A study of growth failure and its related factors in children from 0 to 2 years in Tehran, Iran

Nahid Kholdi[1], Farid Zayeri[2], Alireza Akbarzadeh Bagheban[3], Soheila Khodakarim[3], Ali Ramezankhani[4]

[1]Department of Health and Social Medicine, Shahed University Faculty of Medicine, and [2]Proteomics Research Center, Faculty of Paramedical Sciences, [3]Department of Biostatistics, Faculty of Paramedical Sciences, and [4]Department of Health, Faculty of Public Health, Shahid Beheshti University of Medical Sciences, Tehran, Iran

SUMMARY: Kholdi N, Zayeri F, Bagheban AA, Khodakarim S, Ramezankhani A. A study of growth failure and its related factors in children from 0 to 2 years in Tehran, Iran. Turk J Pediatr 2012; 54: 38-44.

In this study, we aimed to estimate the prevalence of growth failure and identify the risk factors for this health problem in infants under two years old in Tehran, Iran. Using a cluster sampling method, 2182 infants' health files were randomly selected from eight health centers in Tehran. Growth failure was defined as a decrease in a child's weight (minimum 50 grams) at each attendance compared to the previous evaluation. The prevalence rate was between 0.05% and 6.2% at the different measurements. The regression analysis revealed that the presence of diarrhea [odds ratio (OR): 4.01, 95% confidence interval (CI): (3.50, 4.60)], respiratory infections [OR: 4.95, 95%CI: (4.40, 5.57)] and urinary tract infections [OR: 6.35, 95%CI: (3.97, 10.18)], as well as discontinuation of breast-feeding [OR: 10.91, 95%CI: (7.82, 15.23)], teething [OR: 4.14, 95%CI: (3.61, 4.75)] and complementary feeding [OR: 9.58, 95%CI: (6.48, 14.18)] were the significant risk factors for growth failure. Generally, our study showed a high prevalence of growth failure in infants less than two years in Tehran. More efforts are needed for promoting the knowledge level of mothers and healthcare providers to control this health problem in Iran.

Key words: growth failure, infants under two years old, malnutrition, infectious disease.

Growth failure, or failure to thrive (FTT), is one of the most important health problems throughout the world, especially in developing countries[1]. FTT reflects both stunting (low height for age) and wasting (low weight for height), which are used in combination with biochemical indicators[2]. FTT generally occurs when growth fails as a result of inadequate nutrition, which can be caused by inadequate intake, increased losses, or systemic and infectious disease[1].

It was estimated that stunting, severe wasting and intrauterine growth restriction together were responsible for 2.2 million deaths and 21% of disability-adjusted life-years for children younger than five years[3]. Malnutrition or inadequate access to essential nutrients and repeated infections are the most important causes of FTT in the developing world. On the other hand, FTT is less likely to occur because of insufficient food intake or poor food quality in the developed world, but rests more often with local factors such as the child or the child/family unit[1]. In the Islamic Republic of Iran, epidemiologic studies have shown a high prevalence of malnutrition among Iranian children in the previous decade[4,5]. Regarding these studies, growth failure is recognized as one of the most important health problems in Iran, and therefore, health policy makers have applied some interventional planning toward solving this problem in recent years.

In our country, the Islamic Republic of Iran, most of the previous reports about the prevalence and risk factors of growth failure have been confined to unpublished studies, small sample sizes, local surveys, or published papers in Persian. Based on this limited information, we believe that FTT is a serious health problem in Iranian children.

Table I. Frequency Distribution of Risk Indicators for Growth Failure at Different Measurement Time Points

Time	Respiratory infection	Urinary infection	Diarrhea	Discontinuation of breast-feeding
Month 1	107(4.9)	1(0.05)	72(3.3)	0(0.0)
Month 2	0(0.0)	0(0.0)	1(0.0)	0(0.0)
Month 3	5(0.2)	0(0.0)	1(0.0)	2(0.7)
Month 4	9(0.4)	0(0.0)	7(0.3)	1(0.3)
Month 5	14(0.6)	0(0.0)	9(0.4)	0(0.0)
Month 6	19(0.9)	1(0.05)	14(0.6)	2(0.7)
Month 7	22(1.0)	0(0.0)	20(0.9)	0(0.0)
Month 8	29(1.3)	1(0.05)	33(1.5)	1(0.3)
Month 9	39(1.8)	2(0.1)	16(0.7)	0(0.0)
Month 10	57(2.6)	7(0.3)	45(2.1)	1(0.3)
Month 11	44(2.0)	9(0.4)	31(1.4)	0(0.0)
Month 12	62(2.8)	4(0.2)	31(1.4)	1(0.3)
Month 15	43(2.0)	2(0.1)	31(1.4)	3(0.9)
Month 17	22(1.0)	5(0.2)	33(1.5)	4(1.2)
Month 19	31(1.4)	3(01)	22(1.0)	13(3.9)
Month 21	25(1.1)	1(0.05)	18(0.8)	22(7.0)
Month 23	24(1.1)	1(0.05)	19(0.9)	19(6.0)

* No. (%)

We therefore decided to design a longitudinal survey in order to estimate the prevalence rate of growth failure in children under two years old at different time points and to determine some of the most important risk indicators for this problem.

Material and Methods

Study Sample and Sampling Technique

The research was carried out as a longitudinal study in health centers of Tehran from February to July 2007. The study sample was selected using a single-stage cluster sampling technique. In the first stage, eight health centers were randomly selected from 64 health centers of Shahid Beheshti University of Medical Sciences in Tehran. In the next step, the health files of all the two-year-old children in these eight centers were gathered. The inclusion criteria were term labor, uniparous labor, no genetic or congenital disease, and timely presentation to the health center for growth monitoring. After a preliminary assessment, a total of 2,182 files were included in the study. The required information in these health files was recorded every month in the first year and every other month in the second year for each child (a total of 1 measurement).

Assessing Growth Failure and Related Factors

Sociodemographic characteristics including parental education and employment and maternal age at childbirth were recorded. In addition, information about breast-feeding two hours after birth, discontinuation of breast-feeding, regular reference to the health center, parity, and time of initiation of complementary food, vitamins A and D and iron was gathered. We also recorded information about the incidence of diarrhea, fever, respiratory infections, and urinary tract infections for each infant.

For children who had regular reference to the selected health centers, growth failure was defined as a weight decrease (minimum 50 grams) at each attendance compared to the

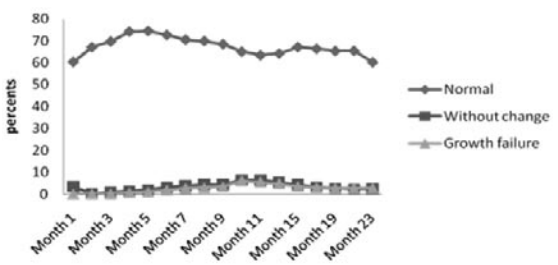

Figure 1. Growth failure trend.

previous evaluation[6]. Regarding this definition, the outcome variable for each child at each time of measurement (growth status) was considered on an ordinal scale with these categories: 0=normal growth, 1=without change and 2=growth failure.

Statistical Analysis

For describing the quantitative variables, values were reported as mean+SD. In addition, to describe the prevalence of growth failure and its risk factors, which were repeatedly registered during the two years after birth, we presented their frequency and percent at the different time points under study. For analytic purposes, because of the longitudinal and ordinal nature of the response variable (status of growth at different times of measurement: 0=normal growth, 1=without change, 2=growth failure), we used a marginal modeling approach (the proportional odds regression model) as well as the Generalized Estimating Equations (GEE) methodology[7,8]. Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) software, version 16.0. A p-value less than 0.05 was considered statistically significant.

Results

The study sample consisted of 2182 children below the age of two years. Among them, 1167 (53.5%) were female and 1015 (46.5%) were male. The mean±SD birth weight for these children was 3200.94±9.78 kg. The mean, median and mode of parity for these children were 1.47, 1.0 and 1.0, respectively (range: 1-6). The age of mothers at childbirth (mean±SD) was 27.27±5.27 years. Among the mothers, 53 (2.4%) were illiterate, 453 (20.8%) had an academic education and 1608 (73.7%) were homemakers. In addition, 18 fathers (1.0%) were illiterate and 532 (24.4%) had an academic education.

As mentioned before, we registered the potential risk indicators for growth failure, such as respiratory and urinary infections, fever, diarrhea, and discontinuation of breast-feeding, repeatedly at 17 time points. Table I shows the frequency distribution of these factors at the different times of measurement.

Table II shows the frequency distribution of growth status of the children under study at the different time points. As can be seen, the rate of growth failure shows an increasing trend before one year (with a peak at month 11) and a decrease after this age. Figure 1 displays the growth status trend in these children.

In the next step, to assess the univariate effect of different risk indicators on growth failure, we used a proportional odds regression model

Table II. Frequency Distribution of Growth Status of the Children at Different Measurement Time Points

Time	Normal	Without change	Growth failure
Month 1	1466(67.2)*	2(0.1)	1(0.05)
Month 2	1522(69.8)	19(0.9)	3(0.1)
Month 3	1621(74.3)	28(1.3)	15(0.7)
Month 4	1627(74.6)	42(1.9)	20(0.9)
Month 5	1587(72.7)	67(3.1)	41(1.9)
Month 6	1540(70.6)	83(3.8)	60(2.7)
Month 7	1527(70.0)	93(4.3)	65(3.0)
Month 8	1496(68.6)	93(4.3)	75(3.4)
Month 9	1420(65.1)	138(6.3)	136(6.2)
Month 10	1385(63.5)	136(6.2)	124(5.7)
Month 11	1402(64.3)	118(5.4)	109(5.0)
Month 12	1467(67.2)	95 (4.4)	78(3.6)
Month 15	1449(66.4)	68(3.1)	67(3.1)
Month 17	1427(65.4)	56(2.6)	59(2.7)
Month 19	1429(65.5)	49(2.2)	59(2.7)
Month 21	1314(60.2)	54(2.5)	61(2.8)
Month 23	1286(58.9)	40(1.8)	43(2.0)

* No. (%)

Table III. Regression Results for the Univariate Relationship between Risk Indicators and Growth Failure

Variable	Category	Estimate*	SE**	P	OR	OR (95%CI)
Sex	Female	0.06	0.02	<0.001	1.06	(1.02, 1.10)
	Male	Reference category				
Parity		0.02	0.01	0.09	1.02	(1.00, 1.04)
Mother's education	Illiterate	-0.09	0.06	0.13	0.91	(0.81, 1.03)
	Non-Academic	0.06	0.02	0.02	1.06	
	Academic	Reference category				
Mother's job	Homemaker	0.24	0.02	<0.001	1.00	(1.02, 1.10)
	Employee	Reference category				
Father's job	Unemployed	0.17	0.04	<0.001	1.20	(1.22, 1.32)
	Employee	Reference category				
Time of initiation of vitamin A and D		0.03	0.01	<0.001	1.03	(1.10, 1.28)
Time of initiation of iron		0.01	0.01	0.14	1.01	(0.99, 1.03)
Time of initiation of complementary foods		0.02	0.01	0.11	1.02	(1.01, 1.05)
Diarrhea	Presence	1.29	0.05	<0.001	3.65	(1.00, 1.04)
	Absence	Reference category				
Urinary tract infections	Presence	1.53	0.23	<0.001	4.64	(3.29, 7.24)
	Absence	Reference category				
Respiratory infections	Presence	1.48	0.05	<0.001	4.38	(3.98, 4.84)
	Absence	Reference category				
Fever	Presence	1.16	0.39	<0.001	3.21	(1.48, 6.85)
	Absence	Reference category				
Discontinuation of breast-feeding	Yes	1.56	0.04	<0.001	4.81	(4.40, 5.15)
	No	Reference category				
Teething	Yes	1.35	0.05	<0.001	3.85	(3.50, 4.25)
	No	Reference category				
Complementary feeding	Yes	1.94	0.15	<0.001	6.98	(5.19, 9.34)
	No	Reference category				

* Estimate of the model parameter
** Standard error of the estimate
OR: Odds ratio. CI: Confidence interval.

and estimated the regression parameters using GEE analysis. To shorten the results, we only reported the obtained findings for the variables with p values less than 0.2 (Table III). Regarding these univariate findings, we can conclude that the child's sex, the mother's educational level and employment, discontinuation of breast-feeding, initiation of complementary food, and presence of diarrhea, urinary infection, respiratory infection, and fever were significantly related with growth failure ($p<0.001$ for all). The interpretation of these results may be more comprehensible in terms of odds ratios (ORs). For instance, the OR of 3.65 for the presence of diarrhea tells us that the odds of growth failure for the children with diarrhea was 3.65 times the same odds for the infants without diarrhea during this two-year period.

In the final step of data analysis, to assess the concurrent impact of different risk indicators on the growth status of children, we fitted a multiple proportional odds regression model to the data. In this process, we first included all the explanatory variables in Table III in a model and determined the significant factors. Then, the final model was fitted to the growth failure data with these significant factors. Table IV shows the obtained results for the final multiple proportional odds regression model. The

Table IV. Regression Results for Concurrent Effect of Different Risk Indicators on Growth Failure

Variable	Category	Estimate*	SE**	P	OR	OR (95%CI)
Urinary tract infections	Presence	1.85	0.24	<0.001	6.35	(3.97, 10.18)
	Absence	Reference category				
Respiratory infections	Presence	1.60	0.06	<0.001	4.95	(4.40, 5.57)
	Absence	Reference category				
Diarrhea	Presence	1.39	0.07	<0.001	4.01	(3.50, 4.60)
	Absence	Reference category				
Discontinuation of breast-feeding	Yes	2.39	0.17	0.02	10.91	(7.82, 15.23)
	No	Reference category				
Complementary feeding	Yes	2.26	0.20	<0.001	9.58	(6.48, 14.18)
	No	Reference category				
Teething	Yes	1.42	0.07	<0.001	4.14	(3.61, 4.75)
	No	Reference category				

* Estimate of the model parameter
** Standard error of the estimate
OR: Odds ratio. CI: Confidence interval.

obtained results showed that the presence of diarrhea, respiratory infections and urinary tract infections as well as discontinuation of breast-feeding, teething and complementary feeding were the statistically significant risk factors for growth failure. Moreover, discontinuation of breast-feeding [OR: 10.91, 95% confidence interval [CI]: (7.82, 15.23)], complementary feeding [OR: 9.58, 95%CI: (6.48, 14.18)] and presence of urinary tract infections [OR: 6.35, 95%CI: (3.97, 10.18)] were the most effective risk factors for growth failure in these children.

Discussion

In this study, we aimed to estimate the prevalence of growth failure in children in Tehran, Iran aged 0 to 2 years and to identify some of the significant risk factors for this health problem. To obtain a more accurate estimate for the prevalence of FTT and gather adequate data for modeling the relationship between a variety of risk indicators and presence of growth failure, we decided to design a longitudinal study and collected the required data at 17 different time points. Our data revealed that only 33.9% of children under study experienced no growth failure in this period of their life. In addition, about 22.3% and 2.7% of these infants had at least 5 or 10 experiences of growth failure, respectively, while less than two years old.

Although growth failure is a common problem, precise epidemiological data are lacking. The population prevalence of growth failure has been found to range anywhere between 1.3% and 20.9% depending on which definition of FTT is used. The World Health Organization estimates that 174 million under-five children in the developing world are malnourished, as indicated by low weight for age, and 230 million are stunted. The number of children in the developing world with FTT varies by country and between urban and rural populations[1]. In addition, 1–5% of pediatric hospital admissions under two year of age settings show signs of growth failure[9]. Another study revealed that of an estimated 178 million stunted children aged less than five years, most live in sub-Saharan Africa and south-central Asia[3]. There are 40 countries with a child stunting prevalence of 40% or more: 23 are in Africa, 16 in Asia and 1 in Latin America. Of the 52 countries with a prevalence of less than 20%, 17 are in Latin America and the Caribbean, 16 in Asia, 11 in Europe, and 4 each in Africa and Oceania[10]. In a cohort study in the United Kingdom, it was revealed that 97 out of 531 infants (18.3%) had slow weight gain in the period from birth to 6-8 weeks, and 334 out of 531 (62.9%) in the period from 6-8 weeks to 9 months[11]. In a study in Ohio, United States, it was demonstrated that about 8%, 28% and 12% of infants had growth failure between the

periods of 4 weeks - 4 months, 4 - 8 months, and 8 - 20 months, respectively[12].

In the present study, the multiple regression results showed that discontinuation of breast-feeding was the most significant risk factor for growth failure. This is not a surprising result, because discontinuation of breast-feeding is known as the principal factor for decreasing weight in children[6,13]. Epidemiologic evidences tell us that decreasing weight is the first answer to malnutrition and infectious diseases[14]. In addition, the regression results revealed complementary feeding as the second important risk indicator for growth failure among the children under study. The reason for this conclusion may be that the children receive inadequate or unsafe complementary diets, especially after discontinuation of breast-feeding. The same results were reported by other researchers elsewhere[13,15-17].

In our research, it was concluded that infectious diseases such as urinary tract (OR: 6.35), respiratory (OR: 4.95) and diarrheal (OR: 4.01) infections had a significant effect on growth failure in two-year-old children. These results tell us that urinary tract infections were the most effective factor on FTT among these infectious diseases. Similar findings for the significant effect of diarrheal and respiratory tract infections on growth failure were reported in Indonesia and Bangladeshi children[18,19]. UNICEF has also introduced nutrition and infectious diseases as the important effective factors on growth failure among children in different communities[14,20]. On the other hand, some other studies demonstrated that the significant effect of diarrheal infections on growth failure probably depends on discontinuation of breast-feeding[21].

Our results also showed that teething is a significant risk factor for growth failure. We did not find any published article about the relationship between teething and growth failure. However, it is commonly believed that teething in infants can cause a variety of signs and symptoms. Previous studies have suggested an association between the eruption of the deciduous teeth and fever, irritability, drooling, rashes, vomiting, diarrhea, night crying, and convulsions[22]. It is now accepted that the localized symptoms of teething vary between individuals; however, 'teething' continues to be an inappropriate diagnosis proffered by both healthcare professionals and lay people[23].

In the present study, we found no significant relationship between sociodemographic characteristics of the children (including the infant's sex and parity, maternal age at birth, parental educational level and employment) and growth failure. De Villiers[24] indicated that the most important determinants of growth failure were the mother's period of residence in a village, status in the household (head of household, role in decision-making), educational status, nutritional knowledge, and health. No clear picture emerged on the role of dietary intake or disease (direct causes) in the development of growth failure. In Indonesia, the relatively high risk of male children compared with females has also decreased. Maternal education and economic status have continued to be very strong predictors of children's nutritional outcomes[13]. Sullivan[9] commented on the ALSPAC study, which showed that there was no significant association between poor weight gain and parental occupation or socioeconomic class, but there was an association with living in rented accommodation or not having the use of a car or telephone.

In conclusion, the results of this study indicated that about two-thirds of infants in Tehran, Iran had experienced growth failure in the first two years of their life (mostly due to infectious disease and malnutrition). More efforts are needed for promoting the knowledge level of mothers and healthcare providers to control this important health problem in our country.

Acknowledgements

We thank the GP students of Shahed University for gathering the data and the staff of the health centers of Tehran for their kind cooperation.

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