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ARAŞTIRMA MAKALESİ / RESEARCH ARTICLE

Evaluation of the Differences in the Body Composition of Childbearing and Non-Childbearing Women

Çocuk Doğuran ve Doğurmayan Kadınların Beden Yapısındaki Farklılıkların Değerlendirilmesi

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Abstract

The aim of this study was to evaluate the differences in body composition between parous and nulliparous women and to investigate whether giving birth influences body structure. This descriptive cross-sectional and prospective study included 806 women aged 25-50 who attended a health club between 2006 and 2016. While 375 of the participants had children, 431 did not. Personal information such as age, parity, exercise and health history were collected. All anthropometric measurements including height, subcutaneous fat thickness and circumference were performed according to the Heat & Carter Anthropometric Reference Manual. Body composition (% fat, fat weight (kg), lean body weight (kg) was measured using a Tanita MC-980A brand bioelectrical impedance device. Body mass index (weight/(height)^2), sum of trunk skinfold thickness taken from four regions (chest (mm), subscapula(mm), suprailiac (mm), abdomen (mm)), sum of extremity skinfold thickness taken from four regions (biceps (mm), triceps (mm), thigh (mm), calf (mm)), waist circumference (cm) and waist-hip ratio (waist circumference / hip circumference) were calculated. Statistical analyzes were performed using IBM SPSS Statistics 24. Independent Samples T-test was used to compare body composition components of parous and nulliparous women. Relationships between variables were evaluated using Pearson correlation analysis. Differences between parous and nulliparous women in terms of % fat, fat weight, total trunk skinfold, total extremity skinfold, BMI, waist circumference and waist-hip ratio were assessed using basic linear regression analysis. Significant differences were found between women who have given birth and those who have not in terms of age, weight, % fat, fat weight, BMI, waist circumference, waist-hip ratio, sum of trunk skinfolds, and sum of extremity skinfolds ($p<0.05$). In the regression model, childbirth had a weak yet significant positive effect on % fat ($R^2=0.38$), fat weight ($R^2=0.31$), and BMI ($R^2=0.23$) ($p<0.05$). The study concludes that childbirth significantly affects women's body composition compared to women who have not given birth.

Keywords: Childbirth, Body composition, BMI, Waist circumferences, Sum of trunk skinfolds.

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Öz

Bu çalışmanın amacı doğum yapmış ve hiç doğum yapmamış kadınlar arasında beden kompozisyonlarındaki farklılıkları değerlendirmek ve doğum yapmanın beden yapısı üzerinde bir etkisi olup olmadığını araştırmaktır. Tanımlayıcı, kesitsel ve prospektif olan bu çalışmaya 2006-2016 yılları arasında sağlık kulübüne giden 25-50 yaş aralığındaki 806 kadın dahil edildi. Katılımcıların 375'inin çocuğu varken, 431'inin çocuğu yoktu. Yaş, doğum sayısı, egzersiz ve sağlık geçmişi gibi kişisel bilgiler toplandı. Boy, beden ağırlığı, deri kıvrım kalınlıkları (biceps, triceps, göğüs, subscapula, suprailiac, abdomen, thigh, and calf) ve çevre ölçümü (bel çevresi, kalça çevresi) dahil tüm antropometrik ölçümler Heat & Carter Antropometrik Referans Kılavuzu'na göre yapıldı. Beden kompozisyonu (% yağ, yağ ağırlığı, yağsız beden ağırlığı) Tanita MC-980A marka biyoelektrik empedans cihazı kullanılarak ölçüldü. Vücut kütle indeksi(ağırlık/(boy)^2), dört bölgeden alınan gövde deri kıvrım kalınlıkları toplamları (göğüs(mm), subskapula(mm), suprailiak(mm), abdomen(mm) ve dört bölgeden alınan ekstremite deri kıvrım toplamları (biseps(mm), triseps(mm), uyluk(mm), kalf(mm), bel çevresi(cm) ve bel-kalça oranı (bel çevresi /kalça çevresi) hesaplanmıştır. İstatistiksel analizler IBM SPSS Statistics 24 kullanılarak yapıldı. Doğum yapmış ve hiç doğum yapmamış kadınların beden kompozisyon bileşenlerini karşılaştırmak için Bağımsız Örneklemler T-testi kullanıldı. Değişkenler arasındaki ilişkiler Pearson korelasyon analizi kullanılarak değerlendirildi. Doğum yapmış ve yapmamış kadınlar arasındaki % yağ, yağ ağırlığı, gövde deri kıvrımı ve ekstremite deri kıvrımı toplamları, vücut kütle indeksi, bel çevresi ve bel-kalça oranı arasındaki farklar temel doğrusal regresyon analizi kullanılarak değerlendirildi. Doğum yapmış ve yapmamış kadınlar arasında yaş, kilo, % yağ, yağ ağırlığı, VKİ, bel çevresi, bel-kalça oranı, gövde deri kıvrımı toplamı ve ekstremite deri kıvrımı toplamı açısından anlamlı farklar bulundu ($p<0,05$). Regresyon modelinde doğumun % yağ ($R^2=0,38$), yağ ağırlığı ($R^2=0,31$) ve VKİ ($R^2=0,23$) üzerinde zayıf ancak anlamlı pozitif etkisi vardı ($p<0,05$). Çalışmada, doğum yapan kadınların beden kompozisyonunun, doğum yapmayan kadınlara göre önemli ölçüde etkilendiği sonucuna varıldı.

Anahtar kelimeler: Doğum, Beden kompozisyonu, Vücut kütle indeksi, Bel çevresi, Gövde deri kıvrımı toplamı.

INTRODUCTION

Pregnancy and childbirth are natural physiological processes that lead to significant biological and structural changes in women's bodies. These changes include hormonal fluctuations, weight gain, and changes in musculoskeletal and body composition parameters (WHO, 2020). Compared to nulliparous women, postpartum women often exhibit significant differences in body composition that can persist in the long term and negatively impact overall health, especially in terms of weight management and fat distribution (Rasmussen et al., 2010; Zhan et al., 2024). Weight gain during pregnancy is a well-documented phenomenon, and some of this weight often remains in the postpartum period (Dalfra et al., 2022). Studies consistently show that postpartum women tend to have a higher body mass index (BMI) and increased fat mass compared to nulliparous women (Ochsenbein-Kölble et al., 2007; Bobrow et al., 2013).

Furthermore, childbirth has been associated with long-term changes in body composition, including increased subcutaneous and abdominal fat accumulation (Linné et al., 2002; Gunderson et al., 2008; Subhan et al., 2019). In particular, these changes generally contribute to increased waist circumference and waist-to-hip ratio in the postpartum period (Gunderson, 2009).

The physiological changes accompanying pregnancy (e.g., increased estrogen, progesterone, and oxytocin levels) and increased energy demands and psychosocial stressors contribute to changes in the musculoskeletal system (Artal and O'Toole, 2003).

In the postpartum period, additional factors such as childcare demands and time constraints may reduce opportunities for physical activity, complicate postpartum weight regulation, and increase the long-term risk of obesity (Mottola, 2009; Temme, 2015).

On the other hand, regular physical activity has been shown to positively affect body composition in the postpartum period. Exercise supports weight control, maintains musculoskeletal health, and increases overall energy levels (Evenson et al., 2014). It also plays an important role in managing psychosocial difficulties that may arise after birth, such as stress, anxiety, and depression (Aune et al., 2017).

Women who engage in regular physical activity after birth are more likely to experience positive changes in body composition, such as reduced fat mass and improved overall health (Evenson and Wen, 2011).

Although there are studies in the literature on changes in body composition before, during, and after birth, there are no studies comparing the physical characteristics of physically active women who have given birth with those who have never been pregnant and have never given birth. In particular, studies with large sample sizes that evaluate variables such as trunk and extremity subcutaneous fat thickness, fat percentage, BMI, and waist circumference over a long period are rare. Therefore, the aim of this study is to investigate whether childbearing has an effect on body structure components by examining the differences in body composition and physical characteristics between women who have given birth and those who have not. In this context, this study aims to answer the question of whether there are differences between the body structures of physically active women who have given birth and those who have not.

The study used data collected from women who were physically active in a health and fitness club in Istanbul between 2006 – 2016. In particular, the focus was on evaluating the effects of childbirth on these parameters by considering parameters such as the total of trunk and extremity subcutaneous fat thickness, fat percentage, fat mass, BMI, waist circumference, and waist-hip ratio. The research hypotheses in the study;

1. H1: There are significant differences between the body components of women who have given birth and those who have not. Having given birth has an effect on body structure.
2. H0: There are no significant differences between the body components of women who have given birth and those who have not. Having given birth has no effect on body structure.

The originality of this study lies in its systematic evaluation of the impact of childbirth on women's body composition using a long-term dataset (2006–2016), and its approach that incorporates both cross-sectional and prospective dimensions. In the context of Turkey, the scarcity of studies with similar scope—comparing anthropometric differences between women who have and have not given birth across a wide age range (25–50 years) and within a relatively large sample (n=806)—underscores the study's significant contribution to the scientific literature. Moreover, the application of detailed anthropometric measurements such as trunk and limb skinfold thicknesses based on the Heath & Carter methodology enhances measurement validity and supports the reliability of the results. The study's use of regression models to assess not only statistical differences but also potential causal relationships further highlights its methodological rigor and unique scientific contribution.

METHOD

Participants

This retrospective study included data from a total of 806 women who attended a health and fitness club in Istanbul, Turkey, between 2006 and 2016. Of the total participants, 375 women had given birth (mean age = 37.34 ± 6.61 years), and 431 women had not given birth (mean age = 35.19 ± 5.79 years). Women with children accounted for 46.5% of the sample, while women without children constituted 53.5%.

The sample size was determined through a power analysis (Shieh, 2020) using the G*Power software. Based on an expected medium effect size (d = 0.5), an alpha level of 0.05, a power (1-β) of 0.80, and an equal group ratio (1:1), the required minimum sample size was calculated to be 51 participants per group, totaling 102 participants. Thus, the inclusion of 806 women substantially enhances the statistical power and reliability of the findings.

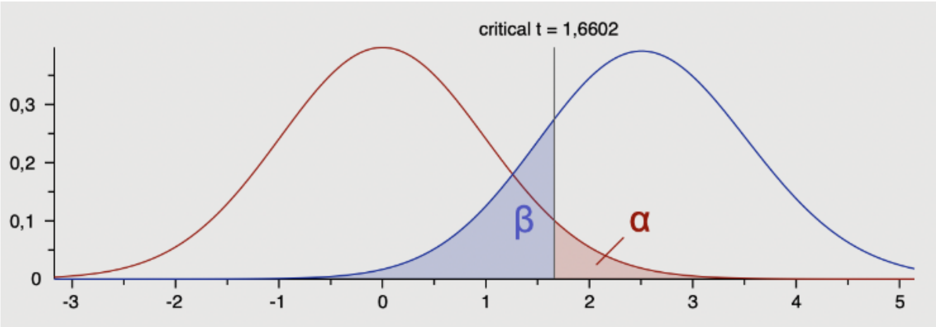

Figure 1. G Power Analysis

The study received approval from the Haliç University Non-Interventional Research Ethics Committee (Ethics Report No: 146). Voluntary informed consent was obtained from all participants before data collection. To ensure consistency, the same researcher between 2006 and 2016 conducted all data collection, and the copyright of the data belongs to the researcher.

Inclusion and Exclusion Criteria

The study included healthy women who exercised 1-4 days a week for health purposes, aged between 25 and 50, had at least 1 child and at most 3 children, and had given birth and those who had not given birth with the same characteristics. Participants were assessed between 1 to 7 years postpartum. Exclusion criteria included acute diseases and chronic conditions that could significantly affect body components (e.g., severe liver, heart or kidney dysfunction and cancer).

Data Collection Tools

Demographic and health-related data including age, education level, family history, parental status, sports participation, and general health status were collected using an SQL-based software developed and copyrighted by the researcher.

Anthropometric measurements followed the standardized procedures outlined in the *Heat & Carter Anthropometric Reference Manual* (Carter, 2002). Measurements included body weight, height, subcutaneous fat thickness (mm) (biceps, triceps, subscapula, suprailiac, abdomen, thigh, and calf), waist circumference (cm), and hip circumference (cm). BMI was calculated as weight (kg) divided by height squared (m^2) and interpreted according to WHO guidelines (2020): underweight (<18.5), normal (18.5–24.9), overweight (25.0–29.9), and obese (≥30.0). Waist circumference ≥88 cm and waist-to-hip ratio (WHR) ≥0.85 were used as indicators of abdominal obesity in women (Ross et al., 2020). Sum of four trunk skinfolds thickness taken from (chest, subscapula, suprailiac, abdomen), sum of four extremity skinfolds thickness taken from (biceps, triceps, thigh, calf) were calculated separately.

Procedures

Body composition was assessed using the Tanita MC-980A multi-frequency bioelectrical impedance analysis (BIA) device (Tanita Corp., Tokyo, Japan) with a tetrapolar electrode configuration. Participants were advised to refrain from vigorous physical activity for at least four hours before the measurement. All assessments were conducted barefoot and in light clothing. The BIA device estimated body fat percentage, fat mass (kg), lean body mass (kg), total body water (kg), and both intracellular and extracellular fluid levels, adjusted for age and sex (Vasold et al., 2019). All measurements were performed by the same trained researcher to ensure procedural consistency across the entire 10-year data collection period.

Analysis of Data

IBM SPSS (Statistical Package for the Social Sciences) version 24.0 was used for data analysis. Skewness and kurtosis values were examined to assess the normality distribution. Due to the normal distribution of the data, an Independent Samples T-test was used to compare the body compositions of childbearing women and non childbearing women. The relationships between variables were evaluated using Pearson correlation analysis. Differences between women who have given birth and those who have not in terms of % fat, fat weight, sum of trunk skinfolds, sum of extremity skinfolds, BMI, waist circumference, and waist-hip ratio were evaluated using basic linear regression analysis. All data were evaluated at a confidence interval of $p<0.05$. The confidence interval of $p <0.05$ was considered significant.

FINDINGS

Table 1. Descriptive Characteristics of the Childbearing and Non-Childbearing Participants

		n	X	SD	Min.	Maks.
Age (years)	**Childbearing**	375	37.34	6.61	25	50
	Non-Childbearing	431	35.10	5.79	25	50
Body Weight (kg)	**Childbearing**	375	61.45	9.28	43.30	106.30
	Non-Childbearing	431	59.10	7.34	44.40	95
Height (cm)	**Childbearing**	375	164.29	5.60	150	180
	Non-Childbearing	431	164.47	5.91	148	183

Descriptive information on the age, weight, and height of childbearing and non childbearing participants is presented in Table 1.

Table 2. Weight, BMI and body composition t-test results of childbearing and non-childbearing women

		n	X	S	t	p
Body Weight(kg)	Childbearing	375	61,4581	9,28212		**,000**
	Non Childbearing	431	59,1090	7,34826	4,006	**,000**
BMI(kg/m2)	Childbearing	375	22,8029	3,41102		**,000**
	Non Childbearing	431	21,8350	2,44983	4,668	**,000**
%Fat	Childbearing	375	31,9789	5,34518		**,000**
	Non Childbearing	431	29,6942	5,00146	6,265	**,000**
Fat Mass(kg)	Childbearing	375	20,078	6,2645		**,000**
	Non Childbearing	431	17,805	4,8628	5,791	**,000**
Lean Body Mass(kg)	Childbearing	375	41,4283	3,69704		,399
	Non Childbearing	431	41,2114	3,58547	,844	,400

*p<0.05, **p<0.01, ***p<0.001

In the study, childbearing women and non-childbearing women compared in terms of weight, BMI, % fat, fat mass, lean body mass and total body water. According to the Independent Sample T-Test results, the weight, BMI, % fat and fat mass scores of childbearing women significantly higher than non childbearing women (p <0.05) (Table 2).

Table 3. Waist circumferences, waist to hip ratio, sum of trunk and sum of extremities skinfolds t-test results of childbearing and non-childbearing women

		n	X	S	t	p
Waist Circumferences (cm)	Childbearing	375	72,76	7,60		
	Non Childbearing	431	69,99	5,89	5,825	**,000**
Hip Circumferences (cm)	Childbearing	375	97,90	7.60		
	Non Childbearing	431	96.61	5.56	2.990	**,003**
Waist to Hip Ratio	Childbearing	375	,74	,049		
	Non Childbearing	431	,72	,040	5,824	**,000**

*p<0.05, **p<0.01, ***p<0.001

According to Independent Sample T-Test results; waist circumferences, waist to hip ratio, sum of trunk skinfolds and sum of extremity skinfolds scores of childbearing women were higher than those of non-childbearing women ($p < 0.05$) (Table 3).

Table 4. T-test results of childbearing and non-childbearing women for skinfold thickness

		n	X	S	t	p
Triceps Skinfold (mm)	Childbearing	375	20,302	6,5119	4,292	**,000**
	Non Childbearing	431	18,422	5,9205		
Subscapula Skinfold (mm)	Childbearing	375	19,478	8,7404	4,674	**,000**
	Non Childbearing	431	16,880	7,0297		
Biceps Skinfold (mm)	Childbearing	375	9,943	4,3876	4,504	**,000**
	Non Childbearing	431	8,671	2563,6		
Chest Skinfold (mm)	Childbearing	375	15,7552	7,44798	5,062	**,000**
	Non Childbearing	431	13,2898	6,37929		
Suprailiac Skinfold (mm)	Childbearing	375	13,529	7,3938	1,958	,051
	Non Childbearing	431	12,619	5,7942		
Abdominal Skinfold (mm)	Childbearing	375	25,5704	9,90422	2,362	**,018**
	Non Childbearing	431	24,0397	8,49061		
Thigh Skinfold (mm)	Childbearing	375	32,8333	8,82704	2,673	**,008**
	Non Childbearing	431	31,2030	8,46967		
Calf Skinfold (mm)	Childbearing	375	19,975	7,8307	2,399	**,017**
	Non Childbearing	431	18,740	6,7852		
Sum of Trunk Skinfolds (mm)	Childbearing	375	74,33	31,07	3,782	**,000**
	Non Childbearing	431	66,83	25,24		
Sum of Extremity Skinfolds (mm)	Childbearing	375	83,05	24,36	3,719	**,000**
	Non Childbearing	431	77,04	21,57		

*p<0.05, **p<0.01, ***p<0.001 Sum of trunk skinfolds (mm) = (chest+ subscapula+ suprailiac+ abdomen);
Sum of extremity skinfolds (mm) = (biceps+triceps + thigh + calf)

According to Independent Sample T-Test results; triceps skinfold, subscapula skinfold, chest skinfold, abdominal skinfold, thigh skinfold and calf skinfold scores of childbearing women were higher than non-childbearing women ($p < 0.05$) (Table 4).

Regression analysis was performed to evaluate the effects of childbearing on body composition. In the regression model, it was observed that childbearing had a positive and weakly significant effect on %fat (R^2=0.038), fat weight (R^2=0.031), BMI (R^2=0.023;) ($p<0.05$).

DISCUSSION

This study aimed to examine the effects of childbearing on women's body composition and body structure, specifically among women who engage in regular physical activity. The findings revealed significant differences between women who had given birth and those who had not, indicating that childbearing is associated with long-term changes in body composition—even in physically active populations.

One of the key findings was that women who had given birth exhibited significantly higher values in several anthropometric and body composition parameters, including weight, body mass index (BMI), waist circumference, hip circumference, waist-to-hip ratio, percentage of body fat (% fat), and fat weight. Additionally, the sum of trunk and extremity skinfolds, as well as individual measurements such as triceps, subscapular, biceps, chest, abdominal, thigh, and calf skinfolds, were all higher among the childbearing group. These results suggest a strong positive association between childbearing and body composition indicators, despite the participants' engagement in regular exercise.

Notably, the average age difference between the two groups was approximately 2.5 years, with women in the childbearing group being older. Age is an important factor influencing body weight and fat accumulation, and this age difference may have contributed to the observed outcomes. As supported in the literature, advancing age—particularly beyond 25 years—is a known risk factor for weight gain and increased adiposity (Frick, 2021). Therefore, it is important to interpret the results within the context of both childbearing status and age-related physiological changes.

Although previous studies in the literature have examined the effects of childbirth on lean body mass (Lovelady et al., 2009), these investigations have predominantly focused on short-term outcomes. In contrast, our study evaluated the long-term effects and found no significant differences in lean body mass between women who had given birth and those who had not. This finding may highlight the potential moderating role of regular exercise in preserving lean body mass over time.

Despite engaging in regular physical activity, women who had given birth demonstrated significantly higher values in parameters associated with central and peripheral fat distribution. These findings are consistent with existing literature showing that pregnancy and childbirth can lead to long-term increases in body fat and central adiposity (Rooney & Schauberger, 2002; Schmitt et al., 2007; Zhang et al., 2024). This highlights the possibility that regular exercise may not fully counteract the physiological and hormonal changes brought on by childbearing, especially in relation to fat accumulation and redistribution. Pregnancy and childbirth induce a range of hormonal fluctuations, particularly increased levels of estrogen and progesterone, which promote fat storage, especially in the abdominal region. Additionally, changes in metabolism and fat distribution during pregnancy are influenced by the body's adaptation to provide energy for fetal growth and postnatal care (Gunderson et al., 2008). While regular exercise helps mitigate some of the effects of these changes, it may not fully offset the long-term redistribution of fat due to the profound hormonal and physiological shifts that occur during and after pregnancy. This is particularly evident in women who continue to engage in physical activity post-childbirth but still experience these lasting changes in fat distribution.

While the present study found significant associations between childbearing and increased fat accumulation, it is important to note that not all studies have reported negative outcomes. Some research suggests that with proper postpartum care and consistent physical activity, many women can return to their pre-pregnancy body composition or even improve certain health markers. Lovelady et al. (2000) demonstrated that moderate-intensity aerobic exercise in postpartum women led to reductions in body fat percentage. Similarly, Kinnunen et al. (2003) found that postpartum women who adopted structured exercise programs showed improved body composition compared to those who did not engage in regular physical activity. These findings indicate that while hormonal and physiological changes during pregnancy promote fat storage, these effects may be attenuated by sustained and targeted exercise interventions in the postpartum period. However, it is important to emphasize that these studies evaluate exercise interventions implemented after childbirth, rather than comparing women who naturally engage in exercise postpartum.

An important contribution of this study is its focus on women who exercise regularly for health, a population that has received limited attention in previous research on postpartum body composition. Most studies have examined sedentary populations or did not control for physical activity levels (Belahsen et al., 2004). Therefore, this study addresses a gap in the literature by assessing the effects of childbearing in a physically active cohort. Nevertheless, the persistence of higher fat mass and circumference measurements in this group suggests that childbearing can have long-lasting effects on body composition, even among those who maintain regular exercise routines.

Despite its contributions, this study has several limitations. First, the cross-sectional design prevents establishing causal relationships between childbearing and body composition changes. Second, while participants were selected based on their engagement in regular physical activity, variations in exercise type, intensity, and frequency were not controlled for or analyzed. This heterogeneity could influence the degree to which exercise moderates the impact of childbearing on body composition. Third, the relatively small age gap between the groups (2.5 years) may still confound the results, given the cumulative effects of age on weight and fat mass. Additionally, other lifestyle factors such as diet, sleep, and stress levels were not assessed, which may interact with both exercise and childbearing effects.

Future studies should adopt longitudinal designs to monitor body composition changes before, during, and after pregnancy in women with varying physical activity levels. Such research would help clarify the temporal dynamics of postpartum body changes and the potential protective effects of sustained exercise. Moreover, including detailed assessments of exercise habits (type, duration, and intensity) could help elucidate which forms of physical activity are most effective in mitigating postpartum weight and fat gain. Lastly, integrating psychosocial variables and metabolic health indicators could provide a more comprehensive understanding of the long-term health implications of childbearing in active women.

CONCLUSION

In conclusion, this study provides evidence that childbearing is associated with increased weight, BMI, waist circumference, hip circumference, waist-to-hip ratio, body fat percentage, and fat mass among women who exercise regularly. These findings underscore the importance of considering childbearing history in evaluating women's health and fitness, even in physically active populations. The limited number of studies addressing this issue in physically active women highlights the need for further research to develop targeted postpartum interventions that support long-term physical health and body composition management.

In the future, longitudinal studies should be focused on monitoring changes in body fat percentage from pre-pregnancy to postpartum. Implementation of health and fitness programs specifically designed for postpartum women and long-term studies on changes in body composition after birth are vital to reduce health risks and improve quality of life.

Conflicts of Interest: There is no personal or financial conflict of interest within the scope of the study.

Authors' Contributions: Design of the study: 1. Author %60, 2. Author %40. All authors have read and approved the final manuscript.

Ethical Approval: Approval for conducting the study was obtained from the Haliç University Non-Interventional Clinical Research Ethics Committee (Decision No: 146, Date: 04.07.2024).

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