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Original Article

Factors associated with growth faltering in Sri Lankan infants: A case-control study in selected child welfare clinics in Sri Lanka

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Abstract

Background
Growth faltering during later infancy is common in Sri Lanka. While retarding the physical and mental development of the infant, its burden on the social and economic aspects of the family, society and country is immense.
Methods
A case-control study, involving 150 controls and 75 cases (Total 225), was conducted in two randomly selected Child Welfare Clinics. Infants with failure to thrive were identified from Child Health Development Records and a pre-tested, interviewer administered questionnaire was used for data collection. Data was analyzed using SPSS 17.0.
Results
Sex distribution was almost equal (Males=52.4%, Females=47.6%). The mean age of mothers was 26 years (SD=4.7) and only 26.2% (n=59) were employed although over 90% had secondary education. Lower segment caesarean section, low birth weight, intra-uterine growth restriction and presence of acute illnesses had a significant association with growth faltering with odds ratios (OR) of 3.3 (95% CI=1.8-5.8), 3.0 (95% CI=1.6-5.6), 3.5 (95% CI=1.3-9.5) and 2.3 (95% CI=1.3-4.1) respectively. Significant factors pertaining to feeding were, non-exclusive breast feeding (OR=2.8 and 95% CI=1.5-5.3), inadequate duration of breast feeding per feed (OR=3.8 and 95% CI= 2.1-6.9), formula feeding (OR=2.1 and 95% CI=1.2-3.7) and inadequate diet (OR=2.7 and 95% CI=1.5-5.0). Parental and household factors such as young maternal age, inadequate maternal education, increased number of children and non-availability of domestic help were not statistically significant. However, low monthly income was a significant factor associated with growth faltering (OR=3.3 and 95% CI=1.8-6.2).
Conclusion
Infant and dietary factors were of paramount importance while parental and household factors played a minor role in growth faltering.

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Introduction

As a developing country, Sri Lanka outshines many of its counterparts in the South Asian region in the field of health. Sri Lanka's health statistics resemble those of a developed country, than of its peer developing countries. However, underweight is still a significant public health problem which needs to be addressed. According to the 2012 statistics of the

Family Health Bureau, national figures for underweight infants and children aged 1 and 2 years are 7.3% and 18.0% respectively[1]. Malnutrition is identified as one of the leading causes for derangement of health parameters in infancy and childhood in the country. The Sri Lanka Demographic and Health Survey 2006/2007[2] showed that malnutrition among Sri Lankan children under five years of age is a significant problem, with the prevalence of underweight, stunting and wasting being a staggering 21.1%, 17.3% and 14.7% respectively. Although a declining trend has been observed, improvement in these nutritional indices is not satisfactory. Further, an age breakdown has shown an increasing trend in the prevalence of these indices after the age of 6-8 months. This is termed growth faltering or failure to thrive.

Growth faltering of the infant affects the infant itself, its family, society and country. It retards the growth of the infant, resulting in stunting or wasting and may cause a developmental delay as well. In later life it may be associated with poor school performance and, at worst, a mentally and physically incapacitated child[3]. It has also been found that recurrent infections and hospital admissions are significantly higher in growth faltered children than normal children[4]. This negatively affects the family and the country in both economic and social aspects. Therefore, it is clear, that growth faltering is undoubtedly a topic of great importance to present day Sri Lanka, although it is, surprisingly, less well known and its effect on the infant and the community has been underestimated to date.

The reasons for growth faltering vary from country to country and society to society, depending on socioeconomic status, cultural background and beliefs. Therefore, this study aims to determine the effect of certain factors on growth faltering, in a selected group of infants in Sri Lanka.

Despite its established status in paediatric literature, there is no consensus on the precise definition of failure to thrive/growth faltering, especially with regard to which growth parameters should be used and the use of attained values or velocities. Static definitions continue to be used despite their limitations. However, dynamic definitions, that assess weight velocity, are increasingly preferred by most researchers, the most frequent being fall across centile lines. For example, O' Brien et al defined failure to thrive as weight falling through two major centile lines of a standard weight chart[5,6].

The main objectives of the study were to determine factors associated with growth faltering in infants of 6 -12 months of age, pertaining to the infant, their parents, feeding practices and the household.

Methods

This was a case-control study, which compared infants who had growth faltering (cases) with infants who did not (controls), during the period of January 2013 to April 2013.

Inclusion criteria

- Definition of a case; infants of 6-12 months of age who had dropping of weight over at least two major weight centile lines in the period starting from 6 months up to 12 months, were selected as *cases* for this study. Growth faltering should be present at the time of data collection.
- Definition of a control; infants of 6-12 months of age who did not have dropping of weight over two major weight centile lines in the period starting from 6 months up to 12 months were selected as controls for this study.

The growth chart in the Child Health Development Record (CHDR) was used to identify cases and controls.

Exclusion criteria

Infants suffering from chronic conditions such as severe forms of cerebral palsy, congenital deformities (eg. cleft palate) and chromosomal disorders such as Down syndrome were excluded from the study. Recent history of a minor acute illness, such as vomiting, diarrhoea or upper respiratory tract infection, or major illness, such as urinary tract infection or lower respiratory tract infection, was not considered an exclusion criterion.

Child welfare clinics of the Medical Officer of Health (MOH) area of Matara and in the Colombo South Teaching Hospital (CSTH) were selected for the study. The sample size was 225, which included 75 cases and 150 controls. Sample size was calculated according to the formula of Schlesselman et al (1982)[7,8] , with slight modifications. Informed verbal consent was obtained prior to data collection. A pre-tested, interviewer administered questionnaire was used for data collection. At the end of the interview, if there were any deficiencies in complementary feeding and breast feeding practices, appropriate advice was given on healthy feeding habits. Data were analyzed using SPSS software package (Statistical Products and Services Solutions, Chicago, USA) version 17.0. Various factor variables and samples were cross tabulated to assess their effect on growth faltering. Odds ratios were calculated for each factor to determine risk and a ninety five percent confidence interval was calculated to assess its significance. Electronic data were password protected. Data collection, processing and analysis involved only the team members, under supervisor guidance. Ethics clearance for the study was obtained from the Ethics Review Committee of the University of Sri Jayewardenepura.

To assess the adequacy of complementary feeding, we used a novel, but simple, scoring system based on the information given in the CHDR. One mark, each, was given for cereals, vegetables, pulses, animal proteins (egg, meat, fish etc.), fruits and fat. Snacks or food given in between meals (yoghurt, biscuits, Thriposha etc.) were also assessed and given one mark each. Semisolid consistency, correct amount according to age and correct number of meals were given one mark each. A total score of 8 at six months, 9 at 7 months and 10 at 8-12 months were used to assess adequacy of diet. Percentages were calculated and the cut off value for inadequate diet was set as 70%, since the mean diet score for the study population was found to be 70%.

Intrauterine growth restriction was defined as a fetus pathologically small for its gestational age as determined by reference to antenatal records and diagnosis cards available with the mother. Acute illness was defined as any illness occurring during the one month preceding the period of growth faltering. We relied on mother's history and available diagnosis cards to determine the illness. Minor illnesses such as vomiting, diarrhea or upper respiratory tract infections and major illnesses such as urinary tract infections or lower respiratory tract infections were both considered. Breast feeding duration was based on maternal questioning. Practice of formula feeding during infancy was a direct yes/no question and no assessment of quantity was done. Domestic help was defined to include servants, close relatives and grandparents.

Classification of maternal age (< 25 years Vs ≥ 25 years), maternal education (≤ grade 11 Vs > grade11) and monthly income (< Rs.20 000 Vs ≥ Rs.20 000) was done per convenience of the researchers.

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Results

The sex distribution of the study population (n=225) was almost equal (male n=118, 52.4%, female n=107, 47.6%). The majority of infants had a birth weight of 2.5 kilograms or more and were exclusively breast fed for 6 months (78.7% and 76.0% respectively). The average age of mothers in the study was 26 years (SD=4.7) and over 90% of them had secondary level education. Only 26.2% of mothers were employed and nearly one fourth of families had monthly income of 20 000 Rupees or less.

Table 1: Association between factors related to the infant and growth faltering

Characteristic	Cases N(%)	Control N(%)	Total N(%)	Odds Ratio	95% Confidence Interval
Sex					
Female	38(50.7)	69(46.0)	107(47.6)	1.2	0.7- 2.1
Male	37(49.3)	81(54.0)	118(52.4)		
Mode of delivery					
LSCS*	42(56.0)	42(28.0)	84(37.3)	3.3	1.8 - 5.8
Normal vaginal delivery	33(44.0)	108(72.0)	141(62.7)		
Birth weight					
<2.5kg	26(34.7)	22(14.7)	48(21.3)	3.0	1.6 - 5.6
≥2.5kg	49(65.3)	128(85.3)	177(78.7)		
IUGR**					
IUGR present	11(14.7)	7(4.7)	18(8.0)	3.5	1.3 - 9.5
No IUGR	64(85.3)	143(95.3)	207(92.0)		
Acute illnesses					
Present	52(69.3)	75(50.0)	127(56.4)	2.3	1.3 - 4.1
Not present	23(30.7)	75(50.0)	98(43.6)		

LSCS*= lower segment cesarean section, IUGR**=Intra uterine growth restriction

Factors associated with growth faltering were analyzed under four major headings. When considering the factors related to the infant (Table 1), it was found that there was more than a threefold increase in the risk of growth faltering in infants born via lower segment caesarean section (LSCS) or with a birth weight less than 2.5 kilograms or who had intra uterine growth restriction (IUGR). Emergency sections did not have added risk over elective sections (Odds ratio (OR)=0.9 and 95% Confidence interval (CI)=0.3-2.1). Female sex of the infant was not found to be a significant cause for growth faltering. However having an acute illness in the preceding month was significantly associated.

Factors related to feeding (Table 2) were studied extensively. Statistically significant factors associated with growth faltering were non-exclusive breast feeding in the first 6 months (OR=2.8 and 95% CI=1.5-5.3), breast feeding for less than the recommended 20 minutes per feed (OR=3.8 and 95% CI=2.1-6.9) and formula feeding during infancy (OR=2.1 and 95% CI=1.2-3.7). It was found that almost 96% of mothers initiated breast feeding within the first hour after delivery.

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Table 2: Association between factors related to feeding and growth faltering

Factors	Cases N(%)	Controls N(%)	Total N(%)	Odds Ratio	95% confidence interval
Exclusive breast feeding					
<6 months	28(37.3)	26(17.3)	54(24.0)	2.8	1.5-5.3
≥6months	47(62.7)	124(82.7)	171(76.0)		
Breast feeding duration					
<20 minutes	52(69.3)	56(37.3)	108(48.0)	3.8	2.1-6.9
≥20 minutes	23(30.7)	94(62.7)	117(52.0)		
Formula feeding					
Yes	33(44.0)	41(27.3)	74(32.9)	2.1	1.2 – 3.7
No	42(56.0)	109(72.7)	151(67.1)		
Diet adequacy					
Diet score <70%	35(46.7)	34(23.0)	69(30.7)	2.7	1.5 – 5.0
Diet score ≥70%	40(53.3)	116(77.0)	156(69.3)		

The majority of controls 77% (n=116) had a diet score of 70% or more, versus only 53% (n=40) for cases. Therefore it was evident that inadequate quality, quantity and consistency of complementary food had a statistically significant impact on infant growth (OR=2.7 and 95% CI=1.5-5.0).

Table 3: Association between factors related to parents and growth faltering

Factors	Cases N(%)	Controls N(%)	Total N(%)	Odds Ratio	95% confidence interval
Maternal age					
<25 years	28(37.3)	64(42.7)	92(40.9)	0.8	0.4-1.4
≥25 years	47(62.7)	86(57.3)	133(59.1)		
Maternal educational status					
Up to grade 11 or less	47(62.7)	80(53.3)	127(56.4)	1.5	0.8-2.6
More than grade 11	28(37.3)	70(46.7)	98(43.6)		
Maternal employment					
Yes	20(26.7)	39(26.0)	59(26.2)	1.0	0.6-1.9
No	55(73.3)	111(74.0)	166(73.8)		

Parental factors such as young maternal age, i.e. less than 25 years, (OR=0.8 and 95% CI=0.4-1.4), inadequate maternal education, i.e. education only up to grade 11 or less, (OR=1.5 and 95% CI=0.8-2.6) and maternal employment (OR=1.0 and 95% CI=0.6-1.9) were not found to be statistically significant factors for growth faltering (Table 3).

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Table 4: Association between factors related to household and growth faltering

Factor	Cases N(%)	Controls N(%)	Total N(%)	Odds Ratio	95% confidence interval
Monthly income					
<Rs.20 000	32(42.7)	27(18.0)	59(26.2)	3.3	1.8-6.2
≥Rs.20 000	43(57.3)	123(82.0)	166(73.8)		
Number of children					
1	27(36.0)	64(42.7)	91(40.4)	0.8	0.4-1.3
>1	48(64.0)	86(57.3)	134(59.6)		
Help available at home					
No	26(34.7)	49(32.7)	75(33.3)	1.1	0.6-2.0
Yes	49(65.3)	101(67.3)	150(66.7)		

Regarding household factors (Table 4), a low monthly income of less than twenty thousand rupees was found to be a statistically significant factor affecting infant growth (OR=3.3 and 95% CI=1.8-6.2). Number of children (OR=0.8 and 95% CI=0.4-1.3) and non-availability of domestic help (OR=1.1 and 95% CI=0.6- 2.0) were not found to be significant factors.

Discussion

Growth faltering has a multifactorial aetiology, which includes infant, feeding, parent and household related factors. When considering factors related to the infant in this study, female sex was not a significant factor for growth faltering, contrary to a study done in rural areas of our South Asian neighbour, Bangladesh[9]. This may be because our study was carried out in suburban and urban areas of the country or may be due to the high literacy rates among Sri Lankans that precludes discrimination of infants on the basis of sex.

The increased risk of growth faltering in low birth weight (LBW) and intra uterine growth restricted (IUGR) infants was 3.0 and 3.5 times respectively. This is supported by a cohort study, carried out in Brazil[10], which found that of low birth weight (LBW) infants included in their study, 56% were wasted (thin), 23% were stunted, and 17% were both wasted and stunted at the end of first 6 months. Babies born via normal vaginal delivery were found to have less risk of growth faltering, while the risk increased by 3.3 times in babies born via caesarian section. Emergency section did add any significant risk to later growth faltering.

A total of 127 infants had had acute illnesses in the preceding month but the majority (75) did not have growth faltering. So it was clear that not all infants with acute illnesses had significant growth faltering. But, on the other hand, the majority of growth faltered infants had a history of acute illness (52 out of 75) and it was shown that having an acute illness in the preceding month increased the risk of growth faltering by 2.3 times.

Feeding plays the most important role in infant growth. It is done in three ways viz. breast feeding, formula feeding and complementary feeding. It was heartening to note that breast feeding initiation within the first hour after delivery was almost 96% in our study population. In contrast to a 6 months exclusive breast-feeding (EBF) prevalence of only 25.3% in Latin America (Chile)[11], 7.8% in urban slums of India[12] and less than 5% in Singapore[13], our study

showed a prevalence as high as 83% in controls and 63% in cases. Exclusive breast feeding significantly promotes growth by providing adequate, complete nutrition up to 6 months and helping to avert gastrointestinal and respiratory tract infections[14,15]. Antenatal education and continuous support from healthcare professionals have played major roles in promoting EBF in Sri Lanka.

The duration of breast feeding was also found to be important, as infants who were breast fed for less than 20 minutes per feed had 3.8 times increased risk of growth faltering and this was statistically significant. Formula feeding was found to increase the risk of growth faltering by 2.1 times. This was consistent with a birth cohort study carried out in underprivileged infants from Mexico City[15] which showed that breast fed infants were heavier and tended to be taller than infants fed formula at 6 months. It is clear that, nutrition wise, formula feeds cannot replace breast milk. Inadequate knowledge on preparation of formula feeds may also contribute to inadequate weight gain because preparation of over-concentrated milk results in osmotic diarrhoea and preparation of diluted milk results in under nutrition. It has been found that 50% of Sri Lankan mothers prepare formula milk erroneously[16].

When analyzing complementary feeding, the consistency and quantity of food were appropriate most of the time. But there was great variability in the quality of food. Assessment was done to determine whether infants were given a balanced diet, including cereals, vegetables, pulses, animal protein (egg, meat, fish etc.), fruits, and fat. Snacks or food given in between meals (yoghurt, biscuit, Thriposha etc.) were also included. The majority of controls 77% (n=116) had a diet score of 70% or more, versus only 53% (n=40) for cases. Thus, when a score of less than 70% was considered as an inadequate diet, having an inadequate diet increased the risk of growth faltering by 2.7 times which was statistically significant.

When considering factors related to the parents, which might have an effect on infant growth, young maternal age (less than 25 years), was not found to be a significant factor for growth faltering. For our convenience in analysis, we divided the education level of mothers into two categories; those who educated up to O/L or less and those educated beyond O/Ls. Majority of mothers (56%) were educated up to grade 11 [Ordinary Level exams (O/L)] or less. However, the infants, of mothers with less education did not have a statistically significant risk for growth faltering. In Sri Lanka, most young or under-educated mothers have experience in handling babies, as it is a common learned social experience for them and most have parents at home to give them a helping hand. Contrastingly, two separate studies done in the Philippines[17] and Vietnam[18] showed that parents' low literacy was a significant risk for growth faltering in children. Maternal employment was found to be a significant factor in growth faltering in under-five children in Vietnam[18], but not in our study.

The socioeconomic background of the household plays an important role in determining the weight of an infant. Several studies have shown that family income is a main determinant of weight gain in infants[17,19]. In our study, too, infants in low income families were found to have a threefold risk of growth faltering, probably due to a poor diet and household conditions which predisposed them to infections. Most of the families included in this study had more than one child. Families having their first baby were found to have 0.8 less risk of growth faltering of their baby but this was not statistically significant. Some studies have found that being the first baby is protective for growth faltering[18]. Infants in families without any domestic help were found to have an increased risk of growth faltering but this was not statistically significant.

Two potential limitations were identified. Faltering of length, which is as important as faltering in weight, was not assessed in this study. This may have underestimated the total burden of under-nutrition in infancy in the study population. In addition, due to feasibility and time constraints the sample size was restricted to 225.

Conclusions and recommendations

Several infant factors were found to play a role in infant growth faltering. Namely, birth via lower segment caesarean section, intra uterine growth restriction, low birth weight and acute illnesses. Female sex was not a factor associated with growth faltering. When factors pertaining to feeding were considered, non-exclusive breast feeding in the first six months, breast feeding less than the recommended 20 minutes per feed, formula feeding and low quality of complementary feeding had a significant impact on growth faltering. Commonly believed factors like young maternal age, low education, number of children in the family and availability of domestic help at home were found to be not significant for growth faltering. Monthly income was the only important household factor, among those considered, associated with growth faltering. It is recommended that educational programmes be planned to correct erroneous practices in infant feeding.

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