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Evaluation of maternal anthropometric measurements to predict cephalopelvic disproportion in nulliparous women in rural Meghalaya

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Abstract
Objective: The study evaluates the effectiveness of maternal anthropometric measurements of our population with estimated fetal weight as an additional parameter to predict Cephalopelvic disproportion (CPD).
Materials and Method: The prospective study conducted in a tertiary care center involved 353 primigravida over 37 weeks of gestation with singleton pregnancy admitted at Nazareth hospital, Shillong, Meghalaya, India. Anthropometric measurements included maternal height, bis-acromial diameter, foot length, estimated fetal weight and vertical and transverse rhomboid diameters. Based on mode of delivery, patients were divided into two groups - CPD group and No CPD group.
Results: Out of 353 patients, 141 (40%) had CPD and 212 (60%) had no CPD. High positive predictive values for CPD was demonstrated for maternal height, foot length, bis-acromial diameter and rhomboid dimensions. The risk factors predicted for CPD in this study were height ≤142 cm, foot length ≤20cm, Bis-acromial diameter ≤ 32.5 cm, Michaelis rhomboid - transverse and vertical diameters ≤9 cm and 9.5 cm, respectively, and estimated fetal weight ≥3255 gm.
Conclusion: Generally, the women in this region are of short stature with an average height of 142 cm. The anthropometric measurements of this population vary from the other populations accordingly. Hence, knowledge of these parameters and their usage will help in early CPD anticipation and timely referral of these patients to tertiary centers. Measuring maternal and fetal parameters is easy and a reproducible skill that can be transferred to midwives in the rural area for better antenatal care.

Keywords: cephalopelvic disproportion, primigravida, anthropometric measurements, caesarean section, positive predictive value

Introduction
In a woman's life cycle the most critical period is during pregnancy [1]. It is regarded as the "welcome event" for a successful womanhood [2]. About 0.5 million women die each year due to complications of pregnancy and child birth globally [3]. Five major complications like - haemorrhage, infection, unsafe abortion, hypertensive disorders of pregnancy, and obstructed labour accounts for more than 70% of all maternal deaths [4]. The most common preventable causes of maternal and neonatal morbidity and mortality in developing countries is obstructed labour [5]. Cephalopelvic disproportion, fetal malposition and malpresentation contributes to the common causes of obstructed labour [6].
Contracted pelvis with an average sized infant is the most frequent cause of CPD [7]. For more than hundreds of years Cephalopelvic disproportion (CPD) has been recognized as an obstetric problem and is the cause for numerous maternal and fetal deaths throughout the history [8]. 2–15% of pregnancies are complicated with pelvic disproportion and it causes significant maternal and fetal complications [9]. Disproportion, in relation to the pelvis, is a state where the normal proportion between the size of the fetus to the size of the pelvis is disturbed.
Cephalopelvic disproportion is the disparity between the size of the fetal head and the pelvis [10]. Whenever there is macrosomia or an arrest of dilatation of cervix or descent of fetal head this can be suspected. In nulliparous women, CPD is best diagnosed by trial of labour. The assumption is that, when labour is augmented with adequate doses of oxytocin infusion, adequate uterine contractions are generated, which in turn, help in the descent and delivery of the fetal head through the birth canal.

Failure of such descent and delivery of the fetus constitutes CPD. In order to prevent its further contribution to obstetric mishaps, it is essential to predict it antenatally and manage it accordingly. It is essential to develop a reliable screening parameter for the health personnel at the primary level to help women in developing countries, who are not able to access tertiary health care facilities [5]. Currently, antenatal charts incorporate maternal height as the only parameter for identification of women at risk of pelvic disproportion. Anthropometric measurements like maternal weight, foot length and external pelvic measurements have also been studied but with conflicting results. Measurement of maternal height is used as a simple means to identify women at risk of CPD, because it is assumed that likelihood of CPD is greater in shorter mothers. Combining maternal anthropometric measurements may increase the likelihood of predicting CPD than maternal height alone, which by itself is of limited value. Timed optimally, a caesarean delivery for CPD is best for the mother as well as for her fetus. To facilitate this, it is imperative that CPD be diagnosed sufficiently early [11]. The consequences of late detection are particularly grave in the developing world where the mother may go into labour in a setting where facilities for performing caesarean section are inadequate [12]. In such situations, it is vital that women at potential risk of CPD are identified prior to the onset of labour to facilitate referral to a centre where a caesarean delivery can be performed [11]. Since anthropometry and stature of women of different ethnic origins vary, it is important to identify the most sensitive predictors of CPD for a particular population [11]. Antenatal care in rural areas is provided by traditional birth attendants (Dais) and village health workers [2]. To prevent these complications, it is important to develop a simple risk indicator, which is easy to use, reliable, and consistent.

This study, thus, will evaluate external maternal measurements like maternal height, maternal weight, bis-acromial diameter, foot length, vertical and transverse diameters of Michaelis rhomboid and clinical fetal weight, and how these factors may improve the predictive value.

Materials and Methods

The study was conducted in the Department of Obstetrics and Gynaecology, Nazareth Hospital, a tertiary health care centre in Shillong, Meghalaya. The total deliveries per year (2018) are 3000 approximately.

This was a Prospective observational study conducted over a period of 8 months from 1st September 2019 to 1st April 2020.

All nulliparous women of gestational age ≥37 weeks of gestation with singleton pregnancy in vertex presentation admitted via emergency or outpatient department after fulfilling the inclusion and exclusion criteria were eligible for the study.

Exclusion criteria were patients with external deformities of foot, spine or pelvis. Patients with other known risk factors with previous LSCS, multiple pregnancy, intrauterine fetal demise, major congenital anomalies of foetus and history of delivered foetuses of <2.5 kg or >4 kg.

A total of 353 mothers were included in the study after written consent from patient and her attendant. The institutional Ethics Committee clearance was also obtained.

Anthropometric measurements were recorded for each woman (in cm), which included:

1. Maternal height
2. Bis-acromial diameter
3. Foot length
4. Vertical and transverse diameters of Michaelis rhomboid.

Height was measured in the standing position following standards of measuring height by using standardized standiometer with an accuracy of 0.5cm (Mothers stood next to a wall with their feet and knees together, knees straight, heels, legs, hip, shoulders, back of the head parallel to the wall, their body completely flat and stretched, hands hanging on both sides, and looking straight ahead. The horizontal plate of the standiometer was placed over the mother's head and standing height was measured). A measuring tape was used to measure various anthropometric measurements. Patient lay supine with knees flexed, as fundal height was marked after correction of uterine dextrorotation. Then, with the patient's knees straightened, the distance from the symphysis to the point marked as fundal height (symphysis-fundal height) was noted.

Fetal weight (in grams) was estimated by Johnson's formula

Johnson's formula = SFH (cm) - n x 15

Where, SFH = symphysis-fundal height in centimetres,
n =11 in engaged head & n = 12 in unengaged head.

Mode of delivery was recorded as normal vaginal, instrumental vaginal (vacuum extraction, forceps) and caesarean delivery.

After delivery the patients were allotted into two groups.

Group-1(CPD): This group included women with pelvic disproportion having a) caesarean section for Non progress of labour following a trial of labor, cephalopelvic disproportion, deep transverse arrest and cervical dystocia and b) Vacuum or forceps assisted delivery.

Group-2 (No CPD): This group included women with uncomplicated vaginal delivery with cephalic presentation.

The data was entered in Microsoft excel 2010 and all the analyses were performed using Statistical Package for Social Sciences, Version 20.0 for windows (SPSS 20.0). The variables were summarized and expressed as mean and standard deviation. The status of CPD and NO CPD among different maternal parameters were reported as frequency and percentages. The variations of CPD and NO CPD among various anthropometric measurements were compared using ANOVA. The predictors of CPD were identified using multivariate logistic regression analysis. The sensitivity, specificity, and positive predictive value of each anthropometric measurement were computed and the measures of association were computed using Pearson Chi-square test. The analysis was considered statistically significant at 5% level (p-value <0.05).

Results

353 nulliparous women were included in the study. CPD group had 141 cases and Non CPD group had 212 cases. Mean age of gravid women was 24.71±4.5. CPD was higher in above 31-year age group which shows that the chance of CPD increases with increase in age. (p value <0.007). The present study had maximum cases between the gestational age of 40.1- 42 week. As the gestational age increased (< 42 weeks) the chances of CPD also increased.

Table 1: Baseline characteristics in two groups

Parameters	Group 1 (n=141)	Group 2 (n=212)	p value
Age in years	25.51	24.18	0.007
Height (cm)	146.9	148.3	0.025
Weight (Kg)	57.9	57.2	0.508

In the study, it was found that lesser the height (< 142 cm), greater the chance of CPD. Hence when comparing the two groups by height distribution the association was strong between the groups.

Table 2: Comparison of maternal parameters in the two groups

Maternal parameters	CPD Group n=141 Mean ± SD	No CPD Group n= 212 Mean ± SD	p - value
Height (cm)	146.9± 5.97	148.3± 5.53	<0.025
Foot length (cm)	21.7± 1.23	21.8±1.29	<0.498
BAD (Bisacromial diameter)	34.5 ±2.98	34.4 ±1.87	<0.868
TD (Transverse diagonal of rhomboid)	9.61±0.79	9.97 ±0.64	<0.01
VD (Vertical diagonal of rhomboid)	10.01±0.83	10.72±0.92	<0.203

The measurements of maternal height, Michaelis rhomboid - transverse and vertical diameter were lesser in the CPD group than that of the No CPD group.

As the measurement of MRTD decreases, the chance of CPD increases. The association between the two groups was statistically significant (p value: 0.00) but the association between the two groups for MRVD is not significant. Foot length is a vital parameter for initial insight to CPD and No CPD. CPD frequency was same between different foot length and Bis Acromion Diameter groups selected. The association between the two groups was statistically not significant.

Table 3: Predictive value of maternal anthropometry and clinical parameter of fetus for CPD

Outcomes	Cut – off Value (10^{th} percentiles)	Sensitivity	Specificity	PPV	NPV	Odd Ratio	Diagnostic accuracy
Height	142 cm	17.7% (25/141)	87.7% (186/212)	49%	61.58%	1.542	77.69
Foot length	20 cm	12.8% (18/141)	83.0% (176/212)	33.3%	58.86%	0.715	67.86
BAD	32.4 cm	12.8% (18/141)	92.0% (195/212)	51.4%	61.32%	1.679	73.24
MRVD	9.5 cm	16.3% (23/141)	95.3% (202/212)	69.7%	63.12%	3.937	80.22
MRTD	9 cm	29.8% (42/141)	89.6% (190/212)	65.6%	65.74%	3.664	95.82
EFW (Johnson's formula)	3255 gms	8.5% (12/141)	84.4% (178/212)	26.7%	58.11%	0.505	62.71

Discussion

The incidence of pelvic disproportion in the present study is 39.94% which was not comparable to the studies by Deepika *et al.* [13] (12.3%), Shagun *et al.* [9] (12%), Rozenholc *et al.* [14] (12.1%) and Liselele *et al.* [15] (4 to 15%). The reason for this may be the average height of the study population is less when comparing to the other population of the country.

Most of the studies including the present study showed that the mean age was higher in the CPD group than in No CPD group. But in the study by Solomon *et al.* [16] the mean age is more in No CPD group. The ACOG bulletin has also reported age more than 35 years to be a risk factor for second stage dystocia [17]. Study by Liselele *et al.* [15] had shown age had no correlation with contracted pelvis/CPD.

Maternal height has a predictive value for obstructed labour as it can reflect maternal pelvic size and is used to predict CPD [18]. Srisupundit *et al.* [19] Liselele *et al.* [15] Rozenholc *et al.* [14] and Deepika *et al.* [13] have reported that height lesser than 145 cm, 157.6 cm, 155.4 cm, and 143.3 cm respectively can be strong predictors for CPD. In this study women were shorter in disproportion group. The mean height for CPD group is 146.91 cm and the mean height for No CPD group is 148.31 cm. Therefore, maternal height can be used as a simple tool to screen the risk factor for CPD, height of < 142 cm is the risk factor for this study population.

Studies done by Deepika *et al.* [13] Benjamin *et al.* [11] Alijahan *et al.* [20] have revealed that maternal foot length measurements can predict CPD to some extent and was proven to be statistically significant. Studies conducted by Awonuga *et al.* [21], Rozenholc *et al.* [14] and Mahmood *et al.* [22], also showed no significant correlation which was comparable to present study. This can be because the overall foot length of this population is less.

Study by Deepika *et al.* [13] Liselele *et al.* [15] and Solomon *et al.* [16] showed bis acromion diameter had positive predictive value for CPD. This study and Benjamin *et al.* [11] did not show any statistical significance and has no association with mode of delivery.

Michaelis Rhomboid transverse diameter is a promising positive predictor of CPD. The transverse diameter of Michaelis Rhomboid is a statistically significant parameter with a p value of < 0.001 in this study. Other studies like Liselele *et al.* Bansal *et al.* Solomon *et al.* and Deepika *et al.* also has proved MRTD to be significant.

Study by Solomon *et al.*, showed no significance in mean vertical diagonal of sacral rhomboid which was also noted in the same line to this study.

A number of factors may affect the accuracy of fetal weight estimation. It has been shown that fetal weight estimation, diminishes in accuracy as birth weight increases. This study has shown that the estimated fetal weight by Johnson's formula, is statistically a significant parameter in predicting CPD with a p value of 0.041.

Studies done in Thailand and Brazil, Sass *et al.* [23] and Numprasert *et al.* [24] have confirmed that Johnson's formula correctly predicts actual birth weight from 61 to 72 %. Clinical palpation should be considered as diagnostic tool for fetal weight estimation and will be more reliable when done by trained medical person. It is cheap and easy to teach.

Conclusion

Cephalopelvic disproportion is a result of a failed interrelation of maternal parameters and fetal weight, rather than an independent result of single maternal parameter or birth weight. Maternal height in isolation has limited value in predicting risk of cephalopelvic disproportion. Combining maternal anthropometric measurements with clinical estimates of fetal weight only enhances the predictive value. Clinical palpation should be considered as a diagnostic tool for estimating fetal weight as it is equally reliable even when done by a trained medical officer.

Most women in the developing world are not able to avail high level of health care. Hence, it is essential to develop simple and

reliable screening parameters that can be used by all health personnel including trained birth attendant, midwives, and nurses at rural settings which are the first points of healthcare to rural and underprivileged folks.

From this study, it is proven that combined estimates of maternal anthropometric measurements and clinical estimation of foetal weight go a long way in predicting CPD, thereby preventing obstetric mishaps and catastrophes by timely referrals and interventions. The population of this region are generally of short stature and the average height prevalent found in this study was 142 cm. Hence the anthropometric values of this population also differ from the anthropometric values of other populations. This enables a tailored approach to delivery of pregnant women in this region.

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