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Feasibility of Ecological Momentary Assessment to Characterize Adolescent Postoperative Diet and Activity Patterns Following Weight Loss Surgery

Megan B. Ratcliff, Ph.D., M.P.H.¹, Meg H. Zeller, Ph.D.¹, Thomas H. Inge, M.D, Ph.D.², Kathleen B. Hrovat, M.S, R.D., L.D.², and Avani C. Modi, Ph.D.¹

¹Division of Behavioral Medicine and Clinical Psychology, Department of Pediatrics, Cincinnati Children's Hospital Medical Center, University of Cincinnati College of Medicine, Cincinnati, Ohio, USA

²Division of Pediatric General and Thoracic Surgery, Department of Pediatric Surgery, Cincinnati Children's Hospital Medical Center, University of Cincinnati College of Medicine, Cincinnati, Ohio, USA

Abstract

Background—Adherence to postoperative lifestyle recommendations may be associated with weight outcomes among weight loss surgery (WLS) patients, but it is difficult to objectively assess and has not been reported among adolescents. Methods of assessment that are ecologically valid and provide important contextual information related to adherence are needed.

Objective—The objective of this pilot study was to demonstrate the feasibility of using a form of Ecological Momentary Assessment (i.e., Daily Phone Diaries; DPD) to assess postoperative diet and activity patterns among a sample of adolescent WLS patients to determine adherence to best-practice lifestyle recommendations.

Setting—Pediatric Medical Center.

Methods—Eight adolescent WLS patients completed 3 consecutive DPD's at 12 and 18 months post-surgery.

Results—Ninety-four percent of DPD's were completed with an average 20.9 ± 5.0 activities per day. Although adolescents engaged in recommended lifestyle behaviors (e.g., >30 minutes moderate physical activity/day; duration of meals/snacks > 20 minutes) some of the time, few were adherent to postoperative physical activity and dietary recommendations the majority of the time.

Conclusions—The DPD provides a feasible and informative methodology for assessing adherence behaviors among adolescent WLS patients. It is a relatively low burden method that

Corresponding author: Megan B. Ratcliff, 3333 Burnet Ave., Cincinnati, OH 45229. Phone (513)636-5329, fax (513) 636-7756. Megan.ratcliff@cchmc.org.

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may be useful in identifying behavioral targets for postoperative intervention. Adherence to postoperative lifestyle recommendations may be a serious concern among this cohort. These preliminary data shed light on potential targets for postoperative intervention. Targeting non-adherence is essential in not only improving health outcomes but in deciphering the true potential effectiveness of WLS in this at-risk population.

Keywords

Adolescent; Bariatric; Adherence; Physical Activity; Diet; Daily Phone Diary

Introduction

Adherence to postoperative eating and physical activity recommendations may be important in determining sustained weight loss or weight maintenance following weight loss surgery (WLS). This may prove especially critical after energy homeostasis involving hormonal, neuronal, and nutrient signals becomes more assimilated after the first year^(1,2). Within the WLS literature, few studies have examined adherence to recommended postoperative lifestyle behaviors^(3–11). The majority of patients in these adult-focused studies self-report non-adherence to at least one postoperative recommendation, with insufficient physical activity and snacking predominating^(4,9). Among adolescents, one retrospective study revealed poor self-reported adherence with exercise and dietary recommendations approximately 6 years postoperatively⁽¹⁰⁾, with another prospective study revealing low rates of electronically-monitored postoperative multivitamin adherence (27–37%)⁽¹¹⁾. Accurately assessing adherence is essential, with evidence-based assessment recommendations including use of innovative technologies that provide a window into “real time” behaviors and detection of barriers to adherence¹².

One such innovative methodology recommended for use with WLS patients is ecological momentary assessment (EMA)⁹. EMA involves a range of methods that allow participants to report on symptoms, affect, behavior, and cognitions in close to real time in their natural environment with repeated sampling over time¹³. EMA has been found to be feasible and informative in assessing postoperative adherence among adult bariatric patients, revealing greater adherence for simple (e.g., taking medication) vs. complex (e.g., exercising 30+ minutes/day) behaviors⁽⁹⁾.

Daily Phone Diaries (DPD) are “a special case” of EMA that utilize a fixed interval, retrospective, coverage strategy to provide a fine-grain snapshot of time allocation across a 24-hour period. DPDs are sensitive to contextual influences (e.g., social and environmental persuasions), providing information that elucidates barriers to adherence. A small number of studies have utilized DPD with adolescents but, to the authors’ knowledge, no DPD studies have been conducted with an adolescent WLS cohort^{14–16}.

To begin to address this gap, this pilot study seeks to demonstrate the feasibility of using the Daily Phone Diary (DPD) to assess postoperative diet and activity patterns among a sample of adolescent WLS patients. Based on prior DPD studies with adolescents with cystic fibrosis, we hypothesize adolescents will be amenable to this methodology as indicated by high completion rates of DPD⁽¹⁵⁾. Secondly, we aim to broadly characterize activity patterns

(e.g., work, school, food-related activities) and engagement in Active and Sedentary behaviors in WLS patients at 12 and 18 months postoperatively. Finally, we aim to estimate rates of adherence with clinically-determined postoperative lifestyle recommendations (i.e., >30 minutes moderate physical activity/day) and dietary recommendations (i.e., duration of meals/snacks > 20 minutes, 3–6 meals/day, eating within 1 hour of waking and > 1 hour before bed)⁽⁹⁾. We hypothesize few adolescents will be adherent to recommendations based on the adult WLS literature and evidence of low adherence in this developmental cohort^(9,11,17).

Methods

The present study is a single-site ancillary study executed within the multi-site prospective observational Teen Longitudinal Assessment of Bariatric Surgery (Teen-LABS) Consortium. Teen-LABS inclusion criteria included: 1) approval by multidisciplinary clinical team to undergo WLS, 2) age < 19 years at time of surgery, and 3) ability to provide informed consent/assent to study procedures, as described elsewhere⁽¹⁸⁾. Participants in Teen-LABS completed baseline study procedures, including anthropometric measures, medical and surgical assessments, and psychosocial and adherence measures within 1 month prior to surgery, 6-months, and annually following the date of WLS.

A trained research coordinator approached Teen-LABS participants who were time-eligible after completion of their 12-month study visit and during the study enrollment window (July, 2009 – January, 2011) to assess interest and obtain consent/assent. DPDs were scheduled within 4 weeks of study enrollment and again at 18 months postoperatively. The lead author (M.R.) completed three consecutive (two weekday, one weekend) calls, each oriented to the prior 24 hours. Calls were scheduled at the same time every day to ensure contiguous reporting across consecutive days. Lifestyle recommendations consistent with published guidelines were reinforced during participants' postoperative clinical appointments (scheduled at 2 and 4 weeks, 3, 6, and 12 months postoperatively). Institutional Review Board approval was obtained. Gift cards (\$30) were provided.

Measures

Daily Phone Diary (DPD)—The DPD facilitates individuals' recall of activities over the previous 24-hours to provide a detailed analysis of activity patterns. While guiding participant using structured prompts, the interviewer records activities lasting >5 minutes using a computer interface. Participants' report type of activity they engaged in, duration of activity, who was present, and their mood. For example, "At 6:15pm, I ate dinner with my mom and brother in the kitchen. My mood was positive." Prompts are provided to aide recall (e.g., "after dinner, what did you do next?"). The DPD has reliable stability coefficients over a 3-week period ($r_s = .61-.71$, $p < .01$) and high levels of interrater reliability (>90%) in cystic fibrosis samples⁽¹⁹⁾. The DPD has been identified as a "well-established" measure of adherence^(20,21). The first author received >20 hours of training in DPD administration with 93% established reliability.

The DPD was developed for pulmonary conditions and has been adapted for several pediatric conditions (e.g., epilepsy, HIV)^(22,23), with slight revisions for this study

population. Ten primary categories of activities include Self-Care (e.g., bathing, dressing), Household Tasks (e.g., cleaning, mowing lawn), Recreation – Home (e.g., watching TV, using computer), Recreation – Away (e.g., going to mall, attending sporting event), School (e.g., attending school, homework), Work (i.e., paid employment), Driving/riding (in automobile to/from activities), Food-Related Activities (e.g., preparing food, eating meals/snacks), Sleep, and Other.

The DPD is well-suited to unobtrusively assess adherence to WLS recommended guidelines. Nutritional recommendations believed to be associated with optimal treatment outcomes include consuming 3–6 meals/day, duration of meals > 20 minutes, and not lying down within 1 hour after eating⁽²⁴⁾. Eating within 1 hour of waking has also been recommended by dietitians working with WLS patients⁽²⁴⁾. Published clinical practice guidelines for perioperative care of WLS patients suggest increasing physical activity (aerobic and strength training) to a minimum of 30 minutes/day⁽²⁾.

Demographic and Weight—Participants provided basic demographic information. Clinically-obtained preliminary weight and weight loss outcomes at 12 and 24 were provided upon request by Teen LABS consortium.

Statistical Analyses

Construct definitions—A composite “Active vs. Sedentary” variable was created to estimate time spent engaged in Active activities (further delineated as Recreation or Chores), Sedentary Recreational activities, and Other activities. These categories were selected to characterize time invested in discretionary activities, compared to more obligatory activities such as work, sleep, and school. Classification of activities into categories was based on the gross average expenditure unit of activities listed in World Health Organization (WHO) report on Energy and Protein Requirements (1986), with <2.2 units/males and <2.1 units/females identified as “sedentary”⁽²⁵⁾. These standards are age-relevant (i.e., based on ages 18 and older). Where activities were not explicitly reported (e.g., watching TV), an approximate activity was used (e.g., sitting quietly). The Active Chores category included active household tasks (e.g., mowing lawn, cleaning). The Active Recreation category included moderate to vigorous physical activities (e.g., exercise, sports). The Sedentary Recreation category included low energy expenditure recreational activities (e.g., watching TV, “hanging out”). The Other category included all other activities (e.g., driving, sleeping, self-care, school, work). Given variability in activity requirements for participants’ jobs, these were not classified as Active or Sedentary.

“Adherence” for engagement in lifestyle behaviors is not systematically defined in the literature. For activities performed multiple times a day (e.g., eating duration > 20 minutes), adherence was defined as meeting recommendation during all daily occurrences.

Statistical analyses were conducted using the Statistical Package for Social Sciences (SPSS), version 21.0. Exploratory analyses were performed using descriptive statistic for all major variables and all major sub-groupings of variables including mean and standard deviation for continuous variables and percentages for categorical variables. Completeness of data and normality of distribution were assessed.

Results

Participant characteristics

Thirteen consecutive, potential participants were eligible for enrollment. Four declined, one consented but did not schedule, and eight completed initial data collection. Consistent with demographics of patients at the recruiting hospital, the sample was 75% female and 75% Caucasian (25% Black)^(26,27). Mean participant age was 18.4 ± 1.8 years (range 14.8–19.7). Six participants (75%) were enrolled in school ($n=3$ high school, $n=3$ college) with 2 employed, high school graduates. Participants underwent Roux-en-Y Gastric Bypass (RYGB, $n=7$) or Sleeve Gastrectomy ($n=1$) 12 months prior to study enrollment. The average weight (kg) and BMI of participants at baseline was 141.5 ± 26.3 and 47.0 kg/m^2 (range 40.8–50.7 kg/m^2), respectively. Postoperative weight decreased by 34% at 24 months with weight (kg) 94.2 ± 16.9 and mean BMI 31.1 kg/m^2 (range 23.7–46.5 kg/m^2). Non-participants were 75% female, 100% Caucasian, mean age 17.7 ± 2.0 years with 75% receiving RYGB. The average weight (kg) and BMI of non-participants at baseline was 146.8 ± 15.5 and 50.2 kg/m^2 (range 43.6–57.8 kg/m^2), respectively. Postoperative weight decreased by 33% at 24 months with weight (kg) 98.6 ± 9.9 and mean BMI 33.9 kg/m^2 (range 31.5–37.3 kg/m^2).

Feasibility

Seven of eight participants completed all 6 DPD calls, with one participant unreachable at 18 months, resulting in 94% completion (45/48 calls). Phone calls lasted 13.1 ± 6.5 minutes (range 6–34). Ninety-three percent (42/45) of DPD's were completed as scheduled; an average 4 attempts were made to complete missed sessions. An average 20.9 ± 5.0 activities were recorded per participant, per day (range 10–35).

Proportion of time spent in activities across weekdays and weekends and both assessment points is depicted in Figure 1. Overall (mean) results revealed more time per day at both 12 and 18 months engaged in combined recreational activities (at home 236.3 ± 82.6 and 282.9 ± 228.4 minutes/weekday; 308.8 ± 284.5 and 187.1 ± 141.2 minute/weekend and away 97.2 ± 76.6 and 54.6 ± 51.5 minutes/weekday; 160.0 ± 135.1 and 310.0 ± 285 minute/weekend) than in work (78.8 ± 152.0 and 134.3 ± 139.0 minutes/weekday; 0 and 21.4 ± 56.7 minute/weekend), school (179.4 ± 147.9 and 281.4 ± 292.6 minutes/weekday; 49.4 ± 100.4 and 12.1 ± 32.1 minute/weekend), and chores (47.2 ± 37.0 and 25.0 ± 40.0 minutes/weekday; 65.0 ± 97.4 and 58.9 ± 104.8 minute/weekend) Adolescents reported slightly less sleep on weekdays at 12 and 18 months (515.6 ± 91.9 and 526.1 ± 36.6) than on weekends (547.5 ± 88.9 and 654.3 ± 204.8 minute/weekend).

“Active” versus “Sedentary” activities

Of the 918 total activities recorded, 82 were classified as Active (52 Active Chores and 30 Active Recreation), 264 were classified as Sedentary Recreation, and 572 Other. Average minutes of activity for all participants were 73.3 ± 88.7 minutes/weekday and 65.8 ± 74.0 minutes/weekend (5% total time). Of this, the average time engaged in Active Recreation was 24.2 ± 39.0 minutes/weekday and 21.0 ± 48.7 minutes/weekend. Average time engaged in Active Chores was 41.7 ± 55.1 minutes/weekday and 54.7 ± 80.3 minutes/weekend).

Average time engaged in Sedentary Recreation was 317.7 ± 177.4 minutes/weekdays (22.1%) and 463.0 ± 211.5 minutes/weekends (32.2%). The top two sedentary activities were watching TV (124 ± 115.6 minutes/day; all participants) and computer/internet use (35.2 ± 61.8 minutes/day; 6 participants).

Adherence to recommended behaviors

Physical Activity—Adherence rates to recommended lifestyle behaviors are listed in Table 1. Participants engaged in at least some Active Recreation on 21/45 days (47%). Participants engaged in >30 minutes of Active Recreation on 12/45 days (27%) with no difference between weekends and weekdays. Average duration of Active Recreation on those days was 77.1 ± 50.6 minutes (range 30–180 minutes). Three participants achieved recommended level of activity (> 30 minutes/day) when averaged over time.

Eating Behaviors—Participants averaged <3 meals/snacks per day. Three outlying eating episodes reported as > 120 minutes were examined in context and considered possible self-report errors (i.e., “hanging out” rather than prolonged eating episodes). These episodes were removed, resulting in average duration of meals/snacks from 23.3 ± 15.2 minutes to 28.1 ± 16.1 minutes. Eating episodes lasting < 20 minutes were variable between weekdays and weekends. Participants ate within 1 hour of waking more frequently on weekends (10/15 days) than on weekdays (14/30 days). The most adhered-to recommendation was to eat > 1 hour before lying down.

Discussion

This study demonstrates the feasibility of using the DPD for systematic and detailed assessment of diet and activity patterns among adolescent WLS patients, with high DPD completion across two time-points. The advantages of the DPD are numerous, including allowing for assessment of lifestyle behaviors in an unobtrusive way and with high-resolution detail. The ecological validity of the DPD allows for the identification of behavioral targets for intervention within teens' lives using technology that many youth access regularly. This method has the benefit of low participant burden and ease of administration, with limited susceptibility to retrospective recall bias⁽²¹⁾.

The second objective was to broadly characterize activity patterns. Allocation of time among participants in this study was similar to that of a large sample of Australian youth, with several notable exceptions, including more time in social activities and eating, and less time in physical activity⁽¹⁴⁾. Similar to adult WLS patients, the most frequent sedentary recreational activity was TV viewing⁽²⁶⁾. Interestingly, adherence appeared to be higher for some dietary behaviors, but not physical activity, on weekends compared to weekdays. Further exploration of time use among WLS patients (both pre and postoperatively) and compared with a healthy-weight sample will be important to better characterize activity norms and identify modifiable intervention targets.

These preliminary data reveal few adolescents met postoperative physical activity and dietary recommendations. Although not surprising given the general pediatric adherence literature, these results still warrant serious concern⁽¹⁷⁾. While a causal relationship is

assumed, research exploring engagement in lifestyle behaviors and clinical outcomes (e.g., weight maintenance over time) is imperative.

This study contributes to the emerging literature by providing insights into the activity patterns and adherence behaviors of adolescent WLS patients during the second postoperative year. It also expands on the DPD literature by uniquely characterizing behaviors as Active (Recreation and Chores) and Sedentary, demonstrating a novel use for the DPD to more comprehensively assess activity beyond engagement in traditional exercise. Additional validation of behavior classification of WHO gross energy expenditure units and establishment of reliability will help to ensure Active and Sedentary groups are appropriately characterized.

Despite these and other strengths of the current study, there are a number of limitations. The small sample size resulted in insufficient power to calculate inferential statistics. There were no alternative behavior assessments (e.g., actigraph or food recall) to confirm content validity. Finally, although DPDs are intended to be scheduled at the same time on 3 consecutive days to ensure data continuity, this may result in some measurement reactivity. Although the potential disadvantages of using the DPD (e.g., data collection across consecutive days, establishing sufficient coder reliability) are noteworthy, they are essential to obtain the depth of data that the DPD provides and are certainly not insurmountable.

The current study is the first to utilize DPD to prospectively examine adherence to lifestyle behaviors among adolescent WLS patients during a crucial postoperative period. The DPD is a feasible and informative methodology, results of which suggest non-adherence is a serious concern among this cohort. Targeting non-adherence is essential in not only improving health outcomes but in deciphering the true potential effectiveness of WLS in this at-risk population.

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Figure 1.

Activity patterns of adolescent weight loss surgery (WLS) patients on weekdays and weekend at 12 and 18 months post-surgery

Table 1

Adolescent rates of adherence to weight loss surgery (WLS) recommended postoperative behaviors

Published Recommendation *	Timepoint	Weekday/end	Observed Behavior (means $\pm$ standard deviation)	Participants meeting recommendations on ALL days
Consumption of 3–4 meals/snacks per day	12 month	Weekday	2.3 $\pm$ 0.6 meals/snacks	13%
		Weekend	2.6 $\pm$ 1.2 meals/snacks	63%
	18 month	Weekday	2.8 $\pm$ 1.1 meals/snacks	50%
		Weekend	2.4 $\pm$ 0.9 meals/snacks	43%
Duration of meals/snacks > 20 minutes	12 month	Weekday	24.9 $\pm$ 20.7 min/eating episode	25%
		Weekend	23.3 $\pm$ 15.2 min/eating episode	13%
	18 month	Weekday	24.9 $\pm$ 16.7 min/eating episode	0%
		Weekend	28.1 $\pm$ 16.1 min/eating episode	29%
Eating <1 hour of waking	12 month	Weekday	31% of days	25%
		Weekend	75% of days	75%
	18 month	Weekday	64% of days	57%
		Weekend	88% of days	88%
Eating > 1 hour lying down	12 month	Weekday	100% of days	100%
		Weekend	100% of days	100%
	18 month	Weekday	81% of days	71%
		Weekend	100% of days	100%
Active recreation > 30 minutes/day	12 month	Weekday	28.1 $\pm$ 36.2 minutes	38%
		Weekend	7.5 $\pm$ 13.9 minutes	25%
	18 month	Weekday	15.0 $\pm$ 9.5 minutes	14%
		Weekend	14.3 $\pm$ 28.3 minutes	29%

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