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Original article

Prevalence and predictors of fetal macrosomia in southern Vietnam: A cross-sectional study

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Abstract. *Background and aim:* Macrosomia, defined as a birth weight of ≥3,500 grams, presents significant health risks for both mothers and newborns. This study aimed to determine the prevalence and associated risk factors of macrosomia among women delivering at 37 weeks or more at Vinh Long General Hospital in the Mekong Delta, Vietnam. *Methods:* A cross-sectional study was conducted from September 2022 to June 2023, including 1,500 participants. Maternal characteristics and pregnancy-related factors were analyzed to identify associations with macrosomia. *Results:* The prevalence of macrosomia was 36%, exceeding global averages. Key maternal risk factors included advanced gestational age (≥40 weeks, OR = 1.3, 95% CI: 1.4–2.5, p = 0.02), parity (OR = 12.4 for single delivery, OR = 3.7 for multiparous women, p < 0.01), and a history of macrosomia (OR = 3.9, p = 0.01). Pre-pregnancy BMI ≥25 kg/m² and excessive gestational weight gain increased the risk by 20.9-fold and 32-fold, respectively. *Conclusions:* This study highlights the high prevalence of macrosomia in the Mekong Delta and underscores the importance of maternal weight management and prenatal care. Targeted interventions, including nutritional counseling and early risk assessment, are crucial, especially in rural areas with limited healthcare access. The cross-sectional design limits causal inferences, necessitating future longitudinal studies to assess the long-term effects of maternal health interventions and develop effective prevention strategies. Expanding research to other regions in Vietnam and similar low-resource settings can provide a broader perspective on macrosomia prevention and management. (www.actabiomedica.it)

Key words: macrosomia, maternal health, obesity, parity, vietnam

Introduction

Pregnancy and childbirth are transformative experiences but come with significant risks for both mothers and newborns. One of the primary concerns during pregnancy is fetal weight development, as deviations from normal weight—whether underweight or overweight—can lead to serious, long-term health consequences for the child (1, 2). While awareness of maternal nutrition has increased, excessive nutritional intake may result in maternal overweight, obesity, glucose intolerance, and ultimately fetal macrosomia. This condition poses considerable challenges for obstetric management and is associated with severe complications for both the mother and the newborn. Macrosomia, despite receiving less attention than small-for-gestational-age (SGA) births, can cause prolonged labor, increased risks of cesarean delivery, severe perineal injuries, and postpartum hemorrhage in mothers. For newborns, macrosomia is linked to birth trauma, clavicle fractures,

brachial plexus injuries, respiratory distress, hypoglycemia, and hypocalcemia. Long-term consequences include heightened risks of obesity and type 2 diabetes (2, 3). Although ultrasound is widely adopted for fetal weight estimation, its limited predictive value for macrosomia, especially in resource-limited settings, highlights a critical gap in preventive strategies. Current research remains limited in exploring region-specific maternal risk factors in rural Southeast Asia, necessitating studies that provide locally relevant data to inform clinical practice. Understanding the factors contributing to macrosomia is critical for developing targeted and effective prenatal care plans, thereby mitigating potential complications (4-7). Vinh Long General Hospital, a provincial-level tertiary care center, provides obstetric services to a predominantly rural population in the Mekong Delta. While serving as a referral center, it also functions as a primary obstetric care provider for surrounding districts. Therefore, this study aims to determine the prevalence of macrosomia and identify associated maternal and pregnancy-related factors among women delivering at ≥37 weeks in a regional hospital in the Mekong Delta, Vietnam.

Materials and Methods

Study subjects

This study included all women who delivered at a gestational age of 37 weeks or more at Vinh Long General Hospital between September 2022 and June 2023. Participants were selected based on predefined inclusion criteria and provided informed consent to participate. The study employed a cross-sectional descriptive design with analytical components to explore the prevalence and associated risk factors of macrosomia. A total of 1,500 women meeting the inclusion criteria were enrolled in the study. The sample size of 1,500 was calculated based on an expected prevalence of macrosomia of 25%, derived from previous regional studies in Southeast Asia reporting prevalence ranging from 20% to 30% (1, 8). The research was conducted at the Obstetrics Department of Vinh Long General Hospital, which serves as a primary healthcare provider for women in the Mekong Delta region. Data collection occurred over a 10-month period, from September 2022 to June 2023.

Inclusion and exclusion criteria

The study included women delivering at a gestational age of 37 weeks or more, as determined by their last menstrual period or a first-trimester ultrasound. Only participants with singleton pregnancies in cephalic presentation were eligible. Comprehensive prenatal records containing all necessary clinical information were required, and all participants provided informed consent to take part in the study. Exclusion criteria were established to ensure data validity and consistency. Exclusion criteria included women with multiple gestations, known fetal anomalies, or incomplete clinical data. Stillbirths were excluded to ensure analysis of live-born infants with accurate birth weights. These criteria were designed to focus on pregnancies with the potential for macrosomia without confounding factors.

Data collection

Pre-pregnancy weight and height were obtained from prenatal medical records documented during the first trimester. If unavailable, measurements taken at the first antenatal visit were used as proxies. Ultrasound examinations performed within 72 hours before delivery was intended to assess fetal position and growth, but fetal weight estimation data were not included in the final analysis due to inconsistency and variability in recording. Neonatal weights were measured immediately after birth, with neonates weighing ≥3,500 grams included in the analysis of macrosomia prevalence and associated factors. To ensure accurate neonatal weight measurements, newborns were wrapped in a cloth for warmth and placed on a mechanical scale. The combined weight of the cloth and cord clamp, approximately 200 grams, was subtracted from the total recorded weight to calculate the precise neonatal weight. This method ensured standardized and reliable measurements for all participants. Excessive gestational weight gain was defined according to the Institute of Medicine (IOM) 2009 guidelines (9). Pre-pregnancy BMI was categorized based on WHO Asia-Pacific criteria (10).

Statistical analysis

Statistical analyses were performed using SPSS version 20.0. Qualitative variables were summarized as frequencies and percentages to provide a clear distribution of categorical data. Quantitative variables were described using means and standard deviations to convey central tendencies and variability within the dataset. A p-value of less than 0.05 was set as the threshold for statistical significance, ensuring that the results were robust and reflective of meaningful associations between the studied variables. Univariate logistic regression was initially performed to estimate crude odds ratios (OR) and 95% confidence intervals (CI) for associations between macrosomia and potential risk factors. Variables with a p-value <0.2 in univariate analysis were subsequently included in a multivariate logistic regression model to determine independent predictors of macrosomia. Adjusted odds ratios (aORs) with 95% CIs were reported. P-values were derived from Wald tests within the regression framework. A two-tailed p-value <0.05 was considered statistically significant.

Ethics approval of research

Ethical clearance for the study was obtained from the Biomedical Research Ethics Committee, Can Tho University of Medicine and Pharmacy (reference number 22. 161.HV-DHYDCT).

Results

Maternal and neonatal characteristics

The study analyzed maternal and neonatal data to assess demographic characteristics, residential distribution, and neonatal weight patterns. Maternal age ranged widely, with the majority of participants (77.5%) being between 19 and 34 years old, aligning with the typical reproductive age group. Women aged 35 years or older accounted for 18.1% of the study population, while those under 18 years comprised a smaller proportion at 4.4%. The mean maternal age was 28.1 ± 6.4 years, with the youngest participant aged 14 years and the oldest 46 years, highlighting a broad age spectrum among the study cohort. In terms of residential distribution, most participants (87.1%) resided in rural areas, reflecting the geographic and socioeconomic characteristics of the Mekong Delta region. A smaller percentage (12.9%) lived in urban areas, which may indicate disparities in healthcare accessibility and service utilization between rural and urban populations. Neonatal weights varied considerably, with an average of 3,289.47 ± 374.5 grams. Recorded neonatal weights ranged from a minimum of 2,500 grams to a maximum of 4,250 grams, demonstrating variability in fetal growth outcomes. Macrosomia was prevalent in the study population, with 32.3% (484 neonates) weighing ≥3,500 grams. Of these, 3.8% (57 neonates) had birth weights of ≥4,000 grams, underscoring the significance of macrosomia as a clinical concern in this cohort. These findings provide crucial insights into the demographic and clinical profiles of the study population, contributing to a better understanding of macrosomia and its associated factors in the region.

Factors associated with macrosomia

The analysis of factors associated with macrosomia highlights significant relationships with gestational age, parity, maternal history of macrosomia, and anthropometric characteristics. As shown in Table 1, gestational age ≥40 weeks was associated with a higher prevalence of macrosomia (21.4%) compared to <40 weeks (78.6%), with an odds ratio (OR) of 1.3 (95% CI: 1.4–2.5, p = 0.02). Parity exhibited a strong correlation, as women with a history of one delivery had an OR of 12.4 (95% CI: 9.3–16.4, p < 0.01), while multiparous women with two or more prior deliveries showed an OR of 3.7 (95% CI: 2.4–5.7, p < 0.01). A history of macrosomia significantly increased the risk for subsequent macrosomia. Among women with prior macrosomic births, 27.1% had macrosomia in the current pregnancy compared to only 7.0% in those without such history (OR = 3.9, 95% CI: 14.6–26.05, p = 0.01). These findings, detailed in Table 1, emphasize the importance of monitoring women with prolonged gestational age, higher parity, and prior macrosomic deliveries.

Maternal anthropometric factors, as shown in Table 2, further illustrate the role of pre-pregnancy BMI and gestational weight gain in macrosomia.

Table 1. Univariate Analysis of Factors Associated with Macrosomia

Characteristic	Macrosomia (n=541)	Normal Weight (n=959)	OR (95% CI)	p-value
Gestational Age				
<40 weeks	425 (78.6%)	800 (83.4%)	1.3 (1.4–2.5)	0.02
≥40 weeks	116 (21.4%)	159 (16.6%)		
Parity				
Primiparous	80 (14.8%)	614 (64.0%)	-	-
Single delivery	419 (77.4%)	259 (27.0%)	12.4 (9.3–16.4)	<0.01
Multiparous (≥2 deliveries)	42 (7.80%)	86 (9.00%)	3.7 (2.4–5.7)	<0.01
History of Macrosomia				
Yes	125 (27.1%)	24 (7.00%)	3.9 (14.6–26.05)	0.01
No	336 (72.9%)	321 (93.0%)		

Women with a BMI of 18.5–22.9 kg/m² were less likely to have macrosomic births (OR = 0.226, 95% CI: 0.116–0.441, p < 0.01). In contrast, those with a BMI of 23.0–24.9 kg/m² and ≥25 kg/m² had significantly elevated risks, with ORs of 2.4 (95% CI: 1.2–4.7, p = 0.007) and 20.9 (95% CI: 9.1–48.1, p < 0.01). Excessive gestational weight gain was a particularly strong predictor, observed in 94.8% of macrosomic cases compared to 36% of normal-weight cases, resulting in a 32-fold increased risk (p < 0.01).

The diagnostic cut-off for pre-pregnancy BMI was determined to be 23.0, with a sensitivity of 81.3% and specificity of 76%. These findings, drawn from Table 2, underscore the critical importance of maternal weight management and timely prenatal interventions in mitigating macrosomia risks.

Multivariate logistic regression analysis identified several independent predictors of macrosomia (Table 3). After adjusting for potential confounders, advanced gestational age (≥40 weeks), single delivery parity, a history of macrosomia, pre-pregnancy BMI ≥25 kg/m², and excessive gestational weight gain remained significantly associated with increased odds of macrosomia.

Discussion

The majority of participants in this study were aged between 19 and 34 years (77.5%), a range consistent with other studies of reproductive age groups in Vietnam. The mean maternal age was 28.1 ± 6.4 years, with a broad spectrum spanning 14 to 46 years. Advanced maternal age (≥35 years), often linked to an increased risk of macrosomia, accounted for 18.1% of participants. Although this study did not find a significant correlation between maternal age and macrosomia prevalence, prior research has reported a 3.5-fold increased risk in mothers aged over 30 years, potentially due to age-related conditions such as gestational diabetes and preeclampsia (1, 11, 12). Most participants resided in rural areas (87.1%), reflecting the geographic characteristics of the Mekong Delta. Urban residents comprised only 12.9%, potentially due to their preference for accessing higher-level or private healthcare services. Rural residence may influence maternal nutrition and prenatal care due to disparities in healthcare access, which could contribute to varying risks of macrosomia. However, efforts to enhance reproductive health communication and prenatal care availability in rural areas may help bridge this gap. The prevalence of macrosomia in this study (36%) is markedly higher than rates reported in China (6.13%–11.66%) and the US (19.7%) (4, 8), while Ethiopia and the United States reported rates of 19.1% and 19.7% (1, 13). This discrepancy may be attributed to differences in population characteristics, diagnostic thresholds, and regional nutritional patterns. In the Vietnamese context, this high rate underscores the urgent need for targeted antenatal interventions, particularly addressing pre-pregnancy BMI and gestational

Table 2. Maternal Anthropometric Factors

Characteristic	Macrosomia (n=541)	Normal Weight (n=959)	OR (95% CI)	p-value
Maternal Age				
<35 years	444 (36.1%)	785 (63.9%)	1.01 (0.7–1.3)	0.91
≥35 years	97 (35.8%)	174 (64.2%)		
Maternal Height				
<155 cm	211 (39.1%)	402 (41.9%)	1.1 (0.9–1.4)	0.27
≥155 cm	330 (60.9%)	557 (58.1%)	-	
Pre-pregnancy Weight				
<45 kg	24 (4.40%)	41 (4.30%)	-	-
45–60 kg	481 (88.9%)	876 (91.3%)	0.9 (0.5–1.5)	0.80
≥60 kg	36 (6.70%)	42 (4.40%)	1.4 (0.7–2.8)	0.21
Pre-pregnancy BMI				
<18.5 kg/m²	15 (2.80%)	28 (2.90%)	-	-
18.5–22.9 kg/m²	86 (16.0%)	701 (73.1%)	0.226 (0.116–0.441)	<0.01
23.0–24.9 kg/m²	284 (52.5%)	216 (22.5%)	2.4 (1.2–4.7)	0.007
≥25 kg/m²	156 (29.0%)	14 (1.50%)	20.9 (9.1–48.1)	<0.01

Table 3. Multivariate Logistic Regression Analysis of Factors Associated with Macrosomia

Variable	Adjusted OR (95% CI)	p-value
Gestational age ≥40 weeks	1.5 (1.1–2.1)	0.018
Parity (single delivery)	10.8 (7.9–14.6)	<0.001
History of macrosomia	3.2 (2.1–5.0)	<0.001
Pre-pregnancy BMI ≥25 kg/m²	17.6 (7.5–41.2)	<0.001
Excessive gestational weight gain	28.9 (12.1–69.1)	<0.001

weight gain. These differences underscore the importance of considering racial, geographic, and maternal body composition factors when evaluating macrosomia prevalence. Asian women, including Vietnamese populations, generally have smaller pelvic dimensions and lower average weights compared to populations in Europe and North America. Adjusting diagnostic thresholds for macrosomia, such as lowering the birth weight cut-off from 4,000 grams to 3,500 grams, aligns better with the maternal and fetal characteristics of these populations and prevents underestimating associated risks. Gestational age ≥40 weeks was significantly associated with macrosomia, with an odds ratio (OR) of 1.3 ($p = 0.02$). This aligns with findings from Lei et al. (2020), which reported that extended gestation increases the likelihood of fetal overgrowth (14). Similarly, parity emerged as a strong predictor of macrosomia. Women with one prior delivery were 12.4 times more likely to have macrosomic births, while those with two or more prior deliveries had a 3.7-fold increased risk ($p < 0.01$). These results are consistent with studies by Du et al. (2020) and Lei et al. (2020), which demonstrated higher macrosomia prevalence in multiparous women (8, 14). Pre-pregnancy BMI and gestational weight gain were critical determinants of macrosomia in this study. Women with a BMI ≥25 kg/m² had an OR of 20.9 ($p < 0.01$), while excessive gestational weight gain increased the risk by 32-fold ($p < 0.01$). These findings align with global research, including studies by Lewandowska (2021) and Chen et al. (2023), which highlight obesity and excessive weight gain as significant contributors to macrosomia (5, 15). The multivariate analysis confirmed that gestational age beyond 40 weeks, prior history of macrosomia,

maternal overweight/obesity before pregnancy, and excessive gestational weight gain were independent predictors of macrosomia. These findings are consistent with previous studies (6, 8), reinforcing the multifactorial nature of macrosomia risk. Notably, excessive gestational weight gain emerged as the strongest independent predictor, highlighting the critical need for effective gestational weight management strategies during antenatal care. Macrosomia is a high-risk condition for both mothers and neonates. For neonates, it increases the risks of shoulder dystocia, brachial plexus injuries, and hypoglycemia, while for mothers, it raises the likelihood of severe perineal lacerations, cesarean delivery, and postpartum hemorrhage. The prevalence of macrosomia in this study (36%) was substantially higher compared to other Asian studies, such as those conducted in China (6.13%–11.66%) (8, 14) and in neighboring Southeast Asian countries where rates ranged from 5% to 15% (Sun et al., 2020). These differences may partly be attributed to the variations in diagnostic criteria, as this study adopted a lower threshold for macrosomia (≥3,500g) appropriate for the smaller body frames of Asian populations (10), whereas other studies often used 4,000g. From a pathophysiological perspective, fetal macrosomia is strongly associated with maternal metabolic alterations. Maternal insulin resistance, which physiologically increases during the third trimester, may be exacerbated by pre-pregnancy obesity and excessive gestational weight gain (16). This leads to increased maternal blood glucose and free fatty acids, promoting fetal hyperinsulinemia and lipogenesis, resulting in accelerated fetal growth and fat deposition. Nutritional practices and access to antenatal healthcare services in rural areas like the Mekong Delta region could also contribute to the observed high prevalence of macrosomia. Rural populations may have less exposure to prenatal nutritional counseling and weight management interventions, resulting in inadequate monitoring of gestational weight gain. This underscores the importance of strengthening maternal health education and integrating nutritional assessments into routine prenatal care programs in resource-limited settings. Advanced maternal age, high BMI, prolonged gestation, and excessive weight gain underscore the necessity for early identification and intervention. Ultrasonography, while useful, has limited sensitivity for predicting macrosomia, as noted by Moraitis et al. (2020) and Szmyd (2021) (17, 18). This study underscores the need for targeted interventions, particularly in maternal weight management and monitoring for women with a history of macrosomia. The findings also highlight the importance of adjusting diagnostic criteria for macrosomia in Asian populations to better capture at-risk cases and implement appropriate prenatal care strategies. This study did not include certain comorbidities such as gestational diabetes mellitus (GDM), which are known to influence macrosomia risk. The omission was due to limited availability of standardized GDM screening data in the study setting. Limitations of this study include its cross-sectional design, which limits causal inference, and the exclusion of some clinical variables such as GDM. Targeted prenatal care interventions focusing on early weight management and glucose screening could significantly reduce macrosomia incidence in similar rural settings. Future prospective studies should include biochemical screening for gestational diabetes and long-term follow-up of neonates to assess the impact of macrosomia on childhood obesity and metabolic disorders.

Conclusions

This study identified a high prevalence of macrosomia and highlighted significant associations with gestational age, parity, pre-pregnancy BMI, and gestational weight gain. These findings support the need for improved prenatal screening and maternal weight management strategies in similar low-resource settings. Comprehensive antenatal care focusing on weight management and timely interventions for at-risk pregnancies can mitigate macrosomia-related complications and improve maternal and neonatal outcomes.

Ethic Approval: Ethical clearance for the study was obtained from the Biomedical Research Ethics Committee, Can Tho University of Medicine and Pharmacy (Reference number: 22.161.HV-DHYDCT), approved on September 1, 2022.

Conflict of Interest: Each author declares that he or she has no commercial associations (e.g., consultancies, stock ownership,

equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted article.

Authors Contribution: H.T.T.H.: Drafting the manuscript, Review; N.T.K.Q.: Data collection; N.H.H.: Supervision; P.T.N.N.: Supervision, Review, Drafting the manuscript.

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