Review Article

Effect of Nutritional Intervention During the Sars-Cov2 Pandemic in Pediatric Patients with Cystic Fibrosis in Mexico

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ABSTRACT

Coronavirus 2, the cause of the COVID-19 pandemic, has affected various areas of population health. Because of the risk associated with morbimortality in patients with cystic fibrosis (CF), it is necessary to maintain and control medical and nutritional treatment, which may be compromised in times of adversity.

Methods: Prospective observational study, whose objective was to identify nutritional evolution of paediatrics CF patients by anthropometry during the COVID-19 pandemic. Anthropometric data of patients from the Cystic Fibrosis Clinic of the Children's Hospital of Mexico were taken and recorded from the beginning of the pandemic (December 2019) until December 2021. During the lockdown period; medical-nutritional follow-up, enzymatic and pharmacological support, was on-site visits at the clinic, in contrast with others CF care centers who used telemedicine during the pandemic.

Results: Data from 54 patients was recollected during the time of the study. In the first period, in 2020, 30 patients were evaluated. In the second period, in 2021, 22 of the first period were re-evaluated, losing the follow-up of 8 patients and 24 new patients were evaluated. Comparing the data of the 2 periods significant differences in z score of BMI and height-age were identified in those patients who received nutritional follow-up during the two periods, in addition patients without dietitian's advice during the COVID-19 pandemic had more prevalence of short stature. Patients meeting the target BMI and MUAC z score, presented median to strong positive correlation (0.68) for those patients with a MUAC z score greater than -1.47.

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Background

The Cystic Fibrosis (CF) incidence varies according to the Ethnic Group. In Central and Occidental Europe is 1 in every 2000-2600 children born and alive, whereas in the United States is 1 in every 1900-2500. In Mexico there are no specific data, while the World Health Organization (WHO) reports 1 per 8,500 newborns, the Secretaría de Salud Mexicana reports 1 per 6,290.

It has been identified broadly that the clinical condition, mainly pulmonary, are strongly related to the nutritional status in CF, has been identified that patients with the body mass index (BMI) over the 50th percentile have better lung function than those below that cut-off point or malnourished. Hence, those patients who are nutritionally compromised will have a minor pulmonary capacity. During nutritional follow-up it is necessary the identification of low energy intake, increased requirements due to pulmonary exacerbation or exercise, bacterial overgrowth, and the effectiveness of the dose of pancreatic enzyme replacement therapy, in order to limit nutritional deterioration, thereby increasing pulmonary compromise [2].

Despite the coronavirus (COVID-19) pandemic interrupted the activities associated with the traditional health model from various countries, including Mexico, the onsite visits of patients with chronic diseases, like CF was a great challenge, mainly because due the risk of pulmonary complications derived from the infection of COVID-19.

Due to the limitation of on-site visits, telemedicine turned into a crucial tool during clinical follow up, reducing the risk of infection by not requiring the patient to leave home. Telemedicine in Mexico presented challenges thanks to its organization, geographical access to the internet and a lack of digital media devices for some patients.

Until this day, despite the COVID-19 pandemic being declared officially over, there is no direct evidence to describe the nutritional evolution of CF patients with nutritional follow-up during this

stage, either through telemedicine or on-site appointments. As in other chronical diseases, the pandemic presented one of the greatest challenges for clinical follow up, having a significant impact in patient's prognosis.

The evidence regarding the course of the nutritional state of the paediatrics patients with CF during the COVID-19 pandemic is low. The main objective of the study is to show the main differences in the anthropometric evolution of the pediatric patients with CF that were kept under nutritional observation during the COVID-19 pandemic.

Methods

Analytical observational study was performed in the CF clinic of the Hospital Infantil de México Federico Gómez (HIMFG), data from January of 2020 till December of 2021 were collected. The start of the pandemic according to the WHO, December of 2019, was considered the beginning of the study period. Two study periods were established, the first 12 months of 2020, the second 12 months of 2021, for a total of 24 months of study. The periods were established based on the reactivation of the clinic's routine activities due to the decrease in the number of COVID-19 infections.

The routine activities of the CF clinic included the follow-up of the multidisciplinary team, which includes pediatric pulmonologists, nutrition, social workers, respiratory therapist, and psychology. Mexico does not have a home delivery system for medications, so 70% of our patients during the COVID-19 pandemic came to the clinic mainly for medications and the pulmonology visit and nutrition, for the rest of the patients only the primary caregiver came the hospital for medications, Data collection includes anthropometric data, weight, height, middle-upper arm circumference (MUAC), triceps skinfold (TSF), the BMI was classified according to Mariotti Z.E. et al., greater than the 50th percentile as nutritional goal. To assess nutritional status z score was calculated according to age and sex, for patients older than 2 years BMI and height for age was used with the Centres for Disease Control and prevention (CDC) data reference, for patients younger than 2 years weight for length (WFL) and length to age (LFA) was used with the WHO reference. To compare the nutritional intervention patients who came both periods were used as reference for those who only came one visit.

Data Analysis

Tests for normality were made using the Shapiro Wilk test, those with a p value of p.05 were considered to be normal distribution; for those that did not meet this condition, free distribution was assigned to them. For the description of the data, qualitative variables were described using frequencies and proportions, while for quantitative variables parametric or nonparametric statistics were used, according to the distribution of the variables. To show differences between groups, paired Wilcoxon ranks or McNemar's test were used. Correlation indexes were calculated for the correlation of variables.

Results

A total of 54 patients were evaluate during the time of the study. The first period 30 patients, during the second period 22 of the first period plus 24 new patients. During the first period data, the median age was 55 months with a higher percentage of women during both periods (Table 1).

By comparing the data for patients who had evaluations in both periods, 2020 and 2021, statistically significant differences were found mainly in the BMI, however, no significant differences were obtained in the nutritional status classification or the z score of height for age (Table 1).

For those patients who only visited during the second period, like in 2020, a higher proportion of women was observed (52%), comparing those who received nutritional follow-up during the two periods with those who only attended the visit in 2021 statistically significant differences were identified between the height-for-age z-score as well as in the proportion of patients with short stature, being 66.7 % in the period without follow-up vs. 28.6 % in those who had follow-up in both periods (Table 2).

Regarding the z score of BMI, goal of BMI and the nutritional status classification no significant differences were found. In contrast, those patients that had monitoring during 2020 and 2021, no differences were shown in the Z score, nevertheless, a mayor prevalence of persistent nutritional risk was shown in the group that had no follow up, 54.2% (Table 2).

Table 1: Anthropometric Evolution of Pediatric CF Patients Attending the Two Nutritional Follow-up Periods During The COVID-19 Pandemic

| Variable N=22	2020 Median (IQR)	2021 Median (IQR)	Value p.
Age, months	55 (79.5)	68 (78)	<0.01[a]
BMI, z score	-0.70 (1.52)	-0.17 (.57)	0.05[a]
BMI > %ile50, n (%)	5 (23.8)	9 (42.9)	0.125[b]
Nutritional status classification - Eutrophic	6 (27.4)	9 (41)	
- Persistent Nutritional Risk	8 (36.3)	8 (36.3)	0.157[c]
- Persistent Malnutrition	8 (36.3)	4 (18.2)	
- Overweight	-	1 (4.5)	
Height, cm	92.5 (39.6)	103 (37.5)	0.001[a]
Low stature, n (%)	11 (52.3)	6 (28.5)	0.125[b]
Height, %ile	5 (24)	10 (21)	0.73[a]
MUAC, %ile	3.5 (49)	7.5 (34)	0.13[a]

BMI: Body Mass Index, %ile: percentile, cm: centimetres, MUAC: midupper-arm circumference. Statistic to: a: Wilcoxon, b: McNemar, c: Friedman

Table 2: Comparison of the Anthropometric Evolution of Pediatric CF Patients with Nutritional Follow-up During the Two Periods of the COVID-19 Pandemic

Variable	Patients with nutritional follow up. Median (IQR) N=22	Patients with no nutritional follow up. Median (IQR) N=24	Value p.
Age	68 (78)	90 (92)	0.098[a]
BMI, z score	-0.17 (.57)	-0.56 (1.49)	0.46[a]
BMI > %ile50, n (%)	9 (42.9)	6 (25)	0.21[c]
Nutritional status classification			
- Eutrophic	9 (41)	5 (20.8)	
- Persistent Nutritional Risk	8 (36.3)	13 (54.2)	0.39[b]
- Persistent Malnutrition	4 (18.2)	5 (20.8)	
- Overweight	1 (4.5)	1 (4.2)	
Height, cm	103 (37.5)	116 (38.4)	0.43[a]
Height /Age, %ile	10 (21)	2.5 (8)	0.01[a]
Low stature, n (%)	6 (28.6)	16 (66.7)	0.01[c]
MUAC, %ile	7.5 (34)	3.5 (26)	0.46[a]

BMI: Body Mass Index, %ile: percentile, cm: centimetres, MUAC: *midupper-arm cincunference*, TSF: Triceps Skinfold. Statistic, to: The sum of ranges a: Wilcoxon, b: U-Mann-Whitney, c: X^2.

To identify the relationship between patients that achieve the objective of the BMI and the MUAC's Z score, when doing the correlation coefficient estimation, a positive median to strong correlation was identified (0.68) for those patients with a MUAC's Z score over -1.47 (Graph 1)
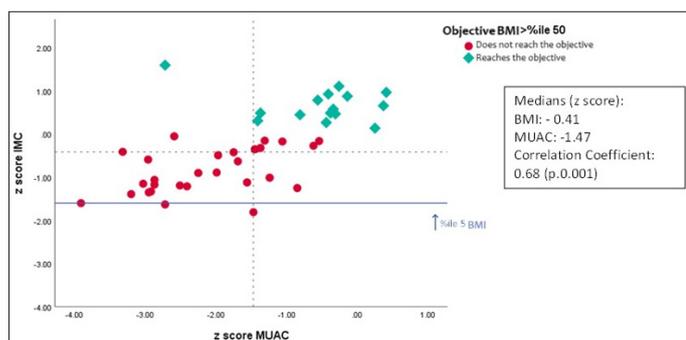
Graph 1: Use of MUAC in Correlation with The Nutritional Objectives for Pediatric Patients with CF

Discussion

The COVID-19 pandemic represented a change in the global and public health systems of each country, which reshaped the on-site appointments structure in several CF care centers, changing the on-site clinical intervention to telemedicine (TM), mainly during the major infection peaks. Some CF centers reported that about one in four appointments was in-person and all the rest via TM, which limited the interaction with all the members of the multidisciplinary team [3].

Most of the CF centers have reported their experience with TM, in contrast with that, our center remain doing on site visits, but not all the patients attend visits with all the specialist, six out of ten patient attend with the nutritionist, for some patients the family were only there for the collection of the medication, as a result of prioritization of physician care over other specialties mainly

during the four first peaks of infection (July 2020-February of 2021), this behaviour has been reported in other chronic diseases, as reported by Sawicki et. al., 34.7% of all patients requested TM for the nutritional monitoring and 97.8% requested TM for the medical monitoring. [4] Furthermore, the Gifford et al. study was able to identify that 97% of CF centers in 2021 were using telemedicine as a tool to follow patients during the covid-19 pandemic in 2021, in contrast to 2020, where only 57% of centers were using telemedicine [5].

A benefit of TM is that it reduces the risk of infection by limiting the number of visits to the clinic, Hendra et.al. documented the opinions of patients or caregivers and it was clear that it is common that weight and height estimation, essential for nutritional follow-up, is easy to carry out at home and it would not be necessary to go to the clinic; likewise, much of the information requested at the nutrition appointment can be given in advance if TM is used, expressions such as "Weight and *height are important but it can be taken at home*" were common. They also identified that two out of ten families do not consider dietary advice as essential and that it should be only one visit per year or even none at all. The data from this study demonstrated that nutritional intervention plays an essential role in the treatment, mostly because the assessment of the calorie intake goals and gastrointestinal symptoms is more complicated if the interview is not conducted accurately. Thanks to the on-site visits during the intervention periods, it was possible targeted treatment depending on the patient's deficiencies and conditions, which was reflected in a better proportion of patients with nutritional risk and low height.

One of the main factors for nutritional evolution is food security. Pepetone A. et al., identified the number of experiences related to food security before and after the outbreak of the COVID-19 pandemic in different countries, including Mexico, through the study was possible to observe that the number of experiences related to food insecurity was statistically significant after the outbreak of the COVID-19 pandemic, both in adults and in

young people aged 10-17 years, this takes relevance due to the socioeconomic context of our study population, due to the fact that the cost of nutritional treatment is very high, mainly in those patients with poor nutritional status who require commercial or home-made enteral supplements. The nutrition intervention in the clinic identifies the food security conditions of patients and their families, allowing recommendations to be made according to the resources available to them, with all these factors together could explain the evolution of those patients who did not come for follow-up during the covid-19 pandemic [6].

In contrast to our result where no significant changes in BMI were observed, Loukou I. et al. described improvement of BMI in patients older than 5 years, which was attributed to the monitoring of energy intake and more meals during lockdown, possibly omitted due to other activities prior to the COVID-19 [7]. Also, Doumit M. et al, described statistically significant improvement in BMI in patients older than 2 years; at the beginning of the pandemic the median BMI percentile was 45 and changed during follow-up to the 67th percentile. In our study, when patients were compared with those who were not followed up, no significant changes were identified in the BMI; however, the behaviour of our population showed improvement in the relationship to height [3,8].

Another disadvantage of the pandemic was the decrease of physical activity, therefore it is possible that the changes in the BMI of the patients may have been due to an increase in adipose tissue, for this, Doumit M. et al, consider that one of the key points to identify it is the measurement of the fat mass index, however, it is not possible to measure body components at home. This measurement was neither possible to perform in this study [8].

It is well known that there is a strong relationship between BMI or nutritional status and forced expiratory volume in one second (FEV1), but during the COVID-19 pandemic, due to an institutional regulation, it was necessary to perform a PCR test for SARSCov2 to perform spirometry, reason why not all patients went, since, due to logistics, they required two visits in the same week, increasing their risk of exposure. An important weakness of this study is the insufficient information on pulmonary function.

Conclusion
Under unfavorable conditions, such as the Covid-19 pandemic, close follow-up is essential to reduce nutritional risk and evaluate growth, even though TM is a useful tool, not all CF centers or countries have the conditions to perform it adequately. It is important to educate patients, family members and health care providers on the importance of attending all specialties as part of the integral treatment of the patient with CF.

Declaration of Competing Interest
Authors declare no conflict of interest.

Acknowledgment

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