Determinants of failure to thrive (FTT) among infants aged 6-24 months: a case-control study

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Key words

Risk factors • Failure to thrive • Infants

Summary

Introduction. *Failure to thrive (FTT) in children is one of the most important health issues around the world, especially in developing countries. Lack of success in identifying and controlling this health problem may lead to dangerous health consequences for children. The aim of this research was to explore the risk factors for this health problem in infants under two years of age in Urmia, Northwest of Iran.*

Methods. *This case-control study was carried out on 445 infants of 6 to 24 months (180 as cases, and 265 as controls) in Urmia, Northwest of Iran, during 2013. The study samples were selected from six health centers, using the purposeful sampling method. To collect data, a questionnaire including items regarding socio-demographics of the children's families, and demographic and nutrition-related variables of infants was utilized. To analysis data and determine the real effect of the aforementioned factors* on growth status of infants, a chi-square test and logistic regression analysis were applied.

Results. *The regression analysis revealed that education level of infants' mothers [AOR = 1.421, 95% CI (1.172, 1.724)], duration of breastfeeding [AOR = 1.859, 95% CI (1.212, 2.852)], birth weight of infants [AOR = 2.777, 95% CI (1.276, 7.166)], family's monthly income [AOR = 1.492, 95% CI (1.117, 2.230)] were correlated with FTT as significant risk factors (P < 0.05). Birth order of infants [AOR = .741, 95% CI (.573- .958)], however, appeared to be a protective factor for child growth (P < 0.05).*

Discussion. *The findings of the study may help health care providers in designing and implementing appropriate interventions for improving children's health. In addition, taking into account the importance of healthy growth of children, educating mothers/caretakers would seem beneficial in preventing dangerous diseases in children.*

Introduction

Children, as a large group in any community, are the most vulnerable population to diverse risk factors [1]. In the world, especially in developing countries, one of the most common problems threatening younger children is failure to thrive (FTT) [2]. Its rapid diagnosis and control can have positive health outcomes on infants and help the state of health and progress in societies [3]. FTT is seen in all socioeconomic strata, but the incidence is especially high among urban and rural families living in poverty. Infants and children who develop FTT are at a higher risk of long term growth, development, and behavior problems [4]. It is estimated that FTT affects 5-10% of young children and approximately 3-5% of children admitted to teaching hospitals [5]. The peak incidence of FTT occurs in children aged 9-24 months, with no significant gender difference [6]. *Iranian National Committee for Child Nutrition* (INCCN) revealed that FTT is still very common in urban and rural children under five years (9-15% suffer from stunting, 10.4% suffer from moderate and severe underweight, and 4.9% suffer from thinness) [7].

Infants 6 to 24 months, due to the rapid transition from breastfeeding to complementary feeding, are more likely to be at risk of FTT. Considering that the brain growth and development occur during the first six months of life, an incidence of growth failure will lead to harmful consequences such as childhood mental retardation [8]. FTT is variously defined, but it is a term used to describe inadequate growth or the inability to maintain growth, usually in early childhood. FTT is not a diagnosis, but a syndrome that results from many different medical, social, or environmental processes [9]. Kholdi et al. defines FTT as a decrease in a child's weight (a minimum of 50 grams) at each attendance, compared to the previous evaluation [10]. Various health indices such as weight for age, height for age, and weight for height have been utilized for diagnosing FTT. Recent research, however, has validated the weight-for-age approach is the simplest and most reasonable marker for FTT [11]. By measuring the weight and monitoring the growth of every child, health care providers can identify and prevent growth failure of infants and subsequent complications using suitable interventions [12]. Compared to height and arm circumference, weight is a more sensitive indicator of health status, dietary adequacy, and

growth delay or recent nutritional problems in younger children [13].

Diverse medical and non-medical causes in this age group lead to increased growth failure, which in turn results in brain impairments, learning difficulties, and an elevated risk of other life-threating problems [14].

As previously mentioned, considering deleterious consequences of infants' growth failure on their health, it is vital to identify causes of this health issue in every society. Therefore, the aim of the current study is to determine factors influencing growth failure among infants aged 6-24 months living in Urmia, northwest of Iran. It seems that the current research results would be helpful to health care providers in designing and implementing appropriate interventions for improving growth of children.

Materials and methods

This case-control study was carried out on infants aged 6-24 months in Urmia, Northwest of Iran, during 2013. Inclusion criteria were as follows: 1) a history of weight decrease (a minimum of 50 grams) in at least two consecutive months, based on growth monitoring charts, 2) willingness of the child's family to participate in the study, 3) not consuming drugs or boosters with an effect on physical growth of the infant, 4) lack of congenital disorders in the infant, 5) lack of gestational diabetes in the child's mother. The mothers not interested in taking part in the study were excluded from the investigation. To diagnose and select infants with growth failure, investigators applied weight-for-age approach. The reason for choosing this approach was that recent research has validated weight-for-age as the simplest and most reasonable marker for FTT [15]. First Six health centers were randomly selected from all health centers located in Urmia, Iran. Then, from among those health centers, based on the definition of FTT by kholdi et al. [10] and using health care files of children, infants with a weight decrease (a minimum of 50 grams) at each attendance compared to the previous evaluation were selected and entered into the study as subjects with FTT (180 subjects as the case group). Against the case group, 360 infants without growth disorder were selected and entered into the study as the control group (two controls against one case). The study groups were matched in terms of sex and age adopting the group matching approach during the sampling process. However, due to different factors (absence of some subjects, defects in filling the questionnaire, lack of response to the instrument etc.), 95 controls were excluded from the study and 265 remained.

To collect data on risk factors related to growth failure of infants, a self-report questionnaire was developed by the authors based on the available scientific literature [10, 16-18]. The questionnaire included two subscales: 1) socio-demographic information related to the children's families (13 items), 2) demographic and nutrition-related variables of the infants (11 items). To determine valid-

ity of the questionnaire, quantitative methods of content validity such as content validity ratio (CVR) and content validity index (CVI) were utilized. The CVR is an item statistic useful in the rejection or retention of specific items. In CVR, experts are requested to specify whether an item is necessary or not. Moreover, they are asked to score each item from 1 to 3 with a three-degree range of "not necessary, useful but not essential, essential". Greater levels of content validity exist as larger numbers of panelists agree that a particular item is essential. The numeric value of content validity ratio is determined by the Lawshe table [19].

The CVI was another approach taken for measuring content validity of the research questionnaire applied by researchers. In this approach, the panel of experts are asked to rate each item of the instrument in terms of relevancy and clarity and score each item from 1 to 4 with a four-point scale of 1 = not relevant, 2 = somewhat relevant, 3 = quite relevant, 4 = highly relevant or 1 = not clear, 2 = needs some revision, 3 = clear but needs minor revision, 4 = very clear. The study tool was sent via email to 10 academics to act as a panel of experts and examine the items in terms of necessity, relevance, and clarity. Then, feedback received from the specialists was analyzed and suggested changes were made to the study tool. Overall, five items did not receive the minimum scores of CVR (0.62) and CVI (> 0.79) and were discarded from the questionnaire. Content validity of the finalized questionnaire was confirmed based on results of CVR and CVI.

To determine the reliability of the questionnaire, the study instrument was completed by interviewing the mothers of all participants from the two groups. Next, Cronbach's alpha coefficient was computed and its value was found to be 0.89. Therefore, reliability of the questionnaire was also confirmed. After collecting, organizing, and classifying the data, statistical analyses were performed using descriptive and inferential statistical methods (chi-square test for independence, also called Pearson's chi-square test, is used to discover if there is a relationship between two categorical variables. In addition, logistic regression test predicts the probability that an observation falls into one of the two categories of a dichotomous dependent variable based on one or more independent variables that can be either continuous or categorical). In this study, a P value of less than 0.05 was considered significant.

Results

The results of this research study were evaluated at two levels. In the first step, along with crosstabing characteristics of the subjects, the univariate analysis of factors related to infants' growth was examined. In the second step, logistic regression analysis was performed to determine the net effect of risk factors on infants FTT, after adjusting for potential confounding variables.

Of the 445 eligible infants who were investigated, 180 (40.5%) had FTT and the remainder (59.5%) were

healthy. The findings showed that the mean age of mothers was 27 ± 5.75 years ranging from 16 to 48. The majority of them (95.5%) were housewives and the rest (4.5%) were working mothers. About 40% of the mothers had high school level education and the rest were from other educational levels. The majority of households (62.2%) had a monthly income of lower than USD300.

The findings highlighted that there were significant associations between undesirable growth of the subjects and their mothers' age (p-value = 0.041), mothers' education level (p-value = 0.007), number of gestation (p-value = 0.006), and family income (p-value = 0.001). These relationships were confirmed by the results of the Pearson's Chi- square test (p < 0.05) (Tab. I).

The present investigation indicated that 93 percent of subjects' birth weight was more than 2,500 gr, and 96.6% of infants Apgar score were more than seven at the time of birth. The majority of participants (96.4%) had been breastfed, and 73.7% of them had started the complementary feeding at the age of six months or more. Univariate analyses showed that there exist significant linkages between participants growth failure and birth weight (p-value = 0.002), duration of breastfeeding (p-value = 0.001), and birth order (p-value = 0.04). These relationships were confirmed by the results of the Pearson's Chi- square test (p < 0.05) (Tab. II).

To determine the real effect of the studied factors on growth failure, we applied a multivariate logistic regression model. Its results indicated that all the significant variables in univariate analyses, except for the mothers' age and number of gestations, have retained in the regression model and were statistically significant (p < 0.05) (Tab. III).

Education level of infants' mothers indicated a statistically significant linkage with undesirable growth. Those infants who had low literate mothers were 1.4 times more likely to have undesirable growth as compared to those children whose mothers were high literate [Adjusted Odds Ratio (AOR) = 1.421, 95% CI (1.172, 1.724)] (p-value = .000). The family's monthly income and child growth were found to have a statistically significant relationship, that is, children who had low family income were 1.5 times more likely to have undesirable growth in comparison with those who had high fam-

Tab. I. Sociodemographic characteristics of the study participants in two groups (n = 445).

Variable	Groups		#Chi-square value	*p*-value
	Cases	Controls		
	N (%)	N (%)		
Gender of infant			1.17	0.28
male	85 (47.2)	139 (52.5)		
female	95 (52.8)	126 (47.5)		
Birth weight/BW			9.31	0.002**
< 2500 gr	19 (10.6)	9 (3.4)		
≥ 2500 gr	161 (89.40)	256 (96.6)		
Apgar score			0.001	0.97
≥ 7	174 (96.7)	256 (96.6)		
< 7	6 (3.3)	9 (3.4)		
Birth age			0.62	0.73
pre-term	6 (3.3)	6 (2.3)		
term	172 (95.6)	257 (97.0)		
post-term	2 (1.1)	2 (0.8)		
Breast feeding			0.58	0.44
yes	175 (97.2)	254 (95.8)		
no	5 (2.80)	11 (4.2)		
Duration of breast feeding			11.62	0.001**
< 12 months	105 (58.33)	112 (42.26)		
≥ 12months	75 (41.67)	153 (57.7)		
Hospitalization			0.69	0.70
yes	35 (19.4)	50 (18.9)		
no	145 (80.6)	214 (80.8)		
Starting complementary feeding			0.34	0.55
< 6 months	50 (27.8)	67 (25.3)		
≥ 6 months	130 (72.2)	189 (74.7)		
Birth order			8.2	0.03*
first	76 (42.2)	145 (54.7)		
second	73 (40.6)	88 (33.2)		
third	24 (13.3)	23 (8.7)		
above	7 (3.9)	9 (3.4)		

* p < 0.05, ** p < 0.01 is significant, # the Pearson's Chi- square test

Tab. II. Sociodemographic characteristics of family of the study participants in two groups (n = 445).

Variable	Groups		#Chi-square value	*p*-value
	Cases	Controls		
	N (%)	N (%)		
Marriage age of mother (in years) < 15 15-25 > 25	21 (11.7) 144 (80.0) 15 (8.3)	23 (8.7) 221 (83.4) 21 (7.9)	1.14	0.56
Mother occupation employment housewife	5 (2.8) 175 (97.2)	15 (5.7) 250 (94.3)	2.32	0.31
Family monthly income < 300 USD 300-600 USD > 600 USD	124 (68.9) 50 (27.8) 6 (3.3)	136 (51.3) 117 (44.2) 12 (4.5)	13.69	0.001**
Maternal age (in years) > 20 20-24 25-29 30-34 > 34	21 (11.7) 43 (23.9) 65 (36.1) 30 (16.7) 21 (11.7)	14 (5.3) 86 (32.50) 86 (32.5) 54 (20.4) 25 (9.4)	9.98	0.04*
Type of delivery vaginal cesarean	116 (64.4) 64 (35.6)	157 (59.2) 108 (40.8)	1.8	0.40
Maternal education illiterate elementary guidance high school university	11 (6.1) 36 (20.0) 28 (15.6) 68 (37.8) 37 (20.6)	8 (3.0) 26 (9.8) 37 (14.0) 110 (41.5) 84 (31.7)	15.85	0.007**
Number of gestation/NG 1-2 3-4 4 and above	115 (63.9) 54 (30.0) 11 (6.1)	192 (72.5) 70 (26.4) 3 (1.1)	10.08	0.03*
Gestation interval (in years) 1-2 3-4 5-6 > 6	110 (61.1) 28 (15.6) 20 (11.1) 22 (12.2)	141 (53.2) 48 (18.1) 38 (14.3) 38 (14.3)	2.80	0.42
Number of family children 1 2 3 ≥ 4	90 (50.0) 61 (33.9) 20 (11.1) 9 (5.0)	130 (49.1) 98 (37.0) 30 (11.3) 7 (2.6)	1.96	0.58

* p < 0.05, ** p < 0.01 is significant, # the Pearson's Chi- square test

ily income [AOR = 1.492, 95% CI (1.117, 2.230)] (p-value = 041). Furthermore, birth weight of the infants had a statistically significant association with their undesirable growth. Those infants with a low birth weight were 2.7 times more likely to have undesirable growth in comparison with those who had a high birth weight [AOR = 2.777, 95% CI (1.276, 7.166)] (p-value = .035). Moreover, duration of breastfeeding was associated with growth of infants. That is, children breastfed for a short-term period were 1.8 times more likely to have undesirable growth and vice versa [AOR = 1.859, 95% CI (1.212, 2.852)] (p-value = .001). Birth order also had a statistically significant association with the undesirable growth of the infants [AOR = .741, 95% CI (.573-.958)] (p-value = .022) (Tab. III).

Discussion

Growth failure in children, especially among infants under two years of age, is in a state of emergency. Health care providers should focus on this issue and find the relevant factors. With this work, we hoped to aid health experts in managing and controlling FTT problem before it develops into dangerous and threatening conditions in children. The study aimed to explore factors influencing growth failure among infants aged 6-24 months in Urmia, northwest of Iran in 2013.

The results revealed that the prevalence of growth failure in female infants was somewhat more than that in the males. This finding was consistent with the study of Mohammad poor Asl et al. [3] and was also supported

Tab. III. Results of logistic regression analysis on growth status of infants (n = 445).

Variable	B	SE	Wald	df	AOR# (95.0% C.I)£	p-value
Gender of infant	-0.083	0.210	0.154	1	0.921 (0.610- 1.391)	0.695
Birth weight/BW	1.021	0.484	4.461	1	2.777 (1.076-7.166)	0.035*
Apgar score	0.243	0.660	0.136	1	1.276 (0.350-4.648)	0.712
Birth age	0.144	0.608	0.056	1	1.155 (0.351-3.803)	0.813
Breast feeding	0.198	0.619	0.102	1	1.219 (0.362-4.102)	0.749
Duration of breast feeding	0.620	0.218	8.060	1	1.859 (1.212-2.852)	0.001**
Hospitalization	0.144	0.285	0.256	1	1.155 (0.660-2.021)	0.613
Starting complementary feeding	0.184	0.239	0.596	1	1.202 (0.753-1.920)	0.440
Birth order	-0.300	0.131	5.229	1	0.741 (0.573-0.958)	0.022*
Marriage age of mother (in years)	0.072	0.289	0.062	1	1.074 (0.610-1.894)	0.804
Mother occupation	0.146	0.409	0.128	1	1.157 (0.520-2.579)	0.721
Family monthly income	0.400	0.196	4.191	1	1.492 (1.017-2.190)	0.041*
Maternal age (in years)	0.025	0.143	0.030	1	1.025 (0.775-1.355)	0.863
Type of delivery	0.084	0.218	0.148	1	1.088 (0.709-1.668)	0.700
Maternal education	0.351	0.098	12.740	1	1.421 (1.172-1.724)	0.000**
Number of gestation/NG	-0.233	0.159	2.235	1	0.587 (0.353-0.975)	0.060
Gestation interval (in years)	0.189	0.132	2.043	1	1.208 (0.932-1.565)	0.153
Number of family children	0.196	0.216	0.822	1	1.216 (0.797-1.857)	0.365

* p < 0.05, ** p < 0.01 is significant, # Adjusted Odds Ratio, £ Confidence interval

and confirmed by the results of Hajian's study [20]. However, our findings were in contrast with that of Vaghari's study [21]. One interpretation would be that such a difference may arise from the social and cultural discrimination between genders. That is, some families pay more attention to nutrition of male children compared to that of the females, which in turn may potentiate growth failure and other health problems in female infants [3].

The present investigation indicated that factors such as education level of the mother, duration of breastfeeding, birth order, birth weight, and family income were associated with the failure growth of the studied infants. Among these variables, education level of mothers was the first and most important predictor of growth failure of children. Infants with illiterate or low literate mothers experienced greater growth failure compared to other children.

Previous studies have also highlighted that in comparison with illiterate or low literate mothers, the high literate mothers had infants with a more desirable growth [22]. Maternal education, even without considering other factors affecting the growth, has a significant impact on improving child growth. In developing countries, insufficient knowledge of parents, and not child malnutrition, is the determining factor [23]. The study conducted by Hameida et al. on Lybian children showed that illiterate mothers had a major role in malnutrition and growth failure of their children [24].

In two independent studies, underweight was more prevalent in children under the age of two whose mothers were illiterate [25]. Likewise, underweight was negatively associated with the parent's education level among children aged 6-30 months [26]. Results of these studies were consistent with our research findings.

The logistic regression results showed that duration of breastfeeding was another risk factor influencing growth failure. Infants who were breastfed for a short-term period experienced more growth failure compared to those breastfed for a long-term period. With the cessation of breastfeeding, babies were fed with supplementary food. Therefore, if healthy food choices are not made for children or if supplementary feeding of children does not start at the right time, it will have a major effect on weight loss of children. Another study has also indicated and confirmed the relationship between cessation of breastfeeding and growth retardation [16]. There is a concordance between findings of these studies and this part of our results.

Breast milk is uniquely suited to the human infant's nutritional needs and is a live substance with immunological and anti-inflammatory properties that protect both the mother and her child against a host of illnesses and diseases [27]. Increasing the rate of breastfeeding can help reduce the prevalence of various illnesses and health problems, which in turn results in lowering health care costs [28].

Children with low birth weight are more susceptible to diseases, experience breastfeeding failures more frequently, and are at a higher risk of growth disorders, as compared to children with appropriate weight at birth [29]. In the present investigation, the infants with a low birth weight (lower than 2,500 gr) experienced more growth failure in comparison with those who had a birth weight higher than 2,500 gr. A low birth weight was found to be a risk factor for growth of children, according to regression results. This finding was confirmed and supported by the study of Marilia de Carvalho Lima et al. They found that there exists a significant correlation between malnutrition and children's birth weight. The largest risk for malnutrition was found in children with a low birth weight; a risk that was around six times higher than that for children with a birth weight of 3,500 gr or

more [17]. Similarly, the study conducted in a rural area of Western Ethiopia showed that children with a low birth weight (LBW) were about 2.4 times more likely to be underweight as compared to high birth weight children [1]. The findings of these studies were in accordance with our research findings. The findings of the current study also showed that household income had a significant relationship with growth failure in children. This was consistent with results obtained in other studies [18]. For this reason, it seems that most children with growth failure or retardation of growth live in families with low economic status.

Ultimately, the results of the present study showed a statistically significant association between birth order of children and their growth status. Indeed, birth order appeared to be a protective factor for growth of children. Infants who were in the first and second order of birth experienced more growth failure compared to children of the third order and so on. This result was consistent with findings of the study by Mohamad Por Asl et al. [30].

The present study, like other research studies, has some limitations. Firstly, a case-control design is not a strong method for understanding cause and effect relationships between variables. It is necessary to assess and identify these associations by applying stronger epidemiological methods. Secondly, the data of this study were collected using a self-report questionnaire. Participants may have underestimated or overestimated risk factors related to FTT, which may have affected the study findings. Thirdly, although weight for age index is the simplest way to identify FTT of children, it is not a comprehensive index. It is recommended that a combination of growth monitoring indices for identifying infants with FTT be used.

Conclusions

The present study highlighted that education level of the mother, duration of breastfeeding, birth order, birth weight, and family income were independently associated with growth status of the studied infants. Thus, national public health intervention programmers and health care providers working on improving child growth should focus on these determinants to reduce growth failure of children. In addition, taking into account the importance of healthy growth of children, it seems that educating mothers/caretakers would be beneficial in preventing dangerous diseases in children.

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