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# The Effect of Nutritional Consultation on the Level of Malnutrition and Growth Indices in Children with Cystic Fibrosis

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***Abstract***

***Background:*** Malnutrition is one of the most common disorders among children with Cystic Fibrosis (CF). The present study aimed to investigate the effect of nutritional consultation on the type and severity of malnutrition in children with CF.

***Materials and Methods:*** This quasi-experimental study was conducted on 78 children with CF referred to Mofid Pediatric Hospital, Tehran, Iran, in 2017-2018. Their parents filled the demographic questionnaire. Participants with malnutrition were undergoing the assessment on growth indices, including weight, height, ideal body weight, mid-upper arm circumference, and Z-score. Moreover, the nutritional consultations were considered for them (30-45 minutes). Children and their parents were consulted and trained about total daily calorie acquirement, type, number of the meal, amount of food intake, drinks, and avoided eating of any low-calorie food like snacks, during the consultation. All patients were reassessed three months later for growth indices. The data were analyzed using SPSS software version 22.0.

***Results:*** We assessed 78 children with CF, 21 (26%) of them had mild, 26 (34%) moderate malnutrition, and 31 (40%) severe malnutrition. The result showed that nutritional intervention was effective. Consequently, 1 (3.8%) of the moderately malnourished child was improved to mild malnutrition and 5 (27.8%) children under five years old were improved from severe to moderate malnutrition. Moreover, 1 (5.6%) child were improved from severe to mild, and 2 (15.4%) of children over five years old were improved from severe to moderate malnutrition.

***Conclusion:*** According to the results, the early growth assessment in hospitalized and outpatient, diagnosis of malnutrition and nutritional intervention will be useful in improving the severity of malnutrition and growth indices in children with CF.

***Key Words:*** Children, Cystic fibrosis, Malnutrition, Nutrition Assessment.

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## 1- INTRODUCTION

Cystic Fibrosis (CF) is one of the most common life-threatening disorder with multi-organ involvement. The incidence rate is 1.67–2.98 in 10,000 live births per year in the United States and 1 in 100,000 in Iran (1-3). The CF was first identified in the 1970swhen the potential of the immune reactive trypsinogen assays for early identification of infants with CF was developed (4). The etiology of this autosomal recessive disease is 1000 mutations of the CF Transmembrane conductance Regulator (CFTR) gene (5). CF is characterized by digestive, hepatobiliary, and respiratory dysfunction, including chronic respiratory infection, progressive lung tissue damage, and chronic diarrhea with generalized malabsorption contributing to growth deficits and premature mortality (6-9).

The spatial pattern of pediatric malnutrition is clustered (10). Frequently, children with CF grow slower and enter puberty later compared to their peers (11). Early diagnosis of malnutrition is crucial and frequently used as a red flag for the imminent clinical deterioration, which requires immediate intervention (12, 13). Researchers found that the prevalence of malnutrition (i.e., inadequate intake, inadequate absorption, increased requirements) among children with CF is increasing (14-16).

In children with CF maintaining normal nutritional status is often tricky for their own/their parents and has a direct effect on their prognosis and survival. Therefore, appropriate intervention is vital for health care systems (8, 17, 18). The literature consists of four types of intervention for improving nutritional status in children with CF: nutritional consulting and behavioural intervention, oral supplementation, enteral nutrition, and parental nutrition (19). Choosing the appropriate nutritional intervention can be initiated at an early stage. The nutritional consultation and behavioural intervention are more effective in improving malnutrition in patients with CF compared to invasive medical procedures (20). Nutritional consultation and behavioural intervention aim to modify the type of meal and parent-child mealtime interaction based on the social learning theory of behaviour. The objective of the behavioural intervention is to train the parents and children to increase calorie consumption in children (21). In this study, we used the best guideline for a nutritional consultation to investigate its effect on the severity of malnutrition and growth indices in children with CF, which is the most important reason for referral Pediatric hospital in Iran.

## 2- MATERIALS AND METHODS

### 2-1. Study Design and Population

This quasi-experimental before/after the study was conducted on a single group of 78 children with two months to 18 years old who suffered from CF referred to Mofid Children Hospital in 2017-2018. The total number of children with CF, which enrolled in our study, was 110. Participants were selected by purposive and convenience sampling method. Finally, 78 patients came back to the nutrition clinic.

### 2-2. Exclusion Criteria

Children with CF who had hypothyroidism, cardiac dysfunction, kidney disease, short bowel syndrome, and respiratory involvement were excluded.

### 2-3. Measuring Tools: Laboratory measurements

In the next step, children's parents filled out a demographic questionnaire. Afterwards, the pediatric gastroenterologist or pulmonologist visited children with malnutrition who referred to the pediatric nutrition clinic. Pediatrics with Ph.D. of nutrition assessed growth

indices included weight, height, Ideal Body Weight (IBW), Mid Upper Arm Circumference (MUAC), weight/length, Bone Mass Index (BMI), Z-score, and percentile using the tap meter, height scale (SECA model, Germany), and weighted (SECA digital weight scale with 10 gr standard error, made in Germany.

**2-4. Intervention**

The research objective was investigating the effect of nutrition consultation on the type and severity of malnutrition. The severity of malnutrition (wasting or stunting) is defined by comparing a child's weight and height measurements with those of the standard population. The World Health Organization (WHO) developed population growth standards in 2006; these describe average child growth from birth to five years from a variety of populations, under optimal environmental conditions. The individual's weight-for-height and height-for-age relative to the population mean was expressed as Z-scores (22).

Besides, MUAC is an accurate and sensitive method to screen for malnutrition. The advantages of the MUAC compared to weight-for-length Z-scores are the better prediction of mortality and more comfortable to perform, which is not affected by dehydration. Although cut off point <115 mm remains the standard for all age groups, one study suggests that higher cutoffs based on age group may better capture the vulnerability and risk of severe and moderate wasting. This study defined the following cutoffs for MUAC. These criteria are based upon the degree of wasting, stunting, and the presence of edema, which are not mutually exclusive. The diagnostic criteria for children with 6-59 months are:

- **Severe Acute Malnutrition**:
  - MUAC <115 mm, or
  - Weight-for-length Z-score <-3, or
  - Bilateral pitting edema.
- **Moderate Acute Malnutrition**:
  - MUAC 115 to 124 mm, or
  - Weight-for-length Z-score -2 to -3.
- **Stunting** (indicates chronic malnutrition):
  - Moderate stunting – Height or length Z-score -2 to -3
  - Severe stunting – Height or length Z-score <-3.

The second research phase involved implementing education and nutritional consultation. Therefore, all malnutrition CF patients were evaluated by taking a careful history and completing a questionnaire form to estimate their daily calorie and nutrient intake. Then nutritional consultation and intervention were provided for them. During the nutritional consultation, patients and parents trained about total daily calorie acquirement, type, number of meals, amount of food intake, drinks, and avoided eating of any low-calorie food like snacks.

The duration of each consultation was 30-45 minutes, according to the patients' condition. The consultation was carried out according to the European Society for Clinical Nutrition (ESPEN) guideline (**Table. 1**) (23). The ESPEN is an experts' panel that alternatively launched a process of developing updated guidelines on nutritional care for infants, children, and adults with CF (23, 24). This society includes physicians, dietitians, educators, and all experts in the field of CF. Thus, this is one of the best nutritional guidelines for children with CF. The final data-gathering phase involved the assessment of growth indices with the same scale and meter after at least three months after the intervention. All patients reassessed three months later.

**Table-1**: Guidelines for Intervention(24).

| W/L Children infant to 18 years | Nutritional Status | Nutritional intervention |
|---|---|---|
| 0 < Z- score ≤ -1 | Normal and Mild nutritional status | Preventive nutritional counseling |
| Z- score < -1 | Moderate impaired nutritional status | Preventive nutritional counseling and Diet modification |
| Z- score ≤ -2 | Severe impaired nutritional status | Preventive nutritional counseling and Diet modification and oral nutrition supplements |

### 2-5. Ethical Consideration

The purposes of the intervention were explained for parents. Afterwards, the parents completed informed consent. Moreover, the ethical committee of Shahid Beheshti University of Medical Sciences with the ethics code of (IR. SBMU approved the study. MSP.REC.1395.94); then, permission for investigation was obtained from the head of departments.

### 2-6. Data Analyses

The data was entered into SPSS V.22.0 and was then statistically analyzed. Normality of data distribution was assessed using the Kolmogorov-Smirnov. All descriptive data had a normal distribution. Therefore, the results for the quantitative variables were reported in the mean ± standard deviation (SD) format and the ordinal qualitative variables were reported in frequency and percentages. The Paired T-test was used to compare the quantitative variable. The levels of p-value and confidence coefficient were considered 0.05 and 95%, respectively.

## 3- RESULTS

Seventy-eight children with CF were enrolled in this quasi-experimental study, including 50 (64.1%) males. The minimum, maximum, and the mean of age were two months, 18, and 5.5 years, respectively. Forty-two of them (53.82%) were under five years, and the mean of diagnosis and follow up time was 14.5 and 3.8 months, respectively (**Table. 2**). At the beginning of the study, among 78 patients with CF, 21 (26%) had mild malnutrition, 26 (34%) had moderate malnutrition, and 31 (40%) had severe malnutrition. Moreover, 42 were under five years old, and 36 were over five years old. Among children under five years, 16 (38%) had mild malnutrition, 8 (19%) had moderate malnutrition, and 18 (43%) had severe malnutrition. Additionally, among the patients with five years old, 5 (14%) had mild malnutrition, 18 (50%) had moderate malnutrition, and 13 (36%) had severe malnutrition.

**Table-2:** Sings and Symptom of Participants across to Group of Study, n=78.

| Variables | Sub-group | <5 year Number (%) | >5 year Number (%) | Total Number (%) |
|---|---|---|---|---|
| Gender | Male | 26(60.5) | 24(64.9) | 50(62.5) |
| | Female | 17(39.5) | 13(35.1) | 30(37.5) |
| Family history | Positive | 4(9.5) | 2(5.6) | 6(7.5) |
| | Negative | 38(90.5) | 34(94.4) | 72(92.5) |
| Appetite | Good | 30(71.4) | 26(68.4) | 56(70.0) |
| | Bad | 11(26.2) | 11(28.9) | 22(27.5) |
| Abdominal | Bloating | 1(2.4) | 2(5.3) | 2(2.5) |

| | | | | |
|---|---|---|---|---|
| Discomfort | Pain | 1(2.4) | 8(21.1) | 9(11.3) |
| | Bloating and Pain | 3(7.1) | 3(7.9) | 6(3.8) |
| | No | 34(81.0) | 25(65.8) | 59(73.8) |
| Steatorrhea | Positive | 13(31.0) | 8(21.1) | 21(26.3) |
| | Negative | 29(69.0) | 30(78.9) | 59(73.8) |
| Meconium ileus | Positive | 4(9.5) | 3(7.9) | 7(8.8) |
| | Negative | 38(90.5) | 35(92.1) | 73(91.3) |
| Constipation | Positive | 3(7.1) | 8(21.1) | 11(13.8) |
| | Negative | 39(92.9) | 30(78.9) | 69(86.3) |
| Nausea | Positive | 5(11.9) | 1(2.6) | 6(7.5) |
| | Negative | 37(88.1) | 37(97.4) | 74(92.5) |
| Vomiting | Positive | 2(4.8) | 1(2.6) | 3(3.8) |
| | Negative | 40(95.2) | 37(97.4) | 77(96.3) |
| Diarrhea | Positive | 5(11.9) | 5(13.2) | 10(12.5) |
| | Negative | 37(88.1) | 33(86.8) | 70(87.5) |

According to the result in **Table. 3**, seven (22.6%) of severely malnutritioned children have improved to moderate malnutrition after the intervention. Also, one (3.8%) of the moderately malnourished child has improved to mild malnutrition. The finding showed that the effect of the intervention on the treatment of malnutrition was practical. On the other hand, five (27.8%) of children under five years old have improved from severe to moderate malnutrition. Also, one (5.6%) of them has improved from severe to mild too. Additionally, two (15.4%) of children over five years old, has improved from severe to moderate malnutrition. According to the results in **Table. 4**, there was a significant difference between the mean score of weight, height, and MUAC before and after the intervention among children under five years old ($P<0.05$). Also, there was a significant difference between the mean score of weight, height, and MUAC before and after the intervention among children over five years old ($P<0.05$).

**Table-3**: Comparison severity of malnutrition between under and over the Age of 5 years.

| Age | Sub-group | Z-score (after ) | | | Total |
|---|---|---|---|---|---|
| | | Mild | Moderate | Sever | |
| Under the Age of 5 years old | Mild | 12 (75.0) | 3 (18.8) | 1 (6.3) | 16(100.0) |
| | Moderate | 1 (12.5) | 6 (75.0) | 1 (12.5) | 8 (100.0) |
| | Severe | 1 (5.6) | 5 (27.8) | 12 (66.7) | 18 (100.0) |
| | Total | 18 (33.3) | 35 (33.3) | 25 (33.3) | 42 (100.0) |
| Over the Age of 5 years old | Mild/Negative | 4 (80.0) | 1 (20.0) | 0 | 5 (100.0) |
| | Moderate | 0 | 18 (100.0) | 0 | 18 (100.0) |
| | Severe | 0 | 2 (15.4) | 11 (84.6) | 13 (100.0) |
| | Total | 4 (11.1) | 21 (58.3) | 11 (30.6) | 36 (100.0) |

**Table-4**: Comparison severity of growth indices between population under and over the Age of 5 years.

| | <5 years | | | >5 years | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| Variable name | Before Mean (SD) | After Mean (SD) | P-value | Before Mean (SD) | After Mean (SD) | P-value | Before Mean (SD) | After Mean (SD) | P-value |
| Weight (kg) | 9.82(4.39) | 10.66(4.00) | <0.001 | 25.29(11.66) | 26.18(11.63) | <0.001 | 16.96(11.50) | 17.82(11.43) | <0.001 |
| Height (cm) | 79.05(17.52) | 81.94(16.87) | <0.001 | 125.81(15.96) | 127.40(15.88) | <0.001 | 100.64(28.80) | 102.92(28.4) | <0.001 |
| BMI | 14.64(2.06) | 14.73(2.14) | .564 | 15.35(4.32) | 15.56(4.26) | .023 | 15.9(3.65) | 15.25(3.63) | 0.04 |
| MUACA | -1.65(1.44) | -1.32(1.60) | .002 | * | * | * | -1.65(1.44) | -1.32(1.60) | .0020 |

SD: Standard deviation, BMI: Body mass index, MUAC: Mid-upper arm circumference.

## 4- DISCUSSION

The present study showed the severity of malnutrition and growth indices improved after the nutritional intervention. This study supported previous research (25-27) on the efficacy of interventions for improving the severity of malnutrition in children with CF. Furthermore, in the current study, the growth indices of the children before and after the intervention were significantly improved. It is possible to obtain a significant difference in linear growth parameters before and after intervention across one group since we used appropriate specific CF diet-related one-on-one training techniques, educating the subjects at their own homes. Saleem et al. 's study showed that educational interventions about appropriate feeding to mothers had a direct positive effect on linear growth of their infants (28). Jin et al. 's study showed that post-surgical parenteral nutrition could significantly improve the severity of nutritional status in participants with gastric cancer (29). Moreover, Schuetz et al. 's study concluded that the use of individualized nutritional support during the hospital stay could improve clinical outcomes and survival compared to standard hospital food (30). Cano et al.'s study revealed that nutritional intervention and dietary consultation could decrease hospital stay (31, 32). Several studies have highlighted the advantages of nutritional consultation on disease outcomes and severity of malnutrition among children. Ling Shi et al.'s study showed that educational intervention on nutritional behaviours leads to substantial behavioural changes of caregivers and also improves infant growth (33). Shi and Zhang's study showed that educational intervention could effectively improve complementary feeding practices. Also, they stated that the educational intervention could improve child nutrition and growth status. They underline that educational intervention should be integrated, accessible, and culturally sensitive with local resources (34). Indeed a systematic review on the effect of maternal education about feeding and provision of foods in developing countries showed education and maternal nutritional consultation leads to the significant increase in weight and height of children with 6-24 months old (35). Vazir et al. 's study showed that community-based nutritional-educational interventions could improve dietary intake, length, and mental development in Iranian children under two years (36). Thus, nutritionists have a crucial role in preventing and treating malnutrition in all of the children. Therefore, they have played an essential role in the improvement of the nutritional status of CF children (23). Nutritional education should be a specific approach.

Inayati et al. 's study showed a level of knowledge and practice of caregivers of mildly wasted children in Nias Island and Indonesia was significantly better compared to general nutritional education (37). The present study supports previous research on the efficacy of nutritional interventions for improving the severity of malnutrition in children with CF.

### 4-1. Study Limitations

The limitations of the study were failure to cooperate and refer parents to the clinic on time to evaluate growth and loss of control group.

## 5- CONCLUSION

Nutritional interventions were effective in improving the severity of malnutrition and growth indices among Iranian children with CF. On the other hand, these findings support continued research on nutritional intervention on the participants with CF. We recommended new studies to be conducted on a larger sample size and prolong duration follow up with nutritional intervention. Finally, early diagnosis of malnutrition and the implementation of nutritional interventions in patients with CF will be associated with reduced morbidity and mortality.

## 6- CONFLICT OF INTEREST: None.

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