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Is there a Correlation between the Size of the Fontanelles and the Maternal Profiles? : A cross-sectional Study in Central Sudan

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ABSTRACT

Background: Variations in the size of fontanelles are studied in correlation with many variables such as regional location, gestational age, gender and maternal ethnicity.
Objective: This study attempted to shed light on the relationship between maternal and pregnancy profiles with the size of the fontanelles in newborn Sudanese children in the State of Gezira, Central Sudan.
Methods: This was a cross-sectional study carried out in Wad Madani Obstetrics and Gynecology Hospital, included 400 babies and their mothers. The collected data included maternal personal data and medical histories besides fontanelles measurement. Reports about the fontanelles were taken twelve hours after birth of the newborn. The Popich and Smith methods in which the baby was in calm state and held in upright position were used to measure the fontanelle size. Fontanelles were demarcated by the researcher and the measurement was taken using a plastic tape. T-tests and one-way ANOVA were employed for data analysis.
Results: The anterior fontanelle (AF), and posterior fontanelle (PF) were present and patent in the entire babies with a mean size of AF (2.09±0.49 cm), and PF (1.7±0.34 cm). The PF size displayed variations in association with maternal comorbid diseases and residency compared to AF. There was no statistically significant correlation between fontanelle size and maternal age (P-value 0.73) (P-value 0.06) and parity (P-value 0.94) (P-value0.89), respectively.
Conclusion: size AF and PF among an apparently healthy Sudanese newborn falls within the same global range. Variations were detected in the size of the PF in correlation with maternal residence and maternal comorbidity.

Keywords: Anterior Fontanelle, posterior Fontanelle, maternal and pregnancy profiles.

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INTRODUCTION

The word 'fontanelle' originates from the Latin Fonticulus and the Old French Fontaine, meaning a little fountain or spring (1). A normal newborn has six fontanelles: a single midline anterior and posterior fontanelle and paired right and left mastoid (asterion) and sphenoid (pterion) fontanelles. Fontanelles facilitate childbirth by allowing skull bone molding during labor (2). Each fontanelle closes chronologically with growth through a process called intramembranous ossification (3). Morphological data of the fontanelles are markers for several conditions such as dehydration, Hyperparathyroidism, hyperthyroidism, and Craniosynostosis (4). The anterior fontanelle (AF) is the most prominent and variable in size and morphology. It is located at the intersection of the two parietal and two frontal bones and is typically rhomboid-shaped. Its average closure time ranges between 13 to 24 months (5, 6).

The size of the anterior fontanelle (AF) reported differently by authors. For Asian and Caucasian populations, reported size ranged between 2.09 and 3.42 cm while studies from America reported AF size ranged between 1.85, 2.84 cm a third group of researchers on African newborns, ranging from 2.58 to 3.7 cm. The posterior fontanelle (PF) is triangular, located at the juncture of the parietal and occipital bones where the lambdoid suture is formed. Usually, the posterior fontanelle closes two to three months after delivery (2). Morphology of the fontanelles is strongly associated with the maternal medical history (7) discuss the direct impact of thyroid hormone on the development of a fetus's bones and the embryonic influence of diabetes mellitus (8) , corroborate this finding. Moreover, hypertension causes a decrease in uteroplacental perfusion in spite taking a short time dietary supplement prescription in the second trimester of pregnancy was enough to reduce the DBP, but did not reduce the risk of developing preeclampsia (9) . Fetal undernutrition is the result of placental insufficiency, which limits the growth of the fetus (10).

Normal maternal thyroid function during pregnancy is found to be essential since it influence fetal skull development thus, associated with delayed closure of the AF and PF and congenital hypothyroidism (7, 10). Similarly diabetic mothers have 2-3 times more chances of having a gestation affected with birth defects include variations in size of fontanelle than non-diabetic mothers (8). Scanty reports about the morphometry of fontanelles in Sudan encouraged the conduct of the current hospital based cross sectional study to shed a light on the correlation of anterior and posterior fontanelles morphometry with maternal profile. This study attempted to shed light on the relationship between maternal and pregnancy profiles with the size of the fontanelles in newborn Sudanese children in the State of Gezira, Central Sudan.

MATERIALS AND METHODS

Study area

This hospital-based cross-sectional study was conducted at Wad Madani Obstetrics and Gynecology Hospital, the referral center for maternal cases in Central Sudan.

Study population

A total of 400 mothers who had normal deliveries between September and November 2022 were included in the study.

Inclusion criteria

- Apparently healthy mothers with normal pregnancy history who underwent vaginal and caesarian section labour.
- Full term normal apparently healthy newborn (singleton and twins pregnancy).
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Exclusion criteria

- Newborn with cephalohematoma, caput succedaneum.
- Newborn babies with severe birth asphyxia.
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Study design

This study is cross sectional, hospital-based study.

Sample size

Rao soft (2004) utilized the WHO sample size computation to estimate the sample size. The sample size should be roughly 369. However, for practical reasons 400 sample size was taken. The hospital's statistical department estimates that there are 9000 babies born annually; therefore, infants were

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included in the sample. There was a 95% confidence level and a 5% error margin.

Data collection

Patient information obtained by using a questionnaire filled through in-person interview. Maternal data included age, residency, parity and medical history as well as BMI of the mother at the time of delivery. Questionnaire validity Test was done to determine the target group, select test subjects, and eliminate irrelevant data gathering questions, a pilot study was conducted. Fontanelle data was reported through application of Popish and Smith method as follows Inspection of the fontanelles after 12 hours since the baby was born. The baby was held in upright position by assistant after being in calm state. The AF was inspected to describe their patency and presence. Figure 1 and 2 Corners of the fontanelles were delineated by the index finger of the examiner Figure 3. Using a plastic tape the transverse diameter and anteroposterior diameter were measured in centimeters (5) Figure 4 and 5. Data entered in the specially created questionnaire.

Data analysis

Dependent variable includes AF, PF size, and independent variables maternal variables: age, place of residence, number of deliveries, BMI, chronic disease, complications during pregnancy were considered during analysis. SPSS Statistics for Windows, Version 22.0, was used to obtain two-tailed student t-test and one-way ANOVA test. P value of 0.05 or less was considered significant.

Ethical clearance

Ethical approval was obtained from the Ethical Committee at Faculty of Medicine, University of Gezira on 16/11/2021. Administration permission taken from Ministry of Health 1/12/2022 and Wad Madani Teaching Hospital for Obstetrics and Gynecology on 2/12/2022. In addition, an informed verbal consent was taking from the participants.

RESULTS

AF and PF were present and patent in all newborn (Table 1). No significant correlation between gender and fontanelle size (Table 2). There was no significant correlation between fontanelle size and maternal age (Table 3). Size of the PF was found to be significantly enlarged with rural residence (Table 4). No significant association was found in correlation of fontanelle size with parity (Table 5). Maternal BMI did not significantly correlate with AF size but was associated with PF size (Table 6). A 16% of the mothers found to have comorbid disease. Among this percentage (5%) had hypertension, 14 (3.5%) had diabetes, 20 (5%) had hypothyroidism, and 10 (2.5%) had hyperthyroidism. These conditions have a significant correlation with both PFS (P = 0.05) and AFS (P = 0.001) (Table 7). With regard to perinatal illness, 83.5 percent of the women reported no problems at all; the remaining women reported complications that significantly affected the size of their PFS (P = 0.014) and AFS (P = 0.002) (Table 8).

Table 1: Size of anterior and posterior fontanelles (in cm) among the newborns in Wad Medani teaching hospital for obstetrics and gynecology 2021

Fontanelle	Frequency	Percent	Mean ± SD in cm
AF	400	100%	2.09±0.49
PF	400	100%	1.7±0.34

Table 2: Correlation of the fontanelles size with gender among newborns

Gender	No	AF mean ± SD	PF mean ± SD
Male	168 (42%)	2.1±0.54	1.69±0.382
Female	232 (58%)	2.07±0.45	1.65±0.322
P value		0.60	0.21

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Table 3: Correlation of fontanelles size in cm with maternal age

Maternal Age group in years	NO (%)	Mean ± SD of AFS	Mean ± SD of PFS
Less than 30 years	209 (52.2%)	2.1±0.5	1.7±0.3
31 to >35	5 8(14.5%)	2.03±0.6	1.6±0.4
Above 35	133 (33.3%)	2.09±0.5	1.6±0.3
P value		0.73	0.07

Table 4: Association of mean and standard deviation of anterior and posterior fontanelles size in cm with maternal residency.

Residency	NO (%)	Mean ± SD of AFS	Mean ± SD of PFS
Urban	253 (63.2%)	2.06±0.5	1.6±0.3
Rural	147 (36.8%)	2.1±0.5	1.7±0.4
P value		0.25	0.02

Table 5: Association of the size of fontanelles measured in cm with maternal parity

Parity	NO (%)	Mean ± SD of AF	Mean ± SD of PF
Primigravida	108 (27%)	2.08±0.4	1.67±0.30
Multipara	196 (49%)	2.09±0.5	1.67±0.35
Grandmultipara	96 (24%)	2.07±0.4	1.65±0.37
P value		0.94	0.89

Table 6: Association of mean and standard deviation of anterior and posterior fontanelles size in cm with maternal BMI

BMI	No (%)	Mean ± SD of AFS	Mean ± SD of PFS
under weight	5 (1.2%)	2.02±0.8	1.54±0.6
normal weight	122 (30.5%)	2.05±0.4	1.64±0.3
overweight	196 (49%)	2.09±0.5	1.64±0.3
obese	77 (19.3%)	2.1±0.5	1.8±0.4
P value		0.18	0.02

Table 7: Association of maternal comorbidity with mean and SD of the size of anterior and posterior fontanelles in cm

Comorbid condition	No (%)	Mean ± SD AFS	Mean ± SD PFS
Hypertension	20 (5%)	2.5±0.7	1.6 ±0.2
Diabetes	14 (3.5%)	2.2±0.54	1.9 ±0.3
Hypothyroidism	20 (5%)	2.2±0.58	1.7 ±0.5
Hyperthyroidism	10 (2.5%)	1.9±0.35	1.7 ±0.3
None	336 (84%)	2.05±0.46	1.6 ±0.3
P value		0.001	0.05

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Table 8: Maternal perinatal illness during pregnancy in correlation to AFS, and PFS of new born whom were born in Wad Madani Teaching Hospital for Obstetrics and Gynecology Central Sudan 2021

Complication	No (%)	AF p -value	PF p -value
Pre-eclampsia	25 (6.25 %)		
Gestational Diabetes	11 (2.75%)		
DVT	3 (0.75%)		
Heart failure	4 (1%)		
Eclampsia	4 (1%)		
UTI	5 (1.25 %)		
Anemia	10 (2.5 %)	0.002	0.014
bleeding	4 (1%)		
None	334 (83.5%)		
Total	400 (100%)		

DISCUSSION

This study provides preliminary data on the normal AF and PF sizes among healthy Sudanese newborns and examines associations with maternal factors such as sociodemographic traits, maternal age, and residency. To do so the fontanelle size of healthy-looking term babies was measured on the first day of life 12 hours after birth applying Popich and Smith techniques. The average AF size (2.09 ± 0.49 cm) is comparable to findings from various global studies that applied the same measurement techniques (5, 7, 10-16). However, some variation in AF size was reported from India (12), Iraq (13), Ethiopia (13, 14) and Nigeria (21, 22). These discrepancies may result from difference in methodology of measurement such as putting paper onto fontanelles, applying ink directly to the scalp, or using digital calipers and time of measurement.

Popich and smith method was suitable for our study because it was reliable, tested before, not expensive .However racial and environmental influences may have some print specially the population of the mentioned regions show homogeneous ethnicity and environmental similarities. These factors may not be applicable in Sudan because the genetic built up is a combination of African – Arabic basis. In addition to this Sudan geographically extends from a Saharan climate in the far north to Equatorial climate in the far south (18).

Regarding the PF, the size was (1.7 ± 0.34 cm), which is greater than the values found in previous American publications (5, 18) PF size was (0.70 ± 0.45 mm), and Iranian study PF size was (0.8 mm) (11). Ethnicity may be the sole explanation for the discrepancy.

Regarding correlation with maternal age and parity, the current study did not find a significant correlation with fontanelle size. To our knowledge studies comparing fontanelle size to age and parity are scanty. Some reports from Ethiopia showed similar to our study (12). Interestingly when comparing the fontanelle size with maternal residency, unlike the anterior fontanelle, the posterior fontanelle was found to be larger in rural residents compared to urbans as well as among obese compared with other reading in the BMI (P value 0.02), further studies may be needed to confirm the influence of factors such as difference in nutritional habits and antenatal care service.

Maternal chronic disease known to have an effect on fontanelles size. In this study, 16% of the mothers had a chronic condition such as diabetes, hypertension, hypothyroidism, or hyperthyroidism. The effects of these conditions are significant for both AFS (P = 0.001) and PFS (P = 0.05). Kim and Mohan, discussed the direct impact of thyroid hormone on the development of a fetus's bones and the embryonic influence of diabetes mellitus. Bhandari et al., corroborate this finding. Moreover, hypertension

causes a decrease in uteroplacental perfusion. Fetal undernutrition is the result of placental insufficiency, which limits the growth of the fetus. (8, 9, 20).

Regarding perinatal illness during pregnancy, 83.5 percent of the women reported no problems at all; the other 16.5 percent of women reported complication such as PIH, gestational diabetes, cardiovascular disease and DVT. That adversely affecting their PFS (P = 0.014) and AFS (P = 0.002). Their babies has large size AF, PF than the mean size. Maternal morbidities can adversely interfere with uteroplacental-fetal blood flow and causing fetal growth restriction. These conditions include PIH, gestational diabetes mellitus, severe cardiopulmonary or renal diseases, severe anemia and infection especially TORCH (20), malnourishment. A finding which matched the reports in literature (21) .

CONCLUSION

The mean AF and PF sizes in Sudanese newborns were within global reference ranges. The PF size was significantly associated with maternal obesity, while both fontanelles were enlarged in cases of maternal comorbidities and perinatal illness. No significant correlation was observed with maternal age or parity.

CONFLICT OF INTEREST

The authors declare that no conflicts of interest.

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