Timing of growth faltering in rural Malawi

K Maleta, S Virtanen, M Espo, T Kulmala, P Ashorn

Aim: To determine the timing of growth faltering among under 3 year old children.

Methods: Prospective population based cohort study in Lungwena, rural Malawi, southeast Africa. A total of 767 live born babies were regularly visited from birth until 3 years of age. Weight, height, and mid upper arm circumference were measured at monthly intervals until 18 months and at three month intervals thereafter. Growth charts were constructed using the LMS method and comparisons made to two international databases: the traditional United States National Center for Health Statistics/World Health Organisation (NCHS/WHO) reference and the recently developed 2000 Centers for Disease Control (CDC) growth reference.

Results: Compared to the 2000 CDC reference population, newborns in Lungwena were on average 2.5 cm shorter and 510 g lighter. On a population level, height faltering was present at birth and continued throughout the first three years. Weight faltering, on the other hand, occurred mainly between 3 and 12 months of age. At 36 months, the mean weight and height of the study children were 2.3 kg and 10.5 cm lower than those of the reference population, respectively. The results remained essentially similar when the comparisons were made to the NCHS/WHO reference.

Conclusions: The fact that weight and height faltering do not follow identical time patterns suggests that they may have different origin and determinants. Further studies on the aetiology of height faltering and different approaches to preventive interventions are needed.

Suboptimal growth is a sensitive and readily measurable indicator of malnutrition or other health problems of under 5 year old children. Furthermore, growth faltering is associated with subsequent cognitive and physical disadvantage, morbidity, and mortality. Anthropometric assessment of growing children thus facilitates early identification and timely interventions for emerging health problems. On a public health level, analysis of growth patterns of specific populations allows the identification of the periods of greatest risk for malnutrition. This process is enabled by the universal similarity of growth potential in various populations of under 5 year old children. Comparison of growth in defined child populations to that of an international reference may thus lead to directed hypotheses of local growth limiting factors and most feasible health interventions in that specific area.

Poor childhood growth is a widespread public health problem in many low income countries, especially in Asia and sub-Saharan Africa. Most available evidence suggests that such growth faltering starts when the children are 4-6 months old. During the past decades, earlier growth faltering has been documented in some communities. Such findings have, however, at least partly been attributed to problems in old. Growth faltering starts when the children are 4–6 months old.

The cultivation of land areas were often small and many farmers had no alternative sources of income, leading to poor food security in the area. The climate was monomodal and the staple food, maize, was harvested in March to April.

The study participants were 767 live born babies from a community based cohort of 795 pregnant women. Because of a very high enrolment rate, the study cohort comprised approximately 95% of all newborn children in the area during the time of enrolment. Details of recruitment, collection of background data, and follow up have been described previously. The research protocol was reviewed and approved by the Malawi National Health Science Research Committee and informed consent was obtained verbally from each pregnant woman before enrolment.

Anthropometric measurements

Eight trained research assistants made home visits to collect anthropometric measurements at monthly intervals from...
Growth faltering in rural Malawi

Proportion of primiparas 24%
Mean (SD) maternal height 155 (6) cm
Proportion of mothers with HIV infection 18%
Sex ratio of the newborns (males:females) 1.05:1.00
Mean (SD) term singleton birth weight 3100 (500) g
Proportion of preterm births <37 completed gestation weeks 22%
Proportion low birth weight (<2500 g) 15%
Proportion of twin births 2%
Median (25th, 75th centile) duration of exclusive breast feeding 0.5 (0.5, 1.0) months
Median (25th, 75th centile) age at onset of complementary porridge 1.5 (1.0, 2.5) months
Median (25th, 75th centile) age at onset of family foods (Nshima) 6.2 (5.5, 6.8) months
Median (25th, 75th centile) size of annual diarrhoea episodes (infancy) 1.1 (0.0, 2.2)
Median (25th, 75th centile) size of cultivated farm land (hectares) 0.4 (0.3, 0.8)
Proportion of families without safe water 37%
Proportion of families with radio, mattress, or bicycle 46%

Table 1

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value</th>
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<tr>
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Table 2

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<th>Age (mth)</th>
<th>Weight (kg)</th>
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3rd centile = 1.88 SD, 50th centile = median (0 SD), 97th centile = 1.88 SD
significant deviation from examination of individual growth trend line were considered questionable and discarded from the analysis. For weight, deviations over 2 kg or 15% of the interpolated value on the individual growth trend line were excluded, whereas height values over 4 cm from the individual growth trend line were similarly excluded. The estimated centile lines were plotted and smoothed using the LMS computer program.

RESULTS

Subjects

Table 1 presents the background characteristics of the participants and their mothers. Of the 767 live born babies who started the follow up, 128 had died and 62 absconded by 36 months of age. Measurements collected before their death or losses to follow up were, however, included in the analysis. For all participating children, the median (range) follow up time was 27 (1–36) months.

In total, anthropometric data were collected at 13,728 independent home visits, of which 961 (7.0%) were excluded from analysis because of age grouping and 38 (0.3%) home visits were excluded because of questionable data quality. After birth, the mean (range) monthly number of measurements included in the analysis was 532 (504–562). Because of the large number of home deliveries, birth measurements (within 48 hours of birth) were available from only 197 children (26%).

Growth in Lungwena in comparison to the reference populations

Figure 1 illustrates the growth pattern of the Lungwena children compared to the 2000 CDC growth reference. At birth, newborns in Lungwena were on average 510 g lighter and 2.5 cm shorter (table 2) than the reference babies. During the first three months, the median weight in Lungwena increased rapidly and approached the reference median, whereas the median height faltered towards the 3rd centile of the reference population. Between 3 and 12 months of age, both the median weight and the median height in Lungwena deviated significantly downwards from the reference. After 12 months, the median weight in Lungwena consistently paralleled the 3rd weight centile of the reference population. For height, the Lungwena curves showed persistent, though slight, deviation from the reference even during the second and third year of life. At 36 months of age, Lungwena children were approximately 2.3 kg lighter and 10.5 cm shorter than the reference children.

DISCUSSION

Several factors have been associated with poor childhood growth in low income countries. Of these, the most commonly identified explanatory variables include suboptimal weaning from breast feeding, enteral and other infections, and inadequate dietary intakes. The first two—complementary feeding and a concomitant increase in the incidence of enteral infections—have received special attention, because their occurrence presumably coincides in time with the typical age of onset for growth faltering. However, strong conclusions have been hampered by the fact that the commonly used NCHS/WHO growth reference is based on mostly formula fed infants, who are known to grow differently from their exclusively breast fed counterparts. Therefore, the age of onset of true growth retardation in low income countries has remained debatable.
In this community based cohort of rural Malawian children using both the new CDC as well as the traditional NCHS/WHO references, babies born premature at birth and linear growth faltering continued throughout the first three years of life. Weight faltering, on the other hand, was largely restricted to the period between 3 and 12 months. During the first three months, babies in Malawi actually gained more weight than the reference children, and after 12 months the populations were comparable in weight increments. The initial weight spurt in Lungwena could be explained by the fact that, although not exclusively breast fed by the WHO definition, the babies were predominantly breast fed during the first three months of life. At this age, exclusively breast fed infants are known to gain more weight than formula fed babies.  

Besides the known growth retardation effects of common infections and inappropriate complementary feeding, there are at least three potential explanations to the small birth lengths and poor linear growth in Lungwena. First, the prevalence of preterm deliveries was very high (22%), resulting in smaller than expected newborns. Additionally, because of the frequency of malaria and the low maternal intakes of energy during pregnancy, many babies may have suffered from intrauterine growth retardation. The fact that lengths were more compromised than birth weights is consistent with the hypothesis that fetal growth was affected before the third trimester. In such conditions, not only lipid accumulation but also cellular synthesis is compromised, leading to shorter newborns who do not express much catch up growth postnatally.

A third possible explanation for the linear growth faltering is perinatal HIV infection, which was a widespread problem in the current study area (18% seroprevalence among the pregnant women). Previous studies from Malawi and elsewhere have shown that babies born to HIV positive women are lighter than those whose mothers are not infected, and they more often exhibit faltering of both weight gain and linear growth during infancy.  

Until now, the community prevention and management of childhood malnutrition has largely focused on weight faltering and the period between 6 and 24 months after birth. Relatively little attention has been put on height gain faltering, although in many countries, especially in sub-Saharan Africa, stunting is much more prevalent than wasting. Although not often directly stated, inherent in this approach is the assumption that weight and height faltering have similar aetologies and that the same interventions may correct both problems. In the light of the present results and those of others, it is not surprising that few interventions have been successful in correcting or preventing linear growth faltering. If linear growth is slowed down at birth (as in the present study) and remains so throughout the first three years of life, interventions focusing on a narrow age range do not address the whole problem. In areas where stunting is a major problem, intervention programmes targeting the infancy period coupled with early enough antenatal period interventions may thus prove to be more successful.

One issue needs to be considered when interpreting the current results. Because of the high number of home deliveries, anthropometric data at birth were available only from every fourth newborn. Theoretically, this might have biased our results on low birth lengths. In practice, this was not a problem since the difference to the reference populations remained identical at 1 month of age, when length data were available from almost every study subject. Some studies have, however, not documented low birth lengths compared to the international reference standard. Thus, some caution is required when applying the current results to other conditions. However, because of the prospective community based design and high enrolment with very low dropout rate, the conclusion that weight and height faltering started at different periods is likely to be a true reflection of the situation in the study area. Similar results have been observed before in some other low income countries.

Taken together, we have documented different periods of greatest risk for weight and height faltering among a cohort of rural Malawian children. Compared to two separate reference populations, weight gain faltering was generally restricted to the ages between 3 and 12 months of age, whereas height faltering occurred from birth and continued throughout the first three years of life. Because both weight and height faltering have important health consequences for growing children, both forms of growth failure need to be considered in a malnutrition prevention and management strategy. Traditional programmes encouraging breast feeding, correct weaning practices, and prevention of enteric infections should be complemented with appropriate antenatal and postnatal interventions against stunting. Further studies are however needed to clarify the details of such interventions.

ACKNOWLEDGEMENTS

We are grateful to the people of Lungwena, the staff at the Lungwena Training Health Centre, and our research assistants for their positive attitude, support, and help in all stages of the study. We also thank Dr Tim Cole and Dr Anneli Pere for their advice on data analysis and Dr Andre Briend and Dr Maureen Duggan for their helpful comments on the manuscript. The study was funded by the Academy of Finland, Emil Aaltonen Foundation, Foundation for Paediatric Research, Medical Research Fund of Tampere University Hospital, the Research Foundation of Mannerheim League for Child Welfare, and the Research Foundation of the University of Tampere.

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REFERENCES


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POSTCARD FROM THE ROAD

Safety first

We arrived in Ayutthaya, about 60 km north of Bangkok in Thailand at the start of the festival Loi Krathong. Celebrated on the full moon day of the twelfth lunar month the event involves, at its simplest and most benign, the floating of little plate sized islands of flowers and candles down the river. At the other extreme it degenerates into the utterly uncontrolled release of fireworks in the street by adults and children alike. For a few pence you can buy a handful of fireworks and contribute to the mayhem. Or, you can buy a large sausage shaped bin bag with fuel source. This, held inverted with the fuel lit, becomes a little hot air balloon. After several moments of anxiety that the whole thing is about to catch fire, it soars up into the warm night air. After a while it winks out of existence—either too far away to see, or burning out, to be discovered in someone’s garden the next day like the sticks of rockets I’d search for on the 6th of November as a boy.

It’s preposterous of course. Dangerous beyond belief, and must result in as many casualties as the British 5th of November bonfire nights of old. Amidst the chaos you’ll see the familiar Thai spectacle of entire families of five crammed onto the one motor scooter—of course none wearing any sort of head protection. At other times and in other countries you’ll see children diving into rivers thick with effluent, and coming up laughing, looking as healthy as any child I’ve seen in the UK or Australia. You’ll see children balance with bare feet on needle sharp coral reefs before executing a beautiful, exuberant 1½ somersault into barely a puddle of water. In still other parts of the world you can see children behind windows of houses or cars, motionless except for the fingers and thumbs which are intent on making Lara Croft execute a similar 1½ somersault, in between conveying high fat, high sugar snacks into their mouths.

This is a jaded, cynical, and somewhat sarcastic comparison, and I’m almost ashamed to write it—but only almost. Risk, and risk taking, is such an essential feature of childhood and growing up—starting right from the peek-a-boo game where the child “risks” losing their playmate—that we’d be foolish to dismiss the essential role of risk in normal development. Being in dangerous—or apparently dangerous—situations teaches us a tremendous amount about how to handle them. However, this can put us, and those around us, at terrible risk of harm, injury, maiming, or even death. If we were to foolishly expose young middle class British children to Loi Krathong, in some sort of misguided attempt to toughen them up, they would do appallingly, and only those that survived would gain anything from the experience. Even as an adult I feared for my safety in a way that those around me must have found amusing. Learning by your mistakes as a useful educational tool only when the stakes are low—like a few bruises or a bump to the ego—but an entirely different matter when life and limb—your own, those around you, or those of your patients—are actually at stake.

As a boy of 10 I’d cycle near our house and further afield, unsupervised, mostly on quiet roads. If now, I saw an equivalent of myself, knocked off my bicycle and in an emergency department, would I have to fight the urge to scold my mother? Was the fact that I never ended up in an emergency room based on luck, or was it some superior ability to cope with my environment? I would say that I’m glad that I was never given fireworks to play with. I’m glad too that manyish children to Loi Krathong, in some sort of misguided attempt to toughen them up, they would do appallingly, and only those that survived would gain anything from the experience. Even as an adult I feared for my safety in a way that those around me must have found amusing. Learning by your mistakes as a useful educational tool only when the stakes are low—like a few bruises or a bump to the ego—but an entirely different matter when life and limb—your own, those around you, or those of your patients—are actually at stake.

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A few winters ago, a light fall of snow was taken by dozens of children as a cue to launch themselves down hills on poorly designed sleds, and, ultimately, into the emergency department where I was working. What struck me was our disapproval as we patched up these broken limbed children. Yes, I’d have preferred it if they’d worn a helmet, and maybe a face guard, and perhaps even done the simple calculation that they weren’t going to stop before getting to the trees at the bottom. But this has to be better than sitting at home and watching Lara Croft living their lives for them, doesn’t it? I

I D Wacogne

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