

## Original Article

# Sustainable Diets, A Way to Improve and Maintain Eating Behaviors and Health in Times of COVID-19 in First-Year University Students

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Sustainable dietary pattern has reported multiple benefits for environmental and human health through sustainable food culture. The Covid-19 pandemic has led the population to adapt to a new virtual reality in all activities and to become more aware of their health. This study explores how evaluate the impact of nutritional education interventions on adherence to MD in first-year university adolescents, before and after the nutritional educational intervention. A total of 165 students participated in the experiment (85 intervention group and 80 control group). A 14-point questionnaire was applied for the adherence to the MD. The study consists of four presentational sessions and four virtual sessions using social media to complete the training. The t-tests show that the group with interventions did not change its adherence during the two periods of data collection ( $p=0.187$ ), contrary to the control group which significantly decreased ( $p=0.001$ ) from 7.41 to 6.62. It has been concluded that it is necessary to work on institutional policies that promote the benefits of this dietary pattern as a lifestyle that would be beneficial to better cope with the pandemic, since many of the products of the MD are used in Latin-American countries for several years.

**Keywords:** COVID-19; Campus residence; Sustainable diet; University students**Abbreviations**

MD: Mediterranean Diet

**Introduction**

The Mediterranean Diet (MD) has been recognized as a healthy dietary pattern, which is characterized especially by its preventive effects in different chronic diseases, including obesity [1]. The adoption of MD leads to a numerous increase in the positive benefits for human health [2]. It has been shown that high adherence to DM is reflected in a preventive effect of the mortality and morbidity rates from cardiovascular diseases and cancer [3,4]. This situation has been observed both in Mediterranean countries as well as in non-Mediterranean countries [3,5,6].

Together, nutritional knowledge and adherence to MD are a tool for the prevention of chronic and cardiovascular diseases. MD has been recognized as one of the healthiest in the world, both in adults and adolescents [4,7]. Studies have shown that the greater the degree of knowledge about nutrition, the greater the adherence to MD in university students [8,9]. The negative impact in university students when they are uprooted from their family bonds lead them to adopt unhealthy diets [10,11], influenced by both academic and social factors [12,13].

Students' health goes through a critical stage during their university stage. However, they may not be aware of this, since the university scene creates life patterns that prevail throughout their adult life, in addition to poor eating habits, where lack of physical

activity stands out [14-16]. The university could play a very important role in promoting nutritional education by encouraging the benefits of DM as a lifestyle [12]. Research in adolescents has shown that nutritional interventions can improve eating habits in this population [15,17].

The need to implement student programs that increase knowledge about nutrition and the benefits that DM provides has become increasingly important [2,18,19]. Research shows the modifying role of nutritional knowledge in the quality of this diet, from unhealthy eating habits towards healthier eating habits based on MD [20]. Currently, the COVID-19 pandemic has brought a new reality to society, generating alterations in routine activities and eating habits [19]. Recently, following the COVID-19 outbreak, a DM-based dietary pattern has been recommended during confinement [19]. The diet is renown by the high consumption of vegetables, fruits, nuts, unprocessed cereals and legumes; protein foods in moderation such as fish (low consumption of red meat and milk derivatives), and high consumption of monounsaturated fats [21], which provide a high content of natural antioxidants with anti-inflammatory properties, crucial to fight viral diseases such as COVID -19, and for strengthening the immune system.

Thus, we hypothesized the following:

H1: Exposure to nutritional education with sustainable patterns results in better adherence, representing greater resilience to the pandemic due to the benefits of the dietary pattern, directly influencing the group with interventions.

H2: Exposure to publications with nutritional information on fresh and processed products, production techniques known in the environment of the participants will help to strengthen the support of the MD.

## Materials and Methods

### Study design

An observational cross-sectional descriptive cohort study was conducted between February and June 2020 at Zamorano University in Honduras. This is a university whose undergraduate program boasts a student population from around 29 countries, mainly from the American continent, who live on campus from January to December for four years, where each year is composed of three academic periods.

Its undergraduate program has a student's population from around 29 countries, mainly from the American continent, with an internship system from January to December spanning four years. The student's community is around 1500 persons, where freshmen represent a quarter of the entire community. The university consist of four main careers in the field of agriculture: agronomy, agribusiness, environmental sciences and food science and technology. The university offers food services at the Doris Stone university cafeteria, and also has supermarkets, cafeterias and restaurants that offer food options to students. The data presented in this study is derived from surveys of eating behaviors and motivations in food choice before and after nutritional educational interventions.

### Participants

This study complies with the ethics protocols, which was approved by the Zamorano University Graduate Research Directorate meeting the ethics. All 319 undergraduate first-year students were summoned to receive a keynote talk on nutrition education during the first period of the 2020 academic year. It was used to voluntarily recruit this population of students. This cohort of first-year students came from 15 countries: Belize, Bolivia, Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, and the Dominican Republic. Recruitment was carried out prior to socializing the study, indicating the objective, theme and benefits for the participants and researchers. Participation was voluntary by signing the informed consent, of which the 165 students who decided to participate received an electronic copy.

There was a group that received nutritional education interventions (n=85), eight sessions of approximately one hour were held, four of them in person and four virtually; and a control group (n=80) who did not receive nutritional education. Second, third and fourth-year students were excluded because the primary objective was to assess adherence to MD considering the eating habits and certain socio-economic factors of students who have not yet become fully familiar with the university system and its new environment.

### Instruments

The 14-point questionnaire was conducted previously used in the PREDIMED study (Prevention with Mediterranean Diet), a nutritional intervention study carried out and validated in Spain, employed to evaluate the long-term efficacy of DM in the primary prevention of cardiovascular diseases [22]. This questionnaire is made

up of 14 direct questions about the consumption of the main foods in the DM: olive oil, fruits, vegetables, legumes, fish, nuts, moderate consumption of wine and white meat, and low consumption of red and processed meats. The scores obtained are grouped into four adherence categories: high (12-14 points), medium (8-11 points), low (5-7 points) and very low (<5 points) [23].

Data collection prior to the beginning of educational interventions in both groups was carried out in print. For the second data collection, the instruments were used virtually. Information was also collected on gender, area of origin (rural or urban), tuition status, social class, attendance at cultural activities, guardianship, and tutor education.

### Statistic

The results were summarized using descriptive statistics such as means, percentages, and standard deviation. A linear regression of the model and a Pearson correlation were carried out for the independent variables: gender, area of origin, tuition status, social class, attendance at cultural activities, guardianship, and tutor education. The dependent variable is adherence to DM. In the case of the "social class" variable, as it is a categorical variable, it was excluded for the middle class; and for the variable "countries", Honduras was excluded, as it was the host country.

## Results

Research participants were students between 16 and 23 years of age, 52.12% were male, and 47.88% female. In the group that received the interventions (n=85), the majority were from Honduras (31.76%; n=27), followed by Ecuador (21.18%; n=18), Guatemala (16.47%; n=14), El Salvador (14.12%; n=12) and others (16.47%; n=14) represented by Belize, Bolivia, Colombia, Costa Rica, Nicaragua, Panama, Paraguay and Dominican Republic. 32% of participants came from rural areas and 68% from an urban area. Regarding the frequency of attendance at cultural sites and activities (theatre, museums, archaeological sites, and classical music concerts) for the last year, 18.82% attended four of these activities, 12.94% attended three of the activities, 32.94% attended two, 20% attended just one, and 15.29% did not attend any cultural events. Regarding social classes, 12% are in the upper class, 59% in the middle class, and 29% in the lower class. One-fourth (25%) have a scholarship for their tuition, while 75% study with their own funds. Regarding the guardians' education, 14% have primary schooling, 25% high school, 41% undergraduate, and 20%, graduate. For the second data collection, only 39% of students were on campus.

For the control group (n=80), the majority (36.25%; n=29) were from Honduras, followed by Ecuador (17.5%; n=14), El Salvador (13.75%; n=11), Guatemala (8.75%; n=7), and others (23.75%; n=19) represented by Belize, Bolivia, Colombia, Costa Rica, Haiti, Mexico, Nicaragua, Panama, and Peru. Participants from rural areas were 33% and 67% from an urban area. Regarding the frequency of attendance at cultural sites and activities (theatre, museums, archaeological sites, and classical music concerts) for the last year, 22.50% attended four of these activities, 12.50% attended three of the activities, 23.75% attended two, 23.75% attended just one, and 17.5% did not attend any cultural events. Concerning social classes, 18.75% are in the upper class, 38.75% in the middle class, and 42.50% in the lower class. One-fourth (25%) have a scholarship for their tuition, while 75% study

**Table 1:** Distribution of means of adherence in the control group and with interventions.

	Before			After		
	Mean	SD	SE	Mean	SD	SE
Intervention	7.75	1.92	0.21	7.42	1.9	0.21
Control	7.41	2.25	0.25	6.62	2.37	0.27

with their own funds. Regarding the guardians' education, 14% have primary education, 16% a high school diploma, 48% undergraduate studies, and 23%, graduate. For the second data collection, only 34% of students were on campus.

The mean adherence to the MD in the first data collection was 7.75 and 7.42 for the group with the intervention and the control group, respectively; for the second data collection, the mean corresponded to 7.42 and 6.62 for the group with the intervention and the control group, respectively, representing a low adherence on all occasions (Table 1).

## Discussion

The MD has garnered great attention worldwide. Numerous studies have shown the positive benefits of adopting MD for health promotion and healthy sustainable nutrition. The present study's main objective was to identify the effect of educational nutrition interventions on adherence to MD in Latin American university students. The results showed that the nutritional intervention did not have a significant effect on the adherence to MD. Overall, this information is important, as it will help develop intervention strategies and long-term methods to improve the adoption of healthy and sustainable dietary patterns and eating behaviors. It can also be used as a reference to identify and develop institutional policies for the promotion and improvement of students' health.

In this study, participants in the group with educational nutrition intervention remained at the level of adherence to MD, according to the analysis of the paired t-test. However, both scores are low adherence to MD (7.75 before and 7.42 after). On the other hand, only the "control" group obtained statistically significant changes in the MD adherence score, ranked similarly to the group with interventions, with low adherence (7.41 before and 6.62 after). This indicates that the educational intervention had a slightly positive impact in terms of adherence; however, it did not improve the overall level of adherence to it. The change in adherence to MD observed in participants during the post-nutritional intervention phase can also be attributed to the difficulty of making a change in university students' food behavior [24] because that behavior is determined by social, cultural, and environmental factors [25]. The COVID-19 pandemic, in addition to the return to their countries of origin [26], living away from home (residing on the university campus during the pandemic) [16], economic difficulties, the low availability of certain foods at the beginning of and during the confinement, the restricted mobilization, among other limitations triggered by the pandemic [27], plus the variable of a lower social class, were predictable and could influence the group with interventions considerably. This may be partly due to the time of intervention and the methods of intervention used [19,28-30].

This result can also be attributed to studies, which found that

university students have poor eating habits and no healthy or balanced diets. Also, they do not meet the recommended intake of vegetables and have a higher preference for processed foods [31,32]. On the other hand, confinement over the pandemic crisis, during which more than 50% of students in each group stayed in their home countries (in their homes), could limit economic and physical access to MD food groups, mostly fruits and vegetables. A 10-week online nutrition and physical activity intervention to encourage healthy food decision-making had a positive and lasting effect on fruit and vegetable intake, maintaining physical activity reference levels in a population experiencing a significant decline in healthy behaviors [33]. Still, few studies have been carried out for this type of population, where the effectiveness of an intervention to improve lifestyle and nutrition is analyzed [34].

This study shows that it is crucial to complement interventions with other types of strategies for better outcomes, especially in times of crisis. However, recent meta-analyses indicated improvements in adherence to healthy lifestyles with "behavioral treatment" interventions, which confirmed that is the preliminary basis for the development, design, and implementation of any intervention program, following a multifactorial approach, including emotional interviews, goal setting, physical activity, and dietary intake analysis, among others [35].

Contrary to our results, previous studies like the ones conducted in university adolescents in the Southwest United States [36], adolescents swimmers in Cyprus (Eastern Mediterranean country) [17], and a population of adults in Italy [9] have confirmed the positive association and better adherence after educational nutrition intervention, nutrition awareness, and better adherence to MD. This supports the theory that a prolonged intervention can translate into better decisions regarding healthy lifestyles and eating [37]. Nevertheless, the results of this study have contrasted with those previous studies about adherence to MD. There is yet another study that coincides with the results from this one, showing that university students practice unhealthy diets, and generally, they do not comply with the recommendations and the bases of the Mediterranean diet [38].

Recent studies show significant improvements in the adoption of better eating habits due to the emergence of the COVID-19 pandemic, showing higher rates of adherence to MD in young adults compared to older adults, a slight increase in physical activity, and low Body Mass Index (BMI) [39]. This can help understand the better level of adherence observed in the intervention group participants compared to the control group since the second data collection happened during the pandemic, which may have impacted eating behaviors and partially leaning toward healthy choices in the intervention group. Also, the holistic themes of nutrition and intervention sustainability could have contributed to the awareness of what to consume during the pandemic [40], if the economic situation allowed them to.

A study, which evaluated food behaviors in a Spanish population during the confinement of the COVID-19 outbreak, found that people who were intervened after the onset of the pandemic adopted healthy dietary behaviors at the beginning of confinement, especially to MD guidelines [27]. However, it was noted that this same situation was not maintained for an extended period; there could be myriad

reasons for this low adherence, from having greater availability of time to leisure activities, or stress, anxiety, depression, and emotional hunger [27,41], factors which have been associated with an intake of unbalanced foods [42-44].

Another point should be noted regarding adherence to MD and lifestyles. In a cross-sectional study that included middle-aged adult participants in Italy, they observed higher rates of adherence to MD, low Body Mass Indexes (BMI) and abdominal circumference in participants who slept regularly compared to participants with inadequate sleep quality [45]. Also, a positive influence of adherence, acceptance, and positive academic performance has been observed in adolescents, directly related to sleep quality [46]. Although this study did not analyze sleep quality, the university scene may lead to alterations due to academic demands, stress, and anxiety generated by test pressure, which can result in non-adaptive consequences [47], including increased consumption of high-calorie foods, sedentary behaviors, and food disorders [48], and could be increased in those participants who were in their home during confinement.

On the other hand, studies have shown the importance of having a healthy diet. Since the levels of gene expression of cytokines are mediated by food and perform a modulating function in the process of inflammation and oxidative stress [19], they are of vital importance to face and prevent the effects of the COVID-19 crisis. Recent studies emphasized the importance of maintaining balanced nutrition to strengthen the immune system and prevent viral diseases [19].

The MD exclusively stands out for certain foods that provide high amounts of vitamins, minerals, especially antioxidants and anti-inflammatory drugs [49]; also, it has been recognized for its ability to strengthen the immune system due to the beneficial foods it provides [19]. Especially fish, vegetables, whole grains, olive oil, legumes, and, in lesser quantities, red meat and dairy products [50] could be challenging to access in rural and even urban people due to supply difficulties during the pandemic. Also, studies suggested that a dietary intake dissimilar to the Mediterranean model's foods leads to a higher likelihood of oxidative damage and susceptibility to COVID-19 [39,51].

Similarly, another study in adolescents found that 59.7% of participants lack adequate feeding and evince low adherence to MD, which is associated with low levels of nutritional knowledge [52]. Despite the protective effect of fruits and vegetables, inadequate fruit and vegetable intake is observed in many countries, especially in the developing countries from which participants come from. Strategies to promote fruit and vegetable intake need to be improved because it is essential for health promotion among the population [53]. On the other hand, Spronk et al., [54], reported that a high nutrition awareness was positively associated with a healthy diet, high in fruits, vegetables, cereals, and fish, and low-fat consumption, equivalent to high adherence to MD. According to Barrios-Vicedo et al., [55], it was shown that negative health implications for the university population are associated with low adherence to MD. In addition, it has been shown that adherence to MD is associated with a high nutritional quality and preventions of chronic diseases [56]. Also, numerous studies have demonstrated all the benefits of MD adherence in university students and adolescents [57,58], and for health in general [3,59].

## Conclusion

It could be verified that it is possible to adhere to and adopt a Mediterranean dietary pattern in non-Mediterranean regions, as participants were able to adopt a new dietary pattern outside their home country. However, it is necessary to continue with the research of the variables because the pandemic could generate changes in the eating habits of the participants. The current study demonstrated a degree of stability in adherence to MD in participants who had a nutritional intervention, which indicates the need to complete educational interventions with innovative strategies that contribute to improving the adherence to MD and thereby to health and environmental issues, seeing, as it is a sustainable diet.

Institutions should also focus on teaching methods that allow students to engage and be dynamic when receiving an on-line intervention, seeing as the new reality due to COVID-19 has forced all institutions to generate digital resources for students to continue their academic activities, as well as extracurricular ones, to strengthen their health with educational nutrition interventions. Therefore, extracurricular strategies that match the benefits of MD would help to get better adherence results.

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