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A prospective study of mental health status in morbidly obese patients.

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INTRODUCTION

- Aim: To determine if co-morbidities have an effect on mood in a cohort of morbidly obese patients.

BACKGROUND

- A significant proportion of adults diagnosed with type 2 diabetes will also have concomitant obesity, currently defined as people with a body mass index (BMI) of > 30 (Gregg et al. 2007).
- This combination of concomitant risk (obesity and type 2 diabetes) has been termed by some clinicians as the 'diabesity' epidemic (Zimmett 2007, Bailey 2009).
- Current research and evidence-based practice guidelines offer a range of treatments and care pathways for reducing obesity +/- type 2 diabetes.
- Prior recent research in the morbidly obese (selected) has examined mental health status and coping mediators related to functionality (Aarts et al. 2014), personal factors associated with QoL (Lerdal et al. 2011), and the relationship of mood to health related quality of life measures (Andanaes et al. 2012). However none of these studies have examined associations of mental health indicators in relation to the presence of type 2 diabetes.

METHODS

- Sequential linear regression analysis conducted on health and demographic data, using two validated anxiety/depression scales combined [Patient Health Questionnaire (PHQ-9) and Generalized Anxiety Disorder (GAD-7)] as the primary outcome.
- Demographic characteristics (body mass index [BMI] age and gender) was recorded on patients. The presence or absence of various co-morbidities - hypertension, sleep apnoea, diabetes, ischaemic heart disease (IHD), arthritis, anxiety/depression, COPD/asthma and hypothyroidism - was also recorded for all patients.
- Individual and summed item scores on the PHQ-9 and GAD-7 instruments were also recorded; with the key outcome variables considered to be the summed scale scores.
- The sample was summarised descriptively. The extent of missing data, and its suitability for imputation, was assessed before analysis. Cases with extensive missing data were deleted from the data set before further analysis.
- The correlation and level of agreement between the PHQ-9 and GAD-7 summed scale scores was assessed. As both these measures comprised similarly worded outcomes, with identical response options and option scoring, it was considered appropriate to derive a composite measure from the two scales for use in a subsequent regression analysis, subject to findings of high correlation and good consistency between the scales.
- The impact of demographic characteristics and co-morbidities was assessed on the combined outcome measure using a sequential modelling strategy, using 2 blocks; comprising respectively all co-morbidity variables (Block 1) and all demographic variables (Block 2). Within Block 1, a backward elimination modelling strategy was utilised to derive a parsimonious subset of variables to be considered in conjunction with demographic variables, all of which, being of greater clinical interest, were forced into the model in Block 2. Standard regression statistics for the final model were reported.
- Regression assumptions were checked using residual plots. Standardised residuals, leverage values and Cook's distances were derived for all data points to check for the presence of values exerting an undue influence on the regression model.

RESULTS

- Outcome data was collected on 464 patients. However, no demographic or co-morbidity data was collected on 54 patients. These patients were deleted from further analysis, leaving 410 patients for analysis. About 0.1% of data on the remaining cases was missing, with complete information available from 406 cases. Imputation was not conducted on the missing data.
- Seventy nine patients (19.4%) had no reported co-morbidities. About half of all patients (211; 51.4%) had 1 or 2 reported co-morbidities; of which hypertension and anxiety/depression were the most common. One hundred and seventeen patients (28.7%) reported 3 or more co-morbidities. The number of reported co-morbidities was linked with age; with older patients were likely to report more co-morbidities (r=0.443; p<0.001). Men reported more co-morbidities than women (mean number of co-morbidities reported by men=2.14 (SD=1.93); mean number of co-morbidities reported by women=1.71 (SD=1.32)). There was no relationship between BMI and number of reported co-morbidities; or between any of the reported demographic variables and either outcome score. The sample is summarised descriptively in Table 1.
- The outcome measures of PHQ-9 and GAD-7 were found to be strongly and significantly correlated (r=0.822; p<0.001). The extent of the correlation suggested that a multivariate analysis or independent regression analyses conducted on the separate scale scores would be of limited benefit; furthermore, independent regression analyses could lead to inflated familywise error rates. hence analysis was conducted on a combined outcome.
- A Bland-Altman plot derived from the two sets of standardised scores (Figure 1) illustrated good levels of agreement between the scales, with no obvious relationship between agreement level and scale scores. Hence a simple composite measure comprising the unweighted total of item scores of both scales was derived for use in a subsequent regression analysis.
- The sequential regression analysis conducted on the combined outcome measure resulted in variables corresponding to patient anxiety/depression and arthritis being carried forward from Block 1 of the sequential regression analysis for inclusion in the final model alongside the demographic variables. In this model, occurrence of arthritis and occurrence of anxiety/depression were both statistically significant at the 5% significance level (p=0.049 for occurrence of arthritis; p<0.001 for occurrence of anxiety/depression), with the presence of both conditions being associated with lower functionality.
- Age appeared to show some substantive association with the outcome (p=0.069); the negative parameter coefficient implies that functionality increases with increasing age (for both of the individual scales, and the combined scale, higher scores indicate lower functionality). BMI and gender did not exhibit any relationship with the outcome measure; with increasing age being associated with slightly improved functionality.
- BMI, gender and the presence of other co-morbidities, including diabetes, did not exhibit any substantive relationship with the outcome measure.
- P-values and parameter estimates with associated 95% confidence intervals (CIs) for all variables in the final model are given in Table 2.
- Controlling for other variables in the final model, a patient with arthritis would score on average 3.15 points more on the combined PHQ9/GAD7 scale than a patient without arthritis (indicating worsening functionality). A patient with anxiety/depression would score on average 7.23 points more on the combined PHQ9/GAD7 scale than a patient without anxiety/depression (also indicating worsening functionality).
- The adjusted-R^2 statistic for this model was 0.075, indicating that the model is a fairly good fit to the data.
- Examination of a plot of standardised residuals against standardised predicted values revealed no violations of regression assumptions (Figure 2).
- The largest absolute value of the standardised residuals was found to be 2.13; well within expectations for a data set of this size. The largest leverage value recorded for any data point was 0.045; about on the limit of expectations for a data set of this size. However, the largest value of Cook's distances recorded for any data point was 0.018, suggesting that no individual data point exerted undue influence on the model.

Table 1: descriptive summary of sample (n=410)

Categorical variable	Frequency (valid %)
Gender	
Male	111 (27.2%)
Female	297 (72.8%)
Hypertension reported	
Yes	136 (33.2%)
No	274 (66.8%)
Sleep apnoea reported	
Yes	76 (18.5%)
No	334 (81.5%)
Diabetes reported	
Yes	107 (26.1%)
No	303 (73.9%)
IHD reported	
Yes	21 (5.1%)
No	389 (94.9%)
Arthritis reported	
Yes	98 (23.9%)
No	312 (76.1%)
Anxiety/depression reported	
Yes	178 (43.4%)
No	232 (56.6%)
COPD/asthma reported	
Yes	101 (24.8%)
No	307 (75.2%)
Hyperthyroidism reported	
Yes	34 (8.3%)
No	375 (91.7%)
Numerical variable	**Mean (SD)**
BMI (kgm^{-2})	46.8 (8.02)
Age (years)	47.3 (12.7)
PHQ-9 total score	12.4 (7.37)
GAD-7 total score	8.68 (6.54)

Table 2: P-values, parameter estimates and confidence intervals: combined PHQ9/GAD7 outcome

Variable	p-value	Parameter estimate	95% CI
Arthritis	0.048	3.15	(0.027, 6.28)
Anxiety/depression	<0.001	7.23	(4.68, 9.78)
BMI	0.217	0.103	(-0.061, 0.266)
Gender[1]	0.410	-1.21	(-4.08, 1.67)
Age	0.069	-0.099	(-0.206, 0.088)

Figure 1: Bland-Altman plot for agreement between PHQ9 and GAD7 outcomes

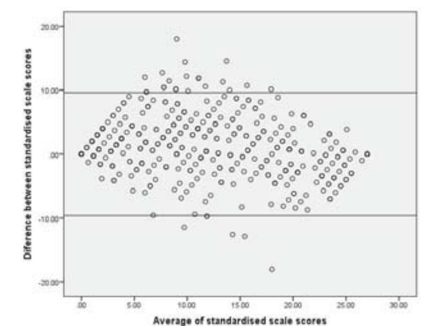
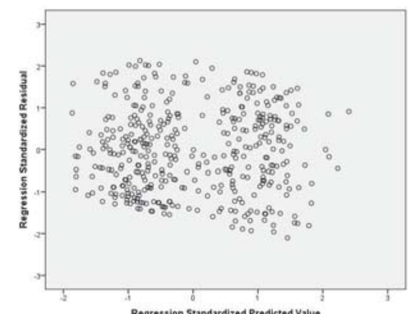


Figure 2: residual plot for final model



CONCLUSIONS

- PHQ9 and GAD7 scales are closely correlated and show good agreement with each other. Hence analysis was conducted on a single outcome measure combined from both of these scales.
- There is insufficient evidence to conclude that either BMI or gender affect scores measured on the combined PHQ9/GAD7 outcome.
- Some substantive association (non-significant) appears to exist between age and combined scale scores; with older patients reporting slightly better functionality.
- Of the various co-morbidities reported by patients, arthritis and, particularly, reported anxiety/depression have the greatest effect on combined scale scores. The presence of both these conditions is associated with lower functionality.
- There is no evidence that the presence of any other co-morbidity affects the combined scale scores.
- There is no evidence for violation of model assumptions or of any individual data point exerting undue influence on the model.

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