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Cognitive Function and Quality of Life in Bariatric Surgery Candidates Short title: Cognition & QoL in Bariatric

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Abstract

Background: Both poor quality of life (QoL) and cognitive impairment are common in persons with severe obesity. Work in other patient populations shows that cognitive impairment is associated with poorer QoL, though this possibility has not been examined in bariatric surgery candidates.

Objectives: We sought to determine the association between cognitive performance and QoL, both total and work-related, in a sample of bariatric surgery candidates.

Setting: Three sites were used for data collection, including the Neuropsychiatric Research Institute in Fargo, ND, Columbia University in NY, and Cornell University in NY.

Methods: Sixty participants from the Longitudinal Assessment of Bariatric Surgery (LABS) project were assessed at pre-operative baseline.

Results: Hierarchical regression analyses showed that poorer cognitive function was independently associated with lower total QoL and that both reported and objectively-measured cognitive impairment were associated with poorer work-related QoL.

Conclusions: These preliminary findings suggest that cognitive impairment may contribute to poorer total and work-related QoL in bariatric surgery candidates. Future studies should examine whether interventions to improve cognitive function can improve QoL and other outcomes in this population.

Keywords

severe obesity; cognition; executive function; quality of life; bariatric surgery

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Introduction

People with severe obesity often report poor quality of life (QoL).^{1,2} QoL refers to an individual's subjective experience of their psychological, social, and physical health. QoL is adversely influenced by disease, but also by psychological aspects such as personal experiences, expectations, and perceptions.³ It is perhaps not surprising that severe obesity is associated with poor QoL as this condition is linked to many medical conditions (e.g. type 2 diabetes, osteoarthritis) and psychosocial issues (e.g. social stigma, depression).^{4,5,6,7}

There is reason to believe that cognitive impairment may be an important contributor to QoL in individuals with severe obesity seeking bariatric surgery. Cognitive function refers to the integrated processes that support organizing, storing, retrieving, and communicating information⁸ on testing and in real world settings. Severe obesity is associated with deficits in multiple cognitive domains^{9,10} and cognitive impairment is associated with poorer QoL in other medically-ill samples, including those with cardiovascular disease and diabetes.^{11,12,13} As even subtle cognitive impairment can lead to reduced daily function,^{14,15} it is likely that cognitive impairment may negatively impact QoL in bariatric surgery candidates, especially work-related QoL. Consistent with this notion, a recent study found that obesity was associated with poorer executive function, functional abilities, and mobility in a sample of older adults (average age = 68 +/-8 years).¹¹ Path analyses showed that executive function mediated the association between obesity and both mobility and functional abilities, such that persons with better executive function exhibited more intact mobility and daily function even at high BMI.¹¹ In addition to this impact on functional abilities, it is likely that cognitive impairment may join factors such as increased affective symptoms (e.g. depression) and limited mobility in disrupting the skills needed to maintain employment.¹³ Although some research has addressed the impact of obesity-related impairments with work performance,^{6,16} little is known about the role of cognitive impairment in this relationship.

The current study examined the possible association between cognitive function and QoL in a sample of bariatric surgery candidates. Based on past work, we predicted that greater cognitive impairment would be associated with poorer total and work-related QoL.

Methods

Participants

A total of 60 bariatric surgery candidates with complete self-report data from the Longitudinal Assessment of Bariatric Surgery (LABS) project were examined for the current study. This number reflects the total number with complete data. All participants provided informed consent prior to inclusion of the study and all necessary approval was obtained by the testing sites' respective Institutional Review Boards. Participants were required to be 18 to 70 years of age and speak English. To ensure potential cognitive impairment was associated with obesity-related illness only, individuals were excluded from the parent study if they endorsed history of learning disability, developmental disability, sensory impairment, neurological disorder/injury (e.g. stroke, dementia), or past/current history of severe psychiatric illness (e.g. bipolar, schizophrenia), or alcohol/drug abuse. Participants in the current study had an average age of 43.59 ± 10.39 years. 80.3% were women and mean body

mass index (BMI) was $45.90 \pm 5.27 \text{ kg/m}^2$. See Table 1 for demographic and medical characteristics of the sample.

Measures

Demographic and medical characteristics—Participants were asked to self-report demographic and medical variables prior to testing and a record review was conducted to corroborate this information, although sometimes record review was considered incomplete due to missing data in medical reports. Most relevant to the current study, participants reported the presence or absence of a number of medical conditions, including depression and pain. Depression and pain were measured using single self-report item presented on a list of potential diagnoses through a Medical History Form (i.e. “Medical History: circle all that apply”). These disorders are associated with QoL in past studies of persons with severe obesity^{17,18} and were employed as covariates.

Quality of Life—QoL was operationally quantified by score on the Impact of Weight on Quality of Life (IWQOL) for the present study. The IWQOL is a validated and widely-used self-report questionnaire^{19,20,21} that assesses quality of life regarding domains of physical functioning, self-esteem, sexual life, public distress, and workplace functioning. In addition to a total score, the IWQOL also generates scores for each subscale, with lower scores reflecting better reported QoL. Due to our primary interest on the impact of severe obesity on workplace functioning and QoL, we focused on total-QoL and work-related QoL scores for the current study. Psychometric evaluation in a community sample (N=494, Mage=38.1; BMI range from <25 to 40+) revealed strong internal consistency (0.96 for total score, range from 0.82–0.94 for subscales), test-retest reliability (0.94 for total score, range from 0.81–0.88 for subscales), and construct validity.¹⁷ A cross validation study in a clinical sample of persons with obesity also indicated strong psychometric properties, including excellent reliability (0.96 for total score, range from 0.90 – 0.94 for subscales) and construct validity.¹⁹

Cognitive function—In the current study, cognitive function was operationally measured by scores on the Integneuro test battery, which comprises computerized versions of popular neuropsychological tests. Findings from past studies in the LABS cohort has shown this measure is sensitive to obesity-related cognitive impairment and changes over time^{22,9} Prior to its use in clinical sample, the Integneuro test battery was shown to have strong psychometric properties in a sample of healthy individuals, including both convergent and divergent validity.²³ For the current analyses, performance on measures from three domains were selected – attention (Forward Digit Span, Switching of Attention-Digits, and Verbal Interference-Word), executive function (Backward Digit Span, Switching of Attention-Letter/Number, Verbal Interference-Color, and Maze Errors), and memory (Verbal List Learning, Short Delay Recall, Long Delay Recall, and Recognition). These domains were selected as previous research shows they are the primary areas of cognitive functioning associated with obesity and obesity-related changes.^{7,8}

Reports of cognitive difficulties—Past work in other samples has shown an inconsistent relationship between subjective and objective cognitive functioning.²⁴ As a

result, each of these approaches was utilized in the present study to help identify their possible relationship to quality of life. Subjective cognitive impairment was quantified using a measure from past work in bariatric surgery candidates²⁵ by asking participants to respond to “I have trouble with my memory, paying attention, or understanding what others are saying to me.” They were provided with five possible responses ranging from “Not at all” to “Very often,” with lower scores reflecting a greater perceived frequency of cognitive impairment.

Data analysis

To facilitate interpretation, raw scores were transformed into t scores based on age, sex, and estimated IQ from the Integneuro normative sample. Estimated IQ was generated from a word reading test embedded within the Integneuro. Hierarchical regression analyses examined the association between cognitive function and QoL indices. Specifically, BMI, depression, and presence of a pain condition were entered into block 1 of the model with the respective cognitive function measure entered in block 2 of the model. This process was conducted separately for total and work-related QoL.

Results

Cognitive Function and Total QoL

Hierarchical regression analyses found that measures of attention [R square = 0.30, R square change = 0.07, $F(3, 53) = 1.81$, $\beta = 0.08$, $p = 0.16$], executive function [R square = 0.31, R square change = 0.08, $F(4, 52) = 1.57$, $\beta = -0.32$, $p = 0.20$], and memory [R square = 0.30, R square change = 0.08, $F(4, 52) = 1.48$, $\beta = 0.31$, $p = 0.22$] were not independently associated with Total QoL after accounting for BMI, depression, and pain. In contrast, greater report of cognitive difficulties was significantly associated with poorer reported Total QoL [R square = 0.29, R square change = 0.07, $F(1, 55) = 5.19$, $\beta = -0.27$, $p = 0.03$]. See Table 2.

Cognitive Function and Work-related QoL

Hierarchical regression analyses found that poorer performance on measures of executive function was independently associated with poorer reported Work-related QoL [R square = 0.31, R square change = 0.14, $F(4, 52) = 2.66$, $\beta = -0.37$, $p = 0.04$]. See Table 3. This significant effect was due to the association between poorer performance on a measure of working memory (i.e., Backward Digit Span, $\beta = -0.26$, $p = 0.04$) and spatial planning and learning (i.e., Maze Errors, $\beta = -0.28$, $p = 0.04$) and QoL. No relationship emerged for measures of attention [R square = 0.20, R square change = 0.03, $F(3, 53) = 0.57$, $\beta = 0.10$, $p = 0.64$] or memory [R square = 0.13, R square change = 0.07, $F(4, 52) = 1.15$, $\beta = 0.20$, $p = 0.34$]. However, greater reported cognitive difficulties were also independently associated with poorer Work-related QoL [R square = 0.30, R square change = 0.13, $F(1, 55) = 9.80$, $\beta = -0.37$, $p = 0.003$].

Discussion

Consistent with work in other medical populations,^{10,11} cognitive impairment showed an independent relationship to poorer QoL in the current sample of bariatric surgery candidates, with effect sizes ranging from 0.26 to 0.37.²⁶ This pattern was especially strong for work-related QoL, with both objective and subjective cognitive impairment being associated with poorer QoL. Such findings are perhaps not surprising, as conditions with similar deficits in working memory and planning are known to adversely impact work performance and workplace stress (persons with Attention Deficit Hyperactivity Disorder).^{27,28} As elevated BMI is associated with reduced productivity, greater absenteeism, and higher risk for disability^{29,30,31,32}, it appears likely that cognitive impairment is an independent contributor to work-related difficulties in persons with severe obesity.

Such findings encourage further research to better understand the adverse impact of cognitive impairment on a wide range of bariatric surgery outcomes. When combined with past work, it appears likely that cognitive impairment is an independent predictor of medical, psychological, and psychosocial outcomes in this population. For example, cognitive deficits are associated with reduced weight loss following bariatric surgery³³ and known to moderate the relationship between obesity and difficulties in daily function in older adults.⁹ If replicated, it is possible that interventions that improve cognitive function may lead to better outcomes for many individuals. Interventions could include compensatory strategies (e.g. daily planners, behaviors techniques to improve on-task performance) or direct cognitive intervention (e.g. cognitive training, pharmacotherapy) to ameliorate the effects of cognitive impairment.³⁴ These studies may have the potential to significantly reduce the personal and societal costs of obesity by having both direct and indirect effects on numerous outcomes.

The findings from this preliminary study are limited in several important ways. Though our sample is representative of persons seeking bariatric surgery, it is largely comprised of middle-aged women and it is possible that the relationship between cognitive function and QoL differs in other samples. Similarly, the current study does not prospectively examine this relationship and both cognitive function and QoL are known to improve following bariatric surgery.^{9,35} Insufficient data were available to adequately test this possibility in the current sample. Though the current study examined the influence of self-reported depression and pain problems on the relationship between QoL and cognitive function, it is important to note these were not formal clinical diagnoses. Any systematic differences between subjective and objective diagnosis for these conditions may influence our current findings. Lastly, the modest sample size of the current study has limited statistical power and confirmation in a larger sample is needed to identify other potential associations.

Conclusions

In summary, results from this preliminary study suggest that cognitive impairment is an independent contributor to poorer total and work-related QoL in bariatric surgery candidates. If confirmed in future work, such findings encourage additional studies to better understand the adverse impact of cognitive impairment on a wide range of bariatric surgery outcomes.

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Highlights

- Reports of problems with memory or other mental abilities are associated with poorer total and work-related quality of life in bariatric surgery candidates
- Poorer performance on tests of executive function are associated with lower work-related quality of life in this population and might be an important target for intervention to improve outcomes

Table 1

Demographics and Medical Characteristics (N=60)

Variables	M(SD)	Absolute Frequency (n)	Relative Frequency (%)
<i>Demographics</i>			
BMIb (kg/m ²)	45.90(±5.27)	-	-
Age (years)	43.59(±10.4)	-	-
Gender (male)	-	12	20
<i>Medical</i>			
Depression	-	16	27
Pain	-	13	22
Diabetes	-	10	17
Hypertension	-	25	42
Sleep apnea	-	22	37
<i>Self-report</i>			
Work QoL	8.70(±3.53)	-	-
Total QoL	89.67(±22.75)	-	-
Subjective Cognition	3.72(±1.01)	-	-
<i>Cognition (t-scores)</i>			
List Learning	43.96(±10.22)	-	-
Short Delay Recall	46.96(±9.34)	-	-
Long Delay Recall	46.57(±9.31)	-	-
Recognition	42.50(±9.04)	-	-
Digit Forward	51.76(±9.65)	-	-
SOA Digit	57.93(±11.62)	-	-
VI Word	55.63(±11.26)	-	-
SOA Mixed	56.51(±12.59)	-	-
VI Color	56.65(±12.37)	-	-
Digit Backward	50.22(±9.89)	-	-
Maze Errors	51.23(±11.71)	-	-

Abbreviation	Definition
BMIb	Body Mass Index baseline
kg	Kilograms
m	Meters
QoL	Quality of life
SOA Digit	Switching of attention – digits
VI Word	Verbal interference – word
SOA Mixed	Switching of attention – letter/number
VI Color	Verbal interference – color
Digit Backward	Digit span backward
Digit Forward	Digit span forward

*
p<.05

**
p<.01

p<.001

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Table 2

Hierarchical Multiple Regression predicting Total QoL from Objective and Subjective Cognition (N=60)

Predictor Variables	Att. Regression		EF. Regression		Mem. Regression		Sub. Cog. Regression	
	B(SE)	β	B(SE)	β	B(SE)	β	B(SE)	β
BMI	1.26(.50)	.29 *	1.36(.51)	.32 *	.90(.52)	.21	1.19(.49)	.29 *
Depression	-3.53(3.17)	-.14	-4.85(3.20)	-.19	-3.41(3.16)	-.13	-2.14(3.16)	-.08 *
Pain	9.17(3.40)	-.34 **	-6.96(3.49)	-.25	-8.01(3.43)	-.29 *	-7.25(3.32)	-.27 *
<i>Attention</i>								
Digit forward	-.58(.29)	-.25 *	-	-	-	-	-	-
SOA Digit	-.09(.23)	-.05	-	-	-	-	-	-
VI color	.42(.25)	.21	-	-	-	-	-	-
<i>Executive function</i>								
Digit Backward	-	-	.31(.24)	.17	-	-	-	-
SOA Mixed	-	-	-.09(.22)	-.05	-	-	-	-
VI Color	-	-	-.40(.29)	-.17	-	-	-	-
Maze Error	-	-	-.51(.26)	-.26	-	-	-	-
<i>Memory</i>								
Verbal list learning	-	-	-	-	-.11(.38)	-.05	-	-
Short Delay Recall	-	-	-	-	.17(.52)	.07	-	-
Long Delay Recall	-	-	-	-	.14(.47)	.06	-	-
Recognition	-	-	-	-	.65(.32)	.26 *	-	-
Subject cognition	-	-	-	-	-	-	-6.14(2.70)	-.27 *
R ²	.30		.31		.55		.29	
F for change in R ²	1.81		1.57		1.48		5.19 *	

Abbreviation	Definition
BMI	Body Mass Index
Att.	Attention
EF.	Executive functions
Mem.	Memory
Sub. Cog.	Subjective cognitive complaint
SOA Digit	Switching of attention – digits
VI Word	Verbal interference – word
SOA Mixed	Switching of attention – letter/number
VI Color	Verbal interference – color
Digit Backward	Digit span backward
Digit Forward	Digit span forward
QoL	Quality of life

* p<.05

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p<.01

p<.001

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Table 3

Hierarchical Multiple Regression predicting Work QoL from Objective and Subjective Cognition (N=60)

Predictor Variables	Att. Regression		EF. Regression		Mem. Regression 3		Sub. Cog. Regression	
	B(SE)	β	B(SE)	β	B(SE)	β	B(SE)	β
BMI	.15(.08)	.22	.16(.08)	.24*	.11(.09)	.17	.13(.08)	.19
Depression	-.78(.53)	-.20	-.94(.50)	-.24	-.72(.51)	-.18	-.40(.49)	-.10
Pain	-1.08(.56)	-.25	-.78(.54)	-.18	-1.10(.56)	-.26	-.84(.51)	-.20
<i>Attention</i>								
Digit forward	-.05(.05)	-.13	-	-	-	-	-	-
SOA Digit	-.03(.04)	-.11	-	-	-	-	-	-
VI color	.03(.04)	.10	-	-	-	-	-	-
<i>Executive function</i>								
Digit Backward	-	-	.04(.04)	.15	-	-	-	-
SOA Mixed	-	-	-.03(.03)	-.11	-	-	-	-
VI Color	-	-	-.09(.04)	-.26*	-	-	-	-
Maze Error	-	-	-.08(.04)	-.28*	-	-	-	-
<i>Memory</i>								
Verbal list learning	-	-	-	-	.00(.06)	.01	-	-
Short Delay Recall	-	-	-	-	-.05(.08)	-.12	-	-
Long Delay Recall	-	-	-	-	.02(.08)	.05	-	-
Recognition	-	-	-	-	.11(.05)	.27*	-	-
Subject cognition							-1.31(.42)	-.37**
R ²	.54		.55		.55		.54	
F for change in R ²	1.81		1.57*		1.48		9.80**	

Abbreviation	Definition
BMI	Body Mass Index
Att.	Attention
EF.	Executive functions
Mem.	Memory
Sub. Cog.	Subjective cognitive complaint
SOA Digit	Switching of attention – digits
VI Word	Verbal interference – word
SOA Mixed	Switching of attention – letter/number
VI Color	Verbal interference – color
Digit Backward	Digit span backward
Digit Forward	Digit span forward
QoL	Quality of life

* p<.05

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p<.01

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