Validation and use of a simple device to identify low birth weight babies at birth

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Summary
In many rural areas of this country, a considerable number of deliveries take place at home unattended or attended to by traditional birth attendants, and majority of the babies are not weighed at birth. This study was carried out to find a simple way in which high risk, low birth weight babies (Birth weight <2500g) can be identified at birth and cared for in order to reduce infant mortality and also to improve documentation of such deliveries at the grassroots level. A birth study of 1625 hospital births showed a strong correlation between mid thigh circumference and birth weight (r = 0.68, t = 4.8, $p<0.000$). A mid –thigh circumference of 13.9 cm and less was reliable in identifying newborn babies with a birth weight less than 2500g with a sensitivity of 93.3%, a specificity of 83.0%, a positive predictive value of 42.4% and a negative predictive value of 98.9%.

A flexible, non-stretch plastic strip was designed for use to identify babies with low birth weight. The strip is acceptable to mothers, it requires no measurements and is presently being used successfully by traditional birth attendants and village health workers in a village in Nigeria. The identified babies are seen regularly in the village clinic.

Keywords: *Low birth weight, Documentation, Infant mortality, Developing countries, Anthropomety, Traditional birth attendants.*

Résumé
Dans plasieurs milieu ruraux de ce pays, il ya un nombre consideable d'accouchement à domicle, ou sous le controle d'accoucheurs traditionels. Par consequent, la majorite des bébés ne sont pas perés à la naissance. Cette étude a été faite afin d'elaborer une methode simple par laquelle le grand riskue associes au faible poids des bebes à la naissance (poids a la naissance < 2.5 kg) pourrait etre identifies à la naissance, de tel sorte que la mortalité in fantile. L'étude avait aussi pour objectif, d'ameliorer la documentation de pareils accouchement au niveau rural. Une étude de 1625 cas daccouchement à l'hopital a montré une forte correlation entre la circonference de la cuisse et le poids à la naissance (r=0.68, t=4, 8; P 0,001). Une circonference de la cuisse de 13.9 cm et moins a été credible pour identifier les nouveaux nées ayant un poids inferieur à 2,5kg avec une sensitivite de 93,3%, une specificitée de 83%, une valeur predictive positive de 42.4% et une valeur predictive negative de 98,9%. Un tube plastique flexible, non etirable a été concut et utulisé afin d'identifier les enfants à fable poids a la naussance. Ce tube est acceptable par les mères,il ne necessite aucune mesure et est presentement utilisé par les accoucheurs traditionels, ainsique les officiers de sante des villages au Nigeria. Les bebes identifies sont visité regulierement dans la clinique du village.

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Introduction

Birth weight of a baby is a very reliable and sensitive indicator for predicting the immediate and later outcome for a newborn child. It is also a national and global indicator of child survival. Low birth weight (LBW) still represents one of the greatest public health problems in Nigeria today and contributes to the very high infant mortality. [6].

While studies have shown that up to 95% of LBW babies born every year in the world come form developing countries, [1] estimates made showed that the rate of LBW babies in developing countries is around 19% [2] and in sub-Saharan African about 16% [3]. In Nigeria, the incidence is put at between 8% and 22% [4-6]. These high figures from hospital based studies probably underestimate the number of LBW babies delivered yearly. LBW has consistently been placed as one of the top factors associated with the very high perinatal and neonantal morality rates in Nigeria [7,8]. Studies have also shown that if LBW babies are identified early, they could be care for even at the Primary Health Care level, which would help reduce their risk of dying. [9] In addition, about two thirds of the country's population still reside in the rural areas in Nigeria. Furthermore only 31% of births are attended to by trained health personnel. [10] Traditional birth attendants (TBA) still assist in the delivery of 22% of urban and 46% of rural babies and not all these TBA are trained. [11] Up to 40% of all deliveries in the south and an estimated 80% and more in the North of the country are home deliveries. [10] This translates to a lot of babies are not being weighed at birth. Data on birth weight for most babies will never reach the appropriate health authorities, particularly in the rural areas where the risk for LBW deliveries is highest. One of the national objectives to be achieved is to reduce LBW rate. The goal is unrealistic until the logistics for identifying LBW in the country, particularly in the rural areas where majority of deliveries occur, are put into place. There is therefore a need to have alternative methods for determining LBW babies at birth apart from weighing. The proposed method has to be technologically sound and acceptable to the people as recommended. [11] In addition, it must not require the use of weighing scales, which are presently not available in most homes and in many rural areas of this country. It is with this background information that a surrogate was developed.

Materials and methods

Data was collected on 2 separate groups of babies. The first group comprised babies from the 4 major hospitals in the city of Ibadan. In a stratified, two stage design, 1625 consecutive normal newborn babies from these hospitals were enrolled into the study.

The hospitals were stratified and randomly selected so that all the socio-economic groups in the community were represented. Accurate measurements of head circumference, length, mid-upper arm circumference and mid-thigh circumference were obtained on all enrolled babies at birth or shortly after birth and no longer than 4 hours. These measurements were collected by the senior nursing officers in the delivery wards who were trained by the author.

Validity checks were made at different times by the author on subsamples of the babies and were found to correspond with measurements made by the nursing staff. The mid-arm circumference was measured at the midpoint between the tip of the acromoion and the olecranon process in the left upper arm with a flexible fibre glass tape to the nearest millimetre. The mid-thigh circumference was obtained at the mid-point between the left hip joint to nearest millimetre. The head circumference was measured by passing the tape between the supra orbital ridges and the maximum occipital prominence, length of baby was taken on infantometer to the nearest millimeter. Weight was measured using standard beam balance to the nearest 20g.

Correlation matrix was determined for birth weight and the anthropometric variables. Although correlation analysis of the relation between birth weight and all 4 measurements were significant *(p<0.0001)* at 95% confidence limit, the mid-thigh was adopted for validation. The mean and median measurements for the mid-thigh which corresponded exactly to the cut off point of 2499 g for LBW were determined. A flexible, non-stretch plastic material was used to design 2 strips using the median value of 14 cm and mean value of 13.9 cms as cut off points (Figure 2). The second group of babies were enrolled at community level from a Primary Health Care clinic where validity testing was done. The baby either made the cut off point and was deemed normal weight (≥25000g) or below the cut off point and identified as being LBW baby.

Table 1: Correlation matrix for birth weight and anthropometric variables

Anthropometric variables	Correlation matrix	95% confidence limit
Head circumference (cm)	0.50	0.45<R < 0.56
Length (cm)	0.50	0.49 < R < 0.59
Mid-upper arm Circumference (cm)	0.65	0.62 < R < 0.68
Mid-thigh circumference (cm)	0.68	0.66 < R < 0.71

P<0.0001 all correlations.

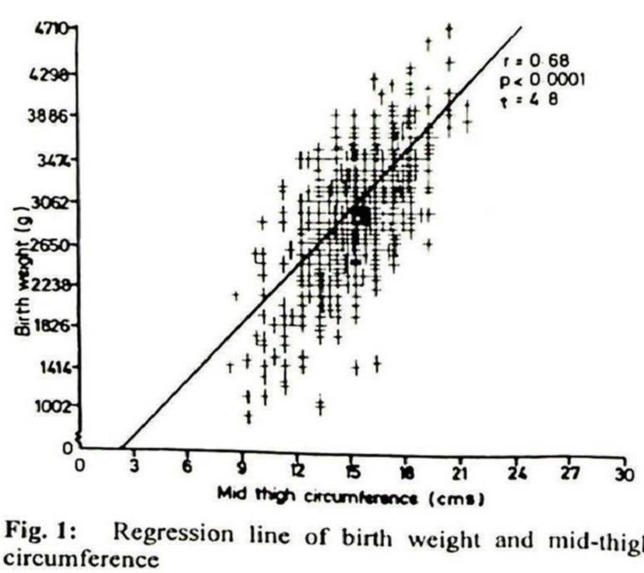

Fig. 1: Regression line of birth weight and mid-thigh circumference

Birth weight of all the babies were also determined using the standard beam balance. January 1997, the strip was introduced to Lagun, a village in South-Western Nigeria. In this village, over 53% of all deliveries occur at home. All identified LBW babies were referred to the village clinic where their mothers were counselled by the nurses on exclusive breastfeeding; the babies were weighed monthly and offered immunization according to the schedule of the National Programme on Immunization.

How to use the strip

Put the strip around the thigh at mid-point between hip and knee joint of baby. The narrower end of this strip is pushed through the slit at the wider end and pulled until the strip fits snugly around the relaxed thigh making sure the skin does not crease. Read the colour at the slit. Black zone indicates a LBW baby, the white zone indicates a baby that is not LBW (Figures 2 and 3).

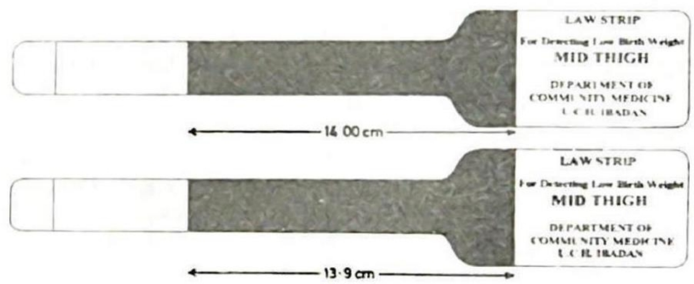

Fig. 2: The strip

Fig. 3: Infant mortality in Lagun, 1996 – 1997.

Results

The mean cut off point for LBW, 13.9 cm had a higher sensitivity, (that is, it had the ability to include most of those babies who were under 2500 grams) than the median cut off point of 14 cm. In addition, using the mean value as cut off point of gave higher positive and negative predictive values, and was more reliable than the cut off point of 14 cm, and was taken as the standard (Table 2).

Table 2: Validity testing using mean and median mid-thigh as cut off points for low birth weight

Cut Off Mark	Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Negative predictive value (%)
13.9 cm (mean)	93.3	83.0	42.4	98.9
14.0 cm (Median)	86.7	83.9	41.9	97.8

In the 12 months (January – December 1997) of use in Lagun village, the surrogate identified (26.1%) LBW babies (16 males and 32 females) among the 184 born in the village and infant mortality appears to be on the decline (Table 3).

Table 3: Infant mortality in Lagun village, 1996-1997

Year	Total births	Infant deaths	Infant mortality rate per 1000 live births.
1996	158	18	113.9
1997	184	*9	48.9

*Includes 6 neonatal deaths (under 28 days) and 3 post neonatal deaths (28 days to under 1 year)

Discussion

The challenges of primary health care continue to bring to light the need for simple, efficient and technologically sound tools for use within the health care delivery system particularly in developing countries already characterised by a shortage of adequate resources. While a few studies have used anthoropometry as surrogate for birth weigh, [13-16] all these required measurements of some sort. The strip was developed in an attempt to provide a simple identification tool for detecting which babies are LBW at birth and which ones are not without the use of a weighting scale. It is safe, quick, relatively easy to use fairly accurate and very cheap. It is also readily reproducible any variations that can arise in its use are due to observer error. This strip has made it possible for the babies who have LBW to be identified as soon as possible after delivery and enables the health workers pay more attention to them with very simple cost effective measures.

It has also improved documentation of LBW rate in the area and since LBW is highly predictive of neonatal mortality, the strip is useful for identifying babies with the highest risk of death in the neonatal period, at the grassroots.

The village health workers and the traditional birth attendants do not need any formal education to be able to apply and correctly interpret the strip which can conveniently be introduced into the existing system of health care in the community for use when there are no weighting scales.

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