The Mediterranean Diet in A University Student Population: A Cross-Sectional Study on Adherence and Perceived Knowledge, Barriers, and Benefits

by

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Abstract

The Dietary Guidelines for Americans recommend incorporating the Mediterranean diet (MD) into one's eating habits. Nevertheless, it is uncertain if university students have increased their adoption of this diet from 2018 to 2023. A survey was conducted among students to investigate adherence to the MD, and perceived benefits and barriers to its consumption. The survey received 761 responses from university students in three different years: 2018 (n = 254), 2020 (n = 216), and 2022 (n = 291). For the data analysis, linear and multivariable linear regression analysis were utilized. The unadjusted model showed that the Mediterranean Diet Adherence Screener (MEDAS) scores were lower for the 2022 group ($p = 0.004$), but not for the 2020 group, when compared to the 2018 group. In the adjusted model, a significant group effect ($p = 0.021$) was observed. In the adjusted and unadjusted models, the 2020 and 2022 groups perceived fewer MD knowledge barriers ($p<0.001$; $p<0.001$, respectively), and the 2022 group perceived fewer MD health barriers in the adjusted model ($p<0.001$), maintaining in the unadjusted model for 2020 ($p=0.037$) and 2022 ($p<0.001$). The 2020 group perceived greater MD health benefits ($p=0.005$), weight loss ($p=0.036$), ethical concerns ($p=0.015$), natural content ($p=0.006$), and sensory appeal ($p=0.002$), while the 2022 group perceived less of these benefits (all $p<0.001$). MEDAS score was higher in females ($p<0.001$), participants aged 25-34 ($p=0.016$) and aged 35-44 ($p<0.001$), and respondents with health-related qualifications ($p<0.001$). Our findings highlight key barriers and benefits of the MD in university students, which could inform targeted interventions.

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MD	Mediterranean Diet
TTM	Transtheoretical Model
PAPM	Precaution Adoption Process Model
MEDAS	Mediterranean Diet Adherence Screener
EBCS	Eating Habit Change Screener

Chapter 1

The Mediterranean diet in a university student population: a cross-sectional study on adherence and perceived knowledge, barriers, and benefits

1.Introduction

The Mediterranean diet (MD) was initially defined as the eating habits of people living in areas surrounding the Mediterranean Sea where olive trees are grown (Trichopoulou et al., 2014). These areas include countries such as Algeria, Bosnia, Croatia, Cyprus, Egypt, France, Gibraltar, Greece, Israel, Italy, Lebanon, Libya, Malta, Monaco, Montenegro, Morocco, Palestine, Slovenia, Spain, Syria, Tunisia, and Turkey (Trichopoulou et al., 2014). The MD is not a uniform diet plan, as each region across Europe - from Spain and North Africa to the Middle East - adapts the basic diet to utilize local food availability and cultural preferences (García-Meseguer et al., 2014). Nevertheless, all regional variations of the MD share common characteristics (García-Meseguer et al., 2014). The MD emphasizes a diet high in whole grains, legumes, nuts and seeds, fruits and vegetables, olive oil, and fish (Bach-Faig et al., 2011; Mariscal-Arcas et al., 2009). It also advocates for a low intake of poultry, red meat, and meat products, while wine consumption is moderate, respects social beliefs and preferably consumed during meals (Bach-Faig et al., 2011; Mariscal-Arcas et al., 2009).

To provide guidance on the recommended intake of different food groups in the MD, a dietary pyramid is often used (Davis et al., 2015). This pyramid illustrates the recommended number of servings for various food groups, such as whole grains, fruits, vegetables, legumes, nuts, seeds, fish, poultry, dairy, and red meat, among others. The MD pyramid serves as a useful visual tool for individuals to better understand and follow the principles of the diet. The first MD pyramid was created by Oldway's Preservation and Exchange Trust in 1993 (Willett et al., 1995). This pyramid illustrated the recommended dietary patterns based on the principles of the MD. Later in 2009, an updated version of the MD pyramid was released to further refine and modernize the guidance based on new research and scientific evidence (Oldway's Mediterranean

Diet Pyramid | 2023). In 2010, the MD Foundation published a new pyramid model of the diet (Bach-Faig et al., 2011). This model was designed to be a flexible and general representation of the MD, and it aimed to provide people with a more adaptable approach to following this way of eating. Table 1 provides a comparison of the recommendations from the two MD pyramids.

Table 1: Comparison of dietary recommendations for two MD pyramids

Foods	Oldway's Preservation and Trust (2009) (Oldways Mediterranean Diet Pyramid | 2023)	Mediterranean Diet Foundation (2011) (Bach-Faig et al., 2011)
Olive Oil	Every meal	Every meal
Vegetables	Every meal	≥2 serves every meal
Fruits	Every meal	1-2 serves every meal
Bread and cereals	Every meal	1-2 serves every meal
Legumes	Every meal	≥2 serves weekly
Nuts	Every meal	1-2 serves every meal
Fish/Seafood	Often, at least two times per week	≥2 serves weekly
Eggs	Moderate portions, daily to weekly	2-4 serves weekly
Poultry	Moderate portions, daily to weekly	2 serves weekly
Dairy foods	Moderate portions, daily to weekly	2 serves daily
Red meat	Less often	<2 serves / week
Sweets	Less often	<2 serves / week
Red Wine	In moderation	In moderation and respecting social beliefs

The two MD pyramids share a similar structure and placement of key food groups, but they differ in their recommendations for the daily intake of certain food groups such as vegetables and fruits, nuts and legumes, fish/seafood, and poultry. While some variations exist, these two pyramids emphasize the consumption of whole, unprocessed foods and the limitation of red meat and unhealthy fats, highlighting the core principles of the MD.

UNESCO recognized the MD as an Intangible Cultural Heritage of Humanity in 2010 (García-Meseguer et al., 2014). This eating pattern is considered to be an important cultural practice that promotes health and well-being(García-Meseguer et al., 2014).

The MD diet as it is known today is a relatively new idea. It is a nutrition guide, a list of dietary suggestions that are based on and influenced by the traditional eating habits seen in Southern Italy and on the Island of Crete in the 1950s and 1960s (Aboul-Enein et al., 2017; Simopoulos, 2001). Ancel Keys, an American physiologist, conducted the Seven Countries Study and discovered a correlation between the dietary patterns of people in the Mediterranean region and their low rates of disease and mortality (Keys et al., 1986). This revelation brought the health benefits of the MD to the forefront and caught the attention of the modern scientific community (Trichopoulou, 2001).

Numerous research studies have documented the dietary habits of various populations worldwide and the resulting impact on their health (Ventriglio et al., 2020). There is increasing evidence indicating that adopting a dietary pattern based on the principles of the MD is linked to various health advantages (D'Alessandro & de Pergola, 2018; Galbete et al., 2018). The Seven-Countries Study and other observational and ecological studies have demonstrated the favorable effects of the MD on reducing the risk of cardiovascular disease, several types of cancers, Alzheimer disease, Parkinson's disease, obesity, stroke and hypertension (Fung et al., 2009a; Gao et al., 2007.; Keys et al., 1986; la Vecchia, 2009; Scarmeas et al., 2009; Tektonidis et al., 2015).

From a nutritional standpoint, the MD is characterized by a low consumption of saturated fats and animal proteins, and a high intake of antioxidants, fiber, monounsaturated fats, and an appropriate balance of omega-6 and omega-3 fatty acids (Ventriglio et al., 2020). The health advantages of the MD can be attributed to the significant consumption of antioxidants, fiber,

monounsaturated fats, omega-3 fatty acids, phytosterols, and probiotics (Davis et al., 2015; Morris & Bhatnagar, 2016).

The MD has been named the Best Diet of 2023 by U.S. News & World Report (Best Diets Overall 2023 - Expertly Reviewed - US News Health, 2023) and endorsed by the American Heart Association for reducing stroke risk, as well as acknowledged for its similar advantages to the DASH diet (Bertoia et al., 2014). Due to the increased availability of Mediterranean fruits and vegetables in local stores and effective public health policies, countries in Northern Europe have begun to adopt a Mediterranean-style eating pattern (I et al., 2009). Despite modern nutrition guidelines including the Mediterranean eating pattern as a recommended healthy dietary pattern, its adoption in the United States is regional (Knight et al., 2019; Lăcătușu et al., 2019).

Beginning university education is a momentous occasion that signifies the shift to adulthood (Chourdakis et al., 2010). Young individuals who begin their university education away from home experience separation from their families and exposure to different people and cultures in a new environment (Madencioğlu & Yücecan, 2022). This period of life is marked by rapid changes, as young people develop a sense of self and identity and gain autonomy in decision-making (Hochberg & Konner, 2020). For many young adults, the university phase represents the first time in their lives when they begin to make their own choices about food and other aspects of their lives (Karam et al., 2021). Research has shown that young adults frequently exhibit unhealthy dietary habits, such as consuming greater amounts of fast food, sugar-sweetened beverages, and alcohol (Buyuktuncer et al., 2018; Winpenny et al., 2018). Research has indicated that young adults are the age group most commonly associated with a decline in adherence to the MD (Cobo-Cuenca et al., 2019).

The application of theories and models of behavior change is recommended as a means of improving the efficacy of nutrition education and fostering the uptake of healthy behaviors and dietary practices (Knight et al., 2019). Some commonly used theories and models of behavior change in nutrition education include the Social Cognitive Theory (Bagherniya et al., 2018), the Health Belief Model (Rosenstock, 1974), and the Transtheoretical Model (TTM) (Prochaska et al., 1997). These models all emphasize different factors that influence behavior change, such as individual beliefs and attitudes, social support, and environmental factors.

TTM suggests that making changes in health behaviors involves a series of stages that people go through, which are precontemplation, contemplation, preparation, action and maintenance (Krebs et al., 2018; Norcross & Wampold, 2011; Prochaska et al., 1992). The TTM proposes that behavior change is not an immediate or conclusive process because it entails altering habitual behavior, which evolves through a repeated cycle. This model has become widely used as both a theoretical and clinical framework in mental health, and has been found to be effective in addressing a range of issues, such as smoking, alcohol abuse, addiction, weight control, and exercise adoption (Prochaska et al., 1992).

The Precaution Adoption Process Model (PAPM) is a sequential stage model that effectively explains the uptake of various health behaviors, including weight management (Wammes et al., 2005). This model involves seven distinct stages that range from ignorance of the behavior to completion of preventive action (“unaware”, “unengaged”, “deciding”, “decided no”, “decided yes”, “action”, and “maintenance”) (Mohr et al., 2010; Weinstein & Sandman, 1992). The PAPM is originated from the TTM and focuses on the stages of change, but differs from TTM by including only one variable and incorporating two additional stages, disengagement and rejection (Salehi et al., 2020.) The stages of change in the PAPM are impacted by various factors,

including an individual's beliefs, prior experiences, knowledge, and perceptions of the benefits and barriers associated with the behavior (Mohr et al., 2010; Weinstein & Sandman, 1992). The perceived barriers and benefits of adopting a particular diet strongly influence an individual's food choices and their likelihood of modifying their current diet (Pollard et al., 2002). Customized nutrition education that corresponds to an individual's stage of change can significantly improve the outcomes of behavior change (Siero et al., 2000).

The 2015-2020 (Desalvo, 2016) and 2020-2025 (Snetselaar et al., 2021) Dietary Guidelines for Americans suggested that a Mediterranean-style diet is a healthy dietary choice for all adults in the United States. According to the US News & World Report, the MD has been ranked as the top diet overall for six consecutive years (Best Diets Overall 2023 - Expertly Reviewed - US News Health, 2023). Furthermore, it remains uncertain whether the extent to which university students have been adopting the MD has increased during the period from 2018 to 2023.This study aimed to evaluate four elements related to the MD among university students: 1) the degree of adherence to the MD; 2) the perceived barriers and benefits associated with the MD; 3) the stage of change that participants were in regarding their adoption of the MD; and 4) the impact of the COVID-19 pandemic on eating habits and adherence to the MD.

2. Materials and Methods

2.1. Survey Distribution

Before disseminating the surveys, the institutional review board of Auburn University approved this study (IRB Protocol # 20-436 EX 2009). This survey was distributed using Qualtrics in 2018 from 23 August–14 September, in 2020 from 23 August–14 September, in 2022 from 23 August–14 September 2022. Target population was an introductory nutrition

course (NTRI 2000) students in the College of Human Sciences. Each instructor in three sections of NTRI 2000 being taught in the fall semester of 2018, 2020, and 2022 recruited students enrolled in their section. The instructors emailed the students in their section an invitation written by the PI that includes a link to the survey on Qualtrics. Once the survey instrument was completed, the students were linked to a separate independent survey on Qualtrics to collect their name and section that was then reported back to the instructor. Students were provided extra credit points for participating and the linking of surveys were ensured that extra credit was provided anonymously.

2.2. Participants

A total of 932 respondents completed the questionnaire (Figure 1). Surveys were excluded for: 1) taking less than 90 seconds to complete the survey (n =42); 2) failing to meet the age requirement of 18 (n = 6); and 3) having missing values (n = 123). After exclusions, 761 valid responses were obtained. Based on the year the survey was collected, the entries were split into three groups: 2018 (n = 254) 2020 (n=216), and 2022 (n=291).

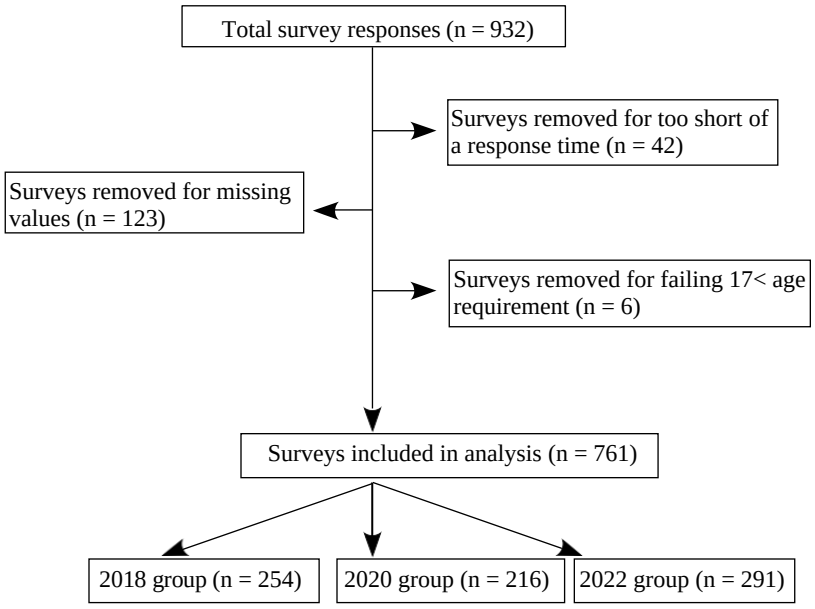

Figure 1: Flow chart of survey results. The survey results were gathered using Qualtrics and a total of 931 responses were obtained. After exclusions, the analysis was based on 761 surveys, with the distribution of respondents being 254 in 2018, 216 in 2020, and 291 in 2022 groups.

2.3. Survey Instrument

To evaluate participant adherence to the MD, their stage of change, barriers to adoption, and benefits of adoption, as well as demographic factors, a previously validated survey questionnaire was employed (Knight et al., 2019). A validated 14-question Mediterranean Diet Adherence Screener (MEDAS) was used to assess MD adherence (Schröder et al., 2011) which has been employed to evaluate MD compliance in nations bordering the Mediterranean Sea basin as well as other parts of the world, including the southeast United States (Bottcher et al., 2017; Hebestreit et al., 2017; Mahdavi-Roshan et al., 2017; Schwarzer et al., 2017) (Supplemental Table 1). Utilizing the PAPM, three questions were posed to participants to gauge their readiness to adopt a MD (stages of change)(Weinstein & Sandman, 1992) (Supplemental Table 2). A set of 26 questions evaluating perceived benefits (weight loss, ethical concerns, sensory appeal, natural content, knowledge, familiarity, price, and mood (Supplemental Table 3) and 18 questions

evaluating perceived barriers to the MD (health, convenience, sensory appeal, and knowledge (Supplemental Table 3) were utilized. A five-point Likert scale was used to score these questions. Sex, age, weight, height, ethnicity, level of education, and prior nutrition education or knowledge were determined via seven demographic and anthropometric questions (Supplemental Table 4). To supplement the aforementioned questions, a classification in college question was included in the 2020 and 2022 groups. This additional question aimed to determine the respondents' class standing in college (Supplemental Table 4). Weight in pounds (lb) divided by height in inches (in) squared, multiplied by a conversion factor of 703, was used to determine body mass index (BMI). A screening tool called the Eating Habit Change Screener (EBCS) was utilized to determine changes in people's eating habits. The EBCS evaluated alterations in portion sizes, the types of food consumed, the frequency of snacking, the frequency of eating out, and the consumption of MD foods during COVID-19 pandemic. The EBCS consisted of six questions (Supplemental Table 5).

2.4. Statistical Analyses

The Rx64 2022.12.0+353 software environment and RStudio were used for all data analyses (RStudio, PBC, Boston, MA, USA). The differences in total MEDAS scores between the groups were evaluated using an unadjusted and multivariable backward stepwise linear regression analysis. An unadjusted and adjusted linear regression analysis was employed to assess the variation in EBCS scores among the groups. Regression coefficient p-values and main effect p-values were reported. A type III Sum of Squares was employed to determine the main impact p-values. The results of the barriers and benefit questions were calculated using an unadjusted linear model, and an adjusted model incorporating all demographic variables. To determine the

demographic characteristics that are the best predictors of the stage of change, a backward stepwise elimination logistic regression was used. The logistic regression model's inclusion and retention standards were set at p-value. To examine variations in demographic categories between groups and participants by stage of change, Pearson's chi-squared tests were used (Supplemental Table 6).

3. Results

3.1.Demographics

We examined whether there were significant differences in the demographics across the 2018, 2020, and 2022 groups. As shown in Table 2, significant differences ($p<0.05$) in age, ethnicity, education, and health related qualification were found among participants across the 2018, 2020, and 2022 groups. The 2022 group had the greatest proportion of the youngest (18–24 years old) participants, the greatest proportion of the white participants, and the greatest proportion of the high school or lower degrees. The group of 2020 had the highest percentage of participants who did not possess any qualifications related to health and nutrition. Between groups, there were no statistically significant differences in sex or BMI.

3.2.MD Adherence

An unadjusted and multivariable backward stepwise linear regression model adjusting for sex, age, health-related qualifications, and BMI was used to examine the overall MEDAS score. In the unadjusted model, for each point increase in MEDAS score in the 2018 group, a significant reduction (0.42 ± 0.15 points, $p = 0.004$) was observed in the 2022 group, but not the 2020 group (Table 3). In the adjusted model, a significant group effect ($p = 0.021$) was observed. However, only a trend was observed in the score reduction in the 2022 group ($p =$

0.072). In the adjusted model, the MEDAS score was 0.57±0.17 points less in males than females ($p<0.001$), 1.05 ± 0.43 points greater in participants aged 25-34 ($p = 0.016$) and 3.69 ± 0.97 points greater in participants aged 35-44 ($p<0.001$), and 0.98 ± 0.24 points greater in respondents with health-related qualifications ($p<0.001$). Race and education as demographic factors were not significant and had no impact on the parsimoniousness of the linear model.

An unadjusted and adjusted linear regression model adjusting for sex, age, ethnicity, education, health-related qualification, and BMI was used to examine the relationship between MD adherence and class standings (Supplemental Table 7). There was no statistically significant relationship between MD adherence and class standings both in the unadjusted and adjusted models. Group and sex as demographic factors were significant ($p=0.002$, $p<0.001$, respectively) and had an effect on the parsimoniousness of the linear model. The MEDAS score was 0.48 ± 0.15 points less in the 2022 group than in the 2020 group ($p=0.002$), 0.80 ± 0.20 points less in males than females ($p<0.001$), and 0.85 ± 0.33 points less in obese respondents ($p = 0.01$). However, age, ethnicity, education, health-related qualification, and BMI were not significant demographic variables.

3.3.Perceived Barriers to Consuming a MD by University Students

The degree of internal consistency of barrier factor questions was determined using Cronbach's alpha. Eighteen questions were divided into four categories—Knowledge, Convenience, Sensory Appeal, and Health— to evaluate internal consistency. Values more than 0.70 are considered optimal for determining internal validity, whereas values greater than 0.60 are deemed sufficient (Churchill, 1979; Nunnally, 1978). Table 4 demonstrates that the Knowledge barrier had a Cronbach's alpha = 0.31, which is suggesting low reliability for the

questions. The reliability of the knowledge barrier was not improved by eliminating specific questions (data not shown). Acceptable reliability was demonstrated by the Convenience (Cronbach's = 0.68), Sensory Appeal (Cronbach's = 0.68), and Health barriers (Cronbach's = 0.83).

With the 2018 group as a reference, we assessed Knowledge, Convenience, Sensory Appeal, and Health barriers in the 2020 and 2022 groups using both an unadjusted and an adjusted linear regression model for sex, age, ethnicity, education, health-related qualifications and BMI. In the adjusted model, the 2020 and 2022 groups perceived less MD Knowledge barriers (Knowledge: β= -1.15, SE = 0.26, $p < 0.001$; β = -1.35, SE = 0.25, $p < 0.001$, respectively), and this relationship persisted in the unadjusted model (Knowledge: β = -1.21, SE = 0.25, $p < 0.001$; β = -1.39, SE = 0.24, $p < 0.001$, respectively). Additionally, the 2022 group perceived less MD health barriers in the adjusted model (Health: β = -3.37, SE = 0.30, $p < 0.001$) and this correlation maintained in the 2020 and 2022 groups in the unadjusted model (Health: β = -0.66, SE = 0.31, $p = 0.037$; β = -3.66, SE = 0.29, $p <0.001$, respectively).

3.4.Perceived Benefits to Consuming a MD by University Student

The perceived benefits of consuming an MD among respondents were evaluated using characteristics related to Mood, Sensory Appeal, Price, Familiarity, Natural Content, Ethical Concerns, Weight Loss and Health. Internal validity was assessed by Cronbach's alpha and was found to be acceptable for each factor (Mood = 0.86, Sensory Appeal = 0.86, Price = 0.54, Familiarity = 0.72, Natural Content = 0.89, Ethical Concerns = 0.86, Weight Loss = 0.87 and Health = 0.96).

To evaluate the benefits of adopting an MD in the 2020 and 2022 groups using the 2018

group as a reference, a linear regression model that was unadjusted, or adjusted for age, BMI, sex, education, health-related qualifications, and ethnicity was utilized (Table 5). In both the unadjusted and adjusted models, the 2020 group perceived the MD to have greater: 1) Health benefits (unadjusted: Health: ß = 1.78, SE = 0.64, p = 0.005, adjusted: Health: ß = 1.84, SE = 0.65, p = 0.005, respectively); 2) Weight Loss (unadjusted: Weight Loss: ß = 0.38, SE = 0.14, p = 0.009, adjusted: Weight Loss: ß = 0.32, SE = 0.15, p = 0.036, respectively); 3) Ethical Concern benefits (unadjusted: Ethical Concerns: ß = 0.43, SE = 0.16, p = 0.009, adjusted: Ethical Concerns: ß = 0.41, SE = 0.17, p = 0.015, respectively); 4) Natural Content benefits (unadjusted: Natural Content: ß = 0.44, SE = 0.15, p = 0.003, adjusted: Natural Content: ß = 0.41, SE = 0.15, p = 0.006, respectively); and 5) Sensory Appeal benefits (unadjusted: Sensory Appeal: ß = 0.47, SE = 0.16, p = 0.003, adjusted: Sensory Appeal: ß = 0.50, SE = 0.16, p = 0.002, respectively).

In contrast, the 2022 group perceived MD to have less: 1) Health Benefits (unadjusted: Health: ß = -16.54, SE = 0.59, p < 0.001, adjusted: Health: ß = -16.32, SE = 0.61, p < 0.001); 2) Weight Loss (unadjusted: Weight loss: ß = -3.32, SE = 0.13, p < 0.001, adjusted: Health: ß = -3.36, SE = 0.14, p < 0.001); 3) Ethical Concerns (unadjusted: Ethical Concerns: ß = -2, SE = 0.15, p < 0.001, adjusted Ethical Concerns: ß = -2.01, SE = 0.16, p < 0.001); 4) Natural Content (unadjusted: Natural Content: ß = -3.83, SE = 0.14, p < 0.001, adjusted: Natural Content: ß = -3.82, SE = 0.14, p < 0.001); and 5) Sensory Appeal (Unadjusted: Sensory Appeal: ß = -3.23, SE = 0.14, p < 0.001, adjusted Sensory Appeal: ß = -3.19, SE = 0.15, p < 0.001) in both models.

The benefits of the MD were perceived to be less in the 2022 group both in the adjusted and unadjusted models for: 1) Familiarity (Unadjusted: Familiarity: ß = -1.39, SE = 0.23, p < 0.001, adjusted: Familiarity: ß = -1.39, SE = 0.24, p < 0.001); 2) Price (Unadjusted: Price: ß = -0.43, SE = 0.15, p = 0.004, adjusted: Price: ß = -0.40, SE = 0.15, p = 0.009); and 3) Mood (Unadjusted:

Mood: ß = -3.78, SE = 0.23, $p < 0.001$, adjusted: Mood: ß = -3.72 SE = 0.24, $p < 0.001$). Familiarity, Price, and Mood as perceived benefits were not significant in the 2020 group in both unadjusted and adjusted models.

3.5.Stages of Change and Demographic Influences

We next assessed whether there were differences across the three groups in the stages of change associated with the PAPM (Mohr et al., 2010; Weinstein & Sandman, 1992). We observed significant differences between the groups for 2018, 2020, and 2022 in terms of how participants were distributed according to change stages ($p < 0.001$) (Table 6). Compared to the 2020 group and the 2022 group, the 2018 group had fewer participants in the Unaware/Unengaged category ($p < 0.001$). However, the 2020 group had more than the 2022 group. In addition, the 2018 group had more respondents in the Deciding ($p < 0.01$) and Action/Maintenance categories ($p < 0.01$). The percentages of participants in the Decided Yes and Decided No categories did not differ between groups.

The probability of being in each stage of change toward adopting the MD was examined using logistic regression to identify the impact of demographic variables (Table 7). If participants were in the 2020 and 2022 groups, they had a statistically significant increased likelihood of being in the Unengaged/Unaware stage (OR = 2.40, 95% CI: 1.62–3.58, $p <0.001$, OR = 2.02, 95% CI: 1.42–2.90, $p <0.001$, respectively). Additionally, the Unaware/Unengaged stage was significantly more prevalent among participants aged 25 to 34 (OR = 0.22, 95% CI: 0.06–0.68, $p <0.05$) and participants with Bachelor's or Higher Degree (OR = 0.27, 95% CI: 0.11–0.60, $p <0.01$).

Regarding the Deciding stage, participants in the 2020 group had a statistically significant

increased likelihood of being in this group (OR = 0.58, 95% CI: 0.37–0.92, p <0.05). Interestingly, the Deciding stage was significantly more prevalent among Chinese and White participants (OR = 4.67, 95% CI: 1.10–20.47, p <0.05, OR = 3.04, 95% CI: 1.23–8.96, p <0.05, respectively) and participants with a Bachelor's or Higher Degree had greater odds of being in this stage (OR = 4.93, 95% CI: 2.25-11.18, p <0.001). Furthermore, the Technical or Trade Certificate group was significantly more likely to be in the Decided No group (OR = 20.57, 95% CI: 0.75–565.72, p <0.05). There were no significant relationships found for the Decided Yes group. Lastly, in terms of the Action/Maintenance stage, respondents in the 2020 (OR = 0.33, 95% CI: 0.12–0.80, p <0.05) and 2022 (OR = 0.26, 95% CI: 0.10–0.64, p <0.01) groups had a statistically significant higher odds of being in this stage. Participants aged 25-34 were also more likely to be in the Action/Maintenance stage (OR = 8.58, 95% CI: 1.69–36.22, p <0.01).

3.6.Predictions by Demographic Factor

We next used logistic regression to examine the prediction of a Low MEDAS score in relation to demographic characteristics. As indicated in Table 8, participants in the 2022 group had a statistically significant increased likelihood of having Low MEDAS (OR = 1.98, 95% CI: 1.40–2.82, p <0.001). In addition, Low MEDAS was significantly more prevalent among Males (OR = 1.74, 95% CI: 1.11–2.81, p <0.05).

3.7.COVID-19 Related Changes in Eating Habits

Two of our groups (2020 and 2022) completed the survey instrument during the COVID-19 pandemic. In these two groups, we sought to examine whether there were any changes in eating habits. We used an EBCS score in an unadjusted and adjusted model for the demographic

variables of sex, age, ethnicity, education, health-related qualifications, and BMI to assess changes in eating habits. Using the 2020 group as the reference group, there was not a significant change in the EBCS score in the unadjusted and adjusted models (Table 9). However, the EBCS score was 0.82 ± 0.38 points more in males than females ($p = 0.03$), 1.28 ± 0.61 points greater in participants with Associate degree ($p = 0.03$) and 1.50 ± 0.63 points less in obese respondents ($p = 0.02$). Cohort, age, ethnicity, health-related qualifications, education and BMI as demographic factors were not significant and had no impact on the parsimoniousness of the linear model.

Individual eating behavior change questions were also analyzed in the 2020 and 2022 groups using an unadjusted and adjusted model for the demographic variables of sex, age, ethnicity, education, health-related qualification, and BMI. As shown in Table 10, both in the unadjusted and adjusted model participants in the 2022 group had a lower frequency of eating out (unadjusted: Health: ß = -0.36 SE = 0.12, $p = 0.002$, adjusted: Health: ß = -0.34, SE = 0.12, $p = 0.004$) and greater frequency of snacking (unadjusted: Health: ß = 0.24, SE = 0.12, $p = 0.04$, adjusted: Health: ß = 0.28, SE = 0.12, $p = 0.02$) compared to 2020 group.

A linear regression analysis using an unadjusted and adjusted model was used to assess the relationship between MD adherence and eating behavior change (Supplemental Table 8). There was not a statistically significant relationship between MEDAS and eating behavior score both in the unadjusted and adjusted models. Group and sex as demographic factors were significant ($p = 0.002$, $p<0.001$, respectively) and had an effect on the parsimoniousness of the linear model. The MEDAS score was 0.45 ± 0.15 points less in the 2022 group than in the 2020 group ($p = 0.002$), 0.78 ± 0.20 points less in males than females ($p<0.001$), and 0.82 ± 0.33 points less in obese respondents ($p = 0.01$). However, age, ethnicity, education, health-related qualification, and BMI were not significant demographic variables.

Table 2: Demographics of participants in the 2018, 2020, and 2022 groups

	2018†		2020†		2022†		
	n	%	n	%	n	%	P-value
Sex							0.18
Male	42	16.5	46	21.3	44	15.1	
Female	212	83.5	170	78.7	247	84.9	
*Age**							**0.009**
18-24	246	96.9	204	94.4	289	99.3	
25-34	7	2.8	8	3.7	1	0.3	
35-44	1	0.4	2	0.9	0	0	
45-54	0	0	1	0.5	0	0	
55-64	0	0	1	0.5	1	0.3	
*Ethnicity**							**0.027**
White	223	87.8	194	89.8	274	94.2	
Black	10	3.9	8	3.7	1	0.3	
Black-other	5	2	2	0.9	0	0	
Chinese	6	2.4	4	1.9	5	1.7	
Indian	0	0	0	0	1	0.3	
Asian-other	6	2.4	3	1.4	3	1	
Other ethnic group	4	1.6	5	2.3	7	2.4	
*Education**							**<0.001**
High School or lower	204	80.3	191	88.4	271	93.1	
GED	5	2.0	5	2.3	2	0.7	
Technical or trade certificate	1	0.4	0	0	1	0.3	
Associate degree	18	7.1	16	7.4	14	4.8	
Bachelor's degree or higher	26	10.2	4	1.9	3	1.0	
BMI							0.070
Underweight	10	3.9	12	5.6	12	4.1	
Normal weight	181	71.3	141	65.3	228	78.4	
Overweight	48	18.9	46	21.3	39	13.4	
Obese	15	5.9	17	7.9	12	4.1	
*Qualification**							**<0.001**
Health or nutrition related qualifications	42	16.5	5	2.3	10	3.4	
No health or nutrition related qualifications	212	83.5	211	97.7	281	96.6	

* Significance across score categories by Pearson's chi-squared test
† 2018, 2020, and 2022

Table 3:Linear regression analysis using an unadjusted and multivariable backward stepwise model to assess MD adherence in the 2018, 2020, and 2022 groups.

		β	SE	p-Value*	Main Effects p-Value‡
Unadjusted Model					
Group					
	2018	Ref †			
	2020	-0.009	0.16	0.95	
	2022	-0.42	0.15	**0.004**	
Backward Stepwise Model					
Group					**0.021**
	2018	Ref †			
	2020	0.15	0.16	0.36	
	2022	-0.27	0.15	0.072	
Sex					**<0.001**
	Female	Ref †			
	Male	-0.57	0.17	**<0.001**	
Age					**<0.001**
	18-24	Ref †			
	25-34	1.05	0.43	**0.016**	
	35-44	3.69	0.97	**<0.001**	
	45-54	0.64	1.69	0.70	
	55-64	-1.31	1.19	0.27	
Qualification					**<0.001**
	No	Ref †			
	Yes	0.98	0.24	**<0.001**	
BMI					0.065
	Healthy	Ref †			
	Obese	-0.68	0.27	**0.012**	
	Overweight	0.06	0.17	0.70	
	Underweight	-0.18	0.30	0.54	

† Ref, reference group
* regression coefficient p-value
‡ Main effects were assessed by ANOVA using a type III Sum of Squares method
p-values < 0.05 are indicated in bold font

Table 4:Unadjusted and adjusted linear analysis of perceived MD barriers

	Unadjusted†			Adjusted††		
Barrier	β	SE	P-value*	β	SE	P-value*
Knowledge (n = 5)‡ (Cronbach's Alpha=0.31)						
2018 ▽	Ref			Ref		
2020	-1.21	0.25	**<0.001**	-1.15	0.26	**<0.001**
2022	-1.39	0.24	**<0.001**	-1.35	0.25	**<0.001**
Convenience (n = 6)‡ (Cronbach's Alpha = 0.68)						
2018	Ref			Ref		
2020	-0.30	0.36	0.40	-0.15	0.37	0.68
2022	-0.58	0.33	0.085	-0.32	0.35	0.35
Sensory Appeal (n = 3)‡ (Cronbach's Alpha =0.68)						
2018	Ref			Ref		
2020	-0.35	0.24	0.15	-0.16	0.25	0.52
2022	-0.38	0.23	0.09	-0.19	0.23	0.41
Health (n = 4)‡ (Cronbach's Alpha =0.83)						
2018	Ref			Ref		
2020	-0.66	0.31	**0.037**	-0.36	0.32	0.26
2022	-3.66	0.29	**<0.001**	-3.37	0.30	**<0.001**

‡Number of questions in each factor
* p-values < 0.05 are indicated in bold.
† Unadjusted linear model
†† Adjusted linear model for sex, age, ethnicity, education, and BMI
▽ 2018 was used as the reference (Ref) group in the linear model

Table 5:Unadjusted and adjusted linear analysis of perceived MD benefits

	Unadjusted[†]			Adjusted[††]		
Benefits	β	SE	P-value*	β	SE	P-value*
Health (n = 10)‡ (Cronbach's Alpha= 0.96)						
2018[▽]	Ref			Ref		
2020	1.78	0.64	**0.005**	1.84	0.65	**0.005**
2022	-16.54	0.59	**< 0.001**	-16.32	0.61	**< 0.001**
Weight Loss (n = 2) (Cronbach's Alpha=0.87)						
2018	Ref			Ref		
2020	0.38	0.14	**0.009**	0.32	0.15	**0.036**
2022	-3.32	0.13	**< 0.001**	-3.36	0.14	**< 0.001**
Ethical (n = 2) (Cronbach's Alpha=0.86)						
2018	Ref			Ref		
2020	0.43	0.16	**0.009**	0.41	0.17	**0.015**
2022	-2	0.15	**< 0.001**	-2.01	0.16	**< 0.001**
Natural Content (n = 2) (Cronbach's Alpha= 0.89)						
2018	Ref			Ref		
2020	0.44	0.15	**0.003**	0.41	0.15	**0.006**
2022	-3.83	0.14	**< 0.001**	-3.82	0.14	**< 0.001**
Familiarity (n = 3) (Cronbach's Alpha=0.72)						
2018	Ref			Ref		
2020	0.35	0.25	0.15	0.36	0.26	0.16
2022	-1.39	0.23	**< 0.001**	-1.39	0.24	< 0.001
Price (n = 2) (Cronbach's Alpha=0.54)						
2018	Ref			Ref		
2020	0.25	0.16	0.12	0.22	0.16	0.18
2022	-0.43	0.15	**0.004**	-0.40	0.15	**0.009**
Sensory Appeal (n = 2) (Cronbach's Alpha=0.86)						
2018	Ref			Ref		
2020	0.47	0.16	**0.003**	0.50	0.16	**0.002**
2022	-3.23	0.14	**< 0.001**	-3.19	0.15	**< 0.001**

Mood (n = 3) (Cronbach's Alpha=0.86)						
2018	Ref			Ref		
2020	0.37	0.25	0.13	0.40	0.26	0.12
2022	-3.78	0.23	< **0.001**	-3.72	0.24	< **0.001**

Number of questions in each factor
* p-values < 0.05 from are indicated in bold font
† Unadjusted linear model
†† Adjusted linear model for sex, age, ethnicity, education, and BMI
▽ 2018 was used as the reference (Ref) group in the linear model

Table 6: Percent of participants in the 2018, 2020 and 2022 groups by stage of change

Stages of Change*	2018	2020	2022
Unaware/Unengaged*	48.8	70.8	68.7
Deciding*	28.7	17.1	20.6
Decided No	4.3	2.3	2.7
Decided Yes	10.2	6.9	5.8
Action/Maintenance*	7.9	2.8	2.1

* Significance across score categories by Pearson's chi-squared test ($p < 0.05$).

Table 7: Backward stepwise elimination logistic regression of stage of change by demographic factors

	Stages of Change				
	Unaware/ Unengaged OR (95% CI)	Deciding OR (95% CI)	Decided Yes OR (95% CI)	Decided No OR (95% CI)	Action/ Maintenance OR (95% CI)
Cohort					
2020	2.40 (1.62-3.58) ***	0.58 (0.37-0.92)*	-	-	0.33 (0.12-0.80) *
2022	2.02 (1.42-2.90) ***	0.74 (0.49-1.12)	0.65 (0.35-1.15)	-	0.26 (0.10-0.64) **
Sex					
Male	-	-	-	1.92(0.70-4.72)	0.23(0.03-0.87)
Age					
25-34	0.22 (0.06-0.68) *	-	-	3.76 (0.54-15.63)	8.58 (1.69-36.22) **
Ethnicity					
Asian-other	-	3.52 (0.61-17.68)	-	-	-
Chinese	-	4.67 (1.10-20.47)*	-	-	-
White	-	3.04(1.23-8.96)*	-	-	-
Education					
Bachelor's degree or higher	0.27 (0.11-0.60)**	4.93 (2.25-11.18) ***	-	-	-
Technical or trade certificate	-	-	-	20.57 (0.75-565.72)*	-
BMI					
Underweight	-	-	-	-	2.40 (0.54-7.56)
Overweight	-	1.39(0.88-2.17)	-	-	-
Obese	-	-	-	-	-

* p-value <.05
** p-value <.01
*** p-value <.001
- Not applicable

Table 8: Backward stepwise logistic regression of Low MEDAS score predictions by demographic factors

	Low MDAS Score[†]
	OR (95% CI)
Cohort	
2022	1.98 (1.40-2.82) ***
Sex	
Male	1.74 (1.11-2.81)*
Age	
25-34	0.36 (0.12-1.06)
Ethnicity	
Black other	0.41 (0.08-1.89)
Education	
High School or lower	1.39 (0.86-2.24)

[†] Low MEDAS Score: 0-4
* p-value <.05
*** p-value <.001
- Not applicable

Table 9: Linear regression analysis using an unadjusted and adjusted model to assess eating behavior change in the 2020 and 2022 groups

		β	SE	p-Value*	Main Effects p-Value‡
Unadjusted Model					
Group					0.92
	2020	Ref †			
	2022	0.025	0.28	0.92	
Adjusted Model					
Group					0.79
	2020	Ref †			
	2022	0.075	0.28	0.79	
Sex					**0.03**
	Female	Ref †			
	Male	0.82	0.38	**0.03**	
Age					0.88
	18-24	Ref †			
	25-34	0.94	1.13	0.40	
	35-44	-0.69	2.79	0.80	
	45-54	-1.21	3.08	0.69	
	55-64	-1.14	2.31	0.62	
Ethnicity					0.79
	White	Ref †			
	Other ethnic group	-0.79	0.90	0.38	
	Asian other	-0.37	1.26	0.77	
	Black	1.44	1.26	0.25	
	Black-other	-0.17	2.17	0.94	
	Chinese	-0.78	1.07	0.47	
	Indian	-2.03	3.05	0.51	
Education					0.13
	High School or lower	Ref †			
	Associate degree	1.28	0.61	**0.03**	
	Bachelor's degree or higher	-2.19	1.51	0.15	
	GED	0.21	1.18	0.86	
	Technical or trade certificate	-0.34	3.12	0.91	
Qualification					0.27
	No	Ref †			
	Yes	-0.89	0.81	0.27	
BMI					0.07

	Healthy	Ref †		
	Obese	-1.50	0.63	**0.02**
	Overweight	-0.56	0.38	0.14
	Underweight	-0.09	0.64	0.89

† Ref, reference group

* Regression coefficient p-value

‡ Main effects were assessed by ANOVA using a type III Sum of Squares method

p-values < 0.05 are indicated in bold font

Table 10: Linear regression analysis using an unadjusted and adjusted model to assess individual eating behavior change questions in the 2020 and 2022 groups

		β	SE	p-Value*
Unadjusted Model				
Change in current eating habits				
	2020	Ref †		
	2022	0.01	0.08	0.87
Change in current portion sizes				
	2020	Ref †		
	2022	-0.01	0.08	0.87
Change in types of foods consumed				
	2020	Ref †		
	2022	0.12	0.08	0.17
Change in frequency of snacking				
	2020	Ref †		
	2022	0.24	0.12	**0.04**
Change in frequency of eating out				
	2020	Ref †		
	2022	-0.36	0.12	**0.002**
Increase in consumption of MD type foods				
	2020	Ref †		
	2022	0.02	0.06	0.72
Adjusted Model				
Change in current eating habits				
	2020	Ref †		
	2022	0.01	0.08	0.91
Change in current portion sizes				
	2020	Ref †		
	2022	-0.03	0.09	0.75
Change in types of foods consumed				
	2020	Ref †		
	2022	0.15	0.09	0.08
Change in frequency of snacking				
	2020	Ref †		
	2022	0.28	0.12	**0.02**
Change in frequency of eating out				
	2020	Ref †		
	2022	-0.34	0.12	**0.004**

Increase in consumption of MD type foods				
	2020	Ref †		
	2022	-0.001	0.07	0.99

† Ref, reference group
* regression coefficient p-value
p-values < 0.05 are indicated in bold font

4.Discussion

In contrast to countries in which the MD is a cultural heritage, there is paucity of research on MD adherence and associated factors impacting adherence among university students in the US. Furthermore, it is not known whether university students' adoption of a MD dietary pattern has increasing over the past six years (2017-2023) since the MD was first named as the healthiest way to eat by the US News and World Report (Best Diets Overall 2023 - Expertly Reviewed - US News Health, 2023). Thus, we employed a recently created survey tool to measure university students' MD adherence, stage of change toward integrating the MD into their lifestyle, and perceived benefits and barriers to consuming an MD (Knight et al., 2019).

Our analysis showed that the 2022 group, but not the 2020 group, had a lower MEDAS score (adherence to the MD), compared to the 2018 group. Similarly, a larger proportion of participants in the 2022 group were in the Unaware/Unengaged stage of change compared to the 2018 group. This result does not support our hypothesis that MD adherence will increase over time. This finding was surprising since a Mediterranean style diet was recommended in the 2015-2020 (Desalvo, 2016) and 2020-2025 Dietary Guidelines for Americans as a healthy diet for all American adults (Snetselaar et al., 2021) and has consistently been ranked as the best diet by the US News & World Report (Best Diets Overall 2023 - Expertly Reviewed - US News Health, 2023).

In our study, we observed that individuals with a Bachelor's degree or Higher were more than four times as likely to be in the "Deciding" stage and less likely to be in the "Unaware/Unengaged" stage, while those with a technical or trade certificate were approximately twenty times more likely to be in the "Decided No" category. Consistent with these findings participants in the age group of 25 to 34 were found to be more than 8

times as likely to be in the "Action/Maintenance" stage of MD adherence, and less likely to be in the "Unaware/Unengaged" stage. Taken together these results are in line with previous research that has demonstrated a significant relationship between education level and MD adherence (Bonaccio et al., 2012; Bottcher et al., 2017; Greiner et al., 2019; Hartman et al., 2013; Holgado et al., 2000; Kolodinsky et al., 2007) and that MD adherence increased with student age (Karam et al., 2021; Martnez et al., 2010). Indeed, it has been reported that older generations are more likely to adhere to traditional diets, while younger generations tend to adopt more Western-style diets (García-Arenzana et al., 2012; Obeid et al., 2022; Sproesser et al., 2019; Veronese et al., 2020).

In all three survey periods the majority of participants were female, which is consistent with previous studies with university students (el Hajj & Julien, 2021 and Madencioğlu & Yücecan, 2022). We observed that females obtained significantly higher MEDAS scores compared to males. The results are consistent with previous studies conducted in the Mediterranean region which found that women, both in the general population and in medical students, had a greater tendency to follow the MD compared to men (A.V. et al., 2015; Fiore et al., 2015). Similarly, in the United States, females were more likely to have a high score for a Mediterranean-style dietary pattern (Rumawas et al., 2009). The results of previous research have indicated that individuals who follow the MD more closely tend to have a lower likelihood of being overweight or obese (Panagiotakos et al., 2006, 2007; Romaguera et al., 2009; Schröder et al., 2004). Consistent with these findings, we observed that individuals who were classified as obese had a lower score on the MEDAS score.

Although the 2020 group was surveyed during the height of the COVID-19 pandemic, their adherence to the MD neither improved nor decreased significantly. On the contrary, the 2022

group was surveyed at the tail end of the COVID-19 pandemic and as such the participants had 2+ years of living through the pandemic. Whether the period in which the surveys were completed over the course of the COVID-19 pandemic influenced MD adherence scores is not known. It has been reported that both high school and university students have been experiencing heightened levels of stress during the COVID-19 pandemic (Camacho-Zuñiga et al., 2021; Fruehwirth et al., 2021; Son et al., 2020) . This stress has affected individuals' food choices, with positive and negative emotions, leading them to prefer less healthy, more palatable, and higher energy-dense options during the COVID-19 pandemic (Cheng & Wong, 2021). It is possible that the impact of stress and emotional eating on dietary behaviors during the COVID-19 pandemic could be a contributing factor to the decreased adherence to a Mediterranean-style diet among the 2022 group, particularly the length of the time in which the 2022 participants lived through the pandemic. However, our study found no association between MEDAS scores and the composite score for changes in eating habits surveyed during the COVID-19 pandemic. Further, the eating habits of individuals remained unaffected during the COVID-19 pandemic in the 2022 group compared to the 2020 group. Yet, based on our examination of the individual questions regarding changes in eating behavior, it was found that snacking and eating out occurred more frequently in the 2022 group. This outcome aligns with previous research conducted on the general population, which have indicated an increase in snacking patterns and habits during COVID-19 pandemic (AlMughamis et al., 2020; Ammar et al., 2020; Husain & Ashkanani, 2020; Zachary et al., 2020).

In both the unadjusted and adjusted models, we found that the Knowledge perceived barrier to adopting the MD was perceived significantly less in the 2020 and 2022 groups compared to the 2018 group. Knowledge can act as an obstacle, impeding individuals from

making healthier food choices, or as an asset, aiding them in making informed decisions about their diet (Hartman et al., 2013; Kolodinsky et al., 2007). We also observed that the Health perceived barrier was perceived significantly less in the 2022 group compared to the 2018 group in both the unadjusted and adjusted models. In contrast to these findings, the 2022 group perceived all eight benefits of the MD (Health, Weight Loss, Ethical Concern, Natural Content, Familiarity, Price, Sensory Appeal, and Mood) to be less beneficial. Interestingly though, all eight perceived benefits of the MD were significantly greater in the 2020 group compared to the 2018 group. Thus, the perceived benefits to consuming a MD were not consistent over time, and our findings indicate that the 2022 participants were less aware of the benefits to consuming a MD. Our findings that benefits of the MD were perceived to be less in the 2022 group in which we observed lower MD adherence scores is consistent with our previous finding that the perceived benefits of Price and Familiarity to consuming a MD is less in people residing in the Stroke Belt, a geographic region with low MD adherence, compared to people residing in California, a geographic region with high MD adherence (Knight et al., 2019).

A strength of the current study is that we surveyed participants three times over the course of six years using validated survey questions to gain an understanding of trends in MD adherence and the perceived barriers and benefits to consuming a MD. In addition, to minimize confounding variables, we surveyed the same university course at the same point in the academic year. However, there are still some limitations. Firstly, the study was conducted solely among students enrolled in the introductory nutrition course and it is worth noting that the majority of participants in the study were females, which may limit the generalizability of our findings to other populations. Moreover, data on stage of change and

adherence to the MD were self-reported, which could have been influenced by personal biases or self-selection bias. Finally, the self-reported data, including weight, height, and dietary assessment, may not accurately reflect actual values. This is because participants may have over- or under-reported their weight or height, or had difficulty accurately recalling and reporting their dietary intake, which could have resulted in measurement error and affected the overall findings of the study. Additionally, some participants may have intentionally provided inaccurate information, further impacting the reliability of the data.

In summary, the 2022 group perceived less barriers, yet fewer benefits of the MD compared to the 2018 group. More participants in the 2022 group were categorized in the Unaware/Unengaged stage of change to adopting a MD, and the MD adherence scores in the 2022 group were lower compared to the 2018 group. The low MD adherence in the 2022 group is surprising given the positive popular press that the MD has received over the past six years (i.e. top diet in the US News & World Report (Best Diets Overall 2023 - Expertly Reviewed - US News Health, 2023). The influence of the COVID-19 pandemic and length of time the participants experienced the COVID-19 pandemic on MD adherence could potentially lead to lower adherence to the diet, as the participants may not see the value in following it. It is possible that the 2022 group may not be fully aware of the health benefits of the MD, which could also influence their adherence to the diet. Education and awareness-raising about the benefits of the MD may be important in increasing adherence among this group. Additionally, identifying and addressing any perceived barriers to following the diet could also be helpful in promoting adherence.

5.Conclusion

Overall, our analysis showed that the 2022 group, but not the 2020 group, had a lower

adherence to the MD, compared to the 2018 group. Compared to the 2018 group, the 2020 and 2022 groups perceived knowledge as less of a barrier to adopting the MD. Similarly, the 2022 group perceived the health barrier as significantly less of a barrier to adopting the MD compared to the 2018 group. While the 2020 group showed a significant increase in their positive perception of all eight benefits of the MD, including health, weight loss, ethical concerns, natural content, familiarity, price, sensory appeal, and mood, compared to the 2018 group, the 2022 group perceived all of these benefits to be less beneficial. Our study found that individuals with a Bachelor's degree or Higher were more likely to be in the "Deciding" stage and less likely to be "Unaware/Unengaged." In contrast, those with a Technical or Trade Certificate were more likely to be in the "Decided No" category. Participants aged 25 to 34 were more likely to be in the "Action/Maintenance" stage and less likely to be "Unaware/Unengaged." The 2020 group's adherence to the Mediterranean diet did not show significant improvement or decline despite being surveyed during the peak of the COVID-19 pandemic. In contrast, the 2022 group was surveyed towards the end of the pandemic, after experiencing over two years of its effects. Whether the timing of the surveys during the COVID-19 pandemic had any influence on the MD adherence scores remains uncertain. Increasing adherence to the MD within this group may be facilitated by providing education and raising awareness about the benefits of the diet. Moreover, it may be necessary to identify and tackle any challenges that may be seen as barriers to following the MD.

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Supplemental Table 1: Mediterranean Diet Adherence Screener

We would like to ask you a few questions about your diet:

	Check the box that applies		
1. Do you use olive oil as main culinary fat?	Yes ☐	No ☐	
2. How many tablespoons of olive oil do you consume in a given day (including oil used for frying, salads, out-of-house meals, etc.)?	<1 ☐	1-4 ☐	>4 ☐
3. How many vegetable servings do you consume per day? (1 serving: ½ cup cooked, 1 cup raw [consider side dishes as half a serving])	<1 ☐	1-2 ☐	>2 ☐
4. How many fruit units (including natural fruit juices) do you consume per day? (1 serving: 1 cup)	<1 ☐	1-3 ☐	>3 ☐
5. How many servings of red meat, hamburger, or meat products (ham, sausage, etc.) do you consume per day? (1 serving: 2-3 ounces)	<1 ☐	1-3 ☐	>3 ☐
6. How many servings of butter, margarine, or cream do you consume per day? (1 serving: 1 tablespoon)	<1 ☐	1-3 ☐	>3 ☐
7. How many sweet or carbonated beverages do you drink per day?	<1 ☐	1-3 ☐	>3 ☐
8. How many glasses of wine do you drink per week? ☐Red ☐White ☐Both	<2 ☐	2-7 ☐	>7 ☐
9. How many servings of legumes (beans, black eyed peas) do you consume per week? (1 serving: 1 cup)	<1 ☐	1-3 ☐	>3 ☐
10. How many servings of fish or shellfish do you consume per week? (1 serving: 2-3 ounces of fish or 3 ounces of shellfish)	<1 ☐	1-3 ☐	>3 ☐
11. How many times per week do you consume commercial sweets or pastries (not homemade), such as cakes, cookies, biscuits, or custard?	<3 ☐	3-5 ☐	>5 ☐
12. How many servings of nuts (including peanuts) do you consume per week? (1 serving: ¼ cup)	<1 ☐	1-3 ☐	>3 ☐
13. Do you preferentially consume chicken, turkey, or rabbit meat instead of veal, pork, hamburger, or sausage? Are you a vegetarian or vegan? ☐Yes ☐No	Yes ☐	No ☐	
14. How many times per week do you consume boiled vegetables, pasta, rice, or other dishes with a sauce of tomato, garlic, onion, or leeks without meat sautéed in olive oil?	<1 ☐	1-2 ☐	>2 ☐

Supplemental Table 2: Stage of changes questions

The next set of questions and responses are based on your knowledge, attitudes, and beliefs about aMediterranean-based diet.

In this survey a Mediterranean-based diet is characterized by a high intake of fruit, vegetables, olive oil, nuts, and cereals; a moderate intake of fish and poultry; a low intake of dairy products, red meat, processed meats, and sweets;and wine in moderation, consumed with meals.

Check the box that applies.

1. Have you ever heard of about a Mediterranean-based diet?
□ Yes [if you checked Yes, go to Question 2]
□ No

2. Are you currently eating a Mediterranean-based diet?
□ Yes
□ No [if you checked No, go to Question 3]

3. Which best describes your thoughts about eating a Mediterranean-based diet?
□ I've never thought about it.
□ I'm undecided about it.
□ I've decided I don't want to eat it.
□ I've decided I do want to eat it.

Supplemental Table 3: Benefits and barriers questions

For next set of questions check the box to indicate whether you agree or disagree with the statements below.

For next set of questions check the box to indicate whether you agree or disagree with the statements below.

		Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree
4.	I need more information about a Mediterranean-based diet.	☐	☐	☐	☐	☐
5.	I do not think about the nutritional aspects of the types of foods I eat.	☐	☐	☐	☐	☐
6.	I find there are a lot of conflicting messages concerning healthy eating.	☐	☐	☐	☐	☐
7.	It would be too expensive to eat Mediterranean-based diet foods.	☐	☐	☐	☐	☐
8.	My family/partner won't eat a Mediterranean-based diet.	☐	☐	☐	☐	☐
9.	Mediterranean-based diet meals or snacks are not available when I eat out.	☐	☐	☐	☐	☐
10.	Someone else decides on most of the foods I eat.	☐	☐	☐	☐	☐
11.	It takes too long to prepare Mediterranean-based diet meals.	☐	☐	☐	☐	☐
12.	I don't want to change my eating habit or routine.	☐	☐	☐	☐	☐
13.	I don't have enough willpower to eat a Mediterranean-based diet.	☐	☐	☐	☐	☐
14.	I don't know how to prepare Mediterranean-based diet meals.	☐	☐	☐	☐	☐
15.	A Mediterranean-based diet would not be tasty enough.	☐	☐	☐	☐	☐
16.	There is not enough protein in a Mediterranean-based diet.	☐	☐	☐	☐	☐
17.	If I eat a Mediterranean-based diet, it would not be filling enough.	☐	☐	☐	☐	☐
18.	If I eat a Mediterranean-based diet, I would miss eating lots of junk.	☐	☐	☐	☐	☐
19.	There is not enough iron in a Mediterranean-based diet.	☐	☐	☐	☐	☐
20.	If I eat a Mediterranean-based diet, I would be worried about my health.	☐	☐	☐	☐	☐
21.	If I eat a Mediterranean-based diet, I wouldn’t get enough energy or strength.	☐	☐	☐	☐	☐

For next set of responses, check the box to indicate whether you agree or disagree with the completion of thefollowing sentence:

By eating a Mediterranean-based diet, I will …

		Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree
22.	Decrease my saturated fat intake	☐	☐	☐	☐	☐
23.	Improve my digestion	☐	☐	☐	☐	☐
24.	Be fit	☐	☐	☐	☐	☐
25.	Have a better quality of life	☐	☐	☐	☐	☐
26.	Live longer	☐	☐	☐	☐	☐
27.	Be healthier by decreasing my intake of chemicals, steroids, and antibiotics that are found in meat	☐	☐	☐	☐	☐
28.	Eat more fruits and vegetables	☐	☐	☐	☐	☐
29.	Reduce my chances of developing major diseases	☐	☐	☐	☐	☐
30.	Eat high protein foods	☐	☐	☐	☐	☐
31.	Eat foods high in fiber and roughage	☐	☐	☐	☐	☐
32.	Eat foods to help me control my weight	☐	☐	☐	☐	☐
33.	Use olive oil which is more healthy for me and/or my family	☐	☐	☐	☐	☐
34.	Help the environment	☐	☐	☐	☐	☐
35.	Help animal welfare / rights	☐	☐	☐	☐	☐
36.	Eat foods that contains natural ingredients	☐	☐	☐	☐	☐
37.	Eat foods that are easy to plan, buy, and prepare	☐	☐	☐	☐	☐
38.	Eat foods that are familiar	☐	☐	☐	☐	☐
39.	Eat foods that are like the foods I ate when I was a child	☐	☐	☐	☐	☐
40.	Save money	☐	☐	☐	☐	☐
41.	Eat foods that are good value for money	☐	☐	☐	☐	☐
42.	Eat foods that tastes better than processed foods	☐	☐	☐	☐	☐
43.	Use olive oil to improve the taste of cooked meals	☐	☐	☐	☐	☐
44.	Eat a greater variety of foods	☐	☐	☐	☐	☐
45.	Be more content with myself	☐	☐	☐	☐	☐
46.	Eat foods to help me cope with stress	☐	☐	☐	☐	☐
47.	Eat foods to make me feel good	☐	☐	☐	☐	☐

Supplemental Table 4: Demographic and anthropomorphic questions

Finally, we would like to ask you a few questions about yourself

1. Are you male or female?
   a) Male ☐
   b) Female ☐

2. How old are you?
   a) less than 18 ☐
   b) 18-24 ☐
   c) 25-34 ☐
   d) 35-44 ☐
   e) 45-54 ☐
   f) 55-64 ☐
   g) 65-74 ☐
   h) more than 75 ☐

What is your classification in college?
   a) Freshman/first-year ☐
   b) Sophomore ☐
   c) Junior ☐
   d) Senior ☐
   e) Graduate student ☐
   f) Unclassified ☐

3. What is your ethnic origin?
   a) White ☐
   b) Black African ☐
   c) Black other ☐
   d) Indian ☐
   e) Pakistani ☐
   f) Chinese ☐
   g) Asian- other ☐
      Please specify:……
   h) Any other ethnic group ☐
      Please specify:……

4. What is the highest level of education you have completed?
   a) Elementary school ☐
   b) Middle school ☐
   c) High school diploma ☐
   d) GED ☐
   e) Technical or trade certificate ☐
   f) Associate degree ☐
   g) Bachelor's degree ☐
   h) Master's or professional degree ☐

5. Do you have any health or nutrition related qualifications?
   a) Yes ☐
      Please specify: ……
   b) No ☐

6. What is your body weight?
   Please specify: ……

7. What is your height?
   Please specify: ……

Supplemental Table 5: Eating Behavior questions

The next set of questions and responses are based on the impact that the COVID-19 pandemic is having on your current eating habits.

1.Do you think there has been any change in your current eating habits?
□ Yes there has been a change
□ No there has not been a change
□ Not sure

2.Have your portion sizes changed compared to your usual intake?
□ Yes my portion sizes have increased
□ Yes my portion sizes have decreased
□ No there has not been a change
□ I don't know

3.Have the types of foods you are currently eating changed compared to your usual intake?
□ Yes they have
□ No they have not
□ Not sure

4.Has the frequency of your snacking changed compared to your usual intake?
□ Yes I am snacking more
□ Yes I am snacking less
□ No it has not changed
□ Not sure

5.Has the amount of times you eat out changed compared to your usual eating?
□ Yes I am eating out more
□ Yes I am eating out less
□ No there has not been a change
□ Not sure

6. Have you increased your consumption of Mediterranean diet-type foods as a result of the pandemic?
□ Yes I've consumed more Mediterranean diet-type foods
□ No I have not consumed more Mediterranean diet-type foods
□ Not sure

Supplemental Table 6: R Scripts

```
Unadjusted Linear Regression
results1=lm(Med_Diet_Total~Cohort,data=datum)
summary(results1)
AIC(results1)
Anova(results1, type="3")
```

```
Multivariable Backward Stepwise Linear Regression Analysis
results10=lm(Med_Diet_Total~.,data=datum)
summary(results10)
AIC(results10)
step(results10, direction = "backward")
results101=lm(Med_Diet_Total ~ Cohort + Sex + Age + Qual + BMI_Cat,
  data = datum)
summary(results101)
AIC(results101)
Anova(results101, type="III")
```

```
Unadjusted Multivariate Linear Model for Each Barrier Question:
results1=lm(BarKFQ_T~Cohort,data=datum)
summary(results1)
```

```
Adjusted Model for Each Barrier Question:
results5=lm(BarKFQ_T~Cohort+Sex+Age+Race+Education+BMI_Cat+Qual,data=datum)
summary(results5)
```

```
Unadjusted Linear Model for Each Benefit Question:
results11=lm(BenHQ_T~Cohort,data=datum)
summary(results11)
```

```
Adjusted Model for Each Benefit Question:
results11=lm(BenHQ_T~Cohort+Sex+Age+Race+Education+BMI_Cat+Qual,data=datum)
summary(results11)
```

```
Backward stepwise elimination logistic regression of stage of change by demographic factors
results1b=glm(UU_d~b2020+c2022+Male+b25_34+c35_44+d45_54+e55_64+Asian_other+Black+B
  lack_other+Chinese+Indian+White+High_blw+GED+Tech+Bach_H+Under+Over+Obese,data=datu
  m,family=binomial)
summary(results1b)

summary(results1b)
```

```
Demographics
tbl2=table(datum$Cohort, datum$Sex)
tbl2
```

```
chisq.test(tbl2)
round(100*prop.table(tbl2,1),digits=1)
```

```
Stage of change
tbl9=table(datum$Cohort, datum$Stage_Change)
tbl9
chisq.test(tbl9)
round(100*prop.table(tbl9,1),digits=1)
```

```
Unadjusted Linear Model for Class Standings:
results1=lm(Med_Diet_Total~Class, data datum)
summary(results1)
```

```
Adjusted Model for Class Standings:
results101=1m(Med_Diet_Total ~ Class + Cohort+ Sex+ Age + relevel (Race, ref="White") + relevel
 (Education, ref ="High school diploma or lower") + Qual + BMI_Cat, data = datum)
summary(results101)
```

```
Backward stepwise elimination logistic regression of Low MEDAS score prediction by demographic
factors
results10=glm(MD_Low~b2020+c2022+Male+b25_34+c35_44+d45_54+e55_64+Asian_other+Blac
 k+Black_other+Chinese+Indian+White+High_bLw+GED+Tech+Bach_H+Under+0ver+Obese,
 data=datum, family=binomial)
summary(results10)
```

```
Unadjusted Linear Model to assess the relationship between Mediterranean diet adherence and eating
behavior change
results1=lm(Med_Diet_Total~EB_Score, data=datum)
summary(results1)
```

```
Adjusted Model to assess the relationship between Mediterranean diet adherence and eating behavior
change
results101=lm(Med_Diet_Total ~ Class + Cohort+ Sex+ Age + relevel (Race, ref="White") + relevel
 (Education, ref ="High school diploma or lower") + Qual + BMI_Cat, data = datum)
summary(results101)
```

```
Unadjusted Linear Model for Eating Behavior Score
results1=lm(EB_Score~Cohort, data=datum)
summary(results1)
```

```
Adjusted Model for Eating Behavior Score
results101=lm(EB_Score Cohort+ Sex+ Age + relevel (Race, ref="White") relevel(Edu,
 ref="High_school_lower") + Qual + BMI_Cat, data = datum
summary(results101)
```

```
Unadjusted Linear Model for Each Eating Behavior Question:
results1=lm(EH_ChangeS~Cohort, data=datum)
summary(results1)
```

```
Unadjusted Linear Model for Each Eating Behavior Question:
results1=lm(EH_ChangeS~Cohort+ Sex+ Age + Race + Education + Qual+ BMI_Cat, data = datum)
summary(results1)
```

Supplemental Table 7: Linear regression analysis using unadjusted and adjusted model to assess the relationship between Mediterranean diet adherence and class standings.

		β	SE	p-Value*	Main Effects p-Value‡
Unadjusted Model					
Class Standings					
	Freshman	Ref †			
	Sophomore	0.09	0.17	0.62	
	Junior	-0.09	0.22	0.69	
	Senior	-0.09	0.29	0.76	
Adjusted Model					
Class Standings					0.74
	Freshman	Ref †			
	Sophomore	0.15	0.17	0.39	
	Junior	0.07	0.23	0.75	
	Senior	0.30	0.33	0.36	
*Group**					**0.002**
	2020	Ref †			
	2022	-0.48	0.15	**0.002**	
*Sex**					**<0.001**
	Female	Ref †			
	Male	-0.80	0.20	**<0.001**	
Age					0.63
	18-24	Ref †			
	25-34	-0.005	0.59	0.99	
	35-44	-	-	-	
	45-54	0.96	1.62	0.56	
	55-64	-1.48	1.25	0.24	
Ethnicity					0.09
	White	Ref †			
	Other ethnic	-0.60	0.48	0.21	
	Asian other	1.25	0.67	0.06	
	Black	0.96	0.66	0.15	
	Black-other	1.10	1.14	0.34	
	Chinese	0.90	0.58	0.12	
	Indian	-1.49	1.61	0.36	
Education					0.94
	High School or lower	Ref †			
	Associate's degree	-0.29	0.35	0.40	
	Bachelor's degree or higher	-0.10	0.80	0.91	
	GED	-0.16	0.62	0.80	
	Technical or	0.23	1.65	0.89	

	trade certificate				
Qualification					0.09
	No	Ref †			
	Yes	0.72	0.43	0.09	
BMI					0.07
	Healthy	Ref †			
	Obese	-0.85	0.33	**0.01**	
	Overweight	-0.20	0.20	0.32	
	Underweight	0.10	0.34	0.77	

† Ref, reference group

* regression coefficient p-value

‡ Main effects were assessed by ANOVA using a type III Sum of Squares method

p -values < 0.05 are indicated in bold font

- Not applicable

Supplemental Table 8: Linear regression analysis using a unadjusted and adjusted model to assess the relationship between Mediterranean diet adherence and eating behavior change.

		β	SE	p-Value*	Main Effects p-Value‡
Unadjusted Model					
Eating Behavior Score		0.006	0.024	0.81	0.81
Adjusted Model					
Eating Behavior Score		0.012	0.024	0.61	0.61
Group*					**0.002**
	2020	Ref †			
	2022	-0.45	0.15	**0.002**	
Sex*					**<0.001**
	Female	Ref †			
	Male	-0.78	0.20	**<0.001**	
Age					0.54
	18-24	Ref †			
	25-34	-0.006	0.59	0.99	
	35-44	1.61	1.46	0.27	
	45-54	1.00	1.62	0.53	
	55-64	-1.28	1.21	0.29	
Ethnicity					0.08
	White	Ref †			
	Other ethnic group	-0.56	0.47	0.24	
	Asian other	1.25	0.66	0.06	
	Black	0.96	0.66	0.15	
	Black-other	1.126	1.14	0.32	
	Chinese	1.01	0.56	0.07	
	Indian	-1.49	1.60	0.35	
Education					0.95
	High School or lower	Ref †			
	Associate degree	-0.26	0.32	0.42	
	Bachelor's degree or higher	-0.02	0.79	0.97	
	GED	-0.15	0.62	0.81	

	Technical or trade certificate	0.10	1.64	0.95	
Qualification					0.08
	No	Ref †			
	Yes	0.75	0.42	0.08	
BMI					0.08
	Healthy	Ref †			
	Obese	-0.82	0.33	**0.01**	
	Overweight	-0.18	0.20	0.36	
	Underweight	0.08	0.34	0.81	

† Ref, reference group

* regression coefficient p-value

‡ Main effects were assessed by ANOVA using a type III Sum of Squares method

p-values < 0.05 are indicated in bold font