Original Article

The pattern of anthropometric measurements among term newborn infants in Khartoum state in relation to maternal factors

Abdelmoneim E.M.Kheir (1), Elfatih E. Abozied(2) , Sarar H. Mohamed(3), Amira A.Salih(2)

(1) Department of Paediatrics, Faculty of Medicine, University of Khartoum, P.O. Box 102, Khartoum, Sudan

(2) Department of Paediatrics, University of medical sciences and technology, Khartoum, Sudan

(3) Department of Paediatrics, College of Medicine, King Saud University, Riyadh, Kingdom of Saudi Arabia

ABSTRACT

Anthropometric measurements of neonates are an important clinical tool for diagnosis of abnormally small or large neonates. This study aimed at finding the means of the anthropometric measurements among newborn babies in Khartoum state and to relate the tendency of the anthropometric parameters to maternal and paternal factors. This observational hospital-based study was carried out in 3 hospitals in Khartoum. Birth weights, crown-heel length and head circumference were taken from term neonates and questionnaire-based interviews were conducted with the mothers. Means of the sample and their associations with maternal and paternal factors were calculated using SPSS. In addition, the means were compared to WHO- MGRS (World health organization-multi growth reference standards).

It was found that the average male newborn weighed 3.16kg with a range of 2.4kg to 4.1kg, measured 48.91cm in length with a range of 46.1cm to 51.4cm and measured 34.74cm in head circumference with a range of 32.3cm to 36.9cm. As for the females, the average newborn weighed 3.11kg with a range of 2.1kg to 4.2kg, measured 48.49cm in length with a range of 45.1cm to 51.7cm and measured 34.16cm in head circumference with a range of 32.3 to 36.4. These values were found to be statistically significant when compared with the WHO- MGR. We conclude that there was a difference observed in relation to Sudanese neonate's anthropometric parameters compared to WHO-MGR standards. Growth charts specific for Sudanese neonates are urgently needed.

Key words

Correrrspondence to:

Dr. Abdelmoneim E. M.Kheir

Department of Paediatrics, Faculty of Medicine, University of Khartoum

P.O. Box 102, Khartoum, Sudan

Telephone +249 9 12313110, Fax +249 183776295

Email: moneimkheir62@hotmail.com

INTRODUCTION

Anthropometric studies in children are important, the periodic measurement of anthropometric variables in different populations and regions of a country reflects changes in children's nutrition and health status and are reliable tools to evaluate social health (1,2). Foetal, maternal and environmental factors may all influence foetal growth (3,4).

According to the UNICEF, in Europe, there are 7, 185, 000 births annually and 6.4% have low birth weight (5). In contrast, in Sudan 31% have low birth weight out of 1, 296, 000 live births annually (6). These figures indicate that there must be a reason behind such a difference: either that the same definition of low birth weight cannot be applied for both countries and that there are factors such as poor maternal health or others to explain the differences.

The high prevalence rates of malaria alone provide an adequate explanation for the Sudanese incidence of low birth weight (7).

The association of socioeconomic factors and newborn growth parameters has been established in many studies (7-10).

Many studies stress the need for anthropometric ranges specific to countries in view of the impact race and ethnicity parameters. A recommendation by the World Health Organization emphasized the importance of sex and race (in terms of ethnicity and geographical distribution) as major factors to be considered when creating appropriate growth charts. This is why, in 2006, the World Health Organization readjusted its growth charts and released a new set of growth standards which were supposed to be more applicable to less developed countries (11).

In the last decades few studies addressed the anthropometric measurements of Sudanese children (16-23). Anthropometric charts define a child's wellbeing in the absence of an overt disease and must be accurately applicable to children of the same ethnicity. This research aims at identifying the pattern of anthropometric measurements among a cohort of Sudanese neonates in relation to maternal and paternal health and to compare the ranges found to international neonatal anthropometric values.

MATERIALS AND METHODS

This was an observational case finding hospital based study that was carried out in Khartoum state, the capital of Sudan. It is comprised of three cities, Khartoum, Khartoum North and Omdurman. The study was conducted in three of the main hospitals in these cities namely Soba university hospital in Khartoum, Alsaudi hospital in Omdurman and Albangadeed hospital in Khartoum North.

The study was carried out during the period (November 2010 to February 2011). A total of 263 neonates were included in the study. All live born term neonates born in the above hospitals were included in the study. Premature and post term neonates, newborns with congenital malformations, neonates admitted to the neonatal unit, multiple births and non-Sudanese neonates were excluded from the study.

Data were collected using a specifically pre coded and pretested designed questionnaire on a total of 263 mothers. Measurements were taken from a total of 263 neonates. Neonatal anthropometric parameters were recorded using measuring tapes, weighing scales which were balanced beforehand and infantometer for length measurement (also adjusted beforehand). The above parameters were taken within 72hours of birth. The head circumference was measured by applying a plastic tape around the forehead (above the eyebrows) and the occipital protuberance. During the period of the study, the plastic tapes were checked against an identical, unused one in order to eliminate error from stretching the tape.

The weight was taken by placing the unclothed infant on the scale, which was calibrated beforehand.

The length was measured using an infantometer, a

metallic rectangular structure, placed on a hard surface to eliminate errors, with a rounded headboard against which the crown of the newborn's head was placed. The measurement from the crown to the heels of the feet was taken using the centimeter scale on the infantometer. Dependent variables were Neonatal birth weight, height and head circumference.

Independent variables were maternal prenatal and post natal morbidities, age, paternal and maternal heights, history of perinatal mortality, occupation, income, exposure to smoking, education and antenatal care. The data obtained were processed and analyzed using Statistical Package for Social Sciences (SPSS) version 17. Frequency analysis and Chi square test were used for comparison of proportions, T-test and z-test for comparison of means. Level of significance was set at an alpha level at 0.05 and 95% confidence limits.

Ethical clearance and approval for conducting this study was obtained from the ethical committee of the University of Medical Sciences and Technology and correspondent hospital's ethical board committees. Prior informed consent was obtained from the mothers participating in this study after full explanation of the study.

RESULTS

A total of 263 babies were included in the study, males were 139 (52.9%), and females were 124 (47.1%). Table 1 shows the mean weight, length and head circumference of newborn babies included in this study.

The maternal age range was between 14 to 44 years with the commonest range being between 22-29 years (43.3%). Maternal age had no significant association to neonatal weight, length nor head circumference (p value of all 3 was above 0.05 in the cross tabs).

Statistics of the crosstabs showed that the maternal parity was only statistically associated with newborn's length (p=0.031), but showed no association to neither

the weight nor the head circumference.

Morbidities during pregnancy were not associated with length (p=0.117) and the weight (p=0.053) but were statistically associated with the head circumference (p=0.026), the commonest morbidity during pregnancy was malaria followed by hypertension and diabetes. Also, there were no associations with neither the timing of disease during the pregnancy nor the control of the disease.

Almost 22%% of the mothers were exposed to tobacco smoke during the pregnancy for prolonged periods but this was not associated to the anthropometric measurements (P value > 0.05). The commonest range for paternal height was found to be 1.5-1.7 meters. The paternal height was found to be associated with the neonatal weight (p value =0.015) and the length (p value =0.000). Paternal height was not associated with the head circumference (P value =0.054).

In relation to maternal education, 10.6% of the sample were illiterate and maternal education was associated with the head circumference of the neonates (p=0.003) but was not associated to the weight and length, P values .662 and .914 respectively.

About 17%of the mothers were employed. Maternal occupation was associated with the neonatal head circumference (p=0.007) but not the length and weight, (P values .313 and .471 respectively).

When comparing the mean values of the weight, head circumference and length in our study with those from the WHO Multigrowth reference (MGR) study, the difference was statistically significant for all these parameters (P value less than 0.05).

Compared to WHO MGR the female anthropometric measurements of the current study showed that, the length and head circumference had P values of .000 and .009 respectively. On the other hand, the weight had a P value of 0.063 meaning the difference between the WHO average and the sample's average was not statistically significant.

Also, when comparing the sample's mean weight

results obtained in our study with the standards set by the CDC (centre for disease control and prevention), it can be seen that the sample's male weight was 10.8% (0.34kg) lighter than the CDC average (3.5kg). Amongst the females, the sample's weight was 9.3% (0.29kg) lighter than CDC average (3.4kg). The same

pattern of differences is also noted with the length (2.3% shorter amongst the males and 1.2% shorter amongst the females) and head circumference (3.7% smaller amongst the males and 2% smaller amongst the females) but it is not as pronounced as that of the weight (12).

Table 1- Mean, minimum and maximum of the neonatal weight, length and head circumference according to gender

Gender	Means and Ranges	Neonatal Weight (kg)	Neonatal Head Circumference (cm)	Neonatal Length (cm)
Male	Mean	3.1640	34.7403	48.9187
	Range (3rd to 97th centiles)	2.4 - 4.1	46.1 - 51.4	32.3 - 36.9
Female	Mean	3.1145	34.1685	48.4984
	Range (3rd to 97th centiles)	2.1 - 4.2	45.1 - 51.7	32.3 - 36.4
Total	Mean	3.1407	34.4707	48.7205

DISCUSSION

This study determined the mean weight, length and head circumference of a cohort of newborn infants in Khartoum state. The study group was selected from three hospitals trying to represent the findings across Khartoum state. Although the sample size was not large enough, this data may help in estimating the actual growth parameters among Sudanese newborn infants. Our findings regarding growth parameters of newborn infants agree with the data reported by Abdel Rahman and Ibrahim who studied 310 Sudanese neonates in 2010 and compared their growth parameters with the findings from another study conducted in 1982 (16,17). It is interesting that growth parameters in these two studies were not changed over three decades despite the socioeconomic changes in the community. In contrary to the findings reported by Abdel Rahman and Ibrahim, Canadian and Japanese studies showed a marked upward secular trend in intrauterine growth

over time. This may reflects the apparent improvement in socioeconomic status of Canadian and Japanese population compared to Sudan.

In 2006, the World Health Organization readjusted its growth charts and released a new set of growth standards which were supposed to be more applicable to less developed countries (11). Compared to the WHO MGRS standard, all growth parameters (mean weight, length and head circumference) were significantly lower in our study group. This may be explained by the fact that the included infants in the WHO study were recruited from few selected countries which are not necessarily representing all nations. Our study demonstrates the need to establish a Sudanese growth chart. Maternal and paternal factors were found to be possible explanations for the results obtained. Also, when comparing the growth parameters results obtained in this study with the standards set by the CDC, it is apparent that our growth parameters were

lower.

This agrees with the findings in Japanese study which showed that the Japanese and Chinese neonate had 5-6% lower birth weight than the American newborns (13). Another study showed that the difference between South Asian newborns and European newborns in relation to weight was of 0.254kg, which is close to this sample's results. Moreover, the difference between the two groups in relation to the head circumference was of 0.5cm, also very similar to this study's results (14). Besides, not only do the findings of this study correlate with the Chinese, Japanese and South Asian population, similar results were also noted in India, which concluded that their neonates had anthropometric measurements that were different from that of the West or more developed countries (15).

Our study showed that the maternal occupation, education, morbidity and parity and the paternal height were the major factors that influence the anthropometric measurements of the infants. Similar results reported in a study conducted in Hong Kong showed that there is a direct relation between infant length and paternal height while parental employment was a predictor of the birth weight (8). Similar results

regarding the strong association of socioeconomic class and maternal growth with a child's birth weight were obtained in another study investigated four different ethnic group.(9) In Central Africa, the average neonatal birth weight was found to be 3.17kg and was strongly associated with future weight in neonatal and infant life (10).

In conclusion this study determines the anthropometric measurements in a cohort of Sudanese newborn infants. It highlights determining the normal pattern of anthropometric measurements amongst Sudanese neonates is necessary in order to accurately assess their birth weights, lengths and head circumferences. We therefore call for establishing Sudanese growth charts based on a large study recruiting neonates from all over the country.

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