Haseli et al. BMC Pediatrics (2025) 25:366
https://doi.org/10.1186/s12887-025-05708-3

RESEARCH

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Postnatal weight loss and exclusive breastfeeding in newborn

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Abstract

Background Despite global efforts to promote breastfeeding, the rate of exclusive breastfeeding (EBF) has remained stagnant in recent decades. Identifying factors that influence EBF is crucial. Therefore, this study aimed to investigate weight patterns and their association with EBF in newborns, specifically comparing infants with and without excessive weight loss.

Methods This retrospective, descriptive-analytical study included 1101 healthy, singleton infants who attended health centers in Kermanshah, Iran, between Nov to Des 2024. All nutritional information and weight of infant from birth to 2 years old were collected in the questionnaire. The data was analyzed using descriptive statistical methods and analytical tests using the SPSS software at significance level less than 0.05.

Results In this study, medical records of 1,101 infants were analyzed. The mean birth weight was 3,282 g (SD = 393), and the mean gestational age was 38.52 weeks (SD = 1.38). During the first 3–5 days after birth, the mean weight loss among infants was 131 g (SD = 92), equivalent to 4.01% ± 3.30% of their birth weight. Weight loss was higher in late preterm infants compared to term infants (91.6% vs. 84.6%, $r = 0.233$) and in cesarean deliveries compared to vaginal deliveries (81.5% vs. 71.4%, $r = 0.455$). Infants who lost more than 5% of their birth weight had a lower mean weight at 24 months compared to those who lost ≤ 5% (11,942 ± 1,646 g vs. 12,484 ± 1,790 g; $p < 0.001$). Exclusive breastfeeding (EBF) rates declined sharply in infants who lost > 5% of their birth weight, dropping from 97% during the first 3 days after birth to 59.3% by 6 months. In contrast, EBF rates remained relatively stable in infants who lost ≤ 5% (57.8% in the first 3 days vs. 49.2% at 6 months).

Conclusion Greater early postnatal weight loss combined with failure to regain birth weight by day 10 is associated with reduced EBF duration and lower infant weight at two years. These findings suggest that interventions to minimize excessive postnatal weight loss and promote timely weight regain may promote EBF and improve long-term infant growth.

Keywords Weight loss, Weight gain, Exclusive breastfeeding, Newborn, Weaning, Perinatal

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Introduction

Exclusive breastfeeding (EBF) means that "the infant receives only human milk. No other liquids or solids are given with the exception of oral rehydration solution, vitamins, minerals or drugs"; World Health Organization (WHO) [1].

The WHO and the United Nations Children's Fund (UNICEF) recommend maintaining EBF for six months to ensure optimal growth, development, and health outcomes [2]. Optimal breastfeeding practices are associated with reduced risks of respiratory infections, diarrhea, allergic diseases, and otitis media. Furthermore, evidence suggests breastfeeding may serve as a protective factor against obesity and diabetes in adulthood [3]. International guidelines also advise continuing breastfeeding, alongside complementary foods, for at least the first 12 months after birth [4]. Despite these recommendations, adherence remains a challenge in some regions. For example, in countries like Iran, while many infants are breastfed from birth, only 29.9% continue breastfeeding for the recommended duration [5].

Although multiple factors contribute to breastfeeding cessation—including social and cultural pressures, maternal employment, and infant weight changes during infancy—qualitative research indicates that concerns about breast milk supply are often triggered by shifts in infant weight patterns [6]. While early weight loss is nearly universal among infants [7, 8], the rate and persistence of this weight loss can heighten maternal anxiety regarding milk sufficiency [9], which may prompt early formula introduction and disrupt exclusive breastfeeding (EBF) [8]. This raises concerns that infants experiencing greater postnatal weight loss may exhibit distinct patterns of weight recovery and breastfeeding outcomes. For instance, Samayan et al.'s study found that neonates with more significant birth weight loss demonstrated lower weight gain at one month compared to others [10].

Despite global efforts to promote breastfeeding, exclusive breastfeeding (EBF) rates have remained stagnant over the past two decades [11]. This underscores the need to identify factors influencing EBF practices. The present study aims to compare weight patterns and EBF outcomes in newborns with abnormal postnatal weight loss to those with typical weight trajectories. Therefore, this study aimed to investigate the association between the degree of early postnatal weight loss and subsequent EBF practices and infant weight trajectories up to two years of age. We hypothesized that infants with greater postnatal weight loss would exhibit shorter EBF duration and distinct weight gain patterns compared to their counterparts.

Methods

Study design and setting

The present study was a retrospective, descriptive-analytical study utilized medical records. The study was conducted in health centers across Kermanshah, Iran. These centers are general healthcare facilities that provide public health services. The study included 1101 healthy, singleton infants born to mothers who received care at these health centers. Demographic information about the mother and baby, pregnancy, delivery, and after delivery were collected from the health file. Inclusion criteria were singleton infants born via uncomplicated vaginal or cesarean delivery, with a gestational age of ≥ 34 weeks (term or late-preterm) even if Low-Birth-Weight (LBW). Exclusion criteria included: infants with congenital abnormalities, infants requiring ICU admission after birth, infants whose caregivers did not attend postnatal health visits per national guidelines (first visit: days 3–5; second visit: days 10–14).

Weight was measured at two critical time points: Initial measurement: 3–5 days postnatal (identifying early weight loss), and follow-up measurement: 10–14 days postnatal (assessing weight regain). We classify weight loss exceeding 5% as excessive in neonates, based on studies defining minimal neonatal weight loss. This threshold may influence breastfeeding outcomes, as reported in a systematic review (2019) [12]. On the other hand, in some papers, the percentage of weight loss for hypernatremia infants was 6–8.6% that is elevated hospitalization risk [13].

It is important to note that under Iran's Ministry of Health national protocol, mothers experiencing difficulties with exclusive breastfeeding receive support after delivery: in the hospital (provided by a breastfeeding manager) and at health centers (managed by trained midwives). Breastfeeding status assessments are part of routine postnatal care evaluations, which continue until the child reaches two years of age.

Sampling method and sample size

To select the sample, we employed a multistage sampling method. First, the city of Kermanshah, Iran, was divided into six regions. After compiling a list of all health centers in each region, 12 centers were randomly selected based on the number of newborns recorded at each facility. Health records of all infants born during the preceding two years were subsequently extracted for analysis. The sample size was calculated using the Cochran formula for the target population, with the following parameters: a margin of error (d) of 0.05 (5%), Z^2 = 3.8416 (95% confidence level), and $p = q = 0.5$. This yielded an initial sample size of 1,000 infants. In this study, 1,640 newborns were initially enrolled. However, 539 infants were excluded due to missed first or second postnatal health visits, resulting in a final sample of 1,101 infants included in the statistical analysis.

Data collection instrument

Data were collected using a researcher-developed questionnaire informed by existing studies and literature reviews [12–15]. The questionnaire included maternal and infant characteristics such as demographic, pregnancy-related, delivery-related, neonatal, and infant-related factors. Longitudinal data spanning from birth to two years of age were recorded, covering: childbirth details, health assessments at 3–5 days, 10–15 days, 1 month (followed by monthly assessments until 6 months), and bimonthly assessments from 6 months to 1 year, trimonthly assessments from 1 to 2 years. Nutritional data (breastfeeding, complementary feeding, weaning) and weight measurements from routine two-year health visits were also documented.

Gestational age was categorized as follows: early preterm (< 34 weeks), late preterm (34–36 weeks and 6 days), early term (37–38 weeks and 6 days), term (39–40 weeks and 6 days), and prolonged pregnancy (≥ 41 weeks) [16]. The content validity of the researcher-developed questionnaire was confirmed through reviews by nine faculty members specializing in midwifery, obstetrics, and neonatology.

Statistical analysis

To evaluate quantitative and qualitative data, descriptive statistical methods (prevalence, mean and standard deviation) and analytical tests (chi-square, Pearson correlation coefficient) were used with SPSS software version 18. We considered the differences to be significant at 0.05 for all statistical tests.

Table 1 Descriptive statistics of selected variables

Categorical Variables		Percentage by Category	
Gestational age, wk	1,101	10.80% Late preterm	
		33.15% Early term	
		53.13% Term	
		2.90% Postdate	
Sex	1,101	55.49% Female	
Parity of mother	1,101	39.15% Primiparus	
Type of delivery	1,099	52.33% NVD	
Continuous variables	Sample size (N = 1,101)	Range	Mean ± SD
Weight Loss, %	1,101	-6.45 to 14.29	4.01 ± 3.30
Weight gain, %	1,098	-0.11 to 10.40	1.21 ± 0.29
Birth weight, g	1,101	1980 to 4700	3282 ± 393
Hospitalization (hour)	1,067	8 to 120	37 ± 17.3
Mother's age (year)	1,097	18–48	31.30 ± 5.81

Result

In this study, medical records of 1,101 infants were analyzed. The mean birth weight was 3,282 g (SD = 393), and the mean gestational age was 38.52 weeks (SD = 1.38). During the first 3–5 days after birth, the mean weight loss among infants was 131 g (SD = 92), equivalent to 4.01% ± 3.30% of their birth weight. Notably, 16.3% of infants lost more than 7% of their birth weight. By ten days postpartum, 66.3% of infants had regained at least their birth weight, while 33.7% remained below it. Weight loss was higher in late preterm infants compared to term infants (91.6% vs. 84.6%, $r = 0.233$) and in cesarean deliveries compared to vaginal deliveries (81.5% vs. 71.4%, $r = 0.455$). A higher proportion of female infants experienced weight loss compared to males, though Spearman's correlation test revealed only a weak statistical relationship (r = -0.0267). Maternal and infant characteristics are summarized in Table 1.

Infants who lost more than 5% of their birth weight had a lower mean weight at 24 months compared to those who lost ≤ 5% (11,942 ± 1,646 g vs. 12,484 ± 1,790 g; $p < 0.001$). This weight difference persisted throughout the two-year period (see Fig. 1 for average weights at each age from birth to 24 months). Additionally, a plateau in weight gain was observed between 5 and 7 months of age among infants with greater postnatal weight loss.

Exclusive breastfeeding (EBF) rates declined sharply in infants who lost > 5% of their birth weight, dropping from 97% during the first 3 days after birth to 59.3% by 6 months. In contrast, EBF rates remained relatively stable in infants who lost ≤ 5% (57.8% in the first 3 days vs. 49.2% at 6 months). A chi-square test confirmed a statistically significant difference in breastfeeding patterns between the two groups (Table 2).

EBF in infants who have lost less than or equal to 5% of their weight has decreased with a low slope and a low amount until the end of 6 months but in infants who have lost more than 5% of weight, EBF during the first 6 months of life has decreased with a high slope and a large amount (Fig. 2).

More than a quarter (27.6%) of infants who have lost weight more than 5% are weaned during 6 to 12 months, while this variable in infants who lost weight less or equal 5% were less than one fifth (17.5%) ($p < 0.001$) (Table 3).

Discussion

Surprisingly, the study revealed that infants who lost significant weight after birth and failed to regain their birth weight by ten days weighed less by the age of two years compared to others. These findings align with Wright's study, which similarly observed that infants with severe postnatal weight loss exhibited weights below the 5th percentile by six months, even if no issues were diagnosed at that stage [17]. However, in the current study,

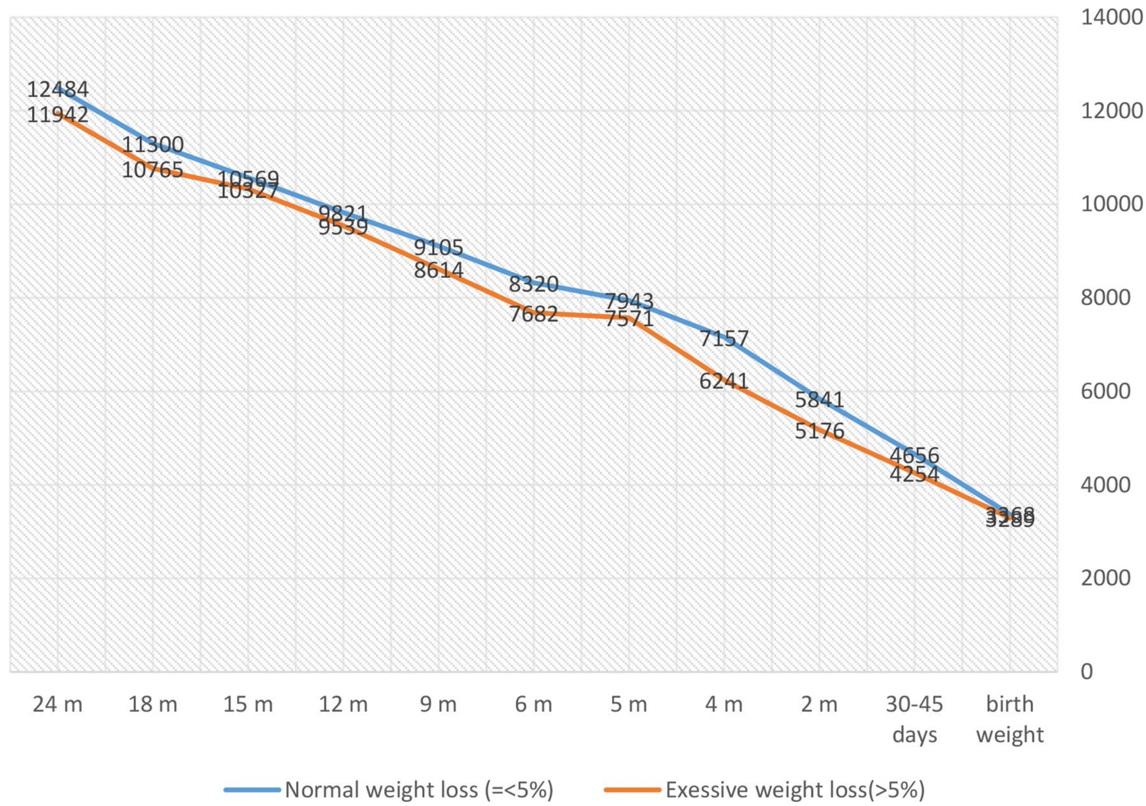

Fig. 1 Average weight from birth to two years of age in infants

Table 2 Breastfeeding pattern to 6 months in infants

Infant's age	group								*p*-value*
	Loss weight less or equal 5%				Loss weight more than 5%				
	Type of nutrition				Type of nutrition				
	Breastfeeding (incomplete), *n* (%)	Formula, *n* (%)	Breastfeeding (full), *n* (%)		Breastfeeding (incomplete), *n* (%)	Formula, *n* (%)	Breastfeeding, (full) *n* (%)	Total, *n* (%)	
After Birth until 3 days	192 (28.8)	89 (13.4)	385 (57.8)	666 (100)	4 (0.9)	4 (0.9)	427 (98.2)	435 (100)	$x^2 = 221.470$ $P < 0.001$
10 to 15 days	198 (30.1)	93 (14.3)	367 (55.8)	658 (100)	50 (11.5)	14 (3.2)	371 (83.5)	435 (100)	$x^2 = 105.56$ $P < 0.001$
30 to 45 days	196 (29.9)	95 (14.5)	365 (55.6)	656 (100)	79 (18.2)	29 (6.7)	327 (75.2)	435 (100)	$x^2 = 43.03$ $P < 0.001$
2 months old	196 (30.2)	137 (21.1)	317 (48.8)	650 (100)	83 (19.8)	55 (12.8)	293 (68)	431 (100)	$x^2 = 38.96$ $P < 0.001$
4 months old	170 (26.2)	173 (26.6)	307 (47.2)	650 (100)	63 (14.6)	95 (22)	273 (63.3)	431 (100)	$x^2 = 0.660$ $P = 30.6$
6 months old	151 (24.5)	162 (26.3)	303 (49.2)	616 (100)	62 (14.5)	112 (26.2)	253 (59.3)	427 (100)	$x^2 = 17.12$ $P < 0.001$

*p- value on Chi square test

the weight trajectories of both groups remained within the normal range according to the WHO's child growth standards [18]. The only notable difference at six months was a plateau in growth rates in both groups, likely linked to the introduction of complementary feeding and the emergence of infant teeth. This pattern raises concerns in developing countries, where infants often thrive during exclusive breastfeeding but subsequently experience slower growth trajectories due to suboptimal feeding practices [19]. During the complementary feeding period, children face a heightened risk of nutritional deficiencies [20]. Complementary foods are frequently nutritionally inadequate, introduced too early or too late, provided in insufficient quantities, or offered infrequently. Additionally, premature weaning or infrequent breastfeeding further exacerbates insufficient energy and nutrient intake in infants over 6 months of age [21].

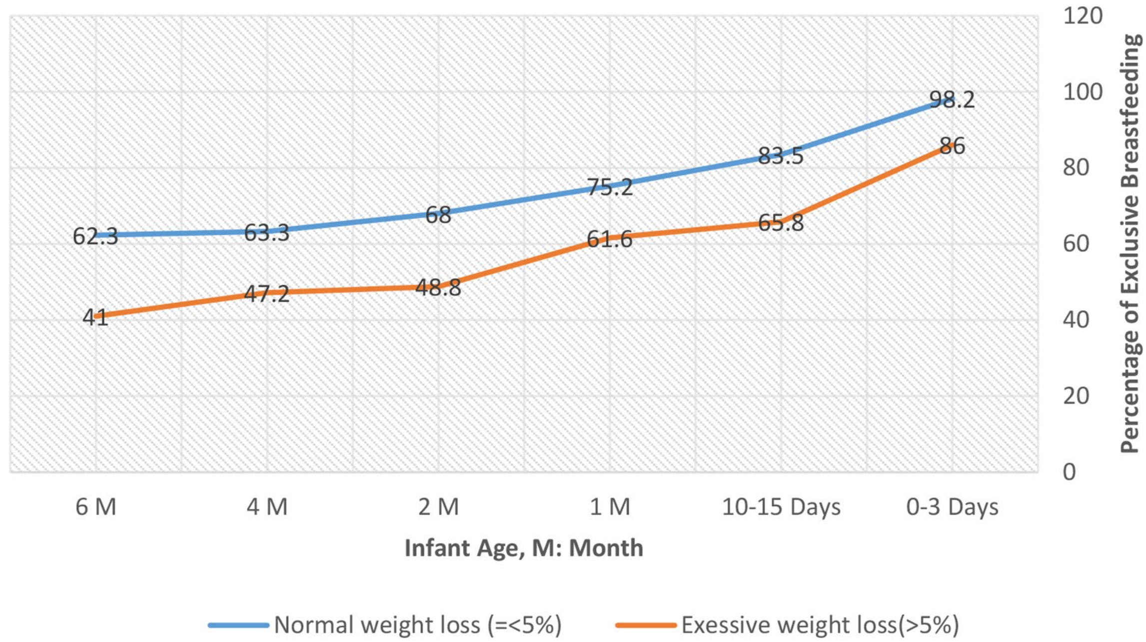

Fig. 2 Percentage of EBF from after birth to 6 months in infants

Table 3 Weaning time in infants

Weaning time	Loss weight less than 5%		Loss weight more than 5%	
	number	percent	number	percent
6–12 months old	110	17.5	118	27.6
12–15 months old	79	12.6	54	12.6
> 15 months old	440	70	256	59.8
Total	629	100	426	100
Chi Square test	$x^2 = 15.979$ df = 2 $P < 0.001$			

Weaning was defined as the complete cessation of breastfeeding

Salivary cortisol levels rise in full-term newborns following rapid body weight loss during the first 24 to 48 h of life [22]. This initial cortisol surge represents a normal physiological response to the stress of birth and adaptation to extrauterine life [23]. However, the potential long-term consequences of this early cortisol elevation—or subsequent increases due to persistent stress—merit further investigation. While prolonged or repeated stress in these infants could contribute to their lower long-term weight, this relationship remains complex and context-dependent. Notably, while elevated cortisol levels in adults are often associated with increased appetite and fat storage [24, 25], its effects in newborns may differ significantly. Additionally, factors beyond initial weight loss may influence cortisol levels.

The study findings revealed that exclusive breastfeeding (EBF) rates among infants losing > 5% of their birth weight declined sharply from 79% at 3–5 days postpartum to 59.3% by six months. In contrast, infants with < 5% weight loss showed a less pronounced decline (57.8% at 3–5 days vs. 49.2% at six months). This discrepancy suggests that significant neonatal weight loss—and maternal concerns about insufficient breast milk supply—may prompt parents to adopt temporary or suboptimal solutions, such as formula supplementation, thereby reducing exclusive breastfeeding rates [9].

It is important to acknowledge that postnatal weight gain patterns are multifactorial and vary significantly among infants. Aydın and Yalçin (2024) recently demonstrated significant associations between maternal factors (e.g., pregnancy health complications, BMI, smoking status), infant characteristics (e.g., jaundice, mode of delivery), and anthropometric characteristics in full-term, breastfed infants during the first month of life [26]. These variables may influence early weight gain trajectories and could partially explain the divergent growth patterns observed in our study population. Future research should account for such confounding factors when exploring links between postnatal weight loss and long-term growth trajectories.

The results revealed that over 25% of infants who lost more than 5% of their birth weight were weaned between 12 and 15 months of age, whereas less than 20% of infants with ≤ 5% weight loss experienced weaning during the same period. Critically, the introduction of formula—even alongside continued breastfeeding—can disrupt milk production. Over time, reduced breast milk supply may lead to earlier weaning. Most experts emphasize that breastfeeding support prior to lactogenesis II (the onset of mature milk production), careful monitoring of infant weight loss during the first weeks postpartum, and adherence to protocols for managing significant weight loss should be integrated into standard feeding guidelines [27].

Infants with greater postnatal weight loss exhibit distinct patterns of weight recovery, exclusive breastfeeding (EBF) duration, and weaning timelines compared to their peers. This discrepancy underscores the need for targeted interventions by healthcare providers to reduce infant morbidity and mortality [9]. Notably, improvements in weight gain patterns after the first week postpartum may reassure mothers about their infant's growth trajectory, fostering confidence in continued breastfeeding [14].

Strengths and limitations

This study has several notable strengths. The large sample size ($n = 1101$) provided substantial statistical power to detect differences in weight patterns and breastfeeding outcomes between infants with varying degrees of postnatal weight loss. Furthermore, the prospective collection of data on infant weight and feeding practices from birth to two years of age offered a valuable longitudinal perspective on growth trajectories.

However, several limitations must be acknowledged. The reliance on retrospective data collection via questionnaires introduced the potential for recall bias, as participants may have struggled to accurately report past events. This is particularly relevant for details about infant feeding practices and weight, which may have occurred months or years prior to data collection. The cross-sectional nature of the analysis also limited our ability to establish causal relationships between postnatal weight loss and long-term outcomes. While we collected data on several relevant factors—including maternal age, mode of delivery, and birth weight—other potentially important confounders were not fully assessed due to data availability constraints. These include socioeconomic status; maternal nutritional status (both pre- and postnatal); and maternal health conditions (e.g., gestational diabetes, thyroid disorders, hypertension). Infant-related factors, such as feeding practices (e.g., timing of solid food introduction, formula supplementation) and access to healthcare services, were also not comprehensively evaluated.

The absence of data on these confounders may limit the generalizability of our findings and introduces the possibility of residual confounding, where observed associations between postnatal weight loss and infant outcomes could be partially explained by unmeasured variables. Future research should incorporate a more comprehensive prospective assessment of maternal, infant, and socioeconomic factors, using validated tools and objective measures where feasible, to better understand their independent and combined impacts on infant weight trajectories and breastfeeding outcomes. Longitudinal studies with repeated measures and robust data collection are needed to confirm these findings and elucidate the mechanisms linking early postnatal weight loss to long-term infant health outcomes.

Conclusion

This study reveals that infants experiencing greater early postnatal weight loss and failing to regain their birth weight by day 10 are associated with shorter durations of exclusive breastfeeding (EBF) and lower weights at two years. These findings suggest that interventions aimed at minimizing excessive postnatal weight loss and promoting timely weight regain could potentially enhance EBF and improve long-term infant growth. However, it is crucial to consider that the relationship between early weight loss and later growth outcomes may be influenced by multiple factors, including nutritional intake and other unexamined variables. Therefore, future studies with robust methodologies are necessary to confirm these findings and explore the complex interplay of factors affecting infant growth and breastfeeding practices.

Abbreviations

EBF	Exclusive Breast Feeding
WHO	World Health Organization
UNICEF	United Nations Children's Fund
SD	Standard Deviation
NVD	Normal Vaginal Delivery
LBW	Low-Birth-Weight

Acknowledgements

We thank all service providers in health centers of Kermanshah University of Medical Sciences. This study is the result of research project No. 50004820, approved by the Student Research Committee at Kermanshah University of Medical Sciences, Kermanshah, Iran. Also, we express our gratitude to the officials of the Clinical Research Development Center, Motazedi Hospital, Kermanshah University of Medical Sciences, Kermanshah, Iran.

Author contributions

Conceptualization: AH, FK Investigation, all authors Data curation, formal analysis: ZK, writing–original draft: AH & ZK writing–review & editing: All authors.

Funding

This work was supported by Kermanshah University of Medical Sciences (50004840).

Data availability

Data is provided within the manuscript or supplementary information files". The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

The procedures followed in this study were in accordance with principles of the Declaration of Helsinki (1964, amended most recently in 2008) of the World Medical Association. The requirement for patient informed consent was waived by the Ethics Commission of Kermanshah University of Medical Sciences due to the observational nature of the study. The study protocol was approved by the Ethics Committee of Kermanshah University of Medical Sciences (Ethical code: IR.KUMS.REC.1403.445) on 6 Nov 2024. (link: https://ethics.research.ac.ir/PortalProposalListEn.php?code=IR.KUMS.REC.1403.445%26;title=%26;name=%26;stat=%26;isAll=).

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

Received: 20 January 2025 / Accepted: 23 April 2025
Published online: 08 May 2025

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