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Poor mental health in severely obese patients is not explained by the presence of comorbidities

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What is already known about this subject

- Obesity is associated with numerous physical comorbidities; the psychological complications are less well understood.
- The prevalence of severe obesity is rising rapidly worldwide.
- Depression in weight management clinic patients has been linked to worse/unsuccessful treatment outcomes.

What this study adds

- Mean self-rated health and psychological well-being scores in this population of severely obese patients are substantially lower than in the Irish population at large. The results suggest the potential merit of brief screening tools for psychological well-being as aids to clinical practice.
- Although self-rated health scores appear to be largely explained by the presence of comorbidities, there appears to be no relationship between psychological well-being and comorbidities.
- The results suggest that social support and mindfulness may be important targets for improving psychological well-being. Improving psychological well-being in addition to weight loss and effective management of comorbidities may be important for improving self-rated health.

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Summary

The prevalence of obesity, especially severe obesity where body mass index (BMI) exceeds 40 kg m^{-2} and where the physical risks are greatest, is increasing. However, little is known about the impact of severe obesity on psychological well-being and self-rated health (SRH). We aimed to investigate this relationship in patients attending an Irish weight management clinic. SRH was measured with a single-item inventory (excellent = 1, poor = 5). Well-being was measured with the validated World Health Organization-Five Well-being Index (WHO-5), in which scores <13 indicate poor well-being. Previous studies of the Irish population have reported mean SRH = 2.56 (males) and 2.53 (females) and mean well-being = 16.96. One hundred eighty-two (46.8%) completed questionnaires were returned. The sample was representative of the clinic population with a mean age of 47.1, mean baseline BMI of 51.9 kg m^{-2} and 64.3% females. Mean SRH was 3.73 in males and 3.30 in females; mean well-being was 10.27 in males and 10.52 in females. In the final multivariable models, number of medications, depression and obstructive sleep apnoea, WHO-5 and current BMI were significant predictors of SRH, and secondary level education, social support and mindfulness scores were significant predictors of psychological well-being. Number of medications was not significant. The results suggest that the poor psychological well-being seen is not explained by the presence of comorbidities and that social support and mindfulness may be important targets for improving psychological well-being. Improving psychological well-being in addition to weight loss and effective management of comorbidities may be important for improving SRH.

Keywords: Comorbidities, depression, self-rated health, severe obesity.

Introduction

Over the last 3–4 decades, the Western world has seen a dramatic increase in the prevalence of obesity (1). Of particular concern is the group at the upper end of the body mass index (BMI) distribution, those with BMI > 40 kg m^{-2}, often referred to as 'severe' obesity (2), as it is this group in which obesity rates are rising most quickly (2,3) and who are at greatest risk for obesity-related comorbidities (3,4).

Self-rated health (SRH) is a commonly used measurement of overall health status (5). In recent years, there has been increasing interest in SRH as a health outcome, especially as studies have repeatedly shown the association between SRH and mortality, even after adjustment for co-existing illness (6). Multiple studies have reported an association between increased BMI and worse SRH (7–9). Little is known about the determinants of SRH in subgroups of the population such as the severely obese.

Despite our extensive knowledge of the physical comorbidities associated with severe obesity, the psychological complications are not as well understood (10–14). Depression in patients attending weight management clinics has been linked with worse/unsuccessful treatment outcomes (10,12,15,16) suggesting that identifying those at risk may help increase the effectiveness of weight-loss interventions.

Here, we examine the relationships between overall health, psychological well-being and obesity-related comorbidities in a cohort of severely obese patients seeking treatment in Ireland. Given that our focus was on the factors predictive of well-being, we chose two widely utilized and well-validated inventories as our outcome measures: a single-item SRH (overall health) and the World Health Organization-Five Well-being Index (WHO-5; psychological well-being) (17). We investigate the factors predictive of these measures, with a view to identifying potential targets to improve the health of these patients.

Methods

This was a cross-sectional study conducted in the Weight Management Service (WMS), St Columcille's Hospital, Loughlinstown, a specialist, tertiary-level referral centre for the management of severe obesity in adults. The service delivers high-intensity behavioural interventions combining dietary, activity and psychological components. Ethical approval was granted by the St Vincent's Healthcare Group Ethics and Medical Research Committee. A census approach was taken and all adults who were confirmed to be alive and had an appointment with the WMS in the past 365 days were included ($n = 389$). In December 2011, patients were invited to complete a paper or online questionnaire which was specifically designed for the study and linked, with consent, to data from the clinic database. Responses were collected until May 2012. The questionnaire covered lifestyle and health factors, including date of birth, weight and height, SRH, general medical services eligibility (means-tested eligibility for free medical care in Ireland), educational status and regular medications. This was followed by six standard inventories, of which four were of interest to this study: the Medical Outcomes Study Social Support Survey (18), the Kentucky Inventory of Mindfulness Skills (KIMS) (19), the WHO-5 (17) and the Emotional Eating Scale (EES) (20). SRH was measured with a widely used single-item inventory asking patients to rate their general health from excellent (=1) to poor (=5). The WHO-5 score measures psychological well-being (range 0–25); scores below 13 indicate poor well-being and are an indication to test for depression (17). Its use as a screening instrument for depression has been validated in multiple clinical settings (21,22).

The following data were extracted from the clinic database: gender, marital status, height, appointment history, nationality, alcohol and smoking history, obesity complications (a specified list of conditions as collected by the doctor at the patient's first visit), other medical or surgical history, date of birth, dates of first and last appointments and accompanying weights. Percentage of weight change per day was computed to take account of both percentage of initial weight lost or gained and the time over which this occurred. Current BMI was calculated from self-reported weight without clothes and clinic height where available. Where weight with clothes was given, 1.5 kg was subtracted (23).

The number of different medications a patient was taking was determined using medical formularies to ensure account was taken of formulations (e.g. tablets) containing multiple medications. Number of medications is a frequently used proxy for comorbidity (24,25) minimizing the effect of unmeasured conditions (26), allowing numerous conditions to be reflected in one variable and enabling adjustment for this confounder in statistical models. It has been found to be a good predictor of future visits to a physician and of mortality (25). In using number of medications as a proxy for comorbidities, we excluded anti-obesity medications (as defined by the WHO Anatomical Therapeutic Chemical classification system) (27) and multivitamins. Depression and obstructive sleep apnoea (OSA) were included separately in analyses, given that they are often treated by means other than medication.

Multiple imputation for missing data

A breakdown of the amount of missing data by variable is shown in Table 1. The pattern of missing data was determined on inspection to be missing at random and non-monotone, and the Markov Chain Monte Carlo method of

Table 1 Percentage of missing data for main variables

Variable	% Missingness
Age	0
Gender	0
GMS status	0.5
Education	0.5
SRH	1.6
MOS-SSS score	1.6
Number of appointments attended	2.2
KIMS score	2.7
EES score	2.7
WHO-5 score	3.3
First clinic BMI	3.3
Last clinic BMI	3.3
Current weight	6.6
Current BMI	6.6
Number of medications	6.6
% weight change per day	6.6
History of OSA	11
History of depression	11
Smoking status	12.1
Marital status	12.6
Alcohol intake	13.7
Nationality	15.4

BMI, body mass index; EES, Emotional Eating Scale; GMS, general medical services; KIMS, Kentucky Inventory of Mindfulness Skills; MOS-SSS, Medical Outcomes Study Social Support Survey; OSA, obstructive sleep apnoea; SRH, self-rated health; WHO-5, World Health Organization-Five Well-being Index.

multiple imputation (MI) was thus applied (28). There was a large amount of missing data for single items in inventories; thus inventories were scaled up to the total score as long as patients had answered over half of the items; the scales had good coefficient alphas and the item-total correlations for the scales were all similar (29) and MI was then applied. MI has been shown to be robust to violations of normality (29) and thus continuous variables were imputed without transformation and the distributions of data in the five imputations were compared with the original data. Convergence of the model was checked as standard (28).

Statistical methodology

Analysis was performed using IBM SPSS Statistics 20 (IBM SPSS Statistics for Windows, Version 20.0, IBM Corp., Armonk, NY). Continuous variables were inspected for normality and subsequently means or medians were tested within two groups using Student's *t*-test or Mann–Whitney U-test. For more than two groups, analysis of variance was used. For correlation of non-normally distributed values, Spearman's rho correlations are given. A range of diagnostic checks were used in both linear and logistic regression models. Variables were entered using a hierarchical approach, with variables significant at the univariate level ($P > 0.10$) entered individually into the multivariable models in a theory-determined order. Age, gender and medications were also included on a theoretical basis. A P value of <0.05 was taken as significant in all analysis. Structured formulae were used in order to obtain overall P values for analysis of variance and chi-square calculations (30,31). For regression analyses, pooled R square values are not obtainable, thus the average from all five imputations as well as the maximum and minimum values are presented (32).

Results

Sample demographics

One hundred eighty-two (46.8%) completed questionnaires were received. One hundred seventy-eight of the 182 (97.8%) gave permission to access their data from the clinic. As shown in Table 2, the study group was deemed representative of the overall clinic population when comparisons were made with published data from 2010 (33). One hundred seventeen of the patients (64.3%) were female, the mean age was 47.1 (range 19–72) and the mean baseline BMI was 51.9.

Prevalence of comorbidities

Obesity-related comorbidity details from the hospital database were obtainable in 162 (89.0%) patients. Table 3 shows the prevalence of the conditions on which information was collected by the clinical staff. After excluding anti-obesity drugs, 87.1% of participants reported regularly taking at least one drug. The mean number of drugs was 5.16 and the median was 4.

Scores on the psychosocial inventories

The mean, median, standard deviation, minimum and maximum of the scores recorded for each psychosocial inventory are shown in Table 4. The mean KIMS (mindfulness) score in those with a history of depression was 116.18 as compared with 125.05 in those without ($P = 0.001$).

Mean SRH and well-being scores broken down by key independent variables are shown in Table 5. The overall mean WHO-5 score in this sample was 10.43, well below the 16.96 reported in the general Irish population (34). A total of 58.5% had a score less than 13. No relationship with number of medications was seen. With regard to SRH, the mean score in females was 3.30 and in males it was significantly worse at 3.73 ($P = 0.005$), compared with the mean scores of 2.53 and 2.56 reported for females and males in the Irish population (35). There was also a clear relationship with medications; mean SRH score in those on no medications approached that of the general population

Table 2 Characteristics of study sample as compared with published data from the weight management clinic

Characteristic	Overall study sample ($n = 182$)†	BMI 30–39		BMI 40–49		BMI ≥50	
		Study sample ($n = 11$, 6.3%)*	Clinic population ($n = 186$, 23%)	Study sample ($n = 68$, 38.6%)*	Clinic population ($n = 316$, 40%)	Study sample ($n = 97$, 55.1%)*	Clinic population ($n = 290$, 37%)
Female (%)	64.3	*	67	66.2	71	62.9	68
Mean age (years)	47.1	*	50	47.6	46	46.6	44
Married (%)	56.0	*	64	57.8	59	52.3	51
Current smokers (%)	15.6	*	19	18.5	23	14.6	18
Education level (%)							
1°	15.5	*	15	16.2	14	16.7	16
2°	47	*	53	45.6	55	44.8	56
3°	37.6	*	32	38.2	31	38.5	28

*Not shown because of small numbers.
†Marital status, smoking status and BMI were obtained from the clinical database and were not available for all participants.
BMI, body mass index.

Table 3 Prevalence of obesity complications as recorded on clinic database

Condition	N	%
Hypertension	78	48.1
Depression	70	43.2
Asthma	55	34
Dyslipidaemia	52	32.1
Diabetes	49	30.2
Osteoarthritis	46	28.4
Obstructive sleep apnoea	38	23.5
Gastro-oesophageal reflux disease	31	19.1
Cholelithiasis	30	18.5
Gout	13	8
Psoriasis	13	8
Non-alcoholic fatty liver disease	12	7.4
Polycystic ovarian disease	12	7.4
Atrial fibrillation	9	5.6
Thrombosis	8	4.9
Cancer	6	3.7
Ischaemic heart disease	5	3.1
Renal stones	3	1.9
Cerebrovascular disease	1	0.6
Peripheral vascular disease	1	0.6
Recurrent cellulitis	0	0

at 2.97. The results of the univariate analysis for all variables as predictors of well-being scores and excellent/very good/good SRH are shown in Table 6.

Multivariable analysis was then conducted. Interaction terms between age and sex for both analyses, between sex and age and SRH for the well-being analysis, and sex and age and well-being for the SRH analysis were also included in the models. The only significant interaction was between age and SRH in the well-being model ($P = 0.029$) thus it was retained in the model. Detailed step-by-step results of the multivariable analyses are shown in Tables S1 and S2 of the Supporting Information.

With regard to well-being, the predictors that were significant at the univariate level were: secondary level education, depression, SRH, social support score and mindfulness score. In the final model, which explained approximately 34.6% of the variance, secondary education (r = –2.361, $P = 0.035$), social support score (r = 0.053, $P = 0.011$) and mindfulness scores (r = 0.062, $P = 0.015$) remained significant. Number of medications was not significant at either the univariate or multivariable level. The interaction term for age × SRH was significant ($P = 0.048$). As shown in the unimputed data in Fig. 1, there is higher well-being overall in those with excellent/very good/good SRH, but the improvement seen in mean well-being as SRH improves is greater in older age groups.

Predictors of excellent/very good/good SRH that were significant at the univariate level were: number of medications, depression and OSA (negative relationships), and mindfulness and WHO-5 scores (positive relationships). After adjustment for all other predictors in the final stage of the multivariable model, the odds ratio and 95% confidence intervals (in parentheses) for the significant variables were as follows: number of medications, 0.881 (0.786–0.988); depression, 0.451 (0.206–0.985); OSA, 0.155 (0.052–0.458); WHO-5 score, 1.118 (1.038–1.204) and current BMI, 0.957 (0.920–0.995). Overall, the final model explained an average of 39.2% of the variance.

Discussion

Overall, the results show that the mean SRH and psychological well-being scores in this population of severely obese patients are substantially lower than those reported in the Irish population at large. Although SRH scores appear to be largely explained by the presence of comorbidities, there appears to be no significant relationship between well-being scores and comorbidities.

Table 4 Descriptives of psychosocial inventory scores

Score [possible range]	N	Mean	Median	Standard deviation	Minimum	Maximum	Cronbach's alpha
Compensatory Health Beliefs [17–85]	175	37.56	37.00	9.36	20.00	68.00	0.77
Medical Outcomes Study Social Support Survey [19–95]	179	68.83	71.78	18.86	21.00	95.00	0.97
Kentucky Inventory of Mindfulness Skills [39–195]	177	121.25	121.00	17.91	71.00	183.30	0.86
Emotional Eating Scale [25–125]	177	71.79	74.00	25.14	25.00	125.00	0.96
World Health Organization-Five Well-being Index [0–25]	176	10.43	10.00	5.61	0	22.00	0.86

Table 5 Mean SRH and well-being scores by key sociodemographic and lifestyle variables*

Variable		N*	Mean SRH	*P* value	N*	Mean WHO-5 score	*P* value
Gender	Males	63	3.73	0.005	62	10.27	0.784
	Females	116	3.30		114	10.52	
Age group	18–34	28	3.14	0.295	27	10.77	0.120
	35–44	44	3.57		43	10.94	
	45–54	61	3.52		61	9.08	
	55+	46	3.43		45	11.57	
Marital status	Married (not separated)	104	3.50	0.507	100.6	10.48	0.903
	Not married	75	3.39		75.4	10.37	
Nationality	Irish	153.4	3.41	0.272	151.6	10.41	0.852
	Non-Irish	25.6	3.70		24.4	10.69	
Alcohol intake	Within recommended limits	159.6	3.49	0.147	157.4	10.35	0.595
	Above limits	19.4	3.14		18.6	11.16	
Current BMI	<30	9	2.89	0.082	9.2	13.67	0.240
	30–39	34.8	3.23		34.6	11.39	
	40–49	69	3.38		67.8	10.15	
	≥50	66.2	3.71		64.4	9.77	
GMS eligibility	No/Don't know	74.8	3.40	0.561	72.8	10.09	0.508
	Yes	104.2	3.49		103.2	10.67	
Level of education	Primary	28	3.61	0.040	27	11.70	0.001
	Secondary	82.4	3.59		84.4	8.81	
	Tertiary	68.6	3.22		64.6	12.01	
Smoking	Ex/Never	143.6	3.39	0.297	140.8	10.44	0.985
	Current	35.4	3.74		35.2	10.41	
Medications†	0	27	2.97	0.033	26	9.59	0.650
	1–5	80.6	3.43		78	10.80	
	≥6	71.4	3.65		72	10.35	
Depression	No	103	3.28	0.014	101.2	11.57	0.003
	Yes	76	3.69		74.8	8.89	

*Non-integers are a result of multiple imputation.
†Number of non-obesity drugs.
BMI, body mass index; SRH, self-rated health; WHO-5, World Health Organization-Five Well-being Index.

Self-rated health

Both depression and WHO-5 score were significant predictors of SRH. The impact of mental health on physical health has been found in several studies of obese patients and may reflect the effect of a depressed affect on the subjective experience of poor physical health (12,14,36). With regard to comorbidities, our results show that the number of medications a participant reported taking regularly was a significant predictor of SRH. The mean SRH in those on no medications approached that of general population. Number of medications has been used in the literature looking at various outcomes; the finding that it is predictive of SRH in this population is noteworthy.

One specific comorbidity, OSA, was also strongly predictive, with an odds ratio of 0.155 for excellent/very good/good SRH. While numerous studies have found OSA to have a negative impact on quality of life (37), very few

Table 6 Results of univariate linear and logistic regression

Variable	Regression coefficient for well-being analysis*	*P* value	OR (95% CI) for SRH analysis	Regression coefficient for SRH analysis* (*P* value)
Sociodemographic variables				
Age	0.024	0.518	0.979 (0.954–1.005)	–0.021 (0.117)
Sex†	0.253	0.775	1.585 (0.854–2.942)	0.461 (0.144)
GMS eligibility‡	0.575	0.504	0.896 (0.494–1.627)	–0.109 (0.719)
Level of education				
Secondary vs. primary	–2.898	0.016	0.827 (0.349–1.959)	–1.90 (0.666)
Tertiary vs. primary	0.306	0.804	1.890 (0.777–4.599)	0.637 (0.160)
Married§	0.107	0.902	0.825 (0.451–1.511)	–0.192 (0.534)
Nationality¶	0.267	0.855	0.598 (0.235–1.522)	–0.515 (0.280)
Health status variables				
Medications**	0.022	0.821	0.867 (0.794–0.946)	–0.143 (0.002)
Depression	–2.675	0.003	0.364 (0.190–0.696)	–1.012 (0.002)
OSA	0.476	0.678	0.233 (0.097–0.557)	–1.457 (0.001)
% weight change per day	–6.770	0.759	0.000 (0.000–89.688)	–10.180 (0.173)
Current BMI	–0.067	0.122	0.971 (0.941–1.002)	–0.029 (0.065)
First clinic BMI	0.007	0.880	0.994 (0.961–1.027)	–0.006 (0.703)
SRH††	–2.270	<0.001	n/a	n/a
Lifestyle variables				
Smoker‡‡	–0.021	0.985	0.474 (0.145–1.554)	–0.746 (0.202)
Alcohol intake§§	0.795	0.574	1.765 (0.574–5.429)	0.568 (0.318)
Psychosocial variables				
MOS-SSS score	0.080	<0.001	1.004 (0.988–1.020)	0.004 (0.609)
KIMS score	0.118	<0.001	1.020 (1.003–1.038)	0.020 (0.025)
EES score	–0.031	0.071	0.989 (0.977–1.001)	–0.011 (0.076)
WHO-5 score	n/a	n/a	1.119 (1.056–1.187)	0.113 (<0.001)

*Pooled unstandardized regression coefficients from all imputations.
†Female vs. male.
‡Yes vs. no, or don't know.
§Married vs. single, widowed, divorced and separated.
¶Other nationality vs. Irish.
**Number of non-obesity drugs.
††Rated excellent to poor (1–5).
‡‡Current vs. ex or never.
§§Above recommended limits vs. within.
BMI, body mass index; CI, confidence interval; EES, Emotional Eating Scale; GMS, general medical services; KIMS, Kentucky Inventory of Mindfulness Skills; MOS-SSS, Medical Outcomes Study Social Support Survey; OR, odds ratio; OSA, obstructive sleep apnoea; SRH, self-rated health; WHO-5, World Health Organization-Five Well-being Index.

studies have investigated its impact on SRH. Attention has previously been drawn to the importance of comorbid depression and OSA management in order to ensure the most effective treatment of obesity (38). Our results suggest that treatment of OSA may not only enhance the effect of the weight-loss intervention but also improve SRH.

Overall, the results suggest that much of the impairment in SRH seen in this population of severely obese patients can be explained by comorbidities. However, even after adjustment for these, and the other factors in the final model, there is an independent relationship with BMI, such as that seen in community-based studies (5,9,39,40). Possible reasons for this include a direct impact of obesity on functional ability, or it may reflect an increased awareness of the health consequences of obesity (9). A prospective study investigating if SRH is a robust predictor of mortality in the severely obese, as has been shown in the general population, would be of interest as it may enable risk stratification and influence treatment plans (6).

Psychological well-being

Of the psychological comorbidities potentially associated with obesity, the relationship with depression is the most extensively researched (13). It remains a highly debated subject, with one systematic review in 2008 finding only weak evidence for a link between obesity and depression (13) and another more recent review concluding that there was good evidence for a prospective relationship between obesity and depression (41). Furthermore, some community-based studies have suggested that the relationship between obesity and poor psychological well-being is

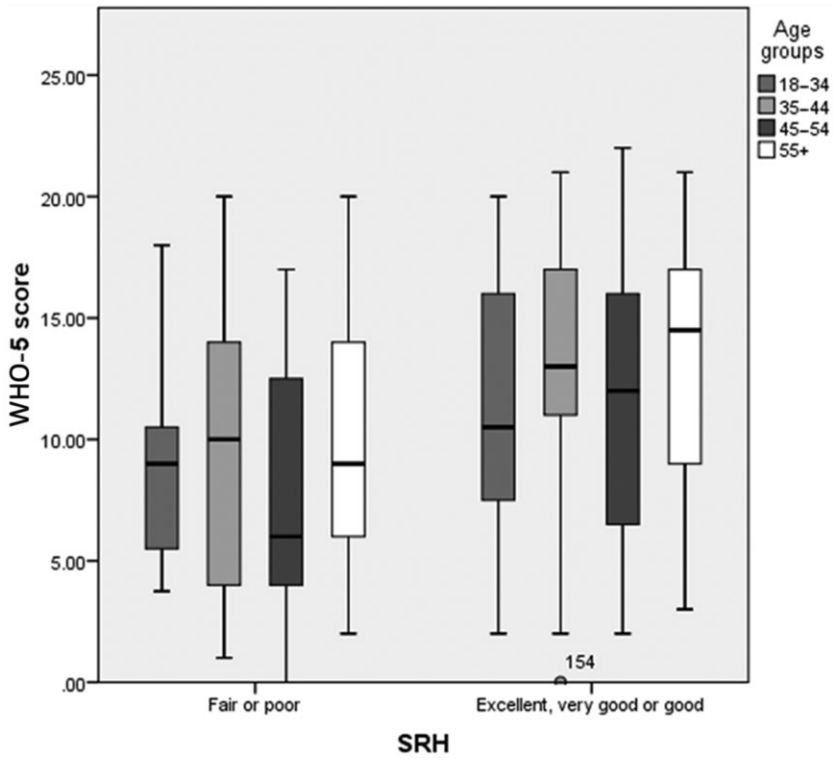

Figure 1 Boxplot of mean well-being scores by age groups within fair/poor and excellent/very good/good self-rated health (SRH) categories.

mostly due to the physical comorbidities of obesity (12,42) while others have found the relationship to remain even after adjustment for chronic diseases (43).

Treatment-seeking obese populations such as our study sample have been found to have higher levels of psychopathology including depression (44) and several studies have shown that depression may be associated with worse outcome from weight management clinics (10,12,15,16). Conversely, there is evidence that successful weight loss can lead to improvement in depressive symptoms (14,45). Most studies assessing depressive symptoms in the treatment-seeking severely obese population have been with a view to determining predictors of successful weight loss, as opposed to predictors of poor psychological well-being as an end in itself (46).

Our results are in line with a study by Dixon *et al*. which did examine predictors of depression within a treatment-seeking population of severely obese patients referred for bariatric surgery. No association with the comorbidities of diabetes, hypertension or osteoarthritis was found. A total of 38% of the patients reported a history of depression and 53% were found to have scores above the threshold for depression (45). Another study in a severely obese treatment-seeking population found an above threshold score in 30% of males and 45% of females (47). We found similar levels in our study participants; 43.2% had a history of depression and 58.5% had a WHO-5 score less than 13. The results show very low WHO-5 scores even in those without a history of depression, suggesting that there may be a considerable burden of previously undiagnosed depression. The results suggest the potential merit of brief screening tools for psychological well-being as aids to clinical practice, as has previously been suggested (10,11,41).

As for the relationship between comorbidities, SRH and psychological well-being in the treatment-seeking obese population, there are few pertinent studies. The available literature comes from *general population* studies, such as those conducted by Keddie and Jorm *et al*. (12,42) both of whom argue that poor physical health is a mediator of the relationship between obesity and depression. However, our results show that while SRH was a predictor of well-being (perhaps because of the relationship between a depressed affect and subjective reporting of health), no relationship between psychological well-being and number of medications or OSA was seen. It seems unlikely, therefore, that the high levels of depression and poor well-being seen in these patients is solely because of the physical comorbidities of obesity.

We were unable to find any other studies specifically examining the relationship between mindfulness and psychological well-being in severely obese population. Mindfulness (KIMS) scores in this sample were significantly worse in those with a history of depression and there was a large drop in the semi-partial correlation coefficient and significance of depression as a predictor of psychological well-being once the KIMS score was included in the model.

Mindfulness-based therapy has been shown to be effective in the treatment of depression (48) and there is also some evidence that therapy with a mindfulness-based component can aid weight loss (49).

Social support score was also a significant predictor of psychological well-being. In the general population, higher levels of perceived social support have been associated with reduced odds of depression (43), an improved response to treatment for depression (50) and with better psychological well-being (as measured by WHO-5 scores) in the Irish population (34). It has been suggested before that increasing social support in the severely obese population may be an effective way of improving psychological well-being (51) and social support may also be an important determinant of the ability to persevere and be successful with a weight-management programme (14).

We did not find a relationship between SRH or psychological well-being and percentage weight loss per day, but this is a relatively crude measure. In order to see if there is an effect of weight loss on SRH or psychological well-being in this population, a prospective study involving repeated administration of the SRH single-item question and the WHO-5 at the beginning and end of a treatment programme might prove useful (39). Improvements in SRH or psychological well-being might also be additional ways of measuring successful treatment outcomes.

Strengths and limitations

This was a cross-sectional study, thus directionality of the relationships cannot be elucidated. We would expect that the samples are not representative of the general obese population, as it may be poor SRH or well-being that prompts referral to weight management clinic (36). It should be borne in mind that the WHO-5 score is a screening instrument and as such is not diagnostic of depression. In terms of our proxy for comorbidity, number of medications, it is important to note that it does not give an absolute indication of disease severity (12) and it takes into account all medications including psychotropic medication, which may affect its ability to act as a proxy for physical comorbidities. However, one would expect this to artificially inflate a relationship between number of medications and psychological well-being, and we saw none. Finally, because of our use of multiple imputation, we were only able to use the total EES and KIMS score and not the individual subscales as recommended by the authors (19,20).

This study was novel in that it investigated areas that have had sparse or no published results to date and it was conducted in a 'real world' clinical setting (16,36). We were able to use data from a hospital clinic database, limiting the use of self-reported data. The outcomes were simple validated measures (39) and we were able to compare the results with data from representative national surveys.

Conclusion

The results suggest that social support and mindfulness may be important targets for improving psychological well-being, and improving psychological well-being as well as effective management of comorbidities as well as weight loss may be important for improving SRH. Using interventions designed specially to improve well-being, such as mindfulness or social support interventions, may in turn improve weight loss. Prospective studies to tease out these relationships and clarify the directionality of associations seen in this study would be a useful next step.

Conflict of Interest Statement

Dr Somerville, Dr Mc Kenzie, Ms Eslami and Professor Wall report grants from Health Research Board of Ireland during the conduct of the study.

Author contributions

RS, KM, SE and CB were involved in the study design. DO and PW provided overall study leadership, review and expert opinion. RS, KM, SE and CB were involved in data collection. RS, KM and SE were involved in the analysis and interpretation of the data. RS wrote the manuscript and all authors were involved in reviewing the manuscript.

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Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's web-site:

Table S1. Multivariable linear regression: factors predictive of psychological well-being in weight management clinic patients.

Table S2. Multivariable logistic regression: factors predictive of excellent/very good/good self-rated health in weight management clinic patients.