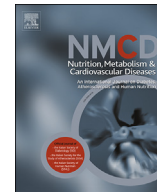




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## A telehealth intervention for ensuring continuity of care of pediatric obesity during the CoVid-19 lockdown in Italy

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**Abstract** *Background and aims:* Restriction measures adopted during the Coronavirus Disease-19 pandemic favored unhealthy behaviors. Tele-health offered the opportunity to pursue alternative ways of chronic diseases management. This retrospective study sought to determine the effects of a telehealth counselling intervention during the lockdown to children and adolescents with obesity previously engaged in a family-based secondary care program in an outpatient clinic of South Italy.

*Methods and results:* 117 out of 156 patients participated to the tele-health intervention. Participants underwent videocalls with each component of the multidisciplinary team to receive support in adopting adequate dietary habits and to practice exercise at home. They were included in a closed social group to watch age-adapted tutorials on healthy habits. 75 patients returned to the Center after the end of the lockdown, while only 7 patients who did not participate to the videocalls, took part to the follow-up. Body Mass Index and body composition were assessed in all these patients. BMI z score did not increase in both groups. However, a significant increase of fat mass was observed in the non-participating group (0.046), while the intervention group showed an increase of fat free mass ( $p < 0.000$ ).

*Conclusion:* Notwithstanding the limited sample size, the telehealth intervention allowed the maintenance of baseline weight status in participants, with an increase of fat-free mass. As the CoViD-19 pandemic moves forward, the increasing adoption of the new technologies may help the continuity of care, even in pediatric obesity treatment.

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### Introduction

The pandemic of Coronavirus 2019 disease (CoViD-19) has caused serious problems to the health systems

worldwide [1]. In order to control the viral spread and reduce the morbidity and mortality associated with the disease, many governments adopted measures of movement restriction, forcing people to stay at home [2]. In Italy, where the epidemic started at the end of February 2020, the complete lockdown was imposed from the 9th of March to the end of May [3]. During this period, schools, offices, stores and the majority of the workplaces

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were closed, and only people in a state of absolute necessity were allowed to leave their homes.

These control measures had important consequences on healthy behaviors of the Italian as well as of the other populations throughout the world [4–7].

Unhealthy lifestyle changes, such as reduced levels of physical activity and increased caloric intake, were reported mainly by individuals with previously worse lifestyles, such as inactive subjects or those with higher BMI [6,7].

In the course of the CoViD-19 pandemic, many activities were completely or fully digitalized by using video-communication platforms. Even e-health has become necessary in many settings to continue providing medical care reducing flow through healthcare facilities and limiting the risk of infection [8]. Management of obesity, which relies upon a chronic model of care, may benefit from innovative e-health solutions [9]. Telehealth or mobile health interventions are not new in the management of pediatric obesity, as demonstrated by several studies published before the pandemic [10–14]. These adjunctive tools help to increase the contact with children and families, which indeed is essential for effective pediatric weight management. However, few data are available regarding the exclusive use of telehealth interventions, especially during the current pandemic [15,16].

In the year 2018, the Local Health Authority “Napoli 3 Sud” (Campania Region) activated a “Second Level Assistance Center for Diabetes and Obesity in Childhood” based upon an integrated multidisciplinary approach involving the whole family.

Due to the restrictive measurements of the lockdown, the patients were not allowed to attend the Center location. Consequently, a telehealth counselling service was promptly activated in order to allow patients to continue their follow-up. This study is aimed to describe the telehealth intervention and to evaluate its effects on the obesity-related participants’ outcomes with respect to patients who did not participate in the intervention.

## Methods

This retrospective study sought to report the effects of the telehealth counselling provided during the Italian CoViD-19 lockdown to children and adolescents with obesity through the assessment of anthropometric changes in patients who participated in the intervention (here defined as “telehealth group”) and in those who did not (here defined as “non-participating group”).

## Participants

All the patients of the Center who had their last visit within three months before the lockdown were invited to participate in the intervention. Their parents were contacted consecutively by phone and invited to enable their children to participate in their previously scheduled visits through video calls.

Those patients who refused the telehealth service provided and came back for a visit to the Center after lockdown, were used for comparison.

## Intervention

The telehealth intervention took place between March and May 2020. All the components of the multidisciplinary team (nutritionists, psychologists, and kinesiologists) continued to supply the usual counselling by phone and videocalls scheduled every three weeks [17].

Each call lasted about 30 min and was structured in three phases. In the first 10 min, a nutritionist continued supporting patients to adopt healthy food habits. New suggestions for preparing or consuming meals were provided with the aim of improving their compliance to the recommended nutritional plan [18]. Thereafter, a psychologist worked at supporting the patients’ motivation for change. A communication strategy oriented to the patient’s empowerment was used to restore the perception of self-efficacy in children and their families through the detection of their own physical, psychological and relational resources [19]. During the last 10 min, the kinesiologist reinforced the information about the importance of reducing the time spent in sedentary activities and encouraged the practice of exercise at home, following the recommendation of the Italian Ministry of Health [20].

In addition, specific video tutorials about types of exercises tailored to the age and the physical characteristics of each patient were provided [21–23].

Furthermore, periodical “snack meetings” based on video calls involving 4/5 age-matched patients have been scheduled every two weeks in order to share eating during the break time and their life experiences during the lockdown (Digital Play Food Education) [24–27].

The videocalls were carried out from the Center location, in order to provide counselling sessions as much as possible similar to those performed in presence. Thus, the patients could experience the same setting they regularly attended (with the same rooms, objects, and their own drawings hung up to the walls) and interact with the entire care team, whom they were familiar to using the same verbal and non-verbal language. All the parents actively participated in videocalls.

In order to support the counselling activities through rapidly shared information, a closed social group named “Centro di Il livello Diabete e Obesità in età evolutiva - ASL Napoli 3 Sud” was also created on the Facebook [28], where daily suggestions and videos related to the promotion of healthy habits at home were posted by each of the components of the multidisciplinary team [17,29,30]. In particular, videos of playful activities aimed at developing motor coordination skills were proposed to children between 5 and 10 years of age and exercise sessions focused on the enhancement of conditional motor skills were proposed to youth of 11–18 years [31].

## Outcomes

At the end of the lockdown ( $T_1$ ), all the patients were invited by phone to reach the Center for their periodical control. Anthropometric outcomes were measured for each patient to detect possible changes respect to their condition before the lockdown ( $T_0$ ). In order to evaluate the immediate effects of the telehealth counselling, only those patients who were assessed in the month following the end of lockdown were included in the analysis.

Weight and height were assessed according to standard procedures by the same investigator, specifically trained. The Body Mass Index (BMI) was calculated and converted into BMI z-score [32].

Waist circumference (WC) was measured through a measuring tape (Seca, Hamburg, Germany). Body composition was assessed by bioelectrical impedance analysis (DS Medica, Milan, Italy); the following parameters were considered: phase angle, fat mass (FM), and fat free mass (FFM).

Body Mass Index was expressed in  $\text{kg}/\text{m}^2$ , while WC in cm. Phase angle was expressed in degrees, while FM and FFM were expressed either in percentages or kilograms.

## Statistical analysis

In order to verify the homogeneity of participating and non-participating groups, a descriptive analysis of socio-demographic and anthropometric characteristics of both groups assessed at the last visit before the lockdown was performed. Categorical variables were reported as number and related percentages, while continuous variables were reported as mean values  $\pm$  standard deviation (SD) or median values with inter-quartile range (IQR) depending on their distribution. The comparison between participating and non-participating groups was performed by the chi-squared test for categorical variables, and by the Student's *t* test for independent samples or the Mann–Whitney test for parametric and non-parametric variables, respectively. The Student's *t* test for paired samples and the Wilcoxon signed-rank test were used to evaluate the changes ( $\Delta$ ) in the outcomes registered at  $T_0$  and at  $T_1$  within each group. Pearson's and a Spearman's correlation analyses were performed in order to highlight possible relationship between the changes in the outcomes considered and gender (categorized as 0 = female, 1 = male), age, duration of engagement in the secondary care program, number of teleconsultations received during the lockdown, and condition at baseline, that is the last visit at the outpatient clinic. The significance level was assumed as  $p < 0.05$ . Analyses were conducted using the IBM SPSS Statistics for Windows, version 26.0 (Armonk, NY: IBM Corp.).

## Results

A total of 117 out of 156 patients who were invited to adhere to the telehealth service accepted to participate. Only 75 patients among the participating group (64.1%)

and 7 among the non-participating group (17.9%) returned for a visit within June 2020 and were included in the final groups. The patients' recruitment procedure is shown in Fig. 1.

The baseline socio-demographic and anthropometric characteristics of the participating and non-participating groups who effectively attended the visit at the end of lockdown were summarized in Table 1. No significant differences were found between the two populations.

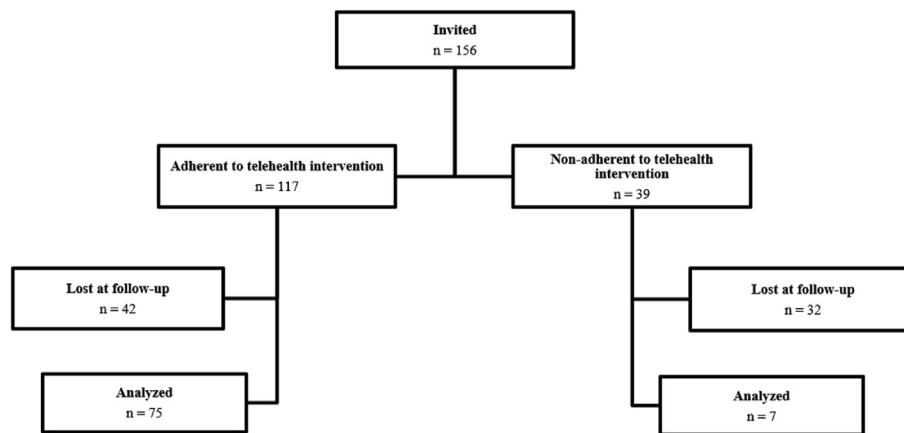
Table 2 reports the mean or median values of each anthropometric or body composition variable assessed at  $T_0$  and  $T_1$  with the corresponding changes between these two periods in participating and non-participating individuals. A significant increase both in BMI ( $+1.2 \text{ kg}/\text{m}^2$ ) and FFM ( $+3.8 \text{ Kg}$ ) was registered in the telehealth group, while a significant increase of FM ( $+3.1 \text{ kg}$ ) was observed in the non-participating group.

The results of the correlation analysis showed that age ( $r = -0.283$ ,  $p = 0.014$ ) and gender ( $\rho = -0.233$ ,  $p = 0.044$ ) were negatively related with changes in BMI. The duration of the engagement in the obesity management program at the Center was positively related with changes in BMI ( $r = 0.268$ ,  $p = 0.020$ ). The baseline condition was negatively associated only with the changes for WC ( $r = -0.370$ ,  $p = 0.001$ ), WC/height ratio ( $r = -0.316$ ,  $p = 0.006$ ), and FM (kg) ( $r = -0.256$ ,  $p = 0.028$ ). The number of videocalls attended did not correlate with any outcome.

## Discussion

This study was aimed at exploring the outcomes of a telehealth intervention offered to children and adolescents with obesity during the lockdown at the time of CoViD-19 epidemic in Italy. In order to highlight the effects of the intervention, we explored changes of anthropometric outcomes in patients who adhered to the remote counselling and in those who did not.

Notwithstanding the short duration of the telehealth intervention (two months) and the small size of the final sample, we registered an increase in BMI in the telehealth group, while no change was observed in the BMI z-score. The length of the intervention was probably too small to detect a change in this latter variable, as reported in the study by Nourse et al. [33]. Similarly, in their randomized study based on a 12-weeks web-based family telehealth nutrition intervention, Chai et al. did not detect significant differences in the weight status of participants [13]. Even in this case, the limited size of the samples may have reduced the power of the comparison. However, it should be noted that BMI z-score did not change either in the non-participating group from our study, but a significant change in body composition was observed respect to the intervention group: a significant increase of FM was found in the former, while an increase of FFM was found in the latter. Therefore, it is possible to assume that the participation to the telehealth intervention contributed at least to improve the body composition. In particular, the use of video tutorials of active games/exercises specifically



**Figure 1** Flow-chart of participants' recruitment, allocation and analysis.

designed for children or adolescents may have contributed to the improved result on FFM among participants. This can be considered an important result in terms of health in a so challenging phase such as the lockdown. The telehealth counselling accompanied children and their parents in the maintenance of a healthy lifestyle even during the emergency period due to the CoViD-19 pandemic, representing also a reference point in a precarious time. The continuity of care is a fundamental aspect in obesity treatment, and its suspension due to a mandatory restriction of outdoor movements might have been very critical for the therapeutic alliance with patients and their families. By continuing their course of treatment through videocalls,

patients were allowed to maintain their relationship with the same care group and the same care setting, strengthening their compliance to healthy choices. To overcome the less-personalized nature of telemedicine, clinicians used effective communication techniques and group activities to reinforce treatment recommendations [10].

In the correlation analyses we found that higher changes in BMI, corresponding to a lesser efficacy of treatment, were related with lower age, female gender and a longer duration of follow-up. These results are in contrast with those of previous experiences based on weight loss interventions for children and adolescents with obesity, delivered via well-structured visits [34,35]. Therefore, it is probable that different factors play a role on the efficacy of telehealth interventions. The baseline condition was inversely related with changes in WC, WC/height ratio, and FM, testifying lower difficulties in improving their condition by subjects with more severe adiposity [34].

As for the compliance to the intervention, three quarters of the patients invited decided to continue the treatment through videocalls. This rate is similar or slightly lower than that reported by other weight management interventions based on telehealth [13,33,36]. Subsequently, a consistent drop-out was registered, mainly among patients who did not adhere to the telehealth intervention. High drop-out rates in pediatric obesity treatment are frequent [37,38]. The review by Dhaliwal et al. shows that having public health insurance, older age, logistical barriers and programs not meeting families' needs may represent predictors of attrition in pediatric obesity management [37].

In our study, no differences were found in the demographic, anthropometric and social variables between those patients who complied and those who did not. Therefore, it was not possible to identify any predictor of adherence and acceptability of telemedicine.

Furthermore, literature suggests that telemedicine may reduce attrition rates in the long-term treatment of chronic conditions, such as obesity [15,16,39].

**Table 1** Baseline characteristics of the final groups participating and non-participating to the tele-health intervention.

	Participating group n = 75	Non-participating group n = 7	P
Gender, n (%)			
Males	46 (61.3)	2 (40)	0.092 <sup>a</sup>
Females	29 (38.7)	5 (60)	
Age, years mean value $\pm$ SD	11.3 $\pm$ 2.9	12.1 $\pm$ 3.4	0.505 <sup>b</sup>
Treatment duration, days mean value $\pm$ SD	149 $\pm$ 183.4	220 $\pm$ 164.9	0.32
Weight, kg median value (IQR)	62.4 (49.5–72.7)	65.5 (51.7–82.0)	0.429 <sup>c</sup>
Height, cm mean value $\pm$ SD	150 $\pm$ 0.1	150 $\pm$ 0.1	0.677 <sup>b</sup>
BMI, Kg/m <sup>2</sup> median value (IQR)	27.0 (25.5–29.7)	26.2 (24.8–30.1)	0.946 <sup>c</sup>
BMI z-score mean value $\pm$ SD	1.9 $\pm$ 0.5	2.0 $\pm$ 0.6	0.945 <sup>b</sup>
WC, cm mean value $\pm$ SD	89.7 $\pm$ 12.2	91.5 $\pm$ 11.1	0.700 <sup>b</sup>

BMI: Body Mass Index; IQR: Inter-Quartile Range; WC: Waist Circumference.

<sup>a</sup> Chi-squared test.

<sup>b</sup> Student's *t*-test.

<sup>c</sup> Mann–Whitney test.

**Table 2** Anthropometric measures of the groups participating and non-participating to the tele-health intervention before and after the lockdown.

		Participating group n = 75	$\Delta$	p	Non-participating group n = 7	$\Delta$	p
BMI, Kg/m <sup>2</sup> median value (IQR)	T <sub>0</sub>	27.0 (25.5–29.7)	1.2	0.042 <sup>b</sup>	26.2 (24.8–30.1)	1.4	0.115 <sup>b</sup>
	T <sub>1</sub>	28.2 (25.2–30.6)			27.6 (25.9–30.4)		
BMI z-score mean value $\pm$ SD	T <sub>0</sub>	1.9 $\pm$ 0.5	0	0.940 <sup>a</sup>	2.0 $\pm$ 0.6	0.1	0.210 <sup>a</sup>
	T <sub>1</sub>	1.9 $\pm$ 0.6			2.1 $\pm$ 0.5		
WC, cm mean value $\pm$ SD	T <sub>0</sub>	89.7 $\pm$ 12.2	–1	0.263 <sup>a</sup>	91.5 $\pm$ 11.1	1.2	0.282 <sup>a</sup>
	T <sub>1</sub>	88.7 $\pm$ 11.7			92.7 $\pm$ 9.6		
WC/height, cm median value (IQR)	T <sub>0</sub>	0.6 (0.6–0.6)	0	0.054 <sup>b</sup>	0.6 (0.6–0.6)	0	0.279 <sup>b</sup>
	T <sub>1</sub>	0.6 (0.5–0.6)			0.6 (0.5–0.6)		
Phase angle, degrees median value (IQR)	T <sub>0</sub>	5.6 (5.2–6.1)	0	0.489 <sup>b</sup>	5.4 (5.2–5.9)	0.2	0.916 <sup>b</sup>
	T <sub>1</sub>	5.6 (5.2–6.1)			5.6 (5.2–5.8)		
FFM, % mean value $\pm$ SD	T <sub>0</sub>	65.1 $\pm$ 6.6	0.9	0.121 <sup>a</sup>	61.1 $\pm$ 6.6	–1.3	0.389 <sup>a</sup>
	T <sub>1</sub>	66.0 $\pm$ 7.3			59.8 $\pm$ 6.2		
FFM, kg median value (IQR)	T <sub>0</sub>	38.9 (32.2–47.1)	3.8	0.000 <sup>b</sup>	43.2 (32.2–44.9)	2.9	0.173 <sup>b</sup>
	T <sub>1</sub>	42.7 (32.9–49.4)			46.1 (33.5–47.2)		
FM, % mean value $\pm$ SD	T <sub>0</sub>	34.8 $\pm$ 6.6	–0.9	0.122 <sup>a</sup>	38.9 $\pm$ 6.6	1.4	0.389 <sup>a</sup>
	T <sub>1</sub>	33.9 $\pm$ 7.3			40.2 $\pm$ 6.2		
FM, kg median value (IQR)	T <sub>0</sub>	20.8 (16.7–25.5)	0.7	0.316 <sup>b</sup>	22.4 (19.5–38.0)	3.1	0.046 <sup>b</sup>
	T <sub>1</sub>	21.5 (16.5–27.9)			25.5 (21.1–38.0)		

<sup>a</sup> paired Student's *t*-test; <sup>b</sup> Wilcoxon signed-rank test.

BMI: Body Mass Index; IQR: Inter-Quartile Range; WC: Waist Circumference; FFM: Fat Free Mass; FM: Fat Mass.

Hence, the reasons for the attrition registered in the present study were not identified. It has to be noted, however, that some of the patients who dropped-out at follow-up returned to the Center in the following months, but they were not included in the final samples because their anthropometric status may have been changed since the end of the lockdown, possibly due to other confounding factors.

The main strength of this study is represented by the objective assessment of anthropometric outcomes and the use of bioelectrical impedance analysis to evaluate body composition in the patients. Inevitably, this led to a reduced sample size, which represents the main limitation of the study. In particular, the limited number of non-participating patients in the final sample did not allow a stronger comparison. Furthermore, the briefness of the intervention and the retrospective design of the study limit the robustness of the results. Therefore, these findings should be considered with caution. Finally, since the reasons of dropout were not investigated, it was not possible to identify flaws in the intervention, and this limits its reproducibility.

However, this study represents a contribute to the characterization of telehealth interventions for childhood obesity. As the CoViD-19 pandemic moves forward, it appears increasingly clear how the new technologies may help the continuity of care, even in obesity treatment. The adoption of video calling tools or social media, which are widespread and easy to use, may strongly support this innovation.

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## Declaration of competing interest

The authors have nothing to disclose.

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