

Evaluation of Dietary Intervention Effectiveness of Pediatric Outpatients with Failure to Thrive (FTT) and Underweight

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ABSTRACT

Purpose: The objectives of this study are to determine the change in growth and body weight and to evaluate the effectiveness of nutrition intervention on growth velocity between intensive dietetic intervention and standard dietetic intervention over a 12-month period in children less than 14 years of age, medically diagnosed with Failure to Thrive (FTT) and /or underweight seen by a pediatric dietitian in outpatient dietetics clinic. **Methods:** This is a retrospective service evaluation of pediatric dietetic outpatient services between January 2021 and December 2021 at AL-Khor Hospital (AKH) in Qatar. **Findings:** There was an improvement in mean weight z-scores over the 12-month period, with significantly larger improvements in mean weight z-score for the intensive intervention compared to standard care. Multidisciplinary team intervention including pediatric dietitian was associated with significant changes in weight gain and velocity. **Conclusion:** Dietetic intervention is crucial and beneficial. Multidisciplinary team intervention and control of underlying medical illnesses may also provide additional improvement in growth.

Keywords: Failure to thrive, medical nutrition therapy, Pediatrics, Growth and Development

INTRODUCTION

In the early years, nutrition is strongly correlated with a child's growth and development, particularly in the first three years [1,2]. Nutritional status in utero, in children, and in adulthood is affected by the quality and quantity of protein and energy supplementation across the lifespan [3,4]. Failure to Thrive (FTT) or faltering growth may be caused by poor nutrition in infancy [5], which has significant short-term and long-term consequences. In 2004 large disease burdens and death globally were caused by underweight children less than five years of age, as a result of undernutrition and FTT. Emotional, cognitive, and psychological deficits

have also been reported later in life [6-8]. The pediatric dietitian can assess of nutritional risks and dietary needs of the pediatric patient and provide appropriate nutritional support and individualized dietary advice for children with FTT and their caregivers [9,10]. Age-appropriate reference standards are usually used [11,12] for comparing a child's growth velocity. The ideal would be growth standards derived from trends of growth in local children, as the average growth of a child varies by country and race. The latest World Health Organization (WHO) velocity growth standards are one of the considered standards [12]. World Health Organization velocity growth standards are based on data collected as part of the WHO Multicenter Growth Reference Study (MGRS) [13]. The WHO MGRS from 1997-2003 was undertaken in six different countries (United States of America, Oman, Norway, Brazil, Ghana, and India), which included 8440 healthy breastfed infants and young children of term gestation (≥ 37 weeks, ≤ 42 weeks) without significant medical comorbidity, to develop growth standards for children below five years of age [14].

During infancy and childhood, children gain weight and grow more rapidly different than at any other time in life. However, some children do not gain weight at a normal range, for many suspected reasons of expected variations related to genetics, being born prematurely, and undernutrition which is known as growth deficit or faltering growth.

Close monitoring of weight gain and evaluation at different ages during childhood period is very important because it could lead to signs of some medical problem that needs treatment. Some complications may be appearing in malnourished children for a long time including weakened immune systems, slower expected linear growth, shorter than expected height, and difficulties in learning. There are many possible causes of poor weight gain including the following: Inadequate energy intake, an improper combination of protein, fat, and carbohydrates, nutrient malabsorption, and requiring a higher-than-normal amount of dietary energy.

Poor weight gain can occur as a result of a medical problem, a developmental or behavioral problem, a lack of adequate food, a social challenge at home, or most frequently, a combination of these problems. Each age group has a specific cause of poor weight gain, this study will focus on afterbirth until 14 years of age: Birth to six months – poor quality of suck, incorrect formula preparation; breastfeeding problems; the inadequate number of feedings; poor feeding interactions, neglect; birth defects that affect the child's ability to eat or digest normally; underfeeding, milk protein intolerance; problems with child's mouth/throat that make it difficult for the child to suck or swallow (eg, cleft lip and palate); medical problems that affect the absorption of nutrients (cystic fibrosis); medical problems that increase the number of calories needed (congenital heart disease), gastroesophageal reflux. Seven to 12 months – Feeding problems (eg, struggles between the child and caregiver about what will be eaten; problems with the child's mouth that make it hard for them to chew or swallow textured foods; delay in solid food introduction; caregiver does not offer enough quantity or variety of solid foods); intestinal parasites; food allergies. Over 12 months – Behavioral (the picky eater), social factors (underfeeding related to fear of overfeeding, limiting food choices, poverty); sensory-based feeding disorders in children with developmental disorders (eg, autism spectrum disorder); swallowing dysfunction; excessive milk or juice intake; not offered enough food or the right combination of healthy foods; celiac disease; food allergies

DIAGNOSIS

Poor gaining weight treatment start with the treatment of the underlying cause, a complete medical history, and physical examination is needed as well an investigation of any of the following is highly required: vomiting, diarrhea (swallowing, regurgitating), avoiding foods with particular textures (eg, hard or crunchy), which may be a sign of a problem with chewing/swallowing or a food aversion, avoids types or groups of food (eg, milk, wheat), which can be a sign of a food allergy or intolerance, drinks large amounts of low-calorie liquids, low-fat milk, or fruit juices, drinking these beverages may prevent the child from eating solid foods, which contain more calories, drinks large amounts of whole milk, which may lead to iron deficiency anemia.

Poor Weight Gain Treatment

Adequate nutrition to "catch up" to a normal weight is the main goal of underweight treatment. Catch-up growth may require changes to the child's diet, feeding schedule, or feeding environment. Healthcare clinicians should work together with caregivers to develop a plan that meets the needs of both the child and the family. Nutritional therapy is the primary treatment for children with poor weight gain. The goal of nutritional therapy is to enable "catch-up" weight gain, which is usually two to three times the normal rate of weight gain for the child's age. The best way to increase dietary energy (measured in calories) depends upon the child's age and nutritional status; individual recommendations should be determined by the child's healthcare clinician or dietitian.

For infants:

Fortified human milk by adding a predetermined amount of formula powder or liquid concentrate to pumped breast milk can increase the calorie content. adding less water to the powder or liquid concentrate or adding a calorie supplement, such as maltodextrin or corn oil is another method to increase the calorie content. In older infants, dietary energy intake (measured in calories) can be increased by adding rice cereal or formula powder to pureed foods.

For older children:

In older children, dietary energy intake (measured in calories) can be increased by adding cheese, butter, or sour cream to vegetables, or by using calorie-enriched milk drinks instead of whole milk. During catch-up growth, the amount of energy (measured in calories) and protein that a child eats is more important than the variety of foods eaten. For example, if a child is willing to eat chicken nuggets and pizza, but refuses all vegetables, this is acceptable. At meal and snack time, solid foods should be offered before liquids. Fruit juice should be limited to four to eight ounces of unsweetened 100 percent juice per day. The older child should eat often (every two to three hours, but not constantly). The child should have three meals and three snacks on a consistent schedule. Snacks should be timed so that the child's appetite for meals will not be.

Poor Weight Gain Follows Up

Children who are underweight are usually seen by their healthcare clinician on a regular basis after treatment begins; the frequency of visits (weekly to monthly) depends upon the individual situation. During these visits, the child will be weighed and measured, and the clinician will talk to the caregiver(s) (and child, if applicable) about any new or ongoing questions or concerns.

These frequent visits are usually continued until the child's weight is near normal and increases regularly. If the child can take in an adequate number of calories, catch-up weight gain is usually complete within three to six months. Many caregivers wonder how poor weight gain will affect the child's height and weight as an adult. A child's size as an adult depends upon several factors, including genetics, the age at which the child was underweight (eg, as a young infant versus toddler), the severity and duration of the malnutrition, the presence of underlying medical problems, and how successfully the child's weight and medical problems were managed.

METHODS

Study Design

Nutrition intervention is a vital part of underweight pediatric patient treatment, which leads to achieving normal weight, improving patient immunity, improve patient health and well-being. This is a hospital-based quality improvement project was conducted retrospectively from the outpatient pediatric dietetics clinic record, at AL-Khor hospital- AKH – Hamad Medical Corporation - HMC – state of Qatar. This project was conducted among all children with FTT and/or with mild, moderate, and severe underweight below fourteen years of age seen by the pediatric dietetic outpatient clinic at AKH between 1st January 2021 to 31st December 2021. AKH is a general hospital sited within the community, with dedicated pediatric and dietetic wards as well as outpatient services. Thus, the children seen have a spectrum of co-morbidities as they come from both community referrals as well as inpatient referrals.

Dietetic Follow-Up

The standard practice for dietetic intervention in children with failure to thrive is as follows: the physician refers the child to pediatric dietitian for targeted nutritional counseling. At the initial visit, nutritional assessment and advice are given to patients and/or their caregivers and a follow-up appointment is recommended two weeks later. At the subsequent follow-up visit, weight and length gain are evaluated. If the rate of weight gain is not meeting catch-up targets, additional assessment and counseling to address the likely causes are provided, and a two to four-week follow-up is then recommended. Conversely, if catch-up targets are met, a one to two-month follow-up is given. This scheduling protocol is followed until the child can achieve weight centiles that are within normal centiles. As frequent intervention may influence growth, considering follow-up frequency and adherence to dietary intervention are important variables in this project, we divided the patients into two groups to evaluate this: standard care versus intensive dietetic care. The intensive care group consisted of patients attending three or more dietetic visits over a twelve-month period; the standard care group consisted of patients who attended less than three visits over the same period.

Eligibility Criteria for The Selection of The Sample

The participants were eligible if they were between the age group of 1 and 14 years, diagnosed as mild, moderately, or severely underweight and/or failure to thrive, male & female. Pediatric patients with normal weight, overweight &/or obese, with a known history of systemic illness such as cardiac problems, renal problems, etc..., were excluded from the study.

Primary Outcome

The primary outcome of this project was to assess the effect of nutritional intervention on improving the nutritional status of malnourished and/or failure-to-thrive children. The nutritional intervention program was delivered by a clinical pediatric dietitian. It includes

health education and a demonstration of the protein-energy-rich meal plan. It also contained knowledge development on the management of malnutrition for mothers and caregivers at home.

Study Rationale

This project was conducted to improve and achieve the following goals: Patient will be able to catch up with his /her food intake according to his/her requirements through dietary intervention within the plan period, reduce the complications, improve the patient's quality of life, reduce outpatient referral and booking, save dietitians time, reduces admission rates, reduces costs. The nutritional status (exact nutritional requirements) of each patient was assessed by a pediatric clinical dietitian, who evaluates the patient's mother's knowledge of the importance to follow the dietary intervention. Deep, detailed & comprehensive nutrition education & counseling session(s) during the treatment duration were implemented. Patient/mother compliance and adherence to educational instructions and a specified nutritional meal plan were evaluated periodically in every follow-up visit. Body weight, height/length were measured to assess the nutritional status and risk of malnutrition. To our knowledge, the effectiveness of dietetic intervention has not been studied previously in the Gulf Cooperation Council (GCC), specifically in the state of Qatar. Therefore, we sought to evaluate the effect of the dietetic intervention and follow-up on children growth aged less than fourteen years. We hypothesize that more frequent dietetic intervention has a positive outcome on the growth centiles of children with failure to thrive, regardless of the cause.

Data Collection

The data was collected using structured instruments including: Age, Weight, Height/Length at the first visit and at the last visit, gender, Number of visits offered as well as attended by the patient. The compliance rate with visits is calculated as a percentage of the total number of offered visits, Length of follow-up, and Calorie and protein intake at the first and final visit. Estimated calorie and protein requirements at each visit. Weight was taken using a Seca 757 baby scale (accurate to two decimal places). Length measurements were taken using a Seca 416 Infantometer, which measures a child's lying position. These measures were plotted on standard growth curves, together with all past measurements of weight and length since birth, to determine if the child was growing appropriately. Z-scores of these parameters were obtained by comparison with the WHO charts. The 24-hour Diet Recall (24-HDR) was used to obtain an estimate of the typical dietary intake. Although this method is subjective, it has been recognized as an acceptable short-term assessment of dietary intake in several studies [15]. It is quick to administer and can provide detailed information on foods [16,17]. Estimations of calorie and protein intakes based on the 24-HDR were calculated at each visit. Estimated calorie requirements were based on this formula [18] $\text{kcal/kg} = (120 \times \text{ideal weight for height (kg)}) / (\text{actual weight (kg)})$. Estimated protein requirements for 'catch-up' growth were calculated at approximately 9% of energy requirements [19].

Statistics

SPSS for Windows (version 20) was used. All the variables (age, gender, number of visits to the dietitian, compliance with offered visits, presence of multidisciplinary team intervention, meeting of calorie target at first visit, meeting of protein targets at first visit, meeting of calorie targets at final visit, meeting of protein targets at final visit) were input into the regression analysis. Chi-square tests were used in accordance with the distribution of data points to

compare baseline data and primary and secondary outcomes between standard care and intensive dietetic intervention groups.

Ethics

This study was approved by the AL-Khor Hospital quality review board.

RESULTS

A total of 17 patients that met the inclusion and exclusion criteria and were seen by dietitians between 1st January 2021 to 31st December 2021 were included in the study. Table 1 shows the baseline characteristics of the study cohort.

Table 1: Baseline characteristics of the study cohort (n = 17)

Characteristics	Study cohort (n = 17)
Gender	
Male	52.9 %
female	47.1%
Mean age at the first visit to the dietitian (years)	4.30±1.12 (range:0.8-11.5)
Initial mean weight z-scores at the first visit (Kg)	-13.40±1.16
Initial mean height z-scores at the first visit (cm)	- 95.65±1.41

Table 2: Baseline Characteristics of Standard Care versus Intensive Intervention Groups.

Characteristics	Standard Care <3 visits (n=17)	Intensive intervention ≥ 3 visits (n=17)	P- value
Gender			
Male	52.9 %	67.4 %	0.023
Female	47.1%	32.6%	
The average age at first visit (years)	5.21 ± 1.12	6.23± 1.51	0.12
The average number of visits to the dietitian	1.82± 0.75	3.6± 1.62	0.031

The overall mean change in z-scores per visit for Weight in the study population is 0.069 ± 0.158. At the initial dietetic visit, 7 of 17 patients (41.2%) met their calorie intakes measured against their requirements. Only 11 of 17 patients (64.7%) visited the dietitian at least a second time, allowing calorie intake to be reassessed; of these 11 patients, all of them met the calorie requirements, all patients had at least two measurements; while 6 of 17 (35.3%) patients did not have a second measurement due to poor adherence to dietary intervention.

The Impact of Dietary Intervention on Food Intake and Nutritional Status

Changes in the adequacy of the dietary intake of the participating patient were reported. This information is converted intake in kilocalories per day for comparison with the results of dietary intervention efficacy. The energy requirement of each patient per actual weight / versus energy requirement per ideal weight was calculated to evaluate if they received adequate intake or not. It was found a significant difference between the energy requirements / actual weight versus the energy requirements / ideal weight Figure 1. Based on this finding dietary intervention is done to increase the energy intake to achieve the ideal weight. Body weight increase was positively correlated to the calorie increments but didn't reach the significant level of $p < 0.05$. Weight increases ranged from (0.5 – 2.7 %) of the child's weight at the first

visit while energy increases ranged from (100 – 700 kcal /day, (14 -50 %) of energy requirements for weight gain. figure 1.

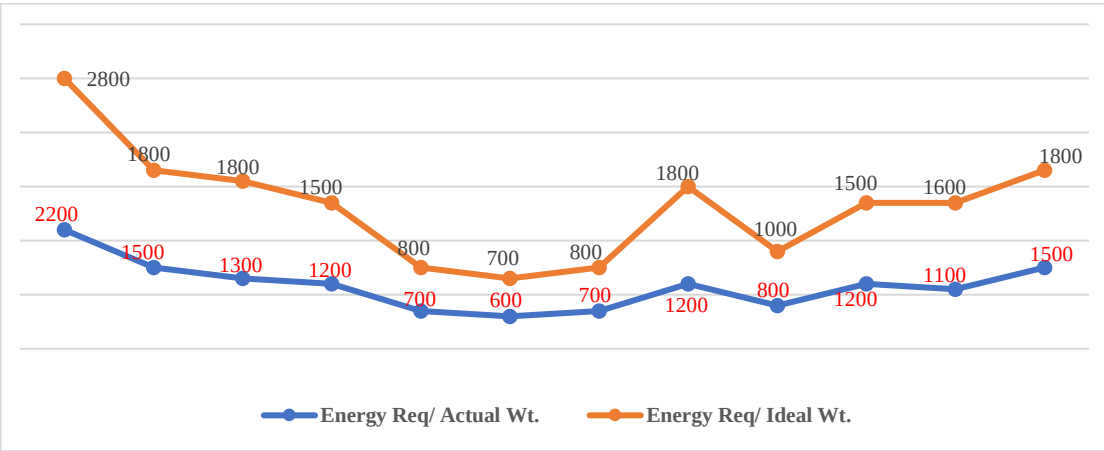


Figure 1: Energy requirements/ actual weight versus energy requirements/ ideal weight

Figure 2 shows the differences in outcomes between the patients who received intensive intervention against those who received standard intervention. The compliance rate in the intensive intervention group was significantly higher, ($P=0.010$) than in the standard care group. The average change in weight was also significantly correlated with compliance rate (number of follow-up visits) Figure 3. A positive but not significant relationship was noticed between the energy increment and weight increment figure 4.

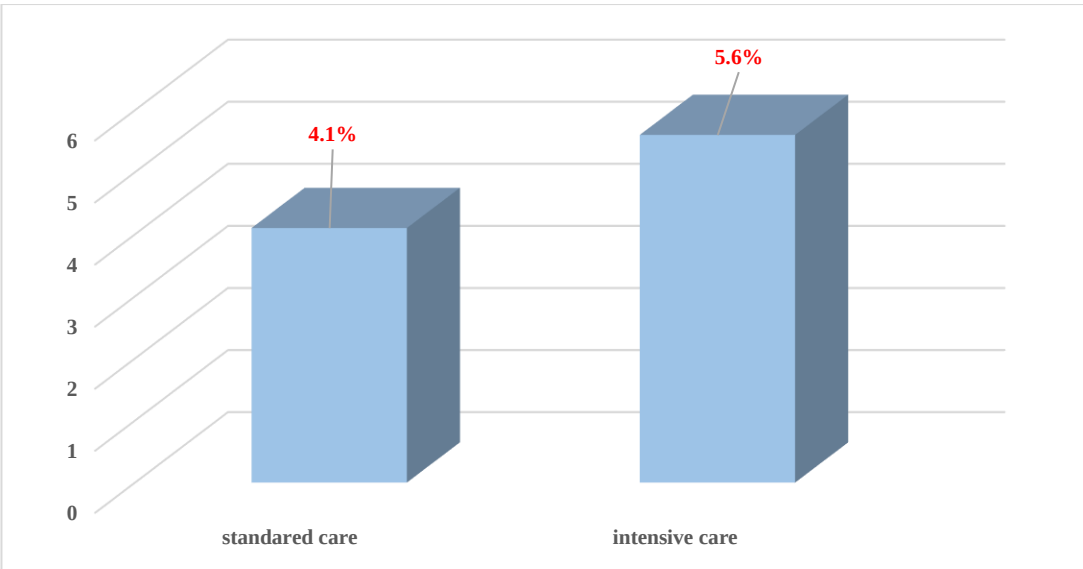


Figure 2: differences in outcomes between intensive intervention against standard intervention

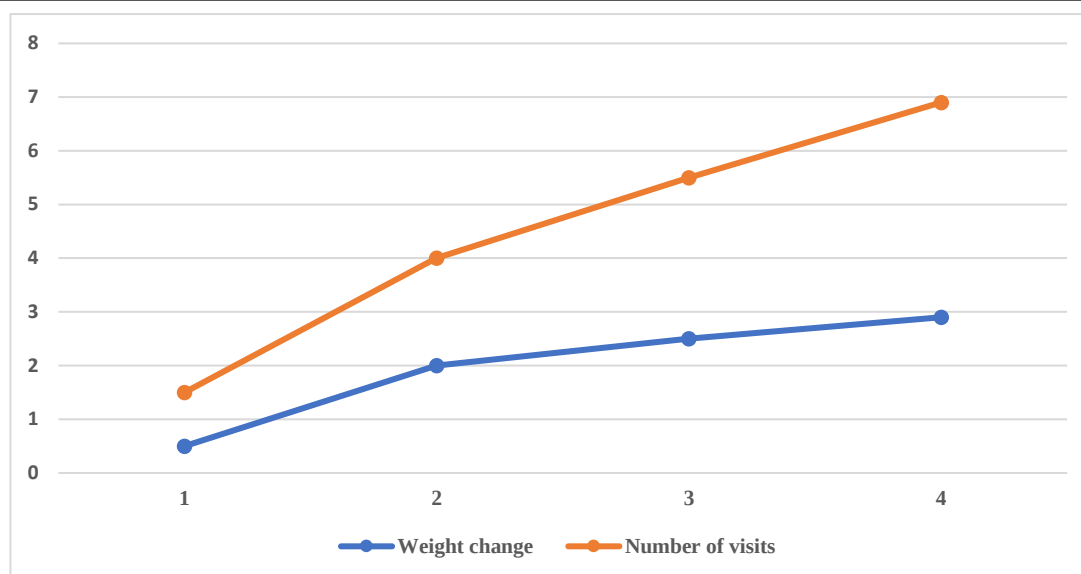


Figure 3: Weight change and number of follow-up visits

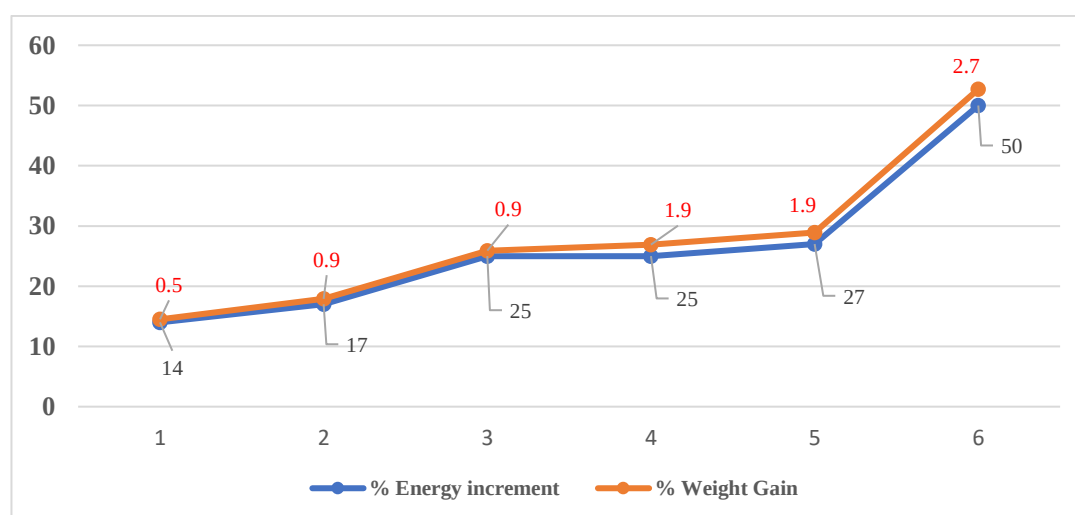


Figure 4: Relation between energy increment and weight gain

DISCUSSION

Nutrition interventions may be critical for the well-being and nutritional status of infants, children, and adolescents. Nutrition interventions alongside sustainable programs aimed at preventing infectious diseases, improving immunity, and overall health of children including psychological health. In addition, providing mothers and caregivers with education on the timely introduction of healthy and nutritious foods is crucial for supporting the health of children aged 0–14 years [20,21]. Young children seen by a pediatric dietitian over a twelve-month period had significantly improved weight. There is a common consensus that the treatment of FTT requires a multidisciplinary approach, which includes the involvement of a nutritionist or pediatric dietitian [22-24]. Multidisciplinary teams with the inclusion of a dietitian have been shown to be effective in improving weight gain in children with low birth weight or faltering growth [25-27]. There was a difference in weight velocity increase between patients; this difference was insignificant, which may have been due to the small sample size

rather than the true absence of a difference. This increase in weight difference was also similarly reported by Hobbs and Hanks [28].

The patients that specifically had comorbidities such as cardiac, renal, or endocrine may require extra calories and protein for catch-up weight and height gain. Control of the medical condition is important, especially where it is known to affect growth, which is dependent not only on provided nutrition but also on anabolic hormones, oxygen-carrying capacity, and absence of metabolic acidosis, in which any or all of which can be deranged in the above areas. This is exemplified in chronic kidney disease, which leads to multiple physiologic derangements that impair growth: anemia, metabolic acidosis, hyperparathyroidism, and vitamin D deficiency as examples. Multidisciplinary team review was a significant predictor of improved weight z-scores over time on multiple regression analysis.

This trial showed that nutrition counseling delivered in outpatient facilities was associated with improved child weight gain. The nutrition advice in the studied group was found to be surprisingly adequate, a fact that is possibly due to the high level of attention given to child health and nutrition. The study design allowed the measurement of the sequence of events that led to improved nutrition. The generic nutrition counseling guidelines were carefully adapted to the local environment and household trials allowed the identification of acceptable, affordable, and feasible recommended foods. However, the adherence to the dietary intervention which includes intake of food amount, energy density, and intake of proteins tended to be higher in the intensive care group than the standard group, this could possibly explain the improvement variation in weight gain.

The results show that nutrition-counseling and dietary intervention improved mother practices and some aspects of the diets and growth of children. Nutrition counseling may have improved diets in ways that were not directly measured in this study, for example, mothers may become more aware of the importance of nutrition in general, including the role of dietary diversity and of appropriate feeding behaviors. The fact that improvements in weight gain were observed mostly in children in the intensive care group. The congruence of these data suggests that supervision and continuing education of patients and their healthcare providers are needed as part of dietary intervention success. The reported use of recommended foods was significantly higher in the intensive intervention group than in the standard intervention group. This reported adherence to dietary recommendations was consistent with the information provided through 24-h recall [29]. There are some limitations to this study, as this was a retrospective study with data derived from a review of medical records, there were some limitations as to the data available. This, therefore, limited the width and depth of the analysis that could be performed, which would have shed more useful information on the outcomes, as growth velocity is multifactorial, and this has been shown in the literature. There were four major areas where limited data led to limitations on analysis and interpretation: further information on the sociodemographic background of each patient; information on the duration of breastfeeding, the efficiency of feeding, and type of feeding difficulty (if present) in each patient would be desirable; information on the exact type, severity, control and complications of comorbid medical conditions where present in each patient. There was no comparison group of children with FTT who did not see a dietitian and continued other routine medical care, and therefore it is not possible to measure the difference when there is dietetic intervention versus none.

CONCLUSION

Dietetic intervention is of benefit to FTT patients. More frequent dietary supervision confers more benefits for weight gain. Multidisciplinary team intervention and control of underlying medical illnesses may provide additional improvement in growth, but more research on a larger scale is needed in this area. A prospective study with a larger sample size, involving young children with FTT with detailed sociodemographic and medical information should be conducted. Overall, there is a need for more standardized guidelines for nutrition interventions delivered for FTT patients.

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