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Association of Lifestyle Factors with Adverse Birth Outcomes Among Postnatal Women: A Hospital-Based Unmatched Case-Control Study in Mysuru, Karnataka

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Research Article

Keywords: Adverse birth outcomes, Lifestyle factors, Maternal health, Case-control study, Pregnancy, Public health

Posted Date: July 23rd, 2026

DOI: https://doi.org/10.21203/rs.3.rs-10378127/v1

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Additional Declarations: No competing interests reported.

Abstract

Background

Adverse birth outcomes remain a major public health concern and contribute substantially to maternal and neonatal morbidity and mortality. Maternal lifestyle factors may influence pregnancy outcomes; however, evidence examining their combined association remains limited in the Indian setting.

Methods

A hospital-based case-control study was conducted among 200 postnatal women attending JSS Hospital, Mysuru. Cases were women with adverse birth outcomes, while controls were women without adverse birth outcomes. Data on physical activity, diet, sleep, mental well-being, and socialization were collected using a structured questionnaire. Logistic regression analysis was performed to identify factors associated with adverse birth outcomes.

Results

A total of 200 postnatal women (100 cases and 100 controls) were included in the study. Women with no physical activity (OR = 3.33, 95% CI: 1.34–8.25), reduced physical activity after marriage/pregnancy (OR = 2.20, 95% CI: 1.20–4.04), inactive lifestyle before pregnancy (OR = 2.12, 95% CI: 1.17–3.84), and moderate sedentary behaviour (OR = 3.30, 95% CI: 1.38–7.90) were associated with adverse birth outcomes. Poor mental health (OR = 3.47, 95% CI: 1.86–6.46), inadequate dietary diversity (OR = 2.69, 95% CI: 1.52–4.78), poor sleep quality (OR = 2.61, 95% CI: 1.46–4.65), and poor social well-being (OR = 2.78, 95% CI: 1.50–5.15) also showed significant associations with adverse birth outcomes among the study participants.

Conclusion

Multiple modifiable lifestyle factors were significantly associated with adverse birth outcomes. Lifestyle-focused interventions may contribute to improved maternal and neonatal health outcomes.

Introduction

Adverse birth outcomes (ABOs), including preterm birth, low birth weight, stillbirth, neonatal mortality, and maternal complications, remain major public health concerns worldwide. The life-course approach to health emphasizes that exposures and behaviours before conception and during pregnancy influence maternal and neonatal outcomes across the lifespan.[1] According to the World Health Organization (WHO), an estimated 13.4 million babies were born preterm globally in 2020, representing nearly one in every ten live births.[2] In addition, more than 20 million infants are born with low birth weight annually, accounting for approximately 15–20% of all births worldwide.[9] These outcomes contribute substantially to neonatal morbidity, mortality, impaired growth, developmental disabilities, and long-term health consequences.[3,4]

Despite improvements in maternal and child health indicators, adverse birth outcomes continue to pose a significant challenge in low- and middle-income countries, including India. Maternal and newborn health remains a priority under the Reproductive, Maternal, Newborn, Child and Adolescent Health (RMNCAH + N) strategy.[5,6] Findings from the National Family Health Survey-5 (NFHS-5) indicate that low birth weight and other adverse birth outcomes continue to contribute substantially to neonatal health burdens in India.[15] Recent Indian studies have identified maternal nutritional status, socio-demographic characteristics, and reproductive factors as important determinants of adverse birth outcomes.[11,12]

The occurrence of adverse birth outcomes is multifactorial and influenced by biological, behavioural, nutritional, environmental, and psychosocial factors operating throughout the reproductive life course. Maternal health before conception, birth spacing, nutritional adequacy, and lifestyle practices during pregnancy have been recognized as important determinants of fetal growth and pregnancy outcomes.[7,13] Consequently, increasing attention has been directed toward identifying modifiable risk factors that can be addressed through preventive interventions before and during pregnancy.

Physical activity is an important component of maternal health and has been associated with improved pregnancy outcomes. Adequate physical activity during pregnancy contributes to healthy gestational weight gain, improved cardiovascular function, and better metabolic regulation, whereas physical inactivity and sedentary behaviour have been linked with adverse maternal and neonatal outcomes.[14,16] Previous evidence also suggests that physical activity before conception and during pregnancy may positively influence fetal growth and overall pregnancy health.[17,18]

Maternal nutrition plays a crucial role in fetal growth and development. Adequate dietary diversity ensures sufficient intake of essential macro- and micronutrients required for maternal physiological adaptations and optimal fetal growth. Studies from India have reported significant associations between poor dietary diversity and low birth weight, highlighting the importance of maternal nutrition during the preconception and antenatal periods.[19] Furthermore, maternal nutritional status, including body mass index (BMI), has been recognized as an important predictor of birth outcomes.[21,22]

In addition to physical and nutritional factors, psychosocial well-being is increasingly recognized as an important determinant of maternal and neonatal health. Poor sleep quality, psychological distress, and inadequate social support may negatively influence maternal health behaviours, physiological functioning, and pregnancy experiences, thereby contributing to adverse birth outcomes.[23,24] These factors are potentially modifiable and represent important targets for preventive interventions aimed at improving maternal and neonatal health.

Although several studies have examined individual determinants of adverse birth outcomes, evidence assessing multiple lifestyle dimensions simultaneously remains limited, particularly in the Indian context. Understanding the combined influence of physical activity, sleep quality, dietary diversity, mental well-being, social well-being, and maternal nutritional status is essential for developing comprehensive maternal health interventions and strengthening preventive strategies across the reproductive life course. Therefore,

the present study was undertaken to assess the association between lifestyle factors and adverse birth outcomes among postnatal women attending a tertiary care hospital in Mysuru, Karnataka.

Materials and Methods

Study Design and Setting

A hospital-based unmatched case-control study was conducted among postnatal women attending the Department of Obstetrics and Gynaecology, JSS Hospital, Mysuru, Karnataka, India, between June 2025 and May 2026. The study is reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement for case-control studies.

Study Population and Sampling

Postnatal women aged 18–45 years within two months of delivery who delivered at JSS Hospital and provided written informed consent were included. The sample size was calculated using OpenEpi Version 3.0 assuming a 95% confidence level, 80% power, 1:1 case-control ratio, 10% exposure among controls, and an odds ratio of 2.5. After accounting for non-response, 200 participants (100 cases and 100 controls) were recruited using purposive sampling.

Case and Control Definition

- **Cases** - Postnatal women with one or more adverse birth outcomes, including preterm birth (< 37 completed weeks of gestation), low birth weight (< 2500 g), neonatal complications requiring NICU admission, perinatal asphyxia, or emergency obstetric intervention.
- **Controls** Postnatal women with normal birth outcomes, defined as term birth (≥ 37 completed weeks), birth weight ≥ 2500 g, absence of NICU admission, and no emergency obstetric intervention.

Data Collection

Data were collected through face-to-face interviews using a structured questionnaire. The questionnaire was reviewed by three experts in obstetrics, epidemiology, and public health to establish content validity before data collection for content validity and pilot tested among a small group of postnatal women prior to data collection. Necessary modifications were made to improve clarity and contextual relevance. Information on socio-demographic characteristics, obstetric history, and lifestyle factors was obtained. Physical activity was assessed using an investigator-developed questionnaire; Sleep quality using a modified Pittsburgh Sleep Quality Index (PSQI); dietary diversity using a modified Minimum Dietary Diversity for Women (MDD-W) tool; mental well-being using the WHO-5 Well-Being Index; and social well-being using a modified Social Connectedness Scale. Birth outcome details were verified from hospital records

Statistical Analysis

Data were entered into Microsoft Excel and analysed using SPSS version 25. Descriptive statistics were expressed as frequencies and percentages. Associations between independent variables and adverse birth outcomes were assessed using the Chi-square test or Fisher's exact test, as appropriate. Crude odds ratios (ORs) with 95% confidence intervals (CIs) were estimated using binary logistic regression. Variables that were statistically significant in the bivariate analysis were entered simultaneously into the multivariable logistic regression model to obtain adjusted odds ratios with 95% confidence intervals. A p-value of < 0.05 was considered statistically significant.

Results

Figure 1 presents the distribution of adverse birth outcomes among the cases. Among the 100 study participants in the case group, preterm birth was observed in 75 women, NICU admission in 69, emergency obstetric intervention in 59, low birth weight in 46, and Apgar score < 7 in 41. Several women experienced more than one adverse birth outcome.

Table 1
Socio-demographic and obstetric characteristics of study participants

Variable	Category	Cases n (%)	Controls n (%)
Study participants	Total	100 (50.0)	100 (50.0)
Maternal age	Optimal maternal age	64 (64.0)	69 (69.0)
	Advanced maternal age	36 (36.0)	31 (31.0)
Education	High school	5 (5.0)	1 (1.0)
	Intermediate/Diploma	17 (17.0)	16 (16.0)
	Degree	78 (78.0)	79 (79.0)
	Postgraduate	0 (0.0)	4 (4.0)
Occupation	Unemployed	31 (31.0)	31 (31.0)
	Elementary occupation	1 (1.0)	4 (4.0)
	Plant & machine operators	2 (2.0)	1 (1.0)
	Craft & trade workers	13 (13.0)	7 (7.0)
	Skilled agriculture/fishery	4 (4.0)	2 (2.0)
	Sales/shop workers	7 (7.0)	4 (4.0)
	Clerks	16 (16.0)	8 (8.0)
	Technicians	9 (9.0)	7 (7.0)
	Professionals	16 (16.0)	33 (33.0)
	Managers	1 (1.0)	3 (3.0)
Residence	Rural	21 (21.0)	16 (16.0)
	Semi-urban	45 (45.0)	39 (39.0)
	Urban	34 (34.0)	45 (45.0)
Socioeconomic status	Upper class	0	2 (2.0)
	Upper middle class	26 (26.0)	36 (36.0)
	Middle class	45 (45.0)	33 (33.0)
	Lower Middle class	23 (23.0)	25 (25.0)
	Lower class	6 (6.0)	4 (4.0)
Gravida status	Primigravida	44 (44.0)	47 (47.0)

Variable	Category	Cases n (%)	Controls n (%)
	Multigravida	56 (56.0)	53 (53.0)
History of abortion	Yes	26 (26.0)	22 (22.0)
	No	74 (74.0)	78 (78.0)
ANC visits	> 5 visits	48 (48.0)	43 (43.0)
	3–5 visits	52 (52.0)	57 (57.0)
Mode of delivery	SVD	17 (17.0)	49 (49.0)
	Caesarean section	82 (82.0)	50 (50.0)
	Instrumental	1 (1.0)	1 (1.0)
BMI before pregnancy	Underweight	15 (15.0)	9 (9.0)
	Normal	47 (47.0)	72 (72.0)
	Overweight	37 (37.0)	19 (19.0)
	Obese	1 (1.0)	0 (0.0)
BMI at delivery	Normal	39 (39.0)	58 (58.0)
	Overweight	40 (40.0)	34 (34.0)
	Obese	21 (21.0)	8 (8.0)
Physical activity in past	Yes	75 (75.0)	83 (83.0)
	No	25 (25.0)	17 (17.0)
Physical activity/week	None	28 (28.0)	15 (15.0)
	1–2 days	30 (30.0)	22 (22.0)
	3–4 days	28 (28.0)	38 (38.0)
	≥ 5 days	14 (14.0)	25 (25.0)
Structured exercise	Yes	16 (16.0)	24 (24.0)
	No	84 (84.0)	76 (76.0)
Walking vs vehicle	Walking	34 (34.0)	38 (38.0)
	Vehicle	66 (66.0)	62 (62.0)
Physical activity reduced after marriage/pregnancy	Yes	41 (41.0)	24 (24.0)
	No	59 (59.0)	76 (76.0)
Sedentary behaviour	Low	34 (34.0)	59 (59.0)

Variable	Category	Cases n (%)	Controls n (%)
	Moderate	47 (47.0)	31 (31.0)
	High	19 (19.0)	10 (10.0)
Walk/climb stairs regularly	Yes	23 (23.0)	28 (28.0)
	No	77 (77.0)	72 (72.0)
Inactive lifestyle during weekends/holidays	Yes	58 (58.0)	61 (61.0)
	No	42 (42.0)	39 (39.0)
Active lifestyle before pregnancy	Yes	27 (27.0)	44 (44.0)
	No	73 (73.0)	56 (56.0)
Sleep status	Good sleep	31 (31.0)	54 (54.0)
	Poor sleep	69 (69.0)	46 (46.0)
Dietary diversity	MDD achieved	43 (43.0)	77 (77.0)
	MDD not achieved	57 (57.0)	23 (23.0)
Mental health	Good	52 (52.0)	79 (79.0)
	Poor	48 (48.0)	21 (21.0)
Social well-being	Present	56 (56.0)	78 (78.0)
	Absent	44 (44.0)	22 (22.0)

Table 1 presents the socio-demographic and obstetric characteristics of the study participants. Overall, cases and controls were comparable with respect to maternal age, educational status, occupation, place of residence, history of abortion, gravida status, and number of antenatal check-ups. No statistically significant differences were observed in socioeconomic status between the two groups. However, differences were observed in BMI before pregnancy, BMI at delivery, and mode of delivery between the two groups.

Table 2
Association between lifestyle factors and adverse birth outcomes

Variable	Category	Case n %	Control n%	Total	Chi square	p value
Age	Optimal maternal age	64(48.1%)	69(51.9%)	133(100%)	0.561	0.454
	Advanced maternal age	36(53.7%)	31(46.3%)	67(100%)		
Education	High School (up to 10th)	5(83.3%)	1(16.7%)	6(100%)	6.25	0.094
	Intermediate or diploma	17(51.5%)	16(48.5%)	33(100%)		
	Degree	78(49.7%)	79(50.3%)	157(100%)		
	Postgraduate	0(0%)	4(100%)	4(100%)		
Occupation	Unemployed	31(50%)	31(50%)	62(100%)	15.023	0.072
	Elementary occupation	1(20%)	4(80%)	5(100%)		
	Plant and machine operators and assemblers	2(66.6%)	1(33.3%)	3(100%)		
	Craft and related trade workers	13(65%)	7(35%)	20(100%)		
	Skilled agriculture and fishery workers	4(66.7%)	2(33.3%)	6(100%)		
	Skilled workers and shop and Market sales workers	7(63.6%)	4(36.3%)	11(100%)		
	Clerks	16(66.7%)	8(33.3%)	24(100%)		
	Technicians and associate professionals	9(56.3%)	7(43.8%)	16(100%)		
	Professionals	16(32.7%)	33(67.3%)	49(100%)		
	Legislators, senior officials and managers	1(25%)	3(75%)	4(100%)		
Place of Residence	Rural	21(56.8%)	16(43.2%)	37(100%)	2.636	0.268
	Semi Urban	45(53.6%)	39(46.4%)	84(100%)		

Variable	Category	Case n %	Control n%	Total	Chi square	p value
	Urban	34(43.0%)	45(57%)	79(100%)		
Socio economic status	Upper class	0(0%)	2(100%)	2(100%)	5.57	0.208
	Upper Middle class	26(41.9%)	36(58.1%)	62(100%)		
	Middle class	45(57.7%)	33(42.3%)	78(100%)		
	Lower Middle Class	23(47.9%)	25(52.1%)	48(100%)		
	Lower Class	6(60%)	4(40%)	10(100%)		
GPLAS - History of abortion	Yes	26(54.2%)	22(45.8%)	48(100%)	0.439	0.508
	No	74(48.7%)	78(51.3%)	152(100%)		
GPLAS - Gravida Status	Primi gravida	44(48.4%)	47(51.6%)	91(100%)	0.181	0.67
	Multi Gravida	56(51.3%)	53(48.6%)	109(100%)		
Number of antenatal checkups attended?	> 5	48(52.7%)	43(47.3%)	91(100%)	0.504	0.478
	3–5	52(47.7%)	57(52.3%)	109(100%)		
Mode of most recent delivery	Spontaneous vaginal delivery	17(25.8%)	49(74.2%)	66(100%)	23.949	0.0001
	Caesarean section	82(62.1%)	50(37.9%)	132(100%)		
	Instrumental (forceps/vacuum-assisted)	1(50%)	1(50%)	2(100%)		
BMI before pregnancy	Obese	1(100%)	0(0%)	1(100%)	13.448	0.002
	Overweight	37(66.1%)	19(33.9%)	56(100%)		
	Normal	47(39.5%)	72(60.5%)	119(100%)		
	Underweight	15(62.5%)	9(37.5%)	24(100%)		
BMI at the time of delivery	Obese	21(70%)	9(30%)	30(100%)	8.661	0.013
	Overweight	40(54.1%)	34(45.9%)	74(100%)		
	Normal	39(40.6%)	57(59.4%)	96(100%)		
Have you regularly engaged in any form of physical activity in the past (e.g., walking, sports, yoga)?	Yes	75(47.5%)	83(52.5%)	158(100%)	1.929	0.165
	No	25(59.5%)	17(40.5%)	42(100%)		

Variable	Category	Case n %	Control n%	Total	Chi square	p value
On average, how many days per week do you do physical activity (for at least 30 minutes)?	None	28(65.1%)	15(34.9%)	43(100%)	9.779	0.021
	1–2	30(57.7%)	22(42.3%)	52(100%)		
	3–4	28(42.4%)	38(57.6%)	66(100%)		
	≥ 5	14(35.9%)	25(64.1%)	39(100%)		
Do/did you participate in structured exercise (gym, yoga, aerobics, etc.)?	Yes	16(40%)	24(60%)	40(100%)	2	0.157
	No	84(52.5%)	76(47.5%)	160(100%)		
Do you prefer walking or using a vehicle for short distances?	Walking	34(47.2%)	38(52.8%)	72(100%)	0.347	0.556
	Vehicle	66(51.6%)	62(48.4%)	128(100%)		
Did your physical activity reduce after marriage or pregnancy?	Yes	41(63%)	24(36.9%)	65(100%)	6.587	0.01
	No	59(43.7%)	76(56.2%)	135(100%)		
On a typical day, how many hours do you spend sitting or reclining (excluding sleep)?	Low Sedentary	34(36.6%)	59(63.4%)	93(100%)	12.796	0.002
	Moderate Sedentary	47(60.3%)	31(39.7%)	78(100%)		
	High Sedentary	19(65.5%)	10(34.4%)	29(100%)		
Do you walk or climb stairs regularly?	Yes	23(45.1%)	28(54.9%)	51(100%)	0.658	0.417
	No	77(51.7%)	72(48.3%)	149(100%)		
During weekends/holidays, do you remain mostly inactive (watching TV/resting)?	Yes	58(48.7%)	61(51.3%)	119(100%)	0.187	0.666
	No	42(51.9%)	39(48.1%)	81(100%)		
Would you say you've had an active lifestyle in general before pregnancy?	Yes	27(38.0%)	44(62%)	71(100%)	6.311	0.012
	No	73(56.6%)	56(43.4%)	129(100%)		
Sleep(PSQI)	Good Sleep	31(36.5%)	54(63.5%)	85(100%)	10.824	0.001
	Poor Sleep	69(60%)	46(40%)	115(100%)		
Diet(MDD)	MDD Achieved	43(39.1%)	67(60.9%)	110(100%)	11.636	0.001
	MDD not achieved	57(63.3%)	33(36.7%)	90(100%)		

Variable	Category	Case n %	Control n%	Total	Chi square	p value
Mental Health(WHO-5)	Good mental well-being	52(39.7%)	79(60.3%)	131(100%)	16.13	0.0001
	Poor mental well-being	48(69.6%)	21(30.4%)	69(100%)		
Socialization(SCS Revised)	Good Social Well-being	56(41.8%)	78(58.2%)	134(100%)	10.945	0.001
	Poor Social Well-being	44(66.7%)	22(33.3%)	66(100%)		

Table 2 presents the relationship between lifestyle factors and adverse birth outcomes. Physical activity frequency, reduction in physical activity after marriage/pregnancy, sedentary behaviour, and active lifestyle before pregnancy showed significant differences between cases and controls. Sleep quality, dietary diversity, mental health status, and social well-being also differed significantly between the study groups. No significant differences were observed for past physical activity, participation in structured exercise, walking preference, regular stair climbing, or weekend inactivity.

Table 3
Regression Analysis of Factors Associated with Adverse Birth Outcomes

Variable	Category	Reference Category	Sig.	AOR	95% CI
BMI before pregnancy	Sub-optimal	Optimal	0	4.84	2.489–9.415
BMI at time of delivery	Sub-optimal	Optimal	0.029	1.976	1.073–3.639
Physical activity (days/week)	None	≥ 5 days/week	0.009	3.333	1.347–8.250
	1–2 days/week	≥ 5 days/week	0.041	2.435	1.036–5.725
	3–4 days/week	≥ 5 days/week	0.51	1.316	0.582–2.976
Physical activity reduced after marriage/pregnancy	Yes	No	0.011	2.201	1.198–4.041
Sedentary behaviour	Moderate sedentary	Low sedentary	0.007	3.297	1.375–7.904
	High sedentary	Low sedentary	0.619	1.253	0.515–3.051
Active lifestyle before pregnancy	No	Yes	0.013	2.124	1.175–3.841
Sleep	Poor sleep	Good sleep	0.001	2.613	1.466–4.658
Diet	MDD not achieved	MDD achieved	0.001	2.691	1.515–4.782
Mental health	Poor mental health	Good mental health	0	3.473	1.866–6.461
Socialization	Socially not well-being	Socially well-being	0.001	2.786	1.504–5.159

Foot note: Mode of delivery was statistically significant in bivariate analysis ($p < 0.001$) but was excluded from the multivariable logistic regression model due to potential reverse causality, as caesarean section may occur as a consequence of adverse birth outcomes rather than an antecedent exposure.

Table 3 presents the results of multivariable binary logistic regression analysis. Women with suboptimal BMI before pregnancy (AOR = 4.84, 95% CI: 2.49–9.42) and suboptimal BMI at delivery (AOR = 1.98, 95% CI: 1.07–3.64) had higher odds of adverse birth outcomes. Among lifestyle factors, women reporting no physical activity (AOR = 3.33, 95% CI: 1.34–8.25), moderate sedentary behaviour (AOR = 3.30, 95% CI: 1.38–7.90), poor mental health (AOR = 3.47, 95% CI: 1.86–6.46), poor social well-being (AOR = 2.78, 95% CI: 1.50–5.15), inadequate dietary diversity (AOR = 2.69, 95% CI: 1.52–4.78), poor sleep quality (AOR = 2.61,

95% CI: 1.46–4.65), reduced physical activity after marriage/pregnancy (AOR = 2.20, 95% CI: 1.20–4.04), and an inactive lifestyle before pregnancy (AOR = 2.12, 95% CI: 1.17–3.84) were independently associated with increased odds of adverse birth outcomes.

Discussion

The present study assessed the association between lifestyle factors and adverse birth outcomes among postnatal women. The findings demonstrated that physical inactivity, sedentary behaviour, poor sleep quality, inadequate dietary diversity, poor mental health, poor social well-being, and suboptimal maternal BMI were significantly associated with adverse birth outcomes. These findings support the growing evidence that maternal lifestyle factors during the preconception and antenatal periods influence pregnancy outcomes.

Physical inactivity and sedentary behaviour were significantly associated with adverse birth outcomes. Similar findings have been reported in previous studies, which observed that inadequate physical activity during pregnancy was associated with adverse maternal and neonatal outcomes.[14–16] Physical activity may contribute to improved maternal cardiovascular function, metabolic regulation, and placental perfusion, thereby supporting healthy fetal growth and development.

Poor sleep quality was also significantly associated with adverse birth outcomes. Previous evidence has shown that sleep disturbances during pregnancy may adversely affect maternal physiological and hormonal processes, increasing the likelihood of unfavourable pregnancy outcomes.[24] Adequate sleep is therefore an important component of maternal health and well-being.

Dietary diversity emerged as another important factor associated with birth outcomes. Women who failed to achieve minimum dietary diversity had higher odds of adverse birth outcomes. Similar findings have been reported in Indian studies examining maternal nutrition and birth outcomes.[19] Adequate dietary intake during the preconception and antenatal periods is essential for meeting the nutritional requirements necessary for fetal growth and development.

Mental health and social well-being were also significantly associated with adverse birth outcomes. Poor psychological well-being and inadequate social support may influence maternal health behaviours, stress responses, healthcare utilization, and overall pregnancy experiences. Previous studies have similarly highlighted the importance of psychosocial factors in determining maternal and neonatal health outcomes.[23]

Suboptimal maternal BMI before pregnancy and at delivery was significantly associated with adverse birth outcomes. Maternal nutritional status is an important determinant of fetal growth, and previous studies have demonstrated associations between maternal BMI and pregnancy outcomes.[21,22] Maintaining an optimal nutritional status before conception and throughout pregnancy may therefore contribute to improved maternal and neonatal health.

The findings of the present study highlight the importance of addressing modifiable lifestyle factors across the reproductive life course. Strengthening preconception care, antenatal counselling, nutrition education, physical activity promotion, and psychosocial support may contribute to reducing the burden of adverse birth outcomes and improving maternal and neonatal health.

Future prospective cohort studies and intervention trials are needed to better understand the temporal relationship between maternal lifestyle factors and adverse birth outcomes and to evaluate whether lifestyle modification before and during pregnancy can improve maternal and neonatal outcomes.

Strengths and Limitations

Adverse birth outcomes were verified using hospital records, reducing the possibility of outcome misclassification. Multiple lifestyle factors, including physical activity, sleep quality, dietary diversity, mental health, social well-being, and body mass index, were assessed within a single framework using standardized tools. However, the hospital-based design may limit the generalizability of the findings, and recall bias cannot be completely excluded due to the retrospective assessment of lifestyle behaviours.

Conclusion

The present study highlights the important role of modifiable lifestyle factors in influencing birth outcomes. Physical inactivity, sedentary behaviour, poor sleep quality, inadequate dietary diversity, poor mental health, poor social well-being, and suboptimal maternal BMI were significantly associated with adverse birth outcomes. Strengthening interventions that promote healthy lifestyles before and during pregnancy may contribute to improved maternal and neonatal health outcomes.

Declarations

Ethics approval

The study was approved by the Institutional Ethics Committee of JSS Academy of Higher Education & Research, Mysuru, Karnataka, India (IEC Approval No.: JSS/MC/PG/5836/2025–26). The study was conducted in accordance with the ethical principles of the Declaration of Helsinki.

Informed Consent

Written informed consent was obtained from all participants prior to enrolment.

Consent for publication

Not applicable.

Availability of data and materials

The datasets generated and analysed during the current study are available from the corresponding author upon reasonable request. De-identified data will be shared in accordance with institutional ethical guidelines and participant confidentiality requirements.

Competing interests

The authors declare that they have no competing interests.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Authors' contributions

NK conceptualized and designed the study, collected the data, performed the statistical analysis, interpreted the findings, and drafted the manuscript. **ASB** supervised the study, contributed to the study design, guided the interpretation of the findings, and critically reviewed the manuscript. **SK** and **KSC** contributed to the study design, provided subject expertise, and critically reviewed the manuscript. **SB** contributed to the statistical analysis, interpretation of the results, and critically reviewed the manuscript. All authors read and approved the final manuscript.

Acknowledgements

The authors sincerely thank all the study participants for their valuable time, cooperation, and contribution to this research. The authors also acknowledge the Department of Obstetrics and Gynaecology, JSS Hospital, Mysuru, and the faculty and staff of the School of Public Health, JSS Academy of Higher Education & Research, Mysuru, for their support throughout the study.

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Figures

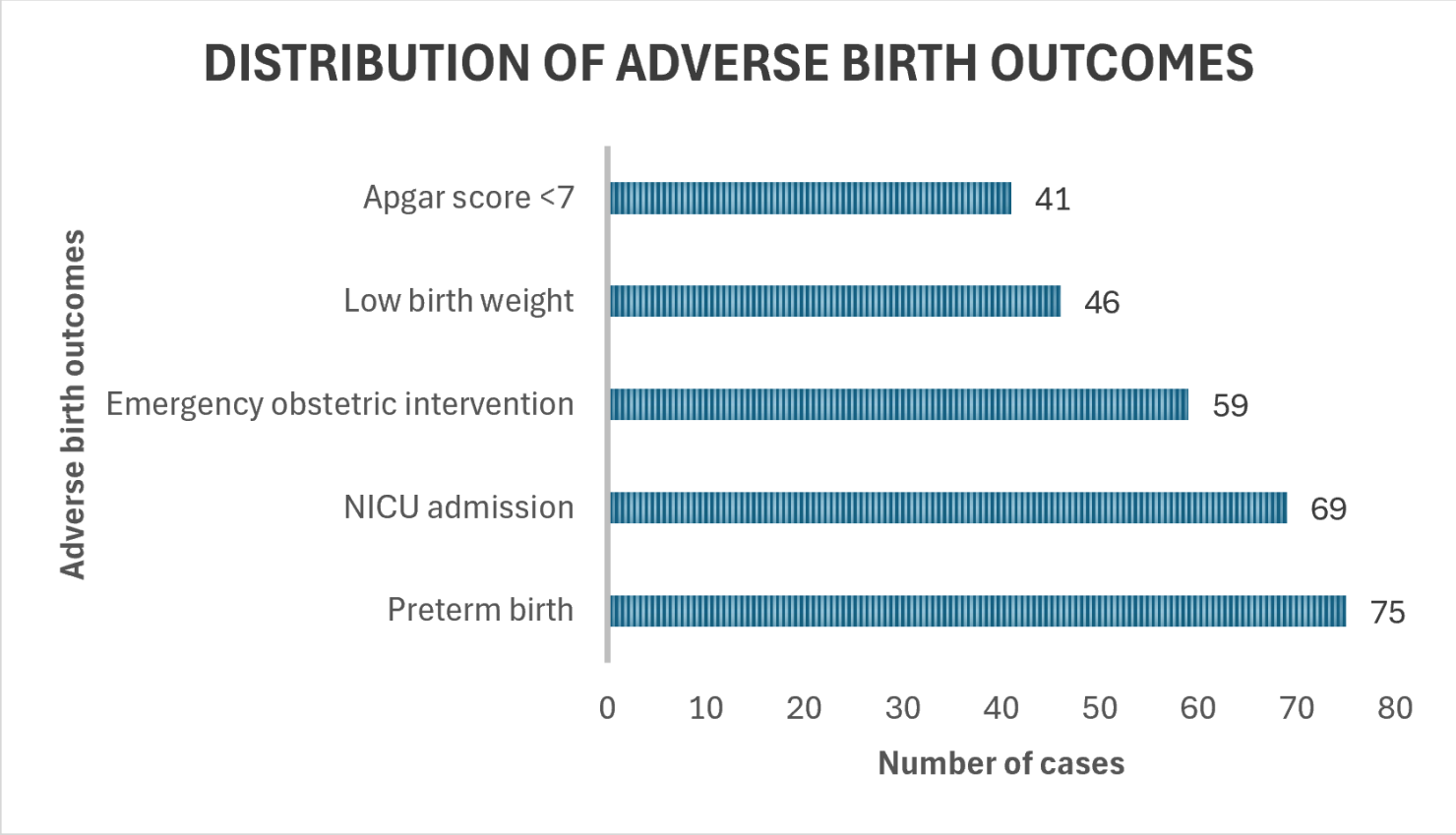


Figure 1

Distribution of adverse birth outcomes among cases (n = 100)

Note: Participants may have experienced more than one adverse birth outcome; therefore, the frequencies do not sum to the total number of cases.