

Metabolic Benefits of Large Volume Liposuction in Prediabetic Patients; A Prospective Clinical Trial

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Background: Liposuction is mostly utilized to eliminate both deep and superficial fat deposits. Large volume liposuction (LVL) plays a major role in reducing metabolic complications due to obesity. The study aimed to assess the LVL effect in prediabetic patients regarding body weight, total body fat and changes during a 3- to 6-month follow-up period.

Patients and method: This prospective clinical trial included 60 prediabetic patients with body mass index (BMI) from 25 to 35 (Kg/m²) and varying degree of localized obesity.

Results: Weight, BMI and plasma insulin were significantly lower after 3 and 6 months after liposuction than preoperatively and decreased after 6 months than after 3month postoperatively (P<0.001). LVL had positive significant correlation with average of weight loss and BMI reduction (r= 0.0.948, r= 0.910 respectively, P< 0.0001).

Conclusion: LVL improved overweight by weight, BMI, and improve blood glucose level and plasma insulin level over 3 m to 6 m follow up period.

Key words: Large Volume, liposuction, prediabetic patients, plasma insulin level.

Introduction

Obesity has been more prevalent in our country and is strongly connected to cardiovascular risk factors and disorders of metabolism.¹ Numerous research has also demonstrated that most obesity-related complications are not only dependent on the obesity degree but also on the distribution of body fat. An abdominal, visceral, or upper-body type of fat distribution (Apple-shaped) is currently a recognized risk factor for metabolic disorders, atherosclerosis and hypertension.²

The World Health Organization (WHO) describes obesity as abnormal or excess fat accumulation that has a health risk. A body mass index (BMI \geq 25) kg/m² is considered overweight, whereas BMI \geq 30 kg/m² is considered obesity.³

Being overweight raises the risk of developing type 2 diabetes(DM) by a factor of three, and obesity by seven, compared to average weight.⁴

The American Diabetes Association suggests that doctors check for type 2 DM and evaluate the risk of developing DM in asymptomatic overweight/obesity patients \geq 45 years old, regardless of age if patients are very obese.⁵

Liposuction is the most frequently done aesthetic surgery worldwide. It is mainly utilized to deposit deep and superficially and reshape the body's appearance. It has evolved into a critical supplemental strategy for enhancing the aesthetic result of several other aesthetic operations as

cervicoplasty, abdominoplasty, brachioplasty thigh lift, mammoplasty reduction or augmentation, and post bariatric body contouring.⁶

Liposuction should not be recommended as an obesity treatment only. It is utilized for eliminating genetically altered or diet-resistant fat. Best liposuction are within 20% of their optimal body weight or less than 50 pounds overweight.⁷

Liposuction is done by several techniques, including tumescent, power-assisted liposuction, ultrasonic liposuction and laser-assisted liposuction, recently. Liposuction is classified into 2 categories according to the volume of solution aspirated: High volume or low volume (<4,000 ml aspirated).⁸

The meaning of "large volume liposuction" (LVL) differs from studies on cosmetic surgery. Although, there is no precise definition, the most frequent definitions refer to one of two things: Whole fat eliminated throughout the surgery (E.g. 4 L of fat removal) or whole amount eliminated within the surgery (5 L total volume elimination of fat and wetting solution).⁹

Liposuction currently appears to have massive potential use in ablation and reconstruction, away from the most usual aesthetic methods.¹⁰ Nowadays, it is suggested LVL plays a major role in reducing metabolic complications due to obesity. Also, insulin-induced lipodystrophy is one of the main indications for performing liposuction.^{11,12}

We assume that liposuction could encourage a group of patients to diet, as large-volume liposuction is

associated with an effective postoperative weight loss, but it did motivate a selective group of our patients to diet after their surgery. We aimed assess the Large-Volume Liposuction effect in prediabetic patients regarding body weight, total body fat and changes during a 3- to 6-month follow-up period.

Patients and methods

This prospective clinical trial was conducted on 60 prediabetic patients (Fasting blood sugar (FBS) is 100 to 125 mg/dL and oral glucose tolerance test (OGTT) is 140 to 199 mg/dL after the FBS) aged 20 to 50 years old, both sex with BM) ranges from 25 to 35 (Kg/m²) with varying degree of localized obesity either in thigh, abdomen, back or gluteal region, arms and in the chest in male patients. After 3 m follow up, four cases dropped out, and two cases dropped out after 6 m follow up.

The study was done after obtaining approval from the ethical committee and informed consent from each patient in Menoufia University Hospitals, Plastic Surgery Department, Faculty of Medicine, Egypt, from March 2018 to March 2020.

Exclusion criteria were patients with major medical conditions such as cardiac, neurological, pulmonary, liver, and renal diseases, and diabetic patients with expectations of body dysmorphic syndrome to prevent the possible confounding effects that these disorders may present.

All cases underwent

Full history and history of previous surgery as bariatric surgery or previous liposuction, and stability of the patient's weight were taken.

General examination was done to evaluate the fitness of patients for the procedures, local examination in the abdomen the presence of the hernia and divarication of recti, and of all aesthetic elements that comprise the deformity.

Anthropometric measurements were estimated for each case pre-operatively involving weight, height, BMI, circumference of the regions as thighs, hips, waist, buttocks, and arms, and pinch test of the skin. The instructions after surgery as wearing the garment for a period from the operation till at least 6 weeks or better till 24 weeks, about the following lifestyle after surgery. And the real expectation after the surgery, then taking the consent from the patient before the surgery.

Investigations

Laboratory tests as complete blood picture (hemoglobin level, prothrombin activity and time, international normalized ratio (INR), random blood sugar level, serum insulin level, serum creatinine (kidney function test), liver profile, (SGOT, SGPT)

and hepatitis markers) were recorded.

Radiological investigations include abdominal ultrasound, lower limb duplex in the thigh liposuction. In body measurements of the total body fat and visceral fat by using in body device (570 body composition analyzer device) (Quantitative analysis, and body composition assessment) Basic data were needed for evaluating the body status). These measures were done during preoperative measurement, 3 months, and 6 months after surgery.

Preoperative consultation (Anesthesia consultation and any other consultation were performed if needed).

Four photographic views: A frontal view with the patient looking straight into the camera, two lateral views (On both sides) and one posterior view were taken.

The patients maintained their normal lifestyle with no changes in diet or physical activity through the perioperative months and stop smoking before the procedure by 2 weeks.

Before the operation

Surgical technique: All cases were done in a well-equipped operation room with a good lightening and anti-septic measures at room temperature. Accurate preoperative markings are essential in standing position, regions to be suctioned are delineated by a fiber tip marking pen. Regions that to be avoided or needed for fat grafting also are independently outlined by another marking pen. Port sites in every area were also identified to permit cross-tunneling suction to decrease abnormalities in surface.

Each patient was subjected to large-volume tumescent liposuction under general or spinal anesthesia, described as eliminating over 4 liters of aspirate. All patients underwent liposuction from the abdomen, plus smaller amounts of fat were eliminated from the flanks, arms, back, thighs or hips in the operating room on a sterile operating table. We prepare the patient in a circumferential manner in the middle and lower limb to suction these areas without repositioning. Then after finishing the skin sterilization, the patient is sedated or taken regional anesthesia as needed.

All zones to be suctioned are inoculated with a large volume of the tumescent infiltration fluid until the tissue's turgor is equal on both sides. Adequate vasoconstriction is reached in about 10 minutes, but it is more effective after 20 minutes. The tumescent fluid was used: Ringer lactate, 0.1% lidocaine (0.075 to 1000 mg/L ringer lactate), Injectable adrenaline (was derived by careful observation of cutaneous blanching and pulse rate as a dose of 0.65 to 1.0 mg/L).

General measures to help lower the risk of developing a DVT are quitting smoking, adequate amount of fluids intake, enoxaparin 1 mg/kg SC /12hr, or 1.5 mg/kg SC /Day (administer at same time each day) was used for management of DVT.

In the postoperative period, patients wore pressure garments for up to 3 months to facilitate better skin retraction, also, the patients were on the diet regimen and sports program till 6 months with monthly measuring the body weight and BMI.

Assessments after liposuction

Subjects were instructed to resume their normal lifestyle after the initial recovery period and to weigh themselves weekly at home. Each subject was contacted via phone by one of the investigators at least once every week after liposuction to reinforce the maintenance of their usual food intake and physical activity, and to maintain a stable body weight.

Also, the patients were on diet regimen and sport program till 6 months with monthly measuring the average body weight, BMI loss, glucose, plasma insulin levels, and HbA1c after 3 month, 6 month.

Sample size

The sample size was calculated. using G. power 3.1.9.2 (Universitat Kiel, Germany). According to a previous study 13 the mean reduction in insulin level (\pm SD) was 14.9 ± 6.5 (mIU/ml) before surgery versus a 13.6 ± 4.1 , four months post-surgery (the primary outcome), based on following

LVL based on the subsequent considerations: 0.05 a error and 95% power of the study. Six cases were added to overcome dropout. Therefore, 60 patients were recruited.

Statistical analysis

The statistical analysis was performed using SPSS v26 (IBM, Chicago, IL, USA). To determine the normality of the data distribution, the Shapiro-Wilks test and histograms were used. The mean and standard deviation (SD) of quantitative parametric data were calculated and analyzed using repeated measurements ANOVA to compare the means of three or more groups when the participants are identical in each group (Tukey). The Chi-square test was used to examine qualitative data expressed as frequency and percentage. Pearson correlation coefficient (r): was used to determine the relationship between two quantitative variables within one group. A two tailed P value < 0.05 was considered statistically significant.

Results

The present study was done on 60 patients who underwent LVL, 15 patients were males (24%), and 45 patients were females (76%). The age ranged between 20-50. The average age of cases was 34.43 ± 9.84 . The mean liposuction volume was (8.40 ± 2.27). (**Table 1**).

After 3 months of follow-up, four cases dropped out, and two cases dropped out after 6 months of follow-up. (**Figure 1**).

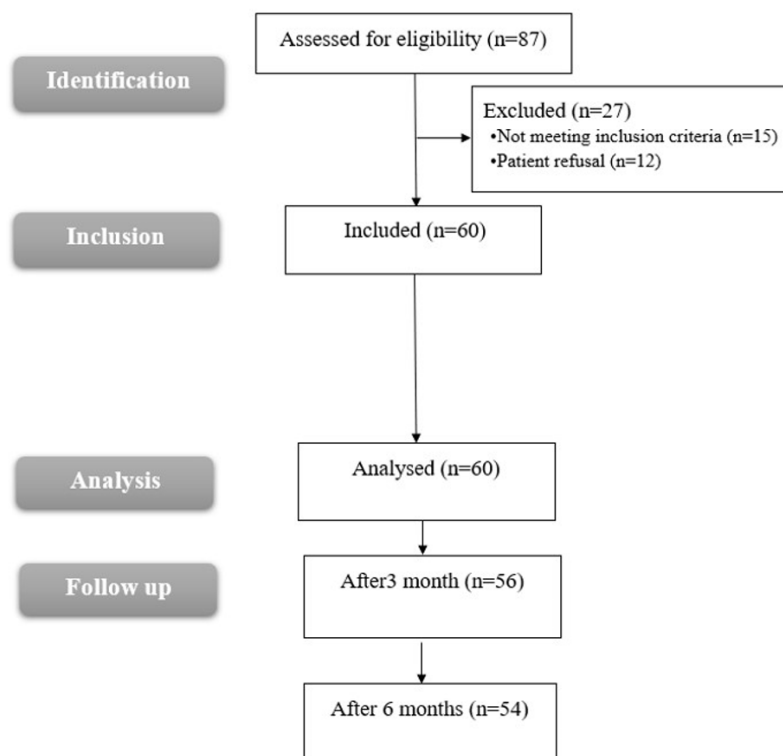


Fig 1: Flow chart of the studied patients.

Preoperatively, the average weight of cases was (88.82 ± 10.55) and decreased after 3 months postoperatively to (81.77 ± 9.96), and after 6 months was decreased to the mean (79.79 ± 10.3). Regarding BMI, preoperatively, the mean BMI was (31.94 ± 2.59) and decreased postoperative after 3 months to (29.56 ± 2.91), and after 6 months to (28.849 ± 2.79). Weight, and BMI were significantly lower after 3m and 6 months after liposuction compared to preoperatively and decreased after 6 m compared to after 3month postoperatively ($P < 0.001$). (Table 2).

Pre- and postoperative photos of a patient. (Figure 2).



Fig 2: Pre- and postoperative photos of a patient.

Regarding the Circumference of arm, thigh, abdomen, and gluteal region, there was a significant difference between preoperative and postoperative measurements (3 months and 6 months). Circumference of arm, thigh, abdomen, and the gluteal region was significantly lower after 6 m and 3 months compared to preoperative and after 6 m compared to after 3month postoperatively. (Table 3).

Glucose and plasma insulin levels were significantly difference between preoperative and postoperative measurements (3 months and 6 months). Glucose level, and plasma insulin was significantly lowered after 3 m and 6 months compared to preoperative and decreased after 6 m compared to after 3month postoperatively. Glycosylated hemoglobin (HbA1C) was significantly lower after 3month,6month compared to preoperatively and was insignificantly different between 3month and 6 months measurements. (Table 4).

Correlation between average weight loss and liposuction volume and between BMI reduction and liposuction volume. (Figure 3).

(Figure 4) shows preoperative photo of patient, post operative photo of patient and liposuction fat.

(Figure 5) shows preoperative photo of patient, post operative photo of patient and liposuction fat.

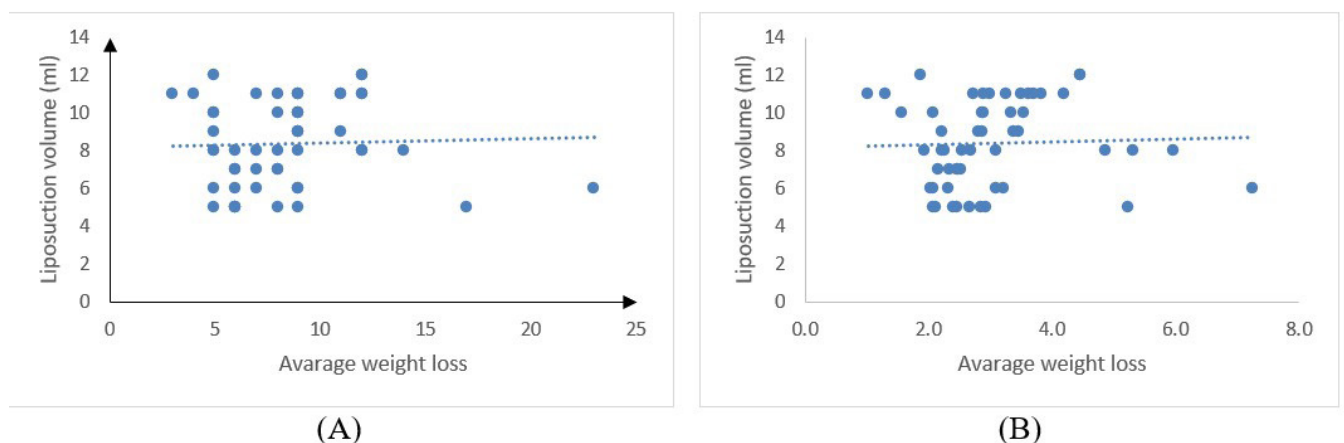


Fig 3: (A) Correlation between average weight loss and liposuction volume, (B) Correlation between BMI reduction and liposuction volume.

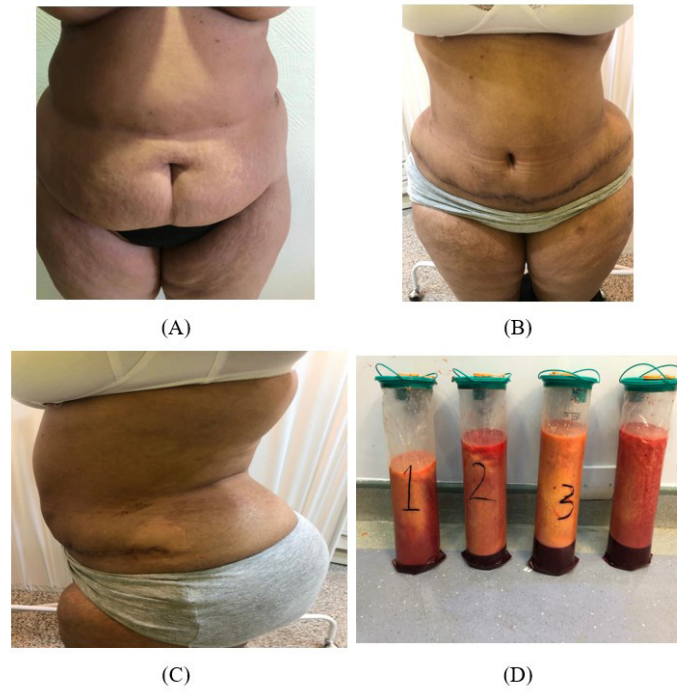


Fig 4: (A) Preoperative photo of patient (B, C) Post operative photo of patient (D) Liposuction fat.



Fig 5: (A) Preoperative photo of patient (B) Post operative photo of patient (C) Liposuction fat.

Table 1: Demographic data of the patients

		(N=60)
Age		34.43 ± 9.84
Sex	Male	17 (28.3%)
	Female	43(71.6%)
Weight (kg)		88.82 ± 10.55
Height (m)		1.67 ± 0.09
BMI (kg/m²)		31.94 ± 2.59
Mean liposuction volume (5-12L)		8.40 ± 2.27

Data presented as mean ± SD, frequency (%), BMI: body mass index.

Table 2: Preoperative and postoperative (3 months and 6 months) measurements

	Before (N=60)	After 3m (N=56)	After 6m (N=54)	P value	
Weight	88.82±10.55	81.77 ± 9.96	79.79±10.3	<0.001*	P1<0.001* P2<0.001* P3<0.001*
BMI	31.94 ± 2.59	29.56 ±2.91	28.849 ± 2.79	<0.001*	P1<0.001* P2<0.001* P3<0.001*

Data presented as mean ± SD, *: significant as P value <0.05, P1: between preoperative and after 3 month, P2: between preoperative and after 6month, P3: between after 3 month and after 6 month.

Table 3: Preoperative and Postoperative (3 months and 6 months) means of the circumference of the arm, thigh, abdomen, and gluteal region.

Circumference of	Before (N=60)	After3m (N=56)	After 6m (N=54)	P value	
Arm	37.67± 6.1	33.79 ± 6.65	32.69 ± 6.58	<000.1	P1<0.001* P2<0.001* P3<0.001*
Thigh	76.93 ±11.48	70.65 ±11.45	67.16±11.44	<0.001	P1<0.001* P2<0.001* P3<0.001*
Abdomen	99.1± 22.39	91.13 ± 22.8	88.85±22.52	<0.001	P1<0.001* P2<0.001* P3<0.001*
Gluteal region	111.43± 16.76	102.22±16.12	97.02±15.79	<0.001	P1<0.001* P2<0.001* P3<0.001*

Data presented as mean ± SD, P1: between preoperative and after 3 months, P2: between preoperative and after 6month, P3: between after 3 month and after 6 months, *: significant as p value <0.05.

Table 4: Preoperative and postoperative (3 months and 6 months) means of blood glucose level and plasma insulin level of patients

	Before (N=60)	After 3m (N=56)	After 6m (N=54)	P value	
Glucose (mg/dL)	157.6±10.46	148.67±10.7	145.02±10.28	0.001**	
					P1<0.001
					P2<0.001
				P3<0.001	
Plasma insulin (mIU/L)	17.35±1.75	14.76±1.88	13.31±2.06	0.001**	
					P1<0.001
					P2<0.001
				P3<0.001	
HbA1c (%)	6.43 ± 0.37	6.04 ± 0.72	5.93±0.79	0.001	
					P1=0.001
					P2<0.001
				P3=0.604	

Data presented as mean ± SD, HbA1c: (%), P1: Between preoperative and after 3 months, P2: Between preoperative and after 6 months, P3: between after 3 month and after 6 months, *: Significant as p value <0.05 *: Significant as p value <0.05.

Discussion

Liposuction is the most usual cosmetic operation as a safe, simple, and effective way of body contouring. Many studies have been done to examine the effect of liposuction on the metabolic complications of obesity, and it has frequently been suggested to manage their complication.¹⁰

Regarding the mean weight, the current study revealed that both weight and BMI of patients were significantly lower at 3m and after 6 months postoperatively compared to preoperatively and reduced after 6 months compared to 3 m.

Preoperatively, the mean of weight of patients was (88.82±10.55) and decreased after 3 months postoperatively to (81.77±9.96) and after 6 months was decreased to the mean (79.79±10.3).

Regarding BMI, preoperatively, the mean BMI was (31.94±2.59) and decreased postoperative after 3 months to (29.56±2.91), and after 6 months to (28.849±2.79). In another study done by Hong Y. G., et al.,¹⁴ on 11 patients preoperatively and 2 months postoperatively, the average body weight reduced from (64.5±18.8) to (59.9±17.8) kg and a significant difference in BMI with its mean dropped from (23.8±4.4) to (22.0±4.2)kg/m². Geliebter A., et al.¹⁵ also found body weight decreased significantly between all times, the point from baseline to 12 weeks, patients had an average weight decrease of (4.7±2.8), BMI declined significantly from baseline to 1 week, 4 weeks and 12 weeks.

In agreement with our results, Habib H., Abd Alazeem S., & Abd Alazeem N.,¹¹ showed that weight was significantly lower after 3 months with mean of weight (77.70±6.36) compared to preoperative with mean (80.87±6.57) and BMI was significantly lower after 3 months as the mean (29.54±2.8) compared to preoperative as its mean (30.97±2.76).

Concerning measurements, the current study reported that there was a significant effect on the circumference of arm, thigh, abdominal (Waist) and gluteal region.

In agreement with our results, Saleh Y., El-Oteify M., Tohamy A., & Abd-Elsayed A. A.,¹⁶ in their study showed that significant effect in buttock and thigh measurement preoperatively and 4 months after large volume liposuction. Geliebter A., et al.,¹⁵ found that waist (Abdominal) circumference decreased overtime, and the average of minimum waist circumference significantly decreased with total of 83 patients.

After the large volume liposuction in the current work, we found that the level of plasma insulin decreased and showed significant difference before and after 6 months postoperative (Improved insulin sensitivity. Also, the current study showed significant changes of glucose level over the period of the study 6 months.

Consistent with our findings, Saleh Y., et al.,¹⁶ described a significant lower in blood glucose level after 4 months postoperatively. Gonzalez-Ortiz M., et al.,¹⁷ also proved that LVL led to reduce in blood glucose level more than 4 weeks postoperatively.

Also, Gonzalez-Ortiz M., et al.,¹⁷ documented that LVL led to enhanced insulin sensitivity.

On the contrary Geliebter A., et al.,¹⁵ showed that no significant changes observed in plasma glucose level in patients underwent liposuction of large volumes of fat. Also Mohammed, B. S., et al.,¹⁸ in their study proved that no subsequent changes in glucose tolerance after surgery.

In other study of done by Geliebter A., et al.,¹⁵ they showed that large volume liposuction had significant decrease in plasma insulin from 1 weeks to 12

weeks. Abd Alazeem S., & Abd Alazeem N.,¹¹ study they found that no significant improve in insulin level preoperatively and 3 months postoperatively.

In our current trial liposuction volume had positive significant correlation with average of weight loss and BMI reduction (R= 0.0.948, r= 0.910 respectively, P< 0.0001).

All surgery centers, as well as our study, place a premium on safety. We observed all 54 patients postoperatively for a minimum of 12 weeks due to dropout due to not all patients followed up after 3 and 6 months. None of the obese patients had DVTs or pulmonary emboli. None of the cases required hospitalization due to an intraoperative complication. The wound dehiscence and infection rates were 5.5 and 11%, respectively. These are proper safety statistics for a population of subjects who are often thought to be at high risk. Dissociative anesthesia is associated with a low risk of pulmonary emboli, which is why we avoid general anesthesia.¹⁹

Further studies are needed to investigate whether liposuction has a positive metabolic effect or not.

It is critical to emphasize that liposuction should not be viewed as a panacea for obesity and related disorders, but rather as a valuable adjunct to multidisciplinary treatment of these conditions. Most notably, surgical fat reduction has no adverse effect on metabolic indices fluctuation. Prospective studies, possibly involving randomized controlled trials and laboratory research, are required to evaluate changes in metabolic parameters (Glycemia, insulin levels) in a homogeneous patient population undergoing liposuction in order to gain a better understanding of the relationship between plastic surgery and cardiovascular or metabolic status.²⁰ From the results of the present study, we can state that complications are minor and infrequent, and patients are able to return to normal daily activities within 3 to 4 days.²¹

Limitations of this research included a small number of participants TO PROVE, the absence of a control group, and. As a result, such a comparison should be encouraged as a possible future study.

Conclusion

After the procedure. Sports and heavy physical activities can be gradually resumed, LVL improved overweight by weight, BMI, and improve blood glucose level and plasma insulin level over 3 m to 6 m follow up period and LVL had positive correlation with average weight loss, and BMI.

It is critical to emphasize that liposuction should not be viewed as a quick fix for obesity and related problems but that it could be an advantageous adjunct to the interdisciplinary treatment of

metabolic illnesses. Most importantly, surgical fat reduction has no adverse effect on metabolic parameters fluctuation.

Conflict of interest: There is no conflict of interest.

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References

1. Powell-Wiley TM, Poirier P, Burke LE, et al: Obesity and cardiovascular disease: A scientific statement from the American Heart Association. *Circulation*. 2021; 143(21): 984-1010.
2. Ansari S, Haboubi H, Haboubi N: Adult obesity complications: challenges and clinical impact. *Ther Adv Endocrinol Metab*. 2020; 11: 204-10.
3. Obeagu EI, Rashid HK, Okafor CJ, et al: A Comparison of haematological parameters of obese individual and non-obese at omisanjana area of Ado Ekiti, Ekiti State, Nigeria. *Journal of Pharmaceutical Research International*. 2022; 34(4B): 32-6.
4. Han SJ, Boyko EJ: The evidence for an obesity paradox in type 2 diabetes mellitus. *Diabetes Metab J*. 2018; 42(3): 179-87.
5. Davidson KW, Barry MJ, Mangione CM, et al: Screening for prediabetes and type 2 diabetes: US preventive services task force recommendation statement. *Jama*. 2021; 326(8): 736-43.
6. Heller L, Menashe S, Plonski L, et al: 1470-nm Radial fiber-assisted liposuction for body contouring and facial fat grafting. *J Cosmet Dermatol*. 2022; 21(4): 1514-22.
7. Davis W, Lawrence N. Weight loss: How does it fit in with liposuction? *Dermatol Surg*. 2020; 46 Suppl 1: 22-8.
8. Cansanção A, Condé-Green A, David JA, et al: Clinical management and safety protocol. In: Cansanção A, Condé-Green A, editors. Gluteal fat augmentation: Best practices in Brazilian Butt Lift. Cham: *Springer International Publishing*. 2021: 57-63.
9. Cardenas-Camarena L: Commentary on: Safety of large volume liposuction in aesthetic surgery: A systematic review and meta-analysis. *Aesthetic Surgery Journal*. 2021; 41(9): 1054-6.
10. Wu S, Coombs DM, Gurunian R: Liposuction: Concepts, safety, and techniques in body-contouring surgery. *Cleve Clin J Med*. 2020; 87(6): 367-75.
11. Habib H, Abd Alazeem S, Abd Alazeem N: Fasting insulin level changes after large volume liposuction. *Egypt J Hosp Med*. 2018; 73(3):

6243-51.

12. Venkataram J, Mysore V: Liposuction-principles, techniques, outcomes. *Dermatological Reviews*. 2021; 2(4): 170-9.
13. Barazzoni R, Cappellari GG, Semolic A, et al: Central adiposity markers, plasma lipid profile and cardiometabolic risk prediction in overweight-obese individuals. *Clinical nutrition*. 2019; 38(3): 1171-9.
14. Hong YG, Kim HT, Seo SW, et al: Impact of large-volume liposuction on serum lipids in orientals: a pilot study. *Aesthetic Plast Surg*. 2006; 30(3): 327-32.
15. Geliebter A, Krawitz E, Ungredda T, et al: Physiological and psychological changes following liposuction of large volumes of fat in overweight and obese women. *J Diabetes Obes*. 2015; 2(4): 1-7.
16. Saleh Y, El-Oteify M, Abd-El-Salam AE, et al: Safety and benefits of large-volume liposuction: a single center experience. *Int Arch Med*. 2009; 2(1): 4-9.
17. González-Ortiz M, Robles-Cervantes JA, Cárdenas-Camarena L, et al: The effects of surgically removing subcutaneous fat on the metabolic profile and insulin sensitivity in obese women after large-volume liposuction treatment. *Horm Metab Res*. 2002; 34(8): 446-9.
18. Mohammed BS, Cohen S, Reeds D, et al: Long-term effects of large-volume liposuction on metabolic risk factors for coronary heart disease. *Obesity (Silver Spring)*. 2008; 16(12): 2648-51.
19. Ersek RA: Dissociative anesthesia for safety's sake: Ketamine and diazepam-a 35-year personal experience. *Plast Reconstr Surg*. 2004; 113(7): 1955-9.
20. Dandona P, Aljada A, Bandyopadhyay A: Inflammation: The link between insulin resistance, obesity and diabetes. *Trends Immunol*. 2004; 25(1): 4-7.
21. Narsete T, Narsete M, Buckspan R, et al: Large-volume liposuction and prevention of type 2 diabetes: A preliminary report. *Aesthetic Plast Surg*. 2012; 36(2): 438-42.