Journal of Rare Cardiovascular Diseases
ISSN: 2299-3711 (Print) | e-ISSN: 2300-5505 (Online)
www.jrcd.eu

RESEARCH ARTICLE

Maternal Vegetarian versus Non-Vegetarian Diets and Neonatal Fat-Free Mass: A Comparative Study from a Tertiary Center

Dr. Kousalya. K. S, Dr. Bharath. S, Dr. Syed Mohammed H, Dr. Lal Devayani Vasudevan Nair, Dr. Kishore. N, Dr. Vasantha Bharathy and Dr. Shreenivas Rachakonda
Department of Paediatrics, Saveetha Medical College and Hospital, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, India

*Corresponding Author
Kousalya. K. S

Article History
Received: 08.08.2025
Revised: 15.09.2025
Accepted: 24.10.2025
Published: 05.11.2025

Abstract: ***Background***: Maternal nutrition during pregnancy plays a critical role in determining fetal growth and neonatal body composition. Differences in dietary patterns, particularly vegetarian versus non-vegetarian diets, may influence the development of fat-free mass in neonates. Objective: "To compare the effect of vegetarian and non-vegetarian maternal diets during pregnancy on the fat-free mass appropriate for gestational age (FFM-for-GA) in neonates. ***Methods***: This was a single-center, hospital-based, observational comparative study conducted in the Department of Pediatrics at Saveetha Institute of Medical and Technical Sciences (SIMATS), Chennai, between January and May 2025. ***Results***: The study findings revealed no significant differences in baseline maternal characteristics such as age, socioeconomic status, height, or BMI between the vegetarian and non-vegetarian groups. However, maternal weight was significantly higher among non-vegetarian mothers. Both groups had similar gestational ages at delivery and parity distribution. Dietary analysis showed that non-vegetarian mothers had significantly higher caloric, carbohydrate, and protein intake compared to vegetarian mothers, although fat intake showed only a non-significant trend toward higher values. Prenatal multivitamin use and neonatal gender distribution were comparable across groups. Importantly, neonates born to non-vegetarian mothers exhibited significantly greater fat-free mass (2.78 ± 0.29 kg vs. 2.64 ± 0.32 kg; $p = 0.001$), higher birth weight (3.12 ± 0.39 kg vs. 3.01 ± 0.41 kg; $p = 0.014$), and increased birth length (49.9 ± 2.2 cm vs. 49.2 ± 2.1 cm; $p = 0.007$) compared to those born to vegetarian mothers. Conclusion: The study concludes that a non-vegetarian maternal diet during pregnancy is associated with significantly higher neonatal fat-free mass, birth weight, and length. Ensuring adequate nutritional intake in vegetarian mothers is essential to support optimal fetal growth outcomes.

Keywords: Maternal nutrition, Neonatal fat-free mass, Vegetarian diet, non-vegetarian diet, Birth outcomes, Body composition analysis.

INTRODUCTION

Nutrient availability in utero is a key determinant of fetal growth, neonatal body composition, and later-life health trajectories.(1,2) Among maternal dietary patterns, vegetarian and non-vegetarian diets differ in energy density, protein quality, micronutrient profile, and nutrient bioavailability, each of which may influence the accrual of lean tissues during fetal development.(3,4) Vegetarian diets are typically rich in fiber and phytochemicals but can be relatively limited in complete proteins and select micronutrients such as vitamin B12, iron, zinc, and long-chain polyunsaturated fatty acids unless carefully planned and supplemented.(3,5) Vitamin B12, in particular, plays a central role in one-carbon metabolism and epigenetic regulation during organogenesis, and inadequate maternal status has been associated with adverse growth phenotypes in offspring.(6,7) Because fat-free mass (FFM)—comprising muscle, bone, and vital organs—reflects the functional component of neonatal composition more directly than birth weight alone, it offers a more nuanced indicator of intrauterine nutrition.(8) The advent of air-displacement plethysmography has allowed precise bedside estimation of neonatal fat mass and FFM soon after birth, enabling rigorous investigation of maternal determinants of tissue partitioning.(9,11) Although literature on maternal diet and birth size is growing, direct comparisons of neonatal FFM between vegetarian and non-vegetarian mothers remain limited, and findings for anthropometric outcomes are inconsistent across settings.(10) Given the sizeable prevalence of vegetarian dietary practices in India for cultural and religious reasons, clarifying whether such diets, as consumed in routine care, support optimal lean tissue deposition in neonates has immediate clinical relevance for antenatal nutrition counseling.(11) Accordingly, we conducted a single-center observational comparative study to evaluate whether maternal vegetarian versus non-vegetarian dietary patterns during pregnancy are associated with differences in neonatal FFM appropriate for gestational age (FFM-for-GA), with secondary comparisons of birth weight and length.

MATERIALS AND METHODS

Study design and setting: We performed a single-center, hospital-based observational comparative study in the Department of Pediatrics at Saveetha Institute of Medical and Technical Sciences (SIMATS), Chennai, India, from January to May 2025.

Ethics and consent: The Institutional Human Ethics Committee of SIMATS approved the protocol prior to enrolment, and all mothers provided written informed consent using a standardized information sheet and consent form.

Eligibility criteria: We included term neonates (gestational age ≥37 weeks) aged 1–10 days who were appropriate for gestational age per INTERGROWTH-21st standards and whose mothers reported consistent adherence throughout pregnancy to either a vegetarian or a non-vegetarian diet; sex matching across groups was undertaken to minimize confounding.(8,11) We excluded neonates born preterm or post-term, those with major congenital anomalies, dysmorphic features, perinatal asphyxia, or requiring intensive care, and excluded mothers with gestational diabetes, chronic hypertension, thyroid disease, or mixed dietary patterns during pregnancy.

Sample size and sampling: Based on an anticipated standardized effect size of 0.40, 80% power, and two-sided α=0.05, the minimum required sample was 150 neonates per group (plus 10% to account for attrition), recruited consecutively during the study period.

Dietary assessment and covariates: Maternal diet during pregnancy was characterized using a validated food-frequency questionnaire capturing habitual intake; we recorded total energy and macronutrients and ascertained prenatal multivitamin use, parity, socioeconomic status, and anthropometry.(12,14)

Neonatal measures: Birth weight was measured using a calibrated electronic scale and converted to weight-for-age Z-scores (WHO Anthro). Skinfolds (triceps, subscapular) were assessed with a Harpenden caliper, recording the mean of three readings. Neonatal body composition was measured with air-displacement plethysmography (Pea Pod®) and FFM was adjusted for gestational age using normative data.(8,9,11)

Outcomes: The primary outcome was FFM appropriate for gestational age (FFM-for-GA). Secondary outcomes included birth weight and birth length.(8,11)

Statistical analysis: Data were analyzed in IBM SPSS Statistics (version 28.0). Normality was assessed with the Shapiro–Wilk test. Between-group comparisons used independent t-tests or Mann–Whitney U tests for continuous variables and Chi-square or Fisher's exact tests for categorical variables, with $p<0.05$ considered statistically significant.

RESULTS

The mean maternal age in the vegetarian group was 27.45 ± 3.21 years, while in the non-vegetarian group it was 27.18 ± 3.56 years (p = 0.416). Socioeconomic status distribution was similar in both groups, with the majority of mothers belonging to the middle class (63.3% in the vegetarian group and 60.0% in the non-vegetarian group), followed by the upper and lower classes; the difference was not statistically significant (p = 0.791). Maternal height and BMI showed no significant differences between the groups, with mean heights of 156.3 ± 5.4 cm and 157.1 ± 5.9 cm (p = 0.258), and BMIs of 25.1 ± 2.4 and 25.4 ± 2.7 kg/m² (p = 0.147) in the vegetarian and non-vegetarian groups respectively. However, maternal weight was significantly higher in the non-vegetarian group (62.5 ± 6.8 kg) compared to the vegetarian group (61.2 ± 6.3 kg), with a p-value of 0.032.

The mean gestational age at delivery was comparable between the groups (38.6 ± 1.1 weeks in vegetarians vs. 38.7 ± 1.0 weeks in non-vegetarians; p = 0.482). Parity distribution was balanced, with primiparous mothers constituting 53.3% in the vegetarian group and 50.0% in the non-vegetarian group (p = 0.563). Dietary analysis revealed that total caloric intake was significantly higher in the non-vegetarian group (2140 ± 162 kcal/day) compared to the vegetarian group (2080 ± 154 kcal/day; p = 0.015). Similarly, intake of carbohydrates (328 ± 30 g/day vs. 320 ± 32 g/day; p = 0.027) and protein (61 ± 5 g/day vs. 58 ± 6 g/day; p = 0.003) were significantly greater in the non-vegetarian group. Fat intake showed a non-significant trend toward higher consumption in non-vegetarians (64 ± 7 g/day) compared to vegetarians (62 ± 8 g/day; p = 0.092). The use of prenatal multivitamins was comparable between groups, with 80.0% of vegetarian and 82.7% of non-vegetarian mothers reporting use (p = 0.553). Neonatal gender distribution was also similar, with males comprising 53.3% in the vegetarian and non-vegetarian groups (p = 1.000).

The comparison of key neonatal outcomes revealed statistically significant differences between the vegetarian and non-vegetarian groups. Neonates born to non-vegetarian mothers had a higher mean fat-free mass (2.78 ± 0.29 kg) compared to those born to vegetarian mothers (2.64 ± 0.32 kg), with a mean difference of −0.14 kg (95% CI: −0.21, −0.07; p = 0.001). Similarly, the mean birth weight was greater in the non-vegetarian group (3.12 ± 0.39 kg) than in the vegetarian group (3.01 ± 0.41 kg), yielding a statistically significant mean difference of −0.11 kg (95% CI: −0.20, −0.02; p = 0.014). Birth length was also higher among neonates in the non-vegetarian group (49.9 ± 2.2 cm) compared to the vegetarian group (49.2 ± 2.1 cm), with a mean difference of −0.70 cm (95% CI: −1.21, −0.19; p = 0.007). These findings indicate that maternal non-vegetarian diet during pregnancy is associated with significantly higher fat-free mass, birth weight, and birth length in neonates.

Table 1: Baseline characteristics of the study groups

Characteristic	Vegetarian Group (n=150)	Non-Vegetarian Group (n=150)	p-value
Maternal age (years), Mean (SD)	27.45 ± 3.21	27.18 ± 3.56	0.416
Socioeconomic status, n (%) - Upper	35 (23.3)	40 (26.7)	0.791
Socioeconomic status, n (%) - Middle	95 (63.3)	90 (60.0)	
Socioeconomic status, n (%) - Lower	20 (13.3)	20 (13.3)	
Maternal height (cm), Mean (SD)	156.3 ± 5.4	157.1 ± 5.9	0.258
Maternal weight (kg), Mean (SD)	61.2 ± 6.3	62.5 ± 6.8	0.032
Maternal BMI (kg/m²), Mean (SD)	25.1 ± 2.4	25.4 ± 2.7	0.147
Gestational age (weeks), Mean (SD)	38.6 ± 1.1	38.7 ± 1.0	0.482
Parity, n (%) - Primipara	80 (53.3)	75 (50.0)	0.563
Parity, n (%) - Multipara	70 (46.7)	75 (50.0)	
Total calories (kcal/day), Mean (SD)	2080 ± 154	2140 ± 162	0.015
Carbohydrates (g/day), Mean (SD)	320 ± 32	328 ± 30	0.027
Protein (g/day), Mean (SD)	58 ± 6	61 ± 5	0.003
Fat (g/day), Mean (SD)	62 ± 8	64 ± 7	0.092
Use of prenatal multivitamins, n (%) - Yes	120 (80.0)	124 (82.7)	0.553
Use of prenatal multivitamins, n (%) - No	30 (20.0)	26 (17.3)	
Neonatal gender, n (%) - Male	80 (53.3)	80 (53.3)	1.000
Neonatal gender, n (%) - Female	70 (46.7)	70 (46.7)	

Table 2: Comparison of study groups by Fat-Free Mass (kg), Birth Weight (kg), and Birth Length (cm)

Parameter	Vegetarian Group	Non-Vegetarian Group	Mean Difference [95% CI] / p-value
Fat-Free Mass (kg)	2.64 ± 0.32	2.78 ± 0.29	-0.14 [-0.21, -0.07] / 0.001
Birth Weight (kg)	3.01 ± 0.41	3.12 ± 0.39	-0.11 [-0.20, -0.02] / 0.014
Birth Length (cm)	49.2 ± 2.1	49.9 ± 2.2	-0.70 [-1.21, -0.19] / 0.007

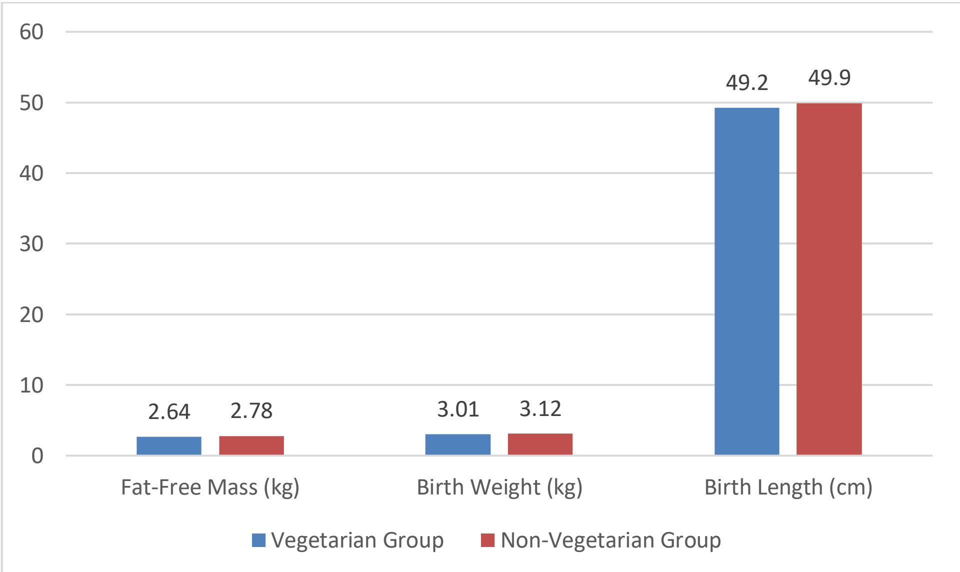

Figure 1: Comparison of study groups by Fat-Free Mass (kg), Birth Weight (kg), and Birth Length (cm)

DISCUSSION

In this comparative study, maternal dietary pattern during pregnancy was associated with meaningful differences in neonatal body composition, with non-vegetarian diets corresponding to higher FFM-for-GA, birth weight, and length. These findings highlight the biological plausibility that higher energy and high-quality protein intakes—together with superior bioavailability of iron, zinc, and vitamin B12 from animal-source foods—promote lean tissue accretion in utero.(3,4,12,13,14) The observed between-group differences persisted despite broadly similar maternal age, socioeconomic status, stature, and BMI, suggesting that dietary quality and macronutrient intake likely explained a substantial component of the association.(12,14)

Our results align with reports that maternal protein and energy intakes correlate with neonatal size and lean mass, particularly when indispensable amino acid needs are met by animal-source proteins.(4,12) From a functional perspective, FFM captures the metabolically active compartment and is therefore a more discriminating indicator of intrauterine nutrition than birth weight alone.(8) Evidence linking early body composition to later growth and metabolic risk underscores the clinical importance of optimizing neonatal FFM.(17,18,19,20,21) At the micronutrient level, vitamin B12 has emerged as a potential epigenetic modulator; low maternal status may impact DNA methylation and cellular differentiation, with downstream effects on fetal muscle and organ development.(6,7) It bears emphasis that vegetarian diets can be compatible with healthy pregnancy outcomes if carefully planned to ensure sufficient energy, high-quality protein (via complementary proteins), and targeted supplementation for nutrients at risk of inadequacy.(22) Nevertheless, routine antenatal counseling should proactively address protein quantity and quality as well as micronutrients such as vitamin B12 and iron, particularly in populations with high adherence to vegetarianism, to avoid deficits that could limit lean mass accretion.(3,10,22)

This study has limitations, including single-center design, potential residual confounding (e.g., unmeasured micronutrient biomarkers or genetic factors), and reliance on self-reported diet; however, the consistent direction and magnitude of effects across FFM, weight, and length support the internal coherence of the findings and their relevance for practice."

CONCLUSION

Non-vegetarian maternal diets, as consumed in this cohort, were associated with higher neonatal fat-free mass, birth weight, and linear size, consistent with the premise that dietary energy, high-quality protein, and bioavailable micronutrients support lean tissue accretion in utero. While well-planned vegetarian diets can be adequate, antenatal care should prioritize individualized nutrition counseling and appropriate supplementation to safeguard fetal growth and optimize neonatal body composition.

REFERENCES

1. Thayer ZM, Rutherford J, Kuzawa CW. The Maternal Nutritional Buffering Model: an evolutionary framework for pregnancy nutritional intervention. Evol Med Public Health. 2020;2020(1):14-27.
2. Godfrey KM, Reynolds RM, Prescott SL, Nyirenda M, Jaddoe VW, Eriksson JG, et al. Influence of maternal obesity on the long-term health of offspring. Lancet Diabetes Endocrinol. 2017;5(1):53-64.
3. Mariotti F, Gardner CD. Dietary Protein and Amino Acids in Vegetarian Diets-A Review. Nutrients. 2019;11(11).
4. Stephens TV, Payne M, Ball RO, Pencharz PB, Elango R. Protein requirements of healthy pregnant women during early and late gestation are higher than current recommendations. J Nutr. 2015;145(1):73-8.
5. Baroni L, Goggi S, Battino M. Planning Well-Balanced Vegetarian Diets in Infants, Children, and Adolescents: The VegPlate Junior. J Acad Nutr Diet. 2019;119(7):1067-74.
6. Socha MW, Flis W, Wartęga M. Epigenetic Genome Modifications during Pregnancy: The Impact of Essential Nutritional Supplements on DNA Methylation. Nutrients. 2024;16(5).
7. Monsen AL, Refsum H, Markestad T, Ueland PM. Cobalamin status and its biochemical markers methylmalonic acid and homocysteine in different age groups from 4 days to 19 years. Clin Chem. 2003;49(12):2067-75.
8. Jerome ML, Valcarce V, Lach L, Itriago E, Salas AA. Infant body composition: A comprehensive overview of assessment techniques, nutrition factors, and health outcomes. Nutr Clin Pract. 2023;38 Suppl 2(Suppl 2):S7-s27.
9. Ellis KJ, Yao M, Shypailo RJ, Urlando A, Wong WW, Heird WC. Body-composition assessment in infancy: air-displacement plethysmography compared with a reference 4-compartment model. Am J Clin Nutr. 2007;85(1):90-5.
10. Sebastiani G, Herranz Barbero A, Borrás-Novell C, Alsina Casanova M, Aldecoa-Bilbao V, Andreu-Fernández V, et al. The Effects of Vegetarian and Vegan Diet during Pregnancy on the Health of Mothers and Offspring. Nutrients. 2019;11(3).
11. Gallagher D, Andres A, Fields DA, Evans WJ, Kuczmarski R, Lowe WL, Jr., et al. Body Composition Measurements from Birth through 5 Years: Challenges, Gaps, and Existing & Emerging Technologies-A National Institutes of Health workshop. Obes Rev. 2020;21(8):e13033.
12. Blumfield ML, Hure AJ, Macdonald-Wicks L, Smith R, Collins CE. Systematic review and meta-analysis of energy and macronutrient intakes during pregnancy in developed countries. Nutr Rev. 2012;70(6):322-36.
13. Dror DK, Allen LH. Vitamin B-12 in Human Milk: A Systematic Review. Adv Nutr. 2018;9(suppl_1):358s-66s.
14. Papadopoulou T, Sarantaki A, Metallinou D, Palaska E, Nanou C, Diamanti A. Strict vegetarian diet and pregnancy outcomes: A systematic review and meta-analysis. Metabol Open. 2025;25:100338.
15. K CA, Basel PL, Singh S. Low birth weight and its associated risk factors: Health facility-based case-control study. PLoS One. 2020;15(6):e0234907.
16. Derbyshire E. Micronutrient Intakes of British Adults Across Mid-Life: A Secondary Analysis of

the UK National Diet and Nutrition Survey. Front Nutr. 2018;5:55.
17. Wibaek R, Vistisen D, Girma T, Admassu B, Abera M, Abdissa A, et al. Associations of fat mass and fat-free mass accretion in infancy with body composition and cardiometabolic risk markers at 5 years: The Ethiopian iABC birth cohort study. PLoS Med. 2019;16(8):e1002888.
18. Admassu B, Wells JCK, Girma T, Belachew T, Ritz C, Owino V, et al. Body composition during early infancy and its relation with body composition at 4 years of age in Jimma, an Ethiopian prospective cohort study. Nutr Diabetes. 2018;8(1):46.
19. van Beijsterveldt I, de Fluiter KS, Breij LM, van der Steen M, Hokken-Koelega ACS. Fat mass and fat-free mass track from infancy to childhood: New insights in body composition programming in early life. Obesity (Silver Spring). 2021;29(11):1899-906.
20. Amati F, McCann L, Castañeda-Gutiérrez E, Prior E, van Loo-Bouwman CA, Abrahamse-Berkeveld M, et al. Infant fat mass and later child and adolescent health outcomes: a systematic review. Arch Dis Child. 2024;109(2):125-9.
21. Pfister KM, Zhang L, Miller NC, Ingolfsland EC, Demerath EW, Ramel SE. Early body composition changes are associated with neurodevelopmental and metabolic outcomes at 4 years of age in very preterm infants. Pediatr Res. 2018;84(5):713-8.
22. Craig WJ, Mangels AR. Position of the American Dietetic Association: vegetarian diets. J Am Diet Assoc. 2009;109(7):1266-82.