



McLean, R.C., Morrison, D., Shearer, R., Boyle, S., and Logue, J. (2016) Attrition and weight loss outcomes for patients with complex obesity, anxiety and depression attending a weight management programme with targeted psychological treatment. *Clinical Obesity*, 6(2), pp. 133-142. (doi:[10.1111/cob.12136](https://doi.org/10.1111/cob.12136))

This is the author's final accepted version.

There may be differences between this version and the published version. You are advised to consult the publisher's version if you wish to cite from it.

<http://eprints.gla.ac.uk/118709/>

Deposited on: 2 May 2016

Attrition and weight loss outcomes for patients with complex obesity, anxiety and depression attending a weight management programme with targeted psychological treatment

Ross C McLean¹, David S Morrison², Ross Shearer³, Susan Boyle³ and Jennifer Logue¹

1Institute of Cardiovascular and Medical Sciences, University of Glasgow, Glasgow, UK

2West of Scotland Cancer Surveillance Unit, 1 Lilybank Gardens, Glasgow G12 8RZ, UK:

3Glasgow and Clyde Weight Management Service, NHS Greater Glasgow and Clyde, Glasgow, UK

Corresponding Author:

Jennifer Logue, Clinical Senior Lecturer and Honorary Consultant in Metabolic Medicine, BHF Cardiovascular Research Centre, University of Glasgow, 126 University Avenue, Glasgow, G12 8TA.

Email: jennifer.logue@glasgow.ac.uk

Keywords

Anxiety, depression, HADS, weight management, weight loss.

Running Title

HADS in weight management: attrition & weight loss

What is already known about this subject?

- Baseline depression is associated with greater attrition rates from weight management programmes and is also with poorer weight loss success.
- There is little evidence regarding the role of baseline anxiety as a predictor of attrition or weight loss in weight management programmes.
- There is some evidence that patients with baseline mood disorders achieve similar weight loss to controls in weight management programmes with an integrated psychological component

What this study adds

- This study confirms that baseline anxiety and depression (identified using HADS) is associated with higher attrition of patients from a weight management programme with an integrated psychology service.
- Despite a significantly less favourable case-mix of risk-factors for poor weight loss:
 - Patients with severe anxiety at baseline achieve similar weight loss outcomes to those without baseline anxiety.
 - Significantly greater weight loss is seen in participants with severe baseline depression at all stages of follow-up in the Glasgow and Clyde Weight Management Service.

Abstract

Objective: To investigate the effect of baseline anxiety and depression, using different definitions for caseness, on attrition and weight outcomes following a multidisciplinary weight management programme.

Design: Prospective observational study. The Hospital Anxiety and Depression Scale (HADS) was used to measure anxiety and depression with 'caseness' scoring ≥ 11 and severity ≥ 14 .

Participants: All patients who began a weight management programme between 1 October 2008 and 30 September 2009 (n=1838).

Setting: Glasgow and Clyde Weight Management Service (GCWMS) is a specialist multidisciplinary service, which aims to achieve a minimum of ≥ 5 kg weight loss. Patients with HADS score ≥ 14 were referred to the integrated psychology service for psychological assessment/intervention.

Results: Patients with caseness (HADS ≥ 11) for anxiety (33%) and depression (27%) were significantly younger, heavier, more socioeconomically deprived and a higher proportion were female. There was a significant positive correlation between HADS anxiety and depression scores and increasing BMI ($r^2=0.094$, $p<0.001$ and $r^2=0.175$, $p<0.001$, respectively). Attendance and completion was lower throughout follow-up amongst patients with anxiety or depression. More patients with HADS score ≥ 11 achieved ≥ 5 kg or $\geq 5\%$ weight loss and by 12 months those with anxiety had a significantly higher mean weight loss ($p=0.032$). Participants who scored for severe anxiety (HADS ≥ 14) achieved similar weight loss to those without, whilst participants who scored for severe depression achieved significantly greater weight loss than non-cases at 3, 6 and 12 months of follow-up ($p<0.01$).

Conclusions: Despite a less favourable case-mix of risk-factors for poor weight loss, patients who scored caseness for severe anxiety/depression and were offered additional psychological input achieved similar or better weight loss outcomes.

Introduction

Obesity (Body Mass Index (BMI) $\geq 30\text{kg/m}^2$) and psychological distress, including anxiety and depression, frequently co-exist, particularly in women¹⁻⁷. Anxiety disorders are characterized by feelings of anxiety and fear, where anxiety is a worry about future events and fear is a reaction to current events, whilst depressive disorders are a common form of mood disorder, characterized by sadness, loss of interest or pleasure, feelings of guilt or low self-worth, disturbed sleep or appetite, feelings of tiredness, and poor concentration⁸. The prevalence of anxiety and depression amongst obese individuals is greater than in the non-obese, and it appears that the prevalence increases with increasing BMI^{1,9}. *Petry et al.*¹⁰ identified a higher lifetime and past year prevalence of anxiety with obesity compared to normal BMI (20.7% vs. 16%, and 13.4% vs. 10.2% respectively), and these findings were confirmed in depression and obesity compared to normal BMI (20.4% vs. 16.4%, and 8.5% vs. 7.15%). According to the World Health Organisation, the prevalence and burden of anxiety and depression are expected to rise to become the largest contributor to the global burden of disease by 2030^{11,12}. It is unclear the extent to which the obesity epidemic and the burden of mental health disorders will drive one another; however what is clear is the parallel between them.

Attrition from weight management programmes is common and reduces the exposure to the intervention, which has been shown to result in poorer weight loss outcomes^{13,14}. Baseline depression¹³⁻¹⁶ or a past history of depression^{17,18} have been shown to increase attrition from weight management programmes, most likely because the lethargy and lack of motivation often associated with depression prevents effective engagement with the demanding weight loss programmes¹⁹. Literature is sparse regarding the role of anxiety disorders in weight loss programme dropout. Baseline depression has been shown to reduce weight loss success in weight management programmes^{15,20,21} and predict weight gain²²; however baseline anxiety has only been identified as a negative predictor of weight loss success in bariatric patients^{23,24}.

The UK National Institute for Clinical Excellence²⁵ has issued guidance on lifestyle weight management services identifying that they should be developed by a multidisciplinary team, including dietitians, psychologists and physical activity instructors. This advice takes into account the importance of behavioural change and psychologist input in weight management programmes, which have been shown to improve weight loss and maintenance²⁶⁻²⁸ rather than diet and exercise alone in the populations attending weight management services. There is some evidence that patients with baseline anxiety and/or depression achieve similar weight loss to controls in weight management programmes with an integrated psychological component^{13,29-32}. However, despite guidelines recommending psychologist input in weight management services, there is a lack of evidence for what screening tools should be used, what interventions should be provided and what their effectiveness is.

This study examines the prevalence and associations of anxiety and/or depressive symptomatology at baseline in patients attending a multidisciplinary weight management programme with a Cognitive Behavioural Therapy (CBT) programme for all patients, with psychological screening and additional psychological intervention when required. Using different HADS scores to diagnose caseness (≥ 11)

and define severity (≥ 14) for anxiety and depression, this study investigates the attrition and weight outcomes at 3, 6, and 12 months following dietary, exercise and psychological intervention.

Methods

Setting

Glasgow and Clyde Weight Management Service

NHS Greater Glasgow and Clyde (NHSGGC), population 1.2 million, implemented the Glasgow and Clyde Weight Management Service (GCWMS) model in 2008: a multicomponent weight management programme that is integrated across primary and secondary care, delivered in out-patient hospital settings and community-based sites. GCWMS aims to support individuals to achieve a minimum of ≥ 5 kg weight loss. In the hierarchy of interventions for the treatment of obesity in NHSGGC, this service sits above local authority, commercial and third-sector services, on the pathway to bariatric surgery.

Glasgow and Clyde Weight Management Service (GCWMS) is described in detail in previous publications^{2,33} and is summarised here. GCWMS is a multidisciplinary weight management programme involving dietitians, clinical psychologists, physiotherapists and administrative staff. Patients aged 18 years and over with complex obesity (defined as BMI of ≥ 30 kg/m² with obesity-related comorbidities or BMI of ≥ 35 kg/m²) are eligible and referred by their GP or hospital doctor. Treatment pathways and goals were developed based on best evidence and national guidelines^{27,28,27,28}.

Integrated Psychology Service

GCWMS have an integrated psychology service within their service model. All clients who access GCWMS have some level of psychological provision ranging from the least intensive: cognitive-behavioural components incorporated within the standard weight management programme; to the most intensive: individual psychological assessment and therapy.

A 'matched-care' model triages psychology assessments and interventions as efficiently as possible (see **Figure 1**). Clients are offered access to psychological approaches through psychological assessments; triage clinics (brief assessment) and psycho-educational talks. The more intense group-interventions and individual therapy are directed to those with the more complex presentations. The current model of psychological provision requires qualified clinical psychologists to provide assessment/intervention and to support less intensive levels of treatment.

Hospital Anxiety and Depression Scale (HADS)

After referral to the service, all patients complete the Hospital Anxiety and Depression Scale questionnaire³⁴⁻³⁶ at initial assessment. This measure is used to assess for symptoms of anxiety and depression to identify those that may require further psychological assessment/support. The scale assesses for presence of morbidity and gives an indication of severity, with a score of 11-14 indicating 'moderate disorder' and ≥ 14 being a 'severe disorder'³⁷. A score of ≥ 11 for either anxiety or depression is used to indicate 'caseness', a threshold for diagnosis, and a score of ≥ 14 identifies those with more severe symptoms.

In GCWMS, all patients scoring ≥ 14 for anxiety and/or depression on the HADS are offered the option to opt-in for an additional psychology assessment and potential intervention with a clinical psychologist, in line with the matched care model detailed above and in **Figure 1**. Given the demands on the service and the capacity to provide the range of psychological interventions, this eligibility score was selected for the more severely symptomatic patients. Although it is higher than cut-offs used in other studies, within this routine service delivery it was selected as a way to match capacity with demand and to target the most psychologically distressed patients. Additionally, patients may also be referred to psychology relating to other difficulties such as disordered eating behaviours, low self-esteem, body image distress, interpersonal difficulties, past trauma, and cognitive impairments; however only their HADS score was considered in this study. Psychological assessment aims to identify the need for additional psychological intervention to support and manage their symptoms, to ultimately maximise their adherence with weight management interventions.

Non-psychology GCWMS staff (dietitians and physiotherapists) are trained to interpret this screening measure at initial assessment. Clinical judgement is also encouraged regarding those who do not meet a score of ≥ 14 but may still benefit from additional psychological assessment/intervention; however these patients were not included in this study.

Data and Analysis

Definitions of completers and time points

Patients were considered to be 'completers' if they attended $\geq 4/9$ sessions in the lifestyle intervention phase, $\geq 2/3$ sessions in the further weight loss treatment phase, and $\geq 6/12$ sessions in the weight maintenance phase. This is consistent with a definition of completion used in another weight management programme in the UK with 50% attendance³⁸. Three, six or twelve month time points were described as follows: for three months, a weight recorded at 84 days (12 weeks) was used; if unavailable the range was extended from 70 to 98 days. For six months, a weight at 182 days (26 weeks, extended range 154 to 210 days) and for 12 months, a weight measured at 364 days (52 weeks, extended range 308 to 422 days).

Socioeconomic status

Patients' socio-economic circumstances were estimated using the Scottish Index of Multiple Deprivation (SIMD)³⁹: an area-based index that uses seven domains (current income; employment; health; education, skills and training; geographic access to services; housing; and crime) to describe the level of deprivation in small geographic areas (data zones). All data zones in Scotland are ranked from 1 (most deprived) to 6505 (least deprived), and we used quintiles of the Scottish population, ranging from 1 (most deprived) to 5 (least deprived) to further categorise.

Data and statistical methods

All referrals to the GCWMS from 1 October 2008 to 30 September 2009 were followed until they completed or left the programme. Data were censored at 1 December 2011, so that full data were

available on patients who completed the weight maintenance period, which occurred around 19 months after starting the programme. Weight change from entry to the programme to 3, 6 and 12 months is described. A conventional statistical significance cut-off of 5% was used. Primary analyses were carried out in all patients who began treatment. Missing data was due to patients failing to attend appointments or leaving the programme early; reasons for non-attendance are generally not known. Where data were missing, the method of last observation carried forward (LOCF) was preferred. Statistical tests for stratified analyses used chi-square tests for categorical variables and Kruskal-Wallis for continuous variables. Independent t-tests and Pearson correlations were performed using the SPSS Statistical Software Package V.21. Non-identifiable data were provided by GCWMS for the purposes of evaluating a routine NHS service and consequently ethical committee review was not sought.

Results

Over the 1-year period from October 2008 to September 2009, 6505 referrals were made to GCWMS, of whom 5637 were eligible for the service, based on BMI, age, area of residence and comorbidities. Of the 5637 eligible patients, 61% (3460) opted into the service, 58% (3249) attended for assessment, 3 were deemed ineligible at assessment because their BMI was lower than 30 kg/m², 38% (2153) opted to enter phase 1 and 34% (1916) attended phase 1 at least once. From the dataset of 1916 patients, we excluded a further 4 whose initial BMI was recorded as ≤ 30 kg/m² and 74 who were directed to a specialised disordered eating group (where they received different, specialised psychological interventions that are qualitatively different from the main programme), leaving a final sample for analysis of 1838 patients.

Prevalence and baseline characteristics

Anxiety and depression was prevalent amongst the 1838 patients who attended at least one session at the GCWMS, and using the widely used definition of HADS ≥ 11 to delineate caseness for moderate symptomatology, the prevalence of anxiety was 33% and 27% for depression. When using the GCWMS cut-off (≥ 14) for severity, 14.3% suffered from anxiety and 10.7% from depression, and this represents the proportion of patients who were offered additional psychological intervention. There were 43 instances of missing HADS-Anxiety (HADS-A) score (2.3%) and 42 instances of missing HADS-Depression (HADS-D) score (2.3%).

Table 1 describes the difference in baseline characteristics in those patients who commenced the GCWMS and shows comparative characteristics between HADS-A and HADS-D scores at cut-offs of 11 and 14. There were significantly more women enrolled in the programme who scored ≥ 11 in HADS-A and -D, and patients were younger in the ≥ 11 group. The mean initial BMI was greater amongst those scoring ≥ 11 for HADS-A and HADS-D, and this is affirmed by the greater initial weight (kg). Additionally, patients who scored ≥ 11 for anxiety and depression were from more socioeconomically deprived backgrounds with almost half of patients being from the most deprived SIMD group.

Those who scored ≥ 14 for HADS-A were significantly younger, more deprived and had a higher proportion of females than those who scored < 14 . There was a significant difference in baseline characteristics with a HADS-D score ≥ 14 , where patients were significantly younger, heavier, and were also proportionately more female and deprived.

Increasing HADS anxiety and depression scores are correlated with increasing BMI (HADS-A: $r^2=0.094$, $p<0.001$; HADS-D: $r^2=0.175$, $p<0.001$). However, despite the correlation, it is not possible to distinguish the directionality or causality of the relationship.

Attendance and Completion

The attendance and completion rates by HADS score are shown in **Table 2**. Both attendance and completion rates are lower amongst patients with anxiety and depression. Significantly fewer patients opted into the weight management programme when they scored for caseness (≥ 11) in HADS-A and HADS-D. Those who scored ≥ 11 for HADS-A had lower rates of completion at 6 months ($p=0.001$),

and for HADS-D there were significantly fewer completers at 6 and 12 months ($p=0.011$ and $p=0.024$ respectively). There were approximately 5% fewer completers who scored ≥ 14 in HADS-A compared to those who scored <14 , and this difference was highly significant at 3, 6, and 12 months. For individuals who scored ≥ 14 in HADS-D, there were approximately 3% fewer completers at 3, 6, and 12 months, and differences were only significant at 12 months.

Weight Outcomes

Table 3a shows the 3, 6 and 12 month weight loss split by HADS-A and HADS-D ≤ 11 and > 11 respectively. At 3 and 6 months, those with HADS-A ≥ 11 had similar weight loss than those scoring <11 , however by 12 months, those with HADS-A ≥ 11 had a higher mean weight loss. **Table 3b** shows a greater percentage of patients achieved $\geq 5\%$ or $\geq 5\text{kg}$ weight loss with HADS-A ≥ 11 at 12 months compared to HADS-A <11 . At 3 months, HADS-D ≥ 11 had significantly less weight loss, but there was no difference by 6 or 12 months. More patients with HADS-D ≥ 11 achieved $\geq 5\text{kg}$ weight loss at 3, 6, and 12 months compared to HADS-D <11 .

Patients who scored ≥ 14 for HADS-A had a similar weight loss to those who scored <14 . However, those who scored ≥ 14 in HADS-D had a significantly greater weight loss at 3, 6, and 12 months of follow-up. There was no difference in the proportion of patients achieving $\geq 5\%$ and/or $\geq 5\text{kg}$ weight loss between HADS-A severe cases and non-severe cases. A higher percentage of those with HADS-D ≥ 14 achieved $\geq 5\%$ and/or $\geq 5\text{kg}$ at 6, and 12 months compared to those who scored <14 .

Outcomes stratified by gender, age and socioeconomic status

There was no difference in attrition at 12 months (**Figure 2a-b**) between males and females when stratified by HADS score. Men had greater weight loss compared to women in the absence of anxiety or depression (HADS <11 or <14). Men had highly significantly greater weight loss when they scored caseness for anxiety (HADS-A ≥ 11) (male -4.61kg , female -3.48kg , $p=0.001$). On examining each gender individually, there was no significant difference in attrition or weight change between patients with anxiety or depression (HADS ≥ 11 or ≥ 14) and those in whom it was absent (HADS <11 or <14).

In patients without anxiety or depression, there was a trend for significantly less attrition at 12 months with increasing age, whilst in patients with caseness for anxiety (HADS-A ≥ 11) younger patients had higher attrition rates (approximately 90%) at 12 months compared to older patients (**Supplementary Figure 1a-b**). Weight loss at 12 months (**Supplementary Figure 1c-d**) was significantly less in younger patients compared to older patients without severe anxiety (HADS-A <14).

There was no evidence of any difference in attrition or weight loss at 12 months by HADS and socioeconomic deprivation (**Supplementary Figures 2a-2d**).

Discussion

This study shows that patients with complex obesity who score for caseness of severe anxiety and/or depression in a weight management service with integrated psychological input achieve the same or better weight loss outcomes than non-cases. Despite patients being at higher risk of poor weight outcomes due to patient mix of younger, more female and more deprived individuals, patients who were offered additional psychological input due to their psychological co-morbidity achieved equal or better outcomes than those without this additional input.

HADS scores for caseness are usually defined at 11 in literature^{34,37,40}; however, GCWMS used 14 to indicate severity as the cut-off for psychological intervention due to resource constraints, and from this study population 1/3 of patients would have been eligible for the intervention if a cut-off of 11 had been used, which would be unsustainable. Consequently, HADS score of ≥ 14 selects approximately 10-15% of patients, granted that these individuals are likely to have more significant and severe psychopathology.

In patients who score for severe anxiety or depression symptoms, mean weight loss was significantly greater in patients with depression than those scoring < 14 ; indicating a population who benefit most from the intervention, and importantly had a sustained benefit at 12 months. This is reinforced by more patients achieving $\geq 5\text{kg}$ and/or $\geq 5\%$ weight loss at all stages of follow-up. Those scoring ≥ 14 in HADS-A achieve the same results as those who score ≤ 14 in HADS-A, which is consistent with other non-surgical weight management programmes²⁹.

Our findings identify that those who have caseness for anxiety or depression (HADS ≥ 11) have similar weight outcomes to those who scored ≤ 11 ; however this study population includes those with HADS ≥ 14 who had the option of additional psychological intervention and consequently may provide a falsely elevated estimate of weight loss in the caseness population. However, this distinction in classification emphasises the importance of providing intervention to the most severe cases, which enables them to achieve similar outcomes to those without anxiety or depression, or less severe forms.

Factors affecting attendance, attrition and completion in weight management programmes have been widely studied, and are understood to be multifactorial^{2,13,15,16,29}, and it is well recognised that greater baseline psychological symptoms are positively associated with attrition. Despite being offered psychological intervention, patients with HADS-A or HADS-D scores ≥ 14 continued to have higher non-attendance and attrition than non-severe cases. Additional factors which can influence attrition include younger age, greater initial weight and deprivation^{2,15,29}. In this study the patients with greater psychological co-morbidity were significantly younger, heavier and more deprived, however, in this population scoring ≥ 14 for HADS-A or HADS-D, with stratified analyses, there was no significant difference in attrition between gender, age or socioeconomic deprivation.

Previous research by Morrison et al.² identified baseline depression (HADS score ≥ 11) as a significant positive predictor of $\geq 5\text{kg}$ weight loss in both sexes (OR=1.81, 95% CI: 1.35,2.44) for the lifestyle intervention phase of this weight management service, and in women alone, anxiety was a significant

positive predictor (OR=1.59, 95% CI: 1.16,2.18). These findings from an earlier stage of GCWMS are reinforced by this study. They additionally identified greater baseline weight (BMI ≥ 30 kg/m²), age ≥ 40 years, and male sex as positive predictors of weight loss, whilst diabetes mellitus and socioeconomic deprivation were negative predictors. We found that men with symptoms of anxiety (HADS-A ≥ 11) had greater weight loss than women, but we did not identify any difference between age groups or socioeconomic deprivation in patients with caseness for anxiety and/or depression.

Strengths and limitations

The GCWMS is a very large NHS service which provides a real-life study cohort for follow-up and provides a broad population in which there is evidence of effective long-term weight loss. Importantly this is an undifferentiated population of all patients referred by community teams and a particular strength of our study is that we report on outcomes among all patients referred to the GCWMS rather than only on those who completed the programme. Our study benefits from a relatively large sample size, a diverse socio-economic catchment population, and objective measures of height and weight.

The key issues with this study are the non-attendance and attrition which occurred throughout service follow-up, and the lack of available data to account for the reasons for this. There is no information about those who were never referred to the GCWMS and who constitute the “hidden” majority of eligible persons. We do not have data on attendance, attrition, the recommended intervention and completion of the targeted psychological component as these are not currently accessible in the electronic records. Additionally, there is a lack of ancillary information such as baseline characteristics, changes in clinical risk factors (e.g. blood pressure, lipids and glycaemic control) and post-intervention mental health symptoms.

Further studies should review the effectiveness of specific psychological interventions, the cost-effectiveness of this weight-management approach, investigate attendance and attrition, and also evaluate post-intervention mental health symptoms.

Conclusions

Patients with complex obesity who scored for severe anxiety and/or depression symptoms and were offered additional psychological input during their weight management programme achieved similar or better weight loss outcomes than non-severe cases, despite a less favourable case-mix of risk-factors for poor weight loss. Effort should focus on improving attendance at weight management services by patients with psychological difficulties such as anxiety and depression.

Acknowledgements

JL conceived the idea for this study. RM carried out all statistical analyses. RM and JL drafted the manuscript; DSM, RS and SB commented on later drafts. All authors contributed to the design of study and approved the final draft of the manuscript.

Financial support

This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Conflict of interest

The authors declare that there is no conflict of interest.

Ethical standards

Non-identifiable data were used for the purposes of evaluating a routine NHS service. The work was, therefore, not considered to require ethical committee review

References

- 1 De Wit L, Luppino F, van Straten A, Penninx B, Zitman F, Cuijpers P. Depression and obesity: a meta-analysis of community-based studies. *Psychiatry Res* 2010; **178**: 230–5.
- 2 Morrison DS, Boyle S, Morrison C, Allardice G, Greenlaw N, Forde L. Evaluation of the first phase of a specialist weight management programme in the UK National Health Service: prospective cohort study. *Public Health Nutr* 2012; **15**: 28–38.
- 3 Bodenlos JS, Lemon SC, Schneider KL, August MA, Pagoto SL. Associations of mood and anxiety disorders with obesity: comparisons by ethnicity. *J Psychosom Res* 2011; **71**: 319–24.
- 4 Singh G, Jackson CA, Dobson A, Mishra GD. Bidirectional association between weight change and depression in mid-aged women: a population-based longitudinal study. *Int J Obes (Lond)* 2014; **38**: 591–6.
- 5 Carpenter KM, Hasin DS, Allison DB, Faith MS. Relationships between obesity and DSM-IV major depressive disorder, suicide ideation, and suicide attempts: results from a general population study. *Am J Public Health* 2000; **90**: 251–7.
- 6 Tuthill A, Slawik H, O’Rahilly S, Finer N. Psychiatric co-morbidities in patients attending specialist obesity services in the UK. *QJM* 2006; **99**: 317–25.
- 7 Onyike CU, Crum RM, Lee HB, Lyketsos CG, Eaton WW. Is obesity associated with major depression? Results from the Third National Health and Nutrition Examination Survey. *Am J Epidemiol* 2003; **158**: 1139–47.
- 8 American Psychiatric Association. Diagnostic and statistical manual of mental disorders (5th ed.). Washington, DC, 2013.
- 9 Pagoto S. *Psychological Co-morbidities of Physical Illness: A Behavioral Medicine Perspective*. Springer New York: New York, NY, 2011 doi:10.1007/978-1-4419-0029-6.
- 10 Petry NM, Barry D, Pietrzak RH, Wagner JA. Overweight and obesity are associated with psychiatric disorders: results from the National Epidemiologic Survey on Alcohol and Related Conditions. *Psychosom Med* 2008; **70**: 288–97.
- 11 Kessler RC, Aguilar-Gaxiola S, Alonso J, *et al*. The global burden of mental disorders: an update from the WHO World Mental Health (WMH) surveys. *Epidemiol Psychiatr Soc* 2011; **18**: 23–33.
- 12 Whiteford HA, Degenhardt L, Rehm J, *et al*. Global burden of disease attributable to mental and substance use disorders: findings from the Global Burden of Disease Study 2010. *Lancet* 2013; **382**: 1575–86.
- 13 Teixeira PJ, Going SB, Houtkooper LB, *et al*. Pretreatment predictors of attrition and successful weight management in women. *Int J Obes Relat Metab Disord* 2004; **28**: 1124–33.
- 14 Bellace D. Predictors of attrition and weight loss in obese treatment-seeking males and females. 2005. <https://idea.library.drexel.edu/handle/1860/462> (accessed 16 Sep2014).
- 15 Fabricatore AN, Wadden TA, Moore RH, Butryn ML, Heymsfield SB, Nguyen AM. Predictors of attrition and weight loss success: Results from a randomized controlled trial. *Behav Res Ther* 2009; **47**: 685–91.

- 16 Somerset SM, Graham L, Markwell K. Depression scores predict adherence in a dietary weight loss intervention trial. *Clin Nutr* 2011; **30**: 593–8.
- 17 Clark MM, Niaura R, King TK, Pera V. Depression, smoking, activity level, and health status: pretreatment predictors of attrition in obesity treatment. *Addict Behav*; **21**: 509–13.
- 18 Marcus MD, Wing RR, Guare J, Blair EH, Jawad A. Lifetime prevalence of major depression and its effect on treatment outcome in obese type II diabetic patients. *Diabetes Care* 1992; **15**: 253–255.
- 19 Markowitz S, Friedman MA, Arent SM. Understanding the Relation Between Obesity and Depression: Causal Mechanisms and Implications for Treatment. *Clin Psychol Sci Pract* 2008; **15**: 1–20.
- 20 Linde JA, Jeffery RW, Levy RL, *et al.* Binge eating disorder, weight control self-efficacy, and depression in overweight men and women. *Int J Obes Relat Metab Disord* 2004; **28**: 418–25.
- 21 McGuire MT, Wing RR, Klem ML, Lang W, Hill JO. What predicts weight regain in a group of successful weight losers? . *J Consult Clin Psychol* 1999; **67**: 177–85.
- 22 Heiskanen TH, Koivumaa-Honkanen HT, Niskanen LK, *et al.* Depression and major weight gain: a 6-year prospective follow-up of outpatients. *Compr Psychiatry* 2013; **54**: 599–604.
- 23 De Zwaan M, Enderle J, Wagner S, *et al.* Anxiety and depression in bariatric surgery patients: a prospective, follow-up study using structured clinical interviews. *J Affect Disord* 2011; **133**: 61–8.
- 24 Legenbauer T, De Zwaan M, Benecke A, Mühlhans B, Petrak F, Herpertz S. Depression and anxiety: their predictive function for weight loss in obese individuals. *Obes Facts* 2009; **2**: 227–34.
- 25 National Institute for Health and Clinical Excellence (NICE). NICE guidelines [PH53]: Managing overweight and obesity in adults – lifestyle weight management services. 2014.<http://www.nice.org.uk/guidance/PH53> (accessed 16 Sep 2014).
- 26 National Obesity Observatory. Obesity and mental health. 2011.[http://www.noo.org.uk/uploads/doc/vid_10266_Obesity and mental health_FINAL_070311_MG.pdf](http://www.noo.org.uk/uploads/doc/vid_10266_Obesity%20and%20mental%20health_FINAL_070311_MG.pdf) (accessed 16 Sep 2014).
- 27 Scottish Intercollegiate Guidelines Network. SIGN Guideline No 115: Management of Obesity. 2010.<http://www.sign.ac.uk/pdf/sign115.pdf> (accessed 16 Sep 2014).
- 28 Shaw K, O'Rourke P, Del Mar C, Kenardy J. Psychological interventions for overweight or obesity. *Cochrane database Syst Rev* 2005; : CD003818.
- 29 Teixeira PJ, Going SB, Sardinha LB, Lohman TG. A review of psychosocial pre-treatment predictors of weight control. *Obes Rev* 2005; **6**: 43–65.
- 30 Ohsiek S, Williams M. Psychological factors influencing weight loss maintenance: an integrative literature review. *J Am Acad Nurse Pract* 2011; **23**: 592–601.
- 31 Ludman E, Simon GE, Ichikawa LE, *et al.* Does depression reduce the effectiveness of behavioral weight loss treatment? *Behav Med* 2010; **35**: 126–34.
- 32 Legenbauer TM, de Zwaan M, Mühlhans B, Petrak F, Herpertz S. Do mental disorders and eating patterns affect long-term weight loss maintenance? *Gen Hosp Psychiatry* 2010; **32**: 132–40.

- 33 Logue J, Allardice G, Gillies M, Forde L, Morrison DS. Outcomes of a specialist weight management programme in the UK National Health Service: prospective study of 1838 patients. *BMJ Open* 2014; **4**: e003747.
- 34 Snaith RP. The Hospital Anxiety And Depression Scale. *Health Qual Life Outcomes* 2003; **1**: 29.
- 35 Bjelland I, Dahl AA, Haug TT, Neckelmann D. The validity of the Hospital Anxiety and Depression Scale. An updated literature review. *J Psychosom Res* 2002; **52**: 69–77.
- 36 Spinhoven P, Ormel J, Sloekers PP, Kempen GI, Speckens AE, Van Hemert AM. A validation study of the Hospital Anxiety and Depression Scale (HADS) in different groups of Dutch subjects. *Psychol Med* 1997; **27**: 363–70.
- 37 Brumpton B, Langhammer A, Romundstad P, Chen Y, Mai X-M. The associations of anxiety and depression symptoms with weight change and incident obesity: The HUNT Study. *Int J Obes (Lond)* 2013; **37**: 1268–74.
- 38 Laws R. A new evidence-based model for weight management in primary care: the Counterweight Programme. *J Hum Nutr Diet* 2004; **17**: 191–208.
- 39 Scottish Executive National Statistics. Scottish Index of Multiple Deprivation 2006: General Report. 2006.<http://www.scotland.gov.uk/Publications/2006/10/13142739/0> (accessed 16 Sep2014).
- 40 Demyttenaere K, Verhaeghen A, Dantchev N, *et al.* 'Caseness' for depression and anxiety in a depressed outpatient population: symptomatic outcome as a function of baseline diagnostic categories. *Prim Care Companion J Clin Psychiatry* 2009; **11**: 307–15.

Table 1. Baseline characteristics of 1838 patients who commenced the GCWMS, stratified by HADS-A and HADS-D scores with severity cut-off scores of 11 and 14

	HADS-A				HADS-D			
	<11	≥11	<14	≥14	<11	≥11	<14	≥14
	N=1201 (67.0%)	N=592 (33.0%)	N=1538 (85.7%)	N=257 (14.3%)	N=1311 (73.1%)	N=483 (26.9%)	N=1603 (89.3%)	N=193 (10.7%)
Age	50.4 (13.7)	46.1 (12.4) **	49.4 (13.6)	46.5 (11.9) **	49.6 (14.0)	47.1 (11.7) **	49.3 (13.7)	46.2 (11.2) **
% Male	29.6%	20.9% **	27.5%	22.2% **	29.0%	20.9% **	27.3%	22.3%**
Initial weight (kg)	117.3 (22.6)	119.9 (25.3) *	118.1 (23.4)	118.3 (24.7)	116.9 (22.9)	121.7 (25.0)	117.4 (22.8)	124.6 (28.6) **
Initial BMI (kg/m ²)	42.8 (6.5)	44.3 (7.8) **	43.2 (6.9)	43.7 (7.5)	42.7 (6.6)	44.9 (7.5) **	43.0 (6.7)	45.5 (8.6) **
SIMD 2006 Quintile	**		**		**		**	
1 (most deprived)	487 (40.5%)	292 (49.3%)	646 (42.0%)	134 (52.1%)	541 (41.3%)	237 (49.1%)	679 (42.4%)	100 (51.8%)
2	225 (18.7%)	107 (18.1%)	286 (18.6%)	46 (17.9%)	248 (18.9%)	85 (17.6%)	298 (18.6%)	35 (18.1%)
3	161 (13.4%)	77 (13.0%)	209 (13.6%)	30 (11.7%)	180 (13.7%)	58 (12.0%)	213 (13.3%)	26 (13.5%)
4	159 (13.2%)	61 (10.3%)	196 (12.7%)	24 (9.3%)	164 (12.5%)	56 (11.6%)	205 (12.8%)	15 (7.8%)
5 (least deprived)	164 (13.7%)	54 (9.1%)	195 (12.7%)	23 (8.9%)	173 (13.2%)	46 (9.5%)	203 (12.7%)	16 (8.3%)

HADS-A: Hospital Anxiety and Depression Scale for Anxiety; HADS-D: Hospital Anxiety and Depression Scale for Depression.

Note: Comparisons between HADS scores by independent samples t-test (comparison of mean SIMD quintile category). *indicates p -value <0.05. ** indicates p -value <0.01.

Table 2. Comparison of attendance and completion rates for HADS-A and HADS-D using severity score of ≥ 11 or ≥ 14 .

		HADS-A						HADS-D					
		<11	≥ 11	p-Value	<14	≥ 14	p-Value	<11	≥ 11	p-Value	<14	≥ 14	p-Value
Opting into programme	Total (N)	2022	1120		2612	530		2246	899		2741	404	
	Opt in	1202 (59.4%)	593 (52.9%)	<0.001	1538 (58.9%)	257 (48.5%)	<0.001	1312 (58.4%)	484 (53.8%)	<0.001	1603 (58.5%)	193 (47.8%)	0.001
	Opt out	820 (40.6%)	527 (47.1%)		1074 (41.1%)	273 (51.5%)		934 (41.6%)	415 (46.2%)		1138 (41.5%)	211 (52.2%)	
Completion: 3 months	Completed	769 (64.0%)	370 (62.4%)	0.200	986 (64.1%)	152 (59.1%)	0.008	841 (64.1%)	300 (62.0%)	0.112	1024 (63.9%)	116 (60.1%)	0.068
	Did not complete	433 (36.0%)	223 (37.6%)		552 (35.9%)	105 (40.9%)		471 (35.9%)	184 (38.0%)		579 (36.1%)	77 (39.9%)	
Completion: 6 months	Completed	474 (39.4%)	210 (35.4%)	0.001	599 (38.9%)	85 (33.1%)	<0.001	510 (38.9%)	173 (35.7%)	0.011	614 (38.3%)	69 (35.8%)	0.136
	Did not complete	728 (60.6%)	383 (64.6%)		939 (61.1%)	172 (66.9%)		802 (61.1%)	311 (64.3%)		989 (61.7%)	124 (64.2%)	
Completion: 12 months	Completed	264 (22.0%)	125 (21.1%)	0.390	344 (22.4%)	45 (17.5%)	<0.001	292 (22.3%)	96 (19.8%)	0.024	352 (22.0%)	36 (18.7%)	0.028
	Did not complete	938 (78.0%)	468 (78.9%)		1194 (77.6%)	212 (82.5%)		1020 (77.7%)	388 (80.2%)		1251 (78.0%)	157 (81.3%)	

HADS-A: Hospital Anxiety and Depression Scale for Anxiety; HADS-D: Hospital Anxiety and Depression Scale for Depression.

Note: Comparisons by independent samples t-test.

Table 3a. Comparison of weight change at 3, 6 and 12 months in GCWMS using HADS score of 11 as diagnostic of anxiety and depressive illness and 14 as diagnostic of severe anxiety and depressive illness. Performed using LOCF analysis.

	HADS-A				HADS-D			
	N	Mean weight change and 95% CI (kg)			N	Mean weight change and 95% CI (kg)		
		3 Months	6 Months	12 Months		3 Months	6 Months	12 Months
<11	1202	-2.69 (-2.89,-2.49)	-3.42 (-3.69,-3.14)	-3.52 (-3.84,-3.20)	1312	-2.70 (-2.89,-2.51)	-3.44 (-3.70,-3.18)	-3.64 (-3.96,-3.32)
≥11	593	-2.67 (-2.98,-2.36) *	-3.40 (-3.83,-2.97)	-3.71 (-4.24,-3.19) *	484	-2.63 (-2.99,-2.27) *	-3.32 (-3.81,-2.83)	-3.43 (-3.98,-2.87)
<14	1538	-2.73 (-2.91,-2.55)	-3.48 (-3.72,-3.23)	-3.65 (-3.95,-3.35)	1603	-2.66 (-2.83,-2.48)	-3.37 (-3.60,-3.13)	-3.54 (-3.82,-3.25)
≥14	257	-2.42 (-2.85,-1.98)	-3.01 (-3.61,-2.41)	-3.20 (-3.91,-2.48)	193	-2.93 (-3.60,-2.26) **	-3.78 (-4.67,-2.90) **	-3.95 (-4.95,-2.95) **

HADS-A: Hospital Anxiety and Depression Scale for Anxiety; HADS-D: Hospital Anxiety and Depression Scale for Depression.

Note: Comparisons (between HADS score groups) by independent samples t-test. *indicates p -value <0.05. ** indicates p -value <0.01

Table 3b. Comparison of weight outcomes at 3, 6 and 12 months in GCWMS using HADS score of 11 as diagnostic of anxiety and depressive illness and 14 as diagnostic of severe anxiety and depressive illness. Performed using LOCF analysis.

		HADS-A				HADS-D			
		N	3 Months	6 Months	12 Months	N	3 Months	6 Months	12 Months
Percentage lost ≥5%	<11	1202	196 (16.3%)	275 (22.9%)	279 (23.2%)	1312	223 (17.0%)	305 (23.2%)	313 (23.9%)
	≥11	593	103 (17.4%)	144 (24.3%)	156 (26.3%) **	484	76 (15.7%)	114 (23.6%)	122 (25.2%)
	<14	1538	257 (16.7%)	358 (23.3%)	373 (24.3%)	1603	269 (16.8%)	367 (22.9%)	380 (23.7%)
	≥14	257	42 (16.3%)	61 (23.7%)	62 (24.1%)	193	30 (15.5%)	52 (26.9%) *	55 (28.5%) **
Percentage lost ≥5kg	<11	1202	251 (20.9%)	333 (27.7%)	322 (26.8%)	1312	276 (21.0%)	357 (27.2%)	354 (27.0%)
	≥11	593	140 (23.6%) *	172 (29.0%)	176 (29.7%) *	484	115 (23.8%) *	148 (30.6%) **	144 (29.8%) *
	<14	1538	336 (21.8%)	434 (28.2%)	431 (28.0%)	1603	348 (21.7%)	442 (27.6%)	438 (27.3%)
	≥14	257	55 (21.4%)	71 (27.6%)	67 (26.1%)	193	43 (22.3%)	63 (32.6%) **	60 (31.1%) *

HADS-A: Hospital Anxiety and Depression Scale for Anxiety; HADS-D: Hospital Anxiety and Depression Scale for Depression.

Note: Comparisons (between HADS score groups) by chi-square test with post-hoc analysis. *indicates p -value <0.05. ** indicates p -value <0.01.