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Original article

Relationship among physical activity, sedentary behaviors, and cardiometabolic risk factors during gastric bypass surgery–induced weight loss

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Abstract

Q5 Objective: We examined the influence of physical activity (PA) and sedentary behavior on modifying cardiometabolic risk after Roux-en-Y gastric bypass (RYGB) surgery.

Setting: University of Pittsburgh Medical Center and East Carolina University bariatric surgery centers.

Methods: Data from 43 women and 7 men who completed testing at 1–3 months after RYGB surgery and again at 9 months postsurgery were analyzed. Outcomes measured included PA level (min/d), steps/d, sedentary time, and body composition. Insulin sensitivity was determined with an intravenous glucose tolerance test. Weight and blood lipid profiles also were obtained.

Results: Patients reduced body mass index by a mean of -8.0 ± 3.4 kg/m² ($P < .001$), increased moderate-to-vigorous PA by 17.0 ± 47.0 min/d ($P = .014$), and decreased sedentary time (-47.9 ± 101.0 min/d, $P = .002$). However, 24% of patients decreased overall PA ($P < .001$), and 39% increased sedentary behavior ($P < .001$). Changes in overall PA ($\rho = -.33$, $P = .006$) and steps/d ($\rho = -.31$, $P = .0106$) were related to weight loss. Insulin sensitivity was associated with light PA before ($\rho = .37$, $P < .001$) and after ($\rho = .37$, $P = .015$) intervention. Increasing overall PA also was related to higher levels of high-density lipoprotein cholesterol ($\rho = .33$, $P < .01$). Decreasing sedentary time was related to decreased fat mass ($\rho = .35$, $P = .012$) but not to other cardiometabolic risk factors.

Conclusions: The majority of patients increased PA (76%) and decreased sedentary time (61%) after RYGB surgery, but the amount of PA and sedentary time varied substantially. Higher PA, even at low intensity levels, was related to beneficial outcomes in body composition, insulin sensitivity,

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Roux-en-Y gastric bypass (RYGB) surgery is an effective treatment for severe obesity and is the most commonly performed bariatric procedure in the United States, accounting for 50% of all surgeries [1,2]. RYGB surgery results in substantial weight loss, remission from type 2 diabetes [3,4] improved dyslipidemia [5], and an improved cardiovascular risk factor profile [6]. Even though the majority of patients experience excess weight loss of ~60% after RYGB surgery [7], there is considerable interindividual variation in weight loss, improvement in cardiometabolic risk profile, and resolution of co-morbidities [8]. Peak weight loss often occurs 1 year postsurgery, followed by a gradual weight regain after 2 years in the majority of patients [9]. Preventing weight regain in the long term seems to be partly associated with increased physical activity (PA), but the benefits of PA are less well established in the early postsurgery phase [10].

Conventional medical treatment of obesity includes increasing PA, which has proven to facilitate additional weight loss when administered in combination with caloric restriction [11]. Moreover, increasing PA during weight loss programs exerts additional improvements in cardiometabolic risk factors, such as improving insulin sensitivity (S_I) [12] and blood lipid markers [13] and maintaining lean body mass [14]. Current PA guidelines for the general adult population recommend 150 minutes of moderate PA per week or 10,000 steps/d [15]. More than 200 minutes per week of moderate intensity PA will provide clinically significant weight loss and prevent weight regain [16].

PA appears to increase after bariatric surgery in correspondence with a greater magnitude of weight loss in the first year postsurgery [17]. However, this observation is based on data generated from self-reported PA questionnaires [17–19], approaches that are prone to the overestimation of activity behavior [20,21]. In reports for which objectively measured PA was assessed between 6 and 9 months after bariatric surgery, some indicate that PA did not change after surgery [21,22], whereas other studies with larger sample sizes reported an increase in PA 12 months after surgery [23,24]. Importantly, in all the reports of objectively measured PA in bariatric surgery patients to date, PA was recorded a maximum of 15 hr/d. This is a serious limitation of the current literature, which may reduce the validity of total daily PA description.

Despite these conflicting reports, a consistent finding is that there is a substantial interindividual variability in PA change after bariatric surgery, which may further modulate changes in cardiometabolic health [21–24]. Next to PA,

time spent sedentary has gained interest recently, with some studies suggesting beneficial effects of decreasing sedentary time on cardiometabolic health, independent of an increase in PA [25]. To date, no studies have objectively measured both PA and sedentary time after bariatric surgery in a comprehensive manner (> 15 hr/d). Furthermore, no studies have examined whether changes in PA and sedentary time are relevant to improvements in key cardiometabolic risk factors and body composition after surgery.

The aim of this analysis was to explore relationships between dimensions of PA (light, moderate, and vigorous) and sedentary behavior and how they might be associated with variation in weight loss, body composition changes, and S_I during RYGB surgery-induced weight loss. Because the RYGB procedure acutely influences metabolism [4] and potentially activity behavior [17], we focused on changes that occurred from 1–3 months until 7–9 months after the surgery, during a period when patients lost ~20% of their presurgery weight.

Methods

Participants

The analysis was conducted on a subgroup of participants who were randomly assigned to the control group of a larger clinical trial (clinicaltrials.gov/NCT00692367) [26]. Of the 62 participants, 3 did not complete the study and complete PA data were not available for 9. Thus, this analysis was conducted on data from 50 participants. The human research ethics committees at the University of Pittsburgh and East Carolina University approved the study protocol. Informed consent was obtained from all individual participants included in the study.

Volunteers were recruited from bariatric surgery centers at the University of Pittsburgh Medical Center (Pittsburgh, PA) and East Carolina University (Greenville, NC) [26]. Male and female patients with a body mass index (BMI) < 55 kg/m² who were 21–60 years of age were eligible to participate in the main clinical trial if they had undergone RYGB surgery within the previous 1–3 months. The parent trial was designed specifically to examine surgery-induced weight loss, independent of the acute effects of energy restriction early after surgery or the effect of the surgical procedure on cardiometabolic risk factors. Exclusion criteria included diagnosis of diabetes (type 1 or 2), among others, as previously described in detail [26]. The use of medication that would influence metabolism and thereby the study results also led to exclusion. Participants were

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