Original article

Changes in birth-weight of Hospital-delivered neonates in Addis Ababa

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Abstract: A retrospective study was conducted to establish recent birth-weight changes in singleton live births at Tikur Anbessa Teaching Hospital, Addis Ababa, Ethiopia for about 20 years period, September 1976 September 1996. The overall mean birth-weight was 3126g (SD=502). A decline in mean birth-weight was observed from 3162g (95% CI 3137-3186) and 3162g (95% CI 3149-3176) in the 70's and the 80's, respectively, to 3058g (95% CI 3041-3075) in the 90's. The over all proportion of low birth weight was 8.4%, increasing from 5.8% (95% CI 4.6%-7.3%) in the 70's to 7.1% (95% CI 6.4%-7.8%) in the 80's and to 11.3% (95% CI 10.2%-12.3%)in the 90's. When birth-weight was controlled for sex and maternal characteristics, a significant decrease on birth- weight was observed in the 90's, by about 81g (95% CI 44.3 - 118.5g) as compared to the 1970's. The odds of low birth-weight in the 90's was about 52% higher compared to the 70's: (OR=1.52, 95%CI=1.04-2.22). Similarly important changes in the distribution of pre-term delivery, maternal age, parity, sex ratio, and ante-natal follow-up that might have favored the decrease in birth weight were noted between the 90's and the earlier decades. Mean birth-weight was observed to peak in the months of August, September, and October ranging from 3143g to 3173g and fall between March and July. The proportion of low birth weight negatively correlated with the mean birth-weight was highest (10%) in April and observed to fall between August and October, with the lowest proportion of 6.2% in September. However, there was no considerable seasonal variation in birth-weight. In conclusion, the study has shown that mean birth-weight has declined in the 90's as compared to the earlier two decades and the proportion of low birth- weight increased in Addis Ababa, despite a continuing increase in the socioeconomic status. However, there was no considerable seasonal variation in birth-weight. [*Ethiop. J. Health Dev.* 2000;14(2):169-176]

Introduction

Birth-weight is recognized as global indicator of community health (1), and it has been shown to increase over time in developed as well as in some developing countries (2-4). This increase is speculated to be attributed to improved environmental conditions (2-4). However, other findings suggest mean birth-weight remained constant in some places for long while socio-economic and nutritional status continue to change (5,6). It is expected in some cases that the increase might have reached its peak and then a plateau.

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Different studies have reported the distribution of birth-weight for Ethiopian babies. In 1962 Hofvander reported a mean birth-weight of 2950g (7). Five years later Young published a mean birth-weight of 3120g (8). Gebre-Medhin et al showed higher mean birth-weight of 3132g for the five year period of 1964-1968 (9). Subsequently other investigators analyzed weights of Hospital delivered singleton live births reported mean birth-weights ranges of 3039-3243g (10-13). What remains unclear, however, is whether mean birth weights increase, decrease or level off in the long run.

Green reported that there was a significant increase of mean birth-weight from 3075g in 1973 to 3181g in 1982 and a significant decrease of the percentage of low birth-weight

from 13% to 8% (10). This was the only study conducted to assess levels and changes of birth weight in the country. It would be difficult, however, to extrapolate these changes. In the first place, mean birth-weights and proportion of low birth-weights of the two years (1973 and 1982), are arbitrarily taken to talk about trends and changes. Secondly and most important is that due to the drought that occurred in 1973, hundreds of thousands of people were estimated to have suffered from shortage of food supply or died in hunger in Ethiopia (14).this in turn might have affected the findings of lower birth-weight reported by Green in that particular year compared to 1982.

Therefore it is pertinent to assess circumstances like environmental factors, availability of food, altitude, season etc. that are related with the fluctuation levels of birth-weight. Studies have reported that birth weight falls during the rainy season, and rises during the dry season in Tanzania (15-17). And this could be due to the shortage of food supply in the rainy season.

As weather conditions vary from year to year and between seasons, continuous data records of longer period would be of paramount importance in providing information whether or not birth-weight has increased or declined. The present study was thus undertaken to determine whether birth weight levels fluctuate from year to year and vary from season to season using continuous clinical records of the Tikur Anbessa Teaching Hospital.

Methods

This study is based on clinical records of about 20 years (September 1976 to September 1996) of the Tikur Anbessa Teaching Hospital.

At Tikur Anbessa Hospital deliveries are attended by medical doctors or midwives. The newborns are weighed immediately with standard scale. The records include the date of birth (month and year), gestational age, birth weight, sex of the newborn; ante-natal status, parity, and age of the mother as well as mode of delivery.

A systematic sampling technique was applied to select a sample size of 10,000 subjects among the eligible newborns, which maintains the proportionality of the data over the 12 months of each year for about 20 years. In the those years 91,000 deliveries had been conducted, of which 67,228 were singleton live births with 28 and above weeks of gestation. In this study eligibility was defined as singleton live births with 28 and more weeks of gestation.

WHO's definitions for Low birth-weight as birth-weight of less than 2500g and equal to, or less than, 1500g for very low birth-weight were used (18). Gestational age was calculated in completed weeks from the date of last menstrual period (LMP) as recorded by the attendant. The record on gestational age was available for only 5284 newborns of the last ten years (1987 to 1996).

Pre-term delivery was defined as delivery before 37 completed weeks, term refers to babies born after 37 to 42 completed weeks.

Parity for each woman is defined in this study as the number of pregnancies which have resulted in a live birth without including the present birth.

Mean(SD) birth-weights (95% confidence intervals) for time spans of 1976-1979, 1980-1989 and 1990-1996, were estimated, One way Analysis of Variance (ANOVA) was used to compare means. Low birth-weight rates were assessed using chi-squared. In order to adjust birth-weight for maternal characteristics, multiple regression analysis was employed on the data. Independent variables included in the analysis were maternal age, gestational age, sex of the baby, parity, ante-natal follow-up, and the time spans of 1976-1979, 1980-1989, and 1990-1996.

Results

Records of a total of 9,975 newborns were reviewed for the years 1976-1996. Data were missing in 25 cases.

The overall mean birth-weight was 3126g (SD=502g). A decline in mean birth-weight was observed from 3162g (95% CI 3137-3186) and 3162g (95% CI 3149-3176) in the 70's and the 80's, respectively, to 3058 (95% CI 3041-3075) in the 90's. The 95% confidence intervals indicate mean birth-weight was significantly lower in the 90's than the 70's and the 80's (Table 1). Figure 1(a) shows mean birth-weight for single years in the study period indicating falling rapidly in the 90's the mean birth weight in 1994 being the lowest.

Table 1: **Changes in birth-weight and other related variables**

Variable	1976-1979 (n=1292)	1980-1989 (n=5194)	1990-1996 (n=3489)	P-value
Birth-weight				
Mean (SD)	3161(461)	3162(499)	3058(515)	<0.00001[a]
Wt<2500g (%)	5.8	7.0	11.2	<0.0001[b]
Wt≤1500g (%)	0.08	0.58	0.83	0.011[b]
Sex ratio				
% females	45.9	46.9	48.1	0.378[b]
Gestational age				
% pre-term		5.5	8.7	<0.0001[b]
Maternal age				
Mean (SD)	25.0(5.6)	26.4(5.9)	26.4(5.9)	<0.0001[a]
Parity (%)				
Para 0	34.3	29.2	40.7	
Para 1	21.4	18.3	22.5	
Para 2+	44.4	52.5	36.8	<0.0001[b]
Ante-natal (%)	49.1	58.5	87.1	<0.0001[b]

[a]One way analysis of variance (F-test), [b]Chi-Squared test

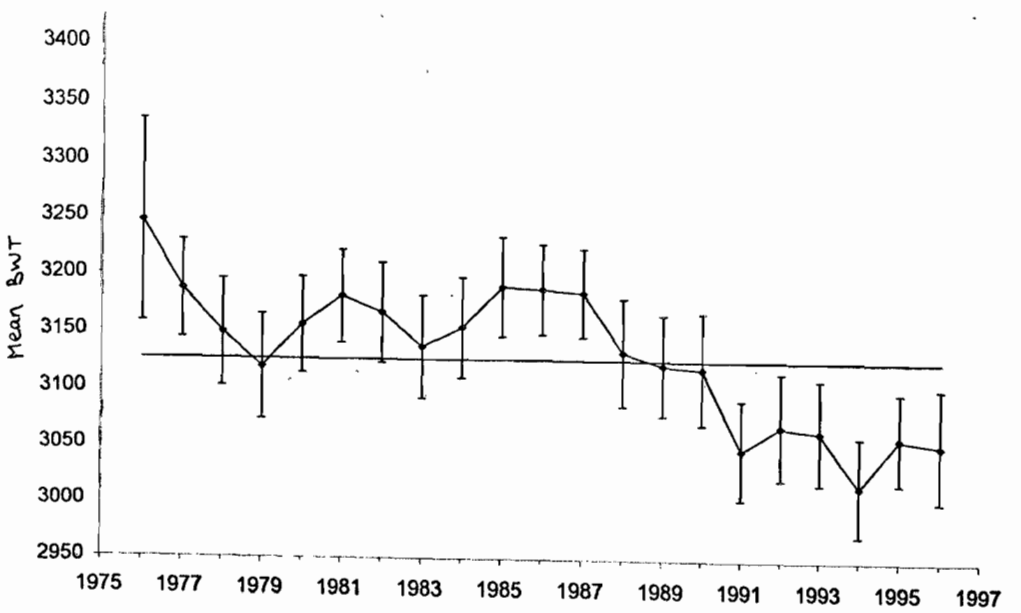

Figure 1a: **Yearly mean birth-wiegth with 95% confidence interval, 1976-1996 (---), showing overall mean birth-weight**

The over all proportion of low birth-weight was 8.4%, increasing from 5.8% (95% CI 4.6%-7.3%) in the 70's to 7.1% (95% CI 6.4%-7.8%) in the 80's and 11.3% (95% CI 10.2%-12.3%) in the 90's. The 95% confidence intervals indicate that low birth-weight rate was significantly higher in the 90's than in the 70's and the 80's (Table 1). There was also a significant increase in the very low birth-weight group from almost none in the 70's to 30(0.58%) and 29(0.83%) in the 80's and 90's, respectively. How ever, the numbers for very low birth-weight groups are too small to skew the over all birth-weight distribution. Figure 1(b) shows the incidence of low birth weight falling below average before 1990's, and then rapidly grown above the average, the incidence in 1994 being the highest.

Similarly important changes in the distribution of pre-term delivery, maternal age, parity, and ante-natal follow-up were noted between the 90's and the earlier years (Table 1).

Pre-term deliveries increased from 5.5% in the 80's to 8.7% in the 90's. There was a significant increase in maternal age, and ante-natal care follow-up has almost doubled in the 90's as compared to the earlier years.

On the other hand the percentage of parous women decreased significantly in the 90's (60%) as compared to the 80's (70%) and 70's (65%). Although the sex ratio has not shown significant change, the percentage of female infants increased from 45.9% in the 70's to 46.7% in the 80's and 48% in the 90's. When birth-weight was controlled for sex, parity, ante-natal follow up, maternal age, and gestational age in the multiple regression analysis (Table 2) there was a slight increase of birth weight by about 15g (but not statistically significant), in the 80's, while a significant decrease on birth-weight was observed in the 90's, by about 81g (95% CI 44.3 - 118.5g) as compared to the 1970's. All the other variables also show significant effect on birth-weight.

Logistic regression analysis on the factors related to low birth-weight (Table 2) showed that time is a significant variable along with gestational age, ante-natal care and parity.

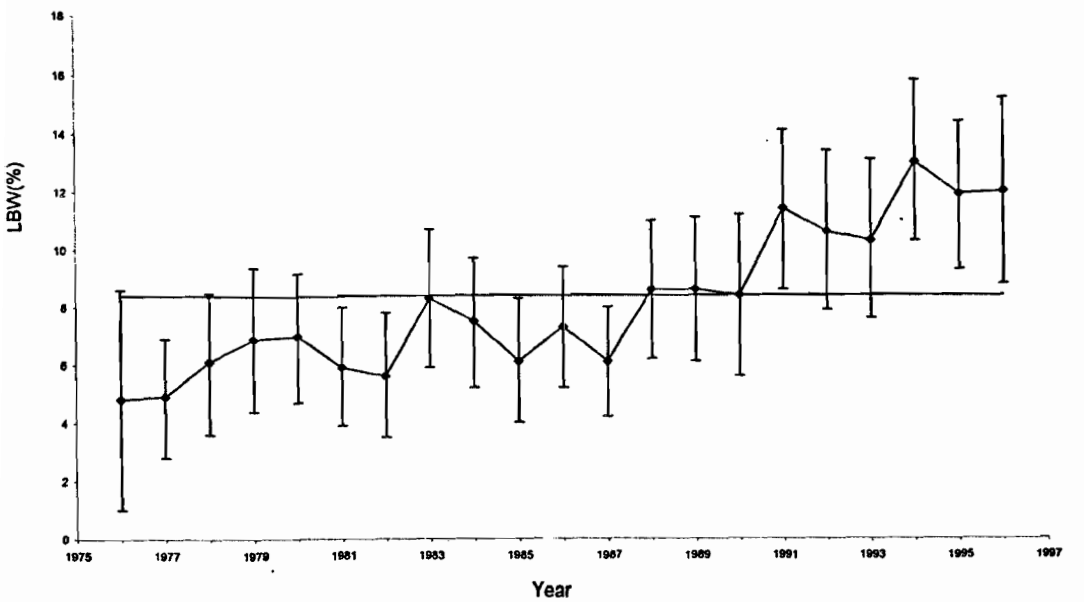

Figure 1b: **Year by incidence of low birth-weight with 95% confidence interval, 1976-1996 (---) showing the overall proportion of birth-weight**

Table 2: **Birth-weight in relation to sex of the baby and maternal characteristics: multiple regression analysis**

Factor	Birth weight		Low birth weight	
	β coeff	95% CI coeff	OR	95% CI
Age	4.6	2.6 - 6.7	0.99	0.97 - 1.01
GA	92.0	86.9 - 97.2	0.62	0.59 - 0.64
Sex				
Male				
Female	-88.9	-108.7 - -69.3	1.16	0.97 - 1.38
ANC				
Yes				
No	-94.0	-116.3 - -71.4	1.31	1.08 - 1.60
Parity				
0				
1-2	136.3	111.2 - 161.5	0.64	0.51 - 0.79
3-4	191.5	158.2 - 224.8	0.58	0.43 - 0.79
5+	188.7	149.7 - 227.6	0.60	0.42 - 0.86
Time span				
1976-1979				
1980-1989	15.4	-19.6 - 50.5	1.04	0.71 - 1.50
1990-1996	-81.4	-118.5 - -44.3	1.52	1.04 - 2.23

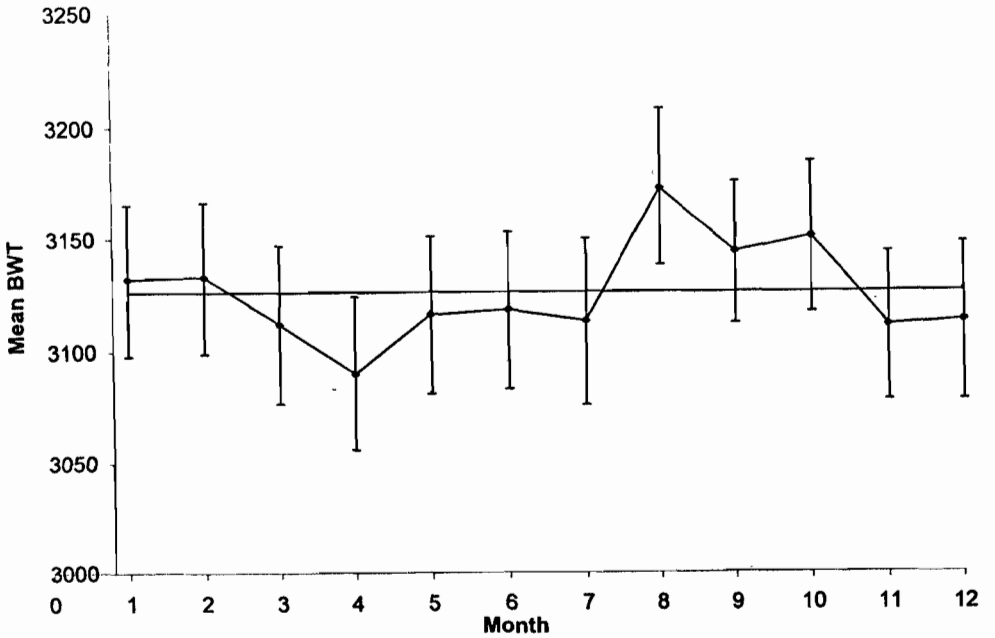

Figure 2a: **Monthly mean birth-weight with 95% confidence interval.**

Adjusting for sex, parity, ante-natal follow up, maternal age, and gestational age, the odds of low birth-weight in the 90's was about 52% higher compared to the 70's: (OR=1.52, 95%CI=1.04-2.22). This association was statistically significant. Similarly the odds of low birth-weight in the 80's was about 3% higher compared the 70's: (OR=1.04, 95%CI=0.71-1.50) which was not statistically significant.

Figure 2(a) shows that, although statistically not significant, mean birth-weight was observed to peak in the months of August,

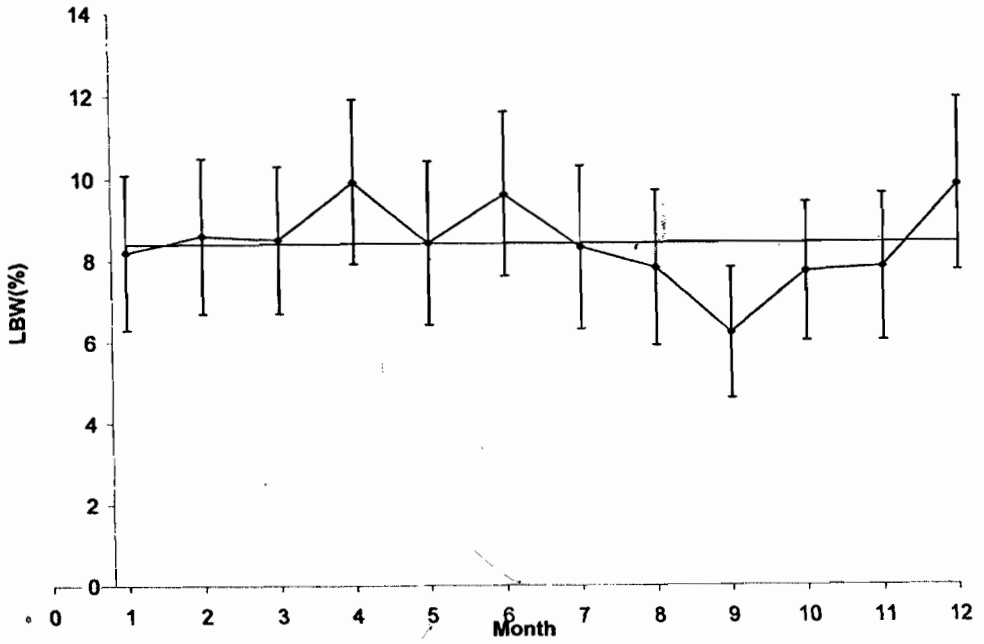

Figure 2b: **Monthly proportion of low birth-weight with 95% confidence interval.**

September, and October ranging from 3143g to 3173g. Mean birth-weight was observed to fall between the beginning of the dry season (March) and the beginning of the rainy season (July), reaching its lowest during or just after the dry and the rainy seasons (April and July). The proportion of low birth-weight negatively correlated with the mean birth-weight, was highest (10%) in April and observed to fall between August and October, with the lowest proportion of 6.2% in September (Fig 2(b)).

Discussion

This study has shown that the mean birth weight estimate of singleton live births delivered at Tikur Anbessa Hospital for the period of 1976-1996 was 3126g (SD=502g). These results are within the range of similar studies reported in Ethiopia as well as most of African countries (7-13,15-17).

It is to be noted that even though Tikur Anbessa Hospital was established as a tertiary referral hospital, it has been handling almost all deliveries coming to the hospital upto the end of 1996 and more than 90% of the deliveries registered were from Addis Ababa. Due to the restructure in 1997, the hospital started handling only referred cases of deliveries which were not included in this study. Our study was confined to Tikur Anbessa Hospital because of the existence and continuation of similar methods of registration of birth-weight and similarity of the personnel and instruments involved in the deliveries throughout the long period.

A recent study on birth-weight, among 4047 consecutive singleton new births from July 1996 to January 1997 in the four referral hospitals (Tikur Anbessa, Zewditu, Gandhi Memorial and St. Paul), in Addis Ababa (19, showed results (mean birth- weight of 3065 ± 465g, and incidence of low birth-weight 9.1%), that are almost similar to our findings of the 1990's.

Our findings suggest that over the last 20 years, mean birth- weight has declined and the rate of low birth-weight has increased while it is recognized that the socio-economic and nutritional states have continued to change (20). Analysis of birth-weight data in Hong Kong showed that birth-weight remained

constant between 1985-1986 and 1995-1996, while studies in India, the United States, and England and Wales showed a steady increase in birth weight (2,4,5).

Adjusting for sex and maternal characteristics in multiple regression analysis our results suggested a decrease of 81g in the period 1990-1996 as compared to 1976-1979. Similarly the odds of low birth-weight in the 90's was about 52% higher compared to the 70's.

Birth-weight is known to increase with gestational age, parity, male sex as well as increased maternal age (5-13,15-17,19, 21). Of these, gestational age has been shown to be the strongest. The changes in the factors that we have described, high rate of pre-term delivery, increased proportion of female sex, and increased proportion of nulliparous mothers (Table 1) with the exception of maternal age, might have favoured the decrease in birth weight in the 90's in addition to the influence of the recent HIV/AIDS pandemic.

The significant increase of low birth-weight particularly in the very low birth-weight group is a public health concern, as these neonates have the highest rates of mortality and morbidity. Although the number for very low birth-weight groups are too small to skew the distribution, it suggests that the overall reproductive performance has deteriorated. The increase in maternal age and increase in HIV/AIDS may account for some of the changes. Similar increase in very low birth weight was observed in Hong Kong (5).

On the other hand the change in the proportion of parous women and the increase in ante-natal follow up in Addis Ababa are suggestive of the decline of fertility rate which was also observed in other reports (20).

The observed changes in the gestational age, more pre-term pregnancies was also seen by other studies (5,22). Mongelli et al suggested that these changes in gestational age are typically seen during a period of transition from dating last menstrual period to dating ultrasound (22).

Although the sex ratio has not shown significant change, the percentage of female infants increased from 45.9% in the 70's to 46.7% in the 80's and 48% in the 90's. It is recognized that birth-weight reflects maternal nutrition and socio-economic level may, therefore, be used as an important indicator of development (15-17). As was reported by Bantje (15-16), our findings suggest that, although not statistically significant, birth weight falls just immediately after the beginning of the rainy season. In this study mean birth weight was observed to peak first in January and February, then remains low between March and July, and again rises and reaches its peak in the months of August, September and October. The seasonal patterns revealed that mean birth-weight was low of 3090g in April and high of 3173g in August. Similarly, the proportion of low birth-weight was observed to be lower between the months of August and October. Similar findings were reported in Morogoro, Tanzania (17). Unlike the Tanzanian studies however, there was no considerable seasonal variation seen in birth weight. Maternal under-nutation and heavy workload during pregnancy are determined by the level of energy intake and energy output, which also are determined by the availability of food (15-17). It is clear that in most developing countries, where agriculture is predominantly the means of subsistence, the availability of food depends on the seasonality and rainfall pattern of the area. In most cases low food stocks coincide with periods of peak labour demands in agricultural activities, for example July in our case.

In conclusion, our study has shown that mean birth-weight has declined in the 90's as compared to the earlier two decades and the proportion of low birth-weight increased in Addis Ababa, despite a continuing in the socioeconomic status. However, there was no considerable seasonal variation in birth-weight.

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