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ABSTRACT

***Background*: Infant mortality remains high in many developing countries in which the contribution of deaths among infants born very low birth weight (VLBW) may be considerable. This contribution has however not been quantified in most such countries. This paper explores a model that can be used in this respect.**
***Objective:* To determine the contribution of very low birth weight infants towards the overall infants deaths in Kenya.**
***Design:* Prospective cohort study.**
***Setting:* Kenyatta National Hospital, Pumwani Maternity Hospital and Kilifi District Hospital.**
***Subjects:* Very low birth weight infants followed up for a period of one year.**
***Results:* The neonatal, post-neonatal and infant mortalities for the cohort were 442, 139 and 581/1000 respectively. These were thirteen, three and seven times higher than the national averages respectively. Of the national birth cohort of 1,300,000 during that year, it was estimated that between 15,600 (1.2%) and 24,700 (1.9%) were born VLBW. Given this VLBW infant burden and extrapolating the infant mortality observed in this study to the general population, between 9,064 (8.9%) and 14,351(14.2%) of the 101,400 (78/1000) infants who die during infancy in the country are born VLBW.**
***Conclusion:* The cohort reports very high infant mortality for VLBW infants when compared to the general population. Despite constituting less than 2% of the birth cohort, these infants contribute between 8.9% and 14.2% of all infant deaths.**

INTRODUCTION

Almost 70% of the 120/1000 under-five year deaths in Kenya occur during infancy (1). If the millennium development goal (MDG) of reducing the under five mortality in Kenya to 35/1000 by the year 2015 is to be realised the infant mortality will have to be reduced drastically. Neonatal deaths are a major contributor to infant mortality in Africa with estimates of over 30% in most sub-Saharan countries including Kenya (2). Newborn survival strategies are therefore pivotal in the drive towards achieving the fourth MDG. Very low birth weight infants are expected to have higher neonatal mortality compared to their bigger usually more mature counterparts even in developed countries (3,4). The factors that determine the impact of VLBW infants on the infant mortality rate (IMR) are their annual burden and specific mortality. In order to estimate the impact of VLBW babies on the national IMR, the authors employed this hospital based cohort to determine the VLBW specific IMR. The VLBW burden was then derived from a previous study based in a rural hospital (5) and unpublished data from the largest delivery unit in the country with over 20,000 births per year.

MATERIALS AND METHODS

Two hundred and sixty infants born weighing 1500grams or less at the Kenyatta National Hospital in the year 2002 were consecutively recruited. This was the entire hospital's birth cohort in that weight category during that year. Kenyatta National Hospital is a national referral and teaching hospital for the University of Nairobi. The study was a non-randomised prospective cohort whose only inclusion criteria was birth weight below 1500grams. Non-residents of Nairobi were excluded due to follow-up logistics. The infants were recruited during the early newborn period with informed parental consent. All the infants completed the neonatal follow-up though three of them were not available for post-neonatal follow-up due to logistical reasons. The three were however included in the analysis and allocated into the worse outcome scenario.

Information gathered and recorded at recruitment included;

(i) Gestational age confirmed by the clinical method described by Ballard (6).
(ii) Birth weight measured using the Misaki Digital Baby Scale with one-gram graduation and an upper limit of 20 kilograms.
(iii) Family identity information and addresses.

Follow-up commenced from recruitment till death or completion of the first year of life. The neonatal care was provided in accordance with the hospital's protocols and upon discharge family contact details were re-confirmed and follow-up numbers assigned. The site of follow-up was the hospital's routine developmental clinic for high-risk newborns. The principal investigator (FNW) reviewed all the patients at each clinic visit. In order to improve compliance, the infants were offered free clinical and developmental reviews as well as the routine iron and vitamin supplements. The reviews were set at three monthly intervals with freedom to visit the clinic on any other day as long as the clinic was in session.

Neonatal deaths were recorded as they occurred and reconciled with the hospital's death registry at the end of January 2003. There was no discrepancy between the two sets of records of neonatal deaths. Post-discharge mortality was obtained using the following methods;

(i) Parents/guardians self-reporting to the follow-up centre. The travel costs for this visit were reimbursed by the study.
(ii) Home visitor employed by the study to trace defaulters often found the reason for defaulting being death. The visitor recorded the date of death.
(iii) Telephone calls to a family member, relative or close friend when home visits did not succeed in tracing the child.

Attrition: Seven infants could not be accounted for at the end of the study due to default. An infant was considered a defaulter if they failed to attend the scheduled clinic and home visits and telephone tracing failed to find them.

Analysis: The denominator used during this analysis was 260 including the seven infants lost to follow-up and three neonatal survivors who were not available for the one year follow-up. The ten were included in the worst outcome category. The neonatal, post-neonatal and infant mortalities were then computed per 1000 live births. The 2003 Kenya Demographic and Health Survey (1) profiles were used as the national baselines for comparison. Two sources of data were used to estimate the national burden of VLBW infants.

(i) The Kilifi District Hospital survey of 1998 -2001 (5) which reported a burden of 1.2%.
(ii) Un-published records at Pumwani Maternity Hospital, a big metropolitan hospital in Nairobi, which serves a wider spectrum of the average Kenyan mother with 1.9% burden.

These two are more representative of the broader Kenyan situation than Kenyatta National Hospital, a tertiary referral facility, with predominantly high-risk deliveries which was likely to exaggerate the VLBW burden.

Ethics: The study received approval by the hospital's ethics and standards committee while each parent/guardian provided a signed consent after receiving a detailed explanation of the study and its value to the local fraternity.

RESULTS

Population characteristics: This was a birth cohort of 260 VLBW infants with 144 neonatal survivors. The baseline characteristics of the cohort at birth and those who survived the newborn period are presented in Table 1. The neonatal survivors were heavier (P<0.001) and more mature at birth (P<0.001) than the original cohort. Proportionately more infants with intrauterine growth retardation survived the newborn period compared to those born appropriate for gestation (P<0.001).

Table 1
Baseline characteristics

	Birth cohort	Neonatal survivors	Statistics
Number	260	143	
Birth Weight, Mean± SD	1240± 106	1380± 96	*P<0.001
Gestation, Mean± SD	30.3±2.8	32.4±2.1	*P<0.001
Male: Female ratio	1: 1.2	2:3	#P=0.070
AGA: SGA ratio	4:1	7:3	#P<0.001

*Analysis of variance #X^2 distribution test

Mortality profiles: These are summarised in Table 2. The group of 260 had 114 (442/1000) neonatal and 151 (581/1000) infant deaths respectively. The post-neonatal mortality was 139/1000. The neonatal and infant mortality were 13 and 7.5 times the national average.

Table 2
Mortality statistics

	Mortality statistics (Per 1000)		
	Present cohort	National average[2]	Difference
Neonatal	442	33	13X
Post-neonatal	139[1]	45	3X
Infant	581	78	7.5X
Neonatal/ Infant %	75.5	42	2X

[1] The ten infants not accounted for included in the worse outcome group

Impact of VLBW infants on overall infant: An estimate of the contribution of infants born weighing 1500grams and below is presented in Table 3. With the study's assumption that VLBW infants constituted 1.2-1.9% of the total birth cohort, this group contributed 8.9-14.2% of the infant deaths. The VLBW neonatal deaths alone were projected to have contributed 16.1-25.4% of all neonatal deaths in the national cohort.

Table 3
The impact of VLBW infants on overall infant mortality

	National birth cohorts	Neonatal deaths (%)	Post- neonatal deaths (%)	Infant deaths (%)
Total	1,300,000	42,900	58,500	101,400
VLBW Burden with 1.2% contribution	15,600	6,895 (16.1)	2,169 (3.7)	9,064 (8.9)
VLBW Burden with 1.9% contribution	24,700	10,917 (25.4)	3,434 (5.9)	14,351 (14.2)

The assumptions made in this module are, 1.2% (5) or 1.9% burden of VLBW infants in the national live-birth cohort and similar mortality among these babies the birth cohort as those described in the present study

DISCUSSION

This study attempts to quantify the contribution of VLBW infants to the overall infant mortality. The disproportionately higher neonatal, post neonatal and infant mortality seen here is consistent with previous reports from more advanced countries (4, 7-9). The advanced countries, however, not only have considerably lower infant mortalities (10) they also enjoy smaller proportionate representation of VLBW infants in their birth cohorts (11). The impact of VLBW infant deaths on infant mortality in poor countries is, therefore, bigger than that observed in the more economically advanced regions. This cohort found that VLBW infants while constituting only 1.2-1.9% of the national birth cohort accounted for 8.9-14.2% of the total infant deaths. The disproportionate contribution is explained by the considerably higher neonatal and infant mortality for the VLBW infants compared to the general population (Table 2). Though there is a global resurgence of concern on the burden of neonatal deaths in developing countries and its influence on the success of the fourth MDG (12), adequate and sustainable activities towards improved newborn survival are yet to take root in many of the poorer countries. The findings of this study suggest that the overall infant survival of VLBW infants should be a point of focus if the IMR is to be reduced in developing countries.

Some methodological issues confounded the deductions of this study. First, the national burden

of VLBW infant births was based on information from two hospital based cohorts. These are likely to overestimate the burden since mothers with preterm or complicated labour are more likely to deliver in hospital than the normal ones. The kilifi study was in a rural district hospital (5) while Pumwani Maternity Hospital is a large metropolitan hospital with over 20,000 deliveries annually and patronised by the poorer urban populations of Nairobi. The second issue regards the extrapolation of neonatal and infant mortality statistics obtained in this closely supervised cohort of VLBW infants to the one expected for the general population. The supervised group is likely to do better than the general population which includes infants born at home or in smaller, less equipped facilities. From this point of view, the findings probably underestimate the true contribution of VLBW infants to IMR. Not withstanding these opposing limitations, the results suggest a notable contribution towards infant deaths by VLBW infants. Improving neonatal and infant survival towards achieving the fourth MDG in the country will require strategies aimed at reducing VLBW infants' neonatal and infant deaths.

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DECLARATION

This study was part of FNW's doctoral thesis in the Department of Paediatrics and Child Health, College of Health Sciences, University of Nairobi.

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