



# Changes in Standing Height Among Post-Operative Bariatric Patients after Undergoing Bariatric Surgery

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## ABSTRACT

**Background** Bariatric surgery is an accepted form of treatment for extreme or class III obesity with a BMI of 40 or greater or a BMI of 35 or greater with comorbidities because it has been shown to reduce weight, prevent obesity-related diseases, and improve overall quality of life better than diet and exercise alone. Obesity exacerbates lower back pain due to increased pressure and restricted spine movement. Therefore, a weight loss regime or plan has been shown to decrease the severity of lower back pain as well as increase disc height in certain regions of the vertebrae.

**Objective** The purpose of this study was to examine changes in standing height before and after undergoing bariatric surgery among morbidly obese patients.

**Methods** All 7 participants filled out a screening questionnaire to confirm their status and eligibility to participate in the study. An informed consent form was given to all participants before starting the study. Patients met for a total of three visits. In each visit, the patient was required to fast for eight hours before body composition measurements were taken. Height was measured using a stadiometer and recorded to the nearest 0.1 cm during the first and third visit. Weight was measured using a Tanita scale during each of the three visits. IBM SPSS Statistics, Version 22 (Armonk, NY) was used to analyze the data. A Wilcoxon signed rank test was used to determine if there were differences initial weight and final weight, initial height and final height, and initial BMI and final BMI. A Kruskal-Wallis test was used to determine if there were differences in height, weight, and BMI between males and females.

**Results** *Height:* The difference between initial height and final height among the participants was not significant at  $P = 0.735$ . The difference between initial and final height among males and females was not significant at  $P = 0.121$  and  $P = 0.245$  respectively. *Weight:* The difference between initial weight and final weight among the participants was significant at  $P = 0.018$ . The difference between initial and final weight among males and females was not significant at  $P = 0.699$  and  $P = 0.439$  respectively. *BMI:* The difference between initial BMI and final BMI among the participants was significant at  $P = 0.018$ . The difference between initial and final BMI among males and females was not significant at  $P = 1.000$  and  $P = 1.000$  respectively.

**Conclusion** It is one of the few studies that solely looked at differences in standing height after undergoing bariatric surgery. In the end, there was no statistically significant difference in height among the 7 participants before and after undergoing bariatric surgery. There was also no statistical difference in height among males and females before and after undergoing bariatric surgery. However, we can see clinical differences in height, which is important note because it shows that there are changes that occurred which may or may not require individual intervention such as additional supplementation with Vitamin D and calcium to prevent osteoporosis/osteopenia. The small sample size skews the data and perhaps amplifies the results that otherwise might not be seen in a larger sample size. However, the data collected from this study provides more information for future research on the implications of bariatric surgery.

*As a research assistant, the data I used was part of a larger study conducted by two Cal Poly Pomona graduate students (Bec McDorman and Heather Garcia) called, Effects of Vitamin Supplementation on Micronutrient Blood Values, Body Composition, Waist-to-hip Ratio and Fasting Blood Glucose After Bariatric Surgery [ClinicalTrials.gov Identifier: NCT02686905]. On behalf of Bec and Heather, I was given permission to use pertinent data from their study to conduct my study. The study was conducted between June 2016 and December 2016*

## BACKGROUND

According to the American Society for Metabolic and Bariatric Surgery, bariatric surgery is a surgical procedure that causes weight loss by limiting the amount of food that the stomach can hold. <sup>1</sup> Bariatric surgery is an accepted form of treatment for extreme or class III obesity with a BMI of 40 or greater or a BMI of 35 or greater with comorbidities because it has been shown to reduce weight, prevent obesity-related diseases, and improve overall quality of life better than diet and exercise alone. In fact, from various studies, bariatric surgery was found to be more effective than non-surgical treatments with greater reductions in overall mortality from diabetes, heart disease, and cancer along with decreases in obstructive sleep apnea and symptoms of asthma. <sup>2</sup>

Obesity is a recognized risk factor for low back pain due to restricted spine movement, followed by degenerative disc changes with compression effects and a change in the biomechanics of the spine. <sup>3</sup> Several studies have been done that have examined the relationship between increasing weight, lower back pain, and disc height in the vertebrae. For example, one study compared the upper (T12-L4) and lower lumbar angles (L4-S2) of normal BMI and overweight young adults. Significant differences in BMI between the 2 BMI groups were found only in the lower lumbar angle but the means of both the upper and lower lumbar angles in the overweight group were greater than those in the normal BMI group. <sup>3(p2344)</sup> In a population-based study of 2,599 southern Chinese volunteers, there was a significant association between the presence, extent, and global severity of disc degeneration with weight in overweight and obese adults. <sup>4</sup> And in another study, researchers determined that a higher body mass index was associated with an increased prevalence of low back pain in both men and women. <sup>5</sup> Therefore, a weight loss regime or plan has been shown to decrease the severity of lower back pain as well as increase disc height in certain regions of the vertebrae. Hooper found that the greatest improvement in pain management occurred in the cervical and lumbar spinal regions from 48 post-operative bariatric patients at 90 and 83 percent respectively. <sup>6</sup> Lidar examined the effect of bariatric surgery on intervertebral disc space height and pain and found that both axial and radicular back pain decreased markedly after surgery ( $P < 0.001$ ) among 30 morbidly obese adults. <sup>7</sup> In fact, Lidar also found a marked increase in lower lumbar angle or between the L4 to L5 intervertebral disc height. <sup>7</sup> However, there was no correlation between the amount of weight lost and the increase in L4 to L5 intervertebral disc height or back pain improvement. And another study noted a 54 percent pain reduction in the lower back region among 25 individuals that had undergone bariatric surgery three months prior to the study. <sup>8</sup> As a result, bariatric surgery or weight loss in general, can reduce weight placed on the vertebrae, improve lower back pain, and increase disc height in certain regions of the vertebrae.

There is a significant amount of research that examines the change in intervertebral disc height and the decline in lower back pain after undergoing weight loss/bariatric surgery. However, there is no data or study that specifically looks at changes in standing height after undergoing bariatric surgery. Nevertheless, there is evidence that the aging process changes disc height and standing height because the discs dehydrate and compress over time, shortening the disc height and overall standing height. <sup>9</sup> Subsequently, there is interest in looking at the relationship between standing height and the changes in the intervertebral disc height in obese individuals after undergoing bariatric surgery. Therefore, the purpose of this study was to examine changes in standing height before and after undergoing bariatric surgery among morbidly obese patients.

## METHODS

**Subjects:** 2 of the 7 participants were male and 5 out of the 7 participants were female. All participants filled out a screening questionnaire to confirm their status and eligibility to participate in the study. Participants were either given a vitamin patch or oral vitamin supplement to consume. 6 of the participants used a vitamin patch supplement while only 1 participant used an oral vitamin supplement. An informed consent form was given to all participants before starting the study.

**Location & Duration:** The study was conducted from the Oliak Center for Weight Loss in Brea, California or at the participant's best convenience. The study was conducted between June 2016 and December 2016.

**Statistics:** IBM SPSS Statistics, Version 22 (Armonk, NY) was used to analyze the data. A Wilcoxon signed rank test is a nonparametric test and is the equivalent of a paired t-test. It is used to determine if there were differences between two sets of scores from the same participant. In this case, initial weight and final weight, initial height and final height, and initial BMI and final BMI. A Wilcoxon signed rank test was used because of the small sample size. A Kruskal-Wallis test is also a nonparametric test and is the equivalent of an independent t-test. It is used to determine if there were differences between two or more groups. In this case, according to sex or males and females. A Kruskal-Wallis test was used because there was not a normal distribution of samples.

**Methods:** Patients met for a total of three visits. In each visit, the patient was required to fast eight hours before the body composition measurements were taken. The first visit was at least one week before the patient's surgical procedure, the second visit was three weeks after the patient's surgical procedure, and the last procedure was three months after the patient's surgical procedure.

**Visit #1:** In the first visit, the participant filled out a screening questionnaire and an informed consent form. Height was measured using a stadiometer and recorded to the nearest 0.1 cm. Participants had to consume a small glass of water before their weight was measured using a Tanita scale.

**Visit #2:** In the second visit, the participant filled out a follow-up questionnaire. Height was not measured on the second visit. Participants had to consume a small glass of water before their weight was measured using a Tanita scale.

**Visit #3:** In the third visit, the participant filled out a follow-up questionnaire. Height was measured using a stadiometer and recorded to the nearest 0.1 cm. Participants had to consume a small glass of water before their weight was measured using a Tanita scale.

## RESULTS

**Height:** The difference between initial height and final height among the participants was not significant at  $P = 0.735$ . The difference between initial and final height between males and females was not significant at  $P = 0.121$  and  $P = 0.245$  respectively.

**Weight:** The difference between initial weight and final weight among the participants was significant at  $P = 0.018$ . The difference between initial and final weight between males and females was not significant at  $P = 0.699$  and  $P = 0.439$  respectively.

**BMI:** The difference between initial BMI and final BMI among the participants was significant at  $P = 0.018$ . The difference between initial and final height between males and females was not significant at  $P = 1.000$  and  $P = 1.000$  respectively.

Figure 1.

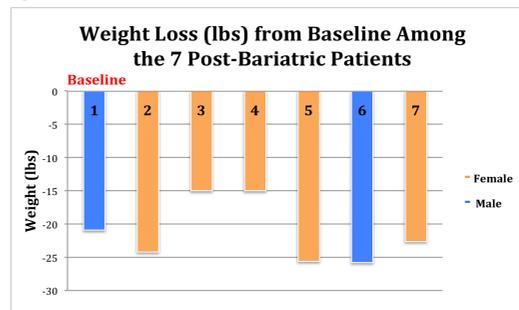
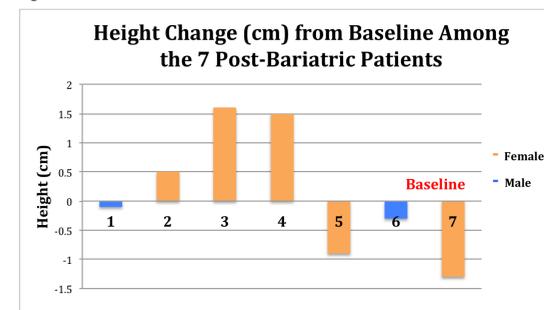


Figure 2.



**Table 1. Differences between initial and final height, initial weight and final weight and initial BMI and final BMI among the 7 participants.**

	P value
Height	0.735
Weight	0.018
BMI	0.018

**Table 2. Differences among males and females on initial and final height, initial weight and final weight and initial BMI and final BMI.**

	P value	
	Initial	Final
Height	$P = 0.121$	$P = 0.245$
Weight	$P = 0.699$	$P = 0.439$
BMI	$P = 1.000$	$P = 1.000$

## DISCUSSION

From the results, it appears that there is a statistical difference in weight loss after undergoing bariatric surgery. Each participant in the study lost weight and subsequently, the P value of 0.018 (less than 0.05) was statistically significant. However, the difference between initial and final height among the participants was not statistically significant. In addition, there was no statistical difference in height between males and females. This can be due to opposite differences as both males lost height while female height went up in 3 and down in 2. And adding up the differences and dividing by 7, we would get an average that would result in "no change" in height among males and females. Even though we did not see a statistical difference in height among the participants or between males and females, we can see clinical differences in height. The clinical difference is important to note because it shows that there are changes that occurred which may or may not require individual intervention. For those individuals that lost height, they might need to be further assessed for osteopenia or osteoporosis, which is common after excessive weight loss in bariatric patients. It is also the reason why vitamin D and calcium are commonly prescribed to help offset bone loss for post-bariatric patients. Three out of the four people that lost height were using a vitamin patch supplement while only one was using the oral vitamin supplement. However, all three individuals that gained height after bariatric surgery were using the vitamin patch supplement. Therefore, the results are inconclusive as to whether or not a vitamin patch or oral vitamin supplement is more or less likely to result in a decline or increase in height after bariatric surgery. Since there was only one individual taking the oral vitamin supplement, we did not analyze differences among the participants or between males and females according to the vitamin supplement form. However, we did compare initial BMI and final BMI among males and females according to the vitamin supplement form and found there was no statistical difference at  $P = 0.614$  and  $P = 0.617$  respectively.

There are several limitations to the results presented in this study. First, there is a small size which skews the data and perhaps amplifies the results that otherwise might not be seen in a larger sample size. Second, there was an uneven distribution of men and women in the study. Therefore, with an even number of men and women, we can get a more fair comparison that might yield more accurate results. In addition, we could also get a more even distribution of people taking either the oral vitamin supplement or vitamin patch supplement to get a more fair comparison. These are several things that can be done differently if the study was conducted again. Nevertheless, the data collected from this study provides more information for future research on the implications of bariatric surgery.

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