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# Association between liposuction and menstrual cycle changes: a retrospective study

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## Abstract

**Aim:** Menstrual irregularities are frequently reported by women following liposuction (L group), yet few studies have explored this phenomenon. This study aimed to investigate potential changes in the menses among women who underwent L group.

**Methods:** A total of 516 patients were included in this retrospective study: 369 underwent L group, and 147 underwent other types of plastic surgery (O group). A paired *t*-test was used to compare preoperative and postoperative menstrual cycles/periods within each group. A hypothesis test was used to compare the incidence of menstrual changes between the two groups. Logistic regression and contingency tests were used to identify potential explanatory variables within each group.

**Results:** In the L group, a statistically significant difference was observed in menstrual cycle length before and after surgery ($P$ = 0.02; 30.01 ± 2.54 days *vs.* 30.11 ± 3.04 days). The incidence of menstrual cycle changes was significantly higher in the L group compared to the O group ($P$ = 0.0002; 1.6% *vs.* 0.46%). Among variables such as aspirated fat volume, body weight, and anesthesia method, the L group site correlated most closely with menstrual changes ($P$ = 0.006). Postoperative menstrual changes were observed in all subjects who underwent L group on both upper arms, bilateral accessory breast tissue, both sides of the waist and abdomen, both upper arms and axillae, or the hip and both upper arms.

**Conclusion:** Compared with other plastic surgeries, L group has a greater impact on menstrual changes. The anatomical site of L group was identified as the most influential factor.

**Keywords:** Menstruation, liposuction, retrospective study

## INTRODUCTION

Lipofilling and lipoplasty have been the two most popular plastic surgeries in recent years, both involving L group. L group can be used not only to improve appearance and relieve obesity-related symptoms in overweight and obese patients, but also to address aesthetic concerns such as facial rejuvenation and/or the removal of localized excess fat. Given its widespread use, there is an urgent need to better understand the effects of L group on patients' overall health. L group is a surgical procedure that uses a specialized instrument to aspirate fat fragments in the subcutaneous fat layer through a small incision[1]. In a study analyzing a group of patients who underwent L group in Chicago, some female patients reported experiencing menstrual irregularities after the procedure[2], raising concerns about a potential link between L group and the early onset of menses. Further analysis showed that this early onset might be related to the volume of adipose tissue aspirated, the amount of anesthesia given, the area of L group, and the patient's body weight. However, the study's small sample size ($n$ = 17) limits the generalizability of the findings, and no additional articles have been published on the impact of L group on menses in other populations.

In the present study, we hypothesized and then proved that L group may affect menstruation in a Chinese population. To ensure accuracy, we excluded patients with postmenopausal or preoperative menstrual irregularities, resulting in a final cohort of 516 female patients. Because surgical stress may also affect menstruation, we compared patients who underwent L group to those who underwent other surgeries to determine whether the observed effects were specific to L group or related to surgical stress in general. We then sought to identify the factors contributing to post-L group menstrual irregularities. A clearer understanding of the impact of L group on menses may help predict the risk of menstrual irregularity after L group and identify individuals at higher risk. This information could benefit both patients and clinicians: patients may experience less psychological distress if they are aware of the potential relationship between L group and menstrual irregularities, and clinicians may implement preventive strategies to mitigate the severity of these irregularities. Furthermore, these findings may offer new insights into the broader causes of menstrual irregularity.

## METHODS

### Study population and design

This single-center retrospective study was conducted at Shanghai Ninth People's Hospital, affiliated with Shanghai Jiao Tong University School of Medicine. The study protocol was approved by the Ethics Committee of Shanghai's ninth hospital, which waived written informed consent because of the retrospective nature of the study (Protocol ID: SH9H-2019-T221-2, Clinical trial.gov ID: NCT04985591). A total of 516 patients who underwent surgery between January 2015 and April 2021 were included and followed in this study. Among them, 369 underwent (L group), while 147 underwent other forms of plastic surgery (O group), such as blepharoplasty or keloid excision. The difference in group sizes was mainly due to the higher cooperation level of the L group patients. Patients were excluded from the study if they were under 18 or over 55 years old, in the perimenopausal or postmenopausal stage, or had a history of menstrual irregularity before plastic surgery. Menstrual irregularity before plastic surgery was self-reported by patients. Before inclusion, the patients were asked whether their menstruation was regular. Responses of "irregular" or "not that regular" were classified as menstrual irregularity. All patients received one of the following

types of anesthesia: (1) local anesthesia alone (i.e., lidocaine in the tumescent solution); (2) a combination of local and intravenous anesthesia; or (3) a combination of local and general anesthesia. For intravenous anesthesia, ketamine was administrated at an induction dose of 1-2 mg/kg intravenously, followed by a maintenance infusion of 2-5 mg/kg/h. In the L group, a small, inconspicuous incision was made to aspirate fat out of the body. In the O group, procedures such as blepharoplasty or keloid excision were performed. The primary endpoint of the present study was to assess any changes in menses during the three months after the intervention (L group or other surgical procedures). Given the retrospective design of the study, there was a risk of recall bias.

### Data collection and follow-up

Demographic, procedural, and childbearing status data were collected from hospital charts or databases. During the initial clinical consultation, each patient's menstrual history, including cycle length and duration of menstrual bleeding, was routinely recorded in their medical documentation. Follow-up visits were conducted 3 months post-surgery, during which menstrual status was reassessed and documented. To further validate and confirm the data, a follow-up telephone survey (follow-up rate: 100%) was conducted between July 28, 2020, and June 11, 2021, resulting in 516 valid responses. Among them, 9 responses were from patients who underwent surgery in 2021, 162 in 2020, 239 in 2019, 44 in 2018, 54 in 2017, and 8 in 2016 or 2015. Patients were asked four questions: (1) What were the exact durations of their pre- or postoperative menstrual cycle? (2) Did they experience any menstrual irregularities within the 3 months after the intervention? (3) Was there a change in menstrual volume? (4) Was there an early/delayed onset of menses? Responses were recorded in terms of days or as yes/no answers. Menstrual irregularity was considered present if any question received a "yes" response or if there was a significant difference between the preoperative and postoperative menstrual cycle length or period duration. Although recall bias may be a potential limitation, the use of both in-person and telephone follow-up was intended to minimize its impact.

### Statistical analysis

We evaluated changes in menses using patient-reported data on alterations in menstrual cycle length, duration of menstruation, menstrual irregularity, menstrual volume, and early/delayed onset of menses after surgery. Patients in the two groups were matched based on their preoperative and postoperative menstrual cycles/periods. We then compared the proportion of patients reporting menstrual changes between the L group and the other plastic surgery group. Continuous variables are expressed as mean ± standard deviation.

Comparisons of clinical characteristics between the preoperative and postoperative menstrual cycles/periods were performed using paired-sample *t*-tests for continuous variables. The hypothesis test for two proportions was used to compare the incidence of menstrual changes between the L group and the other plastic surgery group. Logistic regression and contingency tests were used to assess associations between menstrual changes and factors such as aspirated adipose tissue volume, body weight, anesthesia method, and L group area.

A $P$ value $< 0.05$ was considered statistically significant. All statistical analyses were performed using JMP Pro 16 (SAS Institute Inc., Cary, NC, 1989-2021).

## RESULTS

To evaluate our hypothesis of a putative link between L group and menstrual changes, we analyzed data from 516 patients who underwent surgery between January 2015 and April 2021. Of these, 369 patients

**Table 1. Pre- and postoperative comparison by age, menstrual cycle and menstrual period**

| | Pre-operation | | | Post-operation | | |
|---|---|---|---|---|---|---|
| **Variables** | Liposuction | Other plastic surgery | *P* value | Liposuction | Other plastic surgery | *P* value |
| **Ages (years)** | 32.22 ± 7.94 | 32.75 ± 7.5 | *P* = 0.233 | 32.22 ± 7.94 | 32.75 ± 7.5 | *P* = 0.233 |
| **Menstrual cycle (days)** | 30.01 ± 2.54 | 30.02 ± 1.51 | *P* = 0.27 | 30.11 ± 3.04 | 29.98 ± 1.51 | *P* = 0.95 |
| **Menstrual period (days)** | 5.51 ± 3.14 | 5.09 ± 1.44 | *P* = 0.58 | 5.16 ± 1.38 | 5.11 ± 1.5 | *P* = 0.58 |

Data are shown as the mean ± standard deviation.

**Table 2. Pre- and postoperative comparison by menstrual cycle/period**

| | Menstrual cycle (days) | | | Menstrual period (days) | | |
|---|---|---|---|---|---|---|
| **Variables** | Pre-operation menstrual cycle | Post-operation menstrual cycle | *P* value | Pre-operation menstrual period | Post-operation menstrual period | *P* value |
| **Liposuction** | 30.01 ± 2.54 | 30.11 ± 3.04 | *P* = 0.02 | 5.15 ± 3.14 | 5.16 ± 1.38 | *P* = 0.25 |
| **Other plastic surgery** | 30.02 ± 1.51 | 29.98 ± 1.51 | *P* = 0.09 | 5.09 ± 1.44 | 5.11 ± 1.5 | *P* = 0.31 |

Data are shown as the mean ± standard deviation.

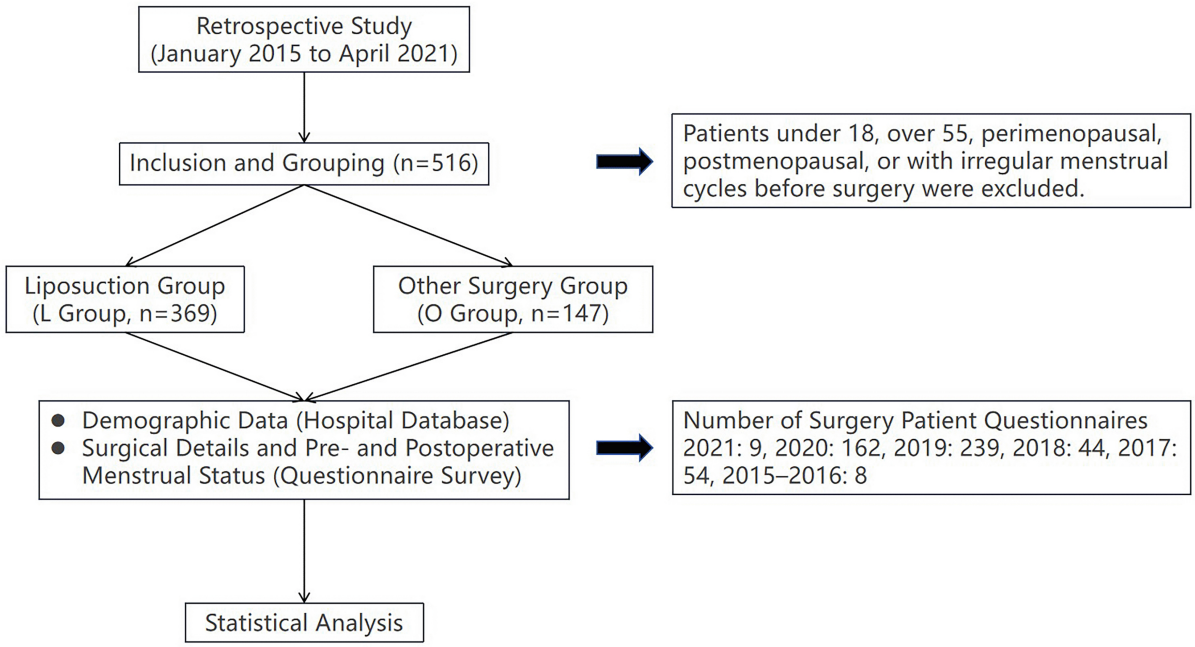


**Figure 1.** Flow diagram of the study.

(71.5%) underwent L group, while 147 patients (28.5%) underwent other types of plastic surgery (O group) [Figure 1]. The mean age of the patients was 36.97 ± 6.31 years, the average menstrual cycle length was 30.04 ± 2.5 days, and the average duration of menstruation was 5.14 ± 1.39 days. Similar trends were observed between the L and O groups in terms of age, menstrual cycle length, and duration. Baseline demographic and clinical variables were well balanced between the two groups [Table 1].

As shown in Table 2, a significant difference was observed in the L group between the preoperative and postoperative menstrual cycle lengths. Further analysis revealed that the postoperative menstrual cycle was significantly longer than the preoperative cycle ($P$ = 0.02). Among patients who experienced a prolonged postoperative menstrual cycle, the mean age was 35.8 ± 4.26 years, the average liposuction volume was 1,550 ± 1,133 mL, and the most commonly treated area was both upper arms. However, there was no difference in the length of the menstrual period before and after surgery in the L group.

A hypothesis test for two proportions was performed to compare the rates of menstrual changes between the two groups. In the L group, 62 out of 369 patients reported changes in menses, compared to 7 out of 147 patients in the O group. The incidence rates of menstrual changes were 1.6% in the L group and 0.46% in the O group, with a statistically significant difference ($P$ = 0.0002) [Figure 2].

Potential factors contributing to menstrual changes were assessed using logistic regression. Neither the volume of aspirated adipose tissue [Figure 3A] nor body weight [Figure 3B] was associated with menstrual irregularities ($P$ = 0.3663 and $P$ = 0.4, respectively).

The anatomical site of L group [Figure 4] had a significant impact on menstrual changes ($P$ = 0.006). All subjects who underwent L group involving both upper arms, bilateral accessory breast tissue, both sides of the waist and abdomen, both upper arms and axillae, the hip and both upper arms, left waist, or other areas experienced postoperative menstrual changes. In contrast, the anesthesia method [Figure 5] did not significantly affect menstrual patterns ($P$ = 0.53), as determined by contingency analysis.

## DISCUSSION

The present study yields three main findings. First, among the Chinese population studied, the post-L group menstrual cycle was significantly longer than the preoperative cycle, although the duration of the menstrual period remained unchanged. Second, there was a significant difference in the rate of menstrual changes between the L group and the O group, with a notably higher incidence observed in the L group. This difference had not been reported in previous studies involving Chicago populations[2], suggesting that L group may affect menstrual patterns differently across populations. Third, we explored factors related to L group that might contribute to menstrual changes. The specific anatomical area targeted by L group emerged as the most closely correlated factor. In contrast, the total volume of fat removed, patient body weight, and the anesthesia method used showed no statistically significant association with menstrual changes.

Menstruation is regulated by multiple interrelated factors, including endocrine balance, organic lesions, general physical health status, and psychological or environmental stressors. While our findings confirm an association between L group and menstrual changes, further exploration is needed to determine the clinical relevance and underlying mechanisms of this relationship. Previous literature has identified that endocrine disruptions - such as hypogonadotropic hypogonadism, various endocrinopathies, and polycystic ovary syndrome (PCOS) - can disrupt menstrual cycles[3-7]. Our study adds a novel insight by suggesting that targeted removal of adipose tissue through L group may also influence menstrual regulation. Clinically, understanding the potential hormonal implications of L group is vital for effective patient counseling and postoperative management. Adipose tissue plays a key role in estrogen metabolism, particularly in the conversion of testosterone to estrone. Thus, a substantial reduction in adipose tissue may alter estrogen levels, indirectly affecting the hypothalamic-pituitary-ovarian (HPO) axis and, consequently, menstrual cycles[8-10]. These findings underscore the importance of counseling patients about the potential impact of L group on menstruation, particularly when the procedure targets hormonally active regions such as the

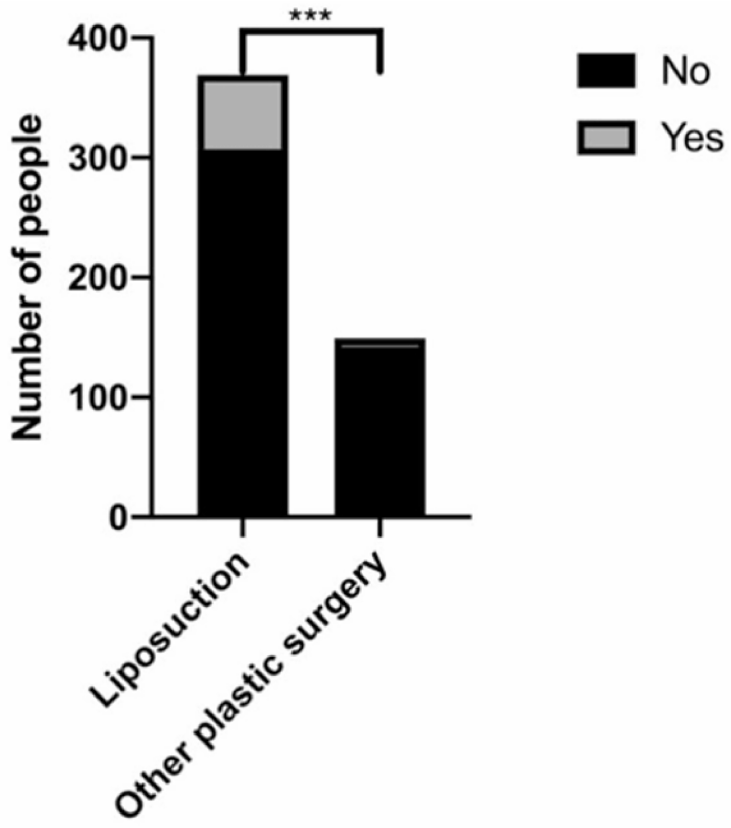


**Figure 2.** Comparison of menstrual change rates between the L and O groups.

waist, abdomen, and upper arms. Additionally, leptin - an adipokine produced by adipose tissue - plays a regulatory role in gonadotropin secretion. A marked postoperative decrease in leptin levels may partly explain the observed menstrual disturbances[11,12]. Similarly, reductions in insulin levels, which are often proportional to the volume of fat aspirated, might indirectly impair ovarian function and contribute to menstrual alterations[13]. Furthermore, the surgical stress itself can inhibit gonadotropin secretion by stimulating adrenocorticotropic hormone release[14]. In summary, these findings emphasize that clinicians should carefully monitor menstrual status postoperatively, considering both hormonal and stress-mediated pathways that may be influenced by L group.

In recent years, considerable attention has been given to the impact of L group on metabolism and endocrine function. A meta-analysis of 24 studies found that, beyond weight loss, serum levels of leptin, triglycerides, glucose, and insulin significantly decreased after L group[15]. As mentioned earlier, these changes could potentially affect menstrual cycles[16], yet relevant research has been lacking. To address this gap, our study included a larger sample size and conducted comprehensive follow-ups. Given that surgical stress responses may contribute to menstrual changes, we included a control group of patients who had undergone other cosmetic surgeries to help control for confounding factors. The results indicate that L

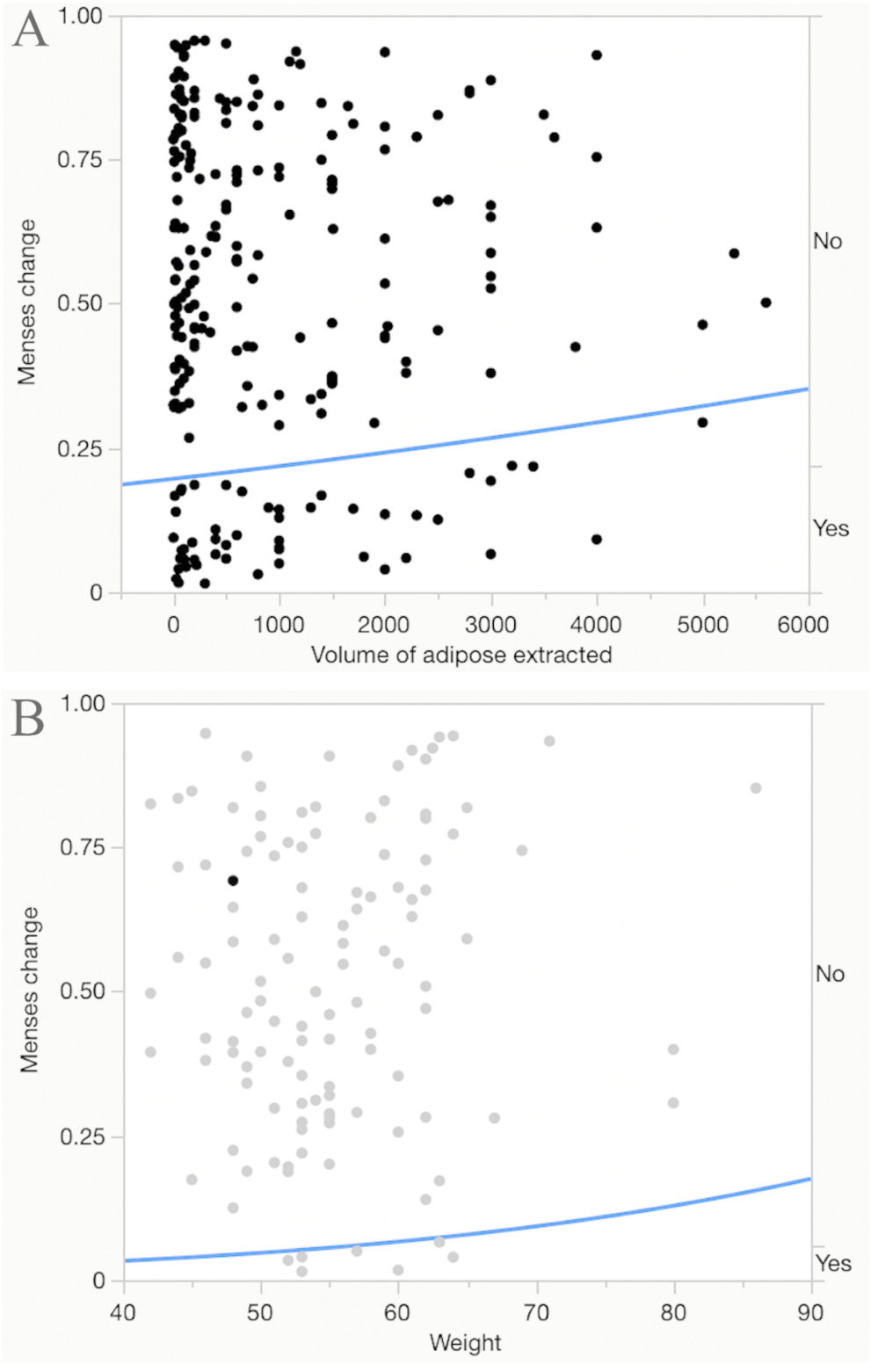


**Figure 3.** Analysis of factors potentially contributing to menstrual changes. (A) Logistic regression analysis of aspirated adipose tissue volume, showing no significant correlation with menstrual irregularities ($P = 0.3663$); (B) Logistic regression analysis of body weight, showing no significant correlation with menstrual irregularities ($P = 0.4$).

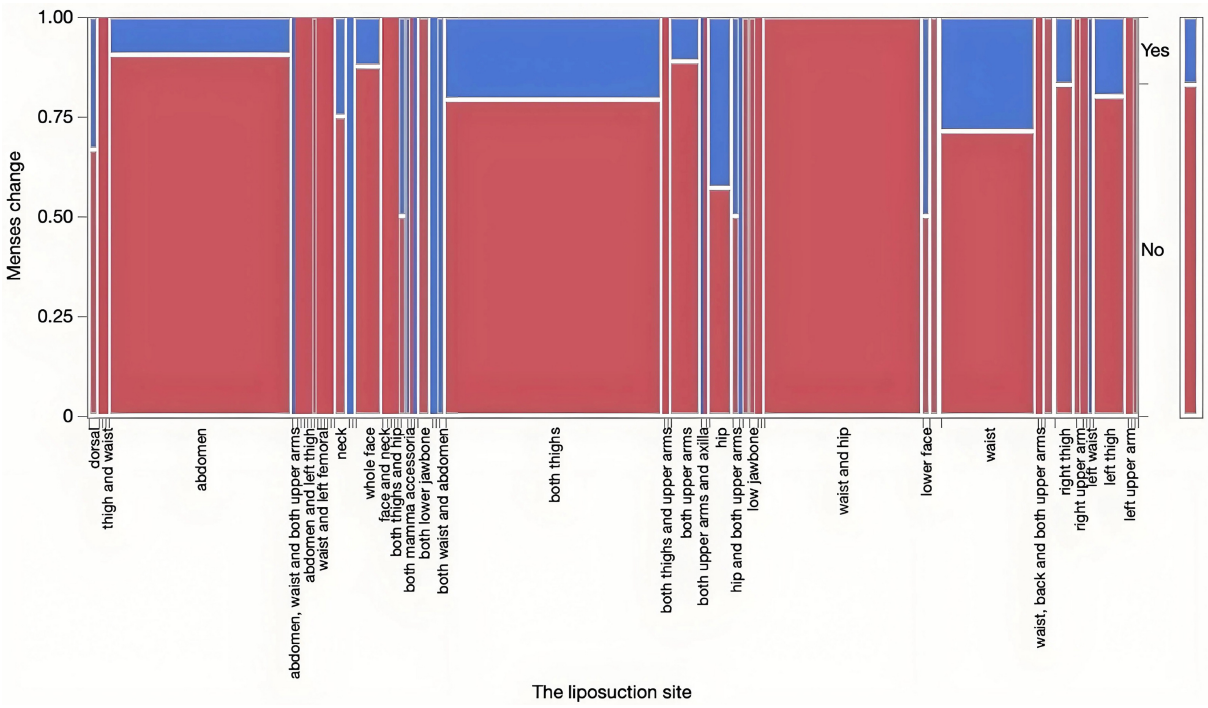


**Figure 4.** Impact of liposuction target area on menstrual changes.

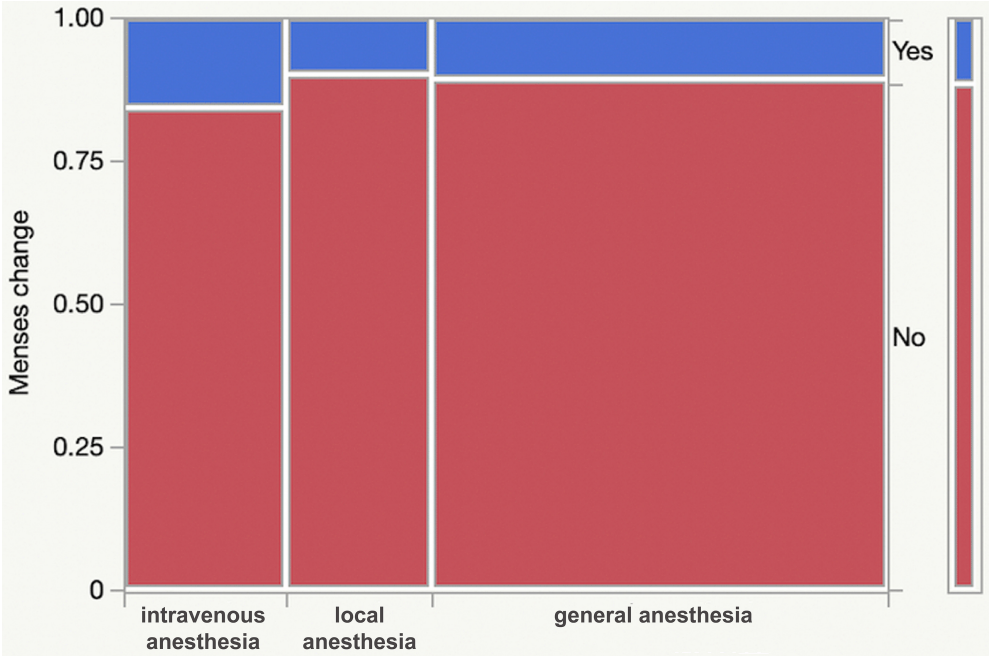


**Figure 5.** Impact of anesthesia method on menstrual changes.

group is associated with menstrual cycle alterations, and that the surgical site may play a role in these changes - consistent with observations from a smaller study conducted in 2004[2]. However, we did not observe a correlation between the volume of fat removed and menstrual changes. This may be due to nonlinear regulatory mechanisms and threshold effects within the endocrine system[17]. For patient safety,

the amount of fat removed is typically below the threshold, which may explain the absence of a significant linear relationship within the range observed in this study.

This study has several limitations. First, as a retrospective analysis, it is subject to potential recall bias. Second, the study population consisted solely of Chinese patients from a single hospital, limiting the generalizability of the findings. Future studies should include more diverse populations across multiple plastic surgery centers. Despite these limitations, this is the first large-scale study to suggest a possible association between L group and menstrual changes - an association that is biologically plausible and warrants further investigation.

This study demonstrates that L group can significantly impact the menstrual cycles of female patients, with effects more pronounced than those observed after other cosmetic procedures. The anatomical site of L group emerged as a key factor, with areas such as the upper arms, waist, and abdomen being more strongly associated with menstrual irregularities. These results highlight the importance of thorough preoperative counseling regarding potential menstrual changes for women considering L group and provide a strong foundation for future research.

## DECLARATIONS

### Authors' contributions

Wrote the first draft of the manuscript: Xie F
Initiated and designed the study and protocol: Xie Y, Zhang Y
Contributed to the data collection: Liu Y, Wang H

### Availability of data and materials

All data relevant to the study are included in the article or uploaded as Supplementary Materials.

### Financial support and sponsorship

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### Conflicts of interest

All authors declared that there are no conflicts of interest.

### Ethical approval and consent to participate

This study was a single-center retrospective analysis conducted at Shanghai Ninth People's Hospital, affiliated with Shanghai Jiao Tong University School of Medicine. The study protocol was reviewed and approved by the Ethics Committee of Shanghai Ninth People's Hospital, which waived the requirement for written informed consent due to the retrospective nature of the study (Protocol ID: SH9H-2019-T221-2, ClinicalTrials.gov ID: NCT04985591).

### Consent for publication

Not applicable.

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