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The Effectiveness of a Preoperative Lifestyle-Based Weight Loss Program on Postoperative Outcomes in Bariatric Patients: A Secondary Data Analysis

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ABSTRACT

Background: Obesity is a multifactorial and largely preventable chronic disease. There are many interventional methods that can be used in treating obesity, such as diet and lifestyle interventions. Surgical intervention is also an effective treatment option that is utilized for those that are severely obese. Bariatric surgery helps to achieve weight loss, as well as reduce the risk and/or manage comorbidities. In the U.S., many insurance companies and certain bariatric centers require patients to lose weight prior to surgery. The explanation for preoperative weight loss stems from its potential correlation with reduction in surgical complications, improved adherence to stringent postoperative nutrition requirements, and increased percent weight loss after surgery.

Objective: To assess the influence of the Loma Linda University Health's (LLUH) Say No to OverWeight (Say NOW) weight loss program on lifestyle and behavioral changes, participants' self-efficacy, and weight loss both pre- and postoperatively, as well as evaluate the potential correlation between pre- and postoperative weight loss.

Methods: Sixteen subjects (age=45.9 ± 11.5 years; BMI=46.1 ± 8.3 kg/m^2) participated in a comprehensive 36-week lifestyle-based program to promote weight loss before and after bariatric surgery. During the preoperative phase, baseline data on anthropometrics, food frequency, meal patterns and timings, miscellaneous lifestyle habits and perceived level of self-efficacy regarding eating behaviors were collected. Participants then underwent a 24-week lifestyle program and at the end of the intervention, the same outcomes were re-assessed before surgery was performed. Following surgery, the subjects completed the same program for 12 weeks, with additional data (as above) being collected at the beginning and at the end of the 12 weeks. Intra- and inter-phase comparative analyses were conducted on anthropometrics (weight, BMI, and waist circumference) using Wilcoxon Signed Ranks Test. Pre- and postoperative survey data was utilized to identify

changes in lifestyle habits (food frequency, meal patterns and timings, miscellaneous lifestyle habits, and perceived level of self-efficacy).

Results: There was a statistically significant reduction weight and BMI from Baseline to Pre-Surgery, Post-Surgery to Final, and Baseline to Final ($p=0.016$, $p=0.003$, $p=0.000$ respectively). A reduction in waist circumference was also observed from Post-Surgery to Final and Baseline to Final ($p=0.002$, $P=0.000$ respectively). Participants who experienced >3% preoperative EWL exhibited greater %EWL after surgery and participants with a larger waist circumference experienced greater preoperative waist circumference loss. Over the course of the program, there was observable improvement in diet and lifestyle-related factors, as well as overall self-efficacy compared to Baseline.

Conclusion: The present findings indicate that a comprehensive lifestyle-based weight loss program can be beneficial in facilitating further benefits among bariatric patients, particularly regarding anthropometric measurements. Additionally, a program such as this can lead to significant improvements in diet and lifestyle-related factors, as well as perceived self-efficacy regarding eating behaviors.

1. Introduction

Obesity is a multifactorial and largely preventable chronic disease.[1] It is defined as extreme or abnormal fat, both visceral and subcutaneous, that accumulates and can impair health.[1] It is characterized by a body mass index (BMI) of greater than 30 kg/m2.[2] Severe obesity, or Class III obese, is characterized by a BMI over 40 kg/m2.[1]

The prevalence of obesity has become a growing concern in the United States.[3] According to the National Center of Health Statistics (NCHS), more than 40% of the U.S. population is considered obese; these numbers continue to rise.[3] It is predicted that by 2030, 48.9% of U.S. adults will be obese and 24.2% will be severely obese.[4]

However, BMI alone is not a good indicator of obesity due to variations in body type and build.[1] There are other ways in which obesity is clinically assessed and diagnosed.[1,5] Indirect measurements other than BMI include anthropometric measures, waist circumference, waist-hip ratio, and body fat percentage.[5] The most accurate methods of measuring obesity status are using direct measurements, such as underwater weighing and dual-energy x-ray absorptiometry (DEXA).[5]

The fundamental root of obesity is beyond the issue of excessive oral intake.[6] These various risk determinants are largely involved in dietary and lifestyle factors such as poor-quality diet, sugar-sweetened beverages, physical inactivity, extended screen time, inadequate sleep, and established environmental characteristics.[6] A higher level of obesity (Class III obese) is associated with a higher risk of morbidity and mortality related to chronic disease, compared to patients that are moderately obese.[7] Examples of weight-related chronic diseases include cardiovascular disease, diabetes mellitus, dyslipidemia, certain cancers, end-stage renal disease, gastrointestinal disorders, and metabolic syndrome.[8,9] To help prevent serious health consequences or to manage

comorbidities (i.e. obstructive sleep apnea, non-alcoholic fatty liver disease, hypertension, and type II diabetes mellitus)[10], certain treatment options must be implemented to facilitate weight loss.[6]

There are many interventional methods that can be used in treating obesity.[11] These treatment options include diet and lifestyle interventions (i.e. calorie restriction, macronutrient composition, meal replacement, dietary pharmacotherapy, and exercise regimens).[11] Surgical intervention is also an effective treatment option that is utilized for those that are severely obese when non-surgical methods have been unsuccessful.[11] Bariatric surgery helps to achieve significant and sustainable weight loss, as well as reduce the risk and/or manage comorbidities.[12]

According to the American Society for Metabolic and Bariatric surgery, an estimated 252,000 individuals underwent bariatric surgery in 2018.[13] This represents an approximate increase of 10% since 2017.[13] There are four distinctive types of bariatric surgery: adjustable gastric banding, Roux-en-Y gastric bypass, sleeve gastrectomy, and bilio-pancreatic diversion with a duodenal switch.[11] The physician will determine the best type of bariatric surgery for their patient.[10] In order to obtain a referral for bariatric surgery from their physicians, patients (female and male) should meet the recommended criteria of a BMI ≥40 kg/m2 or a BMI ≥35 kg/m2 with at least one comorbidity. [10]

In the U.S., many insurance companies and certain bariatric centers require patients to lose weight prior to surgery.[10,14] The explanation for preoperative weight loss stems from its potential correlation with reduction in surgical complications, improved adherence to stringent postoperative nutrition requirements, and increased percent weight loss after surgery.[10] As a result, a preoperative weight loss program is often implemented.[10] The study of pre- and postoperative weight loss in bariatric patients is significant in optimizing this surgical intervention, increasing

the weight loss that follows, and promoting weight maintenance.[10] This can help contribute to the prevention and/or management of weight-related conditions.[6] Many studies have been conducted to assess (1) the relationship between pre- and postoperative weight loss and (2) the efficacy of specific preoperative weight loss strategies.

A retrospective cohort study conducted by Conaty et al. assessed the efficacy of a medically supervised preoperative weight loss program (MPWL) on influencing postoperative weight loss.[15] All participants of this study were required to follow either a full liquid diet or a diet solely of raw, fresh vegetables for 2-8 weeks prior to surgery.[15] Time of intervention implementation was dependent on individual BMI.[15] Participants were split into two cohorts: (1) patients who were not required to lose weight prior to surgery (non-participation in the MPWL) and (2) patients who were required to achieve ≥10% preoperative weight loss (participation in the MPWL).[15] Following surgery, participants in cohort 2 experienced greater percent excess weight loss (%EWL) and %BMI reduction at the 6-month postoperative mark compared to cohort 1.[15] However, at the 1-year and 2-year mark, no significant difference was identified between both cohorts.[15] It is worth noting that the study did not provide any information on additional components that may have been included in the MPWL.[15] As a result, we cannot determine how the MPWL may have contributed to weight loss. Also, the preoperative data provided was limited to change in BMI between both cohorts. Mean %EWL was not disclosed.[15]

A systematic review published by Gerber et al. identified and analyzed 23 publications and 2 review articles that focused on preoperative weight loss.[14] The results of this review regarding the relationship of pre- and postoperative weight loss were inconsistent.[14] For example, Solomon et al., a study within the Gerber systematic review, found that there was a statistically significant relationship between %EWL before and after surgery.[16] Participants of this study were categorized

into two groups prior to surgery: (1) <5% EWL and (2) ≥5% EWL.[16] Nutritional and psychological evaluations were conducted, and a bariatric nutritionist was made available to individuals requiring additional support.[16] The data showed that the individuals who lost ≥5% EWL prior to surgery, experienced a greater reduction in BMI and increase in overall EWL post-surgery after 1 year.[16] One gap identified within this study is that the number of participants individually counseled by the bariatric nutritionist was not disclosed.[16] This would have been helpful in determining the extent to which counseling contributes to the observed weight loss.

The above findings contrast with those of Ali et al., another Gerber systematic review study, which found no significant relationship between pre- and post-op weight loss.[17] In this study, participants were separated into groups 1-4 based on %EWL (≤0%, <5%, 5-10%, ≥10%) prior to surgery.[17] All participants were required to attend a seminar that provided basic education on nutrition and physical activity.[17] For those who struggled with understanding the nutrition information provided and/or needed additional one-on-one assistance, a bariatric surgery dietitian was made available.[16] An exercise physiologist was also accessible to participants that demonstrated difficulty in creating an exercise regimen for themselves.[17] After attending the seminar, participants were instructed to keep a 2-week detailed food journal, which was later assessed by the dietitian.[17] A nutrition quiz was distributed at the end of the program to evaluate the participants' competency.[17] Ali et al. concluded that the data presented within this study was not able to support the initial hypothesis that preoperative weight loss contributes to overall %EWL.[17] The weight loss experienced among the various groups showed little to no statistical significance.[17] Gaps similar to those in Solomon et al. were identified in this study. No data was provided on the number of individuals who received counseling from either the exercise physiologist or dietitian.

Due to the conflicting results on the effect of preoperative weight loss on postoperative weight loss observed in the two previous studies, Gerber et al. was unable to come to a defined conclusion regarding its correlation.[14,16,17] Overall, the lack of controlled data and/or inconclusive data contributed to the mixed findings of the Gerber systematic review.[14]

While a portion of the studies within the Gerber systematic review addressed the potentiality of preoperative weight loss as a predictor of postoperative weight loss, others focused solely on the preoperative component (strategies used for achieving preoperative weight loss).[14] Within most studies of the Gerber systematic review, the main preoperative weight loss strategies were a low-calorie diet (LCD) of 800-1200 kcal/day or a very low-calorie diet (VLCD) of 800 kcal/day or less.[14] Other studies included little to no specific dietary protocols or restrictions and few included weight loss programs.[14]

Kuwada et al. was one study within the Gerber systematic review, that utilized a weight loss program, along with an LCD, as their preoperative intervention.[18] They compared individuals within two different groups: (1) those who participated in a preoperative multidisciplinary medical weight loss program (MMP) (>6 months) and (2) individuals who did not go through the MMP.[18] All participants underwent a comprehensive nutritional evaluation and psychological analysis.[18] They were also required to attend a nutrition education class to prepare for the initiation of a 1,300 kcal/day liquid diet, which was implemented 2 weeks prior to surgery.[18] In addition, MMP participants went through a comprehensive weight loss program, where they worked with medical bariatricians, dietitians, and exercise physiologists.[18] There was no significant difference in preoperative weight loss found between the MMP and non-MMP.[18] Detailed components of the MMP were not disclosed within this study, which would have been beneficial for further assessing the effectiveness/ineffectiveness of the program.[18]

Within the entire Gerber systematic review, Collins et al. showed the most significant preoperative weight loss.[19] This study assessed the efficacy of a preoperative weight loss program using a specialized liquid formula (Optifast liquid LCD).[19] The program lasted an average of 9 weeks; however, the actual duration of program participation was dependent on individual variables (i.e. BMI, body type, co-morbidities, and response to the LCD).[19] A multidisciplinary team approach was taken in this program and consisted of a surgeon, surgical nurse practitioner, endocrinologist, registered dietitian, and behavioral therapist.[19] To monitor the patients, assessments and instruction on a variety of topics were conducted each week.[19] Subjects were also required to participate in a weekly dietitian-led support group and counseling was made available for those that needed additional guidance.[19] At the end of the program, a total weight loss of 8.2%-12.1% was achieved.[19]

These studies demonstrate how specific interventions (MPWL, MMP, LCD, VLCD) are implemented for patients preparing to undergo bariatric surgery.[14,15,18,19] Most studies indicated the use of preoperative weight loss interventions that address nutrition and/or both nutrition and physical activity; however, limitations were observed.[16-18] Critical data was not collected[16,17] and/or adequate information was not disclosed.[15,18] Collins et al. incorporated a multidisciplinary approach that focused on behavioral and lifestyle factors. However, the implementation of the LCD diet was the primary intervention and likely explains the significant weight loss achieved in this study.[19] As a result, the efficacy of the lifestyle component within the Collins study cannot be accurately observed. Restrictive diets, such as an LCD, is less likely to be maintained long-term and/or promote sustainable change in patients as it is largely influenced by non-biological factors (i.e. food environment and social support) and does not hold personal significance.[20] While short-term diets are seen to be effective in initial weight loss, weight-maintenance specific counseling

that consists of behavioral strategies as a primary intervention are associated with long-term success.[20]

Some bariatric patients experience weight regain after surgery, which may be attributed to a variety of factors such as mental health, hormonal, metabolic, surgical, and more commonly, lifestyle.[20,21] Furthermore, the utilization of sustainable preoperative weight-loss programs that incorporate dietary, lifestyle, and behavioral modifications and counseling may prove to be more effective in postoperative weight loss and maintenance.[20]

Few studies have emphasized the utilization of an all-encompassing preoperative weight loss program as the primary intervention; therefore, the use of a comprehensive preoperative weight loss intervention must be assessed. Hence, the purpose of this graduate research study was to evaluate the Loma Linda University Health's (LLUH) Say No to OverWeight (Say NOW) weight loss program. We aimed to assess how successful the program was in promoting lifestyle and behavioral changes, improved the participant's self-efficacy, and how this translated to weight loss both pre- and postoperatively. Another aim of this study was to identify and assess the potential correlation between pre- and postoperative weight loss.

Say NOW is a smaller program within the Living Whole Employee Wellness Program, which was established by LLUH's Department of Risk Management. Risk Management provides a LLUH-sponsored Health Plan, which includes health coverage, special health services, and resources to help promote the health and wellness of employees and their families.

2. Methods

A secondary data retrospective analysis was conducted by graduate student investigators to assess (1) the effectiveness of the Say NOW Program to implement diet, lifestyle, and behavioral

changes, (2) the influence of the Say NOW Program on %EWL achieved pre- and postoperatively, and (3) the correlation between preoperative %EWL and postoperative %EWL.

2.1 Participants

The participants in this study were LLUH employees and/or their spouses who enrolled in the Say NOW Program from 2015-2020 with the aim of going through bariatric surgery. These individuals are covered by Risk Management and referred to the program by their primary care physician upon meeting bariatric surgery requirements (BMI $\geq$ 40 or $\geq$ 35 with at least one comorbidity). To be included in this study, participants had to meet the following criteria: $\geq$18 years of age, completed the entire program prior to surgery, underwent bariatric surgery at Loma Linda University Medical Center (LLUMC) or LLUH affiliated facilities, and completed additional follow-up sessions post-surgery.

2.2 The Living Whole Database

The Living Whole Database contains employee data that is managed by LLUH Department of Risk Management. This web-based archive is highly confidential with limited access. Data was de-identified and extracted according to protocols established by the Department of Risk Management. The variables required for this study included gender, age, weight, height, BMI, and waist circumference.

2.3 The Say NOW Survey

Additional data was collected from the Say NOW Admission Survey. This web-based survey assessed typical dietary intake that included closed- and open-ended questions pertaining to food frequency, meal patterns and timings, miscellaneous lifestyle habits, weight loss history, and individual perception of self-efficacy regarding eating behaviors. Examples of questions included the following: “How many cups of fruit do you eat daily?”, “How many days per week

do you skip meals?", "How many hours per day do you watch T.V.?", and "In the past month, have you been actively trying to keep from gaining weight?". With regards to self-efficacy, patients were provided with situational statements and asked to respond on a scale of 0-5 (0=not confident, 5=very confident). Examples of statements included "I can control my eating on the weekends" and "I can resist eating when I am watching TV".

2.4 The Say NOW Program

Say NOW is a 36-week weight-loss program, comprised of 3 separate 12-week sessions – 24 weeks preoperative and 12 weeks postoperatively. The Say NOW Program included a weekly, 1-hour nutrition education class covering a range of topics, such as macronutrients, portion sizes, food tracking, reading food labels, eating out, goal setting, grocery store tours, etc. Attendance to these classes were required; however, participants could miss up to 2 classes in each 12-week period. They were also required to attend the bariatric surgery seminar and at least one bariatric support group throughout the 24 weeks of the preoperative program. Individualized calorie and macronutrient (carbohydrate, protein, and fat) recommendations were created for each participant.

Following bariatric surgery, participants met with their bariatric surgeon and dietitian from months 0-6. After 6 months post-op, participants returned to the Say NOW Program to complete an additional 12-week session (meeting all prior attendance requirements) and attendance to bariatric support groups were encouraged during this time.

Anthropometrics (weight, BMI, waist circumference) were collected at baseline, pre-surgery (after the first 24 weeks of the program), post-surgery (approximately 6 months post-op), and final (after the final 12 weeks of the program). Participants completed the Say NOW Survey at baseline and final. All data collected was inputted into the Living Whole Database.

3. Procedures

3.1 Data Extraction and Cleaning

The data used in this study was stored in a secure SQL database in a deidentified state. To access this data, authorization was obtained from LLUH Risk Management. Upon approval, the data was pulled from the SQL database and transferred to an Excel spreadsheet. The data within the spreadsheet was reviewed to ensure that all study variables were included and that there was no missing data. The Excel data was imported into SPSS for statistical analysis.

4. Statistical Analysis

Statistical analysis of quantitative variables was conducted on SPSS version 25, IBM Corp. Intra- and inter-phase comparative analyses were conducted on anthropometrics (weight, BMI, waist circumference) change using a Wilcoxon Signed Ranks Test. Pre- and postoperative survey data was utilized to identify changes in lifestyle habits (food frequency, meal patterns and timings, miscellaneous lifestyle habits, and perceived level of self-efficacy). Data was adjusted for confounding factors, as necessary.

5. Results

Subjects (N=16, Age = 45.9 ± 11.5 years; BMI = 46.1 ± 8.3 kg/m2) were LLUH employees and/or their spouses who enrolled in the Say NOW Program from 2015-2020 with the aim of going through bariatric surgery. Demographics shown in **Table 1**.

Table 1: Baseline Mean (SD) Demographic Characteristics

Age (Years)	45.9(11.5)
Height (cm)	162.4(8.6)
Weight (kg)	122.3(28.1)
BMI	46.1(8.3)
Waist Circumference (WC) (cm)	125.9(16.4)

SD: Standard Deviation

There was a statistically significant reduction in weight and BMI from Baseline to Pre-Surgery, Post-Surgery to Final, and Baseline to Final (p=0.016, p=0.003, p=0.000 respectively) **(Table 2)**. A reduction in waist circumference was also observed from Post-Surgery to Final and Baseline to Final (p=0.002, P=0.000 respectively) **(Table 2)**.

Table 2: Mean (SD) Change of Anthropometric Measurements Over Time

	Weight (kg)	BMI	Waist Circumference (WC) (cm)
A) Baseline	122.3(28.1)	46.1(8.3)	125.9(16.4)
B) Pre-Surgery	120.5(28.0)	45.4(8.0)	124.7(15.2)
C) Post-Surgery	91.6(22.7)	34.5(6.8)	104.8(15.4)
D) Final	87.8(22.1)	33.1(6.8)	100.2(14.4)

	Weight Change	P-value	BMI Change	P-value	Waist Circumference (WC) Change	P-value
A-B	-1.8	0.016	-0.7	0.016	-1.2	0.224
C-D	-3.9	0.003	-1.4	0.003	-3.2	0.002
A-D	-34.5	0.000	-13	0.000	-24.3	0.000

A correlation between pre- and postoperative weight loss was observed, as participants who experienced >3% preoperative EWL exhibited greater %EWL after surgery **(Figure 1).** Participants with a larger waist circumference at baseline, experienced a greater reduction by the end of the preoperative portion of the Say NOW Program **(Figure 2)**.

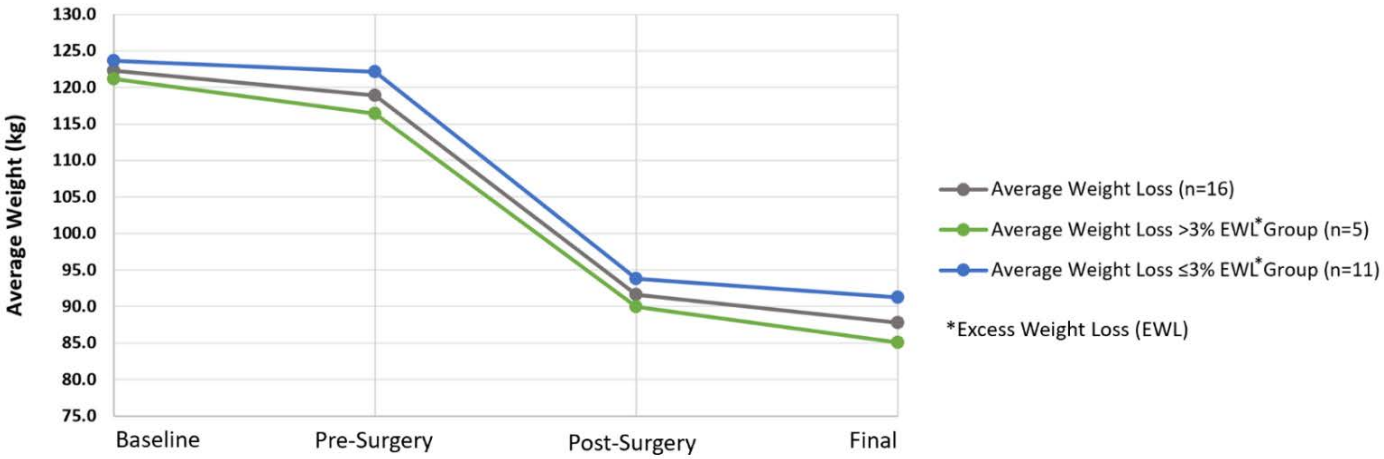

Figure 1: Average Weight (kg) Change Over Time

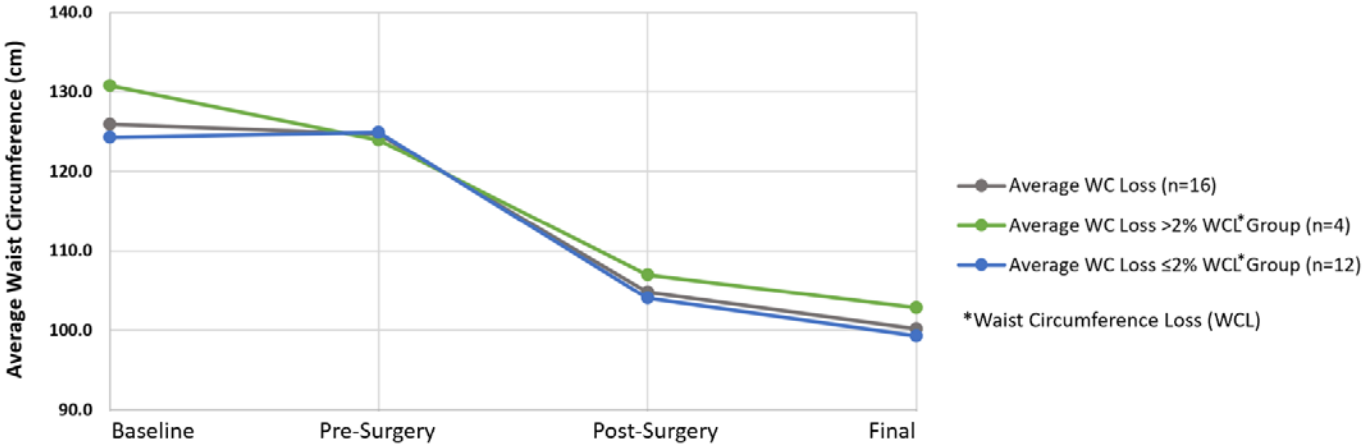

Figure 2: Average Waist Circumference (WC) (cm) Change Over Time

Over the course of the program, there was observable improvement in diet and lifestyle-related factors, as well as overall self-efficacy compared to Baseline **(Table 3)**.

Table 3: Change of Diet, Lifestyle, and Self-Efficacy from Baseline

Questions	Baseline	Final	Change	Interpretation
Fast Food Days/Week	4	2.4	-1.6	Improved
Whole Grain Servings/Day	2.3	2.3	0	No Change
Fruit Cups/Day	2.4	3.6	1.2	Improved
Vegetable Cups/Day	3	4.2	1.2	Improved
Meals Skipped/Day	2	1.8	-0.2	Improved
Screen Time Hours/Day	5.2	5	-0.2	Improved
Self-Efficacy	68.1	78.8	10.6	Improved

6. Discussion

The purpose of this secondary analysis was to assess the influence of the Loma Linda University Health's (LLUH) Say No to OverWeight (Say NOW) weight loss program on lifestyle and behavioral changes, participants' self-efficacy, and weight loss both pre- and postoperatively, as well as evaluate the potential correlation between pre- and postoperative weight loss. We

observed statistically significant reduction of weight, BMI, and waist circumference throughout varying timepoints of the program. While the effects of bariatric surgery contributed to changes observed from Baseline to Final as well as Post-Surgery to Final, we can infer that the components within the Say NOW Program contributed to further reductions in anthropometrics. This inference can be made due to (1) significant reductions prior to surgery and (2) observable improvements in diet, lifestyle, and behavior change. Improvements identified in diet, lifestyle, and behavior change play a valuable role in this conclusion as research indicates that weight-maintenance specific counseling that consists of behavioral strategies as a primary intervention are associated with long-term success.[20] Lifestyle is a major contributory factor of post-surgery weight regain in bariatric patients, implying that preoperative weight loss programs that incorporate methods to encourage dietary, lifestyle, and behavioral modifications are effective in postoperative weight loss and maintenance.[20,21]

To assess the potential correlation between preoperative and postoperative weight loss, participants were separated into two groups: (1) those that lost >3% EWL (n=5), and (2) those that lost ≤3% EWL (n=11). We found that participants that lost >3% preoperative EWL experienced greater weight loss after surgery, which is supported by recent research. Conaty et al. found that those with a required preoperative weight loss (≥10%) exhibited greater %EWL and %BMI reduction 6 months after surgery.[15] Additionally, Solomon et al. had similar findings, with greater reduction in BMI and EWL one year after surgery among participants with greater preoperative EWL (≥5%).[16] While no correlation between pre- and postoperative waist circumference loss was identified, we did observe a relationship between baseline waist circumference and waist circumference loss before surgery. We found that participants with a larger waist circumference at baseline, experienced a greater reduction by the end of the preoperative portion of the Say NOW

Program. Future studies can further explore the extent at which weight loss and waist circumference loss are related. Understanding the significance of the role weight loss plays in waist circumference reduction can act as a valuable motivator for overweight and obese patients. Another suggestion for future research is to include comparisons between two or more lifestyle-based weight-loss programs. This would further facilitate a deeper understanding of specific program components that are especially effective in weight, BMI, and waist circumference reduction.

Limitations of this study should be considered when interpreting the findings of this study. One limitation is the small sample size, which limits the generalizability of the current findings. It is important to obtain an appropriate sample size that is representative of the population, specifically to help limit outliers, and produce results that are statistically different among variables. Further, a larger sample size helps broaden the range of potential data and develops an improved analysis. It is also important to note that there was an inability to observe long-term effects of the program due to a limited follow-up period. While short-term results can indicate the effectiveness of the program, it is the long-term results that will demonstrate the extent of the program's lifelong influence.

7. Conclusion

The present findings indicate that a comprehensive lifestyle-based weight loss program can be beneficial in facilitating further benefits among bariatric patients, particularly regarding anthropometric measurements. Additionally, a program such as this can lead to significant improvements in diet and lifestyle-related factors, as well as perceived self-efficacy regarding eating behaviors. Findings of this study can help to identify strategies for success and recognize areas in need of improvement, in preoperative weight loss programs. This, in turn, can better help

patients reach their weight loss goals and achieve a healthy body composition through long-term diet, lifestyle, and behavioral changes. A healthy body composition can contribute to improved quality of life, which includes physical, mental and emotional, and social aspects of wellbeing.

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