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Research Article

Impact of a Telenutrition Intervention on Body Composition and Eating Behaviour Changes in Individuals Living with Excess Weight

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Abstract

Introduction: Obesity is a serious health problem and according to a 2019 survey, 60.3% and 26.8% of Brazilians are living with excess weight and obesity, respectively. The present study aimed to assess anthropometric and body composition changes associated with behaviour change in individuals living with excess weight participating in a telenutrition education programme.

Methods: Longitudinal, retrospective study that assessed the impact of an intervention conducted from August 2017 to November 2019. The 6-month programme included seven online consultations and three face-to-face consultations (baseline; 3 months and 6 months). Dietary, anthropometric and body composition (using bioelectrical analysis) assessments were performed at the face-to-face consultations. Patients received nutritional advice and were remotely managed by video conference with the use of motivational and educational tools encouraging lifestyle and eating behaviour changes.

Results: The study sample comprised 93 adults and elderly patients living with excess weight (61 female and 32 male) who consented to participate in the study. Age ranged from 23 to 73 years (mean 45.7±11.8 years). The results indicated a significant improvement in weight loss, BMI, waist circumference, waist-to-height ratio and body fat at the end of the study in comparison with baseline values. There was a significant association between weight loss and eating behaviour changes, including decreased consumption of sugar, sweets and industrialized foods and an improved relationship with food.

Conclusions: The telenutrition programme was associated with weight loss and improvement in anthropometric indices and body composition. Besides, it encouraged eating behavior changes that contributed to a better dietary quality.

Keywords: Telenutrition; Telemedicine; Food and nutrition education; Feeding behaviour; Obesity

Introduction

The prevalence of global obesity reaches pandemic proportions, having increased exponentially across all socioeconomic groups and nearly tripled between 1975 and 2016 [1]. Obesity is considered a major risk factor for noncommunicable diseases, with a negative impact on life quality and expectancy [1].

According to the World Health Organization (WHO), more than 1.9 billion adults were living with overweight in 2016, which represents 39% of the world's adult population. Of these, over 650 million adults were living with obesity, about 13% of the world's adult population. It is estimated that by 2025, 2.3 billion adults will be living with overweight and 700 million will be living with obesity [2], representing 18% and 21% of the world's adult men and women, respectively [3]. In Brazil, the results of a survey published in 2019 with data from the Brazilian Institute of Geography and Statistics (IBGE) and the Ministry of Health showed that 60.3% individuals were living with overweight and 25.9% were living with obesity [4].

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An analysis performed by the McKinsey Global Institute indicates that obesity accounts for 5% of the world's deaths and that the global economic impact of obesity amounts to US $2.0 trillion, or 2.8% of the global Gross Domestic Product (GDP). In Brazil, the impact was estimated to be around 2.4% of the GDP and is one of the three major social burdens, along with violence and alcohol abuse. There is an inextricable connection between the rise in obesity rates and the increase of health care costs [5].

The main determinant of weight gain is the imbalance between energy intake and energy expenditure. An important driver of population weight gain was the continued and substantial increase in the intake of ultra-processed foods with high amounts of calories, sugar and fat throughout the last decades [1,6]. In addition, urbanization and changes in the patterns of work and transportation, in virtue of social and environmental modifications, led to increased physical inactivity, also contributing to population weight gain. Finally, there is the lack of support policies for health, agriculture, transportation, urban planning, environment, food processing, marketing and education [1].

One of the cornerstones of obesity treatment is nutrition education combined with lifestyle changes. Nutritional counselling for obesity management is based on approaches using evidence-based tools and strategies to facilitate eating behaviour change. Patients are increasingly seeking personalized and individualized care. To achieve optimal results, nutritionists must provide an informative approach combined with therapeutic counselling, using behaviour change strategies along with nutrition advice. Nutrition interventions should also consider cultural, social and lifestyle-related aspects to promote sustaining results [7].

It is consensus among experts that behavioural therapies comprising a comprehensive lifestyle programme, encompassing interventions that favour behaviour change together with self-monitoring of food intake, physical activity and body weight can be recommended for individuals living with overweight and obesity, through the use of motivational strategies [8,9]. Several studies have evidenced the use of telemedicine and telenutrition in the management of patients living with excess weight and obesity, as a facilitating tool for the patient's access to health care services. The use of telemedicine also enables the applicability of behaviour methods to promote lifestyle change [10-12].

According to the Academy of Nutrition and Dietetics (2019), telehealth is "the use of electronic information and telecommunications technologies to support long-distance clinical health care, patient and professional health-related education, and public health and health administration". All professionals that participate in telehealth must have appropriate protocols to prevent unauthorized access and to protect the security and integrity of patient information during transmission and among all health care services [13,14]. There is strong evidence that structured follow-up interventions with expert-provided nutrition counselling result in significant improvements in weight, body mass index, glycated haemoglobin, blood pressure and blood lipids [10-12,15]. The benefits of this approach include a potential reduction of costs, increased patient engagement and adherence, higher patient and provider satisfaction and improved outcomes, indicating that virtual health care will be increasingly adopted as part of the nutritional care in the digital age, marked by interconnectivity [13].

Therefore, the present study aims to contribute to the management of excess weight, facilitating patient access to health care through the implementation of a telenutrition programme focused on nutrition education, with the objectives of assessing changes in weight, body composition and eating behaviour in individuals living with excess weight, and to associate anthropometric and body composition measures with behaviour changes at the end of the programme.

Methods

Description of the Study Programme

Longitudinal, retrospective study assessing changes in weight, body composition and eating behaviour after a telenutrition intervention in adults living with excess weight and obesity, which participated and completed the programme entitled "*Programa de Reeducação Alimentar* (PRAVOCÊ)", between August 2017 and November 2019. The data from the patients followed in the programme were retrospectively collected from the electronic health records (Cerner Millennium).

The programme comprised seven online consultations and three face-to-face consultations over a 6-month period. On the face-to-face consultation, a complete nutrition assessment was performed: anthropometry, body composition assessment by bioelectrical analysis and dietary assessment. All consultations were conducted at the nutrition outpatient clinic of the Centre for Obesity Management and Prevention, with technical support from the Telehealth Department of the Hospital Israelita Albert Einstein (São Paulo, Brazil).

Anthropometric assessment included weight, obtained from the platform scale of the bioelectrical impedance analysis equipment, and height, measured with a stadiometer. Body Mass Index (BMI) was calculated as the weight in kilograms divided by the square of the height in meters. Waist circumference was measured with an inelastic tape, and the waist-to-height ratio was obtained by dividing waist circumference in centimetres by height in centimetres. Body composition was assessed by bioelectrical impedance analysis using In Body 520, and the dietary assessment was performed using a food intake questionnaire.

The nutritionists involved in the programme were trained to use a standardized consultation process elaborated by a specialist nutritionist. Also, the team was qualified by the professionals of the Telehealth Department to use the video conference application Webex. All devices were equipped with video camera and microphone. Before the first consultations, patients were guided by the Telehealth team on how to install and use Webex. At the scheduled time, both the nutritionist and the patient accessed the Webex application and the virtual room previously reserved for the consultation, making the consultation by video conference.

Patients were remotely managed using motivational and educational tools encouraging lifestyle and eating behaviour changes, and adjustments on the diet therapy plan and nutritional counselling were provided according to the patient's need and adherence. The approaches used to promote behaviour change were motivational interviewing, intuitive eating and mindful eating. During the programme, weekly motivational messages and bi-weekly e-books with nutrition education content were sent by SMS/email.

Based on the literature, a structured questionnaire containing 13 multiple-choice close questions was developed, previously elaborated to assess behaviour change. The questionnaire was applied at the last encounter with the objective to assess the patient's perception regarding the adherence while partici-

pating in the programme [16].

The self-assessment of behaviour change questionnaire included questions about the objectives of the patients regarding the treatment, their perception regarding change and maintenance of eating habits, eating behaviour and clinical changes.

All patients were invited to participate in a programme satisfaction survey, giving their opinion (very satisfied, satisfied or unsatisfied) on questions about the consultations, the frequency and duration of the consultations, the attention from the professionals, the experience with the virtual consultation and the attendance of the patient's expectations.

This research was approved by the Ethics Committee of Albert Einstein Israelita Hospital, according to the resolution of the national health council - CNS 466/12, under the protocol number 3.955.269 de (April 6, 2020 - CAAE 30106520.0.0000.0071).

All participants received the informed consent form electronically trough the REDCap management system, after the approval by the Ethics Committee. Only patients who accepted to participate were included in the research.

Statistical Aanalysis

Categorical data were described by absolute and relative frequencies and numeric variables were described by means and Standard Deviations (SD) or medians and quartiles, as well as minimum and maximum values. The distributions of the numeric variables were examined with histograms and boxplots, and the Shapiro-Wilk test for normality was used [17].

For the comparison between the moments of assessment, we used mixed linear models or generalized linear models [18], considering the dependency between measurements from the same patient in different moments. The results of the models were presented by means at each moment and mean differences between moments, 95% confidence intervals and p-values corrected by the sequential Bonferroni's procedure.

The association between behaviour and clinical changes and programme satisfaction with the weight variation observed at the end of the programme compared to the initial weight (weight after 6 months – initial weight) was investigated using linear models, controlling for the initial weight (covariance). The differences between the categories of the variable of interest were located using multiple comparison tests with sequential Bonferroni's correction.

The analyses of association between behaviour and clinical changes and programme satisfaction with weight variation could only be performed for the variables with few response categories and with a sufficient number of answers for all of the categories of these variables.

The analyses were performed using the SPSS software [19] at a significance level of 0.05. Study data were managed using REDCap electronic data capture tools, in conformity with the Health Insurance Portability and Accountability Act of 1996 (HIPAA), designed to support data capture for research studies [20,21].

Results

The database contained the records of 130 patients who participated and completed the programme and were invited to participate in the study. Of them, 35 did not respond to the invitation and two refused to participate. The study sample comprised 93 adult patients (aged over 18 years) with BMI ≥25 Kg/m² or elderly patients (aged over 60 years) with BMI ≥28 Kg/m², 61 female and 32 male. Age ranged from 23 to 73 years (mean 45.7±11.8 years).

Table 1 presents the anthropometric measurements and body composition obtained from bioelectrical impedance at each face-to-face consultation. Significant reductions in weight, BMI, waist circumference, waist-to-height ratio, body fat, and lean mass were observed after 3 and 6 months compared to the baseline. The same result was observed for the comparison between 3 and 6 months, except for body fat. Two of the participants were not present in the intermediate assessment, but all of them returned for the final 6-month assessment.

At the final consultation, 90 (96.8%) participants answered the self-assessment of behaviour change questionnaire. The main reason cited by the participants for seeking the consultation was aesthetics combined with health concern (60%), while the major encouragement for seeking nutritional care was self-awareness (53,3%), followed by discomfort/dissatisfaction with health and/or aesthetics (32,2%), and Medical recommendation (14,4%).

The patients performed a self-assessment of their behaviour change after participating in the programme, as shown in Table 2. Most of the parameters were improved, in particular meal planning, increased consumption of fruits and vegetables and decreased consumption of sweets, sugar and industrialized foods.

According to the punctuation of the self-assessment of behaviour change questionnaire, from the 90 participants, 44 (48.9%) presented very satisfying results, 37 (41.1%) satisfying results, 7 (7.8%) unsatisfying results, and 2 (2.2%) of the participants signalled very dissatisfying results.

The behavioural and clinical changes perceived by the patients are presented in Table 3. The participants reported improvements in quality and quantity of foods, and the main obstacle for adherence was the work routine combined with lack of time. The maintenance of new habits was related as being

Table 1: Mean values of anthropometric measurements and body composition obtained from bioelectrical impedance of patients followed in the telenutrition nutrition education programme (n=93).

	Baseline	3 months	6 months	p-value	p-value	p-value
				3 months-baseline	6 months-baseline	6 months-3 months
Weight (Kg)	90.6(86.9; 94.4)	87.5(84.0; 91.1)	86.4(82.9; 90.1)	<0.001	<0.001	0.013
BMI (Kg/m2)	31.9(30.9; 32.9)	30.8(29.8; 31.7)	30.4(29.4; 31.4)	<0.001	<0.001	0.014
Waist circumference (cm)	107.3(104.6; 110.2)	103.7(101.1; 106.4)	102.2(99.6; 104.9)	<0.001	<0.001	<0.001
Waist-to-Height Ratio	0.64(0.62; 0.65)	0.61(0.60; 0.63)	0.61(0.59; 0.62)	<0.001	<0.001	<0.001
Body Fat (Kg)	36.3(34,1; 38,7)	33.8(31,7; 36,0)	33.5(31,4; 35,8)	<0.001	<0.001	0.34
Body Fat (%)	40.0(38.3; 41.8)	38.7(37.0; 40.4)	38.8(37.0; 40.7)	<0.001	0.012	0.723
Lean Mass (Kg)	27.8(26.4; 29.4)	27.4(25.9; 28.9)	26.8(25.3; 28.3)	0.001	<0.001	0.028

95% CI: 95% confidence intervals; p-values corrected using Bonferroni's method

Table 2: Behaviour changes of patients followed in the tele nutrition nutrition education programme (n=90).

Behaviour	Worsened or remained inadequate (0)	Remained adequate (1)	Improved (2)
Physical activity practice	25(27.8%)	13(14.4%)	52(57.8%)
Meal frequency	15(16.7%)	13(14.4%)	62(68.9%)
Eating rate and mindful eating	22(24.4%)	11(12.2%)	57(63.3%)
Regarding the relationship with food	14(15.6%)	19(21.1%)	57(63.3%)
Hydration	7(7.8%)	28(31.1%)	55(61.1%)
Meal planning	11(12.2%)	2(2.2%)	77(85.6%)
Fruits and vegetables	5(5.6%)	21(23.3%)	64(71.1%)
Whole grains	9(10.0%)	20(22.2%)	61(67.8%)
Sweets and sugars	18(20.0%)	6(6.7%)	66(73.3%)
Soda or sweetened beverages	3(3.3%)	37(41.1%)	50(55.6%)
Alcoholic beverages	9(10.0%)	59(65.6%)	22(24.4%)
Fried foods and processed meats	3(3.3%)	26(28.9%)	61(67.8%)
Industrialized foods	5(5.6%)	10(11.1%)	75(83.3%)

something easy, or possible with few difficulties by most of the participants. Also, at the end of the study, most of the participants demonstrated the same preoccupation with aesthetics and health and reported improved anthropometric measurements. With regard to laboratory tests, more than half of the patients had not performed any test, while 38.9% reported improved laboratory test results.

Ninety patients answered the satisfaction survey, giving their opinion on their participation in the programme. Most of the participants were satisfied with the format of the programme which attended their initial expectations (87,8% duration, 93,3% covered content, 80% frequency of return and 96,7% attention from the professional, 92,2% telenutrition), and 100% of them recommend the programme.

Table 4 presents the results of the analyses of association between behaviour change and weight variation, showing that the behaviour change variables positively associated with weight loss were the improvement of the relationship with food, the decreased consumption of sugars and sweets and the decreased consumption of industrialized foods.

Weight variation was associated with the perceived changes in anthropometry and body composition, but not with perceived changes in bowel habit, as shown in Table 5.

About half of the patients did not perform laboratory tests after the programme, therefore the change in laboratory tests was not considered in the analyses of association with weight loss.

Table 6 shows evidence of association between weight variation and patients' satisfaction regarding the duration of the follow-up period. On the other hand, we found no association between weight variation and attainment of expectations, despite 87.8% (n=79) of the patients reported being satisfied with the programme.

Table 3: Behaviour and clinical changes of patients followed in the telenutrition nutrition education programme (n=90).

Assessment of the current diet compared with the previous diet	
Improved quality and quantity	70(77.8%)
Improved quantity	3(3.3%)
Improved quality	14(15.6%)
No improvements	3(3.3%)
Main obstacle for behaviour change	
Drastic change in eating habits and/or food restrictions	6(6.7%)
Work routine and/or lack of time	44(48.9%)
Slow aesthetic results	9(10.0%)
Too much hunger or desire to eat	5(5.6%)
Emotional factors	11(12.2%)
Social demands from family and friends	2(2.2%)
Not applicable	13(14.4%)
Maintenance of new dietary habits and lifestyle changes	
Will be easy	37(41.1%)
Will be possible, but with some difficulties	40(44.4%)
Will be difficult	13(14.4%)
Regarding aesthetics and health	
Became less concerned about weight and aesthetics and more concerned about health and behaviours	16(17.8%)
Became more concerned about weight and aesthetics and less concerned about health and behaviours	2(2.2%)
Became concerned with both aspects in a similar manner	9(10.0%)
Remained less concerned about weight and aesthetics and more concerned about health and behaviours	23(25.6%)
Remained more concerned about weight and aesthetics and less concerned about health and behaviours	5(5.6%)
Remained concerned with both aspects in a similar manner	35(38.9%)
Anthropometry and body composition	
Improved	69(76.7%)
Worsened or remained inadequate	21(23.3%)
Bowel habit	
Improved	40(44,4%)
Remained adequate	45(50.0%)
Worsened or remained inadequate	5(5.6%)
Laboratory tests	
Improved	35(38.9%)
Remained adequate	4(4.4%)
Worsened or remained inadequate	5(5.6%)
Were not performed	46(51.1%)

Table 4: Mean values of weight variation (kg) according to behaviour change of patients followed in the telenutrition nutrition education programme (n=90).

Behaviours	Behaviour change			p-value
	Worsened or remained inadequate	Remained adequate	Improved	
Physical activity practice	-2.65 (-4.75; -0.55)	-3.91 (-6.68; -1.15)	-5.07 (-6.47; -3.67)	0.177
Meal frequency	-3.57 (-6.20; -0.95)	-4.23 (-7.05; -1.41)	-4.39 (-5.67; -3.11)	0.861
Eating rate and mindful eating	-2.64 (-4.75; -0.52)	-3.01 (-5.98; -0.03)	-5.08 (-6.39; -3.77)	0.108
Relationship with food	-0.83 (-3.35; 1.70)	-2.55 (-4.75; -0.35)	-5.62 (-6.87; -4.38)	<0.001
Hydration	-6.48 (-10.26; -2.69)	-4,57 (-6.46; -2.67)	-3.77 (-5.12; -2.42)	0.383
Meal planning	-2.95 (-6.06; 0.16)	-4.36 (-5.52; -3.20)	---	0.406
Fruits and vegetables	-3.79 (-8.36; 0.77)	-3.59 (-5.79; -1.39)	-4.47 (-5.74; -3.21)	0.777
Whole grains	-1.51 (-4.79; 1.77)	-3.04 (-5.26; -0.83)	-5.02 (-6.28; -3.75)	0.076
Sweets and sugars	-1.36 (-3.65; 0.93)	-4.53 (-8.50; -0.56)	-4.98 (-6.18; -3.79)	0.023
Soda or sweetened beverages	---	-3.89 (-5.61; -2.17)	-4.43 (-5.90; -2.96)	0.645
Alcoholic beverages	-1.25 (-4.54; 2.05)	-4.21 (-5.50; -2.92)	-5.49 (-7.61; -3.38)	0.103
Fried foods and processed meats	---	-2.89 (-4.67; -1.11)	-4.58 (-5.74; -3.42)	0.119
Industrialized foods	1.12 (-3.48; 5.71)	-2.37 (-5.44; 0.70)	-4.83 (-5.96; -3.71)	0.023

Data expressed as means and 95% confidence intervals (CI) for the difference between the initial weight and weight after 6 months, controlling for the initial weight.

Table 5: Mean values estimated for weight variation according to clinical change of patients followed in the telenutrition education programme.

Characteristics	Clinical change			p-value
	Improved	Remained adequate	Worsened or remained inadequate	
Anthropometry and body composition	-5.33 (-6.45; -4.21)	--	-0.61 (-2.64; 1.43)	<0.001
Bowel habit	-4.04 (-5.65; -2.43)	-4.27 (-5.77; -2.76)	-5.38 (-9.99; -0.77)	0.866

Data expressed as means and 95% confidence intervals (CI) for the difference between the initial weight and weight after 6 months, controlling for the initial weight.

Table 6: Mean values estimated for weight variation according to the patients' satisfaction with the telenutrition education programme.

Characteristics	Satisfaction with the programme			p-value
	No	Partially	Yes	
Follow-up period was satisfactory	-2.63 (-4.88; -0.39)	-3.21 (-5.08; -1.33)	-5.60 (-7.11; -4.09)	0.046
The programme met my expectations	---	-1.63 (-4.64; 1.37)	-4.59 (-5.71; -3.47)	0.071

Data expressed as means and 95% confidence intervals (CI) for the difference between the initial weight and weight after 6 months, controlling for the initial weight.

Discussion

This study showed benefits of the use of telenutrition in a 6-month nutrition education programme resulting in decreased weight, BMI, waist circumference, waist-to-height ratio and body fat, as well as positive changes in eating behaviour. Even though the patients maintained the BMI in the range of obesity, a 5% reduction in initial weight was achieved, which is considered clinically beneficial and relevant for the management of metabolic alterations associated with obesity [22].

Similar weight loss results were found in a study with 25 adults living with obesity, that aimed to assess weight change using a fully online 12-week telehealth programme [23]. In this study, patients were randomly assigned to 2 groups: Video Conference (VC) and Control (CTR). The VC group had monthly meetings with a medical doctor and weekly meetings with a nutritionist, and the CTR group met with the research team at baseline and after 12 weeks. There was a statistically significant difference between the intervention group and the control group for weight loss (VC: -7.3±4.4 kg versus; CTR: -1.2±4.1Kg), as well as for the reduction of body fat (VC: 9.0±8.3% versus CTR: 1.3±7.7%). This work demonstrated that a telehealth programme with video conference support may promote weight loss. The authors concluded that weekly educational video conferencing may be a feasible tool to promote significant weight loss in patients living with obesity [23].

A systematic review with meta-analysis was performed including randomised controlled trials that compared telemedicine tools (e.g., internet-based system, text messaging, telephone or video conferencing) with usual care or standard treatments in people living with overweight, obesity, diabetes and hypertension. A meta-analysis was conducted for the eligible studies, with change in BMI as the primary outcome. A total of 25 randomised controlled trials with 6253 participants were included in the qualitative and quantitative study. The intervention length ranged from 9 weeks to 2 years. The results revealed that interventions using telemedicine were associated with significant decrease in BMI compared to controls, especially in interventions with duration ≥6 months [24].

Another study tested the effectiveness of a telephone lifestyle intervention for individuals living with obesity, at a community health centre in the United States. This 6-month pilot study provided bi-weekly phone coaching sessions aiming to facilitate weight loss. The parameters evaluated were stress, sleep, physical activity and nutritional habits and behaviour. The mind, body and nutrition single-arm intervention was associated with a trend toward weight reduction, sustained for 6 months, as well as significant improvements in systolic blood pressure, perceived stress and behavioural eating [25].

In the present study, an undesirable result was the mean loss of 1.1 kg of lean mass at the end of 6 months; however, this effect generally accompanies weight loss. Corroborating this finding, several clinical studies also reported loss of lean mass during weight loss. In a randomised trial that assessed the effects of weight loss induced by calorie restriction accompanied or not by endurance exercise for 12 to 14 weeks, weight loss was 7% of the initial weight in all groups, and significant decreases in lean mass (0.9 kg) occurred in the group with calorie restriction alone. Exercise preserved lean mass during weight loss, supporting the relevance of exercise as a component of weight loss programmes [26]. In another review study, the data showed that diet-induced weight loss reduces lean mass without adversely affecting muscle strength and while improving global physical function, that high protein intake helps to preserve lean mass during weight loss, but does not improve muscle strength, and that endurance exercises help to preserve lean mass during weight loss and also improve muscle strength [27].

In a meta-analysis of 15 studies that evaluated experimental research on meal frequency with respect to changes in fat mass and lean mass, increased meal frequency (>5 meals) was positively associated with reductions in fat mass and with an increase in lean mass [28], suggesting a potential benefit of increased meal frequency for the preservation of lean mass.

It is important that nutrition interventions for obesity management focus on achieving health outcomes for chronic noncommunicable disease risk reduction and improved quality of life, not only weight changes [29]. Weight-centric approaches are associated with weight stigma and diminished physical health and well-being. Alternatively, interventions should focus on points such as perceiving the internal cues of hunger and satiety, eating nutrient-dense foods on a regular basis, engaging in pleasurable exercise, maintaining adequate hydration, among other sustainable behaviours [30].

Most of the patients sought out for our programme for aesthetics and health reasons and because of self-awareness. At the end of the programme, they were able to identify positive changes in eating behaviour, with regard to meal planning, decreased consumption of industrialized foods, decreased consumption of sugars and sweets, higher consumption of fruits and vegetables and improved meal frequency.

An important result of the present study was the decreased consumption of industrialized foods in association with increased weight loss, which reinforces the findings of several clinical and population studies that showed a strong association between the intake of these foods and the risk of overweight and obesity [6,31-33]. It is well-known in the literature that the category of ultra-processed foods, which are prepared with high amounts of fat and sugars, present high energy density, contributing to excessive calorie intake even in small portions [34]. An inpatient randomised controlled trial of *ad libitum* food intake in which 20 adults were exposed to ultra-processed versus unprocessed diets for 2 weeks each, showed that *ad libitum* consumption of ultra-processed foods resulted in greater energy intake and greater weight gain, while participants lost weight during the unprocessed diet [35].

The impact of the decreased consumption of sugar is also relevant for the management of obesity. Sugar is highly palatable and rewarding, and an excessive intake may trigger neuroadaptations in the brain reward system that might lead to compulsive eating [36]. In a systematic review conducted by Portuguese researchers, the decrease in sugary foods was one of the main factors associated with weight loss maintenance, along with having healthy foods available at home, regular breakfast intake and increasing vegetable consumption [37]. It is worth mentioning that total sugar restriction is not necessary for obesity management. Nutrition education interventions focus on the promotion of a balanced diet, with positive messages about food and nutrition. The communication between health-care professionals and a person living with obesity must involve a non-judgmental, non-stigmatising, helpful and collaborative language [38].

In our study, weight loss was associated with an improved relationship with food. It is likely that the participants experienced a better understanding of the internal cues of hunger and satiety. An improved relationship with food results in decreased food cravings, less food restraint and guilt, and not using food as a compensation for emotional problems.

During the virtual consultations, the obstacles for behaviour change were openly discussed throughout the entire follow-up period, tailoring the lifestyle and nutrition intervention with the use of a variety of educational and motivational strategies to promote treatment adherence.

Considering the alarming prevalence of obesity, treatments with broad reach must be implemented. A systematic review that examined eHealth and telehealth interventions that incorporated motivational interviewing for weight loss indicated that digital interventions (email, phone and online chats) show moderate effectiveness, performing comparable to other types of intervention. Digital interventions had high patient engagement and retention, holding promise as an effective obesity treatment [39].

Approximately 92.2% of the participants reported a good satisfaction with the virtual consultations and all respondents of the satisfaction survey would recommend the programme to others. A similar programme was conducted in the United States, providing eight bi-weekly sessions over a period of 16 weeks to groups of 1 to 10 participants living with obesity, without a control condition. The 1-hour group sessions were led by a multidisciplinary team by video conference. The topics addressed were portion control, self-monitoring, stress management, relapse prevention and effective exercise. At each group session, patients were encouraged to participate in the discussions and were assisted by the health professionals in real-time. Of 138 patients who started the programme, 62% completed the intervention. Completers presented a significant weight loss of 3.5%, reported satisfaction with the programme and 97% would recommend it to others [40].

The use of motivational messages and e-books in our programme also seems to have contributed to behaviour changes and maintenance of healthy attitudes. A systematic review with meta-analysis of 12 studies was conducted to compare the efficacy of the use of mobile phone interventions based on text messaging and multimedia message services compared to other approaches to promote weight loss and increase physical activity. Compared with the control group, the use of mobile phone apps was associated with significant changes in body weight and BMI, showing that mobile phone app-based interventions may be useful tools for weight loss [41].

The advance of information and communication technologies provide opportunities to improve the results of interventions aimed at education and health behaviours [42].

In our study, most of the participants (48.9%) cited work routine and lack of time as obstacles for behaviour change and 44.4% reported that the new habits and lifestyle can be maintained, although with some difficulties. In the study of Brown (2020) [40], one of the providers highlighted the fact that the telehealth programme provided access to a weight loss intervention that would otherwise not have been available to the patients, overcoming transportation and financial barriers.

A recent study conducted in Israel addressed the management of obesity in the context of the outbreak of COVID-19, in which countries around the world declared lockdowns and imposed restrictions that led to significant behaviour changes. These changes included a decrease in daily physical activity, and an increase in screen time, stress and emotional eating, conditions associated with a negative impact on weight. The study was conducted during Israel's first quarantine and assessed the association between changes in dietary and lifestyle habits and

body weight, and the benefits of receiving remote obesity care via telemedicine. There were 279 valid responses to an online survey that showed that, compared to patients not receiving obesity care via telemedicine, patients receiving this care were more likely to lose weight and increase participation in exercise. This study highlighted the relevance of continuous obesity care using telemedicine during the pandemic, in order to promote weight loss and prevent weight gain, despite the trend of deterioration in a number of health habits for many patients living with obesity during the COVID-19 quarantine. Telemedicine has been increasingly recognised as an invaluable tool during the pandemic, and the authors emphasise that its use should be maximised ad integrated with the usual treatment with face-to-face consultations beyond the pandemic [43].

Study Limitations

An important limitation of the present study is the fact that it was not originally designed to compare telehealth to another type of care in the management of individuals living with excess weight. Therefore, this study had no control group. The original purpose of the authors was to provide an extensive care to people living with obesity through the use of telenutrition, encouraging lifestyle changes, especially regarding eating habits.

Perspectives

The incorporation of different forms of technological evolution on society contributes significantly to the provision of qualified care in different kinds of services. In the health field, these advances allow the development of actions aimed at planning, research, assistance and education.

Telehealth can contribute in a satisfactory way to address many health challenges, promoting up-to-date medicine and nutrition. Since Brazil has continental dimensions, telehealth can provide better integration of the healthcare system, overcoming the existing fragmentation and assisting the access to the full right to health with quality and safety, reducing costs and contributing to population health.

Conclusion

The nutritional intervention and follow-up through the use of telenutrition was associated with weight loss with improved anthropometric measurements and body composition. Besides, the programme promoted behaviour changes that contributed to improved dietary quality. Future randomised controlled studies are needed to further understand the improvements and effectiveness associated with the use of telenutrition in nutrition education programmes.

Author Statements

Declaration of Conflicting Interests

No potential conflicts of interest relevant to this article.

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