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The Long-Term Psychological Impact of Laparoscopic Adjustable Gastric Banding Surgery on Individuals Aged ≤ 49 and ≥ 50 Years

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Abstract

The laparoscopic adjustable gastric band [LAGB] is a form of bariatric surgery to assist individuals in losing weight when behavioural and dietary changes alone have been unsuccessful. There has been some debate about how age at time of surgery impacts on weight loss, but there is little known about the impact of age on psychological changes. As part of a longitudinal study exploring the impact of LAGB, 73 participants (aged between 30 and 74 years) were weighed and completed a number of validated psychometric scales seven times over a five year period. Individuals were split into two groups, those aged ≤ 49 and ≥50 years for analysis. Correlations between psychometric measures and Body Mass Index [BMI] at each time point indicated more significant correlations were present for individuals aged ≤ 49 years. Repeated-measures ANOVA exploring changes in BMI and psychological states from pre to five years post-LAGB indicate that BMI reduces and psychological difficulties improve in the years following surgery. These results suggest individuals aged ≤ 49 years have more psychological concerns regarding their weight that need addressing than individuals aged ≥ 50 years.

Keywords

Laparoscopic Adjustable Gastric Banding, Psychological, Age, Longitudinal

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1. Introduction

Bariatric surgery has cruelly been described by some individuals (including health care professionals) as the easy option for weight loss [1-3]. Individuals undergoing this procedure have typically had a lifetime of maladaptive behaviours that have led to obesity, and often have been subjected to stigma due to their weight [4]. There are two forms of bariatric surgery; restriction (e.g., laparoscopic adjustable gastric banding [LAGB]) and malabsorption (e.g., gastric bypass) [5]. Neither form of bariatric surgery is an easy weight loss option, both require lifelong commitment from the individual to adopt and sustain new behaviours following surgery in order to lose and maintain weight loss [6, 7].

Aside from the widely cited health benefits of weight loss [8, 9], bariatric surgery can also positively impact on psychological health [10]. As individuals lose weight there is a return to a feeling of 'normality' attributed to being able to do everyday tasks for oneself, no longer being visibly different, and being able to shop for clothing in high street stores or supermarkets [11, 12].

In the literature there has been some debate on whether age impacts on weight loss, some studies suggest being over 50 years old at time of surgery negatively impacts on weight

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loss [13], whereas other studies suggest being over 50 years old makes no difference to long-term weight loss [14]. In our own work we have explored this issue. Our data suggested that individuals prior to surgery aged ≥ 50 years appeared to continue to lose weight as time since surgery increased compared to individuals aged ≤ 50 years [15]. In addition, the literature currently lacks evidence on the psychological impact of bariatric surgery in the older and younger age groups. It is well documented that poor psychological health negatively impacts on weight loss [10], which often causes individuals to comfort eat [16]. Weight loss for younger people may be to enhance appearance, whereas for older people the focus may be on weight loss for longevity and better perception of oneself [17]. Therefore, the aim of the current study was to use existing data to explore whether there was a difference in psychological outcomes following LAGB surgery between individuals aged ≤ 49 and ≥ 50 years. Our use of existing data to perform secondary qualitative analysis is an effective way to maximise insights from existing data [18].

2. Methods

2.1. Design

This longitudinal study collected data at eight time points: pre-operatively, six, 12 and 18 months post-operatively, then annually until five years post-LAGB.

2.2. Participants

The 73 participants were aged between 30 to 74 years (mean ± standard deviation [SD], 46.3 ± 8.9); one participant stated their ethnicity as Indian, the others identified themselves as White. The sample consisted of 58 (79.5%) females.

2.3. Measures

Hospital Anxiety and Depression Scale (HADS)

This 14-item scale has two subscales each with seven items that measure general anxiety and depression [19]. Responses to questions are based on how the individual has been feeling in the past week rated on a 4-point Likert scale ranging from 0 to 3. Response anchors vary between questions (e.g., “I can sit at ease and feel relaxed” anchored from “definitely” to “not at all”; and “I get sudden feelings of panic” anchored from “not at all” to “very much indeed”). Higher scores on the HADS indicate greater distress. The questionnaire authors suggest that scores are grouped to act as signifiers of distress. In its current form the HADS is divided into four ranges: normal (0-7), mild (8-10), moderate (11-15), and severe (16-21).

Derriford Appearance Scale (DAS-24)

This 24-item scale assesses emotional and behavioural difficulties experienced by individuals with problems of appearance [20]. Responses to questions are based on a 4-point Likert scale ranging from 1 to 4. Response anchors vary between questions (e.g., “I avoid communal changing rooms” anchored from “almost always” to “never/almost never”; and “How rejected do you feel?” anchored from “not at all” to “extremely”), with 11 items having a “not applicable” [N/A] response option scored as 0. Higher scores on the scale indicate more problems associated with social avoidance as a result of appearance concerns. There are no suggested clinical cut-offs for this questionnaire.

World Health Organization Quality of Life Brief (WHOQoL-BREF)

This 28-item scale assesses quality of life within four domains (physical, psychological, social relationships, and environment) [21, 22]. In addition, there are two items assessing overall quality of life and general health. Responses to questions are based on a 5-point Likert scale ranging from 1 to 5. Response anchors vary between domains (e.g., “Do you have enough energy for everyday life” anchored from “almost not at all” to “completely”; and “How satisfied are you with yourself?” anchored from “very dissatisfied” to “very satisfied”). Higher scores in each domain and on the two separate items indicate better quality of life. A suggested useful clinical cut-off for the WHOQoL-Bref domains is 15 [23] (this equates to a score of 69 on the transformed scores that WHO recommend are used to make normative comparisons; [21]), i.e. individuals scoring less than 69 are experiencing significantly reduced levels of quality of life.

Salience and Valance Appearance Questionnaire (CARSAL & CARVAL)

This 13-item scale is divided into two subscales that measure the salience (i.e., CARSAL - seven items focussed on the importance and extent to which an individual thinks about appearance) and valence of appearance (i.e., CARVAL - six items focussed on how the individual feels about their appearance) [24]. Responses to questions are based on a 6-point Likert scale ranging from 1 (strongly disagree) to 6 (strongly agree), with five items being reverse scored. Higher scores on the CARSAL subscale indicate a more positive view of the self while higher scores on the CARVAL subscale indicate a more negative evaluation of one’s appearance.

2.4. Procedure

Participant eligibility, study timelines and setting has been described in detail elsewhere [1, 12, 15]. Briefly, participants needed to meet the National Institute for Health and Care

Excellence [NICE] eligibility criteria for LAGB surgery [26]. Study participants were required to give written informed consent. Data collection typically coincided with the participants' routine visits with the weight loss service (WLS). If a participant did not attend, questionnaires were posted with a pre-paid envelope to return these to the WLS. Sequential numbered identifiers were assigned to participants to ensure anonymity [27].

2.5. Data analysis

Participants were assigned to one of two groups based on their age; ≤ 49 years or ≥ 50 years. Questionnaire author instructions on how to handle missing item responses were followed. Scoring guidelines for the WHOQoL-BREF were used to calculate and transform each domain score to the WHOQoL-100 scale [21]. Descriptive statistics (mean and standard deviation [SD]) were calculated for each measure at each data collection point. In addition, Body Mass Index [BMI] was calculated for each participant at every visit using recommended methods [28]. Where data was missing at a time point, the last observation carried forward [LOCF] method was applied [29].

Pearson correlation was used to explore the relationship between each psychometric measure and BMI at every time point [30]. Following this a series of individual repeated measures ANOVAs were undertaken on each of the measures to explore change over time and between groups (e.g., a 8 (HADS anxiety score at each time point) x 2 (aged ≤ 49 years vs. aged ≥ 50 years). Effect sizes between the two age groups were quantified using Hedges' *g* [31, 32]. Differences between pre-LAGB and five years post-LAGB psychometric scores within groups were explored using paired-sample *t*-tests [30].

3. Results

Means ± SD for each psychometric measure at every time point are shown in Tables 1 (aged ≤ 49 years) and 2 (aged ≥ 50 years).

Table 1. Mean ± Standard Deviation [SD] at each of the data collection points for individuals aged ≤ 49 (n = 46).

Measure	Pre	6 mo	1 yr	18 mo	2 yrs	3 yrs	4 yrs	5 yrs
BMI	52.2 ± 9.4	46.2 ± 8.2	43.5 ± 8.5	42.4 ± 8.5	41.7 ± 8.7	42.1 ± 8.7	42.2 ± 8.9	41.4 ± 9.2
CARSAL	36.4 ± 5.6	35.4 ± 8.5	35.0 ± 6.4	34.5 ± 6.5	35.0 ± 5.7	35.4 ±5.6	34.0 ± 7.6	28.1 ± 13.9
CARVAL	30.9 ± 5.5	29.3 ± 6.1	27.7 ± 6.2	27.4 ± 6.6	27.2 ± 7.4	26.9 ± 7.9	26.7 ± 9.1	36.2 ± 19.3
WHO Q1	2.8 ± 1.1	3.2 ± 0.9	3.4 ± 1.0	3.4 ± 1.2	3.4 ± 1.1	3.3 ± 1.0	3.3 ± 1.1	3.4 ± 1.0
WHO Q2	1.7 ± 0.9	2.3 ± 0.9	2.6 ± 1.2	2.6 ± 1.2	2.6 ± 1.0	2.6 ± 1.1	2.6 ± 1.1	2.7 ± 1.1
WHO Psych.	41.5 ± 18.6	46.3 ± 22.5	50.3 ± 22.2	51.2 ± 24.3	50.4 ± 23.1	48.9 ± 23.6	50.4 ± 23.9	47.8 ± 24.8
WHO Phys.	42.5 ± 21.2	55.9 ± 23.1	58.8 ± 23.8	61.2 ± 23.3	63.0 ± 22.9	60.3 ± 23.5	61.4 ± 25.1	59.3 ± 24.7
WHO Envir.	64.4 ± 17.3	66.4 ± 18.4	68.9 ± 18.1	67.4 ± 21.3	68.0 ± 20.1	65.5 ± 20.3	66.4 ± 21.1	66.2 ± 22.0
WHO Social	51.0 ± 19.3	55.4 ± 24.7	59.3 ± 23.7	54.8 ± 24.7	58.4 ± 25.2	55.4 ± 24.3	56.1 ± 26.2	57.7 ± 24.1
DAS-24	65.0 ± 15.1	60.0 ± 18.5	58.7 ± 15.6	56.7 ± 16.0	57.5 ± 17.0	57.4 ± 17.8	57.4 ± 17.6	58.1 ± 18.0
HADS Anx.	9.4 ± 4.4	8.6 ± 4.5	8.6 ± 4.7	8.4 ± 4.5	8.5 ± 4.3	8.7 ± 4.3	8.8 ± 4.9	8.9 ± 4.6
HADS Dep.	9.4 ± 4.5	6.8 ± 4.6	6.6 ± 6.1	6.4 ± 5.7	5.9 ± 4.6	6.6 ± 5.0	6.2 ± 5.0	7.0 ± 5.2

Table 2. Mean ± Standard Deviation [SD] at each of the data collection points for individuals aged ≥ 50 (n = 27).

Measure	Pre	6 mo	1 yr	18 mo	2 yrs	3 yrs	4 yrs	5 yrs
BMI	50.3 ± 6.9	45.0 ± 6.2	42.9 ± 6.3	41.8 ± 6.3	41.0 ± 7.4	40.5 ± 6.4	41.3 ± 7.3	40.8 ± 5.9
CARSAL	34.5 ± 7.1	32.0 ± 7.8	30.7 ± 8.7	30.7 ± 8.5	29.5 ± 8.6	30.0 ± 7.1	30.4 ± 8.1	23.2 ± 12.8
CARVAL	30.6 ± 6.1	27.1 ± 7.0	26.2 ± 6.2	24.5 ± 6.8	24.1 ± 6.0	24.1 ± 7.2	24.8 ± 7.4	28.8 ± 16.4
WHO Q1	2.6 ± 1.0	3.0 ± 0.9	3.2 ± 1.0	3.4 ± 1.1	3.6 ± 0.8	3.4 ± 1.0	3.4 ± 1.0	3.5 ± 0.9
WHO Q2	1.4 ± 0.5	2.0 ± 0.8	2.6 ± 1.2	2.6 ± 1.2	2.6 ± 1.0	2.6 ± 1.1	2.6 ± 1.1	2.7 ± 1.1
WHO Psych.	43.9 ± 20.2	49.9 ± 17.4	52.9 ± 21.8	53.6 ± 23.3	57.7 ± 19.6	57.9 ± 23.0	57.8 ± 21.8	57.1 ± 23.2
WHO Phys.	39.0 ± 23.9	43.8 ± 23.9	47.2 ± 25.6	50.8 ± 28.1	52.2 ± 25.6	52.1 ± 26.3	49.7 ± 26.2	48.3 ± 30.2
WHO Envir.	60.6 ± 17.5	66.6 ± 13.8	69.1 ± 16.8	71.9 ± 15.4	69.8 ± 14.6	70.7 ± 14.4	69.6 ± 14.4	70.8 ± 16.0
WHO Social	54.0 ± 21.8	60.4 ± 21.1	56.8 ± 19.4	64.0 ± 26.7	65.6 ± 23.9	65.4 ± 19.7	63.2 ± 21.5	59.1 ± 20.9
DAS-24	60.2 ± 16.2	53.5 ± 16.3	52.9 ± 16.4	48.5 ± 15.4	45.8 ± 14.2	48.1 ± 17.4	47.0 ± 17.3	46.4 ± 18.3
HADS Anx.	9.0 ± 4.4	8.0 ± 4.0	7.7 ± 4.2	6.8 ± 4.1	6.6 ± 4.4	7.1 ± 4.7	7.2 ± 4.6	6.8 ± 4.8
HADS Dep.	8.0 ± 3.4	6.4 ± 4.1	6.2 ± 4.4	5.3 ± 4.4	4.4 ± 3.9	5.1 ± 4.1	5.1 ± 3.9	5.3 ± 4.1

Correlations between BMI and each psychometric measure at each time point are shown in Tables 3 (aged ≤ 49 years) and 4 (aged ≥ 50 years).

Table 3. Correlations between BMI and psychometric variables at each of the data collection points for individuals aged ≤ 49 (n = 46).

Psychometric measure	BMI							
	Pre	6 mo	1 yr	18 mo	2 yrs	3 yrs	4 yrs	5 yrs
BMI	.29*	.42**	.26	.41**	.28	.06	.18	.08
CARSAL	-.04	.18	.36*	.21	.36*	.27	.24	-.01
CARVAL	-.34*	-.41**	-.44**	-.44**	-.49***	-.42**	-.38**	-.37*
WHO Q1	-.03	-.29*	-.37*	-.48***	-.35*	-.40**	-.45**	-.36*
WHO Q2	-.31*	-.38**	-.41**	-.48***	-.38**	-.36*	-.31*	-.18
WHO Psych.	-.15	-.39**	-.37*	-.38**	-.28	-.25	-.33*	-.28
WHO Phys.	-.30*	-.21	-.31*	-.33*	-.41**	-.39**	-.33*	-.37*
WHO Envir.	-.20	-.25	-.37*	-.27	-.21	-.10	-.24	-.20
WHO Social	.31*	.08	.45**	.47***	.32*	.32*	.39**	.27
DAS-24	.19	.32*	.23	.35*	.34**	.41**	.38**	.30*
HADS Anx.	.22	.36	.42**	.42**	.32*	.24	.43**	.31*

*p <.05, **p <.01, ***p <.001

Table 4. Correlations between BMI and psychometric variables at each of the data collection points for individuals aged ≥ 50 (n = 27).

Psychometric measure	BMI							
	Pre	6 mo	1 yr	18 mo	2 yrs	3 yrs	4 yrs	5 yrs
BMI	.26	.25	.25	.29	.39*	.43*	.47*	.24
CARSAL	.30	.40*	.40*	.41*	.45*	.47*	.35	-.06
CARVAL	-.31	-.14	-.31	-.21	-.27	-.44*	-.34	-.27
WHO Q1	-.20	-.01	-.43*	-.10	-.42*	-.56**	-.44*	-.27
WHO Q2	-.48*	-.37	-.41*	-.15	-.40*	-.51**	-.36	-.41
WHO Psych.	-.25	-.26	-.31	-.12	-.46	-.49**	-.42*	-.44*
WHO Phys.	.06	-.28	.01	.17	.12	-.10	-.09	-.27
WHO Envir.	-.29	-.21	-.07	.17	.10	-.01	-.10	.15
WHO Social	.36	.47*	.39*	.44*	.41*	.48*	.39*	.37
DAS-24	.38	.10	.12	.02	.20	.40*	.32	.36
HADS Anx.	.30	.10	.36	.23	.33	.52**	.40	.26

*p <.05, **p <.01, ***p <.001

Table 5 shows the mean differences between pre- and five years post-LAGB for the whole sample with effects sizes with confidence intervals, along with the data for the two age groups at five years post-LAGB.

Table 5. Pre and five years post-LAGB mean ± Standard Deviation [SD], mean difference (M diff.), effect size (Hedge's g) and Confidence Interval [CI] of the effect size.

	Pre	Whole sample (n=73)				aged ≤ 49	aged ≥ 50			
		5 yrs	M diff.	g	CI	5 yrs	5 yrs	M diff.	g	CI
BMI	51.5 ± 8.6	41.2 ± 8.1	10.3	1.3	0.9 – 1.6	41.4 ± 9.2	40.8 ± 5.9	0.6	0.1	0.4 – 0.6
CARSAL	35.7 ± 6.2	26.3 ± 13.6	9.4	0.9	0.5 – 1.2	28.1 ± 13.9	23.2 ± 12.8	4.9	0.4	-0.1 – 0.8
CARVAL	30.8 ± 5.7	33.4 ± 18.5	2.6	0.2	-0.5 – 0.1	36.2 ± 19.3	28.8 ± 16.4	7.4	0.4	-0.1 – 0.9
WHO Q1	2.8 ± 1.0	3.4 ± 1.0	0.6	0.6	-0.9 – -0.3	3.4 ± 1.0	3.5 ± 0.9	0.1	0.1	-0.6 – 0.4
WHO Q2	1.6 ± 0.7	2.7 ± 1.1	1.1	1.2	-1.5 – -0.8	2.7 ± 1.1	2.7 ± 1.1	0	0.1	-0.5 – 0.5
WHO Psych.	42.4 ± 19.1	51.2 ± 24.5	8.8	0.4	-0.7 – -0.1	47.8 ± 24.8	57.1 ± 23.2	9.3	0.4	-0.9 – 0.1
WHO Phys.	41.2 ± 22.2	55.2 ± 27.2	14.0	0.6	-0.9 – -0.2	59.3 ± 24.7	48.3 ± 30.2	11.0	0.4	-0.1 – 0.9
WHO Envir.	63.0 ± 17.4	67.9 ± 20.0	4.9	0.3	-0.6 – 0.1	66.2 ± 22.0	70.8 ± 16.0	4.6	0.2	-0.7 – 0.3
WHO Social	52.0 ± 20.1	58.2 ± 22.8	6.2	0.3	-0.6 – 0.0	57.7 ± 24.1	59.1 ± 20.9	1.4	0.1	-0.5 – 0.4
DAS-24	63.2 ± 15.6	53.8 ± 18.9	9.4	0.5	0.2 – 0.9	58.1 ± 18.0	46.4 ± 18.3	11.7	0.6	0.2 – 1.1
HADS Anx.	9.3 ± 4.4	8.1 ± 4.7	1.2	0.3	-0.1 – 0.6	8.9 ± 4.6	6.8 ± 4.8	2.1	0.4	-0.0 – 0.9
BMI	8.9 ± 4.1	6.4 ± 4.9	2.5	0.6	0.2 – 0.9	7.0 ± 5.2	5.3 ± 4.1	1.7	0.3	-0.1 – 0.8

3.1. BMI

Results of correlations between BMI and the psychometric measures will be outlined in subsequent sections. Repeated measures ANOVA analysis showed there was a difference in BMI over the five years, $F(7, 65) = 34.3$, $p < .001$, but not between the two age groups, $F(7, 65) = 0.4$, $p = .93$. The mean difference in BMI between pre- and five years post-LAGB resulted in a very large effect size. Meanwhile the between group mean difference in BMI at five years post-LAGB revealed a very small effect size - individuals aged ≥ 50 years had a BMI only 0.6kg/m^2 less than individuals aged ≤ 49 years. The *t*-test results indicated both the ≤ 49 years and ≥ 50 age groups significantly reduced their BMI at five years post-LAGB compared to pre-operatively, $t(45) = 8.7$, $p < .001$ and $t(26) = 7.2$, $p < .001$, respectively.

3.2. HADS

Correlations showed significant relationships between BMI and anxiety at six time points post-LAGB for the ≤ 49 age group; six months, 18 months, two years, three years, four years, and five years. Additionally for this group, significant relationships between BMI and depression were present at five time points post-LAGB; one year, 18 months, two years, four years, and five years. For individuals aged ≥ 50 years there were significant relationships between BMI and anxiety as well as BMI and depression but only at three years post-LAGB.

Repeated measures ANOVA analysis showed a difference in anxiety scores over the five years, $F(7, 65) = 2.3$, $p = .04$, but not between the two age groups, $F(7, 65) = 0.7$, $p = .66$. The mean difference in anxiety scores between pre- and five years post-LAGB resulted in a small effect size. Meanwhile the between group mean difference in anxiety at five years post-LAGB revealed a small to medium effect size, with the ≥ 50 age group having anxiety scores 2.1 points less than the ≤ 49 age group. The *t*-test results indicated the ≥ 50 group significantly reduced their anxiety scores at five years post-LAGB compared to pre-operatively, $t(26) = 3.4$, $p = .002$, but this was not the case for the ≤ 49 group $t(45) = .99$, $p = .32$.

Repeated measures ANOVA analysis showed a difference in depression scores over the five years, $F(7, 65) = 10.9$, $p < .001$, but not between the two age groups, $F(7, 65) = 0.4$, $p = .90$. The mean difference in depression scores between pre- and five years post-LAGB resulted in a medium effect size, while the between group mean difference in depression at five years post-LAGB revealed a small effect size; with those aged ≥ 50 years having depression scores 1.7 points less than those aged ≤ 49 years. The *t*-test results indicated both age groups significantly reduced their depression scores at five years post-LAGB compared to pre-operatively (≤ 49 years: $t(45) = 3.3$, $p = .002$; ≥ 50 years: $t(26) = 6.9$, $p < .001$).

3.3. DAS-24

Correlations showed significant relationships between BMI and DAS-24 scores at six time points post-LAGB for those aged ≥ 50 years; six months, one year, 18 months, two years, three years, and four years. Similarly, significant relationships between BMI and DAS-24 were present at six time points for individuals aged ≤ 49 years; pre, one year, 18 months, two years, three years, and four years.

Repeated measures ANOVA analysis showed a difference in DAS-24 scores over the five years, $F(7, 65) = 7.8$, $p < .001$, but no difference was observed between the two age groups, $F(7, 65) = 1.2$, $p = .33$. There were medium effect sizes for both the mean difference in DAS-24 scores between pre- and five years post-LAGB as well as the between group mean difference in DAS-24 at five years post-LAGB (where those aged ≥ 50 years had DAS-24 scores 11.7 points less than those aged ≤ 49 years). The *t*-test results indicated both the ≤ 49 years and ≥ 50 age groups significantly reduced their DAS-24 scores at five years post-LAGB compared to pre-operatively, $t(45) = 3.2$, $p = .003$ and $t(26) = 6.1$, $p < .001$, respectively.

3.4. WHOQoL

Correlations showed significant relationships between BMI and WHOQoL question one scores at all eight time points for individuals aged ≤ 49 years. In marked contrast, those aged ≥ 50 years recorded only a single significant correlation at the three year post-LAGB time point between these same variables. For WHOQoL question two scores and BMI, significant relationships were present for the individuals aged ≤ 49 years at all seven post-LAGB time points while those aged ≥ 50 years recorded significant relationships at four post-LAGB time points; one, two, three and four years.

For the psychological sub-scale, significant relationships with BMI were present for the those aged ≤ 49 years at the first seven time points while those aged ≥ 50 years recorded significant relationships at four time points; pre-LAGB, one, two, three and four years post-LAGB. Fewer significant relationships were recorded between the physical sub-scale and BMI; at four times post-LAGB for those aged ≤ 49 years (six months, one year, 18 months, and four years) and three times post-LAGB for those aged ≥ 50 years (three, four and five years). While the group aged ≥ 50 years showed no significant relationships between BMI and the environment sub-scale, for those aged ≤ 49 years all bar the six month post-LAGB time point were recorded with significant correlations. Only one significant relationship between the social sub-scale and BMI was recorded for either group – i.e. those aged ≤ 49 years at one year post-LAGB.

Repeated measures ANOVA analysis showed a difference in WHOQoL question one scores over the five years, $F(7, 64) =$

6.5, p <.001, but with no difference between the two age groups, $F(7, 64) = 0.8$, p =.60. There was a medium effect size for the mean difference in WHOQoL question one scores between pre- and five years post-LAGB. Although the between group mean difference in WHOQoL question one scores at five years post-LAGB revealed a negligible effect with individuals aged ≥ 50 year scoring only 0.1 point more than individuals aged ≤ 49 years. Both age groups showed significant changes in WHOQoL question one scores at five years post-LAGB compared to pre-operatively (≤ 49 years: $t(44) = -3.5$, p =.001; ≥ 50 years: $t(26) = -5.8$, p <.001). Exploration of the means indicates for both groups their scores increased from pre- to five years post-LAGB.

For WHOQoL question two, results showed a difference in scores over the five years, $F(7, 64) = 14.3$, p <.001, but no difference was observed between the two age groups, $F(7, 64) = 0.3$, p =.95. The mean difference in WHOQoL question two scores between pre- and five years post-LAGB resulted in a very large effect size. Meanwhile the between group mean difference in WHOQoL question two scores at five years post-LAGB revealed a negligible effect where again the difference in score between the two groups was only 0.1 point in favour of those aged ≥ 50 years. Both groups had significant changes in WHOQoL question two scores at five years post-LAGB compared to pre-operatively, (≤ 49 years: $t(44) = -6.5$, p <.001; ≥ 50 years $t(26) = -7.0$, p <.001). Exploration of the means indicates for both groups their scores increased from pre- to five years post-LAGB.

For the psychological sub-scale, there was a significant difference in scores over the five years, $F(7, 65) = 5.1$, p <.001, but no such difference was observed between the two age groups, $F(7, 65) = 0.7$, p =.65. The mean difference in psychological sub-scale scores between pre- and five years post-LAGB resulted in a small effect size, as did the between group mean difference in psychological sub-scale scores at five years post-LAGB, with individuals aged ≥ 50 years recording a higher score of 9.3 points. Both the ≤ 49 years and ≥ 50 age groups had significant changes in psychological sub-scale scores at five years post-LAGB compared to pre-operatively, $t(45) = -2.2$, p =.04 and $t(26) = -6.0$, p <.001, respectively. Exploration of the means indicates increased scores for both groups from pre- to five years post-LAGB.

For the physical sub-scale, results showed a difference in scores over the five years, $F(7, 65) = 8.6$, p <.001, but no difference was observed between the two age groups, $F(7, 65) = 0.8$, p =.56. The mean difference in physical sub-scale scores between pre- and five years post-LAGB showed a medium effect size. Although the between group mean difference in physical sub-scale scores at five years post-LAGB revealed a small effect size, with individuals aged ≤ 49 years having an 11.0 points advantage. Both the ≤ 49 years and ≥ 50 age groups had significant changes in physical sub-scale scores at five years post-LAGB compared to pre-operatively, $t(45) = -5.7$, p <.001 and $t(26) = -3.0$, p <.004, respectively. Exploration of the means showed increased scores for both groups from pre- to five years post-LAGB.

There was no difference in scores over the five years, $F(7, 65) = 1.9$, p =.08, nor between the two age groups, $F(7, 65) = 1.2$, p =.30 for the environment sub-scale. The mean difference in environmental sub-scale scores between pre- and five years post-LAGB showed a small effect size, as did the between group mean difference at five years post-LAGB where those aged ≥ 50 years had a higher score by 4.6 points. The t-test results showed those aged ≥ 50 years had significant changes in environmental sub-scale scores at five years post-LAGB compared to pre-operatively, $t(26) = -2.7$, p =.01, but this was not the case for the ≤ 49 age group, $t(45) = -0.7$, p =.47. Exploration of the means indicates for both groups showed their scores increasing over time but to a greater degree in those aged ≥ 50.

For the social sub-scale, there was a difference in scores over the five years, $F(7, 60) = 2.3$, p =.04, as well as between the two age groups, $F(7, 60) = 2.7$, p =.02. The mean difference in social sub-scale scores between pre- and five years post-LAGB recorded a medium effect size. Although the between group mean difference in social sub-scale scores at five years post-LAGB showed a negligible effect size, with the ≥ 50 age group showing a modest 1.4 points advantage. Only the group aged ≤ 49 years had significant changes in social sub-scale scores at five years post-LAGB compared to pre-operatively, $t(44) = -2.1$, p =.04 (≥ 50 group, $t(23) = -1.7$, p =.10). Exploration of the means indicates for both groups showed their scores increased from pre- to five years post-LAGB but to a greater extent in the ≤ 49 age group.

3.5. CARVAL/CARSAL

Correlations showed significant relationships between BMI and CARSAL scores for both age groups - for those aged ≤ 49 years at pre-banding, six and 18 months post-LAGB while for those aged ≥ 50 years they were at two, three and four years post-LAGB. Meanwhile for the CARVAL scale, two significant relationships with BMI were shown for the individuals aged ≤ 49 years; one and two years post-LAGB. Individuals aged ≥ 50 years showed five significant relationships between BMI and CARVAL; six months, one year, 18 months, two years, and three years' post-LAGB.

Repeated measures ANOVA analysis showed a difference in CARSAL scores over the five years, $F(7, 65) = 6.1$, p <.001, but no difference between the two age groups, $F(7, 65) = 1.7$, p =.13. The mean difference in CARSAL scores between pre- and five years post-LAGB showed a large effect size.

Although the between group mean difference in CARSAL at five years post-LAGB revealed a small effect size, with individuals aged ≥ 50 years having CARSAL scores 4.8 points lower than individuals aged ≤ 49 years. Both the ≤ 49 years and ≥ 50 age groups had significant changes in CARSAL scores at five years post-LAGB compared to pre-operatively, $t(45) = 4.3$, $p <.001$ and $t(26) = 4.3$, $p <.001$, respectively. Exploration of the means showed for both groups decreasing scores from pre- to five years post-LAGB.

Repeated measures ANOVA analysis showed a difference in CARVAL scores over the five years, $F(7, 65) = 6.0$, $p <.001$, but no difference between the two age groups, $F(7, 65) = 0.9$, $p =.48$. The mean difference in CARVAL scores between pre- and five years post-LAGB resulted in a small effect size, as did the between group mean difference in CARVAL at five years post-LAGB, with individuals aged ≥ 50 years having CARVAL scores 7.4 points lower than individuals aged ≤ 49 years. Neither age group had significantly different CARVAL scores at five years post-LAGB compared to pre-operatively (≤ 49 years: $t(45) = -1.8$, $p =.08$; ≥ 50 years: $t(26) = 0.6$, $p =.55$).

4. Discussion

There appears to be a strong relationship between BMI and problems with appearance as measured by the DAS-24 pre-LAGB for individuals aged ≤ 49 years which does not seem to be the case for those aged ≥ 50. In contrast to this, both age groups show a marked relationship between BMI and the WHOQoL psychological domain pre-LAGB. But only the group aged ≤ 49 years showed a significant relationship between BMI and environment pre-LAGB.

Repeated measures ANOVA results indicated that for BMI and all but one psychometric measure (WHOQoL environment) there were changes from pre- to five years post-LAGB for the whole sample. Only the WHOQoL social scale showed a difference between the two age groups over time on the repeated measures ANOVA. Data indicates the difference between the means on the social scale from pre- to five years post-LAGB is greater for individuals aged ≤ 49 years than those aged ≥ 50 years. This result may be reflective of the stage of life reached by those in these age groups. It is well documented that younger individuals have larger social networks [33], and greater sexual activity than older individuals [34], which are questions incorporated within the social scale [21]. The lack of statistically significant change in the WHOQoL environment scores despite the means showing improvement may be due to the aspects measured in this scale, for example, finances, home environment and opportunities for acquiring new information and skills may not have been issues faced by the individuals in this sample. Furthermore, the way health services are structured in the United Kingdom means that bariatric candidates do not pay for surgery or post-surgical care during a significant life event [26, 35] and this may have influenced scores on the environment scale.

Exploring the mean scores for the WHOQoL scale compared to the clinical cut-off of 69 suggests that prior to surgery both age groups experience poor quality of life in all four domains. In the years following surgery despite improvements for both groups, only the environmental domain for individuals aged ≥ 50 years reaches over 69 at five years post-LAGB. For the HADS which has clinical cut-off of 8, prior to surgery both age groups appear to be experiencing problems with anxiety and depression. Five years following LAGB individuals aged ≥ 50 years no longer appear to experience problems in either HADS domain, however, for individuals aged ≤ 49 years problems with depression have improved below the cut-off, but issues with anxiety remain. These continuing problems are likely linked to weight as indicated by the positive significant correlation between BMI and the HADS anxiety scores. Despite the significant reduction in BMI from pre- to five year post-LAGB shown by the large effect size, both groups are still in the class III obesity category with BMI's > 40 kg/m^2 [26]. Given both ages groups are still significantly obese compared with healthy norms (i.e., BMI < 25 kg/m^2) it is perhaps unsurprising that although LAGB significantly improves psychological health problems are still present five years following surgery. These individuals are still visibly different [2, 4], and will continue to find some activities of daily living challenging [36, 37]. Furthermore, it is well documented that many individuals have unrealistic expectations of weight loss following bariatric surgery [38, 39], and it may be this group of individuals believed they would lose more weight in the years following surgery than actually did which in turn effected their mental health.

Exploring the scores from the DAS-24 which looks at problems with social avoidance due to appearance, findings were encouraging as over time both age groups had significant improvements. However, data indicates individuals aged ≥ 50 years showed greater improvements than those aged ≤ 49 years. The older age group had a slightly lower mean BMI at five years compared to the younger group, which may have been an influential factor in the lower DAS-24 scores. As discussed previously, older people tend not to be socially active in the same way as younger people, therefore are likely to naturally score less on the DAS-24 than younger people [20]. Considering all data available from the psychological measures, findings are encouraging as they suggest individuals across the lifespan benefit psychologically from undergoing LAGB which supports previous research in other diverse samples [10, 40].

Study strengths and weaknesses

As far as the authors are aware, this is the first longitudinal exploration comparing the long-term psychological impact of LAGB of individuals aged ≤ 49 and ≥50 years in the UK using validated scales.

Limitations of this study include the uneven age group sample sizes which are a common issue in pragmatic health research [41, 42], however, effect sizes were calculated using Hedge's *g* which is designed to deal with this issue [32]. Other limitations which have been discussed in previous publications include; the underrepresentation of individuals from Black and Ethnic Minority [BAME] groups, only focussing on individuals undergoing LAGB surgery, the issue with the question regarding sex life in the WHOQoL social relationships domain, and the use of the LOCF method which may result in a more conservative reporting of the findings than a complete data set [1, 11, 12, 25].

5. Conclusion

Both age groups (≤ 49 and ≥50 years) appear to benefit psychologically from LAGB surgery in the long-term. Furthermore, both groups seem to lose significant amounts of weight in the years following surgery which will have important health benefits. Results suggest individuals aged ≤ 49 may have more psychological concerns regarding their weight that need addressing than individuals aged ≥ 50, however, both groups would likely benefit from support throughout their weight loss journey. Future longitudinal research could benefit from incorporating measures of confidence to determine whether individuals across the lifespan benefit if they have higher levels of this psychological trait following LAGB and other types of bariatric surgery, as confidence in one's ability to achieve a goal is linked to long-term successes.

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Disclosure Statement

The authors declare no conflict of interest.

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