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Energy and Protein Intake Deficits in the Immediate Postpartum Period: A Prospective Observational Study

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Abstract

Background

The early postpartum period requires increased energy and protein for wound healing, involution, and lactogenesis. In India, maternal diets are frequently suboptimal and influenced by cultural food restrictions, yet quantitative data on intake during the first days after delivery are limited. This study aimed to quantify daily energy and protein intake and calculate deficits during the initial postpartum days.

Materials and methods

This prospective longitudinal observational study was conducted in a tertiary care hospital from February 2025 to July 2025. Women aged 18–40 years with singleton pregnancies who were admitted for delivery were enrolled and followed until discharge (up to postpartum Day 5). Daily energy and protein intakes were assessed using 24-hour dietary recalls administered by a dietitian and trained resident physicians. An intake deficit was defined as the difference between the recommended dietary allowance (RDA) and reported intake, using the 2020 Indian Council of Medical Research-National Institute of Nutrition (ICMR-NIN) lactation RDA for sedentary women (2,260 kcal/day and 62.6 g/day of protein) as a fixed benchmark. Trends across Days 1–3 (complete data, N = 100) were analyzed using repeated-measures analysis of variance (ANOVA), whereas data from Days 4–5 (N = 52, hospitalized cesarean subgroup) were analyzed descriptively.

Results

Mean energy intake rose from 791.44 ± 132.20 kcal on Day 1 to 874.63 ± 158.94 kcal by Day 3 ($F(2,198) = 11.73$, $p < 0.001$), and protein rose from 18.09 ± 4.82 to 22.85 ± 4.74 g/day ($F(2,198) = 30.01$, $p < 0.001$). Among the 52 women with cesarean delivery who remained hospitalized, descriptive Day 5 intake was 885.52 ± 121.81 kcal and 23.89 ± 4.91 g/day. Reported intake remained substantially below the RDA throughout, with deficits of $1,468.56 \pm 132.20$ kcal and 44.51 ± 4.82 g on Day 1 (N = 100) and $1,374.48 \pm 121.81$ kcal and 38.71 ± 4.91 g on Day 5 (N = 52). All participants received iron and folic acid supplementation.

Conclusions

Reported energy and protein intake improved significantly from the first to the third postpartum day but remained substantially below the ICMR-NIN 2020 lactation RDA throughout the first five hospital days. This reflects an intake gap against a population benchmark, not a measured physiological deficiency. Multicenter studies with objective dietary measurement and maternal-infant outcomes are needed.

Categories: Obstetrics/Gynecology, Nutrition, Pediatrics

Keywords: dietary intake, energy intake, maternal nutrition, postpartum, protein intake

Introduction

Pregnancy and the early postpartum period impose substantial nutritional demands. The Indian Council of Medical Research and National Institute of Nutrition (ICMR-NIN) 2020 Expert Group therefore set the recommended daily allowance (RDA) for lactating women (0–6 months, sedentary) at 2,260 kcal/day and 62.6 g/day protein, markedly higher than for non-lactating women [1]. Lactation alone costs approximately 626 kcal/day, with a net dietary increment of about 454 kcal/day after mobilization from maternal stores [2], and protein requirements increase by approximately 15 g/day above non-lactating needs to support milk protein synthesis [3].

Maternal diets are characterized by low energy, imbalanced macronutrients, and inadequate micronutrients [4], with limited dietary diversity particularly among marginalized communities [5,6]. Tracking studies show diet quality often remains suboptimal or declines from late pregnancy into the postpartum period, and intake frequently falls below estimated requirements [7–11].

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Most cohort studies assess dietary intake during the first six months postpartum in home settings [7,8]. The first five postpartum days present unique barriers to adequate dietary intake, including nil per os (NPO) restrictions following cesarean delivery, pain, limitations in hospital food provision, and traditional confinement practices that may involve bland, low-protein diets and avoidance of solid foods [12,13]. Cultural food taboos documented during pregnancy in India often persist into the postpartum confinement period, with family members influencing a substantial proportion of food avoidances [12,13]. Economic constraints and limited exposure to counseling further restrict intake [4,13].

Quantifying the acute intake deficit relative to the ICMR-NIN 2020 recommendations may help inform timely inpatient nutritional counseling. Randomized trials have demonstrated that such counseling can improve postpartum dietary quality [14,15]. We therefore prospectively assessed daily energy and protein intake and the corresponding deficits from the first through the fifth postpartum day among women who delivered at a tertiary teaching hospital.

We aimed to quantify daily energy and protein intake and the deficit relative to the ICMR-NIN 2020 lactation RDA over the first five postpartum days, and to test changes over Days 1-3 in the full cohort; Days 4-5 were assessed descriptively in the hospitalized cesarean subgroup.

Materials And Methods

Study design and setting

A prospective longitudinal observational study was conducted in the maternity ward of a tertiary care teaching hospital in Maharashtra, India. It was conducted between February 2025 and July 2025.

Participants

Pregnant women admitted for delivery were consecutively screened for eligibility. Eligible participants were women aged 18-40 years with a viable singleton pregnancy who were willing to provide written informed consent and planned to deliver at the study hospital. Women with multiple pregnancies or complicated pregnancies (e.g., severe anemia, Hb <7 g/dL, preeclampsia, fetal anomaly, pre-existing diabetes mellitus, history of eating disorders, or major medical, psychiatric, or psychosocial illness that could interfere with dietary reporting) were excluded.

The sample size was calculated for the primary descriptive objective, estimating the prevalence of inadequate intake (<50% RDA), assuming 50% prevalence [4], 95% confidence, and 10% absolute precision (n = 96); 100 women were enrolled, allowing 5% attrition. The Day 1-3 trend analysis was secondary. Consecutive eligible participants were recruited until the target was reached.

Data collection

Baseline data were collected using a case record form: maternal age, parity, pre-pregnancy weight, height, BMI (WHO Asian cutoffs), education, occupation, socioeconomic status by the modified Kuppuswamy scale, antenatal visits, and newborn birth weight.

Dietary intake was assessed by an interviewer-administered 24-hour recall conducted once daily by a dietitian and trained resident doctors, covering the preceding 24 hours (Day 1 was defined as the first 24 hours after delivery). Portion sizes were estimated using standard household measures (katoris, cups, spoons). Mixed and home-prepared dishes were converted into ingredient quantities using standardized recipes, and their energy and protein contents were subsequently estimated using the Indian Food Composition Tables 2017. Assessors followed a common protocol and were trained before data collection. Women with normal vaginal delivery were typically discharged by the second or third day per hospital protocol. Data for the first five days were available only for women who underwent lower-segment cesarean section (LSCS) and remained hospitalized (N = 52). Supplementation (iron, folic acid, and calcium) was recorded from drug charts and history. Outcomes were mean daily energy and protein intake and the deficit, defined as the intake gap (RDA minus reported intake) and not a measured physiological deficiency. As no postpartum day-specific recommendation exists, the ICMR-NIN 2020 lactation RDA (0-6 months, sedentary) was used as a uniform benchmark for all days.

Statistical analysis

Data were entered in Excel (Microsoft Corp., Redmond, WA, USA) and analyzed with SPSS Statistics version 24.0 (IBM Corp. Released 2016. IBM SPSS Statistics for Windows, Version 24.0. Armonk, NY). Normality was tested with the Shapiro-Wilk test. Normally distributed continuous variables were expressed as the mean $\pm$ standard deviation (SD), whereas categorical variables were expressed as frequencies and percentages (n (%)). For the full cohort with complete data for the first three days (N = 100), trends were assessed using repeated-measures analysis of variance (ANOVA). Sphericity was evaluated using Mauchly's test, and the Greenhouse-Geisser correction was applied if the assumption of sphericity was violated. Bonferroni-adjusted pairwise comparisons and partial eta squared (η^2_p) were reported. Days 4-5 (N = 52) were summarized descriptively without inferential testing. No observations were missing on Days 1-3. Two-tailed

$p < 0.05$ was considered significant.

Ethical approval

The Ethics Committee for Research on Human Subjects, MGM Medical College and Hospital, Aurangabad, approved the study (MGM-ECRHS/2025/194, dated January 15, 2025). Written informed consent for participation was obtained.

Results

Dietary data were complete for all 100 women on Days 1-3. Data for Days 4 and 5 were available only for the 52 women who underwent cesarean delivery and remained hospitalized ($N = 52$ on each day); these findings are presented descriptively.

As shown in Table 1, the mean age was 23.74 ± 3.94 years, with 72 (72%) aged 18-25 and 28 (28%) aged 26-40. Fifty-four (54%) were primiparous, and 46 (46%) were multiparous. The mean pre-pregnancy weight was 49.90 ± 10.15 kg, and the mean BMI was 20.60 ± 4.00 kg/m². Sixty-seven (67%) belonged to the upper-middle socioeconomic class by the modified Kuppuswamy Scale. Delivery was by cesarean section in 52 (52%) and vaginal delivery in 48 (48%). All 100 participants (100%) received iron and folic acid supplementation.

Characteristic	Category	N (%) or mean $\pm$ SD
Age (years)	18-25	72 (72%)
	26-40	28 (28%)
	Mean $\pm$ SD	23.74 $\pm$ 3.94
Parity	Primiparous (1st delivery)	54 (54%)
	Multiparous (2+ deliveries)	46 (46%)
Pre-pregnancy weight (kg)	≤ 50	51 (51%)
	> 50	49 (49%)
	Mean $\pm$ SD	49.90 $\pm$ 10.15
Pre-pregnancy BMI category	Underweight (≤ 18.5)	31 (31%)
	Normal (18.5-22.9)	48 (48%)
	Overweight (23-27.4)	14 (14%)
	Obesity (≥ 27.5)	7 (7%)
Socioeconomic status (MKSS)	Upper-middle	67 (67%)
	Lower-middle	16 (16%)
	Lower	11 (11%)
	Upper	6 (6%)
Delivery mode	Cesarean	52 (52%)
	Vaginal	48 (48%)
Iron and folic acid supplementation	Received	100 (100%)
Mother working outside the home	Yes	15 (15%)
Antenatal visits	Mean $\pm$ SD	9.66 $\pm$ 2.76
Birth weight (kg)	Mean $\pm$ SD	2.70 $\pm$ 0.50

TABLE 1: Baseline demographic and obstetric characteristics of study participants

Data are presented as N (%) for categorical variables and mean $\pm$ SD for continuous variables.

BMI: body mass index (WHO Asian population cutoffs), MKSS: modified Kuppuswamy scale, SD: standard deviation

As shown in Table 2 and Figures 1-2, mean energy intake increased from 791.44 $\pm$ 132.20 kcal/day on the first postpartum day to 874.63 $\pm$ 158.94 kcal/day on the third postpartum day (N = 100). In the hospitalized cesarean subgroup (N = 52), descriptive Day 5 intake was 885.52 $\pm$ 121.81 kcal and 23.89 $\pm$ 4.91 g/day. Mean protein intake rose correspondingly from 18.09 $\pm$ 4.82 g/day on Day 1 to 22.85 $\pm$ 4.74 g/day by the third postpartum day and 23.89 $\pm$ 4.91 g/day by Day 5. The mean energy deficit was 1,468.56 $\pm$ 132.20 kcal/day on Day 1 (N = 100) and 1,374.48 $\pm$ 121.81 kcal/day on Day 5 (N = 52). The corresponding protein deficits were 44.51 $\pm$ 4.82 and 38.71 $\pm$ 4.91 g/day, respectively (Table 2). Despite this improvement, mean intake remained substantially below the ICMR-NIN 2020 RDA for lactation and sedentary activity level (2,260 kcal/day energy, 62.6 g/day protein) throughout.

Postpartum day	N	Energy intake, kcal/day (mean ± SD)	Energy deficit, kcal/day (mean ± SD)	Protein intake, g/day (mean ± SD)	Protein deficit, g/day (mean ± SD)
Day 1	100	791.44 ± 132.20	1468.56 ± 132.20	18.09 ± 4.82	44.51 ± 4.82
Day 2	100	809.19 ± 161.75	1450.81 ± 161.75	21.48 ± 5.02	41.12 ± 5.02
Day 3	100	874.63 ± 158.94	1385.37 ± 158.94	22.85 ± 4.74	39.75 ± 4.74
Day 4	52	873.52 ± 154.17	1386.48 ± 154.17	23.91 ± 5.08	38.69 ± 5.08
Day 5	52	885.52 ± 121.81	1374.48 ± 121.81	23.89 ± 4.91	38.71 ± 4.91

TABLE 2: Day-wise mean energy and protein intake and deficit from the RDA

Data are presented as mean ± SD for intake and for deficit (RDA minus intake) relative to the ICMR-NIN 2020 RDA for lactation and sedentary activity level (2,260 kcal/day; 62.6 g/day protein). Days 1-3: full cohort (N = 100); Days 4-5: hospitalized cesarean subgroup (N = 52), descriptive only.

RDA: recommended daily allowance, SD: standard deviation, ICMR-NIN 2020: The Indian Council of Medical Research and National Institute of Nutrition 2020

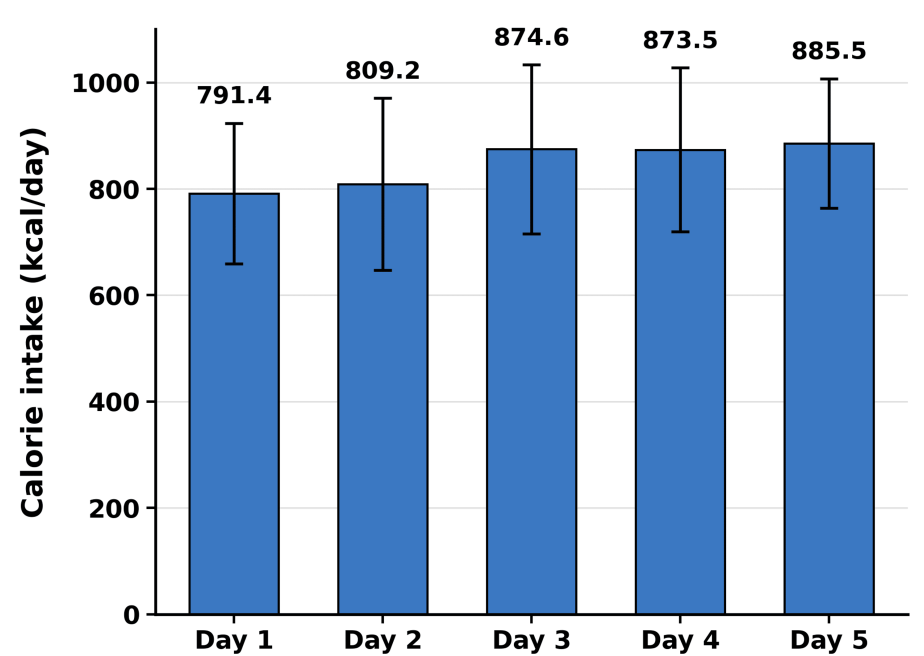


FIGURE 1: Mean energy intake (kcal/day) across the first five postpartum days

The mean energy intake is shown at the top of each day's bars, and the error bars represent the SD.

SD: standard deviation

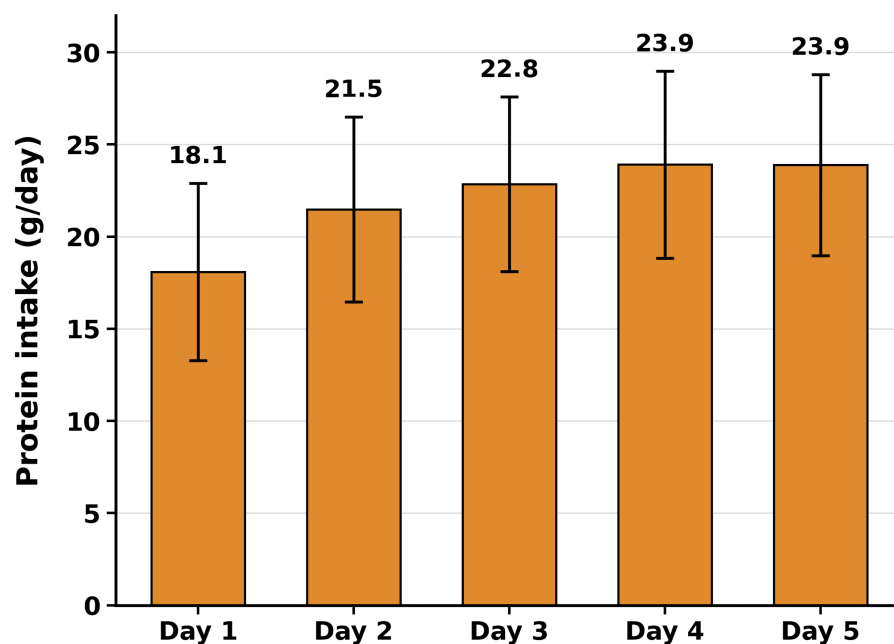


FIGURE 2: Mean protein intake (g/day) across the first five postpartum days

The mean protein intake is shown at the top of each day's bars, and the error bars represent the SD.

SD: standard deviation

A repeated-measures ANOVA was performed to compare mean energy intake across the three postpartum days. The assumption of sphericity was met (Mauchly's test: $\chi^2(2) = 1.49$, $p = 0.474$). There was a significant difference in energy intake across the three days ($F(2,198) = 11.73$, $p < 0.001$, $\eta^2_p = 0.11$). Bonferroni-adjusted pairwise comparisons showed that energy intake on the third day was significantly higher than that on the first day (mean difference: 83.19 kcal; 95% CI: 45.20-121.18; $p < 0.001$) and second day (mean difference: 65.44 kcal; 95% CI: 30.23-100.65; $p = 0.001$), whereas the difference between the first and second days was not statistically significant.

Similarly, repeated-measures ANOVA demonstrated significant differences in protein intake across the three postpartum days. The assumption of sphericity was satisfied (Mauchly's test: $\chi^2(2) = 2.95$, $p = 0.228$). Overall differences across days were statistically significant ($F(2,198) = 30.01$, $p < 0.001$, $\eta^2_p = 0.23$). Bonferroni-adjusted post hoc comparisons revealed significant differences between the first and second postpartum days (mean difference: 3.39 g; 95% CI: 2.09-4.69; $p < 0.001$) and between the first and third days (mean difference: 4.76 g; 95% CI: 3.44-6.08; $p < 0.001$).

Discussion

Among 100 postpartum women at a tertiary care hospital, mean daily energy and protein intakes increased by approximately 83 kcal and 4.8 g, respectively, between the first and third postpartum days. These increases were statistically significant but modest. On the fifth postpartum day, mean energy and protein intakes among the 52 women who underwent lower-segment cesarean section were 886 kcal/day and 23.9 g/day, respectively, corresponding to deficits of 1,374 kcal/day and 38.7 g/day relative to the ICMR-NIN 2020 lactation RDA. Universal iron-folic acid supplementation did not compensate for the macronutrient shortfall.

Our findings agree with Indian literature documenting suboptimal maternal diets. Nguyen et al. reported low energy and macronutrient imbalance across Indian states [4]. Previous studies have also reported limited dietary diversity and inadequate protein intake among women from marginalized communities [5,6]. Similarly, the present cohort demonstrated substantially low energy and protein intakes relative to the RDA. The ECLIPSES cohort in Spain also showed reduced fruit, vegetable, and cereal consumption postpartum with fiber and vitamin shortfalls [8,9]. However, their reported energy intake (approximately 1,800 kcal/day) was higher than that observed in our cohort, potentially reflecting differences in study settings and food security.

Schwedhelm et al. found that postpartum women averaged three meals but missed key meals, with energy

intake below recommendations [7], consistent with our low first-day intake. Moran et al. showed that diet quality declined during pregnancy in overweight and obese women and remained suboptimal postpartum [10]. Similarly, Cucó et al. demonstrated that dietary patterns established before conception may persist through pregnancy and into the postpartum period [11], suggesting the immediate postpartum dip we captured is an acute exacerbation of a pre-existing pattern. Although direct postpartum data from low- and middle-income countries (LMICs) are scarce, pregnancy cohorts consistently report inadequate energy and protein intake in these settings [16], and it is likely that similar or greater deficits persist into the early postpartum period given the additional demands of lactation. Bellows et al. found that both lacto-vegetarian and nonvegetarian pregnant women in Uttar Pradesh, India, had low nutrient adequacy [17], supporting the generalizability of macronutrient deficits across dietary patterns in the Indian context. Our deficit (~60% below RDA) is larger than home-based assessments at six weeks [7-9]. This likely reflects acute, hospital-based assessment during the immediate postpartum period rather than usual intake at home.

The following factors, drawn from earlier literature, may plausibly contribute to the low reported intake; none was directly assessed in this study, and they should be regarded as hypotheses. First, physiologically, cesarean delivery (52% in our cohort) may be associated with postoperative gastrointestinal dysfunction, fasting restrictions, and pain. Second, culturally, traditional Indian confinement includes avoidance of pulses, non-vegetarian foods, and "cold" foods, with bland diets of rice gruel and restriction of solid foods, particularly in the first three to five days [12,13]. Placek and Hagen documented that culturally transmitted food taboos during pregnancy in rural India are shaped by socially learned advice from family and community members [12], and these restrictions frequently extend into the postpartum confinement period, as reviewed by Kavle and Landry in the context of gender norms and family influence on maternal nutrition [13]. Third, institutional factors may contribute to inadequate intake, including insufficient energy provision through hospital meals, inconsistent availability of food brought by family members, and limited access to structured nutritional counseling [4,5]. Finally, knowledge-related barriers, including inadequate healthcare provider training in maternal nutrition and limited time for counseling, may contribute to the poor uptake of dietary recommendations [13].

The significant increase in intake between the first and third postpartum days may reflect the gradual resolution of postoperative dietary restrictions and the reintroduction of foods brought by family members. Yet, it still falls short because lactation energy cost remains high [2] and protein needs increase substantially above non-lactating requirements [3].

Evidence shows health and nutrition education interventions in Hubei improved postpartum dietary quality and reduced unhealthy traditional practices [14], and individualized dietary intervention in Japan improved energy-adjusted protein and micronutrient intake postpartum. However, total energy intake did not change significantly [15]. Similar inpatient counseling, combined with the provision of protein-rich local foods (e.g., sprouted pulses, milk, and eggs, where acceptable), consistent with the WHO breastfeeding counseling guideline [18] and the Lancet breastfeeding series [19], could be piloted. Whether inpatient counseling or provision of protein-rich local foods would narrow this gap cannot be determined from our data; such approaches could be piloted and evaluated, and dietitian support on postnatal wards has been proposed in LMIC settings [13,20]. Larger multicenter studies with longer follow-up to six months, including breast milk volume and infant growth as outcomes, are needed.

Strengths include prospective design from delivery to the fifth postpartum day and comparison to the nationally relevant ICMR-NIN 2020 RDA. Use of repeated-measures ANOVA with sphericity testing strengthens inference for the first-to-third-day trend.

Limitations

The single-center design and modest sample size ($N = 100$) limit the generalizability of the findings beyond the study setting in Maharashtra. Dietary assessment relied on recall, which is prone to underestimation, and no weighed food records or biochemical markers were collected. Data for Days 4 and 5 were available only for the 52 women who underwent cesarean delivery and remained hospitalized, as vaginally delivered mothers were discharged by the third day per standard protocol; therefore, findings from Days 4 and 5 may not be generalizable to women with uncomplicated vaginal delivery. Formal statistical testing was restricted to the first three days. We did not collect pre-pregnancy dietary habits, actual menu composition, or data on nausea, appetite, or lactation counseling exposure. The observational study design precludes causal inference regarding the relationship between dietary intake and clinical outcomes, such as wound healing and breastfeeding success. Future studies should investigate these associations. The ICMR-NIN lactation RDA is a population benchmark for established lactation and is not day-specific; because milk output is lower in the first 2-3 days, the deficits reflect intake gaps rather than clinical nutrient deficiency. Recall-based estimates may be affected by underreporting and portion-size error, with no weighed records or validation. Participants were predominantly upper-middle socioeconomic class, and women with complicated pregnancies were excluded, limiting external validity. The study did not assess maternal recovery, breastfeeding, or infant outcomes, so clinical consequences cannot be inferred.

Conclusions

Reported energy and protein intake improved significantly from the first to the third postpartum day but remained substantially below the ICMR-NIN 2020 lactation RDA throughout the first five hospital days. This reflects an intake gap against a population benchmark, not a measured physiological deficiency. Multicenter studies with objective dietary measurement and maternal-infant outcomes are needed.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

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Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. Ethics Committee for Research on Human Subjects, MGM Medical College and Hospital issued approval MGM-ECRHS/2025/194. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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