Published in final edited form as:

Surg Obes Relat Dis. 2013 ; 9(5): 797–801. doi:10.1016/j.soard.2012.10.008.

Patient reports of cognitive problems are not associated with neuropsychological test performance in bariatric surgery candidates

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Abstract

Background—Recent work shows that cognitive deficits are common in bariatric surgery candidates and associated with reduced weight loss at 12 months post-operatively. As pre-operatively neuropsychological assessment is not available for all patients at all sites, many care providers ask patients to self-report their level of cognitive dysfunction. However, the accuracy of patient self-report of cognitive abilities has not been empirically examined.

Setting—Longitudinal Assessment of Bariatric Surgery (LABS), United States; Medical Center

Methods—Eighty-one bariatric surgery candidates completed self-report measures of cognitive functioning and neuropsychological tests of memory and other cognitive abilities.

Results—Analyses found no association between subjective report of cognitive function and objective performance on neuropsychological testing. However, persons with history of major depressive disorder reported experiencing greater cognitive deficits.

Conclusions—These findings suggest that bariatric surgery candidates have little insight into their current level of cognitive function. Future work is needed to confirm these findings and identify brief, objective measures of cognitive function that are sensitive to deficits in bariatric surgery candidates.

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Keywords

Bariatric; Cognition; Self-report; Memory; Executive Function

Obesity remains pandemic and prevalence rates are expected to continue to increase in coming years⁽¹⁾. More than 10% of men and 16% of women are severely obese⁽²⁾ and such persons are at high risk for medical conditions such as cardiovascular disease, type 2 diabetes mellitus, and sleep apnea among others.⁽³⁾

Though less commonly examined than many other health consequences, a growing literature demonstrates that obesity is associated with poor neurocognitive outcomes. For example, obesity is independently associated with greater risk for Alzheimer's disease and vascular dementia⁽⁴⁻⁵⁾. Brain abnormalities, accelerated cognitive decline, and poorer performance on neuropsychological test performance is also found long prior in obese persons without such conditions⁽⁶⁻⁹⁾.

With the substantial increase in the number of bariatric surgery procedures performed (an estimated 113% from 2003–2008), recent studies have started to examine cognitive deficits in bariatric surgery patients. Such studies reveal nearly a quarter of bariatric surgery patients exhibit cognitive difficulties⁽¹⁰⁾ and poorer performance on tests of memory and executive function predicts reduced weight loss at 12 months post-operatively⁽¹¹⁾. However, not all clinical centers have the opportunity to conduct formal neuropsychological testing on all surgical candidates (although many third party payers now cover the costs of these evaluations) and many sites will ask patients to self-report whether they have difficulties with memory or other cognitive abilities. Unfortunately, self-reported levels of cognitive difficulties often show little or no relationship to objective test performance in persons with other medical and neurological conditions⁽¹²⁻¹³⁾, though no study has examined this possibility in bariatric surgery candidates.

Methods

The following methods were approved by the IRB and all participants provided written informed consent. This project has been listed on clinicaltrials.gov.

Participants

A total of 81 bariatric surgery candidates with an average age of 41.83 years ($\pm$ 10.82 years, 84.7% female) were recruited from a larger multi-site study examining the cognitive effects of bariatric surgery. All participants were part of the parent Longitudinal Assessment of Bariatric Surgery (LABS) project. To be included in this ancillary study, LABS participants were required to be between the ages of 20–70 and be English speaking. Participants were excluded for positive history of a neurological disorder or injury (e.g. stroke), past or current psychiatric severe illness (e.g. schizophrenia, defined by DSM-IV criteria), past or current drug or alcohol abuse, history of a learning disorder or developmental disability (defined by DSM-IV criteria), or any impaired sensory functioning as evidenced by examiner or reported by participant. Medical history was gathered via self-report measures and cross referenced with medical records. The presence of Axis I disorders was assessed through the use of the Structured Clinical Interview for *DSM-IV* disorders (SCID). A complete explanation of the LABS methodology can be found in Flum et al.⁽¹⁴⁾.

Measures

Subjective report of cognitive function—In order to measure subjective reports of cognitive functioning, participants were asked to respond to three questions (1) I have

trouble with my memory, paying attention, or understanding what other are saying to me (2) My ability to remember, pay attention, or understand what others say to me makes it difficult to accomplish what I need to do at work (3) My ability to remember, pay attention, or understand what others say to me makes it difficult to accomplish what I need to do at home. Each question was answered on a five-point Likert scale ranging from "Not at all" to "Very Often." These questions were modeled after existing self report instruments of cognitive abilities and questions asked as part of neuropsychological evaluation.

Neuropsychological Tests—IntegNeuro is a computerized cognitive test battery designed to assess multiple areas of functioning including attention, executive function, memory, and language. The battery has demonstrated excellent convergent validity with correlations ranging from .53 to .77 as well as strong divergent validity with correlations ranging from $-.52$ to $.27^{(15)}$. IntegNeuro has also been demonstrated as a reliable measure with four week test-retest correlations ranging from .52 to $.89^{(16)}$.

Memory

Verbal List Learning: In this subtest participants are presented with an auditory list of 12 words a total of four times and after each trial are asked to recall as many words as possible. After the last trial of the initial list participants are presented with a second list containing different words and again asked to recall as many words as possible. After the distractor list participants are asked to recall as many words as possible from the original list. After a 20-minute delay participants are asked to recall words from the original list. Finally, a recognition trial consisting of words from the original list as well as distractor words is administered. From this test four variables are generated and include; total learning (number of words recalled on learning trials), short-delay free recall, long-delay free recall, and recognition.

Verbal List Short Delay Recall: In this test participants are asked to recall as many words as possible from the original list of learned words following the presentation of a distracter list of words

Verbal List Long Delay Recall: In this test participants are asked to recall as many words as possible from the original list of learned words following a delay of approximately 30 minutes.

Verbal List Recognition: In this test participants are presented with words from the original learned list as well as words from the distracter list. Participants are asked to correctly identify words from the original list.

Attention

Digit Span Forward: This test assesses basic auditory attention. Participants are presented with a series of digits separated by one-second intervals. Immediately after the trial is complete participants are asked to enter the numbers in the correct order on a numeric keypad. The number of digits is increased gradually from three to nine, with two levels at each trial.

Digit Span Backward: This test assesses basic auditory attention. Participants are presented with a series of digits separated by one-second intervals. Immediately after the trial is complete participants are asked to enter the numbers in reverse order on a numeric keypad. The number of digits is increased gradually from three to nine, with two levels at each trial.

Sustained Attention: This test asked participants to monitor a series of letters presented on the screen and press a key (e.g. the space bar) when two of the same letter are presented in succession.

Switching of attention-digits: This test is a computerized adaption of the Trail Making Test A. Participants are presented with a pattern of 25 numbers in circles and asked to start at number one and follow in correct ascending order until the number 25.

Verbal interference-word: This test is similar to the Word trial on the Stroop Color Word Test. Participants are presented with a color words one at a time. Below each colored word is a response area with four possible words displayed in black. Participants are asked to identify the name of each word as quickly as possible after it has been presented.

Language

Letter Fluency: This test asks participants to generate words beginning with a certain letter of the alphabet (F, A, and S) for 60 seconds.

Animal Fluency: This test asks participants to generate as many animal names as possible within 60 seconds.

Executive Function

Switching of attention-mixed: This test is a computerized adaption of the Trail Making Test B. Participants are presented with a pattern of 13 numbers and the first 13 letters of the alphabet in circles. They are asked to start at number one and connect to letter A, then A to two, and so on until the end, following in correct ascending and alphabetical order.

Verbal interference-color: This test is similar to the Color Word trial of the Stroop Color Word Test. Participants are presented with colored words one at a time. The subject is asked to name the color of the ink the word is written in, rather than name the word presented as quickly as possible.

Maze Trial: In this test participants are presented with an 8×8 matrix of circles and are asked to identify the path through the grid. Both auditory and visual cues are presented for correct and incorrect responses. The trial is over when participants have completed the maze twice without error or 10 minutes have passed.

Maze Path: This is the total amount of time needed to learn the correct path through the maze presented during the Maze Trial.

Estimated IQ

Spot the Real Word: In this test participants are presented with pairs of words. Each pair contains one real word and one fake word. Participants are asked to choose the real word from each pair presented. This measure has demonstrated excellent reliability and validity in the estimation of intelligence⁽¹⁷⁾.

Procedures

All procedures were approved by the appropriate Institutional Review Boards.

Data Analysis—To facilitate interpretation, all raw scores of the neuropsychological measures assessing cognitive function were transferred to *t*-scores (a distribution with a mean of 50, and a standard deviation of 10) using existing normative data. Mild to moderate

deficits for each test was operationalized as being >1.0 standard deviations below normative performance and severe deficits were >1.5 standard deviations below. An average composite score for each cognitive domain was calculated by averaging *t*-scores of all measures within each domain.

To investigate the relationship between report of cognitive deficits and objective test performance, partial correlations were conducted while controlling for estimated IQ. To identify the contributors to subjective report of cognitive difficulties, exploratory partial correlations adjusting for estimated IQ were then performed among subjective report of cognitive difficulties, cognitive function, and medical/psychological factors.

Results

Subjective Report and Cognitive Characteristics of Bariatric Surgery Candidates

When asked whether they had trouble with memory, attention, or thinking, 53.4% of bariatric surgery candidates reported having trouble with memory, attention, or understanding others "often" or "very often", while 43.2% responded "sometimes" and "rarely". When asked how cognitive deficits made it difficult to accomplish tasks at work, 75% of participants reported that these problems made it difficult "often" or "very often", while 23.9% responded "sometimes" or "rarely". Additionally, 77.3% responded that these problems made it difficult to accomplish tasks at home "often" or "very often", and 22.7% stated "sometimes" or "rarely".

When compared to age and education-matched normative samples, cognitive deficits were prevalent on objective testing, with up to 22% of bariatric surgery candidates exhibiting difficulties on testing (>1 standard deviation below expected performance). Deficits were particularly common on tests of memory and executive function. See Table 1. Within the sample, cognitive scores were normally distributed, suggesting that this high prevalence of clinically meaningful dysfunction is not due to a small number of outlier cases.

Subjective Cognitive Trouble Not Associated with Objective Cognitive Measures

Partial correlations were conducted between subjective reports of cognitive dysfunction and composite scores from objective testing after controlling for estimated IQ. No associations were found between the subjective report and memory, attention, language, or executive function composite scores. See Table 2.

Given these non-significant findings, we examined whether medical history or aspects of mental health might be better predictors of subjective reports of cognitive dysfunction. Analyses showed that a history of major depressive disorder was associated with greater reported cognitive dysfunction ($r(81) = -0.32, p < 0.01$). However, independent samples *t*-test comparing persons with and without history of major depressive disorder revealed no differences on any of the composite scores from objective testing, indicating that greater reports of cognitive dysfunction were not due to deficits on objective testing. No other significant associations emerged between subjective report of cognitive problems and psychological or medical conditions.

Discussion

Findings from the current study indicate that self-reported cognitive difficulties in bariatric surgery candidates are not associated with objective test performance. Exploratory analyses suggest that these subjective reports are associated with depression, with a past history of major depressive disorder related to higher rates of subjective cognitive deficits.

Examination of patients' self-report of cognitive difficulties revealed that over 50% endorsed having significant trouble in some aspect of their life. This figure is much higher than the number of persons exhibiting difficulties on objective testing, which ranged up to 22% on some tests. Such findings suggest that bariatric surgery candidates have little insight into their current level of cognitive function. Such work is consistent with past studies showing that bariatric surgery patients are often inaccurate (either over-⁽¹⁸⁾ or under-report⁽¹⁹⁾) other medical, mental, or physical factors and studies showing little correlation between subjective and objective cognitive function in other medical populations.^(12–13)

Further studies are needed to clarify the factors that contribute to inaccurate reporting of medical and psychosocial status in this population. In addition to the factors identified in past studies^(18–19), it is also possible that reduced cognitive function may lead some individuals to fail to recall or misrepresent their medical history. If so, this pattern may have important clinical ramifications. As noted above, poorer performance on tests of memory and executive function are associated with reduced weight loss at 12 months post-operatively⁽¹¹⁾. During assessment for bariatric surgery, medical professionals often assess whether perspective surgery candidates have the mental capabilities to understand the surgery and associated risks and are able to adhere to a strict diet and exercise regimen post-surgery. The current findings suggest that bariatric surgery patients have little insight into their level of cognitive function and objective neuropsychological testing may be necessary to help identify those patients at risk for sub-optimal outcomes. Future studies are needed to identify brief and accurate screening measures for this purpose.

Although subjective report of cognitive difficulties was unrelated to objective test performance, persons with a history of major depressive disorder endorsed greater cognitive problems. Such findings are consistent with past work showing that depression is closely related to reports of cognitive dysfunction^(20–21) and the known effects of depression on cognitive test performance in other populations^(22–23). Furthermore, bariatric surgery patients report higher levels of depression before surgery and these rates decrease after surgery⁽²⁴⁾. Such findings raise the possibility that bariatric surgery patients may be even less accurate in their reports of cognitive function prior to surgery—at the time when medical history is often gathered across multiple settings. Confirmation of this possibility in other bariatric surgery patient samples is much needed.

Conclusion

Bariatric surgery patients have little insight into their current level of cognitive functioning, as no relationship emerged between subjective reports of dysfunction and actual impairment on objective neuropsychological testing. Most often, it appears that bariatric surgery patients may overreport their level of cognitive dysfunction. Given the association between poor cognitive function and reduced weight loss, future studies are needed to investigate the mechanisms for this relationship and its influence on surgical outcomes.

Acknowledgments

Funding/Support: This work supported by DK075119 and indirect support from HL089311.

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Table 1

Prevalence of impaired cognitive function in 81 bariatric surgery candidates.

Cognitive Impairment (%)	1.0 SD	1.5 SD
Memory		
Memory Learning Trials	9.5	4.8
Memory Short Delay	13.1	7.1
Memory Long Delay	11.9	2.4
Memory Recognition	11.9	8.3
Attention		
Digit Forwards	8.3	3.6
Digit Backwards	8.4	2.4
Sustained Attention	11.4	3.8
Switching of Attention-Digit	11.9	6.0
Verbal Interference-Word	9.5	6.0
Language		
Letter Fluency	16.7	4.2
Animal Naming	10.7	4.8
Executive Function		
Switching of Attention-Mixed	10.7	6.0
Verbal Interference-Color	22.6	9.5
Maze Trials	19.0	8.3
Maze Path	13.1	4.8

Note. SD= Standard Deviation,

Table 2

Partial correlations among self-reported cognitive impairment and objective test performance and SCID diagnoses after controlling for estimated IQ.

Variable	<i>r</i>	<i>P</i>
Memory Composite	.13	.25
Attention Composite	.04	.70
Language Composite	.12	.29
Executive Function Composite	.06	.61
MDD Lifetime	-.32	.003*
MDD Past Month	.02	.86
GAD Lifetime	-.19	.09
GAD Past Month	-.07	.52
Diabetes	.07	.53
Hypertension	-.01	.90
High Cholesterol	.05	.63
Sleep Apnea	.14	.21

Note.

* denotes $p < 0.05$.

SCID= Standardized Clinical Interview for the Diagnostic Statistical Manual, IQ= Intelligence Quotient, MDD= Major Depressive Disorder, GAD=Generalized Anxiety Disorder.