants by age group and sex

AGE GROUP	MALE (%)	FEMALE (%)	TOTAL (%)
18-24	20 (32.3)	42 (67.7)	62 (100)
25-34	26 (27.4)	69 (72.6)	95 (100)
35-44	33 (31.1)	73 (68.9)	106 (100)
45-54	38 (36.9)	65 (63.1)	103 (100)
55-64	72 (45.6)	86 (54.4)	158 (100)
65-74	42 (45.7)	50 (54.3)	92 (100)
TOTAL	231 (37.5)	385 (62.5)	616 (100)

### 5.3.3 Social deprivation status of participants

The Welsh Government produces the Welsh Index of Multiple Deprivation (WIMD). It is the official measure of relative deprivation for small areas in Wales. The Index is compiled from eight domains, or types, of deprivation, consisting of approximately 40 indicators. The domains and underlying indicators offer a wide range of additional information about the nature of deprivation in disadvantaged areas. Figure 5.3 illustrates the WIMD domains.

Figure 5.3 Welsh Index of Multiple Deprivation domains



([www.ons.gov.uk/ons/about-ons/multiple-deprivation.doc](http://www.ons.gov.uk/ons/about-ons/multiple-deprivation.doc))



The Index score is the weighted sum of the domain scores, and is presented as a set of ranks, with a rank of 1 assigned to the most deprived area through to 1896, the least deprived. Ranks are a relative system of measurement that can indicate which areas are more (or less) deprived than others, but not the extent. This is due to the way the Index has to be constructed. The ONS notes,

*The ranks of the Index are calculated for each of the 1896 lower layer super output areas (LSOAs) of Wales. These SMALL AREAS contain an average population of 1500 people. They were developed by the Office for National Statistics to have consistent population sizes and stable geographies, so that statistical comparisons of small areas over time can be carried out.*

([www.ons.gov.uk](http://www.ons.gov.uk))

The ranks of the Index are aggregated into WIMD deprivation fifths (quintiles) that is, the most-deprived 20% LSOAs in Wales are classified into quintile 1, the next-most deprived 20% of LSOAs in Wales in quintile 2 through to quintile 5 containing the least deprived 20% of LSOAs in Wales.

The distribution of participants between WIMD quintiles is shown in table 5.2.

Table 5.2 Distribution of participants by WIMD quintile

WIMD QUINTILE	NUMBER (%)
1 Highest deprivation	93 (15.1)
2 High deprivation	85 (13.8)
3 Middle deprivation	130 (21.1)
4 Low deprivation	198 (32.1)
5 Lowest deprivation	110 (17.9)
TOTAL	616 (100)

The distribution between the quintiles indicates 50% (n=308) of the sample belong to the least deprived quintiles 4 and 5.

#### 5.3.4 WIMD quintiles by sex

The distribution between WIMD quintiles by sex is given in table 5.3.

Table 5.3 WIMD quintiles by sex

WIMD QUINTILE	MALE (%)	FEMALE (%)	TOTAL (%)
1 Highest deprivation	31 (33.3)	62 (66.7)	93 (100)
2 High deprivation	33 (38.8)	52 (61.2)	85 (100)
3 Middle deprivation	50 (38.5)	80 (61.5)	130 (100)
4 Low deprivation	75 (37.9)	129 (62.1)	198 (100)
5 Lowest deprivation	42 (38.2)	62 (61.8)	110 (100)
TOTAL	231 (37.5)	385 (62.5)	616 (100)

There is a generally even distribution by sex between WIMD quintiles, with a higher percentage of females in the highest deprivation quintile, twice the proportion of males.

#### 5.3.5 WIMD quintiles by age group

The distribution between WIMD quintiles by age group is shown in table 5.4.

Table 5.4 WIMD quintiles by age group

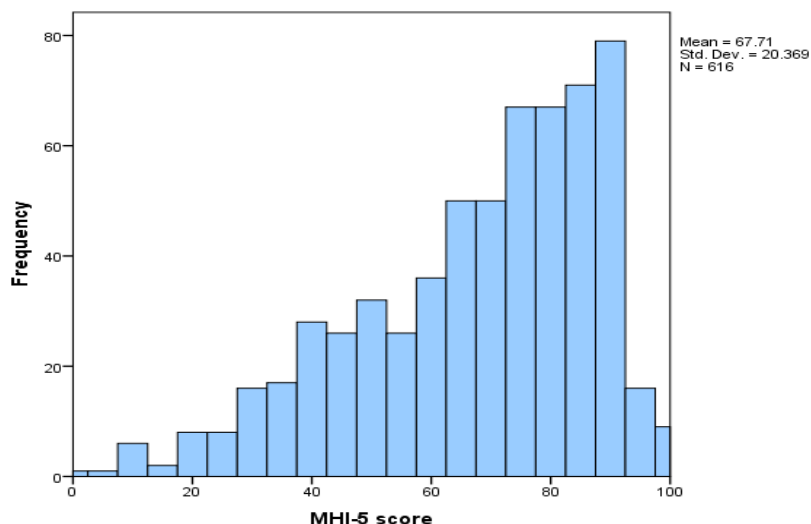
WIMD QUINTILE	AGE GROUP (%)						TOTAL (%)
	18-24	25-34	35-44	45-54	55-64	65-74	
1 Highest deprivation	12 (12.9)	15 (16.1)	18 (19.4)	9 (9.7)	23 (24.7)	16 (17.2)	93 (100)
2 High deprivation	4 (4.7)	14 (16.5)	13 (15.3)	17 (20.0)	21 (24.7)	16 (18.8)	85 (100)
3 Middle deprivation	8 (6.2)	14 (10.8)	24 (18.5)	26 (20.0)	35 (26.9)	23 (17.7)	130 (100)
4 Low deprivation	22 (11.1)	29 (14.6)	34 (17.2)	34 (17.2)	56 (28.3)	23 (11.6)	198 (100)
5 Lowest deprivation	16 (14.5)	23 (20.9)	17 (15.5)	17 (15.5)	23 (20.9)	14 (12.7)	110 (100)
TOTAL (%)	62 (10.1)	95 (15.4)	106 (17.2)	103 (16.7)	158 (25.6)	92 (14.9)	616 (100)

#### 5.4 MHI-5 RESULTS

The raw MHI-5 scores collected were transformed, as described in Chapter 2, to create a scale with a range from 0-100 in multiples of 5, where 100 is complete reported mental well-being. The transformed MHI-5 score is reported in this thesis. The histogram in figure 5.4 illustrates the distribution of scores. The mean

mental health score was 67.7 (SD=20.4) range 0-100. The distribution was negatively skewed.

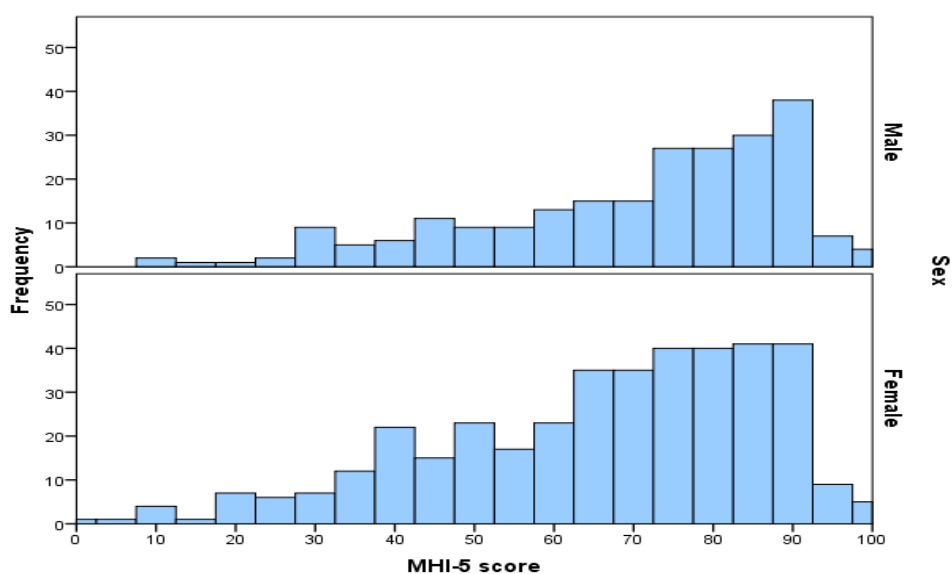
Figure 5.4 Histogram of MHI-5 scores



#### 5.4.1 Mean MHI-5 scores by sex

The distribution of participants' MHI-5 scores, in figure 5.5, varied slightly according to sex. The female mean score of 66.1 is lower than the male mean score of 70.4 suggesting a lower average level of mental health.

Figure 5.5 Distributions of MHI-5 scores by sex



#### 5.4.2 MHI-5 mean scores by age group

Participant MHI-5 mean scores by age group are shown in table 5.5

Table 5.5 MHI-5 mean scores by age group

AGE GROUP (YEARS)	No.	MEAN (SD)
18-24	62	62.4 (19.9)
25-34	95	64.4 (18.3)
35-44	106	60.4 (21.8)
45-54	103	67.0 (19.6)
55-64	158	71.2 (20.9)
65-74	92	77.9 (15.5)
TOTAL	616	67.7 (20.4)

Mean scores increase with each successive age group except for the 35-44 age group which has the lowest mean of 60.4.

#### 5.4.3 MHI-5 mean scores by WIMD quintile

The MHI-5 mean score for each WIMD quintile is shown in table 5.6.

Table 5.6 MHI-5 mean score by WIMD quintile

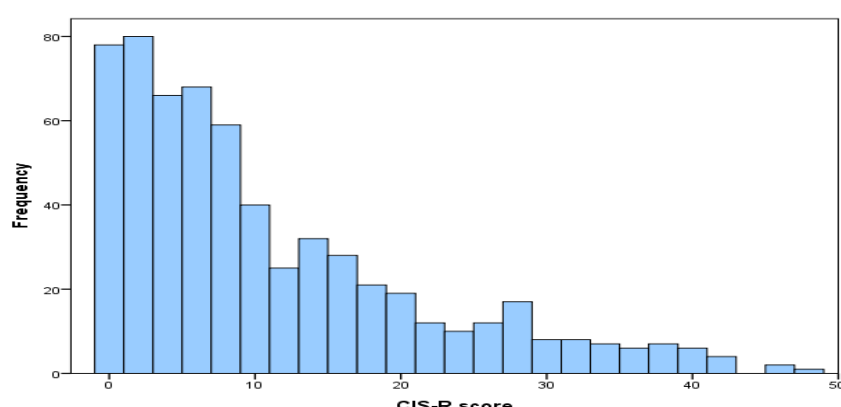
WIMD QUINTILE	No.	MHI-5 MEAN (SD)
1 Highest deprivation	93	66.5 (20.1)
2 High deprivation	85	66.2 (21.1)
3 Middle deprivation	130	69.3 (20.2)
4 Low deprivation	198	69.1 (22.3)
5 Lowest deprivation	110	68.9 (17.5)
TOTAL	616	67.7 (20.4)

The mean scores are similar for the two highest, and three lower deprivation quintiles.

## 5.5 CIS-R RESULTS

As discussed in Chapter 2, the CIS-R scale has a range from 0 to 57 with a higher score indicating poorer mental health. In this sample the highest score recorded was 48; therefore the range used in this chapter is 0-48. The distribution of CIS-R scores for the range 0-48 is illustrated in figure 5.6.

Figure 5.6 Distribution of CIS-R scores



The distribution is highly positively skewed showing that most people report normal mental health. The CIS-R scores are grouped to indicate (1) Not a case (NMH)(scores 0-11), (2) common mental disorder (CMD-NS) (scores 12-17) and (3) CMD-S (scores 18 and above). In these data 65.7% (405) participants were classified as not a case; 13.3% (82) as having CMD-NS, and 20.9% (129) as CMD-S. The prevalence rate for cases of common mental disorder (both classes) is 34.3%.

### 5.5.1 CIS-R group by sex

The distribution of CIS-R group by sex is shown in table 5.7.

Table 5.7 CIS-R group by sex

SEX	CIS-R GROUPS			TOTAL
	NMH (%)	CMD-NS (%)	CMD-S (%)	
Male (%)	158 (68.4)	29 (12.6)	44 (19.0)	231
Female (%)	247 (64.2)	53 (13.8)	85 (22.1)	385
TOTAL	405 (65.7)	82 (13.3)	129 (20.9)	616

It is apparent from table 5.7 that the percentage of males and females in each CIS-R group is similar, with a higher percentage of females in the CMD-NS classification, and by an increasing difference for CMD-S.

### 5.5.2 CIS-R by age group

The numbers (%) of participants in each CIS-R group by age group are shown in table 5.8.

Table 5.8 CIS-R group by age group

AGE GROUP (YEARS)	CIS-R GROUPS (%)			TOTAL
	NMH (%)	CMD-NS (%)	CMD-S (%)	
18-24	33 (53.2)	12 (19.4)	17 (27.4)	62
25-34	52 (54.7)	16 (16.8)	27 (28.4)	95
35-44	59 (55.7)	19 (17.9)	28 (26.4)	106
45-54	65 (63.1)	15 (14.6)	23 (22.3)	103
55-64	117 (74.1)	13 (8.2)	28 (17.7)	158
65-74	79 (85.9)	7 (7.6)	6 (6.5)	92
TOTAL (%)	405 (65.7)	82 (13.3)	129 (20.9)	616

The age group of 25-34 years has the largest percentage of cases of CMD-S, and the 18-24 years age group the highest percentage of cases of CMD-NS. A clear pattern for not a case exists with the classification percentage for each age group increasing as age increases.

### 5.5.3 CIS-R groups by deprivation

The numbers (%) of participants in each CIS-R group by WIMD quintile are shown in table 5.9.

Table 5.9 CIS-R group by WIMD quintile

WIMD QUINTILE	CIS-R GROUPS			TOTAL
	NMH (%)	CMD-NS (%)	CMD-S (%)	

WIMD QUINTILE	CIS-R GROUPS			TOTAL
	NMH (%)	CMD-NS (%)	CMD-S (%)	
1 Highest deprivation	61 (55.5)	16 (14.5)	33 (30.0)	110
2 High deprivation	131 (66.2)	24 (12.1)	43 (21.7)	198
3 Middle deprivation	87 (66.9)	21 (16.2)	22 (16.9)	130
4 Low deprivation	55 (64.7)	13 (15.3)	17 (20.0)	85
5 Lowest deprivation	71 (76.3)	8 (8.6)	14 (15.1)	93
TOTAL (%)	405 (65.7)	82 (13.3)	129 (20.9)	616

The WIMD quintiles 1 and 2 have the largest percentage of CMD-S cases of the quintiles. The WIMD quintiles 3 and 4 have the largest percentage of CMD-NS cases of the quintiles.

#### 5.6 RELATIONSHIP BETWEEN MHI-5 AND CIS-R

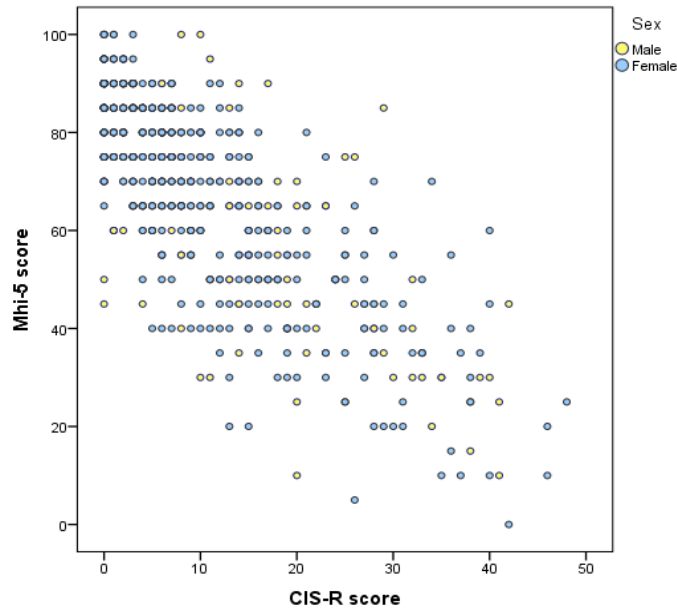
As noted in previous chapters the MHI-5 and CIS-R are used to measure mental health status. They have different designs and length; the MHI-5 contains five questions while the CIS-R is a clinical interview schedule of much greater length and depth. The scoring schemes are different, i.e. the MHI-5 is scored 0-100 with the highest score representing full mental health, while the CIS-R is scored 0-57 and a lower score represents better mental health. Before proceeding to a more detailed analysis of the MHI-5 and CIS-R scores, a preliminary examination of the nature of the relationship between the instrument scores is useful.

##### 5.6.1 Preliminary evaluation of the relationship between the instruments

To establish the nature of the relationship between the MHI-5 and CIS-R scores a number of descriptive statistical techniques were undertaken. These provide a useful and visual means of comparing the relationship between variables.

The variables for the entire range of scores for the MHI-5 and CIS-R were compared in a two dimensional scatterplot as shown in figure 5.7.

Figure 5.7 Scatterplot of CWB scores for MHI-5 and CIS-R

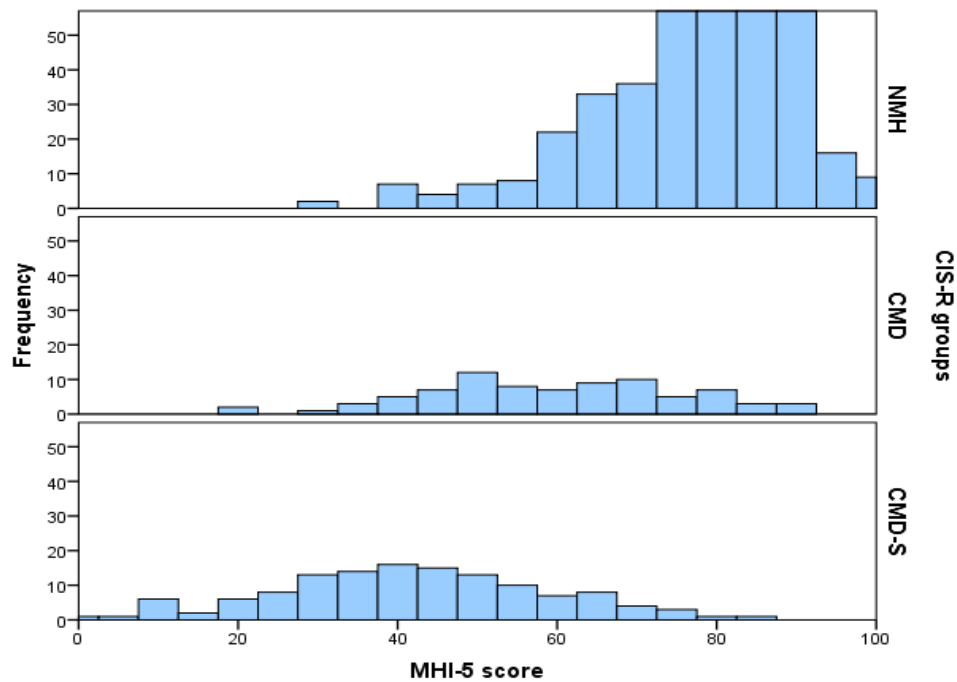


The scatterplot graph demonstrates the relationship between the variables. The scattering of paired values in figure 5.7 forms a consistent pattern for a negative correlation, with the scatterplots running from the top left to bottom right. Because the scales operate in opposed directions, the relationship between the instruments is one that is negatively correlated, for as the CIS-R score increases, the MHI-5 score decreases. The strength and direction of the linear relationship between the two variables used, as measured by Pearson's correlation coefficient, is  $-0.773$ , and Spearman's rho  $-0.749$ .

Histograms were used to show the distribution of MHI-5 scores (0-100) in the CIS-R groups of NMH (scores 0-11), (2) common mental disorder (CMD-NS) (scores 12-17) and (3) CMD-S (scores 18 and above). The results are set out in figure 5.8.



Figure 5.8 Histograms of MHI-5 scores for the CIS-R groups



From figure 5.8 it can be seen that the distributions are different with an overlap. Therefore a cut-point will not give perfect discrimination between the MHI-5 and CIS-R, but appears to be sufficient to enable the use of the MHI-5 as an alternative to the CIS-R.

## 5.7 STATISTICAL METHODS - IDENTIFYING TWO CUT-POINTS ON THE MHI-5

There are two cut-points to be determined; the first will enable a case of common mental disorder to be distinguished from normal mental health, and the second will distinguish a case of CMD-S from a case of common mental disorder. Identifying the cut-points required the use of a number of statistical methods.

### 5.7.1 Sensitivity and Specificity

To determine a cut-point on a measure requires comparison with another scale which can discriminate between individuals who are a case or not a case. The defining scale is known as the gold standard, and in the domain of mental health this is a standardised clinical interview. Ideally, there would be no misclassification and to address this issue the dual statistical concepts of

sensitivity and specificity are utilised. The sensitivity of a test is the probability that a case is identified by the screening tool. In contrast, the specificity of a test denotes the probability of a non-case testing as such or true negative. Preferably, a good test produces high sensitivity and specificity. However, a trade off occurs here because as a cut-point is decreased the sensitivity also decreases, but the specificity increases. Therefore a criterion is needed to decide how this trade off will operate (*Kelly et al. 2008*).

### 5.7.2 Receiver Operating Curves (ROC)

The Receiver Operating Characteristic (ROC) curve plot provides a summary of the effects of all the possible cut-point values for a measure by listing the associated sensitivity and specificity. The ROC curve plots sensitivity (i.e. the true positive rate) on the y-axis, against one minus the specificity (i.e. false positive rate) on the x-axis. Every point on the curve represents a separate cut-point on the measure tested, here the MHI-5. Where a test allocates individuals randomly, a diagonal line at 45 degrees, termed the line of chance, would apply. Therefore a good result produces a ROC curve which passes close to the point (0,1) indicating 100% sensitivity and specificity, with the resultant positioning of the ROC curve above and away from the line of chance (*McFall and Treat 1999*). As noted, as the cut-point selection is varied, the sensitivity and specificity will also vary. An example of a ROC plot is shown in figure 5.9 of this chapter.

A ROC curve plot provides a useful quantitative index of accuracy that corresponds to the information value of the data. It does not 'identify' an optimal cut-point value or illustrate how prevalence affects cut-point selection (*McFall and Treat 1999, citing Hsiao et al. 1989*). Therefore, in order to determine a cut-point, optimisation criteria are used.

### 5.7.3 Optimisation criteria

Before examining the optimisation criteria in detail it is prudent to note the significance of the prevalence rate identified earlier in this chapter. The combined prevalence rate in the CWB sample for common mental disorder and

CMD-S of 34.3% is higher than the upper limit of the general population prevalence rate typically found, as noted in Chapters 1, 2 and 3. This finding alone could be used as the basis for selection of the most suitable optimisation criterion. However, as will become evident, the selection of a cut-point is a far from straightforward matter. This renders it unlikely that a persuasive cut-point can be chosen if only one criterion is used. Therefore, to provide a wide range of optimal cut-points five methods most commonly utilised are discussed and applied. Because each method concentrates on the optimisation of a different criterion, it is not expected or usual that identical optimal cut-points will arise from all methods. Indeed, the extent of the differences can be informative and serve to aid selection of the most suitable cut-point for the purposes of this thesis.

It is important to state that in this thesis, and in keeping with typical practice, the cut-points determined were not selected exclusively on the basis of the outcome of the statistical methods, that is, as the statistically correct ‘answer’ defined by one or more of the optimisation criteria formulae. Rather, they were chosen after consideration of additional factors such as whether the cut-points are sufficiently plausible, the true prevalence rates found in the CWB data, their effect in a real world context, namely the prevalence rates of common mental disorder and CMD-S cases in the CWB data, and ultimately the target CHSNS population.

The optimisation criteria selected for this thesis are:

1. Youden Index
2. Shortest distance to the upper left corner, co-ordinates (0, 1)
3. The Misclassification rate
4. The Minimax method
5. Prevalence matching

Discussion of these methods precedes the analysis to allow review before presentation of the results. More detailed commentary can be found in the

following papers (Youden 1950; Holmes 1998; Hand 1987; Hoeymans et al. 2004; Kelly et al. 2008). The definition of each method is given a reference letter between (a) and (e) which is then used in the tables of results.

#### 5.7.4 Youden Index (J)

In general terms, a good cut-point provides both high sensitivity and specificity. The Youden Index provides a method that maximises the sum of sensitivity and specificity and can be expressed as:-

$$(a) J = \max (1 + \text{sensitivity} + \text{specificity})$$

In selecting this method sensitivity and specificity are deemed to be of equal importance. The cut-point which corresponds to the Youden Index, J, is that with the largest vertical distance from the diagonal line of chance to the ROC curve.

#### 5.7.5 Shortest distance to upper left corner (0, 1)

This method requires the selection of the cut-point paired with the value on the ROC curve that is in closest proximity to the upper left corner of the graph, that is, the cut-point which *minimises*  $d$  in the equation below. Sensitivity and specificity are given equal weight as before.

$$(b) d = \sqrt{(1 - \text{Sensitivity})^2 + (1 - \text{Specificity})^2}$$

This method is based on the premise that a perfect ROC curve would pass through the point (0, 1) i.e. Sensitivity = 1 and Specificity = 1, for a particular cut-point. Where the objective is to select a cut-point that is closest to the point of perfection, with equal weighting for true positives and true negatives, this method is a suitable option.

#### 5.7.6 Misclassification rate

The third method in contrast seeks to minimise the misclassification rate. This includes both false positives and false negatives. Here the false positive rate (FPR) is defined as

$$(c) \text{ FPR} = (\text{Non-case Prevalence}) \times (1 - \text{Specificity})$$

and false negative rate (FNR):

$$\text{FNR} = (\text{Case Prevalence}) \times (1 - \text{Sensitivity})$$

The above is as per Kelly and colleagues (2008). However, these quantities are often defined without the prevalence dependence. The cut-point is the value which minimises  $\text{FPR} + \text{FNR}$  i.e.

$$(c) = \text{FPR} + \text{FNR}$$

This criterion apportions weights to the sensitivity and specificity in direct relation to the prevalence of cases.

#### 5.7.7 Minimax criterion

The fourth criterion entails minimising the occurrence of the most common error. This is comparable to minimising the misclassification rate, except instead of the sum of FPR and FNR being minimised, the maximum of the two terms is minimised.

$$(d) M = \max(\text{FPR}, \text{FNR})$$

#### 5.7.8 Prevalence matching

The fifth and last criterion selects a cut-point that results in the proportion of the 'screened' population categorised as cases being closest to the gold standard case prevalence. The proportion of categorised cases (or screened prevalence) is

compared to the gold standard case prevalence (the true prevalence) to identify the absolute value of the difference between the two. This value needs to be as small as possible, and in practice the 'matched' sums are those which are closest in value (Kelly *et al.* 2008). Therefore the cut-point is chosen to make the screened positive rate as close as possible to the gold standard prevalence rate, by minimising

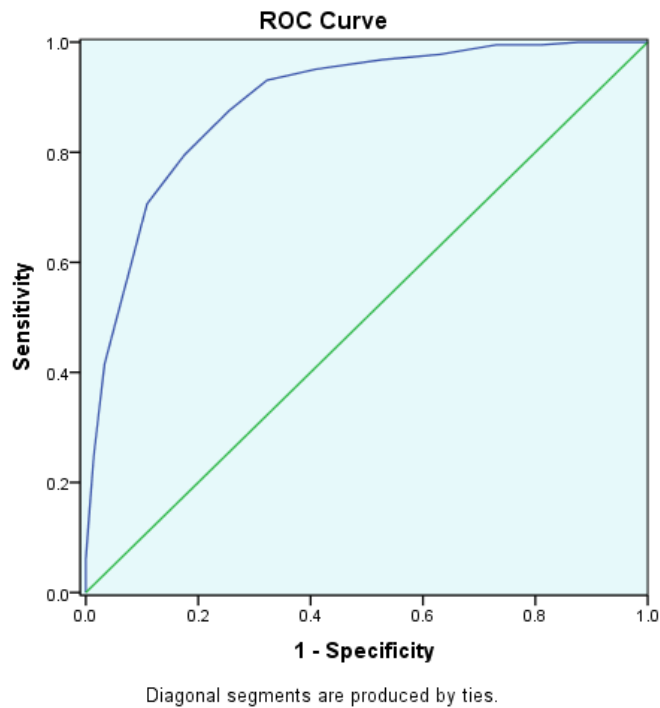
$$(e) = | \text{true prevalence} - \text{screened prevalence} |$$

This chapter has identified the optimisation criteria selected for this thesis, but frequently investigators do not name their selection, though it can be deduced, and as Hand (1987) noted, rarely is it explicitly stated why a particular threshold is chosen.

#### 5.8 THE CWB DATASET: ROC CURVE PLOT AND OPTIMISATION CRITERIA APPLIED

A ROC curve plot was produced and the five optimisation criteria applied. The analysis performed to identify an optimal MHI-5 cut-point used a CIS-R criterion of  $\geq 12$  for a case of common mental disorder. The ROC curve produced is shown in figure 5.9.

Figure 5.9 ROC curve for MHI-5 scores



The more detailed sensitivity and specificity results, together with selected optimisation criteria calculations, are set out in table 5.10.

Table 5.10 ROC curve results and cut-points with selected optimisation criteria calculations for case of common mental disorder on the MHI-5 for both sexes

MHI-5 SCORE (CASE IS ≤ SCORE)	SENSITIVITY	SPECIFICITY	1	2	3*	4	5**
			YOUDEN INDEX (a)	SHORT O,1 (b)	MISCL RATE (c)	MINI- MAX (d)	PREV. MATCH (e)
35	0.270	0.995	1.27	0.73	0.25	0.25	0.248
40	0.370	0.978	1.35	0.63	0.23	0.22	0.203
45	0.474	0.968	1.44	0.53	0.20	0.18	0.161
50	0.592	0.951	1.54	0.41	0.17	0.14	0.109
55	0.678	0.931	1.61	0.33	0.16	0.11	0.066
60	0.744	0.877	1.621	0.28	0.17	0.09	0.008
65	0.825	0.795	1.62	0.27	0.19	0.13	0.073
70	0.891	0.706	1.60	0.31	0.23	0.19	0.154

\*MISCLASSIFICATION RATE \*\* PREVALENCE MATCHING; RED PROBABLE CUT-POINT, BLUE OTHER CUT-POINTS

In table 5.10 there is agreement between three of the criteria with the Youden Index, Minimax, and Prevalence Matching criteria each identifying  $\leq 60$  as the optimal cut-point. The other criteria produced different cut-points; the Short (0, 1) identified  $\leq 65$  and the Misclassification Rate  $\leq 55$ . For these two criteria the closest selectable alternative value for each, which would result in a cut-point of  $\leq 60$ , differed by only 0.01 in the criterion value. These results suggested that the optimal cut-point for a case of common mental disorder on the MHI-5 scale was  $\leq 60$ .

To investigate whether different optimal cut-points were identified for each sex the analysis was repeated. The results for males are set out in table 5.11.

Table 5.11 ROC curve results and cut-points with selected optimisation criteria calculations for common mental disorder by reference to sex: (1) Male

MHI-5 SCORE (CASE IS $\leq$ SCORE)	SENSITIVITY	SPECIFICITY	1 YOUDEN INDEX (a)	2 SHORT 0,1 (b)	3* MISCL RATE (c)	4 MINI- MAX (d)	5** PREV MATCH (e)
30	0.178	0.987	1.17	0.82	0.11	0.10	0.255
35	0.247	0.987	1.23	0.75	0.106	0.09	0.233
40	0.315	0.981	1.30	0.69	0.102	0.08	0.207
45	0.438	0.968	1.41	0.56	0.098	0.07	0.160
50	0.548	0.962	1.51	0.45	0.090	0.056	0.121
55	0.616	0.937	1.55	0.39	0.10	0.055	0.082
60	0.671	0.880	1.55	0.35	0.14	0.10	0.026
65	0.795	0.842	1.64	0.26	0.16	0.13	0.039
70	0.877	0.785	1.66	0.25	0.20	0.18	-0.104
75	0.918	0.633	1.55	0.38	0.33	0.32	-0.221

\*MISCLASSIFICATION RATE \*\*PREVALENCE MATCHING; RED PROBABLE CUT-POINT, BLUE OTHER CUT-POINTS

Referring to the Prevalence Matching and Youden Index criteria cut-points only to provide a more concise comparison, the common mental disorder cut-point for males was  $\leq 60$  using the Prevalence Matching criterion and  $\leq 70$  for



the Youden Index. The cut-point of  $\leq 60$  agreed with the cut-point determined for the sexes combined.

The results of the same statistical analysis carried out to produce cut-points for case of common mental disorder for females are produced in table 5.12.

Table 5.12 ROC curve results and cut-points with selected optimisation criteria calculations for common mental disorder by reference to sex: (2) Female

MHI-5 SCORE (CASE IS $\leq$ SCORE)	SENSITIVITY	SPECIFICITY	1	2	3*	4	5**
			YOUDEN INDEX (a)	SHORT O,1 (b)	MISCL RATE (c)	MINI- MAX (d)	PREV MATCH (e)
30	0.196	1.000	1.20	0.80	0.11	0.11	0.290
35	0.283	1.000	1.28	0.72	0.098	0.09	0.259
40	0.399	0.976	1.38	0.60	0.10	0.08	0.202
45	0.493	0.968	1.46	0.51	0.097	0.06	0.163
50	0.616	0.943	1.56	0.39	0.10	0.05	0.103
55	0.710	0.927	1.64	0.30	0.10	0.06	0.059
60	0.783	0.874	1.66	0.25	0.13	0.10	0.001
65	0.841	0.765	1.61	0.28	0.22	0.20	0.092
70	0.899	0.656	1.56	0.36	0.31	0.29	0.183

\*MISCLASSIFICATION RATE \*\*PREVALENCE MATCHING; RED PROBABLE CUT-POINT, BLUE OTHER CUT-POINTS

By reference to the Prevalence Matching and Youden Index criteria cut-points only, as before, in table 5.12, the common mental disorder cut-point for females was  $\leq 60$  using both the Prevalence Matching and Youden Index criteria. The cut-point of  $\leq 60$  agreed with the cut-point determined for the sexes combined.

A summary of the cut-points for a case of CMD are shown in table 5.13.

Table 5.13 Summary of the cut-points for a case of CMD

MENTAL HEALTH CASE STATUS	OPTIMISATION CRITERIA	MHI-5 CUT- POINTS, MALES	MHI-5 CUT- POINTS, FEMALES	MHI-5 CUT- POINTS, BOTH SEXES
CMD	MR*	$\leq 50$	$\leq 45$	$\leq 55$
CMD	Y/MX/PM**	$\leq 70/55/60$	$\leq 60/50/60$	$\leq 60/60/60$
CMD	S***	$\leq 70$	$\leq 60$	$\leq 65$

\* MR = MISCLASSIFICATION RATE

\*\* Y = YODEN INDEX / MX = MINIMAX / PM = PREVALENCE MATCHING

\*\*\* S = SHORTEST DISTANCE (0, 1)

These results provide good evidence for a cut-point of  $\leq 60$  for a case of common mental disorder. Starting with the Prevalence Matching criterion, the cut-point determined was  $\leq 60$  for the sexes combined, and each sex separately. In addition,  $\leq 60$  was the cut-point identified by the Youden Index and Minimax criteria for the sexes combined. For females separately  $\leq 60$  was the cut-point determined by the Youden Index and Shortest distance (0, 1).

The agreement between three of the optimisation criteria was of particular interest as each method optimised a different specific criterion i.e. the Youden Index maximised the sum of sensitivity and specificity and is largely independent of population case prevalence. The Minimax criterion minimised the occurrence of the most common error, and Prevalence Matching selected the cut-point where the proportion of the population categorised as cases was closest to the gold standard prevalence. In view of the atypical, high case prevalence in the CWB dataset the level of agreement found between criteria was even less likely. These results suggested that the calibration of the MHI-5 with the CIS-R was effective for determining a case of common mental disorder. It is therefore posited that a cut-point score of  $\leq 60$  is both plausible and supported by the analysis to determine a case of common mental disorder in the general population.

## 5.9 ROC CURVE PLOT FOR CMD-S

A second ROC curve plot was produced for cases of CMD-S (i.e. those scoring 18 and above on the CIS-R). The range of potential cut-points for this analysis had an upper limit of 50 because the cut-point must be lower than the range of optimal cut-points identified for a case of common mental disorder

The results of this analysis using the same optimisation criteria are set out in table 5.14.

Table 5.14 ROC curve results and cut-points with key optimisation criteria calculations for CMD-S the sexes combined

MHI-5 SCORE (CASE IS ≤ SCORE)	SENSITIVITY	SPECIFICITY	1	2	3*	4	5**
			YOUDEN INDEX (a)	SHORT 0,1 (b)	MISCL RATE (c)	MINI- MAX (d)	PREV. MATCH (e)
35	0.395	0.984	1.38	0.61	0.14	0.13	0.113
40	0.519	0.959	1.48	0.48	0.13	0.10	0.068
45	0.636	0.936	1.57	0.37	0.13	0.08	0.0264
50	0.736	0.897	1.63	0.28	0.14	0.08	0.0256
55	0.814	0.864	1.68	0.23	0.15	0.11	0.069
60	0.868	0.805	1.67	0.24	0.18	0.15	0.127
65	0.825	0.795	1.62	0.27	0.20	0.16	0.208
70	0.891	0.706	1.60	0.31	0.26	0.23	0.289

\*MISCLASSIFICATION RATE \*\*PREVALENCE MATCHING; RED PROBABLE CUT-POINT, BLUE OTHER CUT-POINTS

In table 5.14, the CMD-S cut-point range for the optimisation criteria was ≤45-55. Youden Index and Short (0, 1) calculated a cut-point of ≤55, Minimax and Prevalence Matching ≤50, and Misclassification rate ≤45. The difference in value of these latter two criteria between the cut-points of ≤50 and ≤45 was particularly small, and in view of the implications of selection upon classification warranted closer examination.

Table 5.15 Summary of selected cut-points for CMD-S with classification rates

MHI-5 CUT-POINT SCORE (OPTIMISATION CRITERIA)	SENSITIVITY	SPECIFICITY	MENTAL HEALTH CASE STATUS CLASSIFICATION		
			NMH & CMD No. (%)	CMD-S No. (%)	CHANGE FROM CIS- R RESULTS (20.9% PREV./N.129 CASES)
≤45 (MR)*	0.636	0.936	503 (81.7)	113 (18.3)	-2.6%/16 (18.3% / 123 cases)
≤50 (MX/PM)**	0.736	0.897	471 (76.5)	145 (23.5)	+2.6%/16 (23.5% / 142 cases)
≤55 (Y/S)***	0.814	0.864	445 (72.2)	171 (27.8)	+6.9%/42 (27.8% / 171 cases)

\* MR = MISCLASSIFICATION RATE

\*\* MX = MINIMAX / PM = PREVALENCE MATCHING

\*\*\* Y = YODEN INDEX / S = SHORTEST DISTANCE (0, 1)

It can be seen from table 5.15 that a cut-point of ≤55 classified an additional 42 (171/129) people as cases above the number determined by the gold standard measure, this together with high prevalence of cases, determined that the Youden Index and Short (0, 1) cut-points were rejected. A cut-point of ≤50 classified an additional 16 (145/129) people as cases above the number determined by the gold standard measure. The only cut-point that did not classify a number of cases above the gold standard level was ≤45 which classified 16 fewer people as cases (113/129). This finding was unexpected, and in view of the results in table 5.14 it was worth examining the difference between the Prevalence Matching cut-points ≤45 and ≤50 and the possible explanations. Table 5.16 shows the difference between the cut-points of ≤45 and ≤50 for two criteria.

Table 5.16 Difference in value between selected cut-points for a case of CMD-S

MHI-5 SCORE	SENSITIVITY	SPECIFICITY	4	5*
			MINIMAX	PREV MATCH
≤45	0.636	0.936	0.08	0.0264
≤50	0.736	0.897	0.08	0.0256
DIFFERENCE BETWEEN CUT-POINTS ≤45 & ≤50			ZERO	0.0008

The variation in value between the two cut-points was zero for Minimax, and 0.0008 for Prevalence Matching. While this was preferable to a large difference, two issues had to be taken into account. First, the estimated nature of the sensitivity and specificity values previously mentioned, and second, sampling variation with the resulting sampling error. All studies with a relatively small sample have to address the issues of reduced precision, and the size of the standard error increasing as sample size decreases. Sampling variation can produce a less than optimal outcome, that is, deviation from the parameter estimated. Therefore, it was useful to assess the plausibility of the results in a wider context, and consider other sources, such as national survey data.

Notwithstanding issues of sampling variations, the size of the difference between the optimised values for two 'candidate' cut-points, and plausibility considerations, arguably, the most important consideration in selection of a cut-point is the effect it will have on the actual number of individuals classified as cases. On this point the true prevalence rate determined by the gold standard measure was crucial. In addition to the requirement to best match the screened prevalence rate to the number of individuals classified as cases, ideally, the selected prevalence will not exceed the true prevalence rate. All the cut-points that would result in such a level of classification were therefore rejected as the true prevalence rate was preferred for this thesis. This left a candidate cut-point of  $\leq 45$  which did not produce a prevalence rate that was higher than the gold standard prevalence rate. Therefore, the cut-point of  $\leq 45$  was the optimal cut-point for CMD-S, identified by the Minimax and Misclassification Rate criteria. It was a more suitable cut-point for a case of CMD-S in this instance even though it was not the calculated optimal cut-point for the Prevalence Matching criterion, previously selected. The basis of the selection made illustrates the necessity and importance of analysing the optimised cut-points to identify the most appropriate. An option available only if multiple optimisation criteria are applied.

In keeping with the analysis conducted for the common mental disorder cut-point the same statistical methods were used to identify the CMD-S cut-point for males and females separately. The results for males are produced first in table 5.17.

Table 5.17 ROC curve results and cut-points with selected optimisation criteria calculations for CMD-S by reference to sex: (1) Male

MHI-5 SCORE (CASE IS ≤ score)	SENSITIVITY	SPECIFICITY	1	2	3*	4	5**
			YOU DEN INDEX (a)	SHORT O,1 (b)	MISCL RATE (c)	MINI- MAX (d)	PREV MATCH (e)
30	.295	.989	1.28	0.71	0.14	0.13	0.125
35	.386	.984	1.37	0.61	0.12	0.11	0.103
40	.500	.979	1.48	0.50	0.11	0.09	0.077
45	.659	.957	1.62	0.34	0.09	0.06	0.03
50	.750	.930	1.68	0.26	0.10	0.05	0.009
55	.795	.893	1.69	0.23	0.12	0.08	0.048
60	.818	.829	1.65	0.25	0.17	0.13	0.104
65	.886	.765	1.65	0.26	0.21	0.19	0.169
70	.932	.695	1.63	0.31	0.25	0.24	0.234

\*MISCLASSIFICATION RATE \*\*PREVALENCE MATCHING; RED PROBABLE CUT-POINT, BLUE OTHER CUT-POINTS

Referring to the Prevalence Matching and Youden Index criteria cut-points in table 5.17, the CMD-S cut-point for males was ≤50 using the Prevalence Matching criterion, and ≤55 for the Youden Index. These cut-points agreed with the cut-points determined for the sexes combined for CMD-S by those criteria.

Finally the same statistical methods were used to produce cut-points for a case of CMD-S for females and the results are presented in table 5.18.

Table 5.18 ROC curve results and cut-points with selected optimisation criteria calculations for CMD-S by reference to sex: (2) Female

MHI-5 SCORE (CASE IS ≤ score)	SENSITIVITY	SPECIFICITY	1	2	3*	4	5**
			YOUDEN INDEX (a)	SHORT O,1 (b)	MISCL RATE (c)	MINI- MAX (d)	PREV MATCH (e)
30	.282	.990	1.27	0.71	0.166	0.15	0.12
35	.400	.983	1.38	0.61	0.145	0.13	0.089
40	.529	.947	1.48	0.50	0.145	0.10	0.032
45	.624	.923	1.55	0.34	0.143	0.08	0.007
50	.729	.877	1.61	0.26	0.155	0.09	0.067
55	.824	.847	1.67	0.23	0.158	0.11	0.111
60	.894	.790	1.68	0.25	0.187	0.16	0.171
65	.953	.690	1.64	0.26	0.251	0.24	0.262
70	.976	.580	1.56	0.31	0.332	0.32	0.353

\*MISCLASSIFICATION RATE \*\*PREVALENCE MATCHING; RED PROBABLE CUT-POINT, BLUE OTHER CUT-POINTS

By reference to the Prevalence Matching and Youden Index criteria cut-points in table 5.18 the CMD-S cut-point for females was ≤45 using the Prevalence Matching criterion and ≤60 for the Youden Index.

Table 5.19 Summary of MHI-5 cut-point scores identified by the five optimisation criteria for a case of CMD-S

MENTAL HEALTH CASE STATUS	OPTIMISATION CRITERIA	MHI-5 CUT- POINTS, MALES	MHI-5 CUT- POINTS, FEMALES	MHI-5 CUT- POINTS, BOTH SEXES
CMD-S	MR/MX*	≤45/50	≤45/45	≤45/50
CMD-S	PM**	≤50	≤45	≤50
CMD-S	Y/S***	≤55/55	≤60/55	≤55/55

\* MR = MISCLASSIFICATION RATE / MX = MINIMAX

\*\* PM = PREVALENCE MATCHING

\*\*\* Y = YOUDEN INDEX / S = SHORTEST DISTANCE (0, 1)

From this analysis it can be seen that three optimisation criteria identified a cut-point of  $\leq 45$  in five instances of all tables, three of which were for females. These results provided additional support for a suggested cut-point of  $\leq 45$  for a case of CMD-S in the general population.

The basis for the selection of the cut-points will be revisited after consideration of related topics.

#### 5.10 MHI-5 CUT-POINTS IDENTIFIED IN EARLIER STUDIES

A number of previous studies have attempted to identify cut-points on the MHI-5. It is useful at this point to examine the approaches adopted by the investigators in these studies, their findings, and how they compare to the cut-points selected in this thesis. Compiling the most informative table of these studies proved problematic from the outset. Each study had a number of limitations, and the range of irreconcilable differences all but precluded useful comparison. This was because of, the use of a different version of the MHI-5, unclear reporting of methods, and the identification of five cut-points that were not possible in the current study. The only features that the studies share were the aim of identifying a cut-point on the MHI-5 scale, and the application of at least one optimisation criterion.

In table 5.20 the pertinent details of seven studies that identified cut-points for the MHI-5, and warranted review, are presented. Three studies concentrated on a cut-point for a case of common mental disorder (CMD) and four concentrated on a range of mood disorders of varying, and in the case of three studies, greater severity than CMD. There are a number of ways in which table 5.18 could be structured, and none were ideal. Therefore on the basis of the first column to list a characteristic of the studies, and the use of a general population sample in the CWB study, the studies were divided into two groups and ordered; 1) General population sample and 2) Specific population sample. The version of the MHI-5 used is stated where it was identifiable.



Table 5.20 shows the MHI-5 cut-point scores identified in earlier studies with the optimisation criteria used.

Table 5.20 Summary of MHI-5 cut-point scores identified in earlier studies with optimisation criteria used

STUDY	POP*	GOLD STANDARD & CUT-POINT USED	DISORDER	CRITERION	MHI-5 CUT-POINT	LIMITATIONS
Hoeymans et al. (2004)	Gen**	GHQ-12 ≥2	CMD	Prevalence Matching	≤72	Non gold standard instrument; Low cut-point of ≥2 used
Kelly et al. (2008) BHPS data used	Gen	GHQ-12 ≥3	CMD	Youden & Short (0,1) Prevalence Matching & Minimax Miscl. Rate	≤76 ≤68 ≤60	Non gold standard instrument; MHI-5 Ver.1
Cuijpers et al. (2009)	Gen	CIDI (Dutch)	MDE (DSM III-R)	Youden	≤74	Non- CMD measure; More severe disorder; MHI-5 Ver 1
Rumpf et al. (2001)	Gen	M-CIDI (German)	DSM IV AXIS I	Short (0,1)	≤65	Non- CMD measure; More severe disorder
Holmes (1998)	Spe***	SCID-NP-HIV	MAJOR DEP (DSM III-R)	Short (0,1)	≤52	Non- CMD measure; More severe disorder; Small specific population sample
Winston & Smith (2000)	Spe	CIS-R ≥12	CMD	Not stated: Arcus Quickstat generated	≤71/72	Small specific population sample; Ethnicity focus; Analysis unclear
Van den Beukel et al. (2012)	Spe	Becks Depression Inventory (Dutch) ≥16	Depressive symptoms	Youden	≤70	Non- CMD measure; Non gold standard instrument; Small specific population sample; MHI-5 Ver 1; Symptoms not caseness identified

\* POP = POPULATION

\*\* GEN = GENERAL POPULATION

\*\*\* SPE = SPECIFIC POPULATION

From table 5.20 it can be seen that the Youden Index and Short (0, 1) criteria were the most frequently selected criteria. Only three studies determined a cut-point for a case of common mental disorder, Hoeymans and colleagues (2004)  $\leq 72$ ; Kelly and colleagues (2008)  $\leq 76$  (Youden and Short (0, 1)),  $\leq 68$  (Prevalence Matching and Minimax),  $\leq 60$  (Misclassification Rate) and Winston and Smith (2000)  $\leq 71/72$ . As noted in Chapter 2 there are two versions of the MHI-5, and a cut-point of  $\leq 60$  on version one is not equivalent to the same cut-point on version 2. In view of the use of version two of the MHI-5, only the cut-point of  $\leq 60$  in the three studies noted above is possible in this study, though it may not be equivalent if version 1 is used, and useful comparisons are restricted by the items in the limitations column. Of the other four studies, three focused exclusively on more severe disorder at clinical disease level. The cut-points identified in these four studies are therefore of no apparent relevance to the cut-points for common mental disorder and CMD-S established in the CWB study.

One of these studies, Holmes (1998), however, warranted some discussion. The Holmes (1998) cut-point of  $\leq 52$  was referred to in Chapter 3 where a prevalence rate of 33.75% was found in a Croatian general population study for CMD-S (Rukavina *et al.* 2012). This is almost the same as the total CMD case prevalence rate found in the CWB study. Although the investigators identified psychological distress, such as depression and anxiety, at a sub diagnostic level, they selected a cut-point determined for clinical disease level disorder. In the Holmes (1998) study a case prevalence rate of 35% was found in a small population sample of 95 HIV positive male patients, which provided a potential explanation of their findings. The investigators in the Rukavina and colleagues study (2012) suggested that the prevalence rate could be explained by what they termed the 'post transitional era' (subsequent to the Croatian war of independence 1991-1995) and the start of the global recession, though it seems probable that the cut-point is simply too high, and a number of individuals with mild to moderate levels of depression have been misclassified. Notwithstanding this it also seems likely that a number of individuals experiencing 'psychological

distress', who would be classified as cases of common mental disorder with a more appropriate cut-point, have been excluded.

A review of the Limitations column quickly reveals that none of the studies in the table satisfy the requirements for determining valid cut-points for cases of common mental disorder or CMD-S in the general population. This limits the application of the findings made, and suggests that valid and reliable cut-points on the MHI-5 do not exist for identifying a case of common mental disorder or CMD-S in the general population.

#### 5.11 OPTIMISATION CRITERIA - SUITABILITY FOR CWB STUDY

Earlier in this chapter the optimisation criteria were discussed primarily in the context of their function. At this point it is helpful to examine which of the optimisation criteria were found to be most suited to this study and why. In epidemiological investigations where a common objective is to correctly estimate disease prevalence within a population, and therefore minimising the inaccuracy of the estimate is a priority, it is unsurprising that the Prevalence Matching criterion is frequently chosen as the most suitable criterion for determining a cut-point. As mentioned previously investigators rarely discuss the rationale for the criteria selected. However, it is common practice to apply two criteria, and where Prevalence Matching is selected the second criterion employed is often the Youden Index. It is suggested that the essential limitation of the Prevalence Matching criterion prompts selection of the Youden Index as the second criterion. The limitation in question is the strength of the relationship between the scales used. A good level of agreement needs to exist between the scales in identifying cases. Additionally, one of the scales must actually be a gold standard or the findings will have diminished value. In the CWB study a good level of agreement was found between the MHI-5 and CIS-R.

The five optimisation criteria used in this thesis can be classified as either, producing results that are largely population prevalence dependent or independent. The Youden Index and Short (0, 1) are considered population

prevalence independent, and the Prevalence Matching, Misclassification rate and Minimax criteria population prevalence dependent (Kelly *et al.* 2008). The question of which is more suitable is determined on a case by case basis. In practice this determination is made prior to the analysis, and the papers reviewed suggested it was unlikely to exceed the selection of two optimisation criteria.

As indicated previously in this chapter the high prevalence rate identified in the preliminary analysis of data suggested that the Prevalence Matching criterion would be one of the key or lead optimisation criteria of interest. Although all of the results were analysed and assessed on the basis of their individual merits, the criteria that are population prevalence dependent were likely to be of particular interest, with the population prevalence independent criteria providing a useful means of comparison.

Looking at the population prevalence independent optimisation criteria first, both produced consistently higher cut-points that were largely implausible. With the exception of the cut-point for females and the sexes combined for a case of common mental disorder, the Youden Index produced improbably high cut-points. Therefore, except as noted, these cut-points were rejected.

In comparison, the results of the population prevalence dependent criteria produced lower cut-points. Using the Prevalence Matching criterion as the benchmark, a good level of agreement and plausibility existed for the cut-point of  $\leq 60$  for a case of common mental disorder. For a case of CMD-S the Minimax and Misclassification rate criteria agreed an optimal cut-point that was lower than the one identified by the Prevalence Matching criterion. Though as previously demonstrated, the margin of difference in values between the cut-points of  $\leq 45$  and  $\leq 50$  was a very small sum, and allowing for sampling error, it was considered appropriate to select the lower and more plausible cut-point.

Where a generalisable cut-point is sought the population prevalence independent optimisation criteria are likely to be the preferred choice. However,

where a population sample has an unusual prevalence rate, as in the CWB study, or correctly measuring the prevalence rate is the over-riding objective, the optimisation criteria that are population prevalence dependent appear to be the more suitable choice.

#### 5.12 SELECTING THE CUT-POINTS - FURTHER CONSIDERATIONS

The preceding analysis of the CWB data examined the range of cut-points produced for the MHI-5, and the application of five optimisation criteria to determine the optimal cut-points for cases of common mental disorder and CMD-S. Concise comments referenced to the optimal cut-points were given for the basis for selection. In this section additional detail is presented. In table 5.21 the cut-points identified by the optimisation criteria, together with the cut-points selected, are shown.

Table 5.21 Summary of MHI-5 cut-point scores identified by the five optimisation criteria with selections made

MENTAL HEALTH CASE STATUS	OPTIMISATION CRITERIA	MHI-5 CUT-POINTS, MALES	MHI-5 CUT-POINTS, FEMALES	MHI-5 CUT-POINTS, SEXES
CMD	MR*	≤50	≤45	≤55
	Y/MX/PM**	≤70/55/60	≤60/50/60	≤60/60/60
	S***	≤70	≤60	≤65
OPTIMAL CUT-POINT FOR A CASE OF CMD CHOSEN: ≤60				
CMD-S	MR/MX	≤45/50	≤45/45	≤45/50
	PM	≤50	≤45	≤50
	Y/S	≤55/55	≤60/55	≤55/55
OPTIMAL CUT-POINT FOR A CASE OF CMD-S CHOSEN: ≤45				

\* MR = MISCLASSIFICATION RATE

\*\* Y = YODEN INDEX / MX = MINIMAX / PM = PREVALENCE MATCHING

\*\*\* S = SHORTEST DISTANCE (0, 1)

There are several reasons why the cut-point determined on the MHI-5 scale was reasonable for determining a case of common mental disorder in the

general population. These were, the application of an extended number of optimisation criteria; the agreement of three optimisation criteria for the sexes combined, and four optimisation criteria when the results of the sexes analysed separately were combined; a general population sample, and the participation of a large number of individuals who were classified as either a case of common mental disorder or CMD-S. An established gold standard measure was also used. By using a cut-point of  $\leq 60$  the MHI-5 identified 207 cases in the CWB dataset, which was four fewer than the number determined by the gold standard CIS-R. Taking these points together gave confidence that  $\leq 60$ , on the MHI-5 scale was a meaningful cut-point for determining a case of common mental disorder in the general population.

Turning to the cut-point for a case of CMD-S this proved to be less straightforward and required greater explanation. The level of agreement between the criteria did not reflect that found for a case of common mental disorder, and the optimal cut-point identified by the key criterion was problematic. As before, reasons that supported the contention that a cut-point of  $\leq 45$  on the MHI-5 scale was reasonable for determining a case of CMD-S in the general population included; the application of an extended number of optimisation criteria; a general population sample; the participation of a large number of individuals who were classified as either a case of common mental disorder or CMD-S. An established gold standard measure was also used. However, these reasons alone did not adequately justify the selection.

Returning to the optimal cut-points results, the Prevalence Matching criterion identified an optimal cut-point of  $\leq 50$  for the sexes combined and males separately, and  $\leq 45$  for females. The cut-point  $\leq 45$  was also identified for females by the Minimax criterion. In addition,  $\leq 45$  was the optimal cut-point for both sexes combined, and males using the Misclassification rate criterion. The Misclassification rate, it will be recalled, apportions weights to the sensitivity and specificity in direct relation to the prevalence of cases. This characteristic is useful where the prevalence rate is unusual.

The following matters are also significant. The high case prevalence rate found, greater number of female participants and the results above, render an optimal cut-point of  $\leq 50$  unpersuasive. This was particularly so when taking into account that it was likely the veracity of the answers given by each sex was different and had affected the accuracy of responses provided. It has been shown that males are particularly concerned about disclosing mental health status information because of the perceived potential adverse consequences it may have on their future employment (Wood *et al.* 2002). A comparison of the cut-points for males and females separately suggested that this may have occurred with males providing responses that indicated a more positive mental state than actually existed. In a questionnaire such as the MHI-5, this phenomenon will serve to raise the total score and thereby increase a dependent cut-point. There were instances in the CWB study data which supported this contention, that is, where the MHI-5 score was higher than suggested by the CIS-R score, and found in the other results, creating disagreement between the measures i.e. a CIS-R score determining caseness, with an associated MHI-5 score, but an MHI-5 score that was higher than the cut-point score determined. This may have been attributable to sequence effects and an initial 'caution' in responding to the MHI-5, the first questionnaire. Accepting this, the cut-point of  $\leq 45$  appeared more plausible, especially when considered in conjunction with the other scores of  $\leq 45$  identified in four instances by three optimisation criteria. A cut-point of  $\leq 45$ , it is suggested, was the best general value for a case of CMD-S in the general population.

The selection of optimisation criteria and cut-points is a challenging undertaking and is arguably as much an art as science. There will rarely be instances where no judgments are required. As has been shown, where reasonable grounds existed to depart from the actual optimal cut-point identified by the lead criterion, an alternative was selected. Each study will have a particular focus that will affect the selection of both optimisation criteria and cut-point. Distinct from previous studies this is the first study to employ a methodology to determine a valid cut-point for a case of common mental

disorder in the general population and without reliance upon a pre-selected solitary optimisation criterion.

### 5.13 STRENGTHS AND LIMITATIONS

#### *Strengths*

The CWB study demonstrated that web-based research is an effective method of collecting sensitive participant data from the general population, including data from individuals with potentially severe mental disorders. Thirteen individuals completed the questions on suicidal ideation in the CIS-R scoring a section maximum score of four. The consultant psychiatrist, who advised on the risk to participants of taking part in the study, indicated that individuals with a severe level of mental disorder would lack the motivation to even open the information pack.

Contrary to conventional wisdom, the CWB study suggests that web-based research is an effective methodology for reaching a comprehensive age range of participants. Participants for each year of the age range 18 to 74 years took part in the CWB study with a sufficient number of people in each group.

The number of participants recruited (616) exceeded the sample size estimation (400) by over 50%, and would have been unachievable with traditional face to face methods due to resource constraints. These data were also collected without any lone researcher safety issues that have to be provided for in field research.

The successful adaptation of a gold standard instrument, and the MHI-5, for web-based use enabled valid cut-points to be determined for the first time.

The selection and use of multiple optimisation criteria ensured that cut-points were determined for both population prevalence dependent and independent optimisation criteria. This enabled the analysis and comparison of



results in a manner not typically available, and increased the robustness of the cut-points identified.

An unusually high number of participants with CMD-S were motivated to take part which increased the plausibility of the cut-points identified because a larger percentage of the participants had CMD case status providing more data for analysis. The use of web-based methods provided greater scope to design the study to specifically assist participants who may have poor mental health. This, together with the remote nature of web-based research and the ability to participate from a domestic location, may have been attractive to participants with poor mental health. Web-based methods are cost effective and a viable option for small studies. The structured pilot testing undertaken reduced both the period of testing and the number of pilot testers required, while delivering high quality feedback allowing all the identified issues to be fixed prior to the start of the data collection stage of the study. The success of the pilot testing ensured a robust website was developed. This is an important consideration where the recruitment of individuals with poor mental health is concerned, as they may be easily deterred by technical issues or erratic flawed performance.

### *Limitations*

Notwithstanding the comments above the number of participants recruited is small in relation to the mailing of 10,000 individuals, though comparable to the AWFG study and UK Biobank. The sample frame of 10,000 people was representative, but response bias i.e. a large number of individuals with an interest in mental health and well-being participating (Leykin *et al.* 2012) suggested the study sample was probably not. Where judgment is exercised in the selection of an 'optimal' cut-point, the basis of such judgment will be open to critical assessment. This issue has been discussed thoroughly, and it was concluded that the selection was considered the most appropriate for the study that could be made. Finally, it would have been preferable if the CIS-R could have been used without any modifications for web-based use, but it did not exist in such a form. Although there were unavoidable adaptations required to

translate the instrument's coding for web-based use, the validated content of the CIS-R was preserved as stipulated by the instrument's author. It is therefore difficult to see why further validation would be necessary

#### 5.14 CONCLUDING SUMMARY

This chapter has met the objectives stated in the introduction.

1. The data collected by the CWB study website has been described and analysed.
2. The relationship between the MHI-5 and CIS-R has been investigated.
3. A range of cut-points identified for the MHI-5 by selected optimisation criteria has been evaluated, and
4. The basis for the cut-points selected has been explained

The overriding objective of this chapter, and a pivotal aspect of this thesis, is the determination of the cut-points for a case of common mental disorder and CMD-S. The cut-points selected in this thesis are appropriate, primarily, for use in epidemiological research. The MHI-5 is predominantly used as a screening instrument for research purposes. It can be classed as a preliminary filter that indicates whether further investigation is required. In the context of large-scale epidemiological studies where participants are anonymous, and there is no subsequent follow-up, the MHI-5 can be used to provide a population prevalence estimate of mental health and well-being. In view of this, the intended application of the cut-points, and the unusually high CMD-S case prevalence found in the CWB study's data, Prevalence Matching was selected as the primary criterion.

This chapter has demonstrated that web-based data collection is an effective research methodology for mental health studies. It appears to secure the participation of individuals with higher levels of poor mental health symptoms.

The relevance of representativeness of a population sample and size is discussed in Chapter 7. At this juncture it is appropriate to suggest that the unusually high prevalence rate of CMD-S found in the CWB population sample, broader points of debate aside, was a helpful feature for this study. When combined with the use of a gold standard measure to determine the case prevalence rate, and employing multiple optimisation criteria to provide optimal cut-points, the contention that the cut-points identified are robust is one that is supported.

The cut-points established in this chapter will be applied to the CHSNS dataset in the next chapter.

## CHAPTER 6

## CHAPTER 6: CHANGE IN MENTAL HEALTH CASE STATUS: ASSOCIATION WITH INDIVIDUAL SOCIAL AND ECONOMIC TRANSITIONS AND AREA FACTORS

This chapter brings together the cut-points determined in the CWB study, and the CHSNS (the survey) dataset for which they were established. The cut-points were be applied to the MHI-5 scores in the two waves of the survey to define mental health case status, prior to the more detailed analysis required to answer the third research question.

This chapter will initially describe the survey dataset, the study variables, and scores for the MHI-5. The MHI-5 results were categorised to determine common mental disorder case status at baseline and follow-up. Change in case status of becoming a case or ceasing to be, and the individual socio-economic and small area level factors significantly associated with such change, was analysed using the study variables. The results from this analysis were then applied to answering the third research question set out in Chapter 1:

3. *To what extent is change in mental health case status associated with individual social and economic transitions and small area level factors?*

Changes in mental health case status were examined for two states, onset and recovery. Onset refers to a participant becoming a case who was not at baseline). Recovery (from CMD (ALL)) refers to returning to normal or healthy state and ceasing to be a case. Participants who were not a case at baseline are noted as NMH, and those who were never a case are noted as NMH-II. The two states of mental health case status were chosen for this thesis because they map the course of a disorder, and provided a more complete view of change in mental health case status since baseline.

In addition, three case status classifications were examined 1. CMD (ALL) this classification includes all cases of CMD irrespective of severity determined by an MHI-5 score of  $\leq 60$ ; 2. CMD-NS (not severe) this excludes all those

participants with an MHI-5 score of  $\leq 45$ ; and 3. CMD-S this excludes all those participants with an MHI-5 score of between 46 and 60. Onset is of particular interest because knowing the life transitions that are associated with the onset of CMD, and of which severity, is a pre-requisite of managing the risk and preventing case status.

## 6.1 THE STRUCTURE OF THE ANALYSIS

The analysis in this chapter is structured in the following way.

1. Overview of the survey
2. Description of the variables and characteristics of the dataset at baseline and follow-up
3. Discussion of the MHI-5 scores
4. Discussion of the analysis plan comprising five models and descriptive tables for Models 2-5.
5. Model 1 Baseline: univariable unadjusted odds ratios and multivariable logistic regression for case of CMD or NMH.
6. Model 2 Onset: univariable unadjusted odds ratios and multivariable logistic regression for CMD case onset or remaining NMH-II at follow-up
7. Model 3 Recovery: univariable unadjusted odds ratios and multivariable logistic regression for CMD case recovery to remaining a case of CMD at follow-up
8. Model 4 Onset of CMD-NS (not severe): fully adjusted multivariable logistic regression for CMD-NS case onset or not a case of any CMD (NMH) at follow-up
9. Model 5 Onset of CMD-S fully adjusted multivariable logistic regression for CMD-S (excluding cases of not severe) case onset or remaining not a case (NMH-II) at follow-up
10. Conclusion

## 6.2 THE CAERPHILLY HEALTH AND SOCIAL NEEDS LONGITUDINAL STUDY DATA SET

As noted in Chapter 1 the survey collected baseline data in 2001 with a questionnaire, receiving responses from 10 892 (60.6%) of the respondents contacted aged 18 to 74 years. A second wave of the survey was carried out after seven years, collecting data from 4558 (50.2%) participants answering the same range of questions. The number of participants for whom there is complete mental health data, in the form of MHI-5 scores for both waves, is 4426. The following analysis is based on the data from these 4426 participants, the survey data.

The analysis strategy was organised as follows: a) Baseline variables – age group, gender and social class, transitions in individual social and economic variables, for example marital and employment status, and b) Enumeration district area-level factors such as social deprivation.

The classifications of common mental disorder are cited frequently and have therefore been simplified to the abbreviated forms CMD, CMD-NS and CMD-S as appropriate. As previously indicated, NMH refers to not a case status or normal mental health, and NMH-II refers to never being a case.

## 6.3 CHARACTERISTICS OF THE SAMPLE

The next section describes the characteristics of the participants at baseline and transitions at follow-up.

### 6.3.1 Sex

Of the 4426 participants, 1893 (42.8%) were male and 2533 (57.2%) were female. Population data for Caerphilly County Borough from the 2011 Census, reports that 49.1% were male and 50.9% female. In this sample, a greater percentage (6.3%) of female participants took part in the study compared to the general population distribution at the time the second wave of the survey was conducted.

### 6.3.2 Age

The age range of participants was 18 to 74 years. The participants were grouped into six 10-year age bands to overcome the known non-linear relationship between individual age and mental health (*Sacker and Wiggins 2002*). The grouping categories adopted follow those used by the Office of National Statistics and set out in the guidelines issued by the International Journal of Epidemiology (1998).

Table 6.1 below shows the distribution of participants by age group.

Table 6.1 Age group at baseline

AGE GROUP	TOTAL (%)
18-24	235 (5.3)
25-34	575 (13.0)
35-44	855 (19.3)
45-54	1085 (24.5)
55-64	989 (22.3)
65-74	687 (15.5)
TOTAL	4426 (100.0)

### 6.3.3 Registrar General Social class

In the UK, social class in official statistics is determined using socio-economic classifications. In this study the Registrar General Social Class (RGSC) measure was used. The RGSC is a classification of occupational status, where professional jobs have higher status than managerial ones and so forth. It is derived from the Standard Occupational Classification (*OPCS 1991*). In 2001 the RGSC was replaced by the National Statistics Socio-economic Classification (NS-SEC). However, as the study design preceded this change, use of the RGSC was used. The formatting of the survey questionnaire has been preserved, but bold appears as small capitals in the font used in this thesis.

The questions asked in the survey questionnaire were as follows:



4. *IN YOUR PRESENT OR MOST RECENT JOB, ARE (WERE) YOU:*
- *A manager; Self-employed (with employees);*
  - *A foreman or supervisor; Self-employed (without employees);*
  - *An employee (other than a manager or foreman); have never been in paid employment.*
- 5A. *WHAT IS YOUR JOB TITLE (IF YOU ARE NOT IN WORK STATE WHAT YOUR PREVIOUS TITLE WAS)?*
- 5B. *WHAT DOES THE ORGANIZATION YOU WORK FOR MAKE OR DO (AT THE PLACE WHERE YOU WORK)?*
6. *MAIN THINGS DONE IN JOB*

Table 6.2 shows the number and percent of participants by baseline RGSC. The largest social class groups are I and II and IV and IV. The largest category for males is IIIM skilled manual and for females was IIIN skilled non manual.

Table 6.2 Baseline Registrar General Social class

REGISTRAR GENERAL SOCIAL CLASS	TOTAL (%)
I & II Professional & Managerial & Technical	1143 (25.8)
IIIN skilled non manual	930 (21.0)
IIIM skilled manual	871 (19.7)
IV & V part & unskilled	1054 (23.8)
Social class other	202 (4.6)
Missing	226 (5.1)
TOTAL	4426 (100.0)

Follow-up data were collected but as social class is highly correlated with employment and income transitions, (Fryers *et al.* 2003) these data were not used.

#### 6.3.4 Marital status

The categories for marital status were derived from the ONS 1991 Census Wales questions. Questions on marital status did not form part of the 2001 survey and were asked retrospectively in the 2008 survey. The questions asked in the survey questionnaire were as follows:

7. *PLEASE COULD YOU TELL US YOUR MARITAL STATUS?*

- *Single; Divorced or separated; Widowed; Living with partner; Married.*

8. *PLEASE COULD YOU TELL US YOUR MARITAL STATUS AT THE END OF 2001?*

- *Single; Divorced or separated; Widowed; Living with partner; Married.*

Table 6.3 shows the number and percent of participants' marital status in each category at baseline.

Table 6.3 Marital status at baseline

MARITAL STATUS	TOTAL (%)
Single	513 (11.6)
Divorced/separated	310 (7.0)
Widow	251 (5.7)
Married/Partner	3325 (75.1)
Missing	27 (0.6)
TOTAL	4426 (100.0)

For the baseline analysis, the full range of variable categories is used, but because the numbers in some categories were too small, certain categories were combined and recoded for the analysis. The three marital status baseline categories of single, divorced and separated, and widow, were combined into two categories of single/divorced/separated/widow, and single, divorced and separated.

Table 6.4 shows the number and percent of participants in each transition of marital status.

Table 6.4 Marital status transitions

MARITAL STATUS TRANSITIONS	TOTAL (%)
Remain Married/Partner	3055 (69.0)
Single/Divorced/Separated/Widow to Married/Partner	187 (4.2)
Remain Widowed	243 (5.5)
Married/Partner to Divorced/Separated/Single	131 (3.0)
Married/Partner to Widow	133 (3.0)
Remain Single/Divorced/Separated	640 (14.5)
Missing	37 (0.8)
TOTAL	4426 (100.0)

More participants remained in, than changed categories.

### 6.3.5 Employment status

The categories of employment status were derived from the ONS 1991 Census Wales questions, and national definitions such as economic activity and seeking work. The questions asked in the survey questionnaire were as follows:

#### 3. WHICH BEST DESCRIBES YOUR SITUATION?

- *Employed (full time or part time); Retired from paid work;*
- *Unemployed and seeking work; Long term carer;*
- *Looking after home or children full time; Permanently unable to work due to illness or disability*
- *Full time student/school; On a Government training scheme*

Table 6.5 shows the number and percent of participants in each category of employment status at baseline.

Table 6.5 Employment status at baseline

EMPLOYMENT STATUS	TOTAL (%)
Employed	2377 (53.7)
Seeking work	86 (1.9)
Student	51 (1.2)
Home/carer	313 (7.1)
Permanently sick & disabled	473 (10.7)
Retired	957 (21.6)
Missing	169 (3.8)
TOTAL	4426 (100.0)

For the baseline analysis the full range of variable categories are used, but because the numbers in some categories were too small, certain categories were combined and recoded for the analysis. The employment status baseline categories, student, home/carer, permanently sick and disabled and retired were combined to form the category economically inactive at follow-up.

Table 6.6 shows the number and percent of participants in each of the employment status transitions.

Table 6.6 Employment status transitions

EMPLOYMENT STATUS TRANSITIONS	TOTAL (%)
Remain Employed	1762 (39.8)
Remain/become Seeking work	74 (1.7)
Become Economically inactive	591 (13.4)
Become Employed	267 (6.0)
Remain Economically inactive	1470 (33.2)
Missing	262 (5.9)
TOTAL	4426 (100.0)

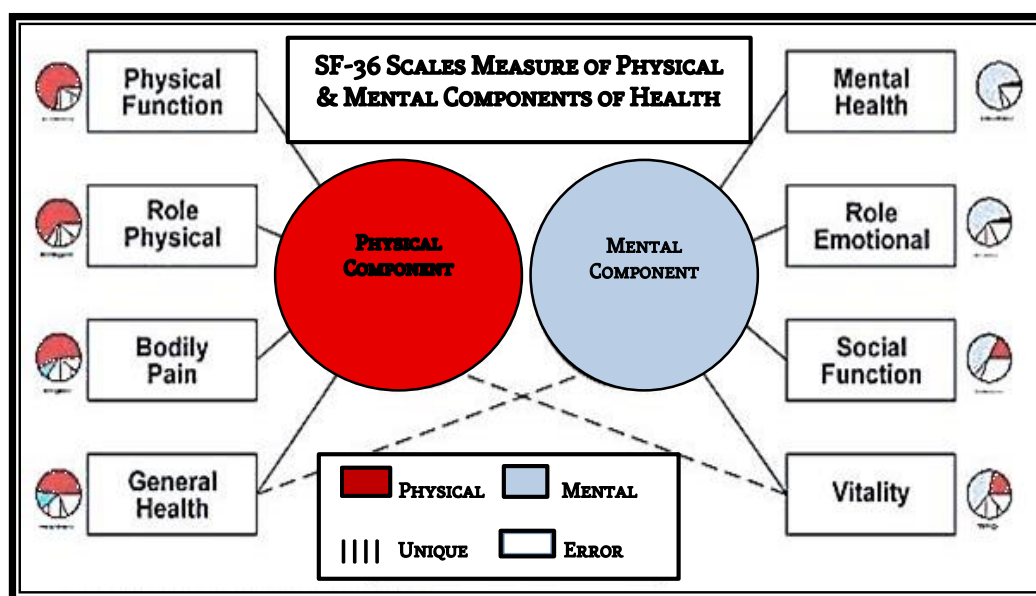
A substantial percentage, 13.4%, become economically inactive.

#### 6.3.6 SF-36 Physical component summary (PCS)

The SF-36 Ver.2 was used to ascertain physical and mental health status. The SF-36 comprises eight health 'concepts' grouped into two components of: physical

health and mental health, which are scored independently of each other. Physical health was assessed using the Physical Component Score (PCS). The physical health concepts include physical functioning, general health, and bodily pain. Figure 6.1 provides a graphical illustration of the composition of the scales.

Figure 6.1 SF-36 Scales Measure of Physical and Mental Components of health with variance estimates



(Ware et al. 1994)

The PCS score has a range of 0-100, and responses were divided into low (poor) PCS (scores 0-50) or high (good) PCS (scores 50-100). The PCS component alone is analysed here.

Table 6.7 shows the number and percent of participants in each category of SF-36 PCS at baseline.

Table 6.7 SF-36 PCS at baseline

SF-36 PCS (SCORE RANGE)	TOTAL (%)
Low PCS (0-<50)	2049 (46.3)
High PCS (50-100)	2041 (46.1)
Missing	336 (7.6)
TOTAL	4426 (100.0)

As expected there is little difference between the percentages in each category, given the way the scale is constructed and by choosing a cut-point at the middle of the distributions.

Table 6.8 shows the number and percent of participants for SF-36 PCS transitions.

Table 6.8 SF-36 PCS transitions

SF-36 PCS TRANSITIONS	TOTAL (%)
Remain High PCS	1593 (36.0)
High to Low PCS	582 (13.1)
Low to High PCS	370 (8.4)
Remain Low PCS	1313 (29.7)
Missing	568 (12.8)
TOTAL	4426 (100.0)

The largest percentage of participants who changed SF-36 status at follow-up was in the transition high to low PCS. The category of remain low PCS had the second largest percentage of participants and shows that nearly one-half of the participants had low PCS. The SF-36 PCS transitions responses have the highest percentage of missing data of all the survey variables, which is a likely consequence of the large number of questions (n=36).

### 6.3.7 Household Tenure

The categories for household tenure at baseline were derived from those utilised by the ONS 1991 Census Wales. The questions asked in the survey questionnaire were as follows:

9. *WHICH OF THE FOLLOWING STATEMENTS BEST DESCRIBES YOUR HOME?*

- *I own or live with the person who owns it;*
- *It is rented from the Local Council or a Housing Association or Housing Trust;*
- *It is rented from a private landlord;*
- *Other (e.g. live rent free, or home comes with job).*

The responses to this question were grouped to form two new categories of 'owner' and 'non-owner'. Table 6.9 shows the number and percent of participants in each category of household tenure at baseline.

Table 6.9 Household tenure at baseline

HOUSEHOLD TENURE	TOTAL (%)
Non owner	647 (14.6)
Owner	3733 (84.3)
Missing	46 (1.0)
TOTAL	4426 (100.0)

Table 6.10 shows the number and percent of participants in each of the household tenure transitions.

Table 6.10 Household tenure transitions

HOUSEHOLD TENURE TRANSITIONS	TOTAL (%)
Remain Owner occupier	3534 (79.8)
Remain Non-owner occupier	484 (10.9)
Owner occupier to Non-owner occupier	178 (4.0)
Non-owner occupier to Owner occupier	159 (3.6)

HOUSEHOLD TENURE TRANSITIONS	TOTAL (%)
Missing	71 (1.6)
TOTAL	4426 (100.0)

Only a small percentage of transitions in housing tenure occurred.

#### 6.3.8 Gross Household Income

This variable represents an approximation of relative household income within the borough. Household income was ‘trichotomised’ to create fairly broad categories because the survey investigators thought this would increase the response rate from individuals, compared to asking for actual income or narrower bands. Gross household income response options were therefore placed in three categories. The question asked in the survey questionnaire was as follows:

39. *WOULD YOU MIND TELLING US YOUR TOTAL CURRENT GROSS WEEKLY OR YEARLY HOUSEHOLD INCOME FROM ALL SOURCES?*

- *Less than £95 per week; Or Less than £5000 per year*
- *Between £95 and £215 per week; Or Between £5000 and £11,250 per year*
- *More than £215 per week; Or More than £11,250 per year*

The categories ‘moderate and ‘low’ are classified as ‘poverty’ level under the UK definition, where households have a gross household income of <60% of median income after housing costs (ONS, *Social Trends* 34). A figure of £11,250 was selected to signify 50% of average UK income of £22,500 based on the most recent data available from the Family Resources Survey when the study was designed (ONS, *Social Trends* 30). This was the nearest equivalent to <60% of median income. The data collected were re-coded into two groups, income poverty and above income poverty. For the second wave data, the poverty threshold was increased and income was adjusted to £217 per week in accordance with the most recent ONS data (ONS *Social Trends* 38). Table 6.11 shows the



number and percent of participants in each category of gross household income at baseline.

Table 6.11 Gross Household Income at baseline

GROSS HOUSEHOLD INCOME	TOTAL (%)
Below Income poverty line	1838 (41.5)
Above Income poverty line	2363 (53.4)
Missing	225 (5.1)
TOTAL	4426 (100.0)

Over 40% of the sample had a gross household income that defined them as living in poverty.

Table 6.12 shows the number and percent of participants in each category of gross household income transitions.

Table 6.12 Gross Household Income transitions

GROSS HOUSEHOLD INCOME TRANSITIONS	TOTAL (%)
Remain above poverty income	1889 (42.7)
Above poverty income to below poverty income	391 (8.8)
Below poverty income to above poverty income	545 (12.3)
Remain below poverty income	1188 (26.8)
Missing	413 (9.3)
TOTAL	4426 (100.0)

There is a notable level of movement between categories.

The relatively high percentage of missing values may reflect the sensitive nature of questions on income. It has been suggested in a study of non-response to income questions that respondents who decline to answer sensitive questions because of privacy concerns often lack the necessary motivation and confidence in the entire process to participate fully (*Schräpler 2003*).

## 6.4 SMALL AREA LEVEL

The geographical unit used in the survey was the enumeration district. The enumeration district is a smaller geographically defined area than the electoral ward. Each enumeration district has an average population of 400 adults. Individual survey responses were geo-referenced to one of the 325 enumeration districts of Caerphilly borough council in the 1991 UK Census using the address postcode. The survey authors considered enumeration districts the most appropriate geographical units for the survey, as these were the smallest and most homogeneous geographical unit available when the survey design was developed (Poortinga *et al.* 2007). They were referred to as small areas.

The next section describes enumeration district small area or neighbourhood factors at baseline including social deprivation, social cohesion and the urban/rural area classification.

### 6.4.1 Social deprivation: Townsend Index

The Townsend Index provides a measure of social and material deprivation or disadvantage. The index is based on four variables originally taken from the 1991 Census: unemployment, car ownership, owner occupation and household overcrowding. It is a widely used composite deprivation index in UK health inequalities research (Gordon 2003). Scores were calculated for enumeration districts, with the individual score for each variable standardised to zero mean and unit variance across the 325 enumeration districts in Caerphilly county borough. The scores were ranked and placed in five groups of deprivation: Lowest, Low, Middle, High and Highest, each including equal counts of enumeration districts.

Table 6.13 shows the number and per cent of participants in each category of deprivation.

Table 6.13 Townsend Index

TOWNSEND INDEX	TOTAL (%)
Lowest deprivation	1110 (25.1)
Low deprivation	873 (19.7)
Middle deprivation	944 (21.3)
High deprivation	782 (17.7)
Highest deprivation	717 (16.2)
TOTAL	4426 (100.0)

The high and highest deprivation categories have the lowest frequencies.

#### 6.4.2 Social Cohesion

The social cohesion section of the survey questionnaire comprised eight questions from the Neighbourhood Cohesion Scale (*Buckner 1988*). This scale is designed to elicit information on participants' sense of belonging to their self-defined neighbourhood and interactions with friends and neighbours using a five-category Likert scale of strongly agree, agree, neither agree or disagree, disagree, and strongly disagree, where 'strong disagreement' was scored as 1 and 'strong agreement' as 5. Summing the responses to these eight questions with equal weighting created a social cohesion subscale ranging from 8 to 40. The mean of the summed participants score for each enumeration district was divided into thirds with equal counts of enumeration districts in each (*Fone et al.2007*).

Table 6.14 shows the number and percent of participants by social cohesion category at baseline. Low social cohesion has the lowest percentage of participants with 28.7%. With a similar number/percentage in the medium and high categories.

Table 6.14 Social Cohesion in thirds at baseline

SOCIAL COHESION	TOTAL (%)
Low	1270 (28.7)
Med	1588 (35.9)
High	1568 (35.4)
TOTAL	4426 (100.0)

#### 6.4.3 Area classification by Rural/Urban category

There is no agreed or standard definition for the classification of geographical areas into urban and rural, also known as ‘settlement type’. The literature describes a range of approaches including settlement size, population density, accessibility, nearest neighbour and multivariate area classification (*Martin et al. 2000*). In the circumstances, practical and sensible definitions have been employed that are appropriate for the study (*Farmer et al. 2001*). It is noted that the ONS introduced new and extensive rural and urban definitions and classifications in 2004 for the 2001 Census LSOAs (Lower Layer Super Output Areas). In 2001, when the survey was designed, the investigators used enumeration districts as the small geographical area. In consequence, in this thesis the ONS enumeration district classification was used (*ONS, 1991 Census*).

Enumeration districts are classified in an ONS data set as ‘urban’ or ‘rural’ based upon the National Land Use Classification (*JLA, 1975*) which defines urban land as ‘*land irreversibly urban in character*’. Administrative boundaries are not applied. An urban enumeration district is defined by the majority of its population residing in distinct urban land within the enumeration district. All other enumeration districts are classified as rural (*ONS, 1991 Census*).

Table 6.15 shows the number and percent of participants by rural/urban enumeration district category at baseline.

Table 6.15 Rural/Urban categories at baseline

AREA CLASSIFICATION	TOTAL (%)
Rural	515 (11.6)
Urban	3911 (88.4)
TOTAL	4426 (100.0)

It can be seen from table 6.10 that the largest percentage of participants lived in an *urban* enumeration district at baseline. In a 2009 ONS report 67% of the population of Wales lived in urban areas and 33% in rural areas (ONS *Regional Trends 43, 2010/2011*). The distribution in the survey sample is consistent with the urban classification of Caerphilly county borough ([www.caerphilly.gov.uk/](http://www.caerphilly.gov.uk/)).

#### 6.5 FIVE-ITEM MENTAL HEALTH INVENTORY SCORES

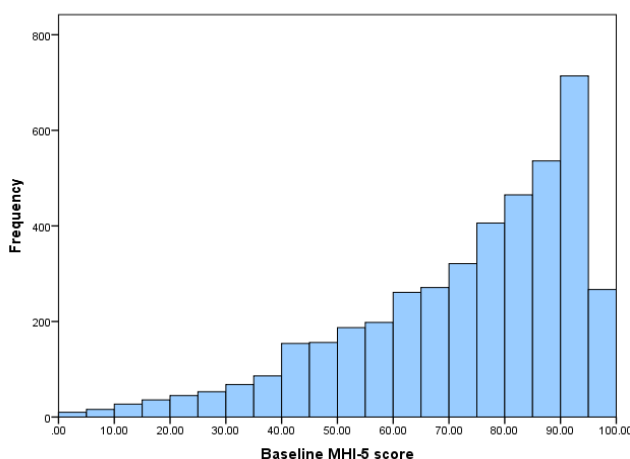
In this section, as an introduction to the categorisation of the MHI-5 scores at follow-up, the baseline scores collected in the survey are analysed by age group, and Townsend Index first. The same method of transforming the MHI-5 scores described in Chapter 5 was used again. The possible values that the MHI-5 scores could have in the survey data differ from those in the CWB study because missing values were imputed in the survey data. The investigators employed the scale developer's recommendation of using a scoring algorithm to impute a value for a missing question if a respondent answered at least one-half of the items in a multi-item scale. Imputation was therefore used if three or four questions were answered. The scale's author explained how the algorithm works.

*The recommended algorithm substitutes a person-specific estimate for any missing item when the respondent answered at least 50 percent of the items in a scale. A psychometrically sound estimate is the average score, across completed items in the same scale, for that respondent.*

(Ware et al. 2000, p.41)

The histogram in figure 6.2 illustrates the distribution of the MHI-5 scores at baseline, 2001.

Figure 6.2 Histogram of transformed MHI-5 baseline score



The distribution was negatively skewed. The mean mental health score was 71.2 (SD 20.7). The transformed MHI-5 score is referred to in the remainder of this chapter as the MHI-5 score.

#### 6.5.1 Five-item Mental Health Inventory mean scores by age group

The number and percent of participants and associated MHI-5 mean scores with SD by age group are shown in the table 6.16 below.

Table 6.16 MHI-5 Mean (SD) scores by age group at baseline

AGE GROUP	N (%)	MEAN (SD)
18-24	235 (5.3)	69.4 (19.8)
25-34	575 (13.0)	71.3 (20.2)
35-44	855 (19.3)	69.3 (21.6)
45-54	1085 (24.5)	71.2 (21.3)
55-64	989 (22.3)	70.9 (20.9)
65-74	687 (15.5)	74.7 (18.7)
TOTAL	4426 (100.0)	71.2 (20.7)

The lowest mean MHI-5 score of 69.2 is found in the 35-44 age group. In general, mental health is better in the older age groups and here there is a notable increase in the score for the 65-74 age group.

#### 6.5.2 Five-item Mental Health Inventory by Townsend Index

The mean (SD) MHI-5 scores by the Townsend Index are shown in table 6.17.

Table 6.17 MHI-5 mean score by the Townsend Index

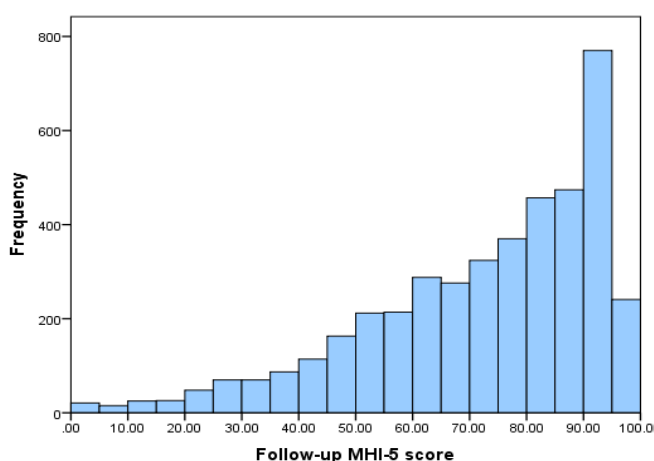
TOWNSEND INDEX	MEAN (SD)	TOTAL
Lowest deprivation	75.2 (18.4)	1110
Low deprivation	73.0 (19.8)	873
Middle deprivation	71.4 (20.7)	944
High deprivation	68.4 (20.9)	782
Highest deprivation	65.8 (23.2)	717
TOTAL	71.2 (20.7)	4426

A consistent trend is shown; the MHI-5 mean scores decrease as the level of deprivation increases.

#### 6.5.3 Five-item Mental Health Inventory results at follow-up

The distribution was, also as expected, negatively skewed. The mean mental health score was 70.9 (SD 21.0), range 0-100.

Figure 6.3 Histogram of MHI-5 scores at follow-up



## 6.6 OVERVIEW OF THE ANALYSIS OF FACTORS ASSOCIATED WITH BASELINE CASE STATUS AND CHANGE IN CASE STATUS AT FOLLOW-UP

In Chapter 5, two cut-points were established to enable cases of CMD and CMD-S to be determined in the survey dataset. Table 6.18 shows the change in case status between baseline and follow-up.

Table 6.18 Change in CMD case status between baseline and follow-up

BASELINE CASE STATUS	FOLLOW-UP CASE STATUS (%)		TOTAL
	NMH-II	CASE	
NMH	2551 (81.3)	586 (18.7)	3137
CASE	536 (41.6)	753 (58.4)	1289
TOTAL	3087 (69.7)	1339 (30.3)	4426

From table 6.18 it can be seen that there were 1289 cases at baseline and 1339 at follow-up, that is an increase of 50 cases. To answer the research question a plan of analysis was formulated. The analysis plan comprises four sections. Each will follow a similar strategy. In the first section, baseline (which is included for context and measure of association), the association of all common mental disorder cases at baseline with the individual and area risk factors is assessed in model 1 using the full dataset of 4426 participants. First, descriptive tables are presented and the univariable unadjusted odds ratios, with 95% confidence intervals, for case of CMD vs. NMH will be estimated in univariate logistic regression. Second, model 2, a multivariable logistic regression will estimate the adjusted odds ratios for age group, gender and social class, all individual and household variables, and third, model 3, the final model will add the area-level variables.

In the second section, onset, the dataset for analysis is the 3137 participants who were NMH at baseline. Model 2 will use the same modelling strategy to investigate the associations between CMD case onset vs. remaining NMH-II at follow-up and all individual and household variables, and area-level variables.



In the third section, recovery, the dataset for analysis is the 1289 participants who were cases of CMD at baseline. Model 3 will use the same modelling strategy to investigate the associations between CMD case recovery vs. remaining a case at follow-up and baseline age group, gender and social class, transitions in the other individual and household variables, and area-level variables.

The fourth section, onset of CMD and CMD-S, distinguishes between CMD-NS (not severe) and CMD-S. The dataset for analysis is the 3137 participants who were NMH at baseline. Full multivariable logistic regression will estimate the adjusted odds ratios for all individual, household and area-level variables. Two models will be investigated: Model 4 will model the associations between the onset of CMD-NS vs. remaining NMH-II at follow-up and the same risk factors; while Model 5 will model the associations between the onset of CMD-S case (excluding cases of CMD-NS) vs. remaining NMH-II at follow-up and the same risk factors.

A summary of the analysis strategy, is shown in table 6.19.

Table 6.19 Analysis strategy

MODEL	CMD CASE STATUS
MODEL 1	Case of CMD (all) or NMH (Not a case) at Baseline
MODEL 2	ONSET of CMD case (all) or NMH-II (Never any case)
MODEL 3	RECOVERY from CMD case (all) at baseline or Maintain case status
MODEL 4	ONSET of a case of CMD-NS or NMH-II (Never any case)
MODEL 5	ONSET of a case of CMD-S (severe case only) NMH-II (Never any case)

## 6.7 MODEL 1 COMMON MENTAL DISORDER CASE STATUS AT BASELINE

This section presents descriptive statistics and analyses the univariable and multivariable associations of baseline common mental disorder case status with baseline variables.

### 6.7.1 Baseline case status and descriptive table for study variables

Table 6.20 shows the number and percent of participants at baseline classified into case of CMD and NMH.

Table 6.20 Number (%) of participants classified into CMD and NMH at baseline

BASELINE CMD CASE STATUS	FREQUENCY (%)
Case	1289 (29.1)
NMH	3137 (70.9)
TOTAL	4426

Nearly one-third of the survey dataset were classified as cases of common mental disorder at baseline.

Table 6.21 shows the description of the study variables by CMD case status at baseline.

Table 6.21 Description of the study variables by Common mental disorder case status at baseline

VARIABLE	CMD CASE STATUS		TOTAL N=4426
	NMH (%) N=3137	CMD CASE (%) N=1289	
GENDER			
Male	1422 (75.1)	472 (24.9)	1893
Female	1716 (67.7)	817 (32.3)	2533
AGE GROUP			
18-24	160 (68.1)	75 (31.9)	235
25-34	413 (71.8)	162 (28.2)	575
35-44	596 (69.7)	259 (30.3)	855
45-54	767 (70.7)	318 (29.3)	1085
55-64	675 (68.3)	314 (31.7)	989
65-74	526 (76.6)	161 (23.4)	687
REG. GEN. SOCIAL CLASS			
I&II	918 (80.3)	225 (19.7)	1143
III NM	679 (73.0)	251 (27.0)	930
III M	634 (72.8)	237 (27.2)	871
IV&V	672 (63.8)	382 (36.2)	1054

VARIABLE	CMD CASE STATUS		TOTAL N=4426
	NMH (%) N=3137	CMD CASE (%) N=1289	
Other	94 (46.5)	108 (53.5)	202
Missing	140 (61.9)	86 (38.1)	226
MARITAL STATUS			
Single	348 (67.8)	165 (32.2)	513
Div/sep	181 (58.4)	129 (41.6)	310
Wid	159 (63.3)	92 (36.7)	251
Mar/Ptr	2433 (73.2)	892 (26.8)	3325
Missing	16 (59.3)	11 (40.7)	27
EMPLOYMENT STATUS			
Employed	1875 (78.9)	502 (21.1)	2377
Seeking	55 (64.0)	31 (36.0)	86
Student	34 (66.7)	17 (33.3)	51
Home/carer	212 (67.7)	101 (32.3)	313
Permanently sick & disabled	140 (29.6)	333 (70.4)	473
Retired	721 (75.3)	236 (24.7)	957
Missing	100 (59.2)	69 (40.8)	169
SF-36 PCS			
Low PCS	1309 (63.9)	740 (36.1)	2049
High PCS	1629 (79.8)	412 (20.2)	2041
Missing	199 (59.2)	137 (40.8)	336
GROSS HOUSEHOLD INCOME			
Low income	1087 (59.1)	751 (40.9)	1838
High income	1879 (79.5)	484 (20.5)	2363
Missing	171 (76.0)	54 (24.0)	225
HOUSING TENURE			
Not owner	350 (54.1)	297 (45.9)	647
Owner	2761 (74.0)	972 (26.0)	3733
Missing	26 (56.5)	20 (43.5)	46
TOWNSEND INDEX			
Lowest deprivation	875 (78.8)	235 (21.2)	1110
Low deprivation	656 (75.1)	217 (24.9)	873
Middle deprivation	667 (70.7)	277 (29.3)	944
High deprivation	504 (64.5)	278 (35.5)	782
Highest deprivation	435 (60.7)	282 (39.3)	717
SOCIAL COHESION			
Low social cohesion	856 (67.4)	414 (32.6)	1270
Medium social cohesion	1093 (68.8)	495 (31.2)	1588
High social cohesion	1188 (75.8)	380 (24.2)	1568
URBAN/RURAL			
Urban	2773 (70.9)	1138 (29.1)	3911
Rural	364 (70.7)	151 (29.3)	515

The percentage of females with case status is higher than males. The age group 65-74 has the lowest percentage of cases. As social class becomes less advantageous the percentage of cases increases, the category IV and V is the second largest overall and the largest for a defined category. The divorced and separated and widow, are the largest marital status categories with case status. Permanently sick and disabled is the largest employment status category by a substantial margin with CMD case status. Low PCS is 75% larger than high PCS, and low income is nearly twice the size of high income. Not owner is almost 90% larger than owner and all these less advantageous categories have a higher percentage of cases. As social deprivation worsens the percentage with case status increases with nearly twice as many in the highest deprivation category compared to the lowest. Generally, the less advantageous a category is a higher percentage of people with case status exists.

#### 6.7.2 Unadjusted and adjusted odds ratios for the baseline Model 1

Table 6.22 shows the unadjusted and adjusted odds ratios for a case of CMD at baseline.

Table 6.22 Unadjusted and adjusted odds ratios for a case of CMD at baseline

VARIABLES & REFERENCE CATEGORY <i>FIRST ITEM</i>	MODEL 1 BASELINE								
	UNADJUSTED			ADJUSTED FOR INDIVIDUAL VARIABLES			ADJUSTED FOR IND. & SMALL AREA VARIABLES		
	OR	95% CI FOR OR		OR	95% CI FOR OR		OR	95% CI FOR OR	
		LWR	UPR		LWR	UPR		LWR	UPR
GENDER <i>MALE</i> Female	1 1.43	1.25	1.64	1 1.47	1.25	1.73	1 1.48	1.26	1.74

VARIABLES & REFERENCE CATEGORY <i>FIRST ITEM</i>	MODEL 1 BASELINE								
	UNADJUSTED			ADJUSTED FOR INDIVIDUAL VARIABLES			ADJUSTED FOR IND. & SMALL AREA VARIABLES		
	OR	95% CI FOR OR		OR	95% CI FOR OR		OR	95% CI FOR OR	
		LWR	UPR		LWR	UPR		LWR	UPR
AGE GROUP	1			1			1		
45-54	1.31	0.83	1.53	1.22	0.84	1.78	1.21	0.83	1.77
18-24	0.95	0.76	1.18	1.23	0.95	1.59	1.22	0.94	1.57
25-34	1.05	0.86	1.27	1.18	0.95	1.47	1.18	0.95	1.47
35-44	1.12	0.93	1.35	0.73	0.58	0.92	0.73	0.58	0.92
55-64	0.74	0.59	0.92	0.47	0.34	0.64	0.47	0.34	0.64
65-74									
REG. GEN. SOCIAL CLASS	1			1			1		
<i>I&amp;II</i>	1.51	1.23	1.85	1.19	0.96	1.49	1.17	0.94	1.46
III NM	1.53	1.24	1.88	1.23	0.97	1.55	1.18	0.93	1.49
III M	2.32	1.91	2.81	1.43	1.15	1.78	1.37	1.10	1.70
IV&V	4.69	3.43	6.41	1.40	0.95	2.10	1.35	0.91	1.10
Other	2.51	1.85	3.40	1.80	1.26	2.58	1.70	1.19	2.44
Missing									
MARITAL STATUS	1			1			1		
<i>MAR/PTR</i>	1.29	1.06	1.58	0.90	0.70	1.16	0.89	0.69	1.15
Sgl	1.94	1.53	2.47	1.35	1.03	1.78	1.35	1.03	1.77
Div/Sep	1.58	1.21	2.06	1.33	0.97	1.82	1.34	0.98	1.83
Wid	1.88	0.87	4.06	1.44	0.62	3.33	1.42	0.61	3.30
Missing									
EMPLOYMENT STATUS	1			1			1		
<i>EMPLOYED</i>	2.10	1.34	3.30	1.39	0.86	2.25	1.42	0.87	2.29
Seeking	1.87	1.03	3.37	1.50	0.77	2.92	1.59	0.81	3.10
Student	1.78	1.38	2.3	1.01	0.75	1.35	1.00	0.75	1.34
Home/carers	8.88	7.12	11.08	5.98	4.57	7.81	5.99	4.58	7.83
Permanently sick & Disabled	1.22	1.02	1.46	1.30	0.99	1.70	1.35	1.03	1.76
Retired	2.58	1.87	3.56	1.88	1.30	2.71	1.93	1.34	2.80
Missing									
SF-36 PCS	1			1			1		
<i>HIGH PCS</i>	2.24	1.94	2.57	1.59	1.34	1.88	1.56	1.32	1.85
Low PCS	2.72	2.14	3.47	1.50	1.13	2.01	1.45	1.08	1.94
Missing									
GROSS HOUSEHOLD INCOME	1			1			1		
<i>HIGH INCOME</i>	2.68	2.34	3.07	1.72	1.44	2.07	1.67	1.39	2.01
Low Income	1.27	0.89	1.69	0.84	0.58	1.20	0.82	0.57	1.17
Missing									

VARIABLES & REFERENCE CATEGORY <i>FIRST ITEM</i>	MODEL 1 BASELINE								
	UNADJUSTED			ADJUSTED FOR INDIVIDUAL VARIABLES			ADJUSTED FOR IND. & SMALL AREA VARIABLES		
	OR	95% CI FOR OR		OR	95% CI FOR OR		OR	95% CI FOR OR	
		LWR	UPR		LWR	UPR		LWR	UPR
HOUSING TENURE <i>OWNER</i>	1			1			1		
Not owner	2.41	2.03	2.86	1.25	1.01	1.54	1.15	0.92	1.42
Missing	2.18	1.21	3.93	1.48	0.77	2.87	1.49	0.77	2.88
TOWNSEND INDEX <i>LOWEST DEPRIVATION</i>	1						1		
Low deprivation	1.23	1.00	1.52				1.06	0.85	1.33
Middle deprivation	1.55	1.26	1.89				1.16	0.93	1.45
High deprivation	2.05	1.67	2.52				1.42	1.12	1.79
Highest deprivation	2.41	1.96	2.97				1.32	1.03	1.70
SOCIAL COHESION <i>LOW SOCIAL COHESION</i>	1						1		
Medium social cohesion	0.94	0.80	1.10				1.02	0.85	1.21
High social cohesion	0.66	0.56	0.78				0.84	0.69	1.01
URBAN/RURAL <i>URBAN</i>	1						1		
Rural	1.01	0.83	1.24				1.03	0.82	1.29

Table 6.22 shows that female gender is significantly associated with CMD case status in all models at baseline. Age is associated, and increased age is protective of onset for the unadjusted odds ratio analysis in the 65-74 age group, and for the adjusted odds ratio analysis in the 55-64 and 65-74 age groups.

Social class in the unadjusted odds ratio analysis is significantly associated with case status for all categories. For the adjusted odds ratio analysis, only the IV & V category is significantly associated, the others are associated.

All categories of marital status are significantly associated with CMD case status in the unadjusted odds ratio analysis, and the divorced and separated category in the adjusted odds ratio analysis.

Being permanently sick and disabled is most significantly associated with case status in all models. All other categories in the unadjusted odds ratio analysis are also associated, and the retired category in the fully adjusted odds ratio analysis. Having a low income is significantly associated with CMD case status for both analyses.

The housing tenure category not owner is significantly associated with case status in the unadjusted odds ratio analysis, and the first adjusted odds ratio analysis, though with a lower OR. In the fully adjusted odds ratio analysis it is associated.

Having poor physical health is significantly associated with CMD case status at baseline.

All categories of deprivation are significantly associated with case status in the unadjusted odds ratio analysis, with higher OR in the two high categories. In the fully adjusted odds ratio analysis high and highest deprivation are significantly associated with case status.

Neither social cohesion nor urban/rural status is significantly associated with case status.

## 6.8 MODEL 2 ONSET OF COMMON MENTAL DISORDER CASE STATUS

This section presents descriptive statistics, and the univariable and multivariable associations between the onset of common mental disorder case status with baseline age group, gender and social class, the transition variables, and the baseline small area level variables.

### 6.8.1 Onset of CMD case status and descriptive data for study variables

Table 6.23 shows the number and percent of participants by CMD case status at baseline and follow-up. Of the 3137 NMH at baseline, 586 (18.7%) of these participants experienced the onset of CMD at follow-up.

Table 6.23 Transitions in Common mental disorder case status between baseline and follow-up

BASELINE CASE STATUS	FOLLOW-UP CASE STATUS (%)		TOTAL
	NMH-II	CASE	
NMH	2551 (81.3)	586 (18.7)	3137
CASE	536 (41.6)	753 (58.4)	1289
TOTAL	3087 (69.7)	1339 (30.3)	4426

Table 6.24 shows the description of the study variables for onset of CMD case status.

Table 6.24 Description of the study variables for onset of Common mental disorder case status

VARIABLES	CMD CASE STATUS		TOTAL
	NMH-II (%) N=2551	ONSET (%) N=586	
GENDER			
Male	1182 (83.2)	239 (16.8)	1421
Female	1369 (79.8)	347 (20.2)	1716
AGE GROUP			
18-24	119 (74.4)	41 (25.6)	160
25-34	328 (79.4)	85 (20.6)	413
35-44	468 (78.5)	128 (21.5)	596
45-54	631 (82.3)	136 (17.7)	767
55-64	570 (84.4)	105 (15.6)	675
65-74	435 (82.7)	91 (17.3)	526
REG. GEN. SOCIAL CLASS			
I&II	788 (85.8)	130 (14.2)	918
III NM	576 (84.8)	103 (15.2)	679
III M	506 (79.8)	128 (20.2)	634
IV&V	510 (75.9)	162 (24.1)	672
Other	71 (75.5)	23 (24.5)	94
Missing	100 (71.4)	40 (28.6)	140
MARITAL STATUS			
Remain mar/ptr	1892 (83.6)	372 (16.4)	2264
Sgl/div/sep/wid to mar/ptr	103 (79.2)	27 (20.8)	130
Remain wid	126 (81.3)	29 (18.7)	155
Mar/ptr to div/sep/sgl	56 (81.2)	13 (18.8)	69
Mar/ptr to wid	65 (67.0)	32 (33.0)	97
Remain sgl/div/sep	292 (72.8)	109 (27.2)	401



VARIABLES	CMD CASE STATUS		TOTAL
	NMH-II (%) N=2551	ONSET (%) N=586	
Missing	17 (81.0)	4 (19.0)	21
EMPLOYMENT STATUS			
Remain employed	1201 (84.9)	214 (15.1)	1415
Remain/become seeking work	26 (59.1)	18 (40.9)	44
Become econ inactive	344 (77.8)	98 (22.2)	442
Become employed	131 (75.3)	43 (24.7)	174
Remain econ inactive	740 (81.2)	171 (18.8)	911
Missing	109 (72.2)	42 (27.8)	151
SF-36 PCS			
Remain high PCS	1140 (87.4)	64 (12.6)	1304
High to low PCS	336 (76.4)	104 (23.6)	440
Low to high PCS	215 (84.6)	39 (15.4)	254
Remain low PCS	614 (77.3)	180 (22.7)	794
Missing	246 (71.3)	99 (28.7)	345
GROSS HOUSEHOLD INCOME			
Remain high income	1335 (86.7)	205 (13.3)	1540
High income to low income	205 (74.5)	70 (25.5)	275
Low income to high income	293 (81.6)	66 (18.4)	359
Remain low income	478 (72.0)	59 (19.7)	664
Missing	240 (80.3)	59 (19.7)	299
HOUSING TENURE			
Remain owner occ	2214 (83.6)	434 (16.4)	2648
Remain non-owner occ	169 (68.1)	79 (31.0)	248
Owner occ. to non-owner occ	68 (68.0)	32 (32.0)	100
Non-owner occ. to owner occ	73 (73.7)	26 (26.3)	99
Missing	27 (64.3)	15 (35.7)	42
TOWNSEND INDEX			
Lowest deprivation	741 (84.7)	134 (15.3)	875
Low deprivation	547 (83.4)	109 (16.6)	656
Middle deprivation	552 (82.8)	115 (17.2)	677
High deprivation	409 (81.2)	95 (18.8)	504
Highest deprivation	302 (69.4)	133 (30.6)	435
SOCIAL COHESION			
Low social cohesion	675 (78.9)	181 (21.1)	856
Medium social cohesion	902 (82.5)	191 (17.5)	1093
High social cohesion	974 (82.0)	214 (18.0)	1188
RURAL /URBAN			
Rural	296 (81.3)	68 (18.7)	364
Urban	2255 (81.3)	518 (18.7)	2773

In age group, as age increases the percentage of participants in onset decreases. For social class the percentage with onset increases as class becomes less advantageous. The transition married/partner to widow has the largest percentage in onset. Remain/become seeking work has a very high percentage for onset, more than double the size of the smallest category. Transitioning from high to low PCS, high to low income, and from owner occupier to non-owner occupier categories have the highest percentage in onset of case status. Highest deprivation has twice the percentage in onset compared to lowest deprivation. Generally, the least advantageous categories have the highest percentage of onset cases, with becoming a widow and remain/become seeking work and owner occupier to non-owner occupier the categories appearing to have the most detrimental effect on mental health status.

#### 6.8.2 Unadjusted and adjusted odds ratios for Onset of CMD Model 2

Table 6.25 shows the unadjusted and adjusted odds ratios for onset of a case of CMD.

Table 6.25 MODEL 2: Onset of CMD Unadjusted and Adjusted Odds ratios

TRANSITIONS VARIABLES & REFERENCE CATEGORY <i>FIRST ITEM</i>	MODEL 2 CMD ONSET								
	UNADJUSTED			ADJUSTED FOR INDIVIDUAL VARIABLES			ADJUSTED FOR IND. & SMALL AREA VARIABLES		
	OR	95% CI FOR OR		OR	95% CI FOR OR		OR	95% CI FOR OR	
		LWR	UPR		LWR	UPR		LWR	UPR
GENDER									
MALE	1			1			1		
Female	1.25	1.05	1.50	1.20	0.97	1.48	1.20	0.97	1.48
AGE GROUP									
45-54	1			1			1		
18-24	1.60	1.07	2.39	2.12	1.31	3.44	2.06	1.27	3.34
25-34	1.20	0.89	1.63	1.79	1.27	2.53	1.81	1.28	2.56
35-44	1.27	0.97	1.66	1.64	1.22	2.21	1.65	1.22	2.22
55-64	0.86	0.65	1.13	0.52	0.38	0.72	0.52	0.38	0.72
65-74	0.97	0.73	1.30	0.44	0.30	0.65	0.45	0.31	0.67
REG. GEN. SOCIAL CLASS									

TRANSITIONS VARIABLES & REFERENCE CATEGORY <i>FIRST ITEM</i>	MODEL 2 CMD ONSET								
	UNADJUSTED			ADJUSTED FOR INDIVIDUAL VARIABLES			ADJUSTED FOR IND. & SMALL AREA VARIABLES		
	OR	95% CI FOR OR		OR	95% CI FOR OR		OR	95% CI FOR OR	
		LWR	UPR		LWR	UPR		LWR	UPR
<i>I&amp;II</i>	1			1			1		
III NM	1.08	0.82	1.43	0.87	0.64	1.16	0.88	0.65	1.19
III M	1.53	1.17	2.01	1.25	0.93	1.68	1.24	0.92	1.67
IV&V	1.93	1.49	2.49	1.24	0.93	1.65	1.22	0.91	1.63
Other	1.96	1.18	3.26	0.70	0.39	1.25	0.68	0.38	1.23
Missing	2.43	1.61	3.66	1.54	0.96	2.46	1.43	0.89	2.30
MARITAL STATUS									
<i>REMAIN MAR/PTR</i>	1			1			1		
Sgl/div/sep/wid to mar/ptr	1.33	0.86	2.07	0.95	0.58	1.57	0.95	0.57	1.57
Remain wid	1.17	0.77	1.78	0.90	0.56	1.45	0.92	0.57	1.48
Mar/ptr to div/sep/sgl	1.18	0.64	2.18	0.91	0.47	1.77	0.91	0.47	1.77
Mar/ptr to wid	2.50	1.62	3.88	2.31	1.44	3.71	2.31	1.43	3.74
Remain sgl/div/sep	1.90	1.48	2.43	1.26	0.94	1.67	1.27	0.95	1.69
Missing	1.20	0.40	3.58	0.67	0.21	2.14	0.67	0.21	2.16
EMPLOYMENT STATUS									
<i>REMAIN EMPLOYED</i>	1			1			1		
Remain/become seeking work	3.89	2.09	7.21	2.37	1.23	4.57	2.37	1.22	4.61
Become econ inactive	1.60	1.22	2.09	1.60	1.15	2.23	1.61	1.15	2.24
Become employed	1.84	1.27	2.68	1.22	0.81	1.85	1.23	0.81	1.87
Remain econ inactive	1.30	1.04	1.62	1.34	0.95	1.89	1.34	0.95	1.90
Missing	2.16	1.47	3.18	1.67	1.05	2.65	1.68	1.06	2.68
SF-36 PCS									
<i>REMAIN HIGH PCS</i>	1			1			1		
High to low PCS	2.15	1.64	2.83	2.35	1.74	3.16	2.33	1.73	3.15
Low to high PCS	1.26	0.86	1.84	1.20	0.81	1.78	1.17	0.79	1.75
Remain low PCS	2.04	1.61	2.57	2.52	1.91	3.33	2.48	1.87	3.27
Missing	2.80	2.10	3.72	3.05	2.16	4.31	2.93	2.07	4.16
GROSS HOUSEHOLD Income									
<i>REMAIN HIGH INCOME</i>	1			1			1		
High income to low income	2.22	1.63	3.03	1.76	1.24	2.50	1.75	1.23	2.48
Low income to high income	1.47	1.08	1.99	1.18	0.84	1.66	1.20	0.85	1.69
Remain low income	2.53	2.03	3.17	1.90	1.40	2.58	1.87	1.37	2.54
Missing	1.60	1.16	2.21	1.23	0.86	1.78	1.23	0.86	1.77
HOUSING TENURE									
<i>REM. OWNER OCC</i>	1			1			1		
Remain non-owner occ	2.39	1.79	3.18	1.18	0.84	1.66	1.06	0.74	1.50
Owner occ. to non-owner occ	2.40	1.56	3.70	1.68	1.05	2.68	1.63	1.01	2.63

TRANSITIONS VARIABLES & REFERENCE CATEGORY <i>FIRST ITEM</i>	MODEL 2 CMD ONSET								
	UNADJUSTED			ADJUSTED FOR INDIVIDUAL VARIABLES			ADJUSTED FOR IND. & SMALL AREA VARIABLES		
	OR	95% CI FOR OR		OR	95% CI FOR OR		OR	95% CI FOR OR	
		LWR	UPR		LWR	UPR		LWR	UPR
Non-owner occ. to owner occ Missing	1.82 2.83	1.15 1.50	2.88 5.37	1.17 2.21	0.71 1.08	1.94 4.52	1.05 2.25	0.63 1.09	1.74 4.63
TOWNSEND INDEX <i>LOWEST DEPRIVATION</i>	1						1		
Low deprivation	1.10	0.84	1.45				0.95	0.71	1.27
Middle deprivation	1.15	0.88	1.51				0.93	0.70	1.24
High deprivation	1.28	0.96	1.72				1.02	0.74	1.40
Highest deprivation	2.44	1.85	3.21				1.61	1.16	2.23
SOCIAL COHESION <i>LOW SOCIAL COHESION</i>	1						1		
Medium social cohesion	0.79	0.63	0.99				0.94	0.73	1.19
High social cohesion	0.82	0.66	1.02				1.13	0.88	1.45
URBAN/RURAL <i>URBAN</i>	1						1		
Rural	1.0	0.76	1.32				0.90	0.66	1.22

Table 6.25 shows that gender is associated with the risk of onset of CMD for the unadjusted odds ratio analysis, but ceases to be when the odds ratios are adjusted. The OR for females > 1 and is almost significant in the adjusted case.

Age is important because in all age groups the ORs are statistically significantly different from the reference group, 45-54. The OR decreases monotonically so that in younger age groups onset is more likely while in older ones it is less likely.

Social class in the unadjusted odds ratio analysis is associated with the risk of onset of CMD with the risk increasing as social class becomes less advantageous. The adjusted odds ratio results are not significant so the effect of social class is accounted for by other variables.

Becoming widowed is strongly associated with onset, with a significant OR of 2.31. Adjustment has led to other factors not being significant. Remaining

or becoming seeking work and becoming economically inactive are associated with an increased risk of onset; the former has a particularly high OR.

Having a low income at follow up, whether or not this was the state at baseline, is associated with an increased risk of onset in the adjusted model. All transitions other than remaining an owner-occupier have ORs significantly greater than 1 in an unadjusted analysis; in the fully adjusted model only becoming a non-owner-occupier has an increased risk of onset.

Having poor physical health at follow-up has an OR significantly greater than 1, whatever the baseline physical health. Only highest deprivation is associated with the risk of onset; the risk is significantly higher in the most deprived areas even when adjusted for individual socio-economic factors. Neither social cohesion nor urban/rural status is significantly associated with onset.

## 6.9 MODEL 3 RECOVERY FROM BEING A CASE OF COMMON MENTAL DISORDER

In this model an OR >1 suggests that recovery is more likely as it is above the reference category. This section presents a description of the study variables by recovery from CMD status, followed by the univariable and multivariable associations between the recovery from common mental disorder case status and remaining a case at follow-up, with baseline age group, gender and social class, the transition variables, and the baseline small area level variables.

There were 1289 cases at baseline and 536 (41.6%), of the participants who were cases experienced recovery from CMD.

### 6.9.1 Recovery from CMD case status and descriptive data for study variables

Table 6.26 shows the description of the study variables by recovery status from being a case of Common mental disorder.

Table 6.26 Description of the study variables by recovery status from being a case of Common mental disorder

VARIABLES	CMD CASE STATUS		TOTAL
	MAINTAIN (%) N=753	RECOVERY (%) N=586	
GENDER			
Male	266 (56.4)	206 (43.6)	472
Female	487 (59.6)	330 (40.4)	1716
AGE GROUP			
18-24	40 (53.3)	35 (46.7)	75
25-34	90 (55.6)	72 (44.4)	162
35-44	164 (63.3)	95 (36.7)	259
45-54	201 (63.2)	117 (36.8)	318
55-64	177 (56.4)	137 (43.6)	314
65-74	81 (50.3)	80 (49.7)	161
REG. GEN. SOCIAL CLASS			
I&II	123 (54.7)	102 (45.3)	225
III NM	134 (53.4)	117 (46.6)	251
III M	136 (57.4)	101 (42.6)	237
IV&V	244 (63.9)	138 (36.1)	382
Other	71 (65.7)	37 (34.3)	108
Missing	45 (52.3)	41 (47.7)	86
MARITAL STATUS			
Remain mar/ptr	448 (56.6)	343 (43.4)	791
Sgl/div/sep/wid to mar/ptr	27 (47.4)	30 (52.6)	57
Remain wid	43 (48.9)	45 (51.1)	88
Mar/ptr to div/sep/sgl	49 (79.0)	13 (21.0)	62
Mar/ptr to wid	24 (66.7)	12 (33.3)	36
Remain sgl/div/sep	151 (63.2)	88 (36.8)	239
Missing	11 (68.8)	5 (31.2)	16
EMPLOYMENT STATUS			
Remain employed	164 (47.3)	183 (52.7)	347
Remain/become seeking work	22 (73.9)	8 (26.7)	30
Become econ inactive	95 (63.8)	54 (36.2)	149
Become employed	39 (41.9)	54 (58.1)	93
Remain econ inactive	356 (63.7)	203 (36.3)	559
Missing	77 (69.4)	34 (30.6)	111
SF-36 PCS			
Remain high PCS	139 (48.1)	150 (51.9)	289
High to low PCS	74 (52.1)	68 (47.9)	142
Low to high PCS	51 (44.0)	65 (56.0)	116
Remain low PCS	340 (65.5)	179 (34.5)	519
Missing	149 (66.8)	74 (33.2)	223
GROSS HOUSEHOLD INCOME			
Remain high income	161 (46.1)	188 (53.9)	349
High income to low income	80 (69.0)	36 (31.0)	116
Low income to high income	88 (47.3)	98 (52.7)	186

VARIABLES	CMD CASE STATUS		TOTAL
	MAINTAIN (%) N=753	RECOVERY (%) N=586	
Remain low income	351 (67.0)	173 (33.0)	524
Missing	73 (64.0)	41 (36.0)	114
HOUSING TENURE			
Remain owner occ	481 (54.3)	405 (45.7)	886
Remain non-owner occ	172 (72.9)	64 (27.1)	236
Owner occ. to non-owner occ	56 (71.8)	22 (28.2)	78
Non-owner occ. to owner occ	26 (43.3)	34 (56.7)	60
Missing	18 (62.1)	11 (37.9)	29
TOWNSEND INDEX			
Lowest deprivation	110 (46.8)	125 (53.2)	235
Low deprivation	118 (54.4)	99 (45.6)	217
Middle deprivation	167 (60.3)	110 (39.7)	277
High deprivation	164 (59.0)	114 (41.0)	278
Highest deprivation	194 (68.8)	88 (31.2)	282
SOCIAL COHESION			
Low social cohesion	279 (67.4)	135 (32.6)	414
Medium social cohesion	280 (56.6)	215 (43.4)	495
High social cohesion	194 (51.1)	186 (48.9)	380
RURAL/URBAN			
Rural	93 (61.6)	58 (38.4)	151
Urban	660 (58.0)	478 (42.0)	1138

The 65-74 age group has the largest percentage in recovery, the older and younger age groups have the highest percentage in recovery and is lowest in the two mid-range age groups. The following transitions have the highest percentage in recovery: single/divorced/separated/widow to married/partner, become employed, low to high PCS, low to high income, non-owner occupier to owner occupier, and the highest for area factors are lowest deprivation and high social cohesion. This suggests that the transitions from the least advantageous category status to the most advantageous, and to a more positive scenario such as widow to married/partner or low to high social cohesion increase the prospect of recovery.

### 6.9.2 Unadjusted and adjusted odds ratios for Recovery from CMD Model 3

In this model it is the prospect of recovery that is analysed, therefore ORs greater than one mean that the chance of recovery is higher than for the reference category. Conversely, an OR of less than one indicates a decreased chance of recovery.

Table 6.27 shows the unadjusted and adjusted odds ratios for recovery from being a case of CMD.

Table 6.27 Model 3: Recovery from being a case of CMD Unadjusted and Adjusted Odds ratios

TRANSITIONS VARIABLES & REFERENCE CATEGORY FIRST ITEM	MODEL 3 CMD (ALL) RECOVERY								
	UNADJUSTED			ADJUSTED FOR INDIVIDUAL VARIABLES			ADJUSTED FOR IND. & SMALL AREA VARIABLES		
	OR	95% CI FOR OR		OR	95% CI FOR OR		OR	95% CI FOR OR	
		LWR	UPR		LWR	UPR		LWR	UPR
GENDER									
MALE	1			1			1		
Female	0.87	0.70	1.10	0.79	0.60	1.05	0.78	0.59	1.03
AGE GROUP									
45-54	1			1			1		
18-24	1.50	0.90	2.50	0.73	0.39	1.38	0.71	0.38	1.35
25-34	1.37	0.93	2.02	0.73	0.46	1.16	0.70	0.44	1.12
35-44	0.99	0.71	1.40	0.62	0.42	0.91	0.61	0.41	0.92
55-64	1.33	0.97	1.83	2.09	1.44	3.04	2.07	1.41	3.02
65-74	1.70	1.16	2.49	2.94	1.84	4.69	2.76	1.72	4.44
REG. GEN. SOCIAL CLASS									
I&II	1			1			1		
III NM	1.05	0.73	1.51	1.21	0.82	1.80	1.23	0.83	1.84
III M	0.90	0.62	1.29	1.15	0.75	1.74	1.15	0.75	1.75
IV&V	0.68	0.49	0.95	1.05	0.72	1.54	1.09	0.74	1.61
Other	0.63	0.39	1.01	1.38	0.78	2.44	1.42	0.79	2.53
Missing	1.10	0.67	1.81	1.69	0.93	3.07	1.71	0.93	3.13



TRANSITIONS VARIABLES & REFERENCE CATEGORY FIRST ITEM	MODEL 3 CMD (ALL) RECOVERY								
	UNADJUSTED			ADJUSTED FOR INDIVIDUAL VARIABLES			ADJUSTED FOR IND. & SMALL AREA VARIABLES		
	OR	95% CI FOR OR		OR	95% CI FOR OR		OR	95% CI FOR OR	
		LWR	UPR		LWR	UPR		LWR	UPR
MARITAL STATUS									
REMAIN MAR/PTR	1			1			1		
Sgl/div/sep/wid to mar/ptr	1.45	0.85	2.49	1.58	0.85	2.94	1.53	0.82	2.90
Remain wid	1.37	0.88	2.12	1.43	0.87	2.35	1.45	0.87	2.40
Mar/ptr to div/sep/sgl	0.35	0.18	0.65	0.45	0.23	0.89	0.42	0.21	0.84
Mar/ptr to wid	0.65	0.32	1.32	0.78	0.37	1.66	0.84	0.39	1.80
Remain sgl/div/sep	0.76	0.56	1.03	1.03	0.72	1.47	1.05	0.73	1.49
Missing	0.59	0.20	1.72	0.73	0.23	2.35	0.76	0.23	2.49
EMPLOYMENT STATUS									
REMAIN EMPLOYED	1			1			1		
Remain/become seeking work	0.33	0.14	0.75	0.44	0.18	1.08	0.44	0.17	1.10
Become econ inactive	0.51	0.34	0.76	0.54	0.34	0.86	0.57	0.36	0.91
Become employed	1.24	0.78	1.97	1.41	0.83	2.42	1.43	0.83	2.45
Remain econ inactive	0.51	0.39	0.67	0.49	0.32	0.74	0.50	0.33	0.75
Missing	0.40	0.25	0.62	0.36	0.21	0.63	0.37	0.21	0.65
SF-36 PCS									
REMAIN HIGH PCS	1			1			1		
High to low PCS	0.85	0.57	1.27	0.77	0.49	1.21	0.76	0.48	1.19
Low to high PCS	1.18	0.77	1.82	1.12	0.69	1.79	1.12	0.69	1.81
Remain low PCS	0.49	0.36	0.65	0.50	0.34	0.74	0.49	0.33	0.72
Missing	0.46	0.32	0.66	0.48	0.31	0.76	0.48	0.30	0.76
GROSS HOUSEHOLD INCOME									
REMAIN HIGH INCOME	1			1			1		
High income to low income	0.38	0.25	0.60	0.47	0.28	0.77	0.45	0.27	0.75
Low income to high income	0.95	0.67	1.36	0.91	0.60	1.38	0.92	0.60	1.40
Remain low income	0.42	0.32	0.56	0.53	0.36	0.79	0.54	0.36	0.79
Missing	0.48	0.31	0.74	0.50	0.30	0.84	0.51	0.30	0.85
HOUSING TENURE									
REMAIN OWNER OCC	1			1			1		
Remain non-owner occ	0.44	0.32	0.61	0.73	0.50	1.06	0.84	0.57	1.24
Owner occ. to non-owner occ	0.47	0.28	0.78	0.63	0.36	1.10	0.64	0.36	1.14
Non-owner occ. to owner occ	1.55	0.92	2.63	1.43	0.78	2.64	1.54	0.83	2.86
Missing	0.73	0.34	1.55	0.63	0.26	1.55	0.66	0.27	1.63
TOWNSEND INDEX									
LOWEST DEPRIVATION	1						1		
Low deprivation	0.74	0.51	1.07				0.80	0.54	1.19
Middle deprivation	0.58	0.41	0.82				0.65	0.44	0.96
High deprivation	0.61	0.43	0.87				0.80	0.54	1.18

TRANSITIONS VARIABLES & REFERENCE CATEGORY FIRST ITEM	MODEL 3 CMD (ALL) RECOVERY								
	UNADJUSTED			ADJUSTED FOR INDIVIDUAL VARIABLES			ADJUSTED FOR IND. & SMALL AREA VARIABLES		
	OR	95% CI FOR OR		OR	95% CI FOR OR		OR	95% CI FOR OR	
		LWR	UPR		LWR	UPR		LWR	UPR
Highest deprivation	0.40	0.28	0.57				0.70	0.46	1.07
SOCIAL COHESION									
Low social cohesion	1						1		
Medium social cohesion	1.59	1.21	2.08				1.50	1.11	2.03
High social cohesion	1.98	1.49	2.64				1.81	1.30	2.52
URBAN/RURAL									
Urban	1						1		
Rural	0.86	0.61	1.22				0.79	0.53	1.18

Table 6.27 shows that gender is not significantly associated with recovery.

Age is significantly associated with recovery in the unadjusted odds ratio analysis for the 65-74 age group, and the 55-64 and 65-74 age groups in the adjusted odds ratio analysis. The OR <1 for the age group 35-44 in the adjusted odds ratio analysis appears not to be associated with recovery. Social class is not significantly associated with recovery.

The transition married/partner to divorced/separated/single has a decreased chance of recovery, and the other marital status transitions are not significantly associated with recovery. Marital status appears not to increase the chance of recovery and can decrease it.

Employment status transitions are significantly associated with recovery, and become economically inactive and remain economically inactive appear to have the lowest chance of recovery in both analyses. Gross household income transitions are significantly associated with recovery and the high to low income category has the lowest chance of recovery. A low income has the lowest chance of recovery in all analyses. Transitions in housing tenure are not significantly

associated with recovery in the adjusted ORs but are in the unadjusted where they decrease the chance of recovery.

Poor physical health decreases the chance of recovery in all analyses for remain low PCS, but the other transitions in SF-36 PCS are not significantly associated with recovery.

Deprivation is significantly associated with recovery by decreasing the chance of recovery in the middle deprivation category in both models. Social cohesion is significantly associated with recovery and the OR increases as the level of social cohesion increases. Urban/rural status is not significantly associated with recovery.

#### 6.10 ANALYSIS OF ONSET OF COMMON MENTAL DISORDER-NOT SEVERE AND COMMON MENTAL DISORDER-SEVERE MODELS 4 AND 5

This section presents the description of the study variables by onset of CMD-NS and CMD-S. Of the 3137 NMH at baseline, 363 (11.6%) participants experienced the onset of CMD-NS, and 223 (7.1%) CMD-S. The total number of participants in this analysis is 2914 for CMD-NS and 2774 for CMD-S.

Table 6.28 shows the description of the sample by study variables with onset of CMD-NS and CMD-S case status.

Table 6.28 Description of the sample by study variables with Onset of Common mental disorder-NS and Common mental disorder-S case status

VARIABLES	CMD CASE STATUS				TOTAL NS	TOTAL S
	NMH-II (%)		CMD-NS (%) N=363	CMD-S (%) N=223		
	NS - N=2551	S - N=2774				
GENDER						
Male	1182 (88.8)	1182 (92.9)	149 (11.2)	90 (7.1)	1272	1331
Female	1369 (86.5)	1369 (91.1)	214 (13.5)	133 (8.9)	1502	1583
AGE GROUP						
18-24	119 (80.4)	119 (90.8)	29 (19.6)	12 (9.2)	131	148
25-34	328 (91.4)	328 (91.4)	54 (14.1)	31 (8.6)	359	382

VARIABLES	CMD CASE STATUS				TOTAL NS	TOTAL S
	NMH-II (%)		CMD-NS (%) N=363	CMD-S (%) N=223		
	NS - N=2551	S - N=2774				
35-44	468 (89.7)	468 (89.7)	74 (13.7)	54 (10.3)	522	542
45-54	631 (91.4)	631 (91.4)	77 (10.9)	59 (8.6)	690	708
55-64	570 (93.8)	570 (93.8)	67 (10.5)	38 (6.2)	608	637
65-74	435 (93.8)	435 (93.8)	62 (12.5)	29 (6.2)	464	497
REG. GEN. SOCIAL CLASS						
I&II	788 (93.8)	788 (93.8)	78 (9.0)	52 (6.2)	840	866
III NM	576 (93.8)	576 (93.8)	65 (10.1)	38 (6.2)	614	641
III M	506 (91.3)	506 (91.3)	80 (13.7)	48 (8.7)	554	586
IV&V	510 (89.9)	510 (89.9)	105 (17.1)	57 (10.1)	567	615
Other	71 (87.7)	71 (87.7)	13 (15.5)	10 (12.3)	81	84
Missing	100 (84.7)	100 (84.7)	22 (18.0)	18 (15.3)	118	122
MARITAL STATUS						
Remain mar/ptr	1892 (93.1)	1892 (93.1)	232 (10.9)	140 (6.9)	2032	2124
Sgl/div/sep/wid to mar/ptr	103 (91.2)	103 (91.2)	17 (14.2)	10 (8.8)	113	120
Remain wid	126 (92.0)	126 (92.0)	18 (12.5)	11 (8.0)	137	144
Mar/ptr to div/sep/sgl	56 (94.9)	56 (94.9)	10 (15.2)	3 (5.1)	59	66
Mar/ptr to wid	65 (82.3)	65 (82.3)	18 (21.7)	14 (17.7)	79	83
Remain sgl/div/sep	292 (87.2)	292 (87.2)	66 (18.4)	43 (12.8)	335	358
Missing	17 (89.5)	17 (89.5)	2 (10.5)	2 (10.5)	19	19
EMPLOYMENT STATUS						
Remain employed	1201 (94.0)	1201 (94.0)	138 (10.3)	76 (6.0)	1277	1339
Remain/become seeking work	26 (74.3)	26 (74.3)	9 (25.7)	9 (25.7)	35	35
Become econ inactive	344 (87.5)	344 (87.5)	49 (12.5)	49 (12.5)	393	393
Become employed	131 (89.1)	131 (89.1)	27 (17.1)	16 (10.9)	147	158
Remain econ inactive	740 (93.2)	740 (93.2)	117 (13.7)	54 (6.8)	794	857
Missing	109 (85.2)	109 (85.2)	23 (17.4)	19 (14.8)	128	132
SF-36 PCS						
Remain high PCS	1140 (95.4)	1140 (95.4)	109 (8.7)	55 (4.6)	1195	1249
High to low PCS	336 (87.5)	336 (87.5)	56 (14.3)	48 (12.5)	384	392
Low to high PCS	215 (96.4)	215 (96.4)	31 (12.6)	8 (3.6)	223	246
Remain low PCS	614 (89.1)	614 (89.1)	105 (14.6)	75 (10.9)	689	719
Missing	246 (86.9)	246 (86.9)	62 (20.1)	37 (13.1)	283	308
GROSS HOUSEHOLD INCOME						
Remain high income	1335 (94.7)	1335 (94.7)	131 (8.9)	74 (5.3)	1409	1466
High income to low income	205 (86.5)	205 (86.5)	38 (15.6)	32 (13.5)	237	243
Low income to high income	293 (92.4)	293 (92.4)	42 (12.5)	24 (7.6)	317	335
Remain low income	478 (87.9)	478 (87.9)	120 (20.1)	66 (12.1)	544	598
Missing	240 (89.9)	240 (89.9)	32 (11.8)	27 (10.1)	267	272
HOUSING TENURE						
Remain owner occ	2214 (93.2)	2214 (93.2)	273 (11.0)	161 (6.8)	2375	2487
Remain non-owner occ	169 (85.8)	169 (85.8)	51 (23.2)	28 (14.2)	197	220
Owner occ. to non-owner occ	68 (80.0)	68 (80.0)	15 (18.1)	17 (20.0)	85	83

VARIABLES	CMD CASE STATUS				TOTAL NS	TOTAL S
	NMH-II (%)		CMD-NS (%) N=363	CMD-S (%) N=223		
	NS - N=2551	S - N=2774				
Non-owner occ. to owner occ	73 (88.0)	73 (88.0)	16 (18.0)	10 (12.0)	83	89
Missing	27 (79.4)	27 (79.4)	8 (22.9)	7 (20.6)	34	35
<i>TOWNSEND INDEX</i>						
Lowest deprivation	741 (93.8)	741 (93.8)	85 (10.3)	49 (6.2)	790	826
Low deprivation	547 (93.5)	547 (93.5)	71 (11.5)	38 (6.5)	585	618
Middle deprivation	552 (92.2)	552 (92.2)	68 (11.0)	47 (7.8)	599	620
High deprivation	409 (92.3)	409 (92.3)	61 (13.0)	34 (7.7)	443	470
Highest deprivation	302 (84.6)	302 (84.6)	78 (20.5)	55 (15.4)	357	380
<i>SOCIAL COHESION</i>						
Low social cohesion	675 (90.2)	675 (90.2)	108 (13.8)	73 (9.8)	748	783
Medium social cohesion	902 (92.7)	902 (92.7)	120 (11.7)	71 (7.3)	973	1022
High social cohesion	974 (92.5)	974 (92.5)	135 (12.2)	79 (7.5)	1053	1109
<i>URBAN/RURAL</i>						
Urban	2255 (92.1)	2255 (92.1)	39 (11.6)	194 (11.6)	2449	335
Rural	296 (91.1)	296 (91.1)	324 (12.6)	29 (8.9)	325	2579

The percentage of those with onset of CMD-NS is highest in the 18-24 age group and more than double the percentage of CMD-S. The percentage decreases as age increases for both classifications, until the 65-74 age group for CMD-NS where a marginal increase is shown.

The Registrar General Social class categories show the percentage of onset cases for both classifications overall, increases as social class becomes less advantageous. There are 7% more cases in the IV and V category for CMD-NS.

The married/partner to widow category has the highest percentage for both classifications. The CMD-NS married/partner to divorce/separated/single category is almost three times the size of the same transition in CMD-S.

The percentage of cases for the transition remain/become seeking work is the same and the largest for both. The transition become economically inactive is also the same. Become employed has the second highest percentage of cases in CMD-NS which is two-thirds larger than for CMD-S. The transition remain economically inactive is twice the size in CMD-NS.

The transition high to low PCS has the highest percentage of cases for CMD-S and is the second highest for CMD-NS, with remain low PCS slightly higher. There are nearly four times as many cases in CMD-NS for low to high PCS, than in CMD-S.

Remain low income has the highest percentage of cases in CMD-NS, which is 8% higher than CMD-S.

The percentage of cases for the transitions owner occupier to non-owner occupier and non-owner occupier to owner occupier are the same for CMD-NS, but for CMD-S the percentage of cases is 8% higher for owner occupier to non-owner occupier.

As deprivation increases the percentage of cases also increases. Highest deprivation has the largest percentage for both classifications, and by a considerable margin from high deprivation. Low social cohesion has the highest percentage of cases in CMD-NS and CMD-S.

#### 6.11. ANALYSIS OF MODELS 4 AND 5: ONSET OF CASE OF COMMON MENTAL DISORDER (NOT SEVERE) AND COMMON MENTAL DISORDER – SEVERE

In this section, the multivariable fully adjusted odds ratio results are presented for Models 4 and 5 comprising, baseline age group, gender and social class, all the individual and household transition variables, and area-level variables.

The fully adjusted odds ratio results at follow up for Models 4 and 5, the onset of CMD-NS and CMD-S, are shown in table 6.29.

Table 6.29 MODELS 4 AND 5: Fully adjusted odds ratio results for Onset of Common mental disorder (NOT SEVERE) AND Common mental disorder – Severe

TRANSITIONS VARIABLES & REFERENCE CATEGORY <i>FIRST ITEM</i>	CMD (NS)			CMD-S		
	ODDS R.	95% CI FOR OR		ODDS R.	95% CI FOR OR	
		LWR	UPR		LWR	UPR

TRANSITIONS VARIABLES & REFERENCE CATEGORY <i>FIRST ITEM</i>	CMD (NS)			CMD-S		
	ODDS R.	95% CI FOR OR		ODDS R.	95% CI FOR OR	
		LWR	UPR		LWR	UPR
GENDER						
MALE	1			1		
Female	1.18	0.92	1.53	1.18	0.86	1.63
AGE GROUP						
45-54	1			1		
18-24	2.43	1.39	4.25	1.45	0.66	3.18
25-34	1.87	1.24	2.84	1.82	1.07	3.08
35-44	1.61	1.11	2.32	1.70	1.10	2.62
55-64	0.61	0.41	0.91	0.39	0.24	0.64
65-74	0.55	0.35	0.88	0.31	0.17	0.57
REG. GEN. SOCIAL CLASS						
I&II	1			1		
III NM	0.93	0.65	1.34	0.76	0.48	1.21
III M	1.36	0.95	1.94	1.05	0.66	1.65
IV&V	1.37	0.96	1.93	0.96	0.61	1.49
Other	0.62	0.30	1.28	0.67	0.29	1.56
Missing	1.32	0.73	2.37	1.52	0.77	3.01
MARITAL STATUS						
REMAIN MAR/PTR	1			1		
Sgl/div/sep/wid to mar/ptr	0.89	0.49	1.62	0.99	0.47	2.12
Remain wid	0.87	0.49	1.53	1.08	0.52	2.24
Mar/ptr to div/sep/sgl	1.19	0.57	2.47	0.52	0.14	1.85
Mar/ptr to wid	1.96	1.10	3.51	3.13	1.59	6.14
Remain sgl/div/sep	1.23	0.87	1.73	1.39	0.91	2.12
Missing	0.54	0.12	2.52	0.88	0.18	4.31
EMPLOYMENT STATUS						
REMAIN EMPLOYED	1			1		
Remain/become seeking work	1.79	0.79	4.08	3.12	1.28	7.60
Become econ inactive	1.32	0.87	2.01	2.27	1.41	3.65
Become employed	1.22	0.74	2.01	1.31	0.69	2.46
Remain econ inactive	1.43	0.95	2.16	1.24	0.73	2.12
Missing	1.48	0.83	2.62	2.15	1.11	4.18
SF-36 PCS						
REMAIN HIGH PCS	1			1		
High to low PCS	1.94	1.34	2.8	3.04	1.96	4.73
Low to high PCS	1.40	0.90	2.18	0.75	0.34	1.64
Remain low PCS	2.05	1.46	2.87	3.25	2.13	4.97
Missing	2.76	1.82	4.19	3.17	1.86	5.40
GROSS HOUSEHOLD INCOME						
REMAIN HIGH INCOME	1			1		
High income to low income	1.64	1.06	2.52	2.02	1.21	3.35
Low income to high income	1.13	0.75	1.71	1.33	0.78	2.28
Remain low income	1.84	1.27	2.66	2.00	1.24	3.23

TRANSITIONS VARIABLES & REFERENCE CATEGORY <i>FIRST ITEM</i>	CMD (NS)			CMD-S		
	ODDS R.	95% CI FOR OR		ODDS R.	95% CI FOR OR	
		LWR	UPR		LWR	UPR
Missing	1.08	0.68	1.71	1.64	0.96	2.80
HOUSING TENURE						
REMAIN OWNER OCC	1			1		
Remain non-owner occ	1.13	0.76	1.70	0.93	0.54	1.60
Owner occ. to non-owner occ	1.22	0.66	2.26	2.64	1.41	4.97
Non-owner occ. to owner occ	1.03	0.56	1.89	1.07	0.51	2.29
Missing	2.14	0.88	5.19	2.47	0.93	6.57
TOWNSEND INDEX						
<i>LOWEST DEPRIVATION</i>	1			1		
Low deprivation	1.00	0.71	1.41	0.88	0.56	1.39
Middle deprivation	0.89	0.63	1.27	1.00	0.64	1.55
High deprivation	1.08	0.73	1.57	0.95	0.58	1.57
Highest deprivation	1.55	1.05	2.29	1.71	1.04	2.79
SOCIAL COHESION						
<i>LOW SOCIAL COHESION</i>	1			1		
Medium social cohesion	0.96	0.72	1.29	0.87	0.60	1.26
High social cohesion	1.16	0.85	1.57	1.02	0.70	1.50
URBAN/RURAL						
<i>URBAN</i>	1			1		
Rural	0.82	0.56	1.19	0.98	0.63	1.53

Table 6.29 shows that the age group 18-24 is significantly associated with the onset of CMD-NS but not CMD-S. The age group categories 25-34 and 35-44 are significantly associated with onset for both classifications with the risk of onset decreasing as age increases, the ORs are quite close indicating a similarly reducing risk of onset for both classifications. The age groups 55-64 and 65-74 have OR's significantly <1 and is lower for CMD-S which suggests increased age is protective against the onset of both CMD-NS and CMD-S, but less so for the latter.

Social class is not significantly associated with onset of either classification.

Becoming a widow is strongly associated with onset for either classification. The OR of 3.13 for CMD-S is high suggesting that becoming a widow is associated with a higher risk for onset of CMD-S.



The employment status transitions remain/become seeking work and become economically inactive are strongly associated with onset of CMD-S, with significant ORs of 3.12 and 2.27 respectively. These were the only transitions significantly associated with onset, and of CMD-S only, suggesting the other transitions present a much lower risk of onset, and of a probable lower severity of classification.

Low income is significantly associated with onset of both classifications with a slightly higher risk of onset of CMD-S. The highest OR of 2.02 is for the transition high income to low income and onset of CMD-S which suggests the adverse effects on an individual are significant, and present a greater risk of the onset of a higher severity of CMD.

Becoming a non-owner occupier is strongly associated with onset of CMD-S and has a significant OR of 2.64. It appears that this transition presents a higher risk of onset of case status of the more severe classification.

Poor physical health is significantly associated with onset of both classifications, though there are significant ORs of 3.04 and 3.25 for high to low PCS and remain low PCS respectively for CMD-S. This suggests that prolonged poor physical health is associated with a higher risk of onset of the higher severity CMD-S.

Only highest deprivation is associated with risk of onset, and for both classifications. The ORs of 1.55 and 1.71 suggest that the risk is similar. Neither social cohesion nor urban/rural status is significantly associated with onset.

## 6.12 DISCUSSION OF THE RESULTS OF THE FIVE MODELS

The models 1 to 5 have been commented on in detail in this chapter. In this section the main findings of interest for case status are discussed.

In model 1, age is associated with baseline case status, and older age appears to be protective of risk of case status. Social class ceases to be

significantly associated, with the exception of IV and V, after adjustment for additional variables suggesting that the effect of social class is accounted for by other variables. The only category of marital status to be significantly associated with case status after adjustment is divorced and separated suggesting that this is a particularly adverse state for individuals. Being permanently sick and disabled is very strongly associated with the highest risk of all the variable categories, suggesting, not unexpectedly, that it is a high risk for case status.

The results for models 2 – 5 are presented together as a comparison of the statistically significant ORs for the risks of onset, and prospect of recovery.

Gender is only significant for the unadjusted OR in model 2.

Age is significantly associated with onset for the age group 18-24 (unadjusted), and 55-64, 65-74 is significant as it decreases the risk of onset in model 2. In model 3 the age group 65-74 (unadjusted) age groups 55-64 and 65-74 (adjusted) are significantly associated and increase the chance of recovery, but age group 35-44 decreases the prospect (adjusted). In model 4 age groups 18-24, 25-34, 35-44 are significant to onset and 55-64 and 65-74 appear to decrease the risk. In model 5, 25-34 and 35-44 age groups are significantly associated with the risk of onset, and 55-64 and 65-74 appear to decrease the risk. It can be seen that age is significant and with increased age the risk of onset decreases, and prospect of recovery increases.

Social class is significant for all categories except IIIM (unadjusted) in model 2, and in model 3, IV and V (unadjusted) appears to decrease the chance of recovery. It is not significant in models 4 and 5.

In model 2, married/partner to widow and remain single/divorced/separated (unadjusted) and married/partner to widow (adjusted) are significantly associated risks for onset. For model 3, the transition married/partner to divorced/separated/single has a decreased chance of recovery in all models. In models 4 and 5, married/partner to widow is a risk and

is strongly associated with CMD-S. Becoming a widow appears to be most detrimental to an individual's mental health and a high risk for onset of CMD-S.

All of the employment transitions (unadjusted) are significant in model 2, and remain/become seeking work and become economically inactive are significant in the adjusted models. In model 3, remain/become seeking work and become economically inactive (unadjusted), and become economically inactive, remain economically inactive (adjusted) are significantly associated with reducing the chance of recovery. Model 5 has statistically significant ORs for remain/become seeking work and become economically inactive. Employment status is not significantly associated with onset of CMD-NS. The same transitions are significant repeatedly, and the detrimental effect is such that the risk of onset is for CMD-S, but not CMD-NS.

All the gross household transitions are significant in model 2 (unadjusted) and high to low income, and remain low income (adjusted). In model 3, high to low income, and remain low income (adjusted/unadjusted) significantly decrease the prospect of recovery. High to low income and remain low income are significant for both model 4 and 5.

The housing tenure transitions remain non- owner occupier, and owner occupier to non-owner occupier (unadjusted) and owner occupier to non-owner occupier (adjusted) are significantly associated with onset in model 2. In model 3, remain non- owner occupier and owner occupier to non-owner occupier (adjusted) are significant and decrease the chance of recovery. For model 5, owner occupier to non-owner occupier is significantly associated with the risk of onset of CMD-S, while housing tenure is not significant for CMD-NS.

The SF-36 PCS transitions high to low PCS and remain low PCS are significant (unadjusted/adjusted) in model 2. In model 3, remain low PCS is significant (unadjusted/adjusted) and decreases the chance of recovery. In models 4 and 5 high to low PCS and remain low PCS are strongly associated with onset.

Social deprivation, highest deprivation (unadjusted/adjusted) is significantly associated with onset in model 2. In model 3 all the categories except low deprivation (unadjusted) and middle deprivation (adjusted) decrease the prospect of recovery. Highest deprivation is significant in both model 4 and 5. The effect of social deprivation appears to be consistently significant at the highest level, and the chances of recovery decrease as deprivation increases.

In model 2, medium social cohesion (unadjusted) is significantly associated with risk of onset. For model 3, medium and high social cohesion (unadjusted/adjusted) are significant and decrease the chance of recovery. Social cohesion is not significant in model 4 or 5. Social cohesion appears to have no significance for the onset of CMD-NS or CMD-S, but is significant in reducing the prospects of recovery.

Urban/rural settlement type is not significant for any model.

A comparison of the results for models 4 and 5 reveals that the age group 18-24 has statistically significant odds for onset of CMD-NS but not for CMD-S, and the employment status remain/become seeking work, become economically inactive, and housing tenure, owner occupier to non-owner occupier, are significantly associated with the onset of CMD-S but not CMD-NS. Overall the odds ratios for onset of CMD-S are higher than the comparable odds ratios for CMD-NS, with the exception of age which appears to have greater significance for the onset of CMD-NS.

A table containing the most significant OR's for models 4 and 5 discussed is provided as a convenient summary.

Table 6.30 shows the variable categories significantly associated with the onset of CMD-NS and CMD-S. The results indicating a protective effect are shown in green.

Table 6.30 Statistically significant Odds ratios for Onset of CMD-NS and CMD-S

VARIABLES & TRANSITIONS & REF CATEGORY	CMD (NS)			CMD-S		
	ODDS RATIO	95% CI FOR OR		ODDS RATIO	95% CI FOR OR	
		LWR	UPR		LWR	UPR
AGE GROUP						
18-24	2.43	1.39	4.25			
25-34	1.87	1.24	2.84	1.82	1.07	1.82
35-44	1.61	1.11	2.32	1.70	1.10	1.70
55-64	0.61	0.41	0.91	0.39	0.24	0.39
65-74	0.55	0.35	0.88	0.31	0.17	0.31
MARITAL STATUS						
Married/Partner to Widow	1.96	1.10	3.51	3.13	1.59	6.14
EMPLOYMENT STATUS						
Remain/become seeking work				3.12	1.28	7.60
Become economically inactive				2.27	1.41	3.65
SF-36 PCS						
Low PCS	1.94	1.34	2.80	3.04	1.96	4.73
Remain low PCS	2.05	1.46	2.87	3.25	2.13	4.97
GROSS HOUSEHOLD INCOME						
High Income to low income	1.64	1.06	2.52	2.02	1.21	3.35
Remain Low Income	1.84	1.27	2.66	2.00	1.24	3.23
HOUSING TENURE						
Owner occupier to non-owner occupier				2.64	1.41	4.97
TOWNSEND INDEX						
Highest deprivation	1.55	1.05	2.29	1.71	1.04	2.79

### 6.13 STRENGTHS

The dataset is of a sufficient size to give reasonable precision for the analysis. The longitudinal nature of the CHSNS study allows analysis at two time points and the MHI-5 scores from both enables change in mental health status to be assessed. The data set contains rich data on a comprehensive scale.

The main strength of the survey dataset is the large number of variables and high sampling fraction for a small area making the data much more precise than in studies with large geographical areas with few participants.

It is a particular strength to show the associations between life transitions and onset of case status for two classifications, compared to the more usual single combined category. A better understanding of the mental health status

data collected in the survey was gained by the application of the cut-points determined in the CWB study. The ability to analyse mental health case status and change, for two classifications of severity of case status provided more insightful results.

#### 6.14 LIMITATIONS

A lower non-response bias percentage was incorrectly used in the survey, though even with a correct percentage the effect of response bias on the associations between changes in mental health case status are unlikely to be significant.

The combining of certain categories due to the small number of responses precluded the analysis of categories that may have provided useful information, such as for those who were single or retired.

In common with many larger scale studies there were some missing data. This was addressed by the creation of a dummy category uniquely identified for missing data.

The data collection points were seven years apart and therefore no data were available on the intervening years. There may have been additional changes in life events and mental health case status not identified, for example a participant who was married/partner at baseline and follow-up may have divorced and remarried. A participant who was classified as not a case in both waves may have been a case between the waves but recovered at follow-up.

The models undertaken in this thesis were limited, and therefore not all possible permutations were analysed. For example, recovery was not analysed for both classifications of CMD. It was outside the scope of the thesis to do so and presents future research.

The variables were analysed at the individual level and not group or area levels precluding use of a hierarchical model enabling simultaneous examination

of individual-level factors and group-level factors. The latter would have had certain advantages, though multi-level analysis is not without its own difficulties, but it was outside the scope of the thesis.

Notwithstanding the limitations identified it is suggested that they are unlikely to alter the findings made substantially, and more importantly indicate areas of future research.

## 6.15 CONCLUSIONS

The analysis in this chapter has answered the third research question by identifying the transitions and area factors most significantly associated with the changes in mental health status of onset and recovery, and for the onset of two classifications CMD-NS and CMD-S.

Age has been shown to have significance across all age groups with increased age appearing to be protective to onset, and increasing the chance of recovery. The least advantageous transitions were repeatedly significant in the models, to the risk of onset or decreasing the prospect of recovery. Seeking work, poor physical health, becoming a widow and ceasing to be an owner occupier are particularly detrimental to mental health case status.

The next chapter synthesises the findings of this thesis, and discusses the implications for researchers and future research.

## CHAPTER 7



## CHAPTER 7: SYNTHESIS OF FINDINGS AND FUTURE RESEARCH

The substantial burden of poor mental health to individuals and society, shown in Chapter 1, presents challenges to public health that demand investigation and strategies to reduce the scale of the problem. In this context, the long outstanding requirement for a valid cut-point on the MHI-5, and the opportunity to use web-based methods to develop existing measures that detect the common mental disorders of depression and anxiety provided the motivation for this thesis. The existence within the Institute of a bespoke web-platform developed to facilitate web-based research, and the support provided for the development of the CWB website, shaped the methodology for the determination of the MHI-5 cut-points. The availability of the survey longitudinal dataset presented the opportunity to apply the new cut-points to a large longitudinal sample. This made possible an investigation of the extent of change in mental health case status associated with a wide range of transitions simultaneously that are generally examined separately or in much smaller number. The literature reviewed across a number of related areas (Chapters 2 and 3) suggested there were gaps in existing knowledge which this thesis would reduce.

The central issue of detection and severity of mental health case status has been examined, and valid cut-points on the MHI-5, a measure in frequent use, have been determined by using web-based methods and optimisation analysis. A 'gold standard' clinical interview schedule, the CIS-R, which establishes the nature and severity of neurotic symptoms, critically, determined the validity of the cut-points. The cut-points established were then applied to an existing longitudinal dataset to facilitate analysis of the individual social and economic transitions, and small area-level factors associated with change in mental health case status. The findings provide an insight into the symptomatology for the onset of, and recovery from, common mental disorder and the onset of CMD-NS and CMD-S, the latter a potential precursor of clinical disease. The objectives of the thesis were met, the research questions were answered, and contributions to knowledge were made. In this final chapter the main findings of the thesis are synthesised, the answers to the research questions are re-visited, and the

contribution to knowledge examined. The implications for researchers are discussed, and future research which will extend the findings made here is suggested. The chapter will close with a concluding comment on the main implications of this thesis.

The points made in the introductory section form the basis of the objectives of this chapter. The following items will be addressed.

1. The research questions; revisiting the answers found
2. Review of the thesis objectives and demonstration of how met
3. Discussion of the strengths and limitations of this thesis
4. Discussion of the contributions made to: the knowledge of methodology, existing knowledge, and discovery of new knowledge results
5. Examination of the implications for researchers
6. Identification of future research to extend the findings made
7. Concluding summary of the thesis

#### 7.1 THE RESEARCH QUESTIONS AND REVISITING THE ANSWERS FOUND

This thesis addressed three research questions:

1. Is it feasible to use web-based methods to collect robust data on mental health and well-being from population samples? What are the strengths and limitations of collecting mental health and well-being data using web-based methods?
2. What are the cut-points on the MHI-5 scale for a case of common mental disorder and a case of more severe common mental disorder (CMD-S)?

3. To what extent is change in mental health case status associated with individual social and economic transitions and small area level factors?

The first research question has two parts, the first of which can be answered by reference to the success of the CWB web-based study. The CWB study collected data on mental health and well-being from 616 participants; 211 (34.3%) were classified as having CMD case status, and 13 (2.1%) answered the questions on suicide and submitted completed questionnaires. The response rate of 6.2% was achieved from a mailing of 10,000 invitation letters, sent at a reasonable cost due to the use of commercial bulk mailing. The cost of producing and mailing the participant information pack together with fixed costs has been estimated to be £1 per prospective participant. The cost of the web-platform was funded by the developer's personal research budget, and the funded studies for which it was originally developed. It has therefore been established that it is feasible to collect robust data on mental health and well-being from population samples using web-based methods. What is considered adequate may differ for each study; in the CWB study adequacy was defined by the recruitment of 400 (4%) of the 10,000 prospective participants mailed.

The second part of this question has two sections, strengths and limitations.

### *Strengths*

The strengths of collecting mental health and well-being data using web-based methods are summarised below.

Web-based methods are cost effective particularly for large scale epidemiological studies in comparison to many conventional and field based methods. There are flexibility and speed advantages, notably with data collection. Remote data collection has no geographical or time constraints, and is free of field research safety issues. It is easier to monitor the progress of data collection and the data collected is in a form ready for use by a computer which

removes the time consuming and problematic task of data entry. Data storage is easier, flexible and more secure. No separate physical storage facilities are required e.g. for completed paper surveys, only dedicated space for the computer servers which will often be housed by the organisation that is host for the study. For example, in the case of the CWB study the University's servers allocated to the School of Medicine were used. The critical platform which supports the research websites develops and improves with each study conducted, irrespective of the subject matter, therefore accelerating the process of its evolution. Investigators in future studies can utilise and adapt existing web-sites and benefit directly from previous technical developments and successful approaches adopted.

There is apparent acceptability of the use of web-based methods by a wide age range of 18 to 74 years. Hard to reach populations and individuals can be reached provided they have access to an internet enabled device. There is greater convenience and privacy for participants. They may appeal more to those with mental health problems than traditional methods due to the remote nature of data collection, flexibility and the comparative ease of participation e.g. no need to deal with a researcher in person, freedom to participate when it suits the individual, and no demand to attend to a paper survey and its return.

### *Limitations*

All studies have limitations and the use of new research methods often determines that knowing precisely what these are will not be known until a study is at an advanced stage or even completed. The limitations of collecting mental health and well-being data using web-based methods are summarised below.

Where bespoke web-sites and data collection methods are required, rendering the cheap commercial options unsuitable, there is an unavoidable necessity for the deployment/recruitment or appointment of external, specialist technical experts. Whichever approach is employed, the initial costs may be

considerable, and effective planning with accurately defined requirements is imperative. The development of a bespoke web-platform will reduce costs in the long run but is likely to have higher set-up costs. It is inadvisable to regard a web-platform as anything other than a long term project that must be designed and developed by suitably qualified individuals. The disparate skill sets and different communication styles of technical staff (often from a commercial background) and academic researchers, require the development of effective working practices and communication process to avoid costly misunderstandings, the consequences of which cannot always be remedied. In the CWB study, none of the costs associated with the web-platform's use or the development of the CWB website were incurred because the CWB study was used to develop aspects of the web-platform's capabilities. While timing played a significant part in this serendipitous arrangement, it is a good example of the benefits that can be gained by genuine collaborative working, and how the results of a study can be used for different purposes to great effect.

Participants must have access to, and the ability to use, internet-enabled devices. Participation is not therefore 'free' as most participants will have incurred acquisition and/or on-going service provider costs. These costs may serve to exclude individuals if they are unable to utilise free public internet access. There is a potential lack of representativeness of the sample recruited, biased towards those who prefer internet-based communication or activities. In contrast those who regard the Internet as a means of engaging in leisure pursuits may be disinclined to use the Internet in a formal manner.

The second research question '*What are the cut-points on the MHI-5 scale for a case of common mental disorder and a case of more severe common mental disorder (CMD-S)?*' was addressed in Chapter 5. The cut-point identified for a case of common mental disorder was  $\leq 60$ , and for a case of CMD-S  $\leq 45$ . The basis of the MHI-5 cut-points is the nature and severity of symptoms identified by the CIS-R and their overall effect; therefore identifying the optimal cut-point is a far from straightforward matter. The level of agreement between optimisation criteria suggests the selected cut-points are credible for the CWB study and may

be suited to use in epidemiological studies. However, with a sample size of 616 participants the findings may be regarded as having insufficient statistical precision to be persuasive without further research. Though counter to this view is the apparent willingness, historically, of investigators to accept cut-points with limited evidence to support them and a host of limitations. This topic is discussed in Chapters 2 and 5.

The third research question '*To what extent is change in mental health case status associated with individual social and economic transitions and small area level factors?*' was answered in Chapter 6, and a summary of the key findings is set out in the next section.

This research question was answered by the findings from four models in Chapter 6. Model 1 baseline (which gave context for the transitions), Model 3, recovery from CMD, model 4, onset of CMD-NS, and model 5, onset of CMD-S.

The analysis for model 3 suggests that only two variables are significantly associated with changing from case status to *recovery*: age group and social cohesion, the categories 55-64 and 65-74 for age group, and medium and high social cohesion for social cohesion. It seems probable that increased age, when many of the career and family pressures have reduced, increases the prospect of recovery.

The analysis for model 4 and model 5 shows there are seven variables with categories/transitions that are significantly associated with *onset* of CMD-NS and/or CMD-S. One variable category is significantly associated with *onset* of CMD-NS only, and that is age group 18-25. For *onset* of CMD-S only, there are two variables and three transitions, remain/become seeking work, become economically inactive, and owner occupier to non-owner occupier. This suggests that the burden to individuals is highly detrimental and a risk factor for more severe case status. Of the remaining variables/categories common to both classifications the risk of *onset* is greater for CMD-S in all categories.

From this it can be seen that change in mental health status by *onset* of CMD-NS and CMD-S is most significantly associated with individual socio-economic transitions, three of which are a risk only for onset of CMD-S. There is only one small area level factor category, highest deprivation, and the risk of *onset* is the lowest of the categories for CMD-NS and second lowest for CMD-S.

There is one finding which gives a particularly interesting insight into the effect of a small area-level factor, and that is social cohesion. The transitions for this variable are not associated with onset but, as set out earlier for model 3, they are significantly associated with recovery. This suggests that community support and social membership is an important resource for recovery, possibly because an individual is able to utilise the benefits available, but which they are unable to when at risk of onset.

In broad summary, the individual socio-economic transitions discussed are associated with change in mental status by onset of case status for both classifications but more strongly for CMD-S, while increased age and social cohesion are associated with recovery from case status.

## 7.2 REVIEW OF THE THESIS OBJECTIVES AND DEMONSTRATION OF HOW MET

This thesis had five objectives set out in Chapter 1.

The first objective required a review of the literature on how mental health is formally defined, measured, and the instruments commonly used which were relevant to this study. The findings of the review were discussed in Chapter 2.

The second objective entailed a further review of the literature of three specific topics. The case prevalence of common mental disorders and how measured (Part I), the individual and area-based risk factors associated with change in mental health case status (Part II); and web-based research and its application to mental health-based studies (Part III). Discussion of this review appears in Chapter 3

The third objective was to collect data from the general population to determine cut-points on the MHI-5 using web-based methods. Participant recruitment was to be from a mailing of a random sample of 10,000 residents of the Caerphilly borough included in a sample frame created by the NHS Wales Informatics Service. The participant recruitment element of the objective was met by first developing an information pack and invitation letter to be mailed to participants that reflected the web-site to be used to collect the data, and then arranging the production and mailing of the information pack and invitation letter by commercial organisation, which was done. The data collection aspect was met by the development of the CWB web-site to host the MHI-5 and CIS-R, which were specifically 'web-adapted' for the study. The web-site was tested and went live shortly before the mailing. Scores were collected for both instruments and prepared for analysis (Chapter 4).

The fourth objective required the data collected to be analysed to determine the cut-points. The paired instrument scores from the data collected in the web-based study were analysed, and using five optimisation criteria the cut-points were established for a case of common mental disorder and CMD-S on the MHI-5 (Chapter 5).

The fifth objective involved applying the cut-points defined to the MHI-5 scores in the survey dataset and identifying the extent to which change in mental health case status is associated with individual social and economic transitions and small-area-level factors. This analysis was conducted and the results reported in Chapter 6.

The thesis objectives were successfully met.

### 7.3 DISCUSSION OF THE STRENGTHS AND LIMITATIONS OF THIS THESIS

This section considers the strengths and limitations of this thesis and includes additional evidence to support the observations made.

Strengths of the thesis



A long standing requirement for a valid cut-point on the MHI-5 to identify a case of common mental disorder was addressed. The significance of the frequency and severity of symptoms can now be investigated because of the determination of a cut-point for a case of CMD-S. The MHI-5 and CIS-R were successfully adapted for web-based use allowing data collection using web-based methods. This is the first study to determine valid cut-points on the MHI-5 by the use of web-adapted versions of the MHI-5, a clinical interview schedule, and five optimisation criteria. No other studies have attempted to establish a valid cut-point for a case of CMD and CMD-S on the MHI-5 using web-based methods.

The Nielsen model developed to test commercial website functionality was used for academic research purposes to pilot test the CWB website functionality, and eliminated all functionality problems using 15 pilot testers. A problematic ethical requirement was satisfied and instrument integrity was preserved by creating a separate linked single webpage 'website'. The existence of this linked webpage would not be apparent or disruptive to participants.

The website designed for the CWB study restricted access to invited participants (by mailed paper invitation) from a specific population, while preserving their anonymity. This demonstrates that it is feasible to use mixed modes effectively, retain participant anonymity, and recruit participants from specific populations other than by the direct recruitment on-line of active web-users.

The sample recruited for the CWB study included participants for every age between 18 to 74 years with a broadly similar distribution for each 10-year age group, suggesting, as expected, that access to internet-enabled devices is widespread.

The determination of the cut-points from a new random sample drawn from the same source population as the survey, and application of the cut-points to the survey dataset, ensured that the cut-points were independent of the original sample. This avoided same source bias.

The breadth of the literature review conducted presented repeated opportunities to examine the primary topics of interest and the pertinence of the research questions, primarily due to the research interests of the leading authors, their collaborations with other researchers on closely related topics, and the continued citing of older studies without newer studies to update or change previous findings. The findings in this thesis are consistent with the literature, but have highlighted the importance of analysing more detailed data on mental health case status if changes are to be interpreted correctly.

The longitudinal survey dataset enabled the investigation of the extent of change in mental health status associated with a wide range of individual socio-economic transitions and small-area-factors, an approach not seen to this level in the literature reviewed. A particular strength of the dataset is the depth of data collected. Although a smaller population and geographical area than comparative studies, there were bigger sampling fractions for each area which provides more detailed data. This compares favourably with national studies which include much larger geographical areas but have small sampling fractions providing less rich data. Previous studies have used a more narrow focus. In this study the wider range of variables and use of two classifications of CMD has enabled a better understanding of the association between life transitions and change in case status of CMD of different severity.

An unusually high CMD-S case prevalence was found in the CWB dataset, but as noted in Chapter 5, this aspect of the data collected can be regarded as useful in this thesis. It was important to establish that individuals with poor mental health would participate in web-based research, and necessary to have a sufficiently high proportion of cases to give adequate precision and credibility to the cut-points determined.

To investigate the case prevalence rate found in the CWB data, it is helpful to examine to what extent it exceeds the more typical rates detected and reported, and whether there is an apparent explanation for the higher prevalence rate identified.

The prevalence of CMD-S cases is particularly surprising in view of the typical difference (APMS, 2007) found in the rate of common mental disorder and CMD-S. Further, the expert opinion provided by a consultant psychiatrist on whether participation in the CWB study posed any potential harm to vulnerable participants with mental disorders suggested that the vulnerable individuals of concern would be unwilling and/or incapable of participating, and unlikely to even open the mailed invitation to participate. While the favourable risk assessment was helpful, these views were cause for concern. Although the level of incapacity referred to by the psychiatrist was primarily at the clinical disease level, the lack of knowledge of where CMD-S ends and clinical disease begins was problematic. If the CWB study failed to recruit sufficient individuals with common mental disorder and CMD-S case status it would not be possible to determine cut-points on the MHI-5 using the CIS-R as the gold standard.

In Chapter 3 Part III (3.3.1) the growth of health information seeking on the Internet and the unexpectedly high level of mental health related topics were discussed. This indicates that individuals with mental health-related concerns are motivated to seek information on the topic. The increasing use of web-based methods for delivery of psychological therapy such as CBT (cognitive behaviour therapy) provides further evidence that it is acceptable to address mental health disorders in this way. It is suggested that individuals with mental health concerns were motivated to take part in the CWB study and assisted to do so by the design philosophy applied throughout. To illustrate this point, of the 129 people who were classified as CMD-S cases, 13 completed all the questions relating to suicidal ideation (six men and seven women). Notwithstanding a prompt to seek support, at which point it was anticipated the individuals would leave the CWB website, all continued and completed the remaining sections of the CIS-R and submitted their responses. Despite the effort made to design an inclusive and enabling web-site, this outcome was not expected.

Table 7.1 shows the case prevalence for CMD and CMD-S reported in this study and a variety of studies from the UK and overseas.

Table 7.1 Case prevalence for common mental disorder and common mental disorder-severe

SOURCE AND LOCATION	CASE PREVALENCE FOR CMD AND CMD-S			MEASURE OF MENTAL HEALTH
	CMD (ALL)	CMD Score 12- 17	CMD-S Score 18+	
Fone et al. (2013) (Wales)	25.5%			MHI-5
CWB (2012)*** (CCB, WALES)	34.3%	13.4%	20.9%	MHI-5
Fone et al. (2007) (Wales)	32.0%			MHI-5
Thomas et al. (2007) (Wales)	26.5%			GHQ-12
Kelly et al. (2008) (UK)	25.3%			MHI-5
APMS (2007)** (UK)	15.1%	7.5%	7.5%	CIS-R
Weich et al. (2005) (UK)	24.6%			GHQ-12
Weich et al. (2003) (UK)	24.7%			GHQ-12
Weich et al. (2002) (UK)	38.9%			CES-D
Weich et al. (2001) (UK)	24.6%			GHQ-12
PMAPH (2000)* (England)	15.0%	8%	7%	CIS-R
Weich and Lewis (1998) (UK)	24.6% (t1) 26.3% (t2)			GHQ-12
Weich et al. (1998) (UK)	26.3%			GHQ-12
Weich et al. (1997) (UK)	30.0%			GHQ-12
Ustun and Sartorius (1995) (UK)	24.8%			GHQ-12
Lewis and Booth (1994) (UK)	33.7% 31.2% 24.8%			GHQ-30
Rukavina et al (2012) (Croatia)			33.75%	MHI-5
Hoeymans et al. (2004) (NL)	21.0%			MHI-5
Araya et al. (2001) (Chile)	26.7%			CIS-R
Reijneveld and Schene (1998) (NL)	32.3%			GHQ-12

\* Psychiatric Morbidity among Adults living in Private Households (England)

\*\* Adult Psychiatric Morbidity Survey

\*\*\* Changes in Well Being web-based study

From the table it is evident that the CMD case prevalence rate found in the CWB study is in the higher range of rates reported in the other studies, though close to the prevalence in the CHSNS dataset. Comparing these studies in detail is

difficult and meaningful conclusions are unlikely to be drawn. In any event it has been suggested that the validity of prevalence surveys may be short-lived.

*Prevalence surveys may lose validity quickly over time, depending on the stability of the condition measured, and they are seldom generalisable across populations.*

*(Rothman et al. 2013, p.1013)*

The CIS-R produced an unusually high prevalence rate of common mental disorder, and CMD-S in particular, but not exceptional or the highest. Perhaps the most important, and apparent, distinction that can be made between the other studies and the CWB study is the fact the web-site design specifically focused on how to increase the probability of recruiting individuals with poor mental health of two classifications of severity. It is apparent from table 7.1 that of the 19 studies noted only three reported the prevalence rate for CMD and CMD-S; the CWB study and two national studies. It was shown in Chapter 4 how different the CWB study's presentation of the CIS-R was from the original. The apparent success of the approach used, great interest in seeking health information on the Internet, combined with a potentially high level of interest in the study by participants with mental health issues who were also comfortable using the Internet, may provide a plausible explanation of why a higher than expected percentage of individuals with poor mental health were recruited to the CWB study.

### *Limitations*

Although a random sample of prospective participants was invited to take part in the CWB study, the sample recruited may have been subject to self-selection bias and a lack of representativeness. Self-selection bias is an inescapable feature of the voluntary participation in research. The characteristics of the CWB sample suggest that there may have been an element of self-selection bias in the form of individuals with mental health problems and a heightened interest in the subject matter of the study taking part. The anonymous, easy, and remote method of data collection may also have been attractive. However, the CWB study recruited

participants of every age between 18 to 74 years and the percentage of male and female participants was within the range commonly reported. In addition, 90.5% (558) of the participants agreed to take part in future research with no specified subject matter. It therefore seems improbable that such a high percentage, 65.7% (total sample) of whom were classified as having normal mental health, agreed to take part in further research due to poor mental health and/or an interest in mental health only. It is also worth noting that expert opinion and conventional wisdom suggested that securing a sufficient number of participants with poor mental health was by no means assured. Accordingly, at no point was it considered likely that the recruitment of individuals with poor mental health would meet or exceed the number calculated in the sample size estimate.

The final topic to discuss is the question of representativeness. The CWB study recruited 616 participants, a 6.2% response rate from a one-off mailing of 10,000 individuals, and a five-week recruitment period. The number of individuals who reached or exceeded the threshold for common mental disorder was 211 or 34.3% of those recruited, comprising 13.4% common mental disorder and 20.9% CMD-S, as previously noted. It is helpful to have comparisons with the CWB study's participant recruitment results. The AWFG study, discussed in Chapter 1, recruited 660 participants, a response rate of 4.4% from a mailing of 15,000 individuals, over a five-month recruitment period. UK Biobank (*Allen et al.* 2012), a large population based prospective cohort, mailed 9.2 million invitations between 2006 and 2010 in multiple mailings. They recruited 503,325 participants, representing a response rate of 5.5%, over a four-year recruitment period.

The topic of representativeness has been keenly debated for over 40 years and shows little sign of abating. A number of recent articles have revisited the current issues. Rothman and colleagues (2013) contend that although a study population may be representative of a larger source population, the overall observations observed in the study population will not necessarily apply to every sub-group. This would produce the unfortunate outcome of unrepresentative observations for a representative population sample.

A further difficulty is identified by Nohr and Olsen (2013)

*Representativeness is time and place specific and will therefore always be a historical concept.*

*(Nohr and Olsen 2013 p.1016)*

If this contention is accepted it suggests that the value of representativeness is less enduring due to the limitations indicated. The authors also note that they and other researchers have found small differences when comparing measures of association from the study population with those from the source population (Nohr and Olsen 2013). Few investigators will have the opportunity to test this, and evidence is required to support the finding.

Another aspect of representativeness is the response rate. Earlier in this section it was stated that the CWB study had a response rate of 6.2%, AWFG 4.4% and UK Biobank 5.5%. Allen and colleagues (2012), suggest that it is not the participation rate, but having a sufficiently large number of participants with different levels of the relevant risk factors under investigation that is of greater importance. A low response rate and small sample size can still be representative; however, a very high response rate and correspondingly large sample is bound to be representative.

The data collected in the CWB study with a response rate of 6.2%, and such a high prevalence of cases of common mental disorder and CMD-S in the sample, cannot be regarded as representative of the Caerphilly population. However, the evidence (Rothman et al. 2013) suggests this unrepresentativeness is unlikely to have an effect on the associations found in the analysis of the survey dataset. A lack of representativeness might be an issue for certain analyses such as causal studies (to avoid introducing bias) and evidence-based health care planning and policy (which requires population-representative data) (Ebrahim and Davey Smith 2013), but not all. Rothman and colleagues note,

*The key issue to addressing the scientific goal is not obtaining a representative study population, but rather including sufficient numbers of subjects across a range of the variable that modifies the association.*

(Rothman et al. 2014, p.634)

It is submitted that the issue of representativeness in the CWB study, following the observation made by Rothman and colleagues (2014), does not matter in a study of this kind, and is of less importance than establishing that data on mental health status can be collected using web-based methods and securing sufficient numbers of individuals with poor mental health. It can also be posited that the determination of cut-points on the MHI-5 was assisted by, if not in fact necessary, the participation of a larger proportion of individuals with poor mental health, to increase the precision of the cut-points identified. The CWB study's findings, it is suggested, were strengthened, not undermined by the characteristics of the sample recruited. An apposite final word on the topic is provided by Ebrahim and Davey Smith (2013),

*We feel that representativeness should neither be avoided nor uncritically universally adopted, but its value evaluated in each particular setting.*

(Ebrahim and Davey Smith 2013, p.1025)

From the discussion in this section it is contended that the limitations identified did not substantially alter the findings made in the CWB study.

#### 7.4 DISCUSSION OF THE CONTRIBUTIONS MADE TO KNOWLEDGE AND RESULTS

The nature and scope of the research questions suggest that it will be helpful to bring together and explicitly state the contributions to knowledge made and in what form. This thesis makes a number of original and significant contributions to knowledge which can be categorised as contributions to methodological knowledge, contributions to existing knowledge, and discovery of new knowledge.

##### 7.4.1 Contributions to methodological knowledge

The CWB study makes a contribution to the knowledge of methodology in the following ways;



1. Adaptation of a short measure and standardised clinical interview for web-based use.
2. Use of a standardised clinical interview to collect mental health status data using web-based methods.
3. Designing a host website to meet multiple demands:
  - remove the requirement for interviewer assistance
  - focused on inclusivity, accommodating users within a wide age range and varying levels of mental health and well-being
  - compatible with multiple forms of internet-enabled devices,
  - retaining consistency of appearance and usability
4. Successful utilisation of the Nielsen model, developed for e-commerce, for usability 'pilot' testing in academic research.

The CWB study demonstrated that, with well-considered design and testing, web-based methods are suitable for collecting sensitive data on mental health status. It was also shown that it is not a pre-requisite of web-based research that instruments or measures must be specifically designed for web-based use to function, but existing ones can be successfully adapted. The CIS-R via PROQSY is a sophisticated and lengthy branched questionnaire written in a bespoke PC software language which had to be re-written in a web-compatible language. In contrast the MHI-5 was in paper form and had to be written in a web-compatible language. Both were successfully adapted for web-based use and functioned as required.

#### 7.4.2 Contributions to existing knowledge

Previous researchers have attempted to determine a cut-point for a case of CMD on the MHI-5 scale, but as discussed in Chapter 2, despite the requirement for a valid cut-point the studies conducted over the last 15 years have not achieved this. There are a number of reasons for this, including the absence of a gold standard instrument, small specific populations, insufficient details of the

analysis conducted precluding verification of results, more severe disorder and not CMD being the condition of interest, and the use of a non-CMD measure. Investigators appear to be content to use the existing cut-points determined notwithstanding the limitations identified, such as Kelly and colleagues (2008) published cut-point of  $\leq 60$  (*Theunissen et al. 2011; Thorsen et al. 2013*), rather than determine a valid cut-point. It is accepted that it would be onerous for each study to attempt to determine a cut-point, and utilising an existing one has a number of advantages. However, if a study's findings are reliant upon the validity of the cut-point used it appears to be an unfortunate compromise. A valid cut-point on the MHI-5 for a case of CMD by use of five optimisation criteria was determined in this thesis.

#### 7.4.3 Discovery of new knowledge

The determination of a new and valid cut-point on the MHI-5 for a case of CMD-S, by use of five optimisation criteria, allows the investigation of change in mental health case status to symptomatology of greater severity detected by the MHI-5. It has been demonstrated in this thesis that the CMD-S classification is relevant by identifying more precisely which life transitions are associated with case status of greater severity e.g. owner occupier to non-owner occupier, and it provides a greater insight into and understanding of, the extent of change in mental health status and factors associated with such change. The facility to make more precise classifications of mental health status using the MHI-5 will expand the findings made.

The extent to which change in mental health case status, at two levels of severity, is associated with individual social and economic transitions and small-area-level factors was identified. The findings show the life transitions that have the greatest adverse effect on individuals and those most relevant to the recovery from common mental disorders. The two classifications of caseness afford an improved insight and understanding of the differing degree to which life transitions are associated with each classification. The awareness of which life transitions present the greatest risk of onset of CMD case status, and for which

classification, will assist the risk management and treatment of individuals where the MHI-5 is used in a clinical setting. In addition, the awareness of what life transitions present the greatest likelihood of recovery from CMD case status, will assist the risk management, and inform the focus of preventative strategies for onset of CMD case status

## 7.5 EXAMINATION OF THE IMPLICATIONS FOR RESEARCHERS

The cut-points determined for the MHI-5 in this thesis should be considered by researchers proposing to measure mental health status with the MHI-5, and the findings of previous studies with MHI-5 scores could be revisited. Previous research shows that investigators have used a range of cut-points determined in previous studies notwithstanding a number of easily identifiable limitations e.g. non-use of a gold standard. Those limitations do not apply here, which suggests that the cut-points determined in this thesis are worthy of serious consideration.

Existing datasets with MHI-5 scores can now be re-analysed to identify the participants' mental health case status affording additional insight.

Planned and existing longitudinal studies which include the MHI-5 could employ the option of collecting follow-up mental health data remotely which may result in a higher participation level if attendance at a research centre became unnecessary.

The MHI-5 could provide an alternative option to the CIS-R in epidemiological studies investigating CMD case status, where the sensitivity and specificity of a gold standard instrument is not required. Investigators without the resources to use the CIS-R, and who only require identification of cases of CMD and CMD-S, will have a viable alternative with considerably reduced research costs.

Much larger populations with no geographical limits can be reached. Existing large-scale longitudinal studies that lack and want to add a mental health measure that determines caseness could include the MHI-5.

## 7.6 IDENTIFICATION OF FUTURE RESEARCH TO EXTEND THE FINDINGS MADE

The findings in this thesis can be extended by investigating, for example, why a higher than expected percentage of individuals with poor mental health were recruited. As noted in Chapter 4, participants in the CWB study were asked if they would consent to further contact for future on-line studies and 558 (90.5%) responded 'yes'. This creates the opportunity, subject to ethical approval, to investigate further the CWB study's findings, and the participants' views on web-based research, particularly those with poor mental health. The 558 participants could be invited to repeat the CWB study's tasks although the CIS-R measure could be removed, and a different questionnaire related to mental health and web-based research or another topic of interest could be included instead. Alternatively, the survey questionnaire could be adapted for web-based use and added to the CWB web-site in place of the CIS-R. The costs would be relatively low as the web-platform and web-site already exist and a mailing of 558 individuals is considerably less expensive than 10,000. Where the sample size is considered too small for a full study, it would provide a substantial sample for a pilot study.

More complex analysis, such as multilevel modelling, and additional analysis could be investigated, for example the recovery from being a case of CMD-NS and CMD-S. Alternatively, new ordinal models could be utilised to analyse all categories simultaneously in existing models to provide more detailed information on the transitions associated with change in mental health case status.

A further research topic of interest is whether the MHI-5 can validly screen for DSM-V clinical disease, with investigation of CMD-S and where this is on the scale in relation to DSM-V. A brief review of the MHI-5, and relevant DSM-V questions, reveals an unexpected degree of similarity on mandatory core diagnostic symptoms, and indicates that the seemingly simplistic questions of the MHI-5 belie their actual depth and sensitivity. This may have been a factor in the

previous studies that have attempted to determine a cut-point on the MHI-5 for DSM clinical disease level symptomatology.

#### 7.7 CONCLUDING COMMENT

This thesis has shown that the MHI-5 and CIS-R could be successfully adapted for web-based use, and that web-based methods are effective in the collection of sensitive mental health and well-being data, even from those who report suicidal ideation. Web-based methods offer a number of advantages over traditional research methods, and have a lower cost burden. As traditional methods become cost-prohibitive, and appear comparatively inflexible and slow, it is suggested that it is inevitable that epidemiological research will become progressively, and irreversibly, linked with web-based methods and remote data collection.

The usefulness of the MHI-5 has been extended, and the importance of the CMD severity classification has been demonstrated. It is therefore posited that it will become increasingly difficult to justify limiting the analysis of mental health case status by use of a single 'combined' classification.

## REFERENCES

- Aalto, A.M. et al. 2012. The Beck Depression Inventory and General Health Questionnaire as measures of depression in the general population: a validation study using the Composite International Diagnostic Interview as the gold standard. *Psychiatry Res.* 197 (1-2):163-171.
- Adult Psychiatric Morbidity Survey of England, (National Centre for Social Research, 2009 (APMS 2007).
- Allen, N. et al. 2012. UK Biobank: Current status and what it means for epidemiology. *Health Policy and Technology*, 1(3), 123-126.
- American Psychiatric Association. 1994. *Diagnostic and Statistical Manual of Mental Disorders: Fourth Edition DSM-IV*. American Psychiatric Association, Washington, DC.
- American Psychiatric Association. 2000. *Diagnostic and Statistical Manual of Mental Disorders: Fourth Edition, Text Revision, DSM-IV-TR*. American Psychiatric Association, Arlington, VA
- Andreassen, H.K. et al. 2007. European citizens' use of E-health services: a study of seven countries. *BMC Public Health*, Apr 10; 7(1):53.
- Andrews, G. et al. 1999. Classification in psychiatry: ICD-10 versus DSM-IV. *British Journal of Psychiatry*, 174: 3-5 doi:10.1192/bjp.174.1.3. [Accessed: 18 February 2013].
- Araya, R. et al. 2001. Common mental disorders in Santiago, Chile: prevalence and socio-demographic correlates. *Br.J.Psychiatry*, 178:228-233.
- Banks, M.H. et al. 1980. The use of the General Health Questionnaire as an indicator of mental health in occupational studies. *Journal of Occupational Psychology*, 53, 187-194.
- Bansil, P. et al. 2006. *Health-related information on the Web: results from the HealthStyles Survey, 2002-2003*. *Prev Chronic Dis.* Apr; 3(2):A36. [http://www.cdc.gov/pcd/issues/2006/apr/05\\_0155.htm](http://www.cdc.gov/pcd/issues/2006/apr/05_0155.htm).A36. [Accessed: 14 March 2011].
- Baksheev, G, et al. 2011. Validity of the 1-item General Health Questionnaire (GHQ-12) in detecting depressive and anxiety disorders among high school students. *Psychiatry Res.* 187, 291-296.

- Bebbington, P. 2004. Recent findings in bipolar affective disorder. *Psychol.Med.* 34 (5):767-776.
- Beard, J.R. et al. 2008. Trajectory and socioeconomic predictors of depression in a prospective study of residents of New York City. *Ann.Epidemiol.* 18 (3):235-243.
- Berwick, D. et al. 1991. Performance of a five-item mental health screening test. *Med.Care*, 29 (2):169-176.
- Bhinder, S. et al. 2010. Feasibility of internet-based health-related quality of life data collection in a large patient cohort. *Journal of medical Internet research*, 12(3).
- Blakely, T.A. and Woodward, A.J. 2000. Ecological effects in multi-level studies. *J Epidemiol Community Health*, 54: 367-74.
- Bland, J. and Altman, D. 1997. Cronbach's Alpha. *British Medical Journal*, 314, 572.
- Blum, R.H. 1962. Case identification in psychiatric epidemiology: methods and problems. *Milbank mem. Fd. Quart*, 40, 253.
- Bolier, L. et al. 2012. Internet-Based Intervention to Promote Mental Fitness in Mildly Depressed Adults: Design of a Randomized Controlled Trial. *JMIR Research Protocols*, 1(1), e2. doi:10.2196/resprot.1791 [Accessed: 23 December 2014].
- British Household Panel Survey, [Accessed: 5 October 2014] [https://www.iser.essex.ac.uk/bhps/documentation/pdf\\_versions/survey\\_documents/index.html](https://www.iser.essex.ac.uk/bhps/documentation/pdf_versions/survey_documents/index.html).
- British Psychological Society 2013. *Ethics Guidelines for Internet-mediated Research*. INF206/1.2013. Leicester: Author. Available from: [www.bps.org.uk/publications/policy-andguidelines/research-guidelines-policydocuments/research-guidelines-poli/](http://www.bps.org.uk/publications/policy-andguidelines/research-guidelines-policydocuments/research-guidelines-poli/).
- Buchanan, E.A. and Hvizdak, E.E. (2009). Online survey tools: ethical and methodological concerns of human research ethics committees. *J Empir.Res.Hum.Res.Ethics*, 4 (2):37-48.
- Buckner, J.C. 1988. The development of an instrument to measure neighborhood cohesion. *American journal of community psychology*, 16(6), 771-791.

- Bulloch, A.G. et al. 2009. The relationship between major depression and marital disruption is bidirectional. *Depression and Anxiety*, 26(12), 1172-1177.
- Caerphilly County Borough *Biodiversity Action Plan – Urban Habitats*, 2004 Vol.pt 2. <http://www.caerphilly.gov.uk/.../Planning/Biodiversity-Action-Plan-Caerphilly-C>. [Accessed: 28 November 2014].
- Centre for Economic Performance, *How mental illness loses out in the NHS*, Mental Health Policy Group, MHI Report June 2012.
- Cepoiu, M. et al. 2008. Recognition of depression by non-psychiatric physicians-a systematic literature review and meta-analysis. *J Gen.Intern.Med.* 23 (1):25-36.
- Chandola, T. et al. 2005. Who you live with and where you live: setting the context for health using multiple membership multilevel models. *J.Epidemiol.Community Health*, 59 (2):170-175.
- Chew-Graham, C.A. 2002. Patients with chronic physical illness and co-existing psychological morbidity: GPs' views on their role in detection and management. *International Journal of Psychiatry in Clinical Practice*, 8(2), 35-39.
- Chu, J.P. 2011. Help-seeking tendencies in Asian Americans with suicidal ideation and attempts. *Asian American Journal of Psychology*, 2(1), 25.
- Churchill, R. 2010. *No health without mental health: a role for the Cochrane Collaboration* [editorial]. *Cochrane Database of Systematic Reviews* 10.1002/14651858.ED000012 [Accessed: 25 January 2013].
- Cimpean, D. and Drake, R. E. 2011. Treating co-morbid chronic medical conditions and anxiety/depression. *Epidemiol Psychiatr.Sci.* 20 (2):141-150.
- Cisco Connected World Technology Report.2011  
2011p://www.cisco.com/c/en/us/solutions/enterprise/connected-world-technology-report/2011-CCWTR-Chapter-3-Media-Deck.pdf.  
[Accessed:3 June 2013].
- Cisco Connected World Technology Report.2014  
2014p://www.cisco.com/c/en/us/solutions/enterprise/connected-world-technology-report/index.html. [Accessed: 9 January 2015].
- Cohen, S. and Wills, T.A. 1985. Stress, Social Support, and The Buffering Hypothesis. *Psychol Bull* 98: 310-357 doi: 10.1037/0033-2909.98.2.3103901065 [Accessed: 23 January 2014].



- Cooper, J.E. (ed) 1994 *Pocket guide to the ICD-10 classification of mental and behavioural disorders, with Glossary and Diagnostic Criteria for research*. Churchill Livingstone (Edinburgh, London, Melbourne, New York and Tokyo), on behalf of WHO.
- Cornelius, B. et al. 2013. The performance of the K10, K6 and GHQ-12 to screen for present state DSM-IV disorders among disability claims. *BMC Public Health*, 13:128.
- Cronbach, L.J. 1951. Co-efficient alpha and the internal structure of tests. *Psychometrika*, 16, 297-334.
- Cuijpers, P. et al. 2009. Screening for mood and anxiety disorders with the five-item, the three-item, and the two-item Mental Health Inventory. *Psychiatry Res.* 168 (3):250-255.
- Dalgard, O.S. and Tambs, K. 1997. Urban environment and mental health. A longitudinal study. *The British Journal of Psychiatry*, 171(6), 530-536.
- Das-Munshi, J. et al. 2008. Public health significance of mixed anxiety and depression: beyond current classification. *Br.J.Psychiatry*, 192, 171-177.
- Davies, A.R. et al. 1988. Scoring manual, adult health status and patient satisfaction measures used in RAND's health insurance experiment.
- Department of Health, 2011. No Health Without Mental Health: a cross-government mental health outcomes strategy for people of all ages, <https://www.gov.uk/government/publications/the-mental-health-strategy-for-england>. [Accessed: 25 January 2015].
- Diez Roux, A.V. 2001. Investigating neighbourhood and area effects on health. *Am.J.Public Health*, 91 (11):1783-1789.
- Dohrenwend, B.S. and Dohrenwend, B.P. 1974. Overview and prospects for research on stressful life events. *Stressful life events: Their nature and effects*, 313-331.
- Dooley, D. et al. 2000. Under-employment and depression: Longitudinal relationships. *Journal of Health and Social Behavior*, 41:421-436.
- Drukker, M. and van Os, J. 2003. Mediators of neighbourhood socioeconomic deprivation and quality of life. *Soc Psychiatry Psychiatr Epidemiol.* 38:698-706

- DSM III-R 1987. Diagnostic and Statistical Manual of Mental Disorders: Third Edition. American Psychiatric Association. [www.psychiatry.org/practice/dsm/dsm-history-of-the-manual/](http://www.psychiatry.org/practice/dsm/dsm-history-of-the-manual/)
- Duncan, G.J. 1996. Income Dynamics and Health. *International Journal of Health Services*, 26:419-424.
- Dutton, W.H. et al. 2005. Oxford Internet Survey website Report: The Internet in Britain <http://microsites.oii.ox.ac.uk/oxis/>
- Dutton, W.H. 2009. Oxford Internet Survey website Report: The Internet in Britain 2009 <http://microsites.oii.ox.ac.uk/oxis/>
- Eales, M.J. 1988. "Depression and anxiety in Unemployed Men". *Psychological Medicine*, 18:935-45.
- Ebrahim, S. and Smith, G. D. 2013. Commentary: Should we always deliberately be non-representative? *International journal of epidemiology*, 42(4), 1022-1026.
- Ekman, A. Litton, J.E. 2007. New times, new needs; e-epidemiology. *Eur J Epidemiol.* 22(5):285-292.
- Eysenbach, G. et al. 2002. Empirical studies assessing the quality of health information for consumers on the world wide web: a systematic review. *JAMA*, 287(20):2691-700
- Fan, W. and Yan, Z. 2010. Factors affecting response rates of the web survey: A systematic review. *Computers in Human Behavior*, 26(2), pp. 132-139.
- Farmer, J.C. et al. 2001. Rural deprivation: reflecting reality. *The British Journal of General Practice*, 51(467), 486.
- Ferrie, J.E. et al. 2002. Effects of chronic job insecurity and change in job security on self-reported health, minor psychiatric morbidity, physiological measures, and health related behaviours in British civil servants: the Whitehall II study. *J.Epidemiol.Community Health*, 56 (6):450-454.
- First, M.B. et.al. 2004. *DSM-IV-TR Guidebook*. American Psychiatric Publishing, Inc. Arlington, VA.
- Fone, D. et al. 2007. Places, people and mental health: a multilevel analysis of economic inactivity. *Soc.Sci.Med.* 64 (3):633-645.
- Fone, D. et al. 2007. Measuring the neighbourhood using UK benefits data: a multilevel analysis of mental health status. *BMC.Public Health*, 7:69.

- Fone, D. et al. 2007. Does social cohesion modify the association between area income deprivation and mental health? A multilevel analysis. *Int.J Epidemiol.* 36 (2):338-345.
- Fone, D. et al. 2012. Cohort Profile: The Caerphilly Health and Social Needs Electronic Cohort Study (E-CATALyST). *Int.J Epidemiol.* dys175.
- Fone, D. et al. 2013. Common mental disorders, neighbourhood income inequality and income deprivation: small-area multilevel analysis. *Br.J.Psychiatry*, 202 (4):286-293.
- Fone, D. et al. 2014. Effect of neighbourhood deprivation and social cohesion on mental health inequality: a multilevel population-based longitudinal study. *Psychol.Med.* 1-12.
- Fox, S. and Jones, S. 2009. The social life of health information. Washington, DC: Pew Internet & American Life Project; Jun 11, [2010-12-07]. website [http://www.pewinternet.org/~media/Files/Reports/2009/PIP\\_Health\\_2009.pdf](http://www.pewinternet.org/~media/Files/Reports/2009/PIP_Health_2009.pdf).
- Freeling, P. et al. 1985. Unrecognised depression in general practice. *Br.Med.J (Clin.Res.Ed)* 290 (6485):1880-1883.
- Fryers, T. et al. 2003. Social inequalities and the common mental disorders. *Soc Psychiatry Psychiatr Epidemiol.* 38: 229-37.
- Funk, K.L. et al. 2010. Associations of Internet Website Use With Weight Change in a Long-term Weight Loss Maintenance Program. *J Med Internet Res* 12(3):e29
- Gallacher, J.P. et al. 2013. A platform for the remote conduct of gene-environment interaction studies. *PLoS.One.* 8 (1):e54331.
- Gill, S.C. et al. 2007. Validity of the mental health component scale of the 12-item Short-Form Health Survey (MCS-12) as measure of common mental disorders in the general population. *Psychiatry Res.* 152 (1):63-71.
- Goldberg, D.P. et al. 1970. A Standardized Psychiatric Interview for the use in Community Surveys. *Brit. J.prev.soc.Med.* 24. 18-23
- Goldberg, D.P. 1972. *The Detection of Psychiatric Illness by Questionnaire*. Oxford, United Kingdom: Oxford University Press.
- Goldberg, D.P. and Hillier, V.F. 1979. A scaled version of the General Health Questionnaire. *Psychological Medicine*, 9, pp 139-145.

- Goldberg, D.P. and Bridges, K. 1987. Screening for psychiatric illness in general practice: the general practitioner versus the screening questionnaire. *J R.Coll.Gen.Pract.* 37: 15-18.
- Goldberg, D.P. and Williams, P. 1988. *A User's Guide to the General Health Questionnaire*. Windsor: NEFR-Nelson.
- Goldberg, D.P. et al. 1990. The influence of social factors on common mental disorders. Destabilisation and restitution. *Br.J Psychiatry*, 156:704-713.
- Goldberg, D.P. and Huxley, P. 1992. *Common Mental Disorders: A Biosocial Model*. London: Routledge.
- Goldberg, D.P. Lecrubier, Y. 1995. Form and frequency of mental disorders across centres. In: Üstün TB, Sartorius N, eds. *Mental illness in general health care: an international study*. Chichester, John Wiley & Sons on behalf of WHO: 323-334. <http://www.who.int/whr/2001/chapter2/en/index2.html>.
- Goldberg, D.P. et al. 1997. The validity of two versions of the GHQ in the WHO study of mental illness in general health care. *Psychological Medicine*, 27, 191-197.
- Goldberg, D.P. et al. 1998. Why GHQ threshold varies from one place to another. *Psychol.Med.* 28 (4):915-921.
- Goodchild, M.E. and Duncan-Jones, P. 1985. Chronicity and the General Health Questionnaire. *Br J Psychiatry*, 146: 55-61.
- Gordon, D. 2003. Area-based deprivation measures: a UK perspective. *Neighbourhoods and health*, 179-207.
- Green, M.J. and Benzeval, M. 2011. Ageing, social class and common mental disorders: longitudinal evidence from three cohorts in the West of Scotland. *Psychol.Med.* 41 (3):565-574.
- Greenhalgh, T. and Peacock, R. 2005. Effectiveness and Efficiency of Search Methods in Systematic Reviews of Complex Evidence: Audit of Primary Sources. *British Medical Journal*. 331:1064-1065.
- Gurin, G. et al. 1960. *Americans View of their Mental Health: A Nationwide Survey*. New York: Basic Books.
- Hand, D. 1987. Screening vs Prevalence Estimation. *Applied Statistics*, 36, 1-7.

- Hardy, G. et al. 1999. Validation of the General Health Questionnaire-12 Using a Sample of Employees From England's Health Care Services. *Psychological Assessment*, 11:2, 159-165.
- Harvey, S. et al. 2011. Depression and work performance: an ecological study using web-based screening. *Occup Med (Lond)* 61 (3): 209-211.
- Health Survey for England, 2012, [Accessed: 20 January 2015], <http://hscic.gov.uk/catalogue/PU B13218/HSE2012-Sum-bklet.pdf>.
- Hirshfield, S. et al. 2004. Substance use and high-risk sex among men who have sex with men: a national online study in the USA. *AIDS care*, 16(8), 1036-1047.
- Hoeymans, N. et al. 2004. Measuring mental health of the Dutch population: a comparison of the GHQ-12 and the MHI-5. *Health Qual.Life Outcomes*, 2:23.
- Holmes, W.C. 1998. A short, psychiatric, case-finding measure for HIV seropositive outpatients: performance characteristics of the 5-item mental health subscale of the SF-20 in a male, seropositive sample. *Med.Care* 36 (2):237-243.
- Hughes, M.E. and Waite, L.J. 2009. Marital biography and health at mid-life. *Journal of health and social behavior*, 50(3), 344-358.
- Houston, T.K. et al. 2001. Screening the Public for Depression through the Internet. *Psychiatric Services*, 52:3, 362-367.
- Hsiao, J.K. et al. 1989. Diagnosing diagnoses: receiver operating characteristic methods and psychiatry. *Archives of General Psychiatry*, 46(7), 664-667.
- International Journal of Epidemiology 1998. *Instructions to authors*. Int. J. Epidemiol. 27 (1): 157-158.
- Jenkins, R. et al. 1997. The National Psychiatric Morbidity surveys of Great Britain strategy and methods. *Psychological Medicine*, 27 (4):765-774.
- Jenkinson, C. et al. 1999. Assessment of the SF-36 version 2 in the United Kingdom. *Journal of Epidemiology and Community Health*, 53, 46-50.
- Karsten, J. et al. 2010. Subthreshold depression based on functional impairment better defined by symptom severity than number of DSM-IV symptoms. *Journal of Affective Disorders*, 123, 230-237.
- Katon, W.J. 1991. Somatization: a spectrum of severity. *Am J Psychiatry*, 148(1), 34-40.

- Katon, W.J. 2003. Clinical and health services relationships between major depression, depressive symptoms, and general medical illness. *Biol.Psychiatry* 54 (3):216-226.
- Kay B.K. and Johnson T.J. 1999. Research Methodology: Taming the Cyber Frontier. *Social Science Computer Review*, 17, 323-337.
- Kelly, M.J. et al. 2008. Evaluating cut-points for the MHI-5 and MCS using the GHQ-12: a comparison of five different methods. *BMC.Psychiatry*, 8:10.
- Kelly, M.J. 2008. *Estimation of synthetic neighbourhood boundaries for multilevel analysis of the contextual determinants of mental health and investigation of associated methodological issues*. PhD Thesis, Cardiff.
- Kerr, C. et al. 2010. The potential of Web-based interventions for heart disease self-management: a mixed methods investigation. *Journal of medical Internet research*, 12(4).
- Kessler, D. et al. 1999. General Practice: Cross sectional study of symptom attribution and recognition of depression and anxiety in primary care Commentary: There must be limits to the medicalisation of human distress. *Bmj*, 318(7181), 436-440.
- Kessler, R.C. et al. 2002. Short screening scales to monitor population prevalences and trends in non-specific psychological distress. *Psychological medicine*, 32(06), 959-976.
- Kessler, D. et al. 2002. Detection of depression and anxiety in primary care: follow up study. *Bmj*, 325(7371), 1016-1017.
- Kessler, D. 2003. *Symptom attribution and the detection of depression and anxiety in Primary care*. MD Thesis, University of London.
- Kessler, R.C. 2003. Depression screening. *J Fam.Pract.* 52 (6):466.
- Kessler, R.C. et al. 2003. Mild disorders should not be eliminated from the DSM-V. *Archives of General Psychiatry*, 60, 1117-1122.
- Kivits, J. 2009. Everyday health and the internet: a mediated health perspective on health information seeking. *Social Health Illn.* Jul;31(5):673-87. [Accessed: 11 April 2011].
- Komiti, A.A. et al. 2001. A comparison of the Composite International Diagnostic Interview (CIDI-Auto) with clinical assessment in diagnosing

- mood and anxiety disorders. *Australian and New Zealand Journal of Psychiatry*, 35(2), 224-230.
- Kralik, D. et al. 2006. Transition: a literature review. *J.Adv.Nurs*. 55 (3):320-329.
- Kreitman, N. et al. 1961. The reliability of psychiatric assessment analysis. *Journal of Medical Science* , 107, 887-908.
- Lamers, F. et al. 2011. Comorbidity patterns of anxiety and depressive disorders in a large cohort study: the Netherlands Study of Depression and Anxiety (NESDA). *JClin Psychiatry*. Mar; 72(3) 341-348.
- Leighton, D. C. and Danly, R. A. 1966. Validity in mental health surveys. *Canadian Journal of Psychiatry*, 3, 167-178.
- Lewis, G. et al. 1988. The development of a computerized assessment for minor psychiatric disorder. *Psychological medicine*, 18(03), 737-745.
- Lewis, G. and Williams, P. 1989. Clinical judgement and the standardized interview in psychiatry. *Psychological medicine*, 15, 971-980.
- Lewis, G. et al. 1992. Measuring psychiatric disorder in the community: a standardized assessment for use by lay interviewers. *Psychol.Med.* 22 (2):465-486.
- Lewis, G. and Booth, M. 1994. Are cities bad for your mental health?. *Psychological Medicine*, 24(04), 913-915.
- Lewis, G. 1994. Assessing psychiatric disorder with a human interviewer or a computer. *Journal of Epidemiology and Community Health*, 48(2), 207-210.
- Lewis, G. et al. 1996. Computerized assessment of common mental disorders in primary care: effect on clinical outcome. *Fam.Pract.* 13 (2):120-126.
- Lewis, G. and Lyons, I. 1999. Computerised assessments for psychiatric disorders. In: Tansella, M. et al. eds. *Common Mental Disorders in Primary Care: Essays in Honour of Professor David Goldberg*. Routledge, pp.156-167.
- Lewis, G. and Araya, R. I. 2001. Classification, disability and the public health agenda. *British Medical Bulletin* 57: 3-15.
- Lewis, J.R. 1994. Sample sizes for usability: Additional considerations. *Human factors* 36, 368-378.

- Leykin, Y. et al. 2012. Are consumers of Internet health information "cyberchondriacs"? Characteristics of 24,965 users of a depression screening site. *Depress.Anxiety*. 29 (1):71-77.
- Lloyd, K.R. et al. 1996. Long-term outcome of patients with neurotic illness in general practice. *BMJ* 313 (7048):26-28.
- Lofors, J. and Sundquist, K. 2007. Low-linking social capital as a predictor of mental disorders: a cohort study of 4.5 million Swedes. *Soc.Sci.Med.* 64 (1):21-34.
- Lopez Ibor, J. J. et al. 1994. Dysthymic disorder: a comparison of DSM-IV and ICD-10 and issues in differential diagnosis. *Acta Psychiatr.Scand.Suppl* 383:12-18.
- Lorant, V. et al. 2007. Depression and socio-economic risk factors: 7-year longitudinal population study. *Br.J.Psychiatry* 190:293-298.
- Lynch, J.W. et al. 1997. Cumulative impact of sustained economic hardship on physical, cognitive, psychological, and social functioning. *N.Engl.J.Med.* 337 (26):1889-1895.
- Macintyre, S. and Ellaway, A. 2003. Neighborhoods and health: an overview. *Neighborhoods and health*, 20-42.
- MacMillan, A.M. 1957. *The Health Opinion Survey: technique for estimating prevalence of psycho-neurotic and related types of disorder in communities.* Psychological Reports 3:325-329.
- Mair, C. et al. 2009. Are neighbourhood characteristics associated with depressive symptoms? A review of evidence. *J.Epidemiol.Community Health*, 62 (11):940-6, 8.
- Malhotra, R.K. and Indrayan, A. 2010. A simple nomogram for sample size for estimating sensitivity and specificity of medical tests. *Indian Journal of Ophthalmology*, 58(6), 519.
- Martin, D. et al. 2000. The (mis) representation of rural deprivation. *Environment and Planning A*, 32(4), 735-752.
- Martin, C.R. and Newell, R.J. 2005. Is the 12-item General Health Questionnaire (GHQ-12) confounded by scoring method in individuals with facial disfigurement? *Psychology and Health*, 20(5): 651-659.



- McCabe, C.J. et al. 1996. Measuring the mental health status of a population: a comparison of the GHQ-12 and the SF-36 (MHI-5). *Br J Psychiatry* 169(4): 516–21.
- McCulloch, A. 2001. Social environments and health: cross sectional national survey. *Bmj*, 323(7306), 208-209.
- McFall, R.M. and Treat, T.A. 1999. Quantifying the information value of clinical assessments with signal detection theory. *Annual review of psychology*, 50(1), 215-241.
- Means-Christensen, A. J. et al. 2005. An efficient method of identifying major depression and panic disorder in primary care. *J Behav.Med.* 28 (6):565-572.
- Meltzer, H. et al. 1995. *OPCS Surveys of Psychiatric Morbidity in Great Britain. Report No.1. The prevalence of psychiatric morbidity among adults aged 16–64 living in private households in Great Britain.* London: HMSO.
- Miniwatts Marketing Group. 2014. *Internet World Stats* [Online]. Available at: <http://www.internetworldstats.com/stats9.htm>. [Accessed: 24 December 2014].
- Montgomery, S.M. et al. 1999. Unemployment pre-dates symptoms of depression and anxiety resulting in medical consultation in young men. *Int.J.Epidemiol.* 28 (1):95-100.
- Murphy, J.M. et al. 1987. Affective disorders and mortality: a general population study. *Archives of General Psychiatry* 44, 473-480.
- Murray, J. et al. 2011. Use of the NHS Choices website for primary care consultations: results from online and general practice surveys. *JRSM Short Reports*, 2(7), 56. doi:10.1258/shorts.2011.011078 [Accessed: 24 February 2013].
- Myers, J.K. et al. 1972. Life events and mental status: a longitudinal study. *J.Health Soc.Behav.* 13 (4):398-406.
- National Centre for Social Research 2009. Adult Psychiatric Morbidity in England, 2007 Results of a Household Survey. <http://www.ic.nhs.uk/statisticsand-data-collections/mental-health/mental-health-surveys/adult-psychiatricmorbidity-in-england-2007:-results-of-a-household-survey>.
- National Land Use Classification 1975. *Joint Local Authority, LAMSAC, SDD and DofE*, 1975.

- NHS Direct. 2010. webcite History of NHS Direct  
<http://www.nhsdirect.nhs.uk/article.aspx?name=HistoryOfNHSDirect>.
- NHS Choices weekly website report – week 24, Posted on June 24, 2014  
<http://blogs.nhs.uk/reporting/2014/06/>. [Accessed: 15 November 2014].
- NICE. Depression in Adults with a Chronic Physical Health Problem. Treatment and management. NICE Clinical Guideline 91. London: National Institute for Health and Clinical Excellence, 2009.  
<http://guidance.nice.org.uk/CG91/NICEGuidance/pdf/English> [Accessed: 5 October, 2010].
- NICE Common mental health disorders, Identification and pathways to care, May 2011 NICE clinical guideline 123, May 2011.
- NICE 2011/085 *New NICE guidance to help millions with common mental health disorders*.  
<http://www.nice.org.uk/guidance/cg123/resources/new-nice-guidance-to-help-millions-with-common-mental-health-disorders2>  
 [Accessed: 7 March, 2012].
- Nielsen, J. 2000. *Why You Only Need to Test with 5 Users*. Available at:  
<http://www.nngroup.com/articles/why-you-only-need-to-test-with-5-users/> [Accessed: 11 January 2010].
- Nielsen, J. 2008. *Middle-Aged Users' Declining Web Performance*. Available at:  
<http://www.nngroup.com/articles/middle-aged-web-users/> [Accessed: 11 March 2010].
- Nielsen, J. 2013. *Seniors as Web Users*. Available at:  
<http://www.nngroup.com/articles/usability-for-senior-citizens/> [Accessed: 12 July 2013]
- Nohr, E.A. and Olsen, J. 2013. Commentary: Epidemiologists have debated representativeness for more than 40 years—has the time come to move on? *International Journal of Epidemiology*, 42(4), 1016-1017.
- O'Connor, D. and Parslow, R. 2010. Mental health scales and psychiatric diagnoses: Responses to GHQ-12, K-10 and CIDI across the lifespan. *Journal of Affective Disorders*. 121, 263-267.
- Ofcom, Market Communications 2012. [Accessed: 23 October 2014]. Available at:  
<http://stakeholders.ofcom.org.uk/binaries/research/cmr/cmr12/uk-4.22.GIF>.

- Office for National Statistics 1991 Census. Available at: <http://www.ons.gov.uk/ons/guide-method/census/1991-and-earlier-censuses/1991-census-data/index.html>. [Accessed: 23 September 2013].
- Office of Population Censuses and Surveys, 1991. *Census: Aggregate data (England and Wales)*. Available at: <http://casweb.mimas.ac.uk>. This information is licensed under the terms of the Open Government Licence Available at: <http://www.nationalarchives.gov.uk/doc/open-government-licence/version/2>. [Accessed: 23 September 2013].
- Office for National Statistics 2000. *Sources of Gross Household Income: by household type, 1997-98: Social Trends 30*. 2000. Available at: <http://www.ons.gov.uk/ons/rel/social-trends-rd/social-trends/no--30--2000-edition/index.html>. [Accessed: 8 June 2014].
- Office for National Statistics 2001. *Census: Aggregate data (England and Wales)*. Available at: <http://casweb.mimas.ac.uk> / <http://infuse.mimas.ac.uk>. This information is licensed under the terms of the Open Government Licence. Available at: <http://www.nationalarchives.gov.uk/doc/open-government-licence/version/2>. [Accessed: 13 November 2013].
- Office for National Statistics 2004. *Percentage of People Whose Income is Below Various Fractions of Median Income: Social Trends 34*. 2004. Available at: <http://www.ons.gov.uk/ons/rel/social-trends-rd/social-trends/no--34--2004-edition/index.html>. [Accessed: 8 June 2014].
- Office for National Statistics 2006. *Super Output Areas (SOAs)*. Available at: <http://www.statistics.gov.uk/geography/soa.asp>. [Accessed: 15 April 2013].
- Office for National Statistics 2008. *Income and wealth Social trends 38*. 2008. Available at: <http://www.ons.gov.uk/ons/rel/social-trends-rd/social-trends/no--38--2008-edition/index.html>. [Accessed: 8 June 2014].
- Office for National Statistics 2011. *Regional Trends 43, 2010/2011*. Available at: <http://www.ons.gov.uk/ons/rel/regional-trends/regional-trends/no--43--2011-edition/index.html>. [Accessed: 11 December 2014].
- Office for National Statistics, 2011. *Census: Aggregate data (England and Wales)*. Available at: <http://infuse.mimas.ac.uk>. This information is licensed under the terms of the Open Government Licence <http://www.nationalarchives.gov.uk/doc/open-government-licence/version/2>. [Accessed: 23 March 2014].

- Office for National Statistics 2013. *Statistical Bulletin; Internet access-Households and Individuals*. Available at : <http://www.ons.gov.uk/ons/rel/rdit2/internet-access-households-and-individuals/2013/stb-ia-2013.html>. [Accessed:15 December 2014].
- Office for Population Censuses and Surveys 1991. *Standard Occupational Classification Volume 3*. London: HMSO.
- Parker, G. et al. 1997. Early onset depression: the relevance of anxiety. *Soc. Psychiatry Psychiatr. Epidemiol.* 32, 30-37.
- Patel, V. et al. 2008. Detecting common mental disorders in primary care in India: a comparison of five screening questionnaires. *Psychological medicine*, 38(02), 221-228.
- Paykel, E.S. and Priest, R.G. 1992. Recognition and management of depression in general practice: consensus statement. *BMJ* 305 (6863):1198-1202.
- Perenboom, R. et al. 2000. *Life-expectancy in good mental health: establishing cut-offs for the MHI-5 and GHQ-12* (in Dutch). Leiden: TNO-report. 2000.
- Pevalin, D.J. and Goldberg, D.P. 2003. Social precursors to onset and recovery from episodes of common mental illness. *Psychol.Med.* 33 (2):299-306.
- Pevalin, D.J. 2009. Housing reposessions, evictions and common mental illness in the UK: results from a household panel study. *J Epidemiol Community Health* 63 (11):949-951.
- Pickett, K.E. and Pearl, M. 2001. Multilevel analyses of neighbourhood socioeconomic context and health outcomes: a critical review. *J.Epidemiol.Community Health* 55 (2):111-122.
- Poortinga, W. et al. 2007. Perceptions of the neighbourhood environment and self- rated health: a multilevel analysis of the Caerphilly Health and Social Needs Study. *BMC Public Health*, 7(1), 285.
- Powell, J. et al. 2011. The Characteristics and Motivations of Online Health Information Seekers: Cross-Sectional Survey and Qualitative Interview Study. *Journal of Medical Internet Research*, 13(1), e20. doi:10.2196/jmir.1600. [Accessed: 5 August 2012].
- Propper, C. et al. 2005. Local neighbourhood and mental health: Evidence from the UK. *Social Science and Medicine*, 61, (10): 2065-2083.

- Rait, G. et al. 2009. Recent trends in the incidence of recorded depression in primary care. *Br.J.Psychiatry* 195:520-524.
- Reijneveld, S.A. and Schene, A.H. 1998. Higher prevalence of mental disorders in socioeconomically deprived urban areas in The Netherlands: community or personal disadvantage?. *Journal of Epidemiology and Community Health*, 52(1), 2-7.
- Renahy, E. et al. 2010. Determinants of the frequency of online health information seeking: Results of a Web-based survey conducted in France in 2007. *Informatics for Health and Social Care*, 35:1 , 25-39. [Accessed: 20 June 2012].
- Rhodes, S.D. et al. 2003. Collecting behavioural data using the world wide web: considerations for researchers *J Epidemiol Community Health*, 57:1 68-73 doi:10.1136/jech.57.1.68 [Accessed: 15 June 2012].
- Romppel, M. et al. 2013. What is the General Health Questionnaire-12 assessing? Dimensionality and psychometric properties of the General Health Questionnaire-12 in a large scale German population sample. *Compr Psychiatry*. May; 54(4): 406-413.
- Rothman, K.J. et al. 1997. Epidemiology and the Internet. *Epidemiology*, 8(2), pp. 123-125.
- Rothman, K.J. et al. 2013. Why representativeness should be avoided. *International Journal of Epidemiology*, 42(4), 1012-1014.
- Rothman, K.J. et al. 2014. Representativeness is not helpful in studying heterogeneity of effects across subgroups. *International Journal of Epidemiology*, 43(2), 633-634.
- Rukavina, T.V. et al. 2012. Prevalence and five-year cumulative incidence of psychological distress: the CroHort study. *Coll.Antropol.* 36 Suppl 1:109-112.
- Rumpf, H.J. et al. 2001. Screening for mental health: validity of the MHI-5 using DSM-IV Axis I psychiatric disorders as gold standard. *Psychiatry Res.* 105 (3):243-253.
- Sacker, A. and Wiggins, R.D. 2002. Age-period-cohort effects on inequalities in psychological distress, 1981-2000. *Psychological Medicine*, 32, 977-990.
- Schrapler, J.P. 2003. *Respondent behaviour in panel studies: a case study for income-nonresponse by means of the British Household Panel Study (BHPS)* (No. 2003-08). ISER Working Paper Series.

- Shelton, N.J. and Herrick, K.G. 2009. Comparison of scoring methods of the General Health Questionnaire-12 with the Edinburgh Postnatal Depression Scale in English women. *Public Health*, 123, 789-793.
- Shephard, M. et al. 1968. An experimental approach to psychiatric diagnosis. *Acta Psychiatrica Scandinavica Suppl.* 201.
- Sherbourne, C.D. and Stewart, A.L. 1991. The MOS social support survey. *Social Science & Medicine*, 32(6), 705-714.
- Silkapit, C. 1997. *A study of Common Mental Disorders in Primary Care in Thailand*. PhD Thesis, University of London.
- Singleton, N. et al. 2001. *Psychiatric Morbidity Among Adults Living in Private Households*. London: TSO (The Stationery Office).
- Skapinakis, P. et al. 2005. Mental health inequalities in Wales, UK: multi-level investigation of the effect of area deprivation. *Br.J.Psychiatry* 186:417-422.
- Skapinakis, P. et al. 2006. Socio-economic position and common mental disorders. Longitudinal study in the general population in the UK. *Br.J.Psychiatry* 189:109-117.
- Slootmaker, S.M. et al. 2009. Feasibility and Effectiveness of Online Physical Activity Advice Based on a Personal Activity Monitor: Randomized Controlled Trial. *Journal of Medical Internet Research*, 11(3), e27. doi:10.2196/jmir.1139 [Accessed: 5 June 2013].
- Soegaard, H.J. 2012. Undetected common mental disorders in long-term sickness absence. *Int.J Family.Med.* 474989, 1-7.
- Stafford, M. and Marmot, M. 2003. Neighbourhood deprivation and health: does it affect us all equally? *Int.J.Epidemiol.* 32 (3):357-366.
- Stafford, M. et al. 2008. Neighbourhood characteristics and trajectories of health functioning: a multilevel prospective analysis. *Eur.J.Public Health* 18 (6):604-610.
- Stafford, M. et al. 2011. Neighbourhood social environment and depressive symptoms in mid-life and beyond. *Ageing and Society*, 31(06), 893-910.
- Tavares, L.P. and Aassve, A. 2013. Psychological distress of marital and cohabitation breakups. *Social science research*, 42(6), 1599-1611.
- Taylor, M. et al. 2005. *British Household Panel Survey User Manual Volume A: Introduction, technical report and appendices*. University of Essex.

- Taylor, M. et al. 2007. The psychological costs of unsustainable housing commitments. *Psychological Medicine*, 37, 1027-1036.
- Theunissen, M.J. et al. 2011. Are mental health and binge drinking associated in Dutch adolescents? Cross-sectional public health study. *BMC research notes*, 4(1), 100.
- Thoits, P.A. 1983. *Reconceptualizing mental illness: Deviations in feeling and expression*. Paper presented at the meeting of the American Psychological Association, Anaheim, CA, August 1983.
- Thomas, C. et al. 2005. Employment transitions and mental health: an analysis from the British household panel survey. *J.Epidemiol.Community Health*, 59 (3):243-249.
- Thomas, H. et al. 2007. Mental health and quality of residential environment. *The British Journal of Psychiatry*, 191(6), 500-505.
- Thorsen, S.V. et al. 2013. The predictive value of mental health for long-term sickness absence: the Major Depression Inventory (MDI) and the Mental Health Inventory (MHI-5) compared. *BMC.Med.Res.Methodol.* 13(1):115.
- Ustun, T.B. and Sartorius, N. 1995. Mental illness in primary care: an international study. *Mental illness in primary care: an international study*, John Wiley & Sons Inc. New York.
- van den Beukel, T.O. et al. 2012. Comparison of the SF-36 Five-item Mental Health Inventory and Beck Depression Inventory for the screening of depressive symptoms in chronic dialysis patients. *Nephrol.Dial.Transplant.* 27 (12):4453-4457.
- van Gelder, M.H.J. et al. 2010. Web-based Questionnaires: The Future in Epidemiology? *Am. J. Epidemiol.* first published online September 29, 2010 doi:10.1093/aje/kwq291 [Accessed: 13 July 2011].
- van Os, J.I.M. 2004. Does the urban environment cause psychosis? *The British Journal of Psychiatry*, 184(4), 287-288.
- Veit, T. and Ware, J.E. 1983. The Structure of Psychological Distress and Well-being in General Populations. *Journal of Consulting and Clinical Psychology*, 51 (5), 730-742.
- Virzi, R. 1990. Streamlining the design process: Running fewer subjects. *Proceedings of the Human Factors Society 34<sup>th</sup> annual meeting, Orlando, FL*, 1 (pp. 291-294), October 8-12, 1990 Stouffer Orlando Resort, Orlando, Florida.

- Virzi, R. 1992. Refining the test phase of usability evaluation: How many subjects is enough? *Human Factors*, 34, 457-468.
- Wacker, H.R. et al. 1992. Identification of cases of anxiety and affective disorders in the community according to ICD- 10 and DSM-III-R by using the Composite International Diagnostic Interview (CIDI). *International Journal of Methods*. 2.91-100.
- Wade, T.J. and Pevalin, D.J. 2004. Marital transitions and mental health. *J Health Soc.Behav.* 45 (2):155-170.
- Waldron, C. 2012. *Cardiovascular Risk Prediction*. PhD Thesis, Cardiff University.
- Ware, J.E. et al. 1980. *Conceptualisation and measurement of health for adults in the Health Insurance Study Volume VI: Analysis of relationships among health status measures*. Santa Monica, CA: The RAND Corporation (publication no. R-1987/6-HEW).
- Ware, J.E. et al. 1994. *SF-36 physical and mental health summary scales: a user's manual*. Health Assessment Lab.
- Ware, J.E. et al. 1995. Comparison of methods for the scoring and statistical-analysis of SF-36 health profiles and summary measures: summary of results from the Medical Outcomes Study. *Medical Care*, 33, AS264-279.
- Ware, J.E. and Gandek, B. 1998. Overview of the SF-36 survey and the international quality of life assessment (IQOLA). *Journal of Clinical Epidemiology*, 51, 903-912.
- Ware, J.E. et al. 2000. *How to score version 2 of the SF-36® Health Survey*. Lincoln, RI: Quality Metric Incorporated.
- Ware, J.E. 2008. Improvements in short-form measures of health status: Introduction to a series. *Journal of Clinical Epidemiology*, 61, 1-5.
- Weich, S. 1997. Do socio-economic risk factors predict the incidence and maintenance of psychiatric disorder in primary care? *Psychol.Med.* 27 (1):73-80.
- Weich, S. et al. 1998. Social roles and gender difference in the prevalence of common mental disorders. *British Journal of Psychiatry*. 173, 489-93.
- Weich, S. and Lewis, G. 1998. Poverty, unemployment, and common mental disorders: population based cohort study. *BMJ* 317 (7151):115-119.



- Weich, S. et al. 2001 Income inequality and the prevalence of common mental disorders in Britain. *British Journal of Psychiatry*. 178, 222-227.
- Weich, S. et al. 2002. Mental health and the built environment: cross-sectional survey of individual and contextual risk factors for depression. *Br.J.Psychiatry* 180:428-433.
- Weich, S. et al. 2003. Contextual risk factors for the common mental disorders in Britain: a multilevel investigation of the effects of place. *J.Epidemiol.Community Health* 57 (8):616-621.
- Weich, S. et al. 2005. Geographical variation in rates of common mental disorders in Britain: prospective cohort study. *Br.J.Psychiatry* 187:29-34.
- Weich, S. et al. 2006. Rural/non-rural differences in rates of common mental disorders in Britain: prospective multilevel cohort study. *Br.J.Psychiatry* 188:51-57.
- Wells, K. B. 1988. Psychiatric disorder and limitations in physical functioning in a sample of the Los Angeles general population. *Am.J Psychiatry* 145 (6):712-717.
- Welsh Government 2013. *Welsh Health Survey 2013*. [Accessed: 10 January 2015], Available at: <http://wales.gov.uk/statistics-and-research/welsh-health-survey/lang=en/>.
- Wheaton, B. 1990. "Life Transitions, Role Histories, and Mental Health." *American Sociological Review* 55:209-23.
- Wight, R.G. et al. 2013. Urban neighbourhood unemployment history and depressive symptoms over time among late middle age and older adults. *Journal of epidemiology and community health*, 67(2), 153-158.
- Williams, P. et al. 1986. Minor psychiatric morbidity and general practice consultations: the West London Survey. *Psychological Medicine*. 9, 1-37.
- Wilkinson, G. and Markus, A.C. 1989. PROQSY: a computerised technique for psychiatric case identification in general practice. *The British Journal of Psychiatry*, 154(3), 378-382.
- Winston, M. and Smith, J. 2000. A trans-cultural comparison of four psychiatric case-finding instruments in a Welsh community. *Social Psychiatry and Psychiatric Epidemiology*, 35, 569-575.

- Wood, F. et al. 2002. Patients' opinions of the use of psychiatric case-finding questionnaires in general practice. *Health Expect.* 5 (4):282-288.
- World Health Organisation 1948, *Official Records of the WHO*, 1948, no. 2, p. 100. World Health Organisation, Geneva.
- World Health Organisation 1992. *The ICD-10 classification of mental and behavioural disorders: Clinical descriptions and diagnostic guidelines*. World Health Organisation, Geneva.
- World Health Organization 1993. *The ICD-10 Classification of Mental and Behavioural Disorders: Diagnostic Criteria for Research*. World Health Organization, Geneva.
- World Health Organization 2001. *The World Health Report: 2001: Mental Health: New understanding, new hope*. Geneva: World Health Organization, 2001. Available at: [http://www.who.int/whr/2001/en/whr01\\_en.pdf](http://www.who.int/whr/2001/en/whr01_en.pdf). [Accessed: 5 October 2010].
- World Health Organization 2004. *The Global Burden of Disease: 2004 update*. Geneva: World Health Organization. Available at: [http://www.who.int/healthinfo/global\\_burden\\_disease/2004\\_report\\_update/en](http://www.who.int/healthinfo/global_burden_disease/2004_report_update/en). [Accessed: 5 October 2010].
- World Health Organisation 2008. *Projections of mortality and burden of disease, 2004-2030*. Available at: [http://www.who.int/healthinfo/global\\_burden\\_disease/projections/en/index.html](http://www.who.int/healthinfo/global_burden_disease/projections/en/index.html) [Accessed: 5 October, 2010].
- World Health Organisation: *Mental health: Mental health: a state of well-being* Available at: [http://www.who.int/features/factfiles/mental\\_health/en](http://www.who.int/features/factfiles/mental_health/en) [Accessed: 10 October 2014].
- Youden, W. 1950. An index for rating diagnostic tests. *Cancer*, 3, 32-35.

## APPENDIX

Participants information letter

Web browser address bars sheet

Participants study information sheet

**[On Cardiff University, School of Medicine Headed stationery]**

**[Name & address]**

**Inserted by IOS]**

*Dear [Salutation inserted by IOS]*

***Invitation to join a study exploring changes in well-being***

*We are asking for your help in studying what affects our well-being. This study involves 10,000 people who are between 18 and 74 years of age and who reside in Caerphilly borough. It is being conducted and funded by the School of Medicine at Cardiff University. You have been contacted through NHS Wales Informatics Service; your identity is not known to us and will not be known, even if you join the study.*

*The study has been designed to make it easy for you to take part. All you have to do is find a computer or device that is connected to the Internet which you can use (e.g. home pc, laptop, Smartphone or a library pc etc.). Then go to the '**Changes in Well-being**' web-site using the following method:*

*Type the website address: **<https://medic.cardiff.ac.uk/new/cwb/>** into the web browser address bar. Please refer to the enclosed help sheet 'Web browser address bars' if these are unfamiliar to you. Access to the website has been intentionally restricted therefore typing the website address into a search engine such as Google will not locate the website.*

*If you are using a Smartphone such as a Blackberry, be sure to scroll down each webpage to ensure that the function buttons are accessible.*

*You can take part whenever it is convenient for you within the next month. The website describes what taking part involves and will help you decide whether or not you wish to do so. If you do, you will need to enter the following number when asked:*

***User ID: [Inserted by IOS]***

*In case you would like to know more now, we have enclosed the study information sheet which describes in more detail what is involved. Please read it. We also have a free-phone helpline on **0800 0 272 194** if you would like to speak to an adviser in our Participant Research Centre to obtain further information or assistance. Please be aware that this number is free from a BT landline but may not be from other providers or mobile telephone networks.*

*Thank you for considering taking part in this study.*

*Yours sincerely*

***[Digital signature given to IOS]***

*Lynn Jessop LLB, MSc, Dip Psych*

*PhD Student*

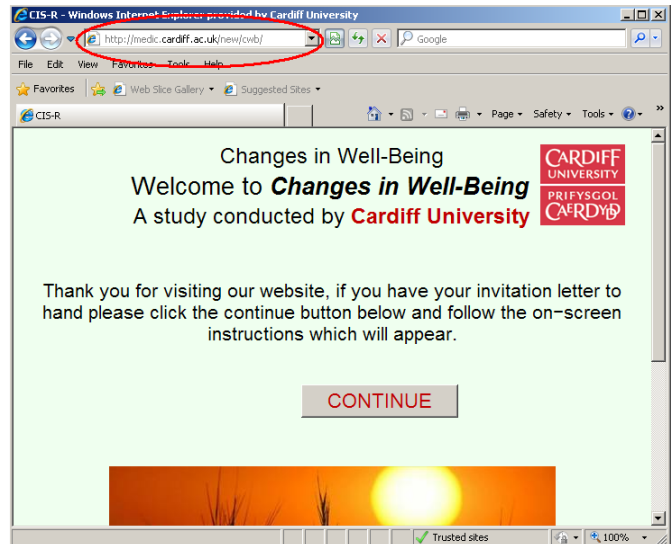
*Study Chief Investigator*

*Cochrane Institute of Primary Care and Public Health  
School of Medicine  
Cardiff University  
Neuadd Meirionnydd  
Heath Park,  
Cardiff CF14 4YS*

## Web browser address bars

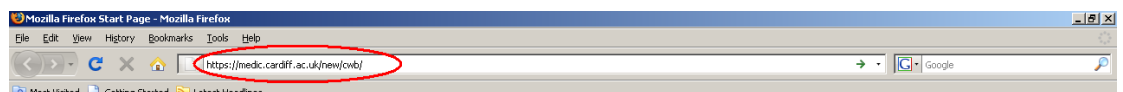
Below are screen shots of the address bars of the more common web browsers in use. If the one you use is not shown, the position and appearance of the address bar will be very similar.

Internet Explorer:

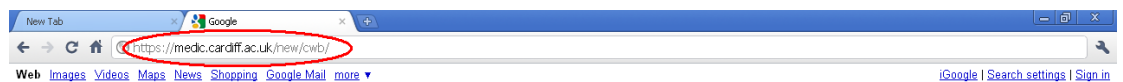


### Website home page

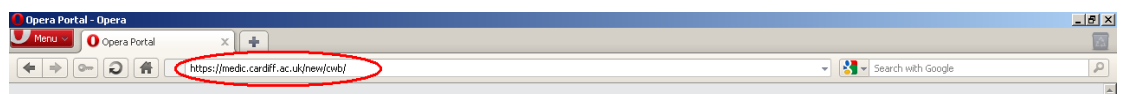
Mozilla Firefox



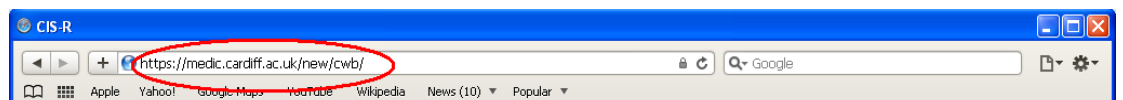
Google Chrome



Opera



Safari



When you open your web browser, highlight the home page address in the address bar and delete it. Then type in <https://medic.cardiff.ac.uk/new/cwb/> and press enter. If the webpage shown above does not appear, check that the address is correctly entered, and if problems persist please contact the free-phone helpline on **0800 0272 194**.



## Changes in Well-Being



### The Study Information sheet

These pages tell you about the study and what taking part involves. It is important that you understand what is involved before deciding whether to take part. We hope you will find everything you need to know here, but, if you have other questions, want further information or would like us to explain something about the study to you, please call our free-phone helpline (Monday-Friday 8.00am - 6.00pm) and one of our advisers in the University's Participant Research Centre will be happy to help you. The helpline number is **0800 0 272 194**. Please be aware that this number is free from a BT landline, but may not be from other providers or mobile telephone networks.

#### ***Why have you contacted me?***

You are being invited to take part in a study into what affects our well-being.

#### ***Who is running it?***

The study is run and funded by Cardiff University's School of Medicine.

#### ***Who is taking part?***

10,000 people (randomly selected) aged 18-74, who reside in the Caerphilly Borough.

#### ***Taking Part is voluntary***

You don't have to take part. If you wish to take part, you will have one month from the date of your invitation letter to do so.

### ***We will not have your personal details***

We won't ask you for any personal identity information. All participant identity information for this study is held securely by NHS Wales Informatics Service and is not released to the research team.

### ***What will I have to do?***

If you would like to take part, we will ask you to do two things:

Give your consent to taking part in the study.

Answer some questions about yourself in two questionnaires. The questions will cover various topics such as aches and pains, mood, sleep, fatigue, and physical health. This will take between 20 - 60 minutes but varies for each person. You can answer these questions at any time on any computer or device with internet access. Both questionnaires must be completed in one attempt, so if you log out half way through and return later, you will have to start over.

### ***How do I join the study?***

Go to the study website using the address provided in your invitation letter and follow the on screen instructions. You will also need your letter for the login details.

### ***How do I complete the study?***

You complete the study by answering all of the questions presented. You will be informed when you reach the end.

### ***Why take part?***

Research is vital; without it numerous invaluable discoveries might never have been made. Without the help of people just like you, many studies would be impossible. This research may lead to beneficial changes in health and well-



being assessment. We hope that you will value being an important part of this study and find the research process interesting.

As a gesture of our appreciation, one person who completes and submits the online questionnaires will be selected at random to receive a ***DAB Internet radio*** at the conclusion of the data collection stage of the study.

NHS Wales Informatics Service will notify the selected recipient as we do not have any participant identity information.

***What if I need support after taking part?***

Please see the Guidance Notes page which follows the questionnaires.

***Any questions?***

If you have any questions regarding any aspect of the '***Changes in Well-Being***' study we can be contacted either on the free-phone number or at the address below:

Cardiff University, Cochrane Institute of Primary Care and Public Health,  
School of Medicine, 4th Floor Neuadd Meirionnydd, Heath Park  
Cardiff, CF14 4YS

**Free-phone 0800 0 272 194 (Monday-Friday 8.00am to 6.00pm)**