



# Effectiveness of a Program Based on Telehealth in Nutritional Knowledge and Body Mass Index in Peruvian University Teachers

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## Abstract

**Background:** University teachers, as agents of socialization, are one of the most influential groups in improving public health, and their nutritional knowledge can influence both the eating behavior of students and the family. **Objective:** This study was carried out to evaluate the effect of a telehealth program on the level of nutritional knowledge and body mass index (BMI) of university teachers. **Methods:** A pre-experimental study was carried out from August to December 2020. A pretest and a posttest were applied. The number of teachers in the initial test was 88 and those included in the final evaluation, 83; and they were selected by nonprobability sampling for convenience. The telehealth-based program lasted 18 weeks and included basic information on nutrition and motivational messages. Sociodemographic and anthropometric data were collected through a predesigned questionnaire before and after the educational program. **Results:** Posttest knowledge scores increased significantly from  $6.40 \pm 1.70$  to  $10.59 \pm 1.18$  ( $P < .001$ ). In relation to time, significant variations are observed in weight measurements ( $P < .001$ ), BMI ( $P < .001$ ), and basic nutritional knowledge ( $P < .001$ ) before and after the intervention program. **Conclusion:** The telehealth-based intervention improved basic nutritional knowledge levels and BMI. Likewise, the current findings provide evidence on the importance and need to develop future nutritional education programs that comprehensively encompass all study plans for the benefit of the university community.

## Keywords

nutritional knowledge, teachers, BMI, university students, telehealth, Peru

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## Introduction

Metabolic diseases, including cardiovascular diseases, obesity, type 2 diabetes mellitus, high blood pressure, and different types of cancer have become one of the most important public health problems in both developed and developing countries; they also represent a higher risk of morbidity and mortality.<sup>1,2</sup> Additionally, it hinders the functional development, academic performance, and socioeconomic development of the country.<sup>3</sup>

The transition from high school to college life involves substantial changes in the lives of young adults.<sup>4</sup> In addition, the university environment represents a real health challenge for students because they can have greater access to foods with higher content of saturated fats, sodium, and

free sugars; consequently, an increased risk of being overweight and obese.<sup>5</sup> Inadequate eating habits, added to the easy access to high-calorie products in university canteens, constitute one of the factors that negatively contributes to the nutritional and health status of university teachers and students.<sup>6,7</sup> Studies have even shown that college students

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are more likely to gain weight than those who do not attend college.<sup>8</sup>

University teachers, as agents of socialization, are one of the most influential groups in improving public health. They interact with students in a permanent way in the university environment.<sup>9</sup> They represent the communication ring between universities and health centers, and transfer their nutritional knowledge to their students, who do the same with their families.<sup>10</sup> Teachers can significantly influence students' eating habits in a number of ways, whether through their eating behaviors, implementation of nutrition education programs, or other healthy lifestyle initiatives in the classroom.<sup>9,11</sup> In fact, studies have shown that the dietary patterns of students are mainly affected by the nutritional knowledge of teachers.<sup>12</sup>

Students represent the future of society, and to keep a society active and healthy, the consumption of healthy foods is essential. Therefore, it is necessary to improve the nutritional knowledge of the entire university population, especially of teachers<sup>13</sup> on topics related to healthy eating and nutrition, and how they prevent the disease and maintain health.<sup>14</sup> Nutrition education programs can induce positive changes by improving the eating habits of teachers and students; which, in turn, will lead to adequate nutrient intake and decreased risk factors for metabolic diseases.<sup>15</sup>

Food is one of the most basic needs of human beings, so nutrition and food hygiene should be considered as one of the educational aspects in the study plan. In fact, the Ministry of Health of Peru, through a technical document, emphasizes the importance of creating and maintaining healthy environments, healthy food and nutrition in the university environment to reduce the risk of communicable diseases and non-communicable.<sup>16</sup> However, university teachers seem to lack effective methods for incorporating health elements into their classrooms due to lack of knowledge.<sup>11</sup>

Telehealth is applied to the use of information and telecommunication technologies to satisfy the demands of health consultations, especially health education for both patients and professionals.<sup>17</sup> It is an effective way to cover multiple health activities for geographically separated people to promote and maintain a healthy lifestyle.<sup>18</sup> Telehealth lifestyle interventions synchronously (ie, at the same time, in a different location) and/or asynchronously (ie, at a different time, in a different location) allow flexible use of tools such as video conferencing, email, phone, mobile apps, data, pictures, text, and photo messaging.<sup>19</sup>

In Peru, various nutritional education programs were implemented to contribute to food security and reduce malnutrition and the risk of obesity.<sup>20</sup> However, research on the impact of nutritional educational programs on university teachers has not yet been explored. Consequently, there is a clear need to carry out studies to evaluate nutritional education programs developed in university spaces to contribute

to changes in eating behaviors for the benefit of the university population and society in general. Therefore, the present study aimed to examine the impact of a telehealth-based nutrition education intervention on the knowledge of healthy eating and BMI in university teachers.

## Materials and Methods

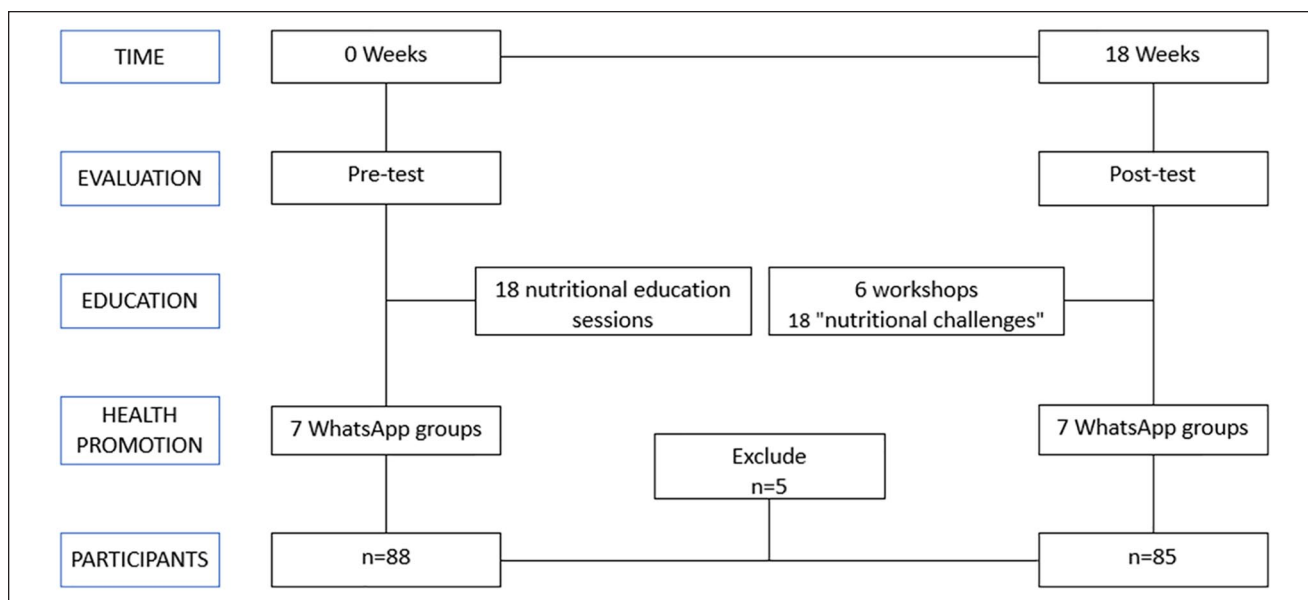
### *Design, Context, and Participants*

A pre-experimental design study was carried out with the help of virtual tools. A preliminary questionnaire, pretest and posttest were applied between August and December 2020 to teachers of a private university in the City of Tarapoto, Peru. The teachers were selected through non-probability convenience sampling, who participated in a nutritional education program based on telehealth, distributed in 18 educational sessions over 18 weeks. Those teachers who were found teaching during the academic cycle 2020-II were selected. The number of teachers who started the initial test was 88, and those who finished the program were 83. The participants were aged between 23 and 61 years. The study was carried out after having requested the approval of the Research Ethics Committee of the Universidad Peruana Unión (Campus Tarapoto) and registered with the reference number: 0001-2020/CE/CT/UPeU. Before the start of the study, electronic informed consent was obtained from the participants. Finally, the study was carried out according to the criteria established in the Declaration of Helsinki.

### *Implementation and Development of the Telehealth Program*

In the first place, the participants were brought together through the virtual platform Zoom Video Communications and they were made aware of the objectives of the educational program; they were explained the delay time of the training and what constituted the different activities that would be required during execution. Likewise, a short online survey was applied to them, which was composed of sociodemographic data (age, sex, origin, marital status, and level of education). Moreover, self-reported anthropometric data (weight and height) were collected from the participants. Similarly, they were administered a preliminary test to assess the current state of their knowledge about healthy nutrition and eating.

Second, immediately after the initial trial, the study's principal investigator delivered a 40-min "importance of healthy eating" training. Teachers had a space to ask questions about the topic discussed. At the end of the session, the teachers were divided into 7 groups; each group was led by a "Health Promoter," who had the task of motivating the members through motivational messages prepared by the



**Figure 1.** Study design.

study researchers via WhatsApp Messenger. Each group was identified by the name of some food.

Finally, after completing the 18 nutrition education sessions, study participants were invited for a post-intervention test that included the same pretest questions, and changes in their level of knowledge about healthy eating were examined. In addition, sociodemographic and anthropometric data were collected again. Both tests (preliminary and later) were applied through a Google Form (Figure 1).

### Materials Development

*Topics/workshops:* Previously, the preparation of theoretical materials was carried out, considering basic information on the characteristics of a healthy diet and the development of 6 workshops, which are described in Table 1.

*Nutrition challenge:* After each training, a poster is sent to the participants with an encouraging message and a challenge to meet, via the instant messaging application WhatsApp Messenger. To demonstrate compliance with the challenge, teachers were required to send photos or videos as evidence. The challenges included topics such as consumption of water, fruits, vegetable salads, nuts, replacing simple sugar with raisins or dried fruits, balanced breakfast, among others. During the week, the “Health Promoter” was in charge of reporting progress regarding meeting the challenge. The results of meeting the challenge were reported during each virtual session conducted weekly by the researcher. To encourage teachers, they were scored based on the following scores: that group in which 100% of the members were observed meeting the challenge, obtained 100 points and, if the number of members who met the challenge corresponded to 80%, the group obtained 80 points.

**Table 1.** Topics/Workshops of the Telehealth Program for University Teachers.

Section	Topics/workshops treated for 9 weeks
1	Healthy eating and its benefits
2	Importance of breakfast
3	Workshop 1: Healthy breakfast
4	Food classification
5	The colors of a healthy plate (antioxidants)
6	Workshop 2: Healthy entrees
7	Nutritional importance of Andean grains
8	Importance of dietary fiber
9	Workshop 3: Healthy lunch
10	Importance of healthy fats in health
11	Water consumption and its benefits
12	Workshop 4: Healthy dinner
13	Healthy mid-morning and mid-afternoon
14	Nutrition label reading and interpretation
15	Workshop 5: Healthy desserts
16	Diet and physical activity
17	Cooking methods: advantages and disadvantages
18	Workshop 6: Healthy snacks

*Healthy recipes:* Every 2 weeks, a demonstration session was held synchronously and asynchronously on healthy recipe preparations. The recipes were previously recorded and later shared with the participants during the training meetings. In addition, they were given the recipes developed during these sessions and were asked to make similar and healthy recipes and share the photos in their respective WhatsApp groups. The demonstration sessions included breakfast, salads, lunch, dinner, desserts, snacks, and healthy vegetable drinks (Table 1).

### Sociodemographic Data and BMI

Sociodemographic data such as age, sex, marital status, region of origin, and level of education were collected. Furthermore, weight and height were self-reported by the participants at the beginning and end of the program (August and December 2020, respectively). The BMI was calculated according to the Quetelet index, in accordance with the parameters established by the World Health Organization (WHO). Likewise, it was classified as follows: (a) thinness  $<18.5$ ; (b) normal weight,  $18.5$  to  $24.9 \text{ kg/m}^2$ ; (c) overweight, between  $25.0$  and  $29.9 \text{ kg/m}^2$ ; (d) obesity  $\geq 30$ .<sup>21</sup>

### Knowledge Questionnaire

The state of knowledge of the participants about nutrition and food was measured through a nutritional knowledge questionnaire developed following the criteria proposed by Food and Agriculture Organization of the United Nations (FAO) in its Guide to assess knowledge, attitudes, and practices in nutrition.<sup>22</sup> It comprises 12 items, the questions of which can be viewed at <http://www.fao.org/3/i3545e/i3545e00.htm>. To determine the clarity and feasibility of the questionnaire, the instrument was tested on a pilot sample of 50 participants. Reliability was determined through the Kuder-Richardson analysis. Cronbach's  $\alpha$  coefficient was  $>.7$ .<sup>23</sup>

### Statistical Analysis

The sociodemographic data (age, sex, origin, marital status, educational level) of the participants were described using the mean ( $M$ ) and standard deviation ( $SD$ ) for continuous variables and frequency (percentages) for categorical variables. In addition, the skewness and kurtosis coefficients were estimated to analyze the behavior of the variables. In turn, a normal distribution analysis was made through the Shapiro-Wilk test and Kolmogorov-Smirnov test. Differences in weight, BMI, and nutritional knowledge before and after the educational program were performed using Wilcoxon's nonparametric statistical test. The level of statistical significance was  $.05$ . All data were analyzed in collaboration with a specialist in biostatistics. Data processing and analysis were performed using the R and SPSS statistical packages, version 27 (SPSS Inc., Chicago, IL, USA).

### Results

Table 2 shows the sociodemographic data and the BMI of the teachers before and after the nutritional education program based on telehealth. The sample consisted of 83 university teachers, with a mean age of  $36.2 \pm 10.0$  between

**Table 2.** Sociodemographic Characteristics and BMI before and after the Telehealth Program.

Variable	M/N	SD/%
Age (years)	36.2	10.0
Sex		
Female	38	45.8
Male	45	54.2
Region of origin		
Coast	22	26.5
Jungle	61	73.5
Marital status		
Married	55	66.3
Single	28	33.7
Degree of instruction		
Undergraduate	40	48.2
Postgraduate	43	51.8
BMI before the telehealth program		
Normal	40	48.2
Overweight	40	48.2
Obesity	3	3.6
BMI after the telehealth program		
Normal	67	80.7
Overweight	15	18.1
Obesity	1	1.2

Abbreviations:  $M$ , mean;  $n$ , frequency;  $SD$ , standard deviation.

both sexes. Men represented the largest proportion of the sample,  $54.2\%$  ( $n=45$ ). The teachers came from 2 of the 3 regions of the country, of which the jungle was the place of origin of most of the teachers:  $73.5\%$  ( $n=61$ ).  $66.3\%$  ( $n=55$ ) were married. The highest proportion ( $51.8\%$ ,  $n=43$ ) of the teachers had a postgraduate degree (master's or doctorate). The proportion of teachers who had a normal weight before the program was  $48.2\%$  ( $n=40$ ). However, it was observed that after the application of the educational program, there was an increase of  $32.5\%$ .

Table 3 describes the mean values of the teachers' scores in the variables weight, BMI, and knowledge before and after the educational program based on telehealth. The mean weight before and after the test was  $66.61 \pm 10.81$  and  $63.90 \pm 9.24$ , respectively, observing very significant differences ( $P < .001$ ). BMI scores decreased significantly from  $25.22 \pm 2.58$  to  $24.19 \pm 1.65$ ,  $P < .001$ . Post-test knowledge scores increased from  $6.40 \pm 1.70$  to  $10.59 \pm 1.18$ . The difference between the teachers' scores before and after the educational program was significant ( $P < .001$ ).

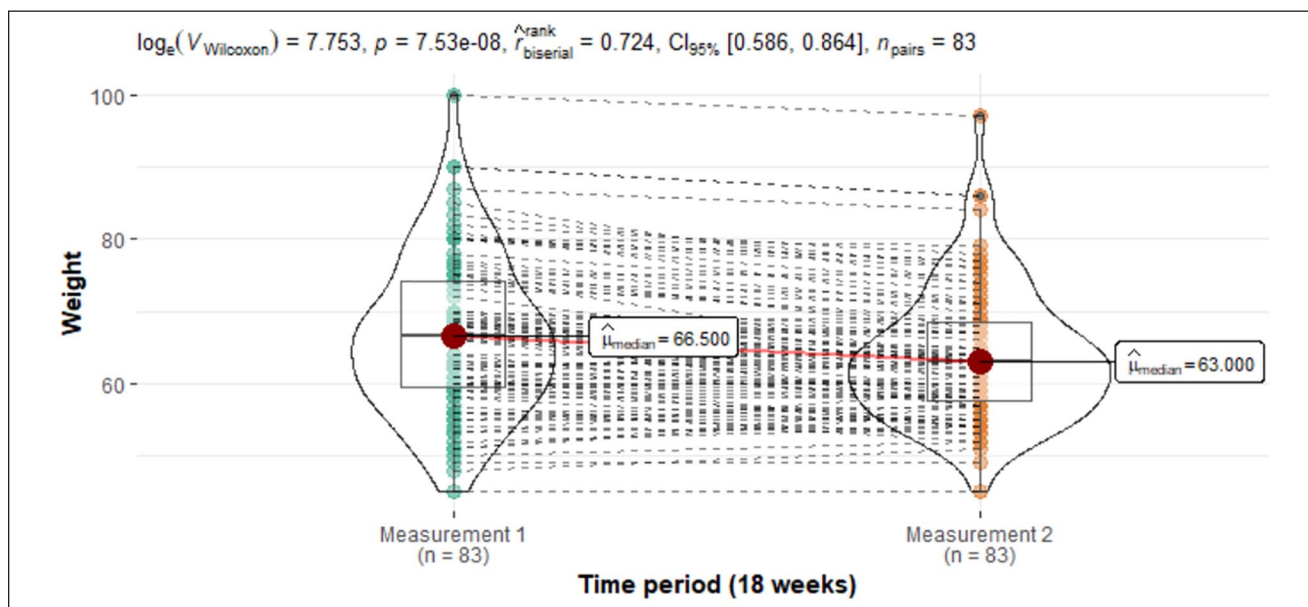
Figures 2 and 3 show the effect of the telehealth-based nutritional education program on teachers' weight and basic nutritional knowledge, respectively. In relation to time, significant variations are observed in weight measurements ( $P < .001$ ) and basic nutritional knowledge ( $P < .001$ ) before and after the intervention program.

**Table 3.** Mean, Standard Deviation, Distribution, Difference of Nonparametric Measures, and Effect Size.

Measures	M	SD	SE	S	K	MD	Wilcoxon	P	E. Size*
Weight (kg) 1	66.61	10.81	1.19	0.51	0.18	2.70	2328	<.001	0.724
Weight (kg) 2	63.90	9.24	1.01	0.39	0.25	—	—	—	—
BMI (kg/m <sup>2</sup> ) 1	25.22	2.58	0.28	0.92	1.32	1.02	2302	<.001	0.705
BMI (kg/m <sup>2</sup> ) 2	24.19	1.65	0.18	1.72	6.35	—	—	—	—
Knowledge 1	6.40	1.70	0.19	-0.19	-0.38	-4.19	5	<.001	0.997
Knowledge 2	10.59	1.18	0.13	-0.61	-0.35	—	—	—	—

Abbreviations: E. Size, effect size; K, kurtosis coefficient; M, mean; MD, mean difference; P, probability of error; S, coefficient of skewness; SD, standard deviation; SE, standard error of the mean.

\*For the Wilcoxon test, the effect size is given by the paired rank biserial correlation and through the Hodges-Lehmann estimator.



**Figure 2.** Effect of the telehealth program on the weight of the participants.

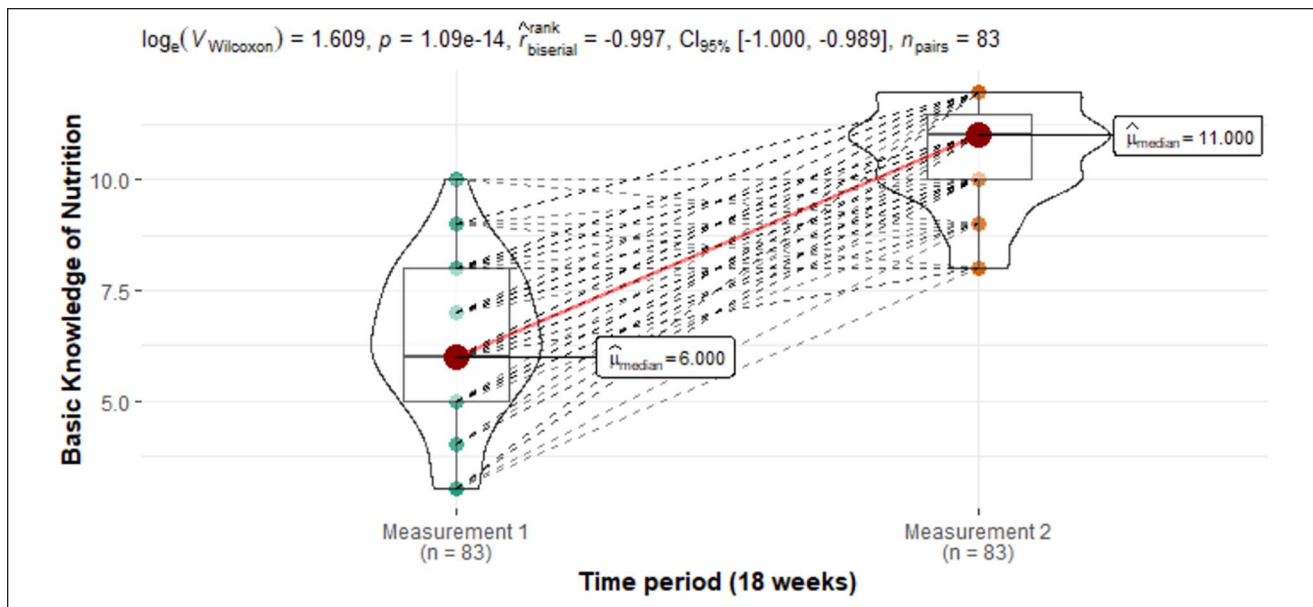
### Discussion

This study was designed to measure improvements in nutritional knowledge and BMI after the application of a nutritional education program based on telehealth in university teachers. The use of telehealth, as well as web-based technological tools (reminders for cell phone messages, WhatsApp Messenger, email, among others) to provide advice on nutrition education could be potentially scalable solutions to improve the basic nutrition knowledge of the population and thus improve health indicators such as weight, BMI, and prevent chronic diseases such as obesity, especially in a context of global health crisis.<sup>17</sup>

As expected, the results of this study indicated that university teachers who participated in the telehealth-based nutrition education program demonstrated better basic nutrition knowledge. Furthermore, the proportion of teachers with normal weight increased significantly after the application of the program.

The results of the current study are in agreement with the findings of previously published studies<sup>11,14,24</sup> in which it is shown that the percentage of correct answers by teachers regarding nutritional knowledge after the intervention increased significantly. The findings of the current study suggest that an intervention of 35 to 40 min per week distributed in 18 sessions has the ability to significantly improve the results of university teachers and, therefore, it can be a valuable tool for teachers to influence the eating habits of students, either through their eating behaviors, incorporation into the classroom of education programs or other lifestyle initiatives.<sup>9,11,25</sup> These results can be justified by the fact that teachers are more likely to know the basic nutritional recommendations; however, other studies show significant cognitive deficiencies regarding scientific dietary guidelines or the role of some specific nutrients in preventing disease and improving health.<sup>24,26</sup>

In Peru, although efforts are being made to implement social programs for food supplementation, in addition to the



**Figure 3.** Effect of the telehealth program on the level of basic nutrition knowledge.

enactment of the Law for the Promotion of Healthy Eating (Law No. 30021), despite this, it has been observed that malnutrition and obesity continue to be 2 important coexisting nutritional problems in the country.<sup>27</sup> Therefore, it is essential that healthy food consumption habits are formed from childhood. However, these habits should be influenced by socialization agents such as teachers, who are useful guides who can play an important role regarding nutritional knowledge.<sup>14</sup> This scenario makes schools and universities an ideal space to promote healthy eating habits. In fact, carrying out food delivery activities such as fruits and vegetables are more effective if they are accompanied by nutritional education.<sup>28,29</sup>

The proportion of teachers who were overweight before applying the nutritional education program was higher than that of the Peruvian population over 15 years of age; 53.8%, of which 35.5% are overweight and 18.3% are obese.<sup>30</sup> A study carried out in 164 Peruvian university teachers has shown that there is a high prevalence of overweight and obesity, and that they present a high cardiovascular and metabolic risk.<sup>6</sup> These findings are consistent with other similar studies carried out in other countries in the Latin American region, showing that the proportion of teachers who are overweight was higher.<sup>31,32</sup> In China, in a study conducted among university teachers and staff, the prevalence of overweight and obesity was 25.2%. Likewise, a significant increase in the prevalence of overweight with age was observed among male teachers.<sup>33</sup> The possible reason for these findings is the easy access that teachers have to the high-calorie products offered by university canteens; to this scenario is added the little physical activity, possibly

caused by the facilities provided by technology that have shortened the movement of people in their daily activities.

Overweight and obesity are one of the public health challenges for the healthcare system in both low-income and high-income countries.<sup>34</sup> They are also risk factors that induce the appearance of various chronic diseases, such as cancer, cardiovascular diseases, diabetes mellitus, among others.<sup>6,35</sup> University teachers are not exempt from these diseases, which, in general, are caused by lack of nutritional knowledge and motivation, inadequate eating habits, and sedentary lifestyle.<sup>36,37</sup> Therefore, the prevention of overweight and obesity in university teachers requires preventive interventions and the promotion of healthy lifestyles.<sup>12,38</sup> For this, the university must ensure learning of an education with a preventive promotional approach, which represents the pillars of the development of a culture of healthy life that involves both teachers and students to improve their lifestyle practices and build healthy environments. Assuming this role on the part of the university community implies permanently articulating research, action and training in the study plans of school and university programs.<sup>39</sup> In the current study, the BMI score of the teachers decreased significantly after the application of the educational program, falling within the normal range, and considering the parameters established by the WHO.<sup>21</sup> Therefore, we argue that overweight and obesity can be prevented by providing teachers with relevant information on healthy eating and nutrition with a motivational approach.

In this study, a nutritional intervention was carried out that was developed with a motivational component to maintain a permanent expectation in the participants considering

the duration of the program. Regarding this, some researchers show that the element of motivation is important because it generates the need for learning and behavioral change.<sup>40</sup> Furthermore, if this motivation is fostered between groups, fostering healthy competition to meet established challenges and obtain a score. The motivational component included “nutritional challenges” that consisted of the formation of 7 WhatsApp groups led by “health promoters” who sent encouraging messages recalling the topics presented during the educational sessions and, thus promoting a healthy diet.

The frequency and number of challenges and motivational messages received could explain the success of the program. In fact, in a similar study in which researchers sent inspirational quotes and “health challenges,” participants reported that receiving more than 1 message per day could be too overwhelming and they would stop reading.<sup>41</sup> On the other hand, in the current study, motivational messages contained the signature of the principal investigator at the end, which possibly played an important role. One study found that the addition of the researcher’s “signature” at the end of messages was acceptable and favorable; in fact, it added credibility to the messages and ultimately increased the confidence of the participants.<sup>42</sup> The motivation of a person to follow a lifestyle that includes healthy eating and nutrition can have very positive implications on the intake of essential nutrients and, therefore, on the anthropometric profile.<sup>36,43</sup>

### Limitations

The main limitation of this study was not having considered a randomized controlled design. On the other hand, the sample size was small and homogeneous. Therefore, future research will need to replicate our findings in larger and more diversified samples. Additionally, although the intervention lasted 18 weeks and was effective, we have not carried out a subsequent follow-up to evaluate the extent to which these positive effects were maintained. Finally, we have not evaluated whether the “nutritional challenge” and motivational messages really influenced the results of body weight. Although that would imply moving away from the scope and purpose of the current study, which was to measure improvements in nutritional knowledge and BMI after the application of a nutritional education program based on telehealth in university teachers. However, evaluating the motivational impact of messages on weight loss is the next sequential step in our research. Moreover, future research should focus on analyzing whether a more holistic model of curriculum in which nutrition education is fully integrated in all areas of education would lead to more significant short- and long-term effects. However, we believe that these limitations do

not invalidate the study’s findings, because it supports the inclusion of telehealth and the effectiveness of nutritional education programs to promote nutritional knowledge and adequate weight in university teachers, which benefits university teachers. the entire university community.

### Conclusion

The results of this study demonstrated a positive impact of the intervention of the nutrition education program based on telehealth on the levels of basic knowledge of nutrition and BMI. The findings of this study provide evidence on the importance and need to develop future nutrition education programs that comprehensively encompass all curricula. This constitutes an essential step to improve the eating behaviors and health of both teachers and university students.

### Author Contributions

JS, SASA, and YECM designed and developed the study protocol. JS and YECM developed and taught the topics and wrote the first draft of the manuscript. RDV, AJCV, and JTC contributed to the design of the study and were co-authors of the protocol. JIPE, AKAH participated in the data collection, reviewed the first draft, and were the main contributors to the study. JS, YCEM, SHV y PGRM analizaron los datos y revisaron varias versiones del manuscrito. All authors reviewed and approved the final version of the manuscript.

### Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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### Ethical Approval/Patient Consent

The study was carried out considering the criteria established in the Declaration of Helsinki and received the approval of the Research Bioethical Committee of the Universidad Peruana Unión and registered under reference number: 0001-2020/CE/CT/UPeU.

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