

REGULAR ARTICLE

**GROWTH MONITORING FOR LOW BIRTH WEIGHT INFANTS IN
OMDURMAN MATERNITY HOSPITAL, SUDAN**

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ABSTRACT

This was a longitudinal study to investigate the growth monitoring of Low Birth Weight (LBW) infants, (weight, length and head circumference) from birth to 6 months of age. 84 LBW infants delivered at Omdurman Maternity were included in the study, normal birth weight or preterm infants were excluded. Data was collected by questionnaire included background of the families and Infant's health and feeding. Mothers were interviewed first in the wards 3-4 h after delivery, then during home visits after 2 w and monthly follow up monitoring were used up to 6 mo. Infant's birth weight was taken immediately after birth and classified as LBW (1500-<2500 g) or VLBW (1000-<1500 g), as well as length and head circumference. Weights taken after 2 w and during monthly follow up. Infant's length and head circumference were measured to the nearest 0.1. cm. The data was analysed using statistical package for social science program (SPSS) and Chi-square test. 96.4% of the infants had LBW and 3.6% VLBW, 78.4% had normal health at birth and the rest suffered from jaundice, chest infection and diarrhoea were transferred to New Born Intensive Care Unit (NICU) for 1-3 w. 32.1% of the infants reached standard weight at the 6th month and 33.3% never reached it at any age. Mean weight attained at every age from birth to 6 months was always below standard weight. Weight attained at 2 w was 1.3 times and at 6 months 3 times the birth weight. Boys and girls had the same mean weight at birth and both doubled their weight in the second month. Length at birth was 58.3% and at 6th month was 53.6% standard length, however, there were 2 growth spurts, in the 2nd week (70.2%) and 4th month (80.9%). There was a steady increase in head circumference (\geq standard) and then a drop in the 5th (51.2%) and 6th (54.8%) months. Growth monitoring using Z-scores showed that girls had normal weight-for-age growth from 1st to 6th months but boys suffered mild underweight for the same period. Both had normal length-for-age growth from 1st to 6th months and both had normal weight-for-length growth only in the 5th and 6th months. Determinants of infants reaching standard weight at 6 months were: order of infant ($P<0.037$), number of family members ($P<0.039$), type of area ($P<0.027$) and diarrhoea infection ($P<0.042$). There was a significant correlation ($P<0.000$) between weight at birth and at 2 w but not with any other weights. The study recommended special care for LBW infants by admitting to the new born intensive care unit (NICU) till they achieve the optimum weight for their age.

Keywords: Growth, Low Birth Weight, Very Low Birth Weight, Extremely Low Birth Weight

INTRODUCTION

It was estimated that around 20-75 million LBW infants are born each year, 94% of them born in developing countries [1, 2]. 72% of these are born in Asia and 22% in Africa. In a study of 15 countries across India, the National Neonatology forum reported that the prevalence of LBW was 33% of which 32% were premature births, which is a major reason for child mortality [3].

Low birth weight is becoming a fairly serious problem in developing countries including Sudan where pregnant mothers face dietary deficiency. It is one of the common persisting and major problems facing the community and this study is an attempt to raise the awareness of people on such an important health problem. This information is highly important to medical and nutrition staff responsible for maternal and child health care specially the LBW infants

who can attain normal growth and live a healthy life.

General objectives of the study

To investigate the growth monitoring of LBW infants, (weight, length and head circumference) from birth to 6 months of age.

Specific objectives

To identify the age at which standard weight is reached by LBW.

To investigate LBW infant's health status from birth till 6 months of age.

To determine the influential factors of the growth among LBW infants from birth till 6 months of age.

Received 18 April 2018; Accepted 24 May 2018

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Hypothesis

Not all LBW infants can catch up the standard weight at 6 months of age.

Girls' weight-for-age growth and weight-for-height growth are better than boys.

MATERIALS AND METHODS

Study design

This was a longitudinal study, included 84 low birth weight infants who delivered in Omdurman Maternity Hospital during the period of the study during the period, January to October, 2009, and resident in Greater Omdurman.

Study area

The study was conducted in Omdurman Maternity Hospital. It was established in 1957 in Greater Omdurman and is a leading teaching hospital for teaching and training of midwives in the Sudan. The hospital served the rural and urban mothers and infants in Khartoum State.

Sample size

It is a total coverage of full term low birth weight infants who delivered in Omdurman Maternity Hospital and resident in Greater Omdurman (Omdurman, Karari and Umbaeda) in the period from January 2009–May 2009.

Inclusion and exclusion criteria

- **Inclusion:** all mothers living in greater Omdurman were included for easy access by the author during the 6 months follow up period.
- **Exclusion:** Mothers living outside Greater Omdurman or who delivered normal birth weight or preterm infants or refused cooperation after leaving hospital or infants who died before age of one month were excluded from the study.

Study team

The author was assisted by two assistant nutritionists and a nurse who were informed about the nature of the research and trained on how to perform their duties.

Tools of data collection

- Structured, coded, pretested questionnaire. The questionnaire containing the following sections.

Demography and socioeconomic data.

Dietary data that included infants feeding practices.

Health situation assessed at each monthly visit when mother was asked about infant's illness during the previous period.

- Anthropometric measurements of infants [weight (kg), length (cm), head circumference (cm)].

Measurement

Infants birth weight was taken immediately after birth and classified as LBW (1500-<2500 g) or VLBW (1000-<1500 g). Weights taken after 2 w and during the monthly follow up.

-Length measurement

Infant's length was measured to the nearest 0.1 cm in the recumbent position by an infant-meter and during the monthly follow up.

-Head circumference measurement

Infant's head circumference was measured to the nearest 0.1 cm and during the monthly follow up.

-Infants' anthropometric measurements (weight, length and head circumference) were compared with those of the (NCHS, 1983).

Z-scores weight-for-age, length-for-age and weight-for-length (WHO, 2006) were used to monitor growth during the 6 months of study period.

Data analysis

SPSS computerized statistical package for social science program was used and results presented in tables and figures. The association and correlation methods of Chi-square were used.

RESULTS

84 of LBW infants were included in the study, 47.6% were males and 52.4% were females, 96.4% had LBW, 3.6% VLBW but none had extremely LBW (Fig.3, 4).

It was observed that (35%) of infants mothers were higher education level, while (28.8%) had medium level. lower education level was (33.7%) mothers. Illiteracy was low. More than half of the infants (57.5%) belonged to nuclear families and 42.5% belonged to extended families, 88% of families under study lived in third class areas while 7.5% in shanty areas and only 3.7% lived in second class areas (table 1).

• Infants' health

The majority of infants (78.6%) had normal health at birth, while 21.4% had suffered from the following diseases: jaundice (4.8%), chest infection (10.7%) and 5.9% had other diseases (injuries, rickets and general infection)

86.9% of the infants were vaccinated immediately after birth and 13.1% were not vaccinated due to their health state. 23.8% of infants were admitted to the Incubator for different periods the longest period was over 2 w stayed by 3.6% of the infants. Similar percentage also stayed for 1-2 w and 16.6% stayed for one week. It was observed that the frequency of diseases increased directly with age as 3.6% of infants were ill during the first and second months and 33.3% at the 6th month. The types of diseases were jaundice, chest infection, diarrhea and vomiting. About two third of the infants (65%) were given medications during their illness; 16.7% had traditional medicine (Yanson, helpa and crawia) while 13.3% had both medications and traditional medicine. Only 5.0% of infants were not given any treatment during their illness (table 2).

• Infants monthly follow up:

• Weight

After two weeks of birth only one infant (1.2%) met the standard weight, 2.4% were above the standard while the rest (96.4%) were still below it.

At the first month, 1.2% of the infants met the standard weight, 10.7% were above it while the percentage of the infants below the standard decreased to 88.1%.

At age two months the proportion of infants above the standard increased to 20.2% and those who met the

standard weight were 17.8%, while others below the standard decreased to 61.9%.

At the 3rd month it was clear that no standard weight was achieved as most of the infants (63.1%) were below the standard and 36.9% above it.

By the fourth month more than half of the infants (57.1%) were below the standard weight, 2.4% achieved it and 40.5% were above it.

At the 5th months of age almost 2/3 of the infants (60.8%) were below the standard weight, 1/3 (33.3%) above it and only few (5.9%) achieved the standard weight.

At 6 months, only 32.1% (n=27) infants reached standard weight at different months and kept it at age 6 mo. However, 67.9% of infants were below the standard weight and 33.3% (n=28) never reached standard weight at any age including 2 VLBW infants (table 3).

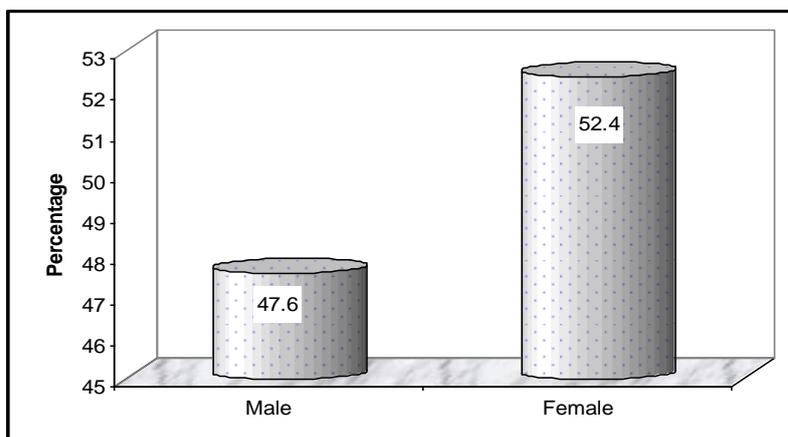


Fig. 1: Distribution of LBW infants by gender (n=84)

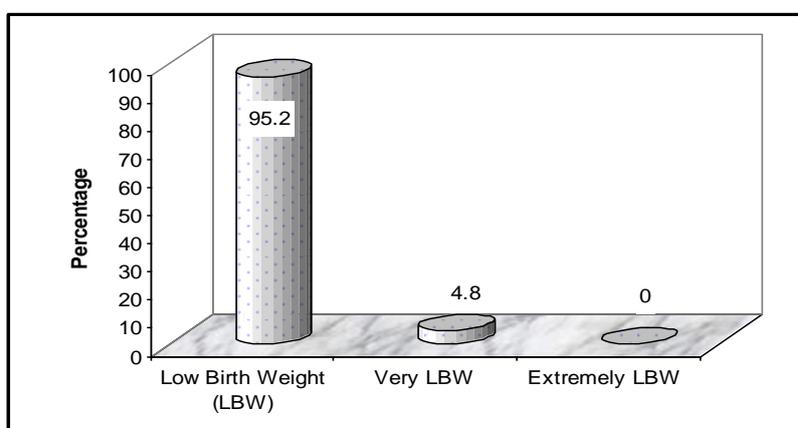


Fig. 2: Distribution of LBW infants according to birth weight (n=84)

Table 1: General background of LBW Infants (n=84)

Category	Variables	No of subjects	Percentage
Mothers educational level	Illiterate	2	2.5
	Khalwa	3	3.7
	Primary School	24	30.0
	Intermediate School	5	6.3
	Secondary School	18	22.5
Type of residential area	University	28	35.0
	Shanty Area	6	7.5
	Third Class	71	88.8
Type of family	Second Class	3	3.7
	Nuclear	46	57.5
	Extended	34	42.5

Table 2: Health of LBW infants (n=84)

Category	Variables	No of subjects	Percentage
Type of disease	Jaundice	4	4.8
	Chest infection	9	10.7
	problems		
Vaccination at birth	Others	5	5.9
	Normal	66	78.6
	Vaccinated	73	86.9
Incubator Period	Not yet	11	13.1
	<1week	14	16.6
	1-2 w	3	3.6
Frequency of illness	>2weeks	3	3.6
	Not Inter	64	76.2
	1st Month and 2 nd Month	3	3.6
	3 rd Month	6	7.2
	4 th Month	11	13.1
	5 th Month	12	14.2
Types of diseases suffered from	6 th Month	28	33.3
	Not ill	24	28.6
	Jaundice	8	9.1
	Chest infection	44	50.0
	Diarrhea and Vomiting	32	36.4
Types of treatments given	Others	2	4.5
	Medications	39	65.0
	Traditional Medicine	10	16.7
	Medications and Traditional Medicine	8	13.3
	Not given	3	5.0

Table 3: LBW Infants' Weights compared to standard weights

Age	Infants<Standard		Infants met standard		Infants>standard		Total	
	No	%	No	%	No	%	No	%
At Births	84	100.0	-	-	-	-	84	100.0
2 W	81	96.4	1	1.2	2	2.4	84	100.0
1 st Month	74	88.1	1	1.2	9	10.7	84	100.0
2 nd Month	52	61.9	15	17.8	17	20.2	84	100.0
3 rd Month	53	63.1	-	-	31	36.9	84	100.0
4 th ` Month	48	57.1	2	2.4	34	40.5	84	100.0
5 th Month	51	60.8	5	5.9	28	33.3	84	100.0
6 th Month	57	67.9	2	2.4	25	29.7	84	100.0

Mean weights of the infants were below the standard weight at every age from birth to 6 mo (table 4). It was 64.7% of the standard weight at birth and increased regularly until the 2nd month to 94.0% and then averaged about 93% till age 6 mo.

Table 4: mean±SD for weight (kg) of LBW infants achieved (combined sex) compared with standard weight

Age	Standard	mean±SD	%of mean
At Births	3.4	2.2±0.2	64.7
2 W	3.6	2.9±0.4	80.5
1 st Month	4.3	3.6±0.7	83.7
2 nd Month	5	4.7±0.7	94.0
3 rd Month	5.7	5.3±0.8	92.9
4 th ` Month	6.3	5.9±0.9	93.6
5 th Month	6.9	6.4±1.0	92.7
6 th Month	7.4	6.7±1.0	90.5

• **Length**

Table 5 below shows that at birth 14.3% of infants had a normal standard length, 44% were above the standard and 41.7% were less than the standard.

At 2 w 13.1% of infants still had the standard length while those above the standard increased to 57.1%.

It was observed that at the 1st and 2nd months of age there was a decrease in number of infants who had standard and above standard lengths and an increase in the number of infants below the standard.

By the 3rd and 4th months there was a decrease in the number of infants who were below the standard and an increase in the number of infants above the standard.

At the 5th month, 51.2% of infants were above the standard lengths, 15.5% met the standard and 33.3% were still below the standard.

At 6th month, more than half of the infants (53.6%) achieved and exceeded the standard length (10.7% met the standard and 42.9% were above the standard). 46.4% had below the standard length.

• **Head circumference**

Table 6 shows that at birth 48.8% of the infants had head circumferences less than the standard, 1.2% met the standard and half of them (50%) had head circumferences above the standard.

At 2 w more than half (54.8%) of the infants were below the standard while 45.2% attained the standard (20.2% met the standard and 25% were above it). At the 1st and 2nd months the percentages of infants who exceeded the standard were dramatically raised to 55.9% and 57.1% respectively. The rest were still below the standard.

At the 3rd month, 3/4 (75.0%) achieved the standard (9.5% met the standard and 65.5% were above it) and only 25% were still below it.

By the fourth month most of infants (61.9%) were above the standard and 22.6% below it. On the 5th and 6th months of age more than half of the infants achieved and exceeded the standard (51.2% and 54.8% respectively) while the rates of the infants below the standard increased to 48.8% and 45.2% respectively.

• **Growth monitoring using Z-scores**

• **Weight-for-age**

Mean weight of girls at birth was 2.2 kg±0.24 equivalent to a Z-score of <-2 SD, so suffered moderate underweight. At 2 w they suffered mild underweight (Z-score =-2 SD), but at age one to six months they had normal weight-for-age (fig. 3).

Table 5: LBW Infants' lengths compared to standard lengths

Age	Infants<Standard		Infants met standard		Infants>Standard		Total	
	No	%	No	%	No	%	No	%
At Births	35	41.7	12	14.3	37	44.0	84	100.0
2 W	25	29.8	11	13.1	48	57.1	84	100.0
1 st Month	32	38.1	9	10.7	43	51.2	84	100.0
2 nd Month	38	45.2	7	8.3	39	46.4	84	100.0
3 rd Month	36	42.9	1	1.2	47	55.9	84	100.0
4 th ` Month	16	19.0	8	9.5	60	71.4	84	100.0
5 th Month	28	33.3	13	15.5	43	51.2	84	100.0
6 th Month	39	46.4	9	10.7	36	42.9	84	100.0

It is worth mentioning that there were two spurts in length, the first at age 2 w when ≥ standard length increased from 58.3% to 70.2%. The second spurt was at age 4 months when the increase was from 57.1% to 80.9%.

Table 6: LBW infants Head circumferences compared to standard.

Age	Infants<Standard		Infants met standard		Infants>Standard		Total	
	No	%	No	%	No	%	No	%
At Births	41	48.8	1	1.2	42	50.0	84	100.0
2 W	46	54.8	17	20.2	21	25.0	84	100.0
1 st Month	36	42.9	1	1.2	47	55.9	84	100.0
2 nd Month	28	33.3	8	9.5	48	57.1	84	100.0
3 rd Month	21	25.0	8	9.5	55	65.5	84	100.0
4 th ` Month	19	22.6	13	15.5	52	61.9	84	100.0
5 th Month	41	48.8	2	2.4	41	48.8	84	100.0
6 th Month	38	45.2	12	14.3	34	40.5	84	100.0

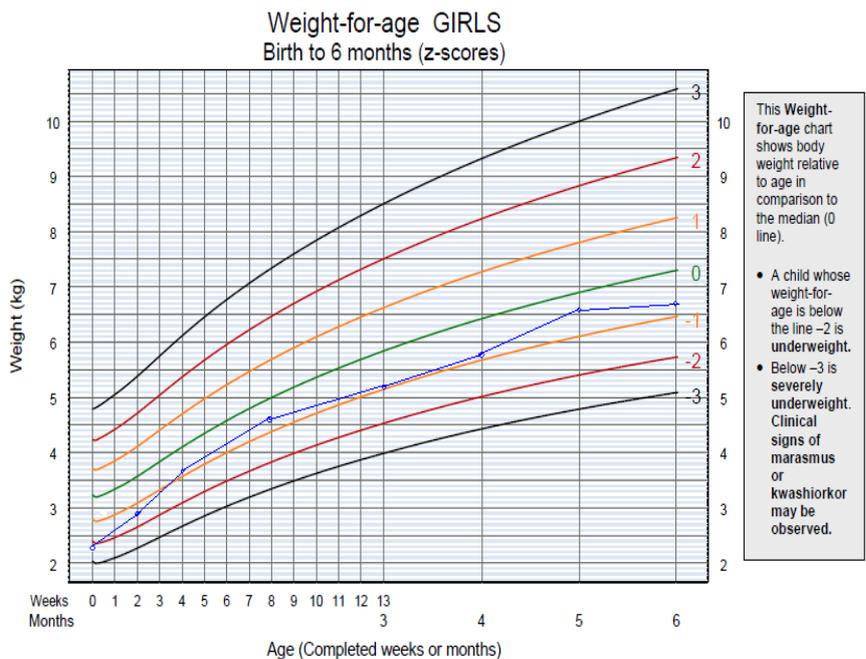


Fig. 3: LBW infant girls' weight-for-age Z-score

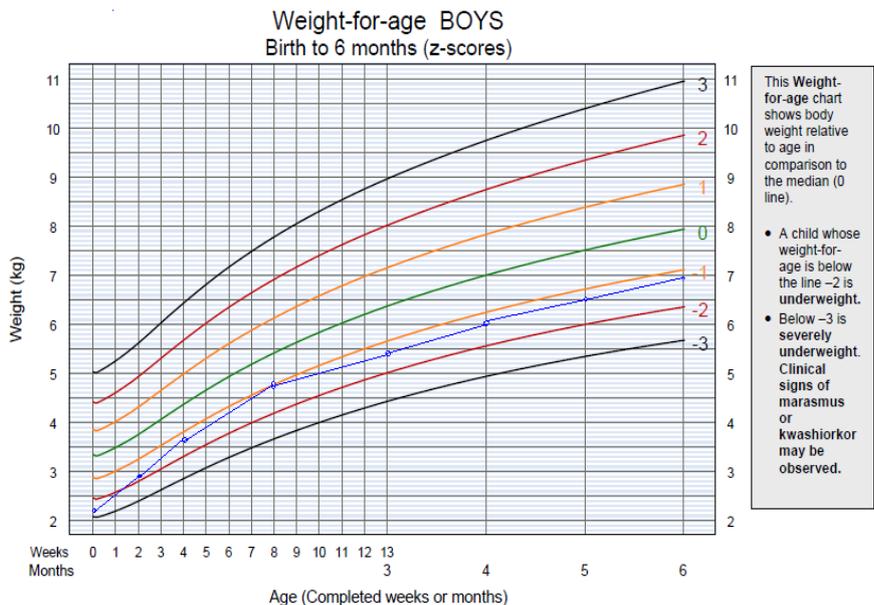


Fig. 4: LBW infants Boys' weight-for-age Z score (n=84)

At birth, boys had a mean weight of 2.2 ± 0.23 which classified their Z-score as < -2 SD so suffered moderate underweight. At age 2 w their Z-score improved to -1 SD hence had normal weight-for-age, however, from the first to the sixth month their Z-score was -2 SD hence suffered mild underweight (fig. 4).

Length-for-age

At birth girls had a mean length of 45.8 cm which classified them as moderately stunted (< -2 SD). They improved at

age 2 w to a mild condition (< -1) but from age one month to 6 mo they had normal length-for-age status (fig. 5).

Boys mean length at birth was 44.6 cm corresponding to a Z-score of < -3 SD so were severely stunted. At age 2 w they improved to a mild stunting condition (-2 SD) and from age one month to 6 mo they had normal length-for-age status (fig. 6).



Fig. 5: Girls' length-for-age Z-score

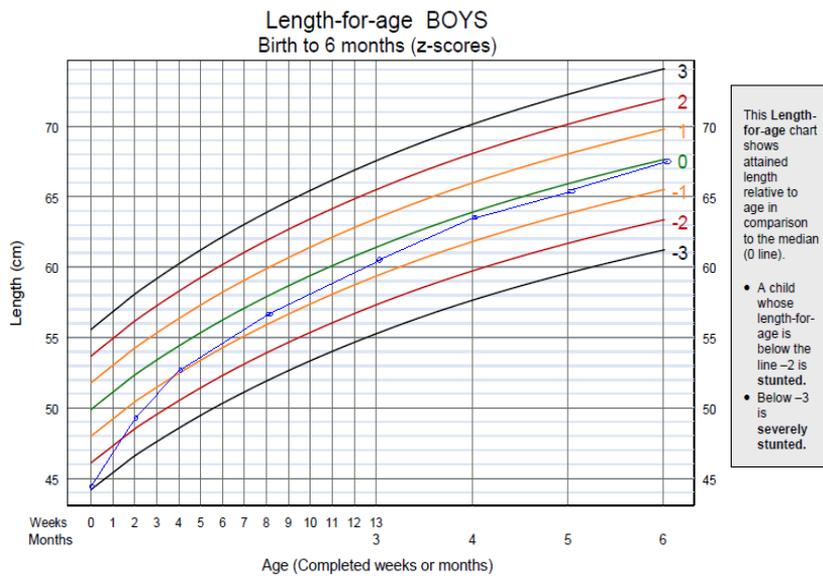


Fig. 6: LBW infants boys' length-for-age Z-score (n=84)



Fig. 7: LBW infants Girls' weight-for-length Z-scores (n=84)



Fig. 8: LBW infants Boys' weight-for-length Z-scores (n=84)

Weight-for-length Z-score

Girls were born suffering from moderate wasting (<-2 SD), had mild wasting from age one to four months but at ages five and six months they had normal weight-for-length as was the case in the second week after birth. Boys had the same weight-for-length Z-scores as the girls (fig. 7, 8).

• Determinants of infant weight gain

Chi-square analysis showed no significant association between standard weight reached at 6 months and complimentary feeding (P<0.739), educational level of mothers (P<0.128), jaundice (P<0.867) or inflammations (P<0.427).

There was a significant association between standard weight reached at 6 months and diarrhoea (P<0.042),

order of infant in the family (P<0.037), number of family members (P<0.039) and type of area (P<0.027).

There was a significant correlation between weight of infants at birth and weight at 2 w (P<0.000) but no significant association between weight at birth and weights at first till the sixth months of age.

DISCUSSION

61.3% were normally delivered and 38.7% by Cesarean delivery. Birth weight was classified as 96.4% LBW and 3.6% VLBW and none had extremely LBW. This shows that incidence of VLBW was minor during the study period.

78.4% of the infants had normal health at birth the rest suffered from different diseases, and were transferred to the Neonatal Intensive Care Unit (NICU) for periods of 1 to 3 w.

Major diseases were jaundice, chest infections, diarrhoea and vomiting. This was also reported by [4], that LBW infants suffered various clinical problems such as jaundice and chest infections.

The proportion of infants who suffered from illness increased with increase in age. During the follow up period, it was observed that diarrhoea and vomiting among the infants were due to the introduction of un-boiled tap water, complimentary feeding, hand feeding and poor sanitation which could affect weight gain. [5] Reported that infections could account for the differences in weight gain between the Sudanese children and NCHS reference.

32.1% (n=27) of the infants reached standard weight at the sixth month irrespective of when it was reached and 33.3% (n=28) never reached standard weight at any age including too VLBW infants. This supports our hypothesis that not all LBW infants will reach standard weight at 6 mo.

Mean weight attained at every age from birth to 6 months was always below the standard weight. It increased regularly until the second month to 94.0%, and then averaged 93.0% but dropped to 90.5% at the sixth month.

In this study mean weight gain at 2 w was 1.3 times the birth weight which support previous studies [7-9]. At age 6 months, the weight gain was 3 times the birth weight also which exceeded the double weight gain mentioned by the above authors.

Boys and girls had the same mean weight (2.2 kg) at birth which disagreed with [9], that girls tend to be smaller at birth but boys were heavier than girls from the second to the sixth month which agreed with the author. Both boys and girls doubled their weight in the second month which was contrary to [5] that boys double their weight earlier than girls.

It can be concluded that exceeding the projected weight gain at 2 w and at 6 months and an average gain in weight of 92.7% from the second week to age 6 months advised for normal birth weight infants can be considered satisfactory for LBW infants

At birth 58.3% had standard or above standard length but at the sixth month the fig. was 53.6%. There were 2 growth spurts in length, at the second week (70.2%) and at the fourth month (80.9%).

At birth 1.2% had standard head circumference while 50.0% had above standard circumference. There was a steady increase in the number of infants with \geq standard circumference up to age 4 months (77.4%), then a drop at the fifth and sixth months (51.2% and 54.8% respectively). The phenomenon that LBW infant had 2 growth spurts in length and a drop in head circumference needs further investigation.

Growth monitoring using Z-scores for weight-for-age Z-score showed, girls at birth suffered moderate underweight but had normal weight-for-age growth from the first to the sixth month. Boys had moderate underweight at birth but suffered mild underweight from age one to six months. Therefore, girls had better weight-for-age growth than boys which agreed with [10] in Khartoum Province. This supports our hypothesis that girl's weight-for-age growth is better than boys. On the other hand, Length-for-age Z-score for the same sex. Girls were born suffering from moderate stunting while boys from severe stunting.

However, both had normal length-for-age growth from age one month to age six months.

LBW infants born with faltering in length to attain normal increases by the first month was because infants are genetically determined to be longer shift channels of growth according to [7]. However, both boys and girls were born suffering from moderate wasting which became mild from the first to the fourth month and then improved to normal weight-for-length growth. This disagrees with our hypothesis that girls had better weight-for-length growth than boys. No difference in growth was observed between girls and boys but in weight-for-age girls had better growth. Weight-for-length is a better indicator of present nutritional status which could possibly be a reason for the discrepancy.

Chi-square analysis showed a significant association between infants who reached the standard weight at age 6 months and order of the infant ($P < 0.037$), type of family members ($P < 0.039$), type of residential area ($P < 0.027$) and diarrhoea infection ($P < 0.042$). These agreed with [5]. No association was found between complimentary feeding, mothers' education and nutritional status, jaundice and inflammations.

There was a significant correlation ($P < 0.000$) between weight at birth and weight at age 2 w but not with any other weights.

CONCLUSION

- 68% of the infants did not reach standard weight at age 6 months and their mean weight never reached standard weight during the 6 months
- 2 growth spurts in length in the 2nd week and 4th month
- Decrease in head circumference at 5th and 6th months
- Girls had better weight-for-age growth than boys; both had similar length-for-age and weight-for-length growth
- Determinants of infants reaching standard weight at 6 months were order of infant, number of family member, type of area and diarrhoea infection
- Weight at birth was correlated with weight at 2 w only.

Recommendations

Special care for LBW infants admitted to NICU until they achieve optimum weight for their age and follow up of their health and nutritional status at home.

ACKNOWLEDGMENT

I am particularly indebted to the DAAD for the financial support. Special thanks to my assistant team work for their great help to complete the field work. My thanks to Omdurman Maternity Hospital staff and mothers who participated in this study.

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