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ASSOCIATION BETWEEN MATERNAL HEIGHT ON MODE OF DELIVERY AND ON FETAL GROWTH: A STUDY OF NULLIPAROUS WOMEN FROM COASTAL KARNATAKA

Dr. Aksharasrri	Junior Resident, Department of Obstetrics and Gynecology, Kasturba Medical College, Manipal, Manipal Academy of Higher Education, Manipal, Karnataka, 576104
Dr. Rajeshwari Bhat	Professor, Department of Obstetrics and Gynecology, Kasturba Medical College, Manipal, Manipal Academy of Higher Education, Manipal, Karnataka, 576104
Dr. Krupa shah	Associate Professor, Department of Obstetrics and Gynecology, Kasturba Medical College, Manipal, Manipal Academy of Higher Education, Manipal, Karnataka, 576104

ABSTRACT **Introduction:** Maternal height is an important anthropometric parameter affecting pregnancy outcome. This is of utmost importance for nulliparous women, as the mode of delivery has an influence not only on the present but also on future pregnancy outcomes. Here, we aimed to evaluate the impact of maternal height on the mode of delivery and on fetal weight. **Methodology:** This study is a retrospective analysis of 510 nulliparous women. The nulliparous group was divided into short, average and tall stature. The mode of delivery and fetal weight were noted as primary data. **Results:** A total of 12.7% of the cohorts were short nullipara, 77.6% had average weight, and 9.6% had tall stature. Cesarean delivery was more common in the short nullipara (53%), but the difference was not statistically significant. Although CPD was significantly more common in short nullipara. There was a significant association between maternal height and fetal weight. Low birth weight and small for gestational age neonates were significantly greater in the short nullipara. **Conclusion:** Height is a simple risk factor in obstetrics that affects the mode of delivery and fetal weight. Short nulligravidae needs attention due to high chance of cephalon-pelvic disproportion resulting in cesarean deliveries. Nutritional aspects of short Nulligravidae should be addressed to reduce the chances of non-constitutional low birth weights and small neonates of gestational age.

KEYWORDS : Maternal Height, Cesarean Delivery, Mode of Delivery, Low Birth Weight, Growth Restriction

INTRODUCTION

Maternal height is a widely used anthropometric parameter during pregnancy in addition to weight. The height of an individual has a strong genetic influence. It is also influenced by the environmental and nutritional status during childhood and adolescent periods. It provides some insight into pelvic adequacy and the fetal growth trajectory. The average Indian height is 152 cm for females of reproductive (18--49 years) age, according to the NFHS-5[1, 2]. When Indian women's height is compared globally, it is less than that of some Western countries, such as the United States, Netherlands, Japan and Brazil, which have average heights of 162, 170, 158 and 160 cm, respectively. The lowest maternal heights reported are from South Asia and Latin America. The mean maternal height of Guatemala was found to be 148 cm, and that of the Philippines was 150 cm[3, 4]. There is wide variation in maternal height across continents and across countries. Even LMICs (low- to middle-income countries) also have wide variation in mean maternal height, mirroring socioeconomic conditions, regions and study populations, with average heights between 149 and 152 cm[3]. The mean female height in India also varies and has been reported to be between 152 and 158 cm across studies.[5]

Individual height is simple to measure and has a predictive ability for certain maternal and fetal outcomes. Hence, the aim of the present study was to ascertain the mean maternal height in the study population. We aimed to establish a reference range for the 5th, 10th, 50th, 90th and 95th centile heights within the nullipara study population of costal Karnataka. Secondly, we aimed to determine the impact of the height of <10th percentile on the fetal growth abnormality and mode of delivery.

METHODOLOGY

A retrospective observational study was conducted for one year, i.e., from January 2023 to January 2024. All the patients were enrolled at Dr. TMA Pai Hospital, Udupi, which is affiliated with the Manipal Academy of Higher Education. The study was approved by the ethical committee (IEC: 388/2023) of Kasturba medical college, Manipal University, Manipal, Karnataka. A total of 1382 pregnant women were delivered, and the data were retrieved from the parturition register and then from the electronic data system. All patients provided consent for treatment and usage of information. Only singleton cephalic pregnancies in nulliparous women with documented heights in any of the trimesters were included. Pregnancies aged <19 years and >35 years were excluded. The data considered were gravidae, age, weight in the third trimester if available, period of gestation at delivery, mode of delivery and fetal weight. Further exclusion was for pregnancies with multiple pregnancies, not documented height and pregnancies with uterine scars, gestational or pregestational diabetes mellitus, thyroid disorders, hypertension during pregnancy, chronic renal disorders, cardiac diseases and fetal malformations. Only low-risk nullipara women were included in the study.

From the enrolled pregnancy cohort, 5th, 10th, 50th, 90th, and 95th centiles height was obtained. All pregnancies with a height of <10th centile were considered short in stature, and those with a height of more than 90th centile were considered tall in the cohort. The mode of delivery was considered either vaginal (which included instrumental) delivery or cesarean delivery. A neonatal weight of <2.5 kg was considered low birth weight (LBW), and a weight of <10th centile was considered small for gestational age/growth-restricted neonates. Neonatal weights >90th percentile were considered large for gestational age neonates; weight percentile charts were generated from Callen's book of ultrasound, sixth edition.[6] We also attempted to calculate the <10th centile neonatal weight for pregnant women with short, tall and average heights.

Statistical Analysis

SPSS software version 22 was used for statistical analysis, and a p value of <0.05 was considered to indicate statistical significance. The chi-square test was used for categorical variables, and Student's t test was used to compare the mean of the two groups. Fisher's exact test was used whenever appropriate. Pearson's correlation was used to assess the relationship between maternal height and fetal weight. A linear regression model was used, with maternal height as a predictor and fetal weight as an outcome, to understand how well height predicts fetal weight. A binary logistic regression model was used to understand the effect of height on the mode of delivery.

RESULTS

The pregnant cohort consisted of 1382 deliveries, 795 of which were nulliparous. After applying the exclusion criteria, a total of 510 nulliparous pregnancies were enrolled and subjected to further analysis. The main reasons for exclusion were multiple pregnancies, age >35 years, hypertension during pregnancy, gestational diabetes mellitus, and non-cephalic presentations.

The height of the participants in the study cohort was 146 cm in the 5th centile, 149 cm in the 10th centile, 156 cm in the 50th centile, 164 cm in the 90th centile and 167 cm in the 95th centile. The height of the participants in the present cohort ranged between 137 cm and 176 cm.

The three groups were derived from the above information, and 65 pregnancies had a <10th centile height (short nullipara/group 1), 403 pregnancies had a height between 10% and 90% (normal height nullipara/group 2), and 49 pregnancies had a >90th centile (tall nullipara/group 3).

Table 1 presents the feto-maternal information of the three groups, whereas age, period of gestation at delivery, BMI and the rate of LSCS were not significantly different among the groups. Fetal weight, maternal weight and LBW significantly differed among the three groups.

Table 2 shows the mode of delivery among the study group. A total of 210 cesarean deliveries (41%) were noted. There were 300 (59%) normal deliveries, 39 vacuum deliveries and 10 forceps deliveries among the vaginal deliveries, accounting for 16.3% of the normal deliveries and 9.6% of the total deliveries. The logistic regression analysis revealed a negative association between maternal height and the likelihood of cesarean delivery. The incidence of CPD resulting in LSCS was significantly greater in short nullipara than in non-short nullipara. The CPD was 22.7% in the short nullipara and 7% in the average height nullipara, and the difference was statistically significant. (p value = 0.012)

Table 3 suggests that the incidence of low birth weight and small for gestational age was significantly associated with short maternal stature. The average height was 146.5 cm in the LBW group and 156 cm in the non-LBW group. The average maternal height was 153 cm for SGA neonates, 156 cm for the AGA group, and 161 cm for the LGA group. Linear regression analysis revealed a statistically significant positive association between maternal height and fetal birth weight (Graph 1). The estimated regression coefficient for maternal height was 1.97, indicating that for every 1 cm increase in maternal height, fetal birth weight increased by approximately 20 grams on average. The association was highly significant. Our findings suggest that only 9.1% of the differences in fetal weight are explained by height, which means that height alone is a weak predictor of fetal weight. We found that a 1 cm increase in height reduces the likelihood of LSCS by 2.8%.

DISCUSSION

Maternal height is a simple and reliable measurement, and short height is often a risk factor for adverse pregnancy outcomes. The present study revealed an inverse relationship between the LSCS and maternal height; however, a significant association between maternal height and cesarean delivery could not be established. The high frequency of LSCS in short nulliparas was due to inadequacy of the pelvis or cephalopelvic disproportion (CPD). In addition, even short women had an average neonatal weight of 2.76 kg, which was not significantly different from the average height of nullipara (2.9 kg). It indicates that there might be a greater chance of labor dystocia and CPD among them. Our study revealed an LSCS rate of 53% in the short stature group and 40% in the average height nulliparous group. The study by Apoorva concluded that height<150 cm is an independent risk factor for LSCS due to CPD, with 104 patients in the study group and 576 patients in the control group; a total of 43% of pregnancies ended in LSCS. In their study, a total of 21% of the patients had a normal delivery, and 34% had instrumental deliveries. They emphasized that simple parameters such as height, is an important tools for counseling about the mode of delivery. [7] Our findings align with the observed findings. Ardent E evaluated a national dataset and concluded that very short (<145 cm) and short (145--149 cm) women had odds ratios of 2 and 2.5, respectively, for LSCS. [8] A Japanese study by Kuritani Y on 1593 nulliparous women revealed that short primi do have an increased risk of intrapartum LSCS. [9] A study by Prasad M suggested that a height of <160 cm should be used as a prediction tool for LSCS; [10] however, Dahan MH suggested that maternal height, weight and age are poor predictors of the need for LSCS due to the arrest of labor.[11]

A significant association between maternal height and birthweight was found via linear regression analysis; for every 1 cm increase in maternal height, fetal birth weight increased by approximately 20 grams on average. Thus, the shorter the height is, the greater is the likelihood of LBW and SGA neonates. A study by Rochow Niels revealed that maternal height affects fetal birth weight more than ethnicity does and that a 1 cm increase in height increases birth weight by 17 grams [12]. A study by Softa et al suggested an increase in 12.8 grams of fetal weight with a 1 cm increase in height[13]; similarly, a study by Azcoora reported a 10 gram increase in fetal weight, and a study by Morgan I suggested a 15 gram change with a 1 cm change in maternal height. [14, 15]. We observed that height has a small positive relationship with fetal weight and 91% of fetal weight is governed by other risk factors, such as nutrition, age at pregnancy, and maternal weight.

Teoh ZN suggested that birthweight increases with maternal height. He emphasized that this result was not different among different ethnic groups in Malysia. He suggested that SGA and LGA be cut according to maternal height apart from gestational age.[16] Our study revealed that the short stature group had a <10th centile neonatal weight of 2.2 kg, with 2.5 kg for the average height group and 2.7 kg for the tall stature group. However, we did not attempt gestational age- or height-specific fetal weight percentiles because of the small sample size.

A study by Tiwari AK suggested that the height of women decreases the relative risk of LBW and SGA neonates, and a study by Deshpande revealed that a short height of <145 cm is a risk factor for LBW[17, 18]. Our findings also align with their observations. The relationship of LBW with short stature may represent a genetically healthy and constitutionally small child. However, LBW and SGA is multifactorial, and age, spacing, nutritional and socioeconomic factors, etc., play significant roles. Hence, efforts to reduce the morbidity and mortality associated with SGA ± LBW need attention, and measures to improve nutritional and literacy status need to be emphasized further.

Limitations and Strengths

The main limitation is the retrospective nature of the study. It is a study from a single center and serves mainly a low- to middle-risk population. There might be some missing data, and the data was from the electronic system. The strength is the good sample size, which addresses only nulligravidae. We suggest that more studies are needed to determine height- and gestational age-specific cutoffs to optimize maternal and fetal outcomes.

CONCLUSION

Short nullipara should have a fair labor trial after adequate assessment. Short woman generally has constitutionally small fetuses; hence, adequate and close labor trials can improve pregnancy outcomes. Adequate nutrition should be promoted among them to curtail the incidence of low-birth-weight neonates and intrauterine growth restrictions. Thus, maternal height should be measured for each pregnant women to timely anticipate probable maternal and fetal consequences.

Table 1: Fetal-maternal Characteristics of the Study Population

Height of the nullipara n = 510	Short (<10%) n = 65 (12.7%)	Normal (10-90%) n = 396 (77.6%)	Tall (>90%) n = 49 (9.6%)	p value
Age (years)	28.7 ± 3.9	27.6 ± 3.3	27.7 ±2.9	0.63
Average weight in 3rd trimester (Kg)	58.2 ± 9.3	64.2 ± 10.9	76.4 ± 11.7	0.001
BMI (kg/m2)	22.4 ± 4.3	21.6 ± 3.8	22.4 ± 3.8	0.13
Period of delivery (weeks)	38.1 ± 0.8	38.3 ± 0.9	38.5 ± 0.8	0.11
LSCS, n (%)	35 (53.8%)	159 (40.2%)	16 (32.7%)	0.051
Average Birth weight (kgs)	2.7 ± 0.36	2.9 ± 0.38	3.17 ± 0.37	0.001
LBW, n (%)	12 (18.5%)	45 (11.4%)	1 (2%)	0.001
SGA, n (%)	21 (32.3%)	79 (19.9%)	2 (4.1%)	0.001

BMI: body mass index, LSCS: lower segment caesarean delivery, LBW: low birth weight, SGA: small for gestational age

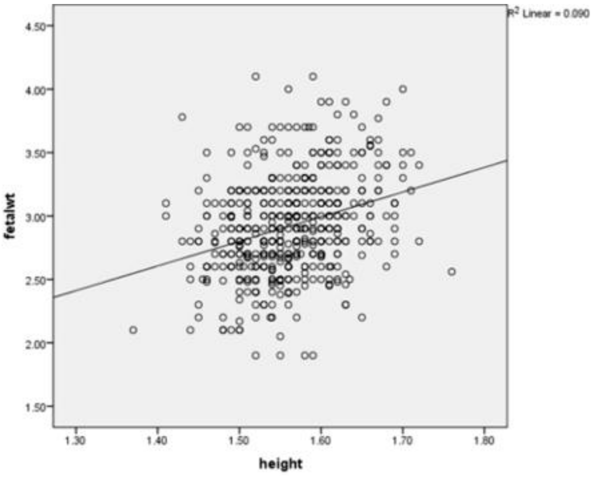
Table 2: Mode of Delivery Among the Study Groups in Nulligravidae

Mode of delivery N=510	Short, n = 65 (100%)	Normal, n = 396 (100%)	Tall, n = 49 (100%)	p value
LSCS (n=210)	35 (53.8%)	159 (40.2%)	16 (32.7%)	0.051
Normal delivery (n=300)	30 (46.2%)	237 (59.8%)	33 (67.3%)	
Total Instrumental (Vacuum /forceps) delivery	4 (4/0)	36 (28/8)	9 (7/2)	Total: 49 (16.3% of ND, 9.6% total deliveries)

ND = normal delivery

Table 3: Fetal Growth Outcomes in Study Population

	Short, n = 65 (100%)	Normal, n = 396 (100%)	Tall, n = 49 (100%)	p value
Low birth weight (n=58)	12 (18.5%)	45 (11.4%)	1 (2%)	0.018
Small for gestational age (n=102)	21 (32.3%)	79 (19.9%)	2 (4.1%)	0.001
Average for gestational age (n=399)	44 (67.7%)	310 (78.3%)	45 (91.8%)	
Large for gestational age (n=9)	0	7 (1.8%)	2 (4.1%)	



Graph 1 : Relation of Maternal Height with Fetal Weight

Declarations

Conflict of Interest: The authors declare no conflict of interest in this manuscript.

Ethical Approval: The study was approved by Kasturba Medical College and Manipal university, Institutional Ethical Committee.

Ethical standards and research involving human participants. The study involving human participants followed the ethical standards of the institute's ethical and research committee and the 1964 Helsinki Declaration and its later amendments.

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AI Declaration: AI is used for reference purposes and similarity of manuscript check.

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