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SHORT COMMUNICATION

Objective Assessment of Time Spent Being Sedentary in Bariatric Surgery Candidates

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Abstract
Background Bariatric surgery candidates spend very little time in moderate-to-vigorous intensity physical activity (≥3 metabolic equivalents [METs]). This study examined (1) how much of their remaining time is spent in sedentary behaviors (SB<1.5 METs) compared to light-intensity activities (1.5–2.9 METs) and (2) whether sedentary time varies by BMI.
Methods Daily time (hours, %) spent in SB was examined in 42 surgery candidates (BMI=49.5±7.9 kg/m^2) using the SenseWear Pro$_2$ Armband. Participants were stratified by BMI to assess the relationship between degree of obesity and SB.
Results Participants wore the armband for 5.4±0.7 days and 13.3±1.7 h/day. On average, 81.4% (10.9±2.1 h/day) of this time was spent in SB. Participants with BMI≥50 spent nearly an hour more per day in SB than those with BMI 35–49.9 (p=0.01).
Conclusions Bariatric surgery candidates spend over 80% of their time in SB. Reducing SB may help to increase physical activity in these patients.

Keywords Sedentary behavior · Physical activity · Bariatric surgery · Obesity · SenseWear Pro$_2$ Armband

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Introduction

For adults with clinically severe obesity, bariatric surgery is increasingly accepted as a viable and safe treatment option for producing significant weight loss and reversing type 2 diabetes [1, 2]. However, there is considerable variability in weight loss and resolution of comorbidities, and consequently, growing interest in how patient behaviors performed pre- and postoperatively may relate to these outcomes. Studies using objective measures of physical activity (PA) indicate that most patients have low PA prior to surgery [3] and spend less time in moderate-to-vigorous intensity PA (MVPA) than normal-weight controls [4]. Moreover, those patients who report larger increases in PA from pre- to postsurgery achieve greater weight losses [5, 6].

While it is evident that these patients spend minimal time in MVPA, it is not clear how much of their remaining time is spent in sedentary behaviors (SB; e.g., television, internet, and sitting) apart from light-intensity PA (e.g., slow walking and household chores). Differentiating SB from light-intensity PA is important for several reasons. Independent of PA levels, greater time spent in SB has been associated with weight gain

[7], obesity [8], and higher risk of morbidity and mortality [9, 10]. Additionally, based on research in pediatric obese populations, reducing SB [11] could be a viable approach for increasing PA and perhaps improving weight loss outcomes in the bariatric surgery population.

Therefore, the purpose of the present study was to objectively quantify the amount of time that bariatric surgery candidates spend in SB. Additionally, we examined whether sedentary time varied as a function of BMI.

Methods

Participants and Procedures

Bariatric surgery candidates with a BMI≥35 kg/m^2 who were between the ages of 18 and 65, non-smokers, and ambulatory were recruited during a surgical consultation visit. Upon arrival to the research laboratory, height and weight were assessed, and demographics information was collected. Participants were provided with an activity monitor to wear during all waking hours (except while bathing or swimming) for seven consecutive days and instructed to maintain their typical pattern of activity. Each device was programmed with the participant's age, height, weight, and gender. Study procedures were approved by The Miriam Hospital Institutional Review Board (Providence, RI, USA).

Objective Measurement of Sedentary Behaviors and Physical Activity

Participants wore the SenseWear Pro$_2$ Armband® (SWA; Body Media, Pittsburgh, PA, USA). This device is worn on the back of the upper right arm and has been shown to accurately assess energy expenditure in the adult population [12]. Data from a unique combination of sensors (heat flux, galvanic skin response, skin temperature, and near body temperature) and a bi-axial accelerometer are integrated into proprietary equations to estimate energy expenditure at different levels of intensity.

For data to be considered valid, participants needed to wear the SWA for ≥8 h/day on ≥4 days, including at least three weekdays and one weekend day. These criteria are similar to those used in previous studies that have objectively assessed PA in obese populations [13].

The intensity of activity for each minute of wear time was calculated and expressed using metabolic equivalents (METs) to determine daily time spent in sedentary, light, or moderate-to-vigorous activity. SB were defined as activities resulting in energy expenditure <1.5 METs, which is equivalent to sitting [14]. Light-intensity PA was defined as 1.5–2.9 METs (e.g., slow walking, cooking, and washing dishes), and MVPA was defined as ≥3 METs (e.g., brisk walking and cycling) [14]. To control for intra- and inter-individual differences in wear time, data were analyzed as the percentage of monitored time $\left(\text{average minutes/day} \div \text{dailyweartime} \times 100\right)$ spent in SB, light PA, or MVPA.

Statistical Analyses

Statistical analyses were performed using the Statistical Package for Social Sciences version 14.0 for Windows (SPSS, Chicago, IL, USA). Descriptive statistics were computed for all variables. Pearson's correlation coefficients were conducted to evaluate the overall association between BMI and time spent in SB. To examine this association in greater detail, participants were categorized by BMI (35–49.9 and ≥50 kg/m^2). Analysis of covariance was used to examine differences in SB between the BMI groups after adjusting for demographic factors (age, sex, race, education, and marital status) and variability in SWA wear time.

Results

Participants

Participants averaged 44.8±9.2 years of age and were severely obese (BMI=49.5±7.9 kg/m^2, 135.9±24.5 kg). The majority were female (79%) and married (68%). Slightly less than half (45%) had received at least a 4-year college/university degree. The sample was 78% Caucasian, 12% Hispanic, and 10% African American.

Time Spent in SB

Participants on average wore the SWA for 13.3±1.7 waking hours/day on 5.4±0.7 days, including 3.5±0.7 weekdays and 1.8±0.4 weekend days. Average duration of monitor wear time on weekdays and weekend days was not significantly different (13.5±1.8 vs. 12.8±2.6 h, p=0.10)

Table 1 shows average daily duration and proportion of monitored time spent in SB, light PA, and MVPA for the sample as a whole and stratified by BMI. Overall, participants spent nearly 11 h/day or 81% of total wear time in SB. Time spent in SB was similar on weekdays (11.1±2.4 h/day, 81% of wear time) and weekends (10.4±2.8 h/day, 81% of wear time). Greater time spent in SB was associated with less time spent in light PA (r=−0.63, p<0.001) and MVPA (r=−0.38 p=0.01).

Higher BMI was associated with both greater waking hours/day (r=0.31, p=0.04) and percentage of wear time (r=0.40, p=0.009) spent in SB. Participants with BMI≥50 (BMI=56.4±6.1 kg/m^2, range=50.3–74.0) spent nearly an

Table 1 Bariatric surgery candidates' daily time spent in sedentary, light, and moderate-to-vigorous activities

	Sedentary activity (<1.5 METs)	Light physical activity (1.5–2.9 METs)	Moderate-to-vigorous physical activity \(≥3 METs)
Total sample (n=42)			
Total time (h/day)	10.90±2.09	1.94±1.07	0.49±0.33
% wear time	81.40±9.99	14.80±8.17	3.80±2.38
BMI<50 kg/m^2 (n=23)			
Total time (h/day)	10.47±2.00	2.22±1.07	0.52±0.32
% wear time	79.12±9.60	16.91±7.86	3.97±2.23
BMI≥50 kg/m^2 (n=19)			
Total time (h/day)	11.42±2.14*	1.59±0.83*	0.46±0.34*
% wear time	84.17±10.02*	12.24±7.99*	3.59±2.60*

Actual means±SD are presented

METs metabolic equivalents

*p<0.05; significantly different from BMI<50

hour more per day (p=0.01) or an additional 5% of their monitored time (p=0.02) at sedentary levels of activity compared to those with a BMI<50 (BMI=43.8±3.4 kg/m^2, range=36.6–48.7).

Discussion

Previous studies have demonstrated that severely obese individuals seeking weight loss spend very little time engaged in MVPA [4, 6, 8, 15]. The current study is the first to objectively examine how much of the day is spent engaged in SB apart from light PA in a bariatric surgery population.

Our findings indicate that bariatric surgery patients are extremely sedentary preoperatively, spending over 80% of their daily waking time in SB. These findings are concerning given previous research that shows greater time spent in SB is associated with higher risk of weight gain [7] morbidity [9] and mortality [10], independent of PA levels.

The 11 h/day that the bariatric surgery candidates spent in SB is in stark contrast to recent NHANES data that indicates Americans on average spend 7.7 h/day or approximately 55% of their objectively monitored time in SB [16]. Compared to the general population, our findings suggest that bariatric surgery candidates spend an additional 3 h/day or 26% more of their time in SB. Although the direction of causality for this higher level of sedentariness is unclear, obesity-related physical function and mobility impairments may play a role in increasing SB in severely obese individuals [17, 18]. Alternatively, a sedentary lifestyle may increase risk of becoming severely obese.

Our findings suggest the importance of decreasing SB among bariatric surgery patients. The demonstrated association between greater sedentary time and less MVPA suggests that reducing SB such as TV viewing might promote substitution of SB with MVPA or at least light PA in this population. Moreover, decreasing TV time could reduce exposure to palatable food images during commercials, decrease time spent eating, and increase awareness of the amount of food being consumed, possibly limiting energy consumption [19]. While such interventions have shown to be effective for increasing liking for high-intensity PA, improving physical fitness, reducing food intake, and producing weight loss in pediatric obese populations [11, 20], they have not been tested in adults undergoing bariatric surgery.

This study has several strengths. It is the first to objectively quantify the proportion of daily waking time that bariatric surgery candidates spend in SB. We used strict monitor wear requirements to help ensure that more precise estimates of time spent in SB were obtained. Participants were stratified by BMI according to defined categories to evaluate the relationship between degree of obesity and sedentary time.

Our study also has certain limitations. Participants were predominantly female, limiting generalizability to males. Validity of the SWA in severely obese populations is unknown. Future studies should determine the extent to which TV, internet, and other leisure-time SB contribute to the high level of sedentariness in this population. Finally, it cannot be determined if this degree of sedentariness is unique to bariatric surgery patients or is characteristic of the general population of severely obese individuals.

In conclusion, our results suggest that bariatric surgery patients are considerably more sedentary compared to the general population, spending 81% of their daily time in SB. In addition, a higher degree of obesity was associated with

greater time spent being sedentary. Future research is needed to determine whether changes in SB occur postoperatively and relate to weight loss and if interventions to reduce SB can increase PA and enhance weight loss outcomes.

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