Introduction

In recent years, a growing body of literatures on “foetal origins hypothesis” suggests that prenatal period is a critical time for fetal growth and thus a period of vulnerability; during which a range of exposures, including maternal psychological state, can have sustained effects across the lifespan, with implications for physical and psychiatric health through epigenetic pathways.[1,2] Evidence suggests that anxiety and stress during prenatal period has an association with low birth weight. However, studies are scarce to determine any association between maternal anxiety and fetal growth. Aims: This study aims to determine the effect of maternal anxiety on fetal growth, measured by gestational age-dependent increase in fetal abdominal circumference (AC). The secondary objective is to determine the effect of maternal anxiety on other fetal parameters (biparietal diameter [BPD], head circumference [HC], femur length [FL]).

Context: Maternal anxiety has an association with low birth weight. However, studies are scarce to determine any association between maternal anxiety and fetal growth. Aims: This study aims to determine the effect of maternal anxiety on fetal growth, measured by gestational age-dependent increase in fetal abdominal circumference (AC). The secondary objective is to determine the effect of maternal anxiety on other fetal parameters (biparietal diameter [BPD], head circumference [HC], femur length [FL]).

Settings and Design: This cross-sectional study was conducted in a tertiary care hospital, Kolkata. Materials and Methods: Four hundred and ten pregnant mothers, between 14 and 40 weeks of gestation, were interviewed with socioeconomic and obstetric profile questionnaire and examined for anthropometric profile and presence and severity of pallor. Anxiety was assessed using Generalized Anxiety Disorder-7 (GAD) questionnaire. HC, AC, BPD, and FL were measured by ultrasound biometry. Analysis Used: A multivariable logistic regression analysis was done to determine the predictors of small-for-gestational-age (SGA). A robust mediation analysis was done to determine mediating effect of anxiety on gestational age-dependent increase in fetal AC. Results: Mild (odds ratio [OR] = 6.23, [2.41, 16.15]) and moderate (OR = 22.42, [5.00, 100.57]) anxiety was significantly associated with SGA fetus. Anxiety increased with the progression of gestation (βGAD: 0.011 [0.007–0.015]) and it had a negative effect on fetal growth (standardized indirect effect of gestational age-mediated by anxiety on AC: −0.037 [−0.059, −0.022]). Anxiety also attenuated gestational age-dependent increment of HC. Conclusion: Mother’s anxiety has a gestational age-dependent temporally incremental negative effect on fetal growth and brain development.

Keywords: Anxiety, fetal growth, maternal anxiety, small for gestational age, ultrasound biometry

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weight as the outcome variable. This approach cannot establish the potential negative effect of antenatal anxiety on fetal growth and therefore there is a lack of conclusive evidence regarding the potential of preventive management of maternal anxiety through antenatal care on low birth weight, which is the ultimate outcome of growth retardation in utero.

Literature suggest that fetal growth can be estimated with considerable accuracy by measuring fetal abdominal circumference (AC), biparietal diameter (BPD), head circumference (HC), and femur length (FL) using ultrasound biometry, which is the gold standard for assessment of fetal size.\(^{[7,8]}\) In utero growth is primarily estimated by AC and AC <10\(^{th}\) percentile for gestational age is associated with poor perinatal outcome.\(^{[9]}\) In this context, we conducted this study to determine the effect of maternal anxiety on fetal growth in utero, measured by gestational age-dependent increase in fetal AC. The secondary objective of the study is to determine the effect, if any, of maternal anxiety on other fetal parameters (BPD, HC, FL) measured by ultrasound biometry.

**Subjects and Methods**

This cross-sectional study was conducted in a tertiary care hospital in Kolkata. Data were collected from all eligible mothers, who had visited the ultrasonography clinic for fetoplacental profile (USG FPP clinic) of Radiology Department, 2 days per week, selected randomly, starting from December 2014 to February 2015.

**Inclusion criteria**

Pregnant mothers having singleton live fetus of gestational age of ≥14 weeks (to avoid the possible confounding effect of beta human chorionic gonadotropin level during early pregnancy).\(^{[7,4]}\)

**Exclusion criteria**

- Gestation >40 weeks
- Elderly primi
- Known illness (e.g., diabetes, hypertension, obesity, obstructive airway disease, thrombotic disease, heart disease, chronic renal disease, and collagen vascular disease)
- Acute illness in the preceding 3 months
- Mothers who ever smoked
- History of intake of psychiatric medication (s), alcohol during current pregnancy.

**Sample size**

Considering the prevalence of small-for-gestational-age (SGA) in India as 46.9\%, the sample size was calculated to be 385.\(^{[10]}\) Among 478 pregnant women, with gestational age ≥14 weeks, who attended the department during the study, 419 were eligible, and among them, 410 consented to participate.

**Data collection**

Mothers were interviewed to obtain information regarding demographic characteristics (age, education, occupation, family type, per capita income) and obstetric history (parity, history of intraterine growth restriction, previous miscarriage or abortion) using a predesigned pretested structured questionnaire and screened for anxiety using Generalised Anxiety Disorder (GAD) 7 questionnaire.\(^{[10]}\) The height of pregnant woman was measured using standardized procedure and weight was obtained from the antenatal card and body mass index was calculated. Mothers were clinically examined to detect pallor over conjunctivae, tongue, and palms or nail beds and pallor was defined as present if found in at least two sites (one site being palm). Pallor was graded according to severity of palmar pallor.

Data regarding fetal HC, AC, BPD, and FL were obtained from USG FPP.

Observed HC, AC, BPD, and FL were compared with expected 10\(^{th}\) percentile score of HC, AC, BPD, and FL for gestational age.\(^{[10]}\) SGA fetus was defined as AC less than the 10\(^{th}\) percentile for the corresponding gestational age.

**Statistical analysis**

Bivariate analysis and multivariable backward stepwise logistic regression analyses were done including all the explanatory variables to determine their association with SGA. For logistic regression, maternal anxiety was transformed into three-level ordinal variable: No (GAD ≤5), mild (GAD ≤10), moderate (GAD ≤15), and severe (GAD >15) anxiety. Sobel test was performed to determine any mediating effect of anxiety on the relationship between gestational age and AC. Based on the result of Sobel test, a robust mediation analysis was done including gestational age as the independent variable, anxiety as the mediating variable, AC as the outcome variable and taking all other explanatory variables as covariates. Secondary outcome analyses were carried in a similar manner for all other fetal parameters.

All analyses were done using IBM SPSS version 20 (IBM Corp. Released 2011. Armonk, NY: IBM Corp.) and Hayes’ Process Tool.

**Ethical consideration**

PNDT act was strictly followed while performing USG. Ethical permission was obtained from the Institute Ethics Committee.

**Results**

Table 1 shows the baseline characteristics of the study participants. About 60% of the mothers had no anxiety, 36% had mild and 3% had moderate anxiety. None of the participants had severe anxiety.

13.41% of the fetuses were SGA. While the proportion of not anxious mothers having SGA fetus was only 3.21%, the proportion was 26.35% and 61.35% for mothers with mild and moderate anxiety, respectively [Table 2].

Lower maternal age, heavy work, higher parity, joint family, pallor, and anxiety (both mild and moderate) were found
to be associated with SGA on bivariate analysis. In the adjusted model, only mild (odds ratio [OR] \( \text{Adjusted} = 1.16, [0.42, 3.19] \)) and moderate pallor (OR \( \text{Adjusted} = 4.74, [1.52, 14.79] \)) and mild (OR \( \text{Adjusted} = 6.23, [2.41, 16.15] \)) and moderate (OR \( \text{Adjusted} = 22.42, [5.00, 100.57] \)) anxiety were significantly associated with SGA [Table 3].

Maternal anxiety had a significant mediating effect on the relationship between gestational age and AC in Sobel test (effect = −0.054 ± 0.013; \( P < 0.000 \)). In mediation analyses, maternal anxiety was found to be increased with the progression of gestation (β \( \text{GAD} = 0.011 [0.007–0.015] \)) and anxiety had a negative effect on fetal growth (standardized indirect effect of gestational age-mediated by anxiety on AC: −0.037 [−0.059, −0.022]) with a small effect size (ratio of indirect to direct effect: −0.037 [−0.058, −0.022]). Increased maternal age, higher per capita income and increased level of mother’s education was associated with less anxiety; while heavy work during pregnancy and presence of pallor predicted higher anxiety [Table 4 and Figure 1].

In secondary outcome analysis mild (OR \( \text{Adjusted} = 4.90, [2.30, 10.41] \)) and moderate (OR \( \text{Adjusted} = 9.92, [3.93, 25.04] \)) pallor and mild anxiety (OR \( \text{Adjusted} = 4.36, [2.18, 8.73] \)) had significant association with small fetal BPD for gestational age. No association was found between maternal anxiety and small FL for gestational age [Supplementary Table 1].

Anxiety was statistically significant mediator of the relationship between gestational age and HC (Sobel test: Effect: −0.041 ± 0.01; \( P = 0.0000 \)) (standardized indirect effect: −0.032 [−0.05, −0.02]; ratio of indirect to direct effect: −0.035 [−0.049, −0.020]) [Supplementary Table 2].

### Table 1: Background characteristics of the study population (n=410)

| Characteristics | Categories | Frequency (%) |
|----------------|------------|---------------|
| Age*           | Below primary | 26.15 (3.81) |
| Education (completed) | Primary | 39 (9.51) |
|                | Middle     | 136 (33.17) |
|                | Secondary and above | 166 (40.49) |
|                | Heavy      | 69 (16.83) |
| Occupation     | Sedentary  | 289 (70.49) |
|                | Moderate   | 24 (5.91) |
|                | Heavy      | 38 (9.27) |
| Per capita income (Rs./month) | <842 (Prasad’s social Class V**) | 1 (0.24) |
|                | 842-1684 (Prasad’s social Class IV) | 22 (5.37) |
|                | 1685-2807 (Prasad’s social Class III) | 100 (24.39) |
|                | 2808-5614 (Prasad’s social Class II) | 268 (65.37) |
|                | >5614 (Prasad’s social Class I) | 19 (4.63) |
| Family type    | Nuclear    | 254 (61.95) |
|                | Joint      | 168 (40.49) |
|                | 28-40      | 244 (59.51) |
| Parity         | 0          | 190 (46.34) |
|                | 1          | 24 (5.83) |
|                | 2          | 110 (26.83) |
|                | 3 or more  | 19 (4.63) |
| Height*        | Absent     | 166 (40.49) |
|                | Mild       | 192 (46.83) |
|                | Moderate   | 52 (12.68) |

*For continuous variables mean±SD has been mentioned. **Modified BG Prasad scale 2014 has been used for determination of social class. SD: Standard deviation

### Table 2: Distribution of small-for-gestational age foetus with respect to maternal anxiety in the study population (n=410)

| Maternal anxiety | SGA absent, n (%) | SGA present, n (%) | Total, n (%) |
|------------------|--------------------|--------------------|-------------|
| Absent           | 241 (96.79)        | 8 (3.21)           | 249 (60.73) |
| Mild             | 109 (73.65)        | 39 (26.35)         | 148 (36.10) |
| Moderate         | 5 (38.46)          | 8 (61.54)          | 13 (3.17)  |
| Total            | 355 (86.59)        | 55 (13.41)         | 410         |

SGA: Small-for-gestational age

### Figure 1: Relationship between gestational age, maternal anxiety, and fetal abdominal circumference in the presence of different cofactors (n = 410)

Discussion

We found that anxiety and pallor were significant predictors of growth restriction in fetus. In addition, the explained variability in the risk factor model was largely improved on modeling the gestational age-dependent confounding effect of anxiety on fetal growth. In this model, we found that antenatal anxiety increased with the advancement of pregnancy and had a negative effect on fetal AC. This implied that anxiety had a time-dependent incremental negative effect on fetal growth. A similar effect of anxiety was found on fetal HC. This finding was also in line with the finding that fetal BPD was significantly less in the presence of prenatal anxiety. In addition, we found that antenatal anxiety was significantly less among mothers with higher age, higher per capita monthly income, and higher level of education, while mothers having pallor and mothers involved in heavier work had higher anxiety.

The findings of our study support the evidence laid down by previous researchers that prenatal anxiety and fetal growth restriction were correlated. However, our study extended the available knowledge by implying that maternal anxiety was not an attribute with fixed level and that its negative effect on fetal growth was incremental with respect to gestational age.
Moreover, the negative effect of anxiety on fetal HC and BPD implied a poor neurodevelopmental outcome including low IQ among children of anxious mothers, which corroborated with past evidence.\textsuperscript{[15],[16]} Our study additionally extended the knowledge that more prolonged was the prenatal anxiety, the more grievous impact it would have on the brain development of the fetus.

The biologically plausible explanation of the negative effect of maternal anxiety on fetal growth can be implied by the role of increased cortisol level during anxiety and stress in altering fetoplacental circulation.\textsuperscript{[12],[17]}

The findings also implied that improvement in educational and financial status of women, delayed age of pregnancy, and less heavy work during pregnancy and reduction of anemia would reduce the mother’s anxiety during antenatal period and improve fetal outcome. This implication supported the available evidence that provision for social support among pregnant mothers to reduce life stress were necessary for better birth outcome.\textsuperscript{[18]}

The design being cross-sectional the establishment of a causal effect of maternal anxiety on fetal growth is subject to further investigation. In addition, we described anemia during pregnancy with the presence of pallor only. Hemoglobin estimation was not possible due to limited resources. Assessment of maternal anxiety was limited to assessment by GAD 7 only. The implication that anxiety increases temporally with advancing gestation is subject to further confirmation by longitudinal studies serially estimating anxiety of the same mother at different ages of gestation.

On balance, our study informs the policy that the existing programs on maternal and child health should integrate with mental health programs to prevent anxiety during pregnancy and to provide early diagnosis and adequate treatment to anxious mothers to improve fetal growth, and brain development and prevent low birth weight. The role of the frontline workers in improving the family climate by counseling the family members and thereby reducing the stress among pregnant mothers may be investigated for a cost-effective solution.

**Acknowledgment**

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**Table 3: Association of small-for-gestational age with explanatory variables: Bivariate and multivariate analyses (n=410)**

| Explanatory variables (reference category) | Categories | OR** | CI       | AOR*** | 95% CI       |
|-------------------------------------------|------------|------|----------|--------|--------------|
| Age                                       | Per year increase | 0.80 | 0.73-0.88 |        |              |
| Education (secondary and above)            | Below      | 2.62 | 0.97-7.04 |        |              |
|                                          | Primary    | 1.08 | 0.46-2.54 |        |              |
|                                          | Middle     | 0.71 | 0.30-1.70 |        |              |
| Occupation (sedentary)                    | Moderate   | 0.53 | 0.06-9.49 |        |              |
|                                          | Heavy      | 4.13 | 1.45-11.80|        |              |
| Per capita income                         | Per rupee increase | 1.00 | 1.00-1.00 |        |              |
| Family type (nuclear)                     | Joint      | 2.97 | 1.66-5.31 |        |              |
| Parity                                    | Per unit increase | 0.43 | 0.29-0.65 |        |              |
| Height                                    | Per centimeter increase | 0.97 | 0.91-1.04 |        |              |
| Pallor (no pallor)                        | Mild pallor | 2.94 | 1.22-7.07 | 1.16   | 0.42-3.19   |
|                                          | Moderate pallor | 22.71 | 8.95-57.68 | 4.74   | 1.52-14.79  |
| Anxiety (no anxiety)                      | Mild anxiety | 10.78 | 4.87-23.84 | 6.23   | 2.41-16.15  |
|                                          | Moderate anxiety | 48.20 | 12.86-180.58 | 22.42   | 5.00-100.57 |

\textsuperscript{a}Reference categories of the categorical variables have been shown in the parenthesis. **ORs for bivariate analyses have been shown in the OR column. ***AOR at the final step of multiple LR (backward LR) has been shown in the AOR column. Hosmer-Lemeshow test: \( \chi^2 (df) = 48.20, P = 0.049 (3) \), Nagelkerke R\(^2\) = 0.32. ORs: Odds ratios; CI: Confidence interval; AOR: Adjusted odds ratio; LR: Logistic regression

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**Table 4: Time-varying (gestational age-dependent) confounding effect of mother’s anxiety on fetal abdominal circumference: Result of mediation analysis (n=410)**

| Models (outcome: Fetal AC) | Models (outcome: Mother’s GAD score) | \( \beta_{GAD} \) | \( \beta_{AC} \) |
|---------------------------|-------------------------------------|------------------|------------------|
| Model 1                   | Gestational age (days)               | 0.011 (0.007-0.015) | 1.39 (1.34-1.43) | 1.44 (1.40-1.48) |
| Model 2                   | Mother’s age (years)                | -0.22 (-0.27-0.17) | 0.57 (0.08-1.05) | -1.4 (-2.7-0.2) |
|                           | Per capita monthly income (in 1000 Rupees) | -0.5 (-0.7-0.4) | -1.4 (-2.7-0.2) | -1.4 (-2.7-0.2) |
|                           | Mother’s education (years of schooling) | -0.15 (-0.27-0-0) | 2.82 (1.31-4.33) | 2.10 (0.66-3.54) |
|                           | Mother’s occupation (each level increase from sedentary work) | 0.24 (0.12-0.37) | -2.20 (-3.61-0.79) | -1.79 (-3.54-0.03) |
|                           | Parity                               | 0.65 (0.39-0.91)  | -8.02 (-10.89-5.15) | -4.85 (-7.52-2.18) |
|                           | Pallor                               | 1.2 (0.2-2.2)     | -1.79 (-3.54-0.03) | -4.88 (-6.24-3.51) |
|                           | Mother’s anxiety (GAD score)         | -8.95-57.68       | 8.47-31.16       | 2.94 (0.73-0.88) |

\( \beta_{GAD} \): Coefficient in model with mother’s GAD score as outcome; \( \beta_{AC} \): Coefficient in model with fetal AC as outcome. Only statistically significant coefficients have been displayed in the table. Variables included: Gestational age, mother’s age, maternal education, maternal occupational severity, per capita monthly income, family type, parity, grade of pallor. GAD: Generalized anxiety disorder; AC: Abdominal circumference.
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Conflicts of interest
There are no conflicts of interest.

References
1. Almond D, Currie J. Killing me softly: The fetal origins hypothesis. J Econ Perspect 2011;25:153-72.
2. Kinsella MT, Monk C. Impact of maternal stress, depression and anxiety on fetal neurobehavioral development. Clin Obstet Gynecol 2009;52:425-40.
3. Dunkel Schetter C, Tanner L. Anxiety, depression and stress in pregnancy: Implications for mothers, children, research, and practice. Curr Opin Psychiatry 2012;25:141-8.
4. Evans J, Heron J, Francomb H, Oke S, Golding J. Cohort study of depressed mood during pregnancy and after childbirth. BMJ 2001;323:257-60.
5. Chauhan SP, Cole J, Sanderson M, Magann EF, Scardo JA. Suspicion of intrauterine growth restriction: Use of abdominal circumference alone or estimated fetal weight below 10%. J Matern Fetal Neonatal Med 2006;19:557-62.
6. Williams KP, Nwebube N. Abdominal circumference: A single measurement versus growth rate in the prediction of intrapartum Cesarean section for fetal distress. Ultrasound Obstet Gynecol 2001;17:493-5.
7. Shiefa S, Amargandhi M, Bhupendra J, Moulali S, Kristine T. First trimester maternal serum screening using biochemical markers PAPP-A and free ß-hCG for down syndrome, patau syndrome and edward syndrome. Indian J Clin Biochem 2013;28:3-12.
8. Leung TY, Chan LW, Leung TN, Fung TY, Sahota DS, Lau TK. First-trimester maternal serum levels of placental hormones are independent predictors of second-trimester fetal growth parameters. Ultrasound Obstet Gynecol 2006;27:156-61.
9. Black RE. Global prevalence of small for gestational age births. Nestle Nutr Inst Workshop Ser 2015;81:1-7.
10. Spitzer RL, Kroenke K, Williams JB, Löwe B. A brief measure for assessing generalized anxiety disorder: The GAD-7. Arch Intern Med 2006;166:1092-7.
11. Papageorghiou AT, Ohuma EO, Altman DG, Todros T, Cheikh Ismail L, Lambert A, et al. International standards for fetal growth based on serial ultrasound measurements: The fetal growth longitudinal study of the INTERGROWTH-21st project. Lancet 2014;384:869-79.
12. Diego MA, Jones NA, Field T, Hernandez-Reif M, Schanberg S, Kuhn C, et al. Maternal psychological distress, prenatal cortisol, and fetal weight. Psychosom Med 2006;68:747-53.
13. Uguz F, Gezginc K, Yazici F. Are major depression and generalized anxiety disorder associated with intrauterine growth restriction in pregnant women? A case-control study. Gen Hosp Psychiatry 2011;33:640.e7-9.
14. Rondó PH, Ferreira RF, Nogueira F, Ribeiro MC, Lobert H, Artes R. Maternal psychological stress and distress as predictors of low birth weight, prematurity and intrauterine growth retardation. Eur J Clin Nutr 2003;57:266-72.
15. Gale CR, O’Callaghan FJ, Bredow M, Martyn CN; Avon Longitudinal Study of Parents and Children Study Team. The influence of head growth in fetal life, infancy, and childhood on intelligence at the ages of 4 and 8 years. Pediatrics 2006;118:1486-92.
16. Henrichs J, Schenk JJ, Roza SJ, van den Berg MP, Schmidt HG, Steegers EA, et al. Maternal psychological distress and fetal growth trajectories: The Generation R Study. Psychol Med 2010;40:633-43.
17. Hompes T, Vrieze E, Fieuws S, Simons A, Jaspers L, Van Bussel J, et al. The influence of maternal cortisol and emotional state during pregnancy on fetal intrauterine growth. Pediatri Res 2012;72:305-15.
18. Feldman PJ, Dunkel-Schetter C, Sandman CA, Wadhwa PD. Maternal social support predicts birth weight and fetal growth in human pregnancy. Psychosom Med 2006;62:715-25.
### Supplementary Table 2: Time-varying (gestational age-dependent) confounding effect of mother’s anxiety on fetal head circumference: Result of mediation analysis (n=410)

| Models | Variables | $\beta_{GAD}$ | $\beta_{HC}$ |
|--------|-----------|----------------|---------------|
|        |           | Not adjusted for GAD | Adjusted for GAD |
| Model 2 (outcome: fetal HC) | Model 1 (outcome: GAD score) | Gestational age (days) | 0.011 (0.007-0.015) | 1.23 (1.19-1.27) | 1.27 (1.23-1.31) |
|        |           | Mother’s age (years) | -0.22 (−0.27−0.17) | -0.49 (−0.90−0.08) |
|        |           | Per capita monthly income (1000 Rs.) | -0.5 (−0.7−0.4) | 1.4 (0.6-2.3) |
|        |           | Mother’s education (years of schooling) | -0.15 (−0.27−0.02) | 2.11 (0.86-3.37) | 1.56 (0.36-2.76) |
|        |           | Mother’s occupation (each level increase from sedentary work) | 0.24 (0.12-0.37) | -2.20 (−3.61−0.79) | -1.61 (−2.72−0.50) |
|        |           | Pallor | 0.65 (0.39-0.91) | -4.73 (−7.03−2.44) | -2.30 (−4.42−0.18) |
|        |           | Mother’s anxiety (GAD score) | 0.65 (0.39-0.91) | -4.73 (−7.03−2.44) | -3.74 (−4.68−2.81) |

$\beta_{GAD}$: Coefficient in model with mother’s GAD score as outcome; $\beta_{HC}$: Coefficient in model with fetal HC as outcome. Only statistically significant coefficients have been displayed in the table.

Variables included: Gestational age, mother’s age, maternal education, maternal occupational severity, per capita monthly income, family type, parity of the mothers, grade of pallor, maternal height, and maternal anxiety. AOR: Adjusted odds ratio; CI: Confidence interval; LR: Logistic regression

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### Supplementary Table 1: Association of dichotomized fetal biometric outcomes with explanatory variables:

Multivariate analyses (n=410)

| Explanatory variables (reference category*) | Categories | Biparietal diameter* | Femur length* |
|------------------------------------------|------------|---------------------|---------------|
|                                          |            | AOR 95% CI         | AOR 95% CI    |
| Parity                                   | One unit increase | - | - |
| Occupation (heavy)                       | Moderate   | - - 0.00 0.00 | - |
|                                          | Sedentary  | - 0.31 0.11-0.89  |
| Pallor (no)                              | Mild       | 4.90 2.30-10.41 | - |
|                                          | Moderate   | 9.92 3.93-25.04 | - |
| Anxiety (no)                             | Mild       | 4.36 2.18-8.73 | - |
|                                          | Moderate   | 4.29 0.94-19.55 | - |

*Reference categories of the categorical variables have been shown in the parenthesis. Goodness-of-fit of final model: Hosmer-Lemeshow test: $\chi^2$(8), P = 0.07, Nagelkerke R² = 0.19. Hosmer-Lemeshow test: $\chi^2$(8), P = 0.18, Nagelkerke R² = 0.11. Variables entered at step 1 for all the backward LR were: mother’s age, maternal education, maternal occupational severity, per capita monthly income, family type, parity of the mothers, grade of pallor, maternal height, and maternal anxiety. AOR: Adjusted odds ratio; CI: Confidence interval; LR: Logistic regression.