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Prevalence of Failure to Thrive and Associated Risk Factors in In-patients Under 5 Years of Age

Manijeh Khalili [1], Alireza Teimouri [2,*] and Masroor Babaeian [3]

[1]Department of Pediatric Gastroenterology, Children and Adolescents Health Research Center, Research Institute of Cellular and Molecular Sciences in Infectious Diseases, Zahedan University of Medical Sciences, Zahedan, Iran

[2]Demographer, Children and Adolescents Health Research Center, Research Institute of Cellular and Molecular Sciences in Infectious Diseases, Zahedan University of Medical Sciences, Zahedan, Iran

[3]Pediatric resistant, Children and Adolescents Health Research Center, Research Institute of Cellular and Molecular Sciences in Infectious Diseases, Zahedan University of Medical Sciences, Zahedan, Iran

[*]*Corresponding author*: M.Phil, PhD in Demography, Children and Adolescents Health Research Center, Research Institute of Cellular and Molecular Sciences in Infectious Diseases, Zahedan University of Medical Sciences, Zahedan, Iran. Email: alirezateimouri260@gmail.com

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Abstract

Background: Failure to thrive (FTT) is defined as delaying or stopping a child's growth and mightlead to more serious complications, such as reduced learning ability, mental or physical disability, and mortality.

Objectives: The present study aimed to assess the prevalence of growth retardation in children under 5 years of age and its risk factors.

Methods: This cross-sectional study was conducted on all 2038 children admitted to Ali Ebne Abitalib and Ali Asghar hospitals in Zahedan, Iran, in 2016. The samples entered the study based on census sampling, and the children's height, weight, and other growth indices were measured. The children with confirmed growth retardation were recognized as the case group. Other children were regarded as controls. The parents' characteristics were recorded in a list provided for this purpose. Data analysis was performed with SPSS software (version 20) using logistic regression with an error level of 0.05.

Results: Of all children, 52.6% were male. The mean age of the total patients was 17.6 ± 4.14 months. The prevalence of children with growth failure was 747 patients (36.6%). In this study, the prevalence of short stature was significantly associated with factors such as parental height, low household level of education, high patients' birth order, dry feeding, low birth weight, place of residence, and presence of background disease ($P < 0.05$). Nevertheless, the prevalence of short stature was not significantly associated with gender, age, polygamy status, age of complementary feeding, and gestational age ($P > 0.05$).

Conclusions: The present study concluded that the prevalence of FTT was high due to socioeconomic factors in the studied society. Parental short stature, education, nutrition, low birth weight, and residence in rural areas were the most significant factors.

Keywords: Prevalence, Failure to Thrive, Risk Factors, Hospitalized Children

1. Background

Failure to thrive (FTT) is one of the major health problems worldwide due to both short stature and low weight for age. Moreover, FTT can be used in combination with biochemical indicators (1). It is more prominent in developing regions and is used to account for growth rates below age-appropriate growth rates (2, 3). The actual height of a child is determined by its initial height at birth and its growth over time. Growth has the highest rate at birth and then gradually diminishes during epiphyseal cartilage fusion until the peak of adolescent growth results in a sudden slowdown in adolescent height (4).

The average height of a newborn is about 50 cm, 76 cm at 1 year, 89 cm at 2 years, and 97 cm at 3 years. The growth rate is 5 cm per year from 3 years to puberty (3, 4). However, this modeling glitch does not necessarily mean a child has FTT. This is because if the height is small, it might be regular at normal growth rates. Children can be small only because their parents are small. Similarly, some children grow slowly only before puberty. This is known as constitutional growth delay. These children can also grow slowly in the first year of life and show normal growth (3). The most common definitions are weight less

than the third to fifth percentile for age on more than one occasion or weight measurements that fall two major percentile lines using the standard growth charts of the National Center for Health Statistics (NCHS) (4).

On the other side, FTT is a term describing a set of symptoms and signs but not a diagnosis, and as a significant delay in expected growth, it has been described in early childhood (5). A lack of appropriate growth providers has caused concerns for all health caregivers and policymakers; however, FTT could still be the beginning of complications and mortalities in most countries, even in the developed population (6). As defined, anthropometric indicators are widely used to assess FTT and nutritional status. Growth in the first 2years of life is a sign of health, nutrition, and well-being (7).

There are several conditions that can lead to a decrease in growth rate, which can be detected early by growth monitoring (8). Many have a family history with similar growth patterns; many can eventually reach normal adult height; nevertheless, others remain small as adults (9). Short stature was endocrine-related in 5% of children (3). Various reasons, often in combination, might be responsible for FTT, such as the inability to use the eaten calories due to malabsorption or inborn errors of metabolism, poor nutrition, and anatomical problems or enhanced metabolic needs, such as chronic infection (10, 11). The diagnosis of the underlying causes is often complex and difficult and might be a combination of organic and psychological problems (12). With respect to the above-mentioned issues and due to the high given prevalence of FTT in Sistan and Baluchestan province, Iran, with a limited number of comprehensive studies, this study was performed to provide basic principles to improve child health after evaluating the current health status.

2. Objectives

Therefore, the main objective of the present study was to estimate the prevalence of FTT and associated risk factors for in-patient children under 5 years of age.

3. Methods

3.1. Study Design and Samples

This cross-sectional survey was carried out on all children aged under 5 years who were hospitalized as in-patients at the pediatric wards of Ali Ebne Abitalib and Ali Asghar hospitals in 2016in Zahedan (the capital of Sistan and Baluchestan province) to estimate the prevalence of FFT and associated risk factors. After considering exclusion criteria, 2038 children entered the study. The patients with confirmed growth retardation in accordance with the NCHS were assigned to the case group, and those without growth retardation were regarded as controls. The hospitalized children who had specific characteristics, such as age lower than a month, premature labor, and intrauterine growth retardation history, were excluded from the study.

3.2. Ethical Approval

The purpose of the intervention was explained to the parents. The parents then agreed. In addition, this study was approved under the ethical approval code of IR.ZaUMS.REC.1392.935.

3.3. Factors and Measures

The characteristics of parents, such as maternal age, polygamy, parental education, ethnicity, demographic, social habits, and socioeconomic status, such as gender of the child, type of nutrition, place of residency, gestational age (GA), presence of diseases, weight at the time of birth with weight, height, and head circumference at the time of the survey, and onset age of feeding, were recorded in a list provided for this purpose. The height of children under 2 years was measured lying down on a flat wooden calibration table, and the height of children over 2 years was measured while standing on a ruler.

In this study, children over 2 years old were weighted using a weighting scale (RASA, made in Islamic Republic of Iran) by an error factor of 100 g, while those under 2 years old were weighted using a recumbent weighting scale (MIKA, made in Japan) by an error factor of 10 g.

Head circumference was measured with flexible non-stretchable tape. The child's age was calculated from birthday to study time according to the identification card.

3.4. Statistical Analysis

Data analysis was performed using SPSS software (version 20). All descriptive variables had a free distribution. Therefore, the Mann-Whitney U test was used to compare quantitative variables and for the grouping data. The chi-square test was employed for possible associations. Afterward, binary logistic regression was applied for significant variables. The significant level was considered $P < 0.05$.

4. Results

In this study, of 2038 children,747 cases (36.6%) had growth retardation. The gender distribution of participants was reported as 1072 (52.6%) and 966 (47.4%) for male and female subjects, respectively, with a mean age of 17.6 ± 4.14 months.

Table 1 shows that children with and without FTT had similar ages (P > 0.05). A similar pattern was observed for the mother's age. Parental height was a significant factor in FTT; accordingly, children with FTT had shorter parents (P < 0.001). Children with a higher number of parties had less chance of being without FTT (P < 0.001). The onset age for the children with FTT was higher but not significant than those without FTT. Childbirth weight was significantly lower in children with FTT than in those without FTT (P < 0.001).

Table 1. Changes of Quantitative Variables Due to Failure to Thrive

Failure to Thrive	Mean ± Standard Deviation	Mann-Whitney U Test	P-Value
Age (mo)		471313.5	0.395
Yes	17.87 ±14.388		
No	17.46 ± 14.386		
Mother's age (y)		318045.5	0.818
Yes	25.91 ± 5.861		
No	25.78 ± 5.411		
Father's height (cm)		324466	< 0.001
Yes	171.89 ± 6.626		
No	174.22 ± 6.893		
Mother's height (cm)		257259	< 0.001
Yes	161.54 ± 5.874		
No	163.59 ± 5.991		
Child parity		181428	< 0.001
Yes	3.82 ± 2.359		
No	2.86 ± 1.695		
Supplement age (mo)		274189.5	0.89
Yes	6.45 ± 1.712		
No	6.08 ± 1.123		
Weight at birth (g)		181636	< 0.001
Yes	2587.08 ± 490.045		
No	3057.12 ± 471.903		

Table 2 shows the association between FTT and some categorical variables. Gender distribution was similar in children with and without FTT (P > 0.05). About 32 households in the study had polygamy status; accordingly, 14 cases had a child with FTT with no significant effect (P > 0.001). Parental education had a significant effect on FTT; accordingly, by increasing the educational level of parents, the chance of having FTT decreased (P < 0.001). Of 747 children with FTT, 32%, 56%, and 12% had breastfeeding, formula feeding, and mixed nutrition style. The type of nutrition had a significant effect on having a child with FTT (P < 0.001). The place of residence, acute diseases, and ethnicity had a significant effect on FTT; accordingly, most of the children with FTT had acute diseases (P < 0.001). Of children without FTT, the majority lived in rural areas. The Baloch ethnicity was a cause of having FTT in the study; accordingly, from those with FTT, the majority were Baloch (73.60%) (P < 0.001).

The GA did not show any significant effect on FTT in the study children (P > 0.05). This study considered the significant variables for the logistic regression analysis to shorten the results. Regarding these univariate findings, maternal and paternal education, ethnicity, type of nutrition, place of residence, diseases, and weight at birth had a significant impact on FTT. In the case of paternal education, the university level was considered the reference, and the odds ratio of 6.38 was observed for the illiterate/elementary school educational level. It means that children with fathers in the illiterate/elementary school educational level had a 3.65 times higher chance of having FTT than children with university graduate fathers.

In the final step of the data analysis to assess the simultaneous impact of different risk indicators on child FTT, a multiple proportional odds regression model was fitted to the data of key factors obtained from the univariate analysis. The obtained results showed that paternal and maternal education, ethnicity, diet, place of residence, GA, presence of diseases, and birth weight had a significant effect on growth retardation (Table 3).

5. Discussion

The FTT is defined as the failure to achieve normal physical growth or weight gain (1). Diagnosis requires repeated measurements of growth over time using the age-appropriate percentile growth charts (13). The present study is one of the most extensive studies to present a comprehensive overview of the prevalence of FTT and its risk factors in in-patient children with less than 5 years in Zahedan, the capital city of the Sistan and Baluchestan

Table 2. Association Between Study Factors and Failure to Thrive [a]

Groups	Failure to Thrive		Total	P-Value
	Yes	No		
Gender				0.984
Male	394 (52.70)	674 (52.70)	1068 (52.70)	
Female	353 (47.30)	605 (47.30)	958 (47.30)	
Polygamy				0.401
Yes	14 (1.90)	18 (1.40)	32 (1.60)	
No	733 (98.10)	1273 (98.60)	2006 (98.40)	
Paternal education				< 0.001
Illiterate/elementary school	417 (55.80)	287 (22.20)	704 (34.50)	
Secondary school	115 (15.40)	258 (20.00)	373 (18.30)	
High school	143 (19.10)	430 (33.30)	573 (28.10)	
University graduate	72 (9.60)	316 (24.50)	388 (19.00)	
Maternal education				< 0.001
Illiterate/elementary school	454 (60.80)	464 (35.90)	918 (45.00)	
Secondary school	161 (21.60)	290 (22.50)	451 (22.10)	
High school	88 (11.80)	363 (28.10)	451 (22.10)	
University graduate	44 (5.90)	174 (13.50)	218 (10.70)	
Nutrition				< 0.001
Breastfeeding	239 (32.00)	757 (58.60)	996 (48.90)	
Powdered milk	418 (56.00)	386 (29.90)	804 (39.50)	
Mixed	90 (12.00)	148 (11.50)	238 (11.70)	
Place of residence				< 0.001
Urban	367 (49.10)	870 (67.40)	1237 (60.70)	
Rural	380 (50.90)	421 (32.60)	801 (39.30)	
Gestational age				0.203
Pre-term	75 (10.00)	108 (8.40)	183 (9.00)	
Term	672 (90.00)	1183 (91.60)	1855 (91.00)	
Underline diseases				< 0.001
Yes	353 (47.30)	293 (22.70)	646 (31.70)	
No	394 (52.70)	998 (77.30)	1392 (68.30)	
Ethnicity				< 0.001
Fars	197 (26.40)	563 (43.60)	760 (37.30)	
Baluch	550 (73.60)	728 (56.40)	1278 (62.70)	

[a] Values are expressed as No. (%).

province as one of the most disadvantaged provinces in Iran.

The study results showed that the prevalence of FTT was 36.6%, with more frequency in male subjects. The most common cause of FTT is not taking in enough calories. Other risk factors that might contribute to poor nutrition include poor feeding habits, low birth weight, and residence in rural areas.

The most common causes of FTT have been reported genetic status, intrauterine disease, starvation, chronic disease, hormonal imbalances, and in rare cases, intellectual disability or primary central nervous system

Table 3. Univariate (Unadjusted) and Multivariate (Adjusted) Analysis Factors Associated with Failure to Thrive

Risk Factors	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Gender		
Male	1.002 (0.84, 1.20)	
Female	Reference category	
Polygamy		
Yes	1.35 (0.67, 2.73)	
No	Reference category	
Paternal education		
Illiterate/elementary school	6.38 (4.74, 8.58)	5.98 (4.17, 8.57)
Secondary school	1.96 (1.40, 2.75)	1.60 (1.06, 2.40)
High school	1.46 (1.06, 2.01)	1.36 (0.93, 1.99)
University graduate	Reference category	
Maternal education		
Illiterate/elementary school	3.87 (2.71, 5.52)	
Secondary school	2.20 (1.50, 3.22)	
High school	0.96 (0.64, 1.44)	
University graduate	Reference category	
Ethnicity		
Baluch	2.16 (1.77, 2.63)	2.03 (1.58, 2.62)
Fars	Reference category	
Type of nutrition		
Powdered milk/formula feeding	3.43 (2.81,4.19)	3.75 (2.90, 4.83)
Powdered milk/formula feeding/breastfeeding	1.93 (1.43, 2.60)	1.73 (1.18, 2.53)
Breastfeeding	Reference category	
Place of residence		
Rural	2.14 (1.78, 2.57)	2.22 (1.75, 2.82)
Urban	Reference category	
Gestational age		
Pre-term	1.22 (0.90, 1.67)	1.49 (1.01, 2.21)
Term	Reference category	
Diseases		
Yes	3.05 (2.51, 3.71)	3.38 (2.64, 4.33)
No	Reference category	
Birth weight (g)		
< 2500	5.14 (4.08, 6.50)	4.88 (3.70, 6.43)
≥ 2500	Reference category	
Average height of parents	0.94 (0.93, 0.96)	0.95 (0.93, 0.97)

Abbreviations: OR, odds ratio; CI, confidence interval.

disorder. Growth retardation occurs when a child is not growing at normal rates (14). The delay might be due to underlying health conditions, such as growth hormone deficiency and hypothyroidism. Early treatment can help a child grow to a normal or near-normal height. Intrauterine growth restriction occurs when problems or abnormalities hinder cell or tissue growth or reduce cell size (15). This issue can occur if, in fetation, the fetus does not receive the nutrients and oxygen needed for the growth and development of organs and tissues or due to an infection (16).

A study reported that the prevalence of FTT in different regions of the UK was within the range of 1.3-20.9% and identified a significant correlation between slow weight gain in children and the short stature of parents (17). A few Iranian studies revealed that the prevalence of FTT in female subjects was higher than in male subjects (18-20). The findings of the aforementioned studies are inconsistent with the present study's results which showed a higher frequency in male subjects. One explanation for this difference is the difference in gender discrimination in society and culture, as some families prefer male children to female children and are more concerned with the diets of male children, which might increase stunting and other health problems in female children (18).

The present investigation indicated that the factors of maternal education, duration of breastfeeding, birth order, birth weight, and family income are related to FTT. Among these variables, maternal education was the first and the most important predictor of FTT; accordingly, children with illiterate or less literate mothers experienced a greater risk of FTT. Miller et al. (21) studied the effect of maternal and neonatal factors on FTT in children with human immunodeficiency virus (HIV). Miller et al. concluded that children with HIV had a lower mean GA but similar weight at birth, height, and head circumference compared to those not infected. The aforementioned study also demonstrated an association between a history of pneumonia and FTT among children with HIV.

Olsen et al. (22) showed that the prevalence of FTT was 17% lower than the current study's result and revealed that low weight for age, low body mass index, and low conditional weight had a significant effect on FTT. In Singapore, Goh et al. (13) concluded that the foremost common causes of FTT were malnutrition, psychosocial and caregiver components, malabsorption, and existing congenital or chronic diseases. Jaffe (23) conducted a study to assess the causes of FTT. They focused on the history of diseases in participants and showed that background disease was introduced as a cause of growth retardation for 10% of cases. Growth problems can be a characteristic of syndromes, such as Cushing's syndrome, Turner syndrome, Down syndrome, Noonan syndrome, Russell-Silver syndrome, and Prader-Willi syndrome.

In another study, Khalili et al. (24) demonstrated that most mothers had a moderate range of knowledge, and about half had a moderate level of practice regarding childhood diarrhea and diet. More than half of the mothers expressed that dehydration is a major complication of diarrhea, followed by vomiting and loss of appetite. In the present study, children with a background chronic disease had a higher chance of experiencing FTT, and maternal education was one of the leading causes with a significant impact on FTT, similar to the present study's results.

Ahmadi et al. (25) assessed the risk factors of growth disorders in children less than 1 year of age. Ahmadi et al. indicated that 46.3% of children had FTT, and the significant factors were early-onset complementary feeding, low socioeconomic status, diseases after 6 months of age, birth weight, and maternal diseases; however, FTTwas not correlated with age and parental education, birth order, height, and head circumference at birth. The present study concluded that growth retardation was associated with low birth weight, parental education, and birth order. In Gohari et al.'s study (26), the effective factor was maternal education. In some way, a similarity was observed between the current study's results and the aforementioned study's results related to the presence of diseases; accordingly, Gohari et al. demonstrated the effects of diarrhea, urinary and respiratory infections, teething, feeding, weaning, and other diseases on growth disorders.

In a study by Taghavi Ardekani and Talebiyan (27), 48% of children experienced growth failure, and the gender distribution was reported as 27% and 21% for males and females, respectively. The prevalence of growth retardation was higher in the present study. Taghavi Ardekani and Talebiyan also concluded that the most common types of malnutrition for males and females were mild and severe, respectively, and the most frequent age group was less than 1 year (27). In accordance with indices of undernutrition, stunting, and wasting, the frequency of growth retardation was 48%, 19%, and 10%, respectively. In a comprehensive study, Khalili et al. (28) showed a similar pattern of weight gain in 3 months after constipation.

Shahramian et al. (29) demonstrated that infants with prebiotic formula feeding had significantly higher weight gain than both breastfeeding and regular formula feeding.

At different points of age in the first year of life, Sotoudeh et al. (30) evaluated 69 hospitalized children at a pediatric intensive care unit for malnutrition and reported55.1% with malnutrition, 23.2% at risk, 15.9% with a normal state, and 5.8% with overweight. Sotoudeh et al. concluded that most hospitalized children had malnutrition or were at risk. With regard to the fact that resulted from the present study, 37% of in-patient children had growth disorders. With respect to the nutritional instructions and physical growth, it would be useful to advise the parents, especially mothers, about the growth problems in children to reduce the risk of mortality.

The limitation of the study was that it was single-center, making it impossible to generalize the results to the whole province. The time from disease onset to hospitalization time was not recorded, which might have a strong effect on FTT.

5.1. Conclusions

Based on the study's results, it can be concluded that the prevalence of FTT was high due to socioeconomic factors in the studied society. Parental short stature, education, nutrition, low birth weight, and residence in rural areas were the most significant factors. With respect to the conclusion, it is necessary to carry out a comprehensive study with further factors, and it is recommended to implement useful plans to increase parental education and awareness regarding nutrition to provide a well-balanced diet.

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Footnotes

Authors' Contribution: M.K.: Study design and main concepts: A.T.: Data analysis and drafting; M.B.: Data collection.

Conflict of Interests: The authors declared no conflict of interests.

Data Reproducibility: The dataset presented in the study is available on request from the corresponding author during submission or after its publication. The data are not publicly available due to a large database.

Ethical Approval: The purpose of the intervention was explained to the parents. The parents then ruled out the declaration of consent. In addition, this study was approved under the ethical approval code of IR.ZaUMS.REC.1392.935.

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