Clinical Article

Effect of Nutritional Intervention on Physical Growth in Children at Risk of Malnutrition

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Abstract

This 4-month study evaluated the effects of oral nutritional supplementation and dietary counseling on the growth and nutritional status of an outpatient pediatric population at risk of malnutrition. A total of 174 subjects, aged 12 months to 10 years, received a daily nutritional supplement (Rinforza™) and nutritional counseling was provided to their parents. Almost all patients (97%) had dietary intake at baseline that was insufficient or slightly insufficient/not well balanced. Following 4 months of nutritional intervention, adequate intake was observed in 72% of patients. The percentage of subjects with weight-for-height below the 25th percentile decreased from 56% at baseline to 45% after 2 months and 42% after 4 months of nutritional intervention. These differences were statistically significant at 4 months (p=0.007) but not at 2 months. Similarly, the mean weight-for-height percentile for all subjects increased from 27.6 at baseline to 29.1 after 2 months (p=0.084) and 33.9 after 4 months (p<0.001). The results of this study indicate that nutritional supplementation, together with nutritional counseling, can improve food intake and growth in children at risk for malnutrition.

Key words: enteral nutrition, child nutrition, diet, nutrition, nutritional status

Introduction

Nutritional surveys of the pediatric populations of Western countries reveal deficiencies in some nutrients, but cases of primary malnutrition are rare. In these countries, it is more common to find malnutrition secondary to an underlying disease.1-6 For instance, malnutrition or significant risk of malnutrition may be present in children with chronic hyporexia (low appetite), that can be multifactorial in origin. Many children who exhibit eating difficulties have a recent or past history of organic problems (developmental delay or chronic illness).7

Subclinical malnutrition may be present but mostly undetected or neglected in small groups of disadvantaged healthy children of low socio-economic conditions, as confirmed by nutritional surveys of the pediatric population in both the USA and other developed countries.8 Mild protein-energy malnutrition may be associated with micronutrient deficiency (mainly iron deficiency) and subsequent nutrition-related disorders (anemia, learning failure, etc.) as well as growth retardation.8,9

Periods of variable duration characterized by poor appetite, inappropriate foods for age, and/or food refusal are observed in healthy children. Children with eating problems are a common concern of parents and the severity of these findings vary widely, from failure to gain weight and height to loss of body weight.10-12 Children who are unable to maintain adequate energy and nutrient intake require modifications in their feeding habits and oral nutritional supplements may be indicated and effective.13 Food and nutrition programs may help to achieve the goal of providing safe and healthy nutrition for these children and adolescents.14,15 These programs can comprise additional feeding with a nutritional supplement and/or increased intake from regular food following guidelines provided by dietary recommendations.

Rinforza® (PediaSure®) is an enteral feeding product designed to provide complete, balanced nutrition to meet the growth needs of children 1 to 10 years of age. It is nutritionally balanced and contains high quality protein, vegetable oil, essential fatty acids, carbohydrates, vitamins, and minerals as recommended by guidelines of the National Academy of Science National Research Council (NAS-NRC). The aim of this study was to evaluate the effects of oral nutritional supplementation with Rinforza® and dietary counseling on the nutritional status and behavior of an outpatient pediatric population at risk of malnutrition.

Methods

Subject Enrollment

Children 12 months to 10 years of age, who were at risk of malnutrition, were included in this study. Children enrolled in the study if they had weight-for-height <25th percentile (National Center for Health Statistics (NCHS)); decreased energy and nutrient intake correlated with poor appetite, weakness lasting for at least 3 months, and/or <5% decrease in habitual body weight;
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or pulmonary (bacterial or viral pneumonia) or urinary tract infections (UTI), with possible unfavorable effects of ongoing infectious episodes on the subject’s appetite.

Subjects were excluded from the study if they had a history of preterm delivery, diagnosis of neoplastic disease, metabolic disorders, HIV infection, presence of severe gastrointestinal disorders, anorexia nervosa, food allergy, or disorders of hemoglobin structure, function, or synthesis.

The study was conducted by 170 family practitioners in Italy between April 1999 and July 2000. The protocol was approved by the Institutional Review Board at each site and the study was conducted in accordance with the Declaration of Helsinki and Good Clinical Practices. The subject’s parents or legal guardian gave written informed consent before enrollment.

Treatments and Evaluations

Children were evaluated for dietary intake and nutritional habits, previous nutritional interventions, and ongoing drug therapy at baseline. Total dietary intake was evaluated by 24-hour recall and was classified as insufficient (<90% of Italian Recommended Dietary Allowances [LARN]); slightly insufficient and/or not balanced (90-100% of LARN with inadequate intake of carbohydrates or proteins, fruit and vegetables [<3 serving sizes/day]); sufficient and well balanced (100-120% of LARN); or high: (>120% of LARN).

Nutritional supplementation (Rinforza® [PediaSure®], Abbott Italy SpA) was administered to supply at least 16% of kcal LARN for age (Table 1). The supplement was prepared by mixing 50 g of powder per 200 mL of water or whole milk and was administered daily for 4 months. The supplement is comprised of 12% protein, 44% carbohydrate, and 44% fat. A 50 g serving provides 246 kcal and at least 25% of the National Academy of Sciences Recommended Dietary Allowances (RDA) for children 1 to 6 years of age.

Subject’s families were provided with dietetic counseling in the form of written recommendations at baseline (Table 2). These recommendations were discussed with the subjects’ parents and this nutritional counseling was reinforced at the follow-up visits.

Subjects returned for follow-up visits at 1, 2, 3, and 4 months. At these times compliance with supplement intake and other nutritional habits were assessed and dietary counseling was provided. Anthropometric parameters (height and weight) were measured at baseline and at the follow-up visits.

Statistical Methods

Anthropometric data weight-for-height percentiles were calculated by Anthro 1.02, Centers for Disease Control (CDC), Department of Nutrition, Atlanta, GA, USA. Statistical analysis was performed by the chi-square test for heterogeneity for categorical variables and by paired t-test for continuous variables. The standard value of \( p \leq 0.05 \) was considered as statistically significant. In cases of multiple comparisons, the Bonferroni’s rule was used, dividing the standard p-value (0.05) by the number of comparisons performed (for baseline data vs. month 2 and month 4) to obtain the new value of \( p \leq 0.025 \) as threshold limit of significance. All tests were two-tailed.

Results

A total of 88 males and 86 females with a mean age 56.8 months were enrolled in the study. Chronic low appetite (hyporexia) for at least 3 months prior to baseline was noted for 168/174 (96%) subjects (Table 3). Almost all subjects (169/174; 97%) had dietary intake at baseline that was insufficient or slightly insufficient/not well balanced (Table 4).

At time of enrollment, 8 patients presented an acute infectious disease: 5 pneumonias and 3 urinary tract infections. All episodes healed within the first month of follow up with appropriate antibacterial therapy.

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Recommended amount of supplement per day*</th>
<th>Proportion of LARN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Energy (kcal)</td>
</tr>
<tr>
<td>1-3</td>
<td>50 g</td>
<td>16%</td>
</tr>
<tr>
<td>4-6</td>
<td>70 g</td>
<td>18%</td>
</tr>
<tr>
<td>≥7</td>
<td>100 g</td>
<td>22%</td>
</tr>
</tbody>
</table>

* Supplement was prepared by mixing 50 g powder per 200 mL milk or water.
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The supplement was prepared with water for 73% of subjects, whole milk for 25% of subjects, and orange juice or other liquid for the remaining 2% of subjects. Mean daily intake of the supplement was 50 g (95% CI: 47-54), which supplied 246 kcal (1028 kJ). Together with increased caloric intake from other foods, this resulted in adequate energy intake (at least 100% of LARN) in 126/174 (72%) subjects at the end of the study. The majority of children (137/174, 78%) found the formula agreeable to the taste and complied with the physician's intake prescriptions.

Anthropometric measurements showed that at the baseline assessment 56% (98/174) of subjects had a weight-for-height below the 25th percentile. This decreased to 45% (78/174) after 2 months of nutritional intervention and to 42% (73/174) after 4 months. The differences were not statistically significant between baseline and 2 months (p=0.042), but were statistically significant between baseline and 4 months (p=0.007). Similar changes were observed for the mean weight-for-height. The mean weight-for-height percentile for all subjects increased from 27.6 at baseline to 29.1 after 2 months (p=0.084) and 33.9 after 4 months (p<0.001).

There was a notable improvement in the children’s nutritional habits during the study. A total of 126 children had poor nutritional intake at baseline compared with 48 children at the end of the study.

No adverse events or episodes of gastrointestinal intolerance were reported during the study.

Discussion

This study demonstrates the efficacy of nutritional intervention in a pediatric population at risk of malnutrition. Both the subjects and their families showed good compliance with the planned nutritional intervention (oral supplementation plus dietetic counseling). The increased quantity of energy and nutrients consumed over the 4-month treatment period resulted in significant weight gains. Since nutritional intake from sources other than the supplement were not measured, it was not possible to determine how much of the improvement in growth could be attributed to supplement intake and how much to nutritional intake from other sources. However, the role of dietetic counseling provided by the pediatrician during monthly visits should not be underestimated since this presumably contributed not only to weight gain, but also to a marked improvement in the subjects’ nutritional habits.

In children with eating problems, oral supplementation may be easier and more effective than trying to increase regular food intake. However, even oral nutritional supplements are often not appreciated by children who are fussy eaters. The majority of subjects in this study accepted the nutritional supplement with pleasure. In our experience children usually prefer powdered products to liquid supplements, possibly because of the unpleasant taste associated with highly processed liquid foods.
This study was not designed to provide socio-economic profiles of the enrolled subjects, nor did it include a prolonged follow-up. However, our results show that even in the absence of disease, improved weight gain in children can be supported by well-balanced nutritional supplements together with nutritional counseling. Further studies are necessary to better understand and evaluate eating problems in children.

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References


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