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Cystic fibrosis patients assisted by a program nutrition therapy: assessment of the use of supplements in patients colonized and non colonized by *P. aeruginosa*

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ABSTRACT

Objective. To assess the use of dietary supplements used in food consumption, the clinical nutritional status and biochemistry of patients colonized and not colonized with *Pseudomonas aeruginosa* participants of a program of home nutritional therapy. **Material and methods.** Observational analytic study, carried out with 47 patients, 2-19 years. The nutritional failure was referred to as with nutritional deficit and those in adequate nutritional status and at risk, were considered without nutritional deficit, according to the international consensus. Spirometry was performed with the cutoff point of 80%. The pancreatic enzyme replacement therapy and nutritional supplementation were recorded. **Results.** In the association between the use of nutritional supplements and cystic fibrosis patients without nutritional deficit found that the proportion of patients taking supplements was statistically lower than among non users, when considering the American Consensus (p = 0.0098). The variable nutritional status was significantly associated with the types of dietary supplements and frequency of supplementation (p = 0.0445 and p = 0.0266, respectively). There was no correlation between the variables: nutritional status and colonization by *Pseudomonas aeruginosa* on consensus (p = 0.2355). **Discussion.** Home care programs which provide nutritional and clinical support, and nutritional follow-up of chronic patients such as cystic fibrosis patients should be encouraged in Latin American countries so that the disease might be treated effectively, with reduction of morbidity and frames of disease exacerbation.

Key words. Cystic fibrosis. Dietary supplements. Nutritional status. Spirometry. *Pseudomonas aeruginosa*.

Pacientes con fibrosis quística atendidos por un programa de la terapia nutricional enteral domiciliario. Evaluación del uso de suplementos, estado nutricional y clínico de los pacientes colonizados y no colonizados con **P. aeruginosa**

RESUMEN

Objetivo. *Evaluar el uso de suplementos dietéticos utilizados en el consumo de alimentos, el perfil nutricional y clínico, la bioquímica de los pacientes colonizados y no colonizados con* Pseudomonas aeruginosa *participantes de un programa nutricional enteral domiciliario.* **Material y métodos.** *Estudio observacional, analítico, realizado con 47 pacientes, 2-19 años. La insuficiencia nutricional fue clasificada con déficit nutricional, y aquellos con estado nutricional adecuado y en riesgo como sin déficit nutricional según el Consenso Internacional Americano. La espirometría fue realizada con punto de corte de 80%. La terapia de reemplazo de enzima pancreática y la suplementación nutricional fueron registradas.* **Resultados.** *En la asociación entre el uso de suplementos nutricionales y los pacientes con fibrosis quística sin déficit nutricional, se encontró que la proporción de pacientes que toman suplementos fue estadísticamente menor que entre los no usuarios, según el Consenso Americano (p = 0.0098). La variable de estado nutricional se asoció significativamente con los tipos de suplementos dietéticos y con la frecuencia de suplementación (p = 0.0445 y p = 0.0266, respectivamente). No se encontró correlación entre las variables: estado nutricional y colonización por* Pseudomonas aeruginosa *en el consenso (p = 0.2355).* **Discusión.** *Programas de atención domiciliaria que prestan asistencia nutricional, clínica y seguimiento nutricional de pacientes crónicos (como los pacientes con fibrosis quística) deben fomentarse en los países de América Latina a fin de que la enfermedad pueda ser tratada con eficacia, con reducción de la morbilidad y cuadros de exacerbación de la enfermedad.*

Palabras clave. *Fibrosis quística. Suplementos dietéticos. Estado nutricional. Espirometría.* Pseudomonas aeruginosa.

INTRODUCTION

Cystic fibrosis (CF) is an autosomal recessive disease, considered the most prevalent in white Caucasians.[1] The product of the CF gene is the protein cystic fibrosis transmembrane conductance regulator (CFTR) present on the apical surface of the epithelial cells. In the absence or deficiency of this protein, there is no adequate rehydration fluid lumen leading to more viscous secretions that predispose to colonization and subsequent chronic infection by opportunistic agents such as non-mucoid and mucoid strains of *Pseudomonas aeruginosa*, an important characteristic related to pulmonary disease progression.[2,3]

Diseases related to nutrition are common and associated with poor clinical outcomes with delayed recovery from illness and reduced quality of life. The inadequate nutritional status, airway colonization with *Pseudomonas aeruginosa*, pancreatic insufficiency and frequent pulmonary exacerbations are associated with fast deterioration of pulmonary function.[4] Spirometry performed in attendance of CF patients is considered the most widely used functional parameter in the CF and forced expiratory volume in one second (FEV1) and its rate of decline is identified as the most reliable parameters in prediction of survival.[5]

A variety of laboratory data could be useful in the nutritional evaluation of patients with CF, and biochemical indicators may enhance the nutritional and clinical evaluation. Albumin and hemoglobin, when reduced, present physiological stress as an important protein catabolism, in addition to the reduction of substrate. The alteration in blood glucoses due to CF, although late at times, is directly related to food intake and infirmity that may affect both exocrine and endocrine pancreas, the latter being responsible for insulin production.[6]

Pancreatic exocrine insufficiency (PEI) is generally well controlled with modern pancreatic enzyme replacement therapy (PERT). Maldigestion due to PEI is a characteristic feature of CF and the majority of patients, therefore, requires PERT for weight gain and nutritional status during the critical period of intense growth in young children and adolescents with diagnosed CF.[1,6]

The scoring system was used to evaluate objectively the severity and the clinical status of the patient with cystic fibrosis. The Shwachman-Kulczycki (SK) score is divided into four categories according to degree of impairment: general activity (attendance to school or home confinement), physical examination (cough manifestation and frequency, digital clubbing), nutrition (nutritional status evaluation in percentis), and radiological findings (manifestation of emphysema, atelectasia and bronchiectasis). The SK score comes with functional decline and is correlated with spirometric data.[7]

The SK score is an useful tool for monitoring the severity of cystic fibrosis, adequately reflecting the functional impairment and chest radiography and tomography changes, especially in patients with greater impairment of lung function.[7]

The cost and managing patients with medium or high risk disease related to malnutrition is high, particularly in patients with chronic diseases. Public health policies related to nutrition and quality of life offered by the Government of the Federal District (GFD) allow access without financial costs (free access) of the patient with cystic fibrosis to the home nutritional therapy service and dietetics supplements. The GFD believes that it is necessary to improve the clinical-nutrition and prevalent epidemiological characteristics in patients with cystic fibrosis.[8,9]

Nutritional supplementation may contribute to increasing muscular and adipose tissue reservations and also the total caloric intake of patients, once adequate nutrition is essential to the survival, stability and improvement of pulmonary function of patients.

There are many types of nutritional supplements available. High-energy dense preparations and polymeric diets should be used wherever necessary, however, at the present time, there is a lack of evidence to support the use of dietary supplements.[1,6]

Scientific investigations performed in reference centers like this in Brazil can show and prove the need to ensure the actions and provide financial resources for the assistance program for cystic fibrosis patients in the community, and to expand the understanding of the economic benefits of appropriate use of oral nutritional supplements.

This study aims to assess the use of dietary supplements used in food consumption, the clinical nutritional status and biochemistry of patients colonized and not colonized with Pseudomonas aeruginosa participants of a Program of Home Nutritional Therapy.

MATERIAL AND METHODS

Observational analytic study, carried out with 47 patients, 2-19 years (9.6 mean ± 4.2), from August 2009 to July 2011, all participants of the Program of

Home Enteral Nutrition (PHEN) performed in a Cystic Fibrosis Reference Center of the Federal District, Brazil. Although the Reference Center has 66 registered patients, 14 CF patients were excluded because they were adults who were not accompanied by the same team or in breastfeeding. There were two deaths (one child and a teenager) and 3 refused to participate. In the sample, no patient had been undergone lung transplantation.

The diagnosis of CF was made according to the Guidelines of the Cystic Fibrosis Foundation.[10] The research protocol was based on the patient chart formulated by the service staff of the Reference Center and included clinical and nutritional data. Adolescents aged from 10 to 19 years were taken into account, and the remaining samples were considered children, according to the World Health Organization classification.[11] The weight (W) and height (H) were measured as children and teenagers wearing only light clothing and no shoes. It was used a platform-type anthropometric scale, brand Filizola® Brazil, with a maximum capacity of 150 kg. The height was measured with a stadiometer, brand Sanny®, with the child or adolescent wearing no shoes, standing upright with their heels against the wall with no baseboard, staring straight ahead. Measurements of weight and height were used to determine the body mass index (BMI) percentile[12] and W/H% for the definition of acceptable nutritional status (> 25th percentile or W/H% above 90%), with risk (10th-25th percentiles or W/H% 85-89) and nutritional failure (< 10th percentile or W/H% < 85) according to the recommendations proposed by the American Consensus on CF.[13,14] The anthropometric assessment was conducted by a nutritionist at the Center of Reference.

To summarize the statistical analysis of the nutritional status, patients with nutritional failure were referred to as with nutritional deficit and those in adequate nutritional status and at risk, were considered without nutritional deficit.

According to the protocol of the Reference Center, biological sample was collected from expectorated sputum and material from oropharynx (swab) during the attendance, for research of colonization by mucoid and non mucoid *Pseudomonas aeruginosa*.[15]

The most common methods used to identify the existing pathogen in the respiratory tract are sputum tests, oral-pharynx swab post respiratory physiotherapy/coughing and bronchoalveolar lavage (BAL). The BAL is considered the gold standard procedure, since it improves the chance of presenting colonization of respiratory tract but, being an invasive procedure; it is not a part of infection diagnosis routine at the Reference Center, mainly due to small children medical care.[15]

The SK score was performed by the pediatric pulmonologist and nutritionist during the monitoring routine. It was scored according to the degree of impairment of general activity, physical examination, nutrition and radiological findings. The four scores were totaled and the obtained score was classified for the study into > 70 or ≤ 70, following the pattern Shwachman & Kulczycki of excellent (86-100), good (71-85), medium (56-70) bad (41-55), and severe (≤ 40).[16]

As nutritional status is one of SK score components, the statistic correlation was not performed with other variables such as total caloric value and nutritional status. However, the result of the four conditions demanded by the score was summed up considering patients ranging from excellent to critical profile of the disease.

In their assessment of spirometry and clinical associations, 37 cystic fibrosis patients were taken into consideration due to the peculiar characteristics of the pulmonary function test, such as the need for patient cooperation (age) and the use of standardized technique.[17]

Spirometry was performed in children older than 6 years due the difficulty of conducting the examination in young children and the cutoff predicted point was 80% for height and sex as the lower limit of normality for the parameter of forced expiratory volume in one second (FEV1).[17] The technique of examination followed the recommendation of the American Thoracic Society (ATS)[18] and was held in portable equipment of standardized volume, model Spida®. The technician responsible for the spirometry was able to evaluate correctly the curves and maneuvers of pulmonary function test.

It was conducted by a 24-h dietary recall (24HDR) by a nutritionist in order to register the amount of food consumption and the total caloric value (TCV) of the diet. The 24HDR was analyzed by Avanutri 4.0 software. For the recommendations of energy intake, they were based on guidelines from 120 to 150% of the established energy for healthy individuals of similar age and sex according to the Recommended Dietary Allowances/DRIs.[19]

The dietetic supplements used by CF patients were classified in present or absent, during food consumption, and regarding the dietary types of supplements in normocaloric polymeric formula (1.0 Kcal/mL) and hypercaloric ones (1.25 Kcal/mL and 1.5 Kcal/mL) or whether they use or not

supplements. The definition of formulas was followed with special industrialized purposes and specially formulated for people in specific metabolic conditions offered by home nutritional therapy service.[6,9] The frequency in which the supplements consumed were also registered as twice a day, 3 times a day, 4 times a day or no supplements.

The pancreatic enzyme replacement therapy (PERT) were recorded and classified as present and absent. There was no difference in the use of supplements provided orally or via gastrostomy.

Biochemical tests were performed after a 12 h fasting and included blood glucose (mg/dL), albumin (mg/dL) and hemoglobin (g/dL) dosages.

Data were analyzed using the statistical program SAS 9.2 for Windows. Student t test was used for variables with Gaussian distribution. For those which did not present a Gaussian distribution, the Mann-Whitney test was used. The χ^2 or Fisher's exact test was used for the analysis of qualitative variables. In the evaluation, it was used a significance level of 5%.

To ensure the reliability of the results in some associations and statistical analysis, 37 cystic fibrosis patients' samples were taken into consideration, not 47, because not all patients could go through spirometry, and values related to the use of nutritional supplements enzymes and vitamins were absent.

The study was approved by the Ethics Research Committee of Health Secretary of the Federal District, Brazil (Protocol 186/2009). All patients were invited to participate and signed a Free Informed Term of Consent.

RESULTS

In this study, 59.5% of the patients were male, the average age of CF patients and the ages of diagnosis were 9.61 years and 23.33 months, respectively. The analyses of the evidence of pulmonary function FEV1, SK score, biochemical tests of glucose, albumin and hemoglobin were within normal limits. However, the caloric value of diet did not reach the average percentage of achievement of the Recommended Dietary Allowances/ DRIs among CF patients, being below the recommended 120 to 150%[20] (Table 1).

The associations between the classification of the nutritional status and laboratory tests of blood glucose, albumin and hemoglobin (p = 0.7166, p = 0.9581 and p = 0.5315, respectively) were not statistically significant.

Table 1. Description of sex, age, dietary intake and clinical profile of cystic fibrosis patients on home enteral therapy in Brazil (2009-2010).

Variable	n = 47
Sex (male/female)	28 / 19
Age (months), mean ± SD	9.61 ± 4.2
Age diagnostic (months), mean ± SD	23.33 ± 33.81
TCV (Kcal), mean ± dp	1959.30 ± 501.45
Shwachman Score, mean ± SD	77.61 ± 15.37
Glucose (mg/dL), mean ± SD	86.09 ± 9.48
Albumin (mg/dL), mean ± SD	4.24 ± 0.39
Hemoglobin (g/dL), mean ± SD	13.4 ± 1.26

TCV: total caloric value. SD: standard deviation.

For the nutritional supplement variable, the rate of CF patients without nutritional deficit is statistically lower among those who use supplements than among those who do not use supplements, when considering the American Consensus[13] (p = 0.0098) (Table 2).

The statistical analysis did not find significant association between pancreatic enzyme replacement therapy and American Consensus nutritional status (p = 0.1660).

The variable nutritional status was significantly associated with the types of dietary supplements and frequency of supplementation (p = 0.0445 and p = 0.0266, respectively) (Table 3).

For the variable presence of colonization by non-mucoid *Pseudomonas aeruginosa,* the proportion of patients with FEV1 ≥ 80% is statistically lower than the proportion of CF patients with FEV1 < 80% (p = 0.0073), however, for the variable colonization by mucoid strain, the proportions were not statistically significant (Table 4).

DISCUSSION

Malnutrition and progressive pulmonary disease are common in patients with cystic fibrosis. Clinical and pulmonary impairments associated with high mortality rates could be prevented with early diagnosis and neonatal screening.[20] In this study, the samples were diagnosed when they were, on average, 23 months old, in other words, later. Farias, *et al.,* and Rodrigues, *et al.,* identified the average age of diagnosis of less than 18 months showing the results of early diagnosis. Clinical observations over the last decade are suggestive as to the favorable results of neonatal screening for cystic fibrosis, especially in relation to nutritional deficits, early identification and treatment of pancreatic disease

Table 2. Nutritional status and the relationship among biochemical values, use of supplements, PERT, colonization by *P. aeruginosa* cystic fibrosis assisted by the home care enteral nutrition program in Brazil (2009-2011).

Variables	Nutritional Status American Consensus[13]		p-value
	Without deficit, n = 34	With deficit, n = 13	
Glucose (mg/dL), mean $\pm$ SD	86.41 $\pm$ 8.9	85.18 $\pm$ 11,3	0.7166
Albumin (mg/dL), mean $\pm$ SD	4.24 $\pm$ 0.41	4.25 $\pm$ 0.35	0.9581
Hemoglobin (g/dL), mean $\pm$ SD	13.50 $\pm$ 1.3	13.24 $\pm$ 1.01	0.5315
NSu (%)			
Present	20 (60.61)	13(39.39)	0.0098
Absent	14(100.0)	0	(0.00)
PERT (%)			
Present	27(67.50)	13(32.50)	0.166
Absent	7	(100.0)	0 (0.00)
P. aeruginosa			
Present	17 (50.00)	9 (69.23)	0.2355
Absent	17 (50.00)	4 (30.77)	

* p-values obtained by tests t student, Fisher exact and χ^2. NSu: nutritional supplements. PERT: pancreatic enzyme replacement therapy. SD: standard deviation. Borowitz, *et al.* 2002.[13]

Table 3. Nutritional status and the types of dietary supplements relations, frequency of supplementation among cystic fibrosis patients on home enteral nutrition in Brazil (2009-2011).

Variables	NS American Consensus[13] Without deficit, n = 34	NS American Consensus[13] With deficit, n = 13	p-value**
Types of dietary supplements*			0.0445
Not use supplements	14 (41.18)	0 (00.00)	
Supplement 1.0 Kcal/mL	8 (23.53)	6 (46.15)	
Supplement 1.25 Kcal/mL	7 (20.59)	5 (38.46)	
Supplement 1.5 Kcal/mL	5 (14.70)	2 (15.39)	
Frequency			0.0266
Not use supplements	14 (41.18)	0 (00.00)	
Use 2 times per day	2 (05.88)	2 (15.38)	
Use 3 times per day	17 (50.0)	9 (69.24)	
Use 4 times per day	1 (2.94)	2 (15.38)	

* Supplements with high content of proteins and lipids. ** p-value obtained by Fisher exact test. NS: nutritional status. Kcal: kilocalories. Borowitz, *et al.* 2002.[13]

Table 4. Pulmonary function test FEV_1 and colonization by *Pseudomonas aeruginosa* mucoid and non mucoid among cystic fibrosis patients on home enteral nutrition in Brazil (2009-2011).

Variables	FEV_1 < 80%*, n = 14	$FEV_1 \geq$ 80%*, n = 23	p-value**
Pseudomonas aeruginosa			
Present	12 (85.71)	9 (39.13)	0.0073
Absent	2 (14.29)	14 (60.87)	
Pseudomonas aeruginosa mucoid			
Present	2 (16.67)	1 (9.09)	1
Absent	10 (83.33)	10 (90.91)	

* In their assessment of spirometry and clinical associations, 37 CF patients were considered and performed in children older than 6 years, due to the peculiar characteristics of the pulmonary function test. ** p-value obtained by Fisher exact test. FEV_1: forced expiratory volume in one second.

and number of hospital admissions in the first two years of life.[21,22] In the United States, around 50% of CF patients have the diagnosis confirmed by completing six months of life.[23]

Although no changes were observed in biochemical parameters singly nor associations with nutritional status, it is known that albumin in patients with CF is associated with the severity of disease constituting in a prognostic factor in CF patients.[24] Forte, et al., and Pereira, et al., corroborate with the findings of this sample where CF patients have albumin values above 3.5 mg/dL showing a good nutritional status of this sample.[25,26]

The SK score, in this study, indicated a favorable clinical status, because it showed values > 70. Good nutritional status and appropriate clinical status were found in a cross-sectional study similar to this survey conducted with CF patients until 18 years, shown by the value of SS of 83. 6 ± 11. 13, and albumin > 3.5 g/dL.[26]

The score is intensely disseminated and used at medical appointments. It is easily applied by physicians and nutritionists offering immediately a global appreciation of the patient. However, most of its categories (general activity, physical examination, nutrition and radiological findings) is based in subjective information about general clinical status. This score presents a high intra and interobserver reproducibility, but it lacks a category to evaluate the pulmonary function. If applied together with other clinical observations and pulmonary function proof, it allows an adequate monitoring of the patient.[7]

In this study, blood glucose levels were remained appropriate, however, glucose metabolism is strongly influenced by the impairment of insulin secretion from the pancreas and the risk increases with age, thus, individuals with CF who develop diabetes suffer accelerated decline in clinical status of the disease and in pulmonary function, as well as the mortality rate is higher than those who do not have diabetes.[27,28]

The negative association between PERT and nutritional status (p = 0.1660) may be related to the type of analysis performed for PERT, classified as present and absent, and not the amount used (units lipase per Kilogram body weight per meal/day). It is, therefore, a limitation of the study because pancreatic insufficiency has direct influence on nutritional status. Factors such as the correct or incorrect use of the enzyme, treatment adherence, insufficient doses or higher doses were not evaluated, as well as the method of administration, so the result should be observed carefully.[1,14]

In the assessment of nutritional status (NS) of CF patients, literature has recommended the use of specific consensus of NS classification to ensure an adequate assistance to patients and the prevention and treatment of the nutritional failure effectively, including the use of nutritional supplements. Consensus for this population has detected more cases of malnutrition than nonspecific parameters.[13,14,29]

When evaluating the association between the use of nutritional supplements and nutritional status, they showed significant correlation (p = 0.0098) and these findings are in agreement with the study by Montoya, et al., where intervention with nutritional support increased the caloric density of meals and CF patients had weight gain and showed improvements in the nutritional state.[30] In a longitudinal research with nutritional supplementation in CF patients, the authors found significant gains in weight and height, as well as increased muscle and fat reserves and, during the follow-up, higher achievement of the nutritional recommendations was remarked with the use of supplements.[31]

According to the dietetic prescription, the supplements should be given before or after meals or before bedtime in order to insure that the appetite for normal food is maintained and that there will not be any substitution of the main meals. The inadequate use of supplements increases the cost, since the formulas are expensive and may reduce the amount of food eaten without improving total energy intake.[6,32]

In this study the using recommendations were followed, and the supplements may have contributed to increasing caloric intake. The types of supplements and the frequency showed a significant association with nutritional status, p = 0.0445 and p = 0.0266, respectively.

Although the achieved results in this research showed the positive results on nutritional status, at the present moment, we lack evidence to support the use of dietary supplements. A recent systematic review showed that using energy supplements does not improve nutritional status in people with cystic fibrosis,[32] however, supplements, according to the dietary guidance nutritionist Reference Center may be used, mainly because they can be consumed away from home, in places such as schools and workplaces, and by sports enthusiasts to complete the energetic support, but should not be regarded as essential.

An intake of dietetic supplements more frequent than three times a day, as observed in a CF patient

of this study should not be encouraged, since it may alter the consumption of other essential food, signal the lack of willingness to try new food and encourage the preference for drinks instead of solid foods, especially when consumed by children.

Researches and randomized controlled trials are needed to establish the role of energy supplements for the short-term in people with CF and acute weight loss and also for long-term nutritional management or advanced lung disease or both.[32]

Nutritional supplements of the Program of Home Enteral Nutrition Therapy were prescribed for patients to maintain or achieve the nutrition goals set, however, researches, that found a significant association as that one observed in our study, are scarce. Although CF patients receive formulas with no cost facilitating adherence to the treatment, the nutritional needs were not reached, suggesting a reorganization in the management and monitoring of the use of nutrition service formulas.

A study about the food consumption among CF patients corroborates with the obtained results in this survey, where most of the CF patients did not reach the recommendations and were observed associations related to age.[26]

When evaluating the association between NS and colonization by mucoid and non mucoid *Pseudomonas aeruginosa* on American Consensus,[13,14] no correlation was found between the variables. In a prospective cohort study conducted with n = 42 CF patients, the researchers also did not identify any association between *P. aeruginosa* and NS. The authors suggest that the few cases colonized by *Pseudomonas aeruginosa* may have contributed to the lack of association, as well as the aggressive eradication therapies with antipseudomonal strategies.[33]

Although no association between the NS and colonization has been found, Steinkamp, *et al.*, and Que, *et al.*, found through cohorts the relationship between *P. aeruginosa* and FEV1 (p < 0.05) and that they are according to the findings of this survey (p = 0.0073) showing the negative impact of colonization and deterioration of pulmonary function. No associations were found with the mucoid *P. aeruginosa* which is associated with accelerated rate of decline in pulmonary function.[34,35]

Differently, the longitudinal study in Reference Center for attendance of FC patients found significance in the association of pulmonary colonization by mucoid *Pseudomonas aeruginosa* and FEV1 (p = 0.010). It is known that the mucoid strain increases morbidity and mortality in CF patients.[25]

Therapeutic intervention in CF remains a challenge, partly because of the number of organs and tissues affected by the lack of a functional cystic fibrosis transmembrane conductance (CFTR) protein. CF was originally regarded primarily as a gastrointestinal (GI) disease because of the failure to thrive and early death from malnutrition in infants with CF. However, successful interventions for the GI manifestations of CF have left chronic lung infections as the primary cause of morbidity and mortality. Despite a complex microbiology within the CF lung, one pathogen, *Pseudomonas aeruginosa,* remains the critical determinant of pulmonary pathology. Treatment and management of this infection and its associated symptoms are the major targets of extant and developing CF therapies.[36]

Home care programs which provide nutritional support, clinical and nutritional follow-up of chronic patients such as cystic fibrosis patients may be aroused in Latin American countries and in socioeconomic development so that the disease might be treated effectively, with reduced morbidity and mortality and frames of disease exacerbation.

ACKNOWLEDGMENTS

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