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# Nutritional Data of Cystic Fibrosis Patients

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**Objective: To identify the nutritional status of Cystic fibrosis (CF) population in Saudi Arabia and its relation to mortality.**

**Method: A retrospective chart review of all confirmed CF patients for the period November 1994 to October 1998 for patients' characteristics, clinical and nutritional data.**

**Results: Of 96 CF patients, 81 (84%) CF patients are alive, 15 (16%) died. Fifty (52%) were males and 46 (48%) were females. Age at diagnosis was 2.9 ± 3.5 years. The mean follow up period was 3.24 ± 2.8 years. Sixty-two of 96 patients (65%) were in the mild to moderate malnutrition stage, and sixty of 96 patients (63%) were in the mild to moderate stunted growth. Weight for height (Wt/Ht) Z score has shown improvement in the first 6 month (P value= 0.0001), but developed a plateau level thereafter (P value > 0.05). Height for age (Ht/ age) Z score has shown no significant improvement in the first 12-month, but better response thereafter. Albumin level at follow up was low (35 ± 1 g/L). Calculated Wt/Ht and low albumin level at last follow up were some of the factors that contributed to early death (P value 0.01) and (0.001) respectively.**

**Conclusion: Early nutritional rehabilitation is needed to improve survival of our CF patients. Delay in nutritional rehabilitation could lead to early mortality.**

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The incidence of cystic fibrosis (CF) in Saudi Arabia was reported to be 1 in 4,243 children[1]. Epidemiological and genetic data have been described in details in many Gulf countries, but no hematological data has been described before in the Arabian countries. The importance of nutritional status in long-term survival and well being of patients with CF is well documented[2-8]. There is a clear association between malnutrition and deteriorating lung function. Chronic pulmonary infections (Pseudomonas aeruginosa (Pseud) are associated not only with anorexia, increased metabolic rate and energy requirements[6,9-11]. Nutritional deficiency in CF ranges from mildly depleted fat stores to frank signs and symptoms of energy and protein malnutrition[9]. Deficiencies are most likely to occur at times of rapid growth, during pulmonary exacerbation and increased severity of lung disease[6-8]. Consensus report and recommendations were generated by the CF foundation (CFF) in USA to provide nutritional guidelines for the care of CF patients[12]. Weight (WT), Height (Ht) and growth velocity are important parameters in the evaluation of CF growth[7,13,14]. CFF recommended that Wt be expressed as Wt for Ht, age and gender[14]. Active dietary

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intervention should be initiated when Wt declines below the established Wt curve or becomes under Wt (85-89% of ideal Wt/Ht). In this study we present the nutritional data of the largest CF population in the Gulf area and discuss its relation to mortality.

## METHODS

The records of all CF patients referred to the CF clinic during the period from November 1994 to October 1998 were reviewed. Cystic Fibrosis was diagnosed according to the clinical picture and high sweat chloride test after two consecutive tests >60 mmol/L by the guantitative method (Wescor, USA).

**Definitions:**

Calculated weight (CWT) (6): Express actual weight as a percentage of ideal body weight (IBW) = $\frac{\text{Actual weight x 100}}{\text{IBW for height}}$

Calculated height (CHT) (6): $\frac{\text{Actual height x 100}}{50^{th} \text{ percentile height for age}}$

**Nutritional failure:** weight for height index below 85% of ideal weight/ standard height, loss of weight for >2 month and or plateau in weight gain for 2-3 month[6].

**Z score:** It is the standard deviation of weight (Wt) and or height (Ht) from the mean of a reference population, e.g. if a patient weight for height is at 97$^{th}$ percentile, Z score will be (+1.9), but if another patient parameter at 17$^{th}$ percentile, his Z score will be (–1.0)[14].

The data were analyzed on IBM, PL300, computer using JMP program version 3.2. All variables with normal distribution, mean, standard deviation (SD) and median were calculated using student t-test, other wise for non-parametric variables, Wilcoxon test was used. For categorical variables, Chi-square of First exact test was used. Uni-variant analysis was performed in all variables. Results were presented at a level of significance of p= <0.05. All values were expressed in mean ± SD.

Epi Info version 6 (CDC, 1994) was used to calculate Z-score, namely weight for height Z-score, height for age Z-score, weight for height percentile and height for age percentile. Mean and standard deviation was calculated for all scores. Initial 96 patients were studied, but only individuals (30 patients) with data at all time points were presented. Weight for age Z- score (WHZ) and height for age Z- score (HAZ) at diagnosis, 6,12,18,24 were compared graphically. At each time point, the graph shows the box plot of the score. Also is shown the error bar around the mean. Each score was compared with the previous score using paired t-test. P value of less than 0.05 was considered significant. We used Bonferroni correction because of multiple comparisons. JMP was used to produce the graph and statistical analysis. JMP version 3.2, 4SAS institute Inc. Carey, NC, USA.

**Patient management:** All confirmed CF patients had their Wt and Ht measured in the first visit and each follow up visit thereafter, which is usually every 2-4 month. All patient with signs and symptoms of pancreatic insufficiency as diarrhea or positive fat in the stool are started on pancreatic enzymes according to CFF

recommendation and fat-soluble vitamins (A, D, E and K). Nutritional management and intervention are done by a specialized nutritionist according to CFF recommendations[6]. Most of the patients accept oral nutritional rehabilitation, but refused nasogastric (NGT) feeding or gastrostomy (GT) feeding for social reasons and school embarrassment.

## RESULTS

Ninety-six CF patients were diagnosed on clinical findings and sweat chloride test >60 mmol/L during the period November 1992 to November 1998. Eighty-one (84%) CF patients are alive, Fifteen (16%) died. Fifty (52%) were males and 46 (48%) were females. Age at diagnosis was 2.9 ± 3.5 years. The mean follow up period was 3.24 ± 2.8 years with a range of 0.01- 13.8 years. Mean Wt at diagnosis 9.5 ± 7 kilogram (kg), a range of 2.4-36 kg. Calculated Wt/Ht 82 ± 19%, a range of 40 ± 162%. Sixty-two of 96 patients (65%) were in the mild to moderate malnutrition stage (<90$^{th}$ percentile), and thirty-four of 96 patients (35%) were in the normal level for Wt/Ht (>90$^{th}$ percentile). The mean of calculated Ht/age was 91 ± 12 centimeter, sixty of 96 patients (63%) were in the mild to moderate stunted growth (<90$^{th}$ percentile) (Table 1). Vitamin D (1,25 di-hydroxy cholecalciferol) (Vit D) mean level was 48 ± 27 (N= 52-312 nmol/L). The albumin level at presentation was 40 ± 0.5 (N= 35-50g/L) and at follow up was low (35 ± 1 g/L). There were no significant difference in all variables between males and females (Table 2). Wt/Ht Z score (Table 3) (Fig 1) has shown improvement in the first 6 month from (-1.7 ± 0.16) to (-0.77 ± 2) (P value= 0.0001), but developed a plateau level thereafter at 12,18 and 24 month with Z score (-0.86 ± 1.01), (-0.89 ± 1.01) and (-0.93 ± 1.01) respectively (P value= > 0.05) (Fig 1) (Table 3). Ht/age Z score has shown no significant improvement in the first 12-month, but better response at 18 and 24 month (Fig 2). Comparison of growth values between CF patients who are still alive during this study and those who died from the same disease has shown that calculated Wt/Ht and albumin level at last follow up are factors that contributed to early death (P value- 0.01) and (0.001) respectively (Table 5).

Table 1. **Cystic fibrosis growth parameters in Saudi population (96 patients)**

| Variable | Number | % | Percentile | Status |
|---|---|---|---|---|
| CWT | 33 | 35 | < 75% | Severe malnutrition |
| | 7 | 8 | 75- 79% | Moderate malnutrition |
| | 11 | 11 | 80- 84% | Mild malnutrition |
| | 11 | 11 | 85- 89% | Under weight |
| | 30 | 31 | 90- 110% | Normal weight |
| | 4 | 4 | > 110% | |
| Total | 96 | 100 | | |
| CHT | 19 | 20 | < 85% | Severe stunted |
| | 8 | 8 | 85-89% | Moderately stunted |
| | 33 | 35 | 90- 94% | Mildly stunted |
| | 36 | 37 | 95- 100% | Normal |
| Total | 96 | 100 | | |

CWT= calculated weight for age CHT= calculated height for age

Table 2. **Comparison between females and males of patients (96 patients)**

| **Variables** | **Females** | **Males** | **P values** |
|---|---|---|---|
| Number | 46 (48%) | 50 (52%) | |
| Age at diagnosis | 3 ± 4 | 3 ± 4 | 0.7 |
| Age at follow up | 7 ± 4 | 6 ± 5 | 0.5 |
| Period of follow up | 3.4 ± 3 | 3 ± 3 | 0.5 |
| Alive | 42 | 39 | 0.9 |
| Died | 8 | 7 | |
| Calculated weight for height | 83 ± 15 | 80 ± 22 | 0.63 |
| Calculated height for age | 94 ± 8 | 89 ± 15 | 0.34 |
| Protein | 66 ± 12 | 67 ± 11 | 0.9 |
| Albumin at diagnosis | 37 ± 7 | 36 ± 6 | 0.3 |
| Albumin at follow up | 40 ± 4 | 40 ± 4 | 0.6 |
| Vitamin D | 51 ± 29 | 45 ± 25 | 0.5 |

Vitamin D = 1,25 Di-hydroxy cholecalciferol

**Table 3. Weight for height z score during 2 years follow up (30 patients with data at all study points)**

| **Period** | **Mean score** | **Number** | **P=value** |
|---|---|---|---|
| WHZ at Diagnosis | -1.7 ± 0.16 | 74 | |
| WHZ at 6 month | -0.77 ± 2 | 74 | 0.0001 |
| WHZ 12 M | -0.86 ± 1.01 | 58 | |
| Z score 12 M and 6 M | | | 0.918 |
| WHZ 18 M | -0.89 ± 1.01 | 48 | |
| Z score 18 M and 12 M | | | 0.588 |
| WHZ 24 M | -0.93 ± 1.01 | 46 | |
| Z score 24 M and 18 M | | | 0.703 |

WHZ= weight for height Z score M= month

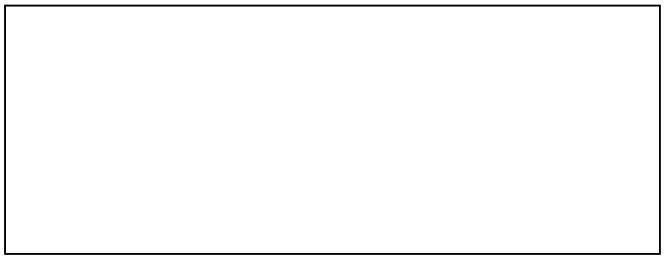

Figure 1. **Weight for height Z-score (24 months)**
WHZDX= Weight for height Z-score at diagnosis
WHZ6= Weight for height Z-score at 6 months follow-up
WHZ12= Weight for height Z-score at 12 months follow-up
WHZ18= Weight for height Z-score at 18 months follow-up
WHZ24= Weight for height Z-score at 24 months follow-up

(Zero line)= determine the mean weight Z-score of the standard population
(-1) line= determine the mean weight Z-score of the study population

**Table 4. Nutritional factors and their relation to mortality (96 patients)**

| Variables | Alive | Died | P value |
|---|---|---|---|
| Sex Females<br>Males | 42<br>39 | 8<br>7 | 0.9 |
| Age diagnosis years | 2.88 ± 3.5 | 3.2 ± 3.5 | 0.7 |
| Period of follow up | 3 ± 3 | 4 ± 3 | 0.1 |
| Age at follow up | 6 ± 4 | 8 ± 6 | 0.2 |
| CWT | 84 ± 18 | 71 ± 17 | 0.01 |
| CHT | 92 ± 12 | 91 ± 10 | 0.8 |
| Vitamin E diagnosis | 19 ± 12 | 19 ± 18 | 0.9 |
| Vitamin E follow up | 23 ± 2 | 16 ± 7 | 0.34 |
| Protein | 65 ± 11 | 70 ± 11 | 0.1 |
| Albumin at diagnosis | 37 ± 7 | 35 ± 5 | 0.3 |
| Albumin follow up | 40 ± 0.5 | 35 ± 1 | 0.001 |

CWT= Calculated weight for height, CHT= Calculated height for age
Vitamin E, Tocopherol

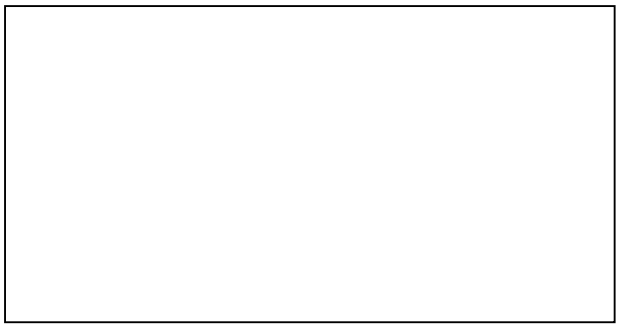

Figure 2. **Height for age Z-score (24 months)**

HAZDX= Height for age Z-score at diagnosis
HAZ6= Height for age at 6 months follow-up
HAZ12= Height for age at 12 months follow-up
HAZ18= Height for age at 18 months follow-up
HAZ24= Height for age at 24 months follow-up

Zero line)= determine the mean height Z-score of the standard population
(-1) line= determine the mean height Z-score of the study population
Height for age Z-score (24 months)

## DISCUSSION

Many studies have shown that early nutritional intervention has improved survival. Corey et al compared 2 CF centers in Toronto, Canada and Boston, USA, with similar CF population size and age distribution[12]. The only difference is in the nutritional management: Toronto center advocated high fat, high calorie diet with up to 20-30 pancreatic capsules/meal, whereas Boston center advocated a low fat, high calorie diet with less pancreatic enzymes/meal. The result was important in that, Patients in Boston tended to be shorter than patients in Toronto in both males and females 10-20

years of age. Toronto CF males weight was more than Boston Males. Median age of survival in Boston was 21 years compared to 30 years in Toronto. Since that time, it became mandatory to use high fat, high calorie diet in the management of CF patients.

Levy et al studied 14 patients on gastrostomy feeding for 1 year and found that supplemental feeding resulted in increase of Wt as percentage of standard by 2 percent in the treated group but declined by 3 percent in the control group[15]. Forced vital capacity (FVC) didn't change in the treatment group, but declined 12 percent in the control group, but remained unchanged in the treatment group (P value <0.01), and forced expiratory volume in one second (FEV1) by 13 percent in the control group (P value <0.01). He also noted that in the treatment group, there was a marked increase in the ability to participate in the activity of daily living.

Shephard et al followed 10 patients with NGT feeding for 2 years, and found that long term nutritional rehabilitation resulted in a catch up weight gain and sustained improvement in linear growth, fewer pulmonary infections per year, a significant reversal of the deteriorating lung function[13]. Protein synthesis exceeded protein breakdown by one-month supplementation. The mean change in 2 Z scores for Wt and Ht were significantly greater in treatment group compared to control group as no catch up growth was noted in the latter.

In this study, more than 85 percent of patients were in the mild to moderate level of malnutrition at presentation, but Z score has improved in the first 6-12 month after starting pancreatic enzymes and vitamins and initial oral nutritional rehabilitation, but gradually plateau or progressively decreased due to progressive lung disease and refusal of many parents for NGT or GT nutritional rehabilitation. Oral nutritional rehabilitation did not show any improvement in growth especially in patients with progressive lung disease. This may explain our finding of the direct relationship of CWT and albumin to early mortality. Other factors that may need to be considered for early mortality is multi resistant bacteria and poor compliance to treatment and chest physiotherapy as most parents have other healthy siblings to take care of and ignore the sick child.

## CONCLUSION

**Our study has shown that: Oral nutritional rehabilitation may improve nutritional status the first 6-12 months, but further parentral nutrition such as nasogastric tube or gastrostomy feeding may need to be considered to improve nutritional status. Other factors as poor compliance to chest physiotherapy and early treatment of chest infection need to be addressed early in the course of the management to improve survival.**

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