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Clinical Science

Cognitive function after bariatric surgery: evidence for improvement 3 years after surgery

Michael L. Alosco, M.A.[a], Rachel Galioto, B.S.[a], Mary Beth Spitznagel, Ph.D.[a,b], Gladys Strain, Ph.D.[c], Michael Devlin, M.D.[d], Ronald Cohen, Ph.D.[e], Ross D. Crosby, Ph.D.[f], James E. Mitchell, M.D.[f], John Gunstad, Ph.D.[a,b,*]

[a]*Department of Psychology, Kent State University, 238 Kent Hall Addition, Kent, OH 44242, USA;* [b]*Summa Health System, Akron, OH, USA;* [c]*Weill Cornell Medical College, New York, NY, USA;* [d]*Columbia University Medical Center, New York, NY, USA;* [e]*University of Florida Institute on Aging, Gainesville, FL, USA;* [f]*University of North Dakota School of Medicine and Health Sciences and Neuropsychiatric Research Institute, Fargo, ND, USA*

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Abstract

BACKGROUND: Bariatric surgery is associated with improved cognition, and it is possible that such improvements are found at extended follow-ups. We hypothesized that cognitive improvement would be maintained 3 years after bariatric surgery.

METHODS: Fifty bariatric patients were recruited from the Longitudinal Assessment of Bariatric Surgery parent project. Participants completed a computerized cognitive test battery to assess cognitive function at 12 weeks, 12 months, 24 months, and 36 months after surgery.

RESULTS: Repeated measures revealed main effects for attention, executive function, and memory. Attention improved up to 24 months and then slightly declined although it still fell within the average range at 36 months. Improvements in executive function reached their peak at 36 months after surgery. Short-term improvements in memory were maintained at 36 months. No main effect emerged for language.

CONCLUSIONS: Bariatric surgery may lead to lasting improvements in cognition. Prospective studies with extended follow-ups (eg, 10 years) should examine whether bariatric surgery can attenuate cognitive decline in severely obese patients.

Obesity has reached epidemic proportions, with up to 35.5% of adult men and 35.8% of adult women categorized as obese.[1] It is well established that obesity leads to poor health (eg, diabetes, hypertension, and coronary artery disease)[2] and outcomes (eg, increased mortality and morbidity risk).[3] Extant evidence also shows that obesity adversely affects the brain. For example, obesity has been linked with an increased risk for neurologic changes, including Alzheimer disease, vascular dementia, and brain atrophy.[4,5] Indeed, obese persons also exhibit impairments on formal cognitive testing, including tasks of attention, executive function, and memory.[6,7]

Bariatric surgery has become an increasingly popular and effective treatment option for weight loss among severely

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* Corresponding author. Tel.: +1-330-672-3786; fax: +1-330-672-2399.

E-mail address: jgunstad@kent.edu

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obese people.[8,9] Bariatric surgery is associated with lower mortality and morbidity risk, decreased hospitalizations, and reduced need for medications.[10–12] Recent work also shows that bariatric surgery is associated with cognitive improvement at 12 weeks and 24 months postoperatively, particularly in memory abilities.[13,14]

Despite these findings, the long-term impact of bariatric surgery on cognitive function remains poorly understood. This is unfortunate because the acute improvements in cognitive function after surgery and the substantial weight loss may reduce the known cognitive decline in obese people[15] or even the risk of Alzheimer disease.[4] The purpose of the current study was to determine the effects of bariatric surgery on cognitive function up to 3 years after surgical intervention. Based on past studies, we hypothesized that bariatric surgery patients would exhibit improved cognitive function immediately after surgery and such improvements would be maintained at the long-term follow-up, including 36 months postoperatively. Exploratory analyses among a subsample also examined the hypothesis that cognitive benefits would last up to 4 years after bariatric surgery.

Methods

Trial design and participants

A total of 50 consecutive bariatric patients were recruited into this multisite prospective study examining the neurocognitive effects of bariatric surgery. All participants were part of the Longitudinal Assessment of Bariatric Surgery (LABS) parent project and were recruited from 3 LABS sites.[16] Patients participating in the parent project who were eligible for the current study were approached at the time of enrollment regarding this ancillary cognitive study. Greater than 80% of participants approached opted to enroll. For study inclusion, participants were required to be enrolled in LABS, between the ages of 20 and 70 years, and English speaking. Exclusion criteria included a history of neurologic disorder or injury (eg, dementia, stroke, or seizures), moderate or severe head injury (defined as >10 minutes loss of consciousness),[17] past or current history of severe psychiatric illness (eg, schizophrenia or bipolar disorder), past or current history of alcohol or drug abuse (defined by *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition*), history of a learning disorder or developmental disability (defined by *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* criteria), or impaired sensory function that precluded cognitive testing (eg, visual deficits preventing adequate perception of test stimuli) per participant report or examiner observation.

Medical history was obtained via medical record review from the LABS study as well as participant self-report. Within the sample, just 1 bariatric surgery patient underwent gastric banding procedure, and, thus, no comparisons for type of surgery (Roux-en-Y gastric bypass vs gastric banding) were conducted.

The present sample represents all participants that have completed 36 months of follow-up data. Participants excluded as a result of attrition and/or subsequent missing data across time points were not different in terms of age (t_{127} = .63, P = .53); baseline body mass index (BMI) (t_{127} = .54, P = .59); or baseline cognitive function in attention (t_{127} = .42, P = .68), executive function (t_{127} = .14, P = .89), memory (t_{127} = 1.14, P = .26), or language (t_{127} = −.98, P = .33).

In addition, exploratory analyses also examined cognitive function 48 months after bariatric surgery. For these analyses, the sample size was reduced to 21 as a result of further participant attrition. Participants excluded as a result of incomplete data at 48 months did not differ in terms of age or baseline medical history of diabetes (chi-square$_1$ [N = 50] = .49, P = .49) or sleep apnea (chi-square$_1$ [N = 50] = 2.79, P = .10). However, participants excluded were more likely to have a diagnosis of hypertension at baseline (chi-square$_1$ [N = 50) = 6.65, P = .01; 65.5% vs 28.6%). Table 1 provides demographic and clinical characteristics.

Interventions and clinical follow-up

All procedures were approved by the appropriate institutional review boards before study onset. All participants provided written informed consent before study involvement. Bariatric surgery participants completed a series of self-report instruments and a computerized cognitive test battery at baseline (within 30 days before surgery), 12 weeks (± 5 days), 12 months (± 30 days), 24 months (± 30 days), 36 months (± 30 days), and 48 months (± 30 days) after surgery. Medical records were reviewed by research staff to corroborate and supplement self-report.

Outcomes

The IntegNeuro (Brain Resource Company Ltd, San Francisco, CA) cognitive test battery assesses estimated premorbid intellectual abilities as well as performance in multiple cognitive domains (eg, attention, executive function, and verbal memory) and can be completed in 45 to 60 minutes. It has excellent psychometric properties[18,19] and has been shown to be sensitive to the effects of obesity in past work.[20] Specific tests were categorized into attention, executive function, memory, and language domains.

Attention and executive function. Digit span. This test assesses basic auditory attention and working memory. Participants are presented with a series of digits on the touch screen separated by a 1-second interval. The subject is then immediately asked to enter the digits on a numeric keypad on the touch screen. The number of digits in each sequence is gradually increased from 3 to 9, with 2 sequences at each level. The participants complete these