ASSOCIATION BETWEEN FOOD ENVIRONMENT AND ADHERENCE TO THE MEDITERRANEAN DIET IN LEBANESE ADULTS

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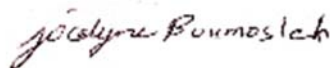Faculty of Nursing and Health
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ABSTRACT

Background: The Mediterranean diet (MD), the golden standard for healthy nutrition, has positive health impacts on metabolic disorders. Over the last few decades, Lebanon has been witnessing a gradual change in food intake nowadays referred to as "nutritional transitioning" defined as a shift from traditional to Western dietary pattern. Exploring the main determinants of adherence to the MD may be useful in understanding and counterbalancing this shift toward a Western diet.

Objectives: The aims of our study were to assess the level of MD adherence and examine the associations between perceived food environment at home and in food stores and MD adherence among Lebanese adults prior to the COVID-19 pandemic and economic crises that have hit Lebanon since February 2020.

Methods: During the month of July 2021, a cross-sectional study was carried out among a convenient sample of 326 Lebanese adults who completed an online self-administered questionnaire composed of a) questions about socio-demographics, anthropometrics and lifestyle behaviors; b) the 14-item Mediterranean Diet Adherence Screener (14-MEDAS); and c) the Perceived Nutrition Environment Measures Survey in the Mediterranean Context (NEMS-P-MED-AR).

Results: The overall sample had a mean 14-MEDAS score of 7.59±2.22 reflecting moderate-to-fair adherence to the MD. Significant positive associations were reported between availability of whole wheat pasta, rice or flour; whole grain or brown bread; and fish at home and MD score. After controlling for the effects of individual characteristics, only availability of whole wheat pasta, rice or flour and fish at home remained to be significantly associated with MD score. In addition, borderline significant association between perceived importance of availability of easy

to cook foods at food stores and MD adherence score was reported before and after controlling for the effects of the individual characteristics.

Conclusion: The findings of our study emphasize the need for addressing availability of healthy foods at home and individual cooking/meal preparation skills so that to improve the MD adherence in Lebanon.

Keywords: Mediterranean Diet, Adherence, Determinants, Food Environment, Lebanon.

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Chapter

I.   **BACKGROUND**

   A. The Mediterranean Diet (MD)

Over the last few decades, Lebanon, among other Mediterranean countries, has witnessed gradual change in food intake referred to as "nutritional transitioning" (Naja et al., 2018). Due to the westernization of foods, the traditional Mediterranean diet (MD) has been fading, promoting a novel dietary pattern characterized by an increased intake of foods from animal sources which are high in energy, fat, added sugars, and salt, and a reduced intake of fruits, vegetables, dietary fibers (plant-based foods), and complex carbohydrates causing a higher prevalence of diet-related diseases in the Middle East and North Africa (MENA) region (Nasreddine, 2014; Sibai, 2010). Also, people are moving to less time-consuming meals and more energy-dense foods.

The Mediterranean eating pattern has been of interest ever since a study conducted by Dr. Ancel Keys in the 1950s discovered that people living in the Mediterranean countries had lower rates of coronary heart disease (CHD) (Keys & Grande, 1957). Several studies have reported health benefits of the MD including reduced risk of obesity (Pereira-da-Silva et al., 2016), cardiovascular diseases (Liyanage et al., 2016), diabetes mellitus (DM) (Nowlin et al., 2012), with the last two benefits being attributed to the negative associations between the MD and levels of inflammatory markers (Nowlin et al., 2012) and abdominal fat (Mistretta et al., 2017).

Added by the United Nations Educational, Scientific and Cultural Organization (UNESCO) to the Representative List of the Intangible Cultural Heritage of Humanity (UNESCO, 2010), the MD, a healthy and balanced dietary pattern, is based on the consumption of antioxidant-rich foods grown across the Mediterranean Sea. It also includes optimal macronutrient (carbohydrates, proteins and fats) proportions and low intakes of saturated fats contributing to

less than 8% of the total daily caloric intake (García-Fernández, 2014; Willett, 1995). It is a near-vegetarian diet rich in monounsaturated fatty acids (MUFAs) which come primarily from olive oil (the primary source of fats), and thus offers the above-mentioned health benefits. MD patterns differ among countries but are all characterized by high intake of fruits and vegetables, breads and cereals (primarily whole grain), legumes and nuts, as well as modest intake of poultry, fish, eggs, and dairy products and an occasional intake of lean cuts of red meat and sweets (less than two servings per week) (Bach-Faig, 2011; Hardman, 2016).

In 1993, Oldways, in partnership with the Harvard School of Public Health and the World Health Organization (WHO), created the MD pyramid as a healthier alternative to the United States Department of Agriculture's (USDA's) original food pyramid (figure 1) (Willet et al., 1995). The USDA's food pyramid created in 1992 is divided into six horizontal sections with food images from each food group. However, it has been criticized for recommending six to eleven daily servings of bread, cereal, rice and pasta without differentiating between whole grains and refined products. Unlike the MD pyramid, it doesn't include heart-healthy components such as encouraging the intake of healthy dietary fats any physical activity or moderate consumption of wine (Food Guide Pyramid, 2013). Figure 2 depicts the MD pyramid, a clear graphic representation of the most recent international scientific evidence supporting the health and culinary benefits of a balanced, conventional Mediterranean eating and drinking pattern. At the bottom of the pyramid, all plant foods (fruits, vegetables, whole grains, nuts, legumes, beans, olives, and olive oil) are grouped together, suggesting that they should be the basis of most meals. Among animal proteins, fish and shellfish should be consumed in the highest amount (4-5 servings per week), followed by poultry (1-3 servings per week) and last by red meat (4-5

servings per month. Other important elements of the MD pyramid are sharing meals with family and friends, enjoying a glass of red wine and being physically active.
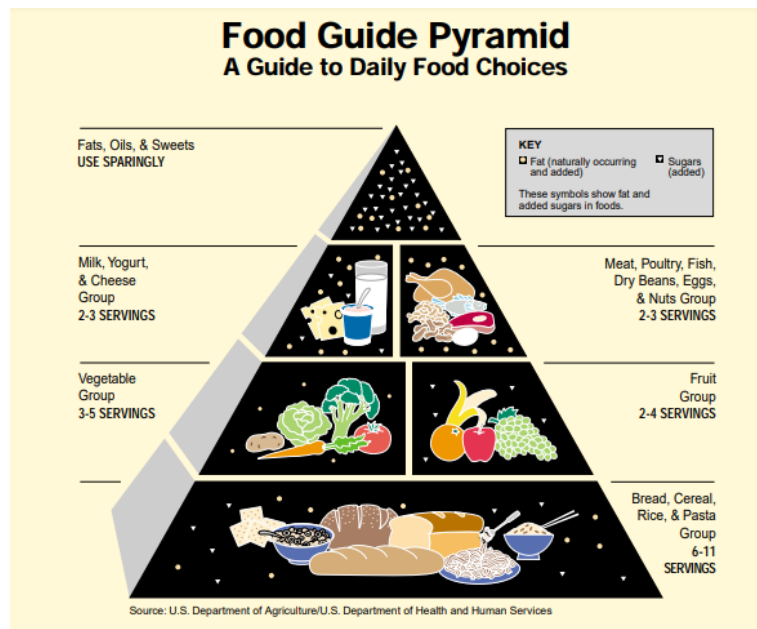
Figure 1. *The 1992 USDA Food Guide Pyramid*
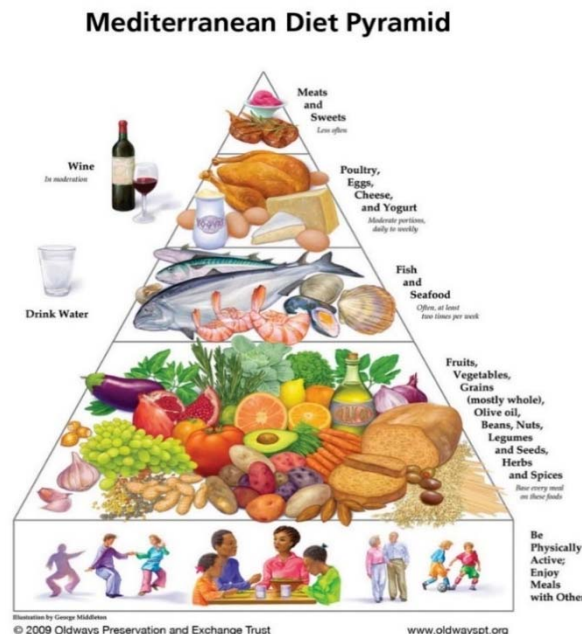
Figure 2. *The Mediterranean Diet Pyramid*

1. <u>MD Adherence</u>

Many indices were proposed to measure MD adherence over the years, with the majority of these indices coming from Europe (Bach et al., 2006) mainly Italy, Spain, Greece, Crete and France (Agnoli, 2011; Buckland, 2009; Gerber, 2006; Martínez-González, 2012; Panagiotakos, 2006; Trichopoulou, 2005).

The Mediterranean Diet Scale (MDS), the first and most widely used MD adherence assessment index, was developed in Greece in 1995 and updated in 2003 to evaluate the impact of the MD on total mortality (Trichopoulou, 1995; Trichopoulou, 2003). This index is the only one that uses a sex-specific median computation as a cut-off for each of the nine food groups.

In 2005, another international score that included predefined cut-off portions was created in Greece and was proposed to be a good alternative for the sex-specific median MDS. It has been used in several studies, including the ATTICA study in Greece and the CARDIO2000 case-control study (Panagiotakos et al., 2006). However, the Middle East, and particularly Lebanon, lacked a standardized MD assessment tool which is crucial for comparing compliance with the MD between European and Middle Eastern countries of the Mediterranean Sea (Naja et al., 2015). Therefore, in 2015, Naja and her colleagues developed a Lebanese index, known as the Lebanese Mediterranean diet index (LMD) to assess adherence to the MD. The LMD was based on nine characteristic foods of the traditional Lebanese dietary pattern (Naja et al., 2015). Another MD adherence tool known as the 14-item Mediterranean Diet Adherence Screener (14-MEDAS), was developed by Martínez-González et al. (2012) and was shown to be a reasonably valid tool for the rapid estimation of MD adherence, without the need for a food frequency questionnaire, food diary or 24-hour recall as opposed to the above scores.

Previous findings reported low to moderate MD adherence in different populations including the Lebanese population (Cavaliere, 2018; Tong, 2018). In a population-based cross-sectional study of 2,610 Lebanese adults, only 13% of participants had a high adherence to the MD as per the LMD score (Naja et al., 2019). Similar results were reported in another cross-sectional study done by El Hajj & Julien (2021) where only 18% of 303 Lebanese university students had a high adherence to the MD as per the Mediterranean Diet Quality Index (KIDMED) score. Moreover, the mean adherence score in a cross-sectional study of 525 Lebanese university students was found to be 7.96±2.2, reflecting moderate adherence as per the MEDAS score (Karam et al., 2021).

2. <u>MD Adherence Determinants</u>

Our food choices and nutrient intakes can be influenced by a variety of individual, social, and environmental factors. Individual factors such as socio-demographic, anthropometric and lifestyle factors were examined in relation to MD adherence in studies done in Lebanon as well as in other countries.

Individual Factors

In a cross-sectional study of 411 Italian adults (18-85 years), a higher MD adherence was observed in people with older age (OR=1.030; 95% CI 1.016,1.044) and more qualified employment (OR=1.136; 95% CI 1.043,1.237), whereas gender, marital status and body mass index (BMI) showed no association with MD adherence (Vitale et al., 2019). Similar positive associations between MD adherence, older age, and higher educational levels were found in a cross-sectional study of 7,430 Italian adults (20 and above) by Ruggiero et al. (2018) (OR= 2.40; 95% CI 1.61,3.58 for those aged > 75 years as compared with 20–34 years and OR=1.77; 95% CI 1.40,2.24 for post-secondary education as opposed to lowest educational attainment) and in a cross-sectional study of Lebanese adults by Naja et al. (2015) (OR=1.04; 95% CI 1.03,1.06 for older age and OR=1.85; 95% CI 1.29,2.64 for higher educational levels). As for gender, MD adherence was found to be higher in females than in males in Naja et al. (2015) (OR=1.67; 95%CI 1.33,2.09) and in another cross-sectional study of 12,417 British adults (30-65 years) (MD mean score=9.3 for females vs 8.7 for males, p<0.001) (Tong et al., 2018). However, in a cross-sectional study by Farhat et al. (2016), MD adherence did not differ significantly between Lebanese men and women ≤ 30 years, while women > 30 years had a statistically significant poorer MD score than men within this age group. No association between marital status and MD adherence was found in Ruggiero et al. (2018) as well as in Naja et al. (2015) and Tong et al.

(2018). In addition, the MD was found not to be associated with BMI (Ruggiero et al., 2018), obesity (BMI and waist circumference) or metabolic syndrome (Baalbaki, 2015). Furthermore, a healthier lifestyle consisting of high levels of physical activity (OR=1.62; 95% CI 1.30,2.03), no smoking (OR=0.78; 95% CI 0.62,0.97), higher frequency of breakfast consumption (OR=1.08; 95% CI 1.05,1.12), and lower frequency of eating out (OR=0.93; 95% CI 0.89,0.98) was associated with medium-high adherence to the MD (Baalbaki, 2015; Naja, 2015). Similarly, physically active Italian adults, those with higher frequency of main meals/week (Ruggiero et al., 2018), along with those with higher frequency of breakfast consumption and non-smokers (Cavaliere et al., 2018) had a higher level of adherence to the MD. In addition, reporting good self-rated health status had significant positive association with MD adherence (adjusted OR=1.63; 95% CI 1.38,1.92) while meal patterns (frequency of main meals and frequency of main meals eaten out of home) and sleep quality showed no association with MD adherence (Ruggiero et al., 2018). Moreover, a cross-sectional population-based study that investigated the impact of economic crisis on dietary intake and habits of 1,829 Italian adults found that 20% of participants have reported negative diet-related changes (buying food of low quality from discount shops, spending less on food) due to the economic downturn, while over 30% of participants described their eating habits as being partly affected by recession. Also, they had lower adherence to MD and reduced consumption of some Mediterranean foods like fish, fruits and vegetables (Bonaccio et al., 2018).

Environmental Factors

Processed and convenience foods are now widely available and accessible at relatively low prices and in larger portion sizes in multiple food environment settings. In addition, more meals are being consumed away from home and family meals are becoming infrequent since parents are working longer hours (Institute of Medicine, 2005). Improving eating and lifestyle habits and

reducing obesity requires a sustained public health effort, which addresses both individual behaviors and the environmental context in which people live and make choices.

B. Food Environment

Recently, there has been a surge of interest in assessing the food environment and understanding how it impacts health habits. Food environment is a highly complex construct resulting from the interaction between multiple physical and social influences, not just availability of healthy foods or the presence of supermarkets (Díez et al., 2018). Food environments can be divided into two domains: home food environment and the neighborhood/retail food environment (Story et al., 2008). Survey of the former involves assessment of food availability and accessibility of healthy and unhealthy foods, modeling of healthful dietary intake by parents and siblings and frequency of having family meals. Assessment of the neighborhood/retail food environment, on the other hand, involves measuring the community food environment (number, type, location, and accessibility of food outlets such as grocery stores, fast-food restaurants, and full-service restaurants) and the consumer food environment (consumers experiences in and around places where they buy food: availability, cost, and nutritional quality of food choices, and promotions in stores). Food environments can be measured objectively (by the presence of or distance to specific foods stores, real inspection of food's availability, quality, cost, etc.) or subjectively (individuals' perceptions of the accessibility of aforesaid parameters that define food environment). People's experiences and interpretations of their neighborhoods differ according to their socioeconomic, cultural characteristics and social needs; therefore, individuals' perceptions are thought to be important for understanding the association between their unique behaviors and the food environment (van Ansem et al., 2012). Valid and reliable tools are available to measure the perceived food environment. The Nutrition Environment Measures

Survey (NEMS) (Glanz et al., 2005), developed in the United States (US) for the American context, is one of the most commonly used instruments to classify the consumer food environment. To date, the "Perceived Nutrition Environment Measurement Survey" (NEMS-P) (Green & Glanz, 2015) is the only tool that assesses the perception of various types of food environments (Martínez-García et al., 2019). Unlike other NEMS instruments, the NEMS-P is not an actual observation measure (where trained individuals or observers make quantitative judgments about behaviors of interest); instead it is a tool that evaluates the perceived food environment by assessing the perception people aged 18 and above have regarding their food habits and food environment, with a focus on food stores, restaurants and home. Food environments differ among countries. Mediterranean food environments have distinctive characteristics, like the diverse types of food stores, with the presence of small food markets as opposed to the high dependence on supermarket chains in the US (Díez et al., 2018). Hence, Martínez-García et al. (2020) culturally adapted the original NEMS-P to NEMS-P-MED to study the perceived characteristics of food environment in the Spanish Mediterranean urban context. Despite a growing interest in assessing the food environment and understanding how it impacts food choices, there remains a requisite for more research about the role of specific food environment variables and their interactions with individual factors in affecting food choices.

1. <u>Home Food Environment</u>

Multiple factors within the home environment have been linked to healthy food choices and eating habits; availability (foods present in the house) and accessibility (whether available foods are in a form or location that promotes their consumption, such as vegetables on the counter) of healthy foods at home, the frequency of family meals, and parental and sibling modeling of healthy dietary choices are among the strongest ones.

In Lebanon, only one cross-sectional national study by Naja et al. (2020) researched the food environment and reported higher household food insecurity scores (defined as the inability of the household to secure, either from its own production or through purchases, nutritious, adequate and safe food for meeting the dietary needs of all members of the household) associated with lower adherence to the LMD among 693 adolescents (β=−0.026, 95% CI −0.046, −0.006).

In a cross-sectional study of 4,942 US adults, food placement/accessibility, frequency of shopping for fruit, and a greater variety of fruits and vegetables available at home found to be significantly associated with meeting the recommended fruit and vegetable intake guidelines (OR=1.49, 95% CI 1.28,1.74; OR=1.52, 95% CI 1.14,2.01 and OR=1.09, 95% CI 1.08, 1.11, respectively) (Kegler et al., 2021). Similar results were also reported in another cross-sectional study of 790 US adolescents, where for each 1-unit increase in sugar-sweetened beverages (SSBs) available at home, there was a mean of 15.1-ounce increase in adolescents' SSBs consumption per day ($p<0.001$) (McCormick et al., 2021). Within the home, social-environmental factors such as parental and sibling modeling of healthy dietary choices and habits, and more frequent family meals, can promote healthy food consumption among children and adolescents. In a study done by McCormick et al. (2021), it was found that for each 1-unit increase in caregiver behaviors and caregiver rules, there was a mean of 3.4-ounce and 4.6-ounce decrease in adolescents' SSBs intake per day ($p<0.05$), respectively. Similarly, findings from another cross-sectional study of 1,623 Brazilian adolescents revealed statistically significant positive association between family meals and higher scores on the diet quality index (Prevalence Ratio=1.01, 95% CI 1.00, 1.02) (Dos Santos et al., 2021).

2. <u>Neighborhood/retail Food Environment</u>

The consumer food environment is what consumers encounter in and around places where they buy food, such as the availability, cost, and quality of healthful food choices. A cross-sectional study by Alber et al. (2018) found that perceived availability and quality of fruits and veggies in the neighborhood was significantly related to daily fruit and vegetable intake among American adults. Similar results were reported in another cross-sectional study of 3,670 Chinese children aged 9-12 years where children of caregivers who perceived high local healthy food availability were more likely to have vegetables, fruits, 100 percent juice, and low-fat milk or skimmed milk at all times in their homes (Liu et al., 2020). In addition, data collected from Canadian grocery and convenience stores found that compared to "healthier" food items, "less healthy" food items were found to be more prominently displayed, highly promoted, and often more affordable with the exception of breakfast cereals (Kholina et al., 2020).

Food labeling is an important communication tool through which consumers can learn about the nutritional quality of packaged goods at the time of purchase, as well as the date of production, storage conditions, cooking instructions, and the expiration date. The use of food labels helps promote healthier food choices and make people more aware of their dietary choices (Miller & Cassady, 2015). Compared to non-food label users, 1,026 Spanish university students who used food labels had a higher adherence to MD (OR=1.30; 95% CI 1.18,1.43) and were more likely to consume a higher intake of fruits (OR:1.22; 95% CI 1.11,1.34), vegetables (OR=1.15; CI 95% 1.08,1.12), and fish (OR=1.94; 95% CI 1.38,2.7), and a lower intake of meat (OR=0.76; 95% CI 0.58,0.9) (Navarrete-Muñoz et al., 2018). Also, a higher MD adherence was observed in Italian adults aged 18 years and above who expressed an interest in reading food labels (OR = 2.057, p<0.0001) as compared to those who had no interest in reading food labels (Vitale et al., 2019).

Another factor reported to play a major role in shaping people's food purchase and consumption decisions is food cost. It has been proposed that nutrient-dense foods cost more than calorie-dense foods (Schröder et al., 2006). A population-based study in Spain among 3,162 adults aged 25-74 years found out that adults who closely adhered to the MD paid 1.2 Euro ($p<0.001$) more per day for food consumption than those who had a low adherence to this dietary pattern (Schröder et al., 2006). Similarly, a recent cross-sectional study of 6-12-year-old Spanish school children (n=139) reported a statistically significant positive relationship between diet cost and MD adherence (Pastor et al., 2021). Thus, the increasing price of the main MD foods has been suggested as a major factor in people giving up this eating pattern in favor of less costly, energy-dense foods of lower nutritional quality. In-store characteristics of retail food environments are thus promising places for impacting positive change in food choices.

In Lebanon, there is a lack of research assessing MD adherence and its associated environmental determinants in adults. Therefore, to better promote adherence to MD among Lebanese adults, a study is crucial for identifying environmental factors associated with MD adherence in this population. Understanding Mediterranean food environments may help to 1) prevent further the westernization of the traditional diet, 2) result in reversion to the Mediterranean diet, and 3) reduce the burden of chronic diseases among Lebanese adults. Therefore, this study aims to 1) evaluate the level of adherence to the MD among adults in Lebanon, and 2) examine the independent associations between perceived food environment at home and in stores and MD adherence.

II.   METHODS

A. Sampling

A cross-sectional study was carried out during the month of July 2021 among a convenient sample of 326 subjects of both genders recruited from urban Lebanese governorates (Beirut, Mount Lebanon, North, South and Bekaa). Prior to the initiation of the study, the study protocol was approved by the Institutional Review Board of Notre Dame University. Participants were selected via an e-flyer (Appendix A') where researchers briefed them about the study's objectives, procedures, inclusion and exclusion criteria for participation. The inclusion criteria included: being a healthy Lebanese adult aged 18-65 years, responsible for most or all of the food and grocery shopping and the exclusion criteria included pregnant and lactating women and those reporting following dietary modifications due to chronic diseases (diabetes, kidney disease, cancer). Eligible participants were then invited to sign electronically a consent form (Appendix A) and complete an online self-administered survey. Subjects had the right to withdraw from the study at any time. Furthermore, participants were assured that their data will be solely accessed by study researchers and that the information they provide will be kept anonymous.

B. Data Collection

Data from participants were collected via an online survey developed by study researchers composed of 3 well-structured questionnaires (background including socio-demographic, anthropometrics and lifestyle habits, 14-MEDAS, NEMS-P-MED-AR; Appendices B, C and D respectively). The survey was translated from English to Arabic by a professional translator and was pre-tested on a pilot sample of 10 participants whose feedback was used to make any necessary changes to the questionnaires before use in the actual study. Data collected from the pilot sample did not constitute part of the data that were collected from the study participants in

the actual study and analyzed. All filled-out questionnaires were reviewed for completion immediately after collecting them from the participants. Data were entered and checked to ensure that typographical or other errors in data files were corrected; duplicate entries were removed from the database and all data from all participants were entered into the database.

1. Background: Socio-Demographic Information

Data on socio-demographic status included age (in years), gender (male, female), having children (no, yes), area of residence (Beirut, Mount, South or North Lebanon, Bekaa), marital status (single, married, separated/divorced, widowed), educational status (university level, secondary school, pre-secondary), specialty in a health-related major (yes, no), employment status (full-time employee, part-time employee, unemployed actively seeking employment, unemployed, not seeking employment).

2. Background: Lifestyle Information and Anthropometric Measurements

Data on lifestyle factors included eating habits such as frequency of meals/day (four or more, three, two, one), frequency of main meals/week (6-7 days per week, 3-5 days per week and 0-2 days per week), frequency of breakfast intake/week, frequency of eating out/week, smoking status (non-smoker, smoker), and physical activity status (followed a regular routine or no). Anthropometrics included self-reported weight (kg) and height (cm) measurements for determination of body mass index (BMI), a main indicator of obesity. BMI (kg/m^2) was calculated by dividing the weight (kg) over the height squared (m^2) and classified according to the Center for Disease Control and Prevention (CDC) where participants with a BMI ≥ 30 kg/m^2 were classified as obese and those with a BMI less than 30 kg/m^2 were considered to be non-obese (CDC, 2020). Moreover, perceived overall sleep quality, health status and impact of economic crisis/pandemic on dietary habits were addressed at the end of the background

questionnaire (Appendix B). In this section, the following responses were recoded into different variables: overall sleep (Background questionnaire, q17), collapsed "very good" and "fairly good" as one category, and "very bad" and "fairly bad" as another, and health status (q18), collapsed "very good" and "good" as one category and "fair" and "poor" as another.

3. Food Environment

Food environment perception and self-efficacy questions were assessed using the NEMS-P-MED questionnaire by Martínez-García et al. (2020). This tool measured the perception about availability, accessibility and marketing of 3 types of food environment: home, shops and restaurants. It is composed of five main sections with a total of 32 questions: Home Food Environment (2 questions), Perceived Food Environment in Stores (7 questions), Perceived Food Environment in Restaurants (4 questions), Your Food Habits and Thoughts About Food (4 questions) and General / Background Information Questions (15 questions). In order to adapt the NEMS-P-MED to the Lebanese context, the questionnaire was translated from Spanish to Arabic (NEMS-P-MED-AR) and some sections were modified. As such, in the first section "Home Environment", we added two questions ("How often did you share meal times with your household members?" and "How often did your parents/siblings encourage you to have healthy food choices when you tempt to eat junk foods?"). In section two, "The Perceived Food Environment in Stores", we modified two questions related to type of food stores and transportation means needed to access the food stores. Three questions were also added to this section ("I often read food labels", "I find it easy to understand the food labels", "Why did you read nutrition labels"?). Section three (4 questions) on the "Perceived Food Environment in Restaurants" was removed; our study aim was narrowed down to the food environment in stores. In addition, section five "General/Background Information Questions" (15 questions) in the

original NEMS-P-MED questionnaire was removed; same questions were integrated in our background questionnaire. Lastly, two questions were removed from section four "Your Food Habits and Thoughts About Food"; one was unnecessary as per our study objectives and the other was one of the questions incorporated in the 14-MEDAS tool ("When you eat out at a restaurant or get take-out food, how important to you is taste? nutrition? price? convenience? weight control? and "How often do you eat fruits and vegetables?"). The final questionnaire (NEMS-P-MED-AR), therefore, was composed of 13 questions that were grouped into 3 dimensions (Home Food Environment, Perceived Food Environment in Stores, and Your Food Habits and Thoughts About Food). The questions had different types of responses: dichotomous (yes/no), ordinal with a Likert-type scale from 3 to 5 options depending on the dimension (degree of agreement, importance or frequency). The complete NEMS-P-MED-AR questionnaire is available in Appendix D. In this section, the following responses were recoded into different variables: motivation to select place of food shopping (q6, NEMS-P-MED-AR) were collapsed into "not important" and "a little important" as one category, and "somewhat important" and "very important" as another. With respect to price of fruits and vegetables compared to other stores, we collapsed "expensive" and "very expensive" as one category and "cheap" and "inexpensive" as another (q7, NEMS-P-MED-AR). Likert scales responses in questions related to ease of buying foods in stores (q8), reading and understanding food labels (q10.g-i), and marketing perceptions (food placement and promotions) (q10.a-f) were recoded as follows: "disagree" and "strongly disagree" as one category, and "agree" and "strongly agree" as another. Lastly, for questions related to food habits/thoughts about food (q12), we collapsed "somewhat important" and "very important" as one category.

4. <u>Dietary Intake and Calculation of the MD adherence score</u>

The measure used in this study to estimate participants' MD adherence was a 14-item Mediterranean Diet Adherence Screener (14-MEDAS) questionnaire, a questionnaire that was developed by researchers who conducted primary prevention nutrition-intervention trial, known as the PREDIMED study (Martínez-González et al., 2012). The 14-MEDAS questionnaire has been adapted to and validated in both Mediterranean (Greece, Cyprus, Italy, Spain and Portugal) (García-Conesa et al., 2020) and non-Mediterranean (i.e., Germany, USA, UK, Korea) populations (Bottcher, 2017; Hebestreit, 2017; Kwon, 2020; Papadaki, 2018).

This tool consisted of 12 questions on food consumption frequency and two questions on food intake habits that are considered specific to the Spanish Mediterranean diet (Schröder et al., 2011). Each question was scored 0 or 1. One point was given for using olive oil as the principal source of fat for cooking, preferring white meat over red meat, or for consuming: 1) 4 or more tablespoons (1 tablespoon = 15 ml) of olive oil/day (d) (including that used in frying, salads, meals eaten away from home, etc.); 2) 2 or more servings of vegetables/d (1 serving= ½ cup cooked or 1 cup raw); 3) 3 or more servings of fruits/d (1 serving= 1 medium piece or ½ cup of juice); 4) <1 serving (<150 g) of red meat or sausages/d; 5) <1 tablespoon (12 g) of animal fat (butter, margarine etc.)/d; 6) <1 can (1 can = 355 ml) of sugar-sweetened beverages/d; 7) 7-14 glasses of wine/week (wk) or 1-2 glasses/d; 8) 3 or more servings of pulses/wk (1 serving=1 cup or 150 g cooked); 9) 3 or more servings of fish (100-150 g cooked), seafood (4-5 pieces), shellfish (200 g)/wk; 10) fewer than three commercial pastries/wk; 11) 3 or more servings of unsalted nuts/wk (1 serving=1/4 cup or 30 g); or 12) 2 or more servings/wk of a dish with a traditional sofrito sauce of tomatoes, garlic, onion, saute´ed in olive oil. If the condition was not met, 0 points were assigned to that question. The resulting score thus ranged from 0 to 14 with

the higher score indicating greater adherence to the MD. For categorization of the adherence to the MD, we applied the following criteria: low adherence, ≤5; moderate to fair adherence, 6–9; good or very good adherence ≥10 (García-Conesa et al., 2020).

C. Statistical Analyses

Analysis of data was carried out using Statistical Package for the Social Science (SPSS) software version 22 for Windows. Descriptive statistical analyses were performed to determine means and standard deviations (SD) for continuous variables, and frequencies and percentages for categorical ones. Chi square test/Fisher's Exact test was used to explore relationships between categorical variables. Group differences on continuous variables were tested using one-way ANOVA when there were more than 2 groups to be compared. Multiple logistic regression analyses were used to assess the association between food environment at home and in stores and MD adherence after controlling for the effects of individual characteristics. A p-value <0.05 was considered statistically significant. Preliminary analyses were conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity and homoscedasticity.

III.   RESULTS

1. Socio-demographic, Anthropometric and Lifestyle Characteristics

The socio-demographic, anthropometrics, lifestyle characteristics as well as the level of adherence to the Mediterranean diet **(**MD) of the study participants are presented in **Table 1**. Overall, the sample consisted of 326 individuals (~21% males and ~79% females) with a mean age of 37.14±11.84 years. Most of the study participants lived in Mount Lebanon (~79 %), were married (~54 %), had children (~88 %), holders of a university degree (~80 %), majored in non-health-related majors (~70 %), had normal body weight (~58%) and healthy lifestyle habits (~ 64% non-smokers, ~83% eat out at a restaurant 0-2 days/week, 54% eat main meals, with ~54% eating breakfast, 6-7 days/week, ~56 % read food labels, with ~59% stating the reason as helping

them to make healthy food choices, and ~61 % of them understand food labels). In the total

sample, the mean MD adherence score was 7.59±2.22. The majority of the study participants

(~83%) had a good to fair adherence level (MD score ≥ 6) and only about 17 % had a low

adherence level (MD score ≤ 5).

Table 1. Socio-demographic, anthropometric, lifestyle characteristics and level of adherence to
the Mediterranean diet of the study population.

	Total (n=326)		Total (n=326)
	Mean ± SD Or n (%)		**Mean ± SD Or n (%)**
Age (years)	37.14±11.84	**Meals per day**	
Gender		One	2 (0.6)
Male	67 (20.6)	Two	44 (13.5)
Female	259 (79.4)	Three	146 (44.8)
Living area		Four or more	134 (41.1)
Beirut	38 (11.7)	**Frequency of main meals**	
Mount Lebanon	259 (79.4)	0-2 days per week	54 (16.6)
South Lebanon	7 (2.1)	3-5 days per week	96 (29.4)
North Lebanon	12 (3.7)	6-7 days per week	176 (54)
Bekaa	10 (3.1)	**Frequency of breakfast consumption**	
Marital status		0-2 days per week	83 (25.5)
Single	138 (42.3)	3-5 days per week	68 (20.9)
Married	177 (54.3)	6-7 days per week	175 (53.7)
Separated/divorced	7 (2.1)	**Perceived impact of economic crisis/pandemic on dietary habits**	
Widowed	4 (1.2)	Yes	142 (43.6)
Children		Partly	120 (36.8)
Yes	167 (88.8)	No	64 (19.6)
No	21 (11.2)	**Perceived sleep quality**	
Education level		Fairly good/very good	263 (80.7)
Pre-high school or its equivalent	10 (3.1)	Fairly bad/very bad	63 (19.3)
High school or its equivalent	55 (16.9)	**Perceived health status**	
University or its equivalent	261 (80.1)	Excellent	46 (14.1)
Health-related major		Very good/good	229 (70.2)
Yes	78 (29.9)	Fair/poor	51 (15.6)
No	183 (70.1)	**Read food labels**	
BMI		Disagree	70 (21.5)
Underweight (<18.5kg/m2)	10 (3.1)	Neither agree nor disagree	72 (22.1)
Normal weight (18.5-24.9 kg/m2)	190 (58.3)	Agree	184 (56.4)
Overweight (25-29.9 kg/m2)	82 (25.2)	**Reason for reading food labels**	
Obese (≥30 kg/m2)	44 (13.5)	Helps make healthy food choices	150 (58.6)

Employment status		Medical doctor/dietitian recommendation	9 (3.5)
Full-time employee	189 (58)	Lose/control weight	46 (18)
Part-time employee	39 (12)	Curiosity (compare different food products)	51 (19.9)
Unemployed, actively seeking employment	34 (10.4)	**Understand food labels**	
Unemployed, not seeking employment (student, housewife, retired, disabled etc.)	64 (19.6)	Disagree	50 (15.3)
Smoking		Neither agree nor disagree	78 (23.9)
Yes	117 (35.9)	Agree	198 (60.7)
No	209 (64.1)	**MEDAS mean score**	7.59 ± 2.22
Physical activity		**MD adherence level**	
Yes	118 (36.2)	Good adherence (score ≥ 10)	64 (19.6)
No	208 (63.8)	Moderate to fair adherence (score 6-9)	208 (63.8)
Frequency of eating out at a restaurant		Low adherence (score ≤ 5)	54 (16.6)
0-2 days per week	271 (83.1)		
3-5 days per week	43 (13.2)		
6-7 days per week	12 (3.7)		
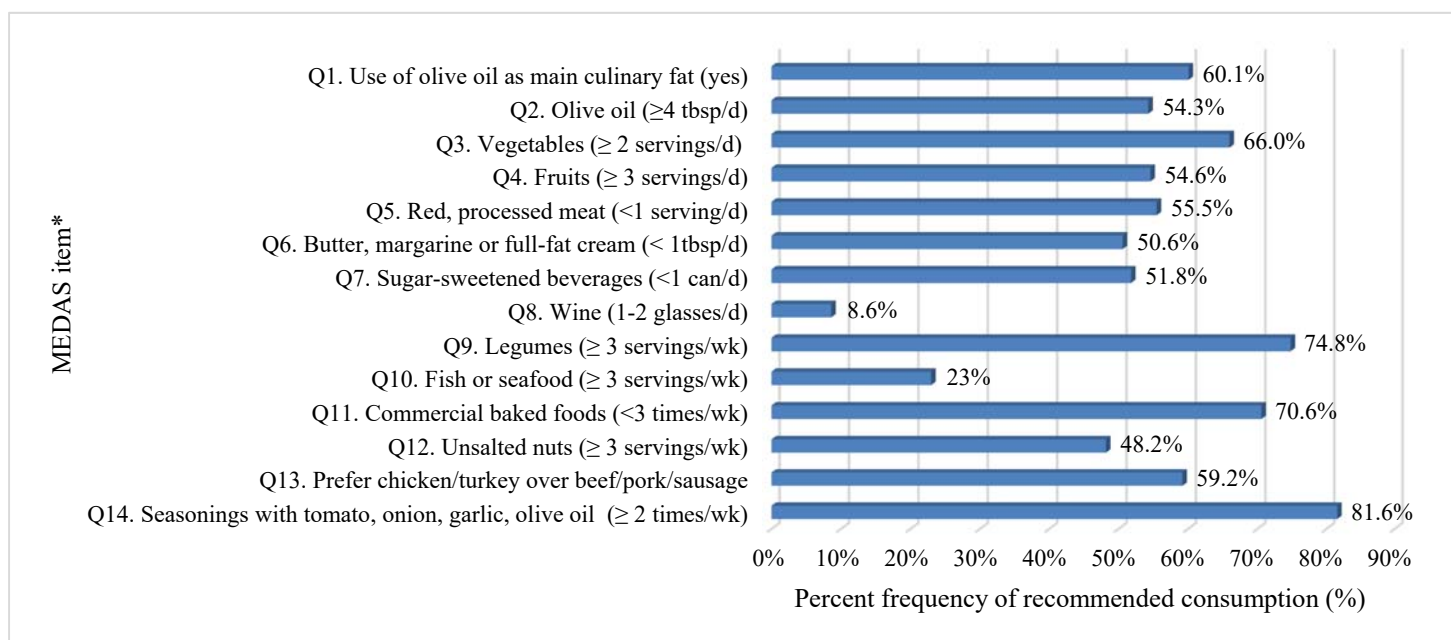
*MEDAS: Mediterranean Diet Adherence Screener

Figure 3. *Level of adherence to each category of the 14-MEDAS score*

Figure 3 shows the percentage of study participants who met the recommended consumption

frequency of 12 food groups/ items as per MEDAS. More than 50 % met the recommended

consumption of food seasoned with sofrito sauce made of tomato, onion, garlic and olive oil (81.6%), legumes (74.8%), commercial baked goods (70.6%), vegetables (66%), red/processed meat (55.5%), fruits (54.6%), olive oil (54.3%), sugar-sweetened beverages (51.8%) and butter, margarine or full-fat cream (50.6%). In addition, most of the participants met the recommendation of using olive oil as the main culinary fat (60.1%) and consuming chicken or turkey rather than beef/pork/sausage (59.2%). Less than half of the participants, however, met the recommended consumption of unsalted nuts (48.2%), fish or seafood (23%) and wine (8%).

2. <u>Description of Home and Food Store Environment</u>

The description of the home food environment is presented in **Table 2** (n=326). Most of the study participants reported availability of certain healthy foods at home. These foods included fruits (~97%), vegetables (~99%), legumes (~95%) whole-grain or brown bread (~70%), fresh/frozen fish (~56%) and diet soft drinks (~53%). However, less than half of the individuals included in the study reported availability of other healthy foods at home; specifically, low-fat or non-fat milk (~47%), whole wheat pasta, rice or flour/low-fat or non-fat dairy (~41%). It is noteworthy to mention that at least two-thirds of the study participants reported frequent easy access to fruits and vegetables (fruits and vegetables in the fridge (always/often: ~91%) or on the kitchen counter (always/often: ~67%). On the other hand, a high percentage (≥2/3) of the study participants also reported availability of certain unhealthy foods at home. These foods included refined pasta rice/flour (~97%), meat products (92%), sweets and pastries (~85%), cold cuts and charcuterie (~79%), white bread (~77%), chips and snacks (~73%), full-fat dairy (~74%) and full-fat milk (~65%). In addition, half of the participants reported availability of regular soft drinks at home. It is worth mentioning, however, that about 50% of the study participants

reported infrequent easy access (sometimes/rarely, never) to sweets and pastries (sweets and pastries on the kitchen counter).

As for family-level factors that affect dietary habits, 54% reported having meals with the family all the time and ~63 % reported having consistently parental and sibling support to make healthy dietary choices.

Table 2. Description of the home food environment

	Total (n=326) n (%)			
	Yes	**No**		
Availability of healthy foods				
Fruits	317 (97.2)	9 (2.8)		
Vegetables	321 (98.5)	5 (1.5)		
Diet soft drinks	174 (53.4)	152 (46.6)		
Whole wheat pasta, rice or flour	132 (40.5)	194 (59.5)		
Wholegrain or brown bread	229 (70.2)	97 (29.8)		
Legumes	309 (94.8)	17 (5.2)		
Fresh/frozen fish	183 (56.1)	143 (43.9)		
Low-fat or non-fat milk	153 (46.9)	173 (53.1)		
Low-fat or non-fat dairy	132 (40.5)	194 (59.5)		
Availability of unhealthy foods				
Sweets and pastries	278 (85.3)	48 (14.7)		
Chips and snacks	239 (73.3)	87 (26.7)		
Cold cuts and charcuterie	257 (78.8)	69 (21.2)		
Regular soft drinks	163 (50)	163 (50)		
Refined pasta, rice, or flour	315 (96.6)	11 (3.4)		
White bread	252 (77.3)	74 (22.7)		
Meat (chicken, beef…)	300 (92)	26 (8)		
Full-fat milk	213 (65.3)	113 (34.7)		
Full-fat dairy	241 (73.9)	85 (26.1)		
	Always	**Often**	**Sometimes**	**Never/rarely**
Accessibility of foods				
Fruits and vegetables in fridge	222 (68.1)	74 (22.7)	23 (7.1)	7 (2.1)
Fruits and vegetables on	146 (44.8)	71 (21.8)	68 (20.9)	41 (12.6)

kitchen counter				
Sweets, pastries on kitchen counter	87 (26.7)	79 (24.2)	118 (36.2)	42 (12.9)
	Always	**Sometimes**	**Never/rarely**	
Frequency of family meals	176 (54)	142 (43.6)	8 (2.5)	
Family support to make healthy food choices	204 (62.6)	96 (29.4)	26 (8)	

The description of the food environment in stores is presented in **Table 3** (n=326). The majority of the participants reported going to supermarkets for food shopping (81.6%) while an equal percentage of the remaining participants reported going minimarkets (35.3%) or small grocery stores (34.4%). When asked about motivations to select a place for food shopping, the proportion of participants indicating each of the suggested motivations as important was as follows: quality (92%), price (~88%) and variety (~84%) of food available at a food store, proximity of the food store to the participant's house (~78%)/other places the participant goes to (~76%), and same shopping store as that of friends/family (~33 %). The majority of the study participants (~68 %) indicated that the prices of fresh fruits and vegetables at the food store where they buy their food were not expensive as compared to those in other food stores. Furthermore, at least 70% of the participants agreed that healthy, unhealthy and a variety of food products are easy to buy (healthy (68-76%): fruits, vegetables, lean meats, low-fat products; unhealthy (71%-80%): sweets, snacks and sodas or sugary drinks; a variety of food products :85.9%). When asked about the transportation means used to visit food stores, the majority of the study participants reported that they use their own car (~87%). The remaining participants reported that they go walking (~18%), use delivery services (17.2%), or ride with a neighbor (5.5%).

As regards food placement and promotions in stores where participants buy most of the food, only ~22% agreed that unhealthy foods were placed at one of the ends of the aisles, and 32%

agreed that they bought food items placed at eye-level on shelves. While ~51% agreed that food items placed next to cash registers were usually unhealthy, only ~18% agreed that they bought food items placed next to the cash registers. Moreover, about 43% participants reported that they used to see signs that encourage the customer to buy healthy food whereas only 34% reported that they used to see signs that encourage the customer to buy unhealthy food. ~62% of study participants perceived most pre-packed food products had a nutrition facts label. When shopping in a particular food store, the proportion of participants indicating each of the suggested characteristics of food as important when considering purchase of a particular food was as follows: food taste: ~98%; healthy food: ~94%; price: ~91%; convenience/easy to cook: 88%, and weight control: ~82%. Furthermore, most of the study participants reported use of a shopping list to buy their groceries (sometimes: ~43%; always: ~33).

Table 3. Description of the food environment in stores, food purchase behavior and perceptions

	Total (n=326) n (%)		
	Yes	**No**	
Type of food store mostly shopped from			
Small grocery store	112 (34.4)	214 (65.6)	
Minimarket	115 (35.3)	211 (64.7)	
Supermarket	266 (81.6)	60 (18.4)	
	Not important	**Important**	
Motivation to select place of food shopping			
Close to my house	72 (22.1)	254 (77.9)	
Close to other places I go to	80 (24.5)	246 (75.5)	
My friends and family shop there	220 (67.5)	106 (32.5)	
Variety of food offered	51 (15.6)	275 (84.4)	
Quality of food offered	26 (8)	300 (92)	
Price of food offered	40 (12.3)	286 (87.7)	
	Not	**Expensive/Very**	**I don't know**

	expensive	expensive		
Fruits & vegetables prices compared to that in other food stores	222 (68.1)	61 (18.7)	43 (13.2)	
	Disagree	**Neither agree nor disagree**	**Agree**	
Easy to buy healthy foods				
Fresh fruits and vegetables	34 (10.4)	56 (17.2)	236 (72.4)	
Canned fruits and vegetables	49 (15)	54 (16.6)	223 (68.4)	
Low-fat products	18 (5.5)	61 (18.7)	247 (75.8)	
Lean meat (chicken, turkey…)	43 (13.2)	62 (19)	221 (67.8)	
Easy to buy a variety of foods	19 (5.8)	27 (8.3)	280 (85.9)	
Easy to buy unhealthy foods				
Sweets, pastries, cookies, biscuits	28 (8.6)	44 (13.5)	254 (77.9)	
Potato chips and snacks	46 (14.1)	49 (15)	231 (70.9)	
Sugar-sweetened drinks	25 (7.7)	40 (12.3)	261 (80.1)	
	Yes	**No**		
Transportation to food store				
Walking	58 (17.8)	268 (82.2)		
In my own car	284 (87.1)	42 (12.9)		
Go with neighbor	18 (5.5)	308 (94.5)		
Call and ask for delivery	56 (17.2)	270 (82.8)		
	Disagree	**Neither agree nor disagree**	**Agree**	
Marketing perception: placement of foods				
Unhealthy foods were placed at one of the ends of the aisles	163 (50)	92 (28.2)	71 (21.8)	
Food items placed next to cash registers were usually unhealthy	78 (23.9)	83 (25.5)	165 (50.6)	
Often bought food items placed at eye-level on shelves	148 (45.4)	73 (22.4)	105 (32.2)	

Often bought food items placed next to the cash registers	190 (58.3)	78 (23.9)	58 (17.8)	
Marketing perception: food promotions				
Used to see signs that encouraged me to buy healthy food	114 (35)	73 (22.4)	139 (42.6)	
Used to see signs that encouraged me to buy unhealthy food	117 (35.9)	98 (30.1)	111 (34)	
Most pre-packed foods had a nutrition facts label	40 (12.3)	83 (25.5)	203 (62.3)	
	Not important	**Important**		
When shopping for food, how important is				
Taste	8 (2.5)	318 (97.5)		
Nutrition (healthy food)	20 (6.1)	306 (93.9)		
Price	28 (8.6)	298 (91.4)		
Convenience (easy to cook)	39 (12)	287 (88)		
Weight control	58 (17.8)	268 (82.2)		
	Never	**Occasionally**	**Sometimes**	**Usually or always**
Use of a shopping list	28 (8.6)	49 (15)	140 (42.9)	109 (33.4)

3. <u>Relationship Between Home Food Environment and MD Adherence</u>

Associations between home food environment and MD adherence levels are presented in **Table 4.** (n=326). A significantly higher percentage of participants who reported to have healthy foods available at home such as whole wheat pasta, rice or flour (Good: 25% vs. Moderate: 63.6% vs. Low:11.4%, p=0.032), wholegrain or brown bread (Good: 21% vs. Moderate: 68.1% vs. Low: 10.9%, p=0.000), fresh/frozen fish (Good: 25.7% vs. Moderate: 65% vs. Low: 9.3%, p=0.000), and low-fat or non-fat dairy (Good: ~22.7 % vs. Moderate: ~66.7% vs. Low: ~10.6%, p=0.047) were found to have good/moderate-fair MD adherence level. Similarly, a significantly higher percentage of participants who didn't report availability of unhealthy foods at home such as

sweets and pastries (Good: 33.3% vs. Moderate: 52.1% vs. Low ~14.6%, p=0.035), chips and snacks (Good: 28.7%, vs. Moderate: 55.2%, Low: 16.1%, p=0.041) and regular soft drinks (Good: 24.5% vs. Moderate: 64.4% vs. Low: 11%, p=0.007) were found to have good/moderate-fair MD adherence level. Moreover, a significantly higher percentage of participants who reported infrequent access to sweet and pastries was found to have good MD adherence level (sweet and pastries on the kitchen counter: never/rarely: 35.7% vs. always: 24.1% vs often: 10.1% vs. sometimes: 16.9%).

Table 4. Association of home food environment with Mediterranean diet adherence level

	Total (n=326) MD Adherence n (%)			
	Good	**Moderate to fair**	**Low**	**P value***
Availability of healthy foods				
Fruits				0.480
Yes	63 (19.9)	203 (64)	51 (16.1)	
No	1 (11.1)	5 (55.6)	3 (33.3)	
Vegetables				1
Yes	63 (19.6)	205 (63.9)	53 (16.5)	
No	1 (20)	3 (60)	1 (20)	
Diet soft drinks				0.265
Yes	31 (17.8)	118 (67.8)	25 (14.4)	
No	33 (21.7)	90 (59.2)	29 (19.1)	
Whole wheat pasta, rice or flour				0.032
Yes	33 (25)	84 (63.6)	15 (11.4)	
No	31 (16)	124 (63.9)	39 (20.1)	
Wholegrain or brown bread				0.000
Yes	48 (21)	156 (68.1)	25 (10.9)	
No	16 (16.5)	52 (53.6)	29 (29.9)	
Legumes				1
Yes	61 (19.7)	197 (63.8)	51 (16.5)	
No	3 (17.6)	11 (64.7)	3 (17.6)	
Fresh/frozen fish				0.000
Yes	47 (25.7)	119 (65)	17 (9.3)	
No	17 (11.9)	89 (62.2)	37 (25.9)	
Low-fat or non-fat milk				0.262
Yes	30 (19.6)	103 (67.3)	20 (13.1)	
No	34 (19.7)	105 (60.7)	34 (19.7)	
Low-fat or non-fat dairy				0.047

Yes	30 (22.7)	88 (66.7)	14 (10.6)	
No	34 (17.5)	120 (61.9)	40 (20.6)	
Availability of unhealthy foods				
Sweets and pastries				0.035
Yes	48 (17.3)	183 (65.8)	47 (16.9)	
No	16 (33.3)	25 (52.1)	7 (14.6)	
Chips and snacks				0.041
Yes	39 (16.3)	160 (66.9)	40 (16.7)	
No	25 (28.7)	48 (55.2)	14 (16.1)	
Cold cuts and charcuterie				0.204
Yes	46 (17.9)	170 (66.1)	41 (16)	
No	18 (26.1)	38 (55.1)	13 (18.8)	
Regular soft drinks				0.007
Yes	24 (14.7)	103 (63.2)	36 (22.1)	
No	40 (24.5)	105 (64.4)	18 (11)	
Refined pasta, rice, or flour				0.396
Yes	62 (19.7)	199 (63.2)	54 (17.1)	
No	2 (18.2)	9 (81.8)	0 (0)	
White bread				0.679
Yes	50 (19.8)	158 (62.7)	44 (17.5)	
No	14 (18.9	50 (67.6)	10 (13.5)	
Meat (chicken, beef…)				0.582
Yes	61 (20.3)	190 (63.8)	49 (16.3)	
No	3 (11.5)	18 (69.2)	5 (19.2)	
Full-fat milk				0.791
Yes	40 (18.8)	136 (63.8)	37 (17.4)	
No	24 (21.2)	72 (63.7)	17 (15)	
Full-fat dairy				0.217
Yes	47 (19.5)	149 (61.8)	45 (18.7)	
No	17 (20)	59 (69.4)	9 (10.6)	
Accessibility of foods				0.242
Fruits and vegetables in fridge				
Always	48 (21.6)	138 (62.2)	36 (16.2)	
Often	12 (16.2)	49 (66.2)	13 (17.6)	
Sometimes	1 (4.3)	17 (73.9)	5 (21.7)	
Never or rarely	3 (42.9)	4 (57.1)	0 (0)	
Fruits and vegetables on kitchen counter				0.244
Always	37 (25.3)	90 (61.6)	19 (13)	
Often	8 (11.3)	49 (69)	14 (19.7)	
Sometimes	12 (17.6)	42 (61.8)	14 (20.6)	
Never or rarely	7 (17.1)	27 (65.9)	7 (17.1)	
Sweets, pastries on kitchen counter				0.006
Always	21 (24.1)	56 (64.4)	10 (11.5)	
Often	8 (10.1)	51 (64.6)	20 (25.3)	
Sometimes	20 (16.9)	81 (68.6)	17 (14.4)	

Never or rarely	15 (35.7)	20 (47.6)	7 (16.7)	
Sharing meals with family				0.819
Always	31 (17.6)	113 (64.2)	32 (18.2)	
Sometimes	31 (21.8)	90 (63.4)	21 (14.8)	
Never or rarely	2 (25)	5 (62.5)	1 (12.5)	
Family support to make healthy food choices				0.374
Always	42 (20.6)	134 (65.7)	28 (13.7)	
Sometimes	17 (17.7)	60 (62.5)	19 (19.8)	
Never or rarely	5 (19.2)	14 (53.8)	7 (26.9)	

Significant at p<0.05

4. <u>Relationship Between Food Environment in Stores and MD Adherence</u>

Associations of food environment in stores, consumer purchasing behavior and perceptions of food marketing strategies with MD adherence level are presented in **Table 5.** (n=326). A significantly higher percentage of participants who perceived importance of food stores' proximity to their houses, importance to food quality in selecting place of food shopping, and importance to convenience while shopping in food stores were found to have low MD adherence level than those who did not perceive these factors as important (food store proximity: not important 6.9% vs. important 19.3%, p=0.002; food quality: not important 7.7% vs. important 17.3%, p=0.045; convenience: not important 7.7% vs. important 17.8%, p=0.039). In addition, a significantly higher percentage of participants who found it easy to buy canned fruits and vegetables in stores were found to have low MD adherence level compared to those who disagreed or neither agreed nor disagreed (disagreed: 6.1% vs. neither agreed nor disagreed: 33.3% vs. agreed: 14.8%, p=0.003). It is worth mentioning that associations were found between additional in store characteristics and MD adherence level, but these associations were of borderline statistical significance. Specifically, a significantly higher percentage of participants who perceived importance of food variety in selecting place of food shopping was found to have low MD adherence level than those who did not perceive this factor as important (not important: 7.8% vs. important: 18.2%, p=0.057). Moreover, a significantly higher percentage of participants

who reported to go to the food store with their neighbor was found to have lower MD adherence level than those who reported otherwise (Yes: 38.9% vs. No: 15.3%, p=0.051).

Table 5. Associations of food environment in stores, consumer purchasing behavior and perceptions of food marketing strategies with Mediterranean diet adherence level.

	MD adherence (%)			
	Good	**Moderate to fair**	**Low**	**P value***
Type of food store mostly shopped from				
Small grocery store				0.100
Yes	29 (25.9)	64 (57.1)	19 (17)	
No	35 (16.4)	144 (67.3)	35 (16.4)	
Minimarket				0.767
Yes	25 (21.7)	72 (62.6)	18 (15.7)	
No	39 (18.5)	136 (64.5)	36 (17.1)	
Supermarket				0.901
Yes	51 (19.2)	171 (64.3)	44 (16.5)	
No	13 (21.7)	37 (61.7)	10 (16.7)	
Motivation to select place of food shopping				
Close to my house				0.002
Not important	23 (31.9)	44 (61.1)	5 (6.9)	
Important	41 (16.1)	164 (64.6)	49 (19.3)	
Close to other places I go to				0.554
Not important	19 (23.8)	49 (61.2)	12 (15)	
Important	45 (18.3)	159 (64.6)	42 (17.1)	
My friends and family shop there				0.361
Not important	47 (21.4)	140 (63.6)	33 (15)	
Important	17 (16)	68 (64.2)	18 (19.8)	
Variety of food offered				0.057
Not important	15 (29.4)	32 (62.7)	4 (7.8)	
Important	49 (17.8)	176 (64)	50 (18.2)	
Quality of food offered				0.045
Not important	10 (38.5)	14 (53.8)	2 (7.7)	
Important	54 (18)	194 (64.7)	52 (17.3)	
Price of food offered				0.151
Not important	12 (30)	24 (60)	4 (10)	
Important	52 (18.2)	184 (64.3)	50 (17.5)	
Fruits & vegetables prices compared to that in other food stores				0.644
Not expensive	44 (19.8)	139 (62.6)	39 (17.6)	
Expensive/ Very expensive	9 (14.8)	43 (70.5)	9 (14.8)	
I don't know	11 (25.6)	26 (60.5)	6 (14)	

Easy to buy healthy foods				
Fresh fruits and vegetables				0.611
Disagree	8 (23.5)	22 (64.7)	4 (11.8)	
Neither agree nor disagree	10 (17.9)	33 (58.9)	13 (23.2)	
Agree	46 (19.5)	153 (64.8)	37 (15.7)	
Canned fruits and vegetables				0.003
Disagree	9 (18.4)	37 (75.5)	3 (6.1)	
Neither agree nor disagree	7 (13)	29 (53.7)	18 (33.3)	
Agree	48 (21.5)	142 (63.7)	33 (14.8)	
Low-fat products				0.497
Disagree	6 (33.3)	10 (55.6)	2 (11.1)	
Neither agree nor disagree	11 (18)	37 (60.7)	13 (21.3)	
Agree	47 (19)	161 (65.2)	39 (15.8)	
Lean meat (chicken, turkey…)				0.360
Disagree	6 (14)	27 (62.8)	10 (23.3)	
Neither agree nor disagree	10 (16.1)	39 (62.9)	13 (21)	
Agree	48 (21.7)	142 (64.3)	31 (14)	
Easy to buy a variety of products				0.879
Disagree	5 (26.3)	12 (63.2)	2 (10.5)	
Neither agree nor disagree	4 (14.8)	18 (66.7)	5 (18.5)	
Agree	55 (19.6)	178 (63.6)	47 (16.8)	
Easy to buy unhealthy foods				
Sweets, pastries etc.				0.240
Disagree	10 (35.7)	16 (57.1)	2 (7.1)	
Neither agree nor disagree	8 (18.2)	28 (63.6)	8 (18.2)	
Agree	46 (18.1)	164 (64.6)	44 (17.3)	
Potato chips and snacks				0.193
Disagree	13 (28.3)	25 (54.3)	8 (17.4)	
Neither agree nor disagree	5 (10.2)	33 (67.3)	11 (22.4)	
Agree	46 (19.9)	150 (64.9)	35 (15.2)	
Soft drinks and SSBs				0.455
Disagree	8 (32)	14 (56)	3 (12)	
Neither agree nor disagree	7 (17.5)	24 (60)	9 (22.5)	
Agree	49 (18.8)	170 (65.1)	42 (16.1)	
Transportation to food store				
Walking				0.107
Yes	15 (25.9)	30 (51.7)	13 (22.4)	
No	49 (18.3)	178 (66.4)	41 (15.3)	
In my own car				0.499
Yes	53 (18.7)	184 (64.8)	47 (16.5)	
No	11 (26.2)	24 (57.1)	7 (16.7)	
Go with neighbor				0.051
Yes	2 (11.1)	9 (50)	7 (38.9)	
No	62 (20.1)	199 (64.6)	47 (15.3)	
Call and ask for delivery				0.774
Yes	10 (17.9)	35 (62.5)	11 (19.6)	

No	54 (20)	173 (64.1)	43 (15.9)	
Marketing perception: placement of foods				
Unhealthy foods were placed at one of the ends of the aisles				0.238
Disagree	35 (21.5)	95 (58.3)	33 (20.2)	
Neither agree nor disagree	16 (17.4)	66 (71.7)	10 (10.9)	
Agree	13 (18.3)	47 (66.2)	11 (15.5)	
Food items placed next to cash registers were usually unhealthy				0.869
Disagree	14 (17.9)	50 (64.1)	14 (17.9)	
Neither agree nor disagree	17 (20.5)	50 (60.2)	16 (19.3)	
Agree	33 (20)	108 (65.5)	24 (14.5)	
Often bought food items placed at eye-level on shelves				0.547
Disagree	34 (23)	88 (59.5)	26 (17.6)	
Neither agree nor disagree	14 (19.2)	47 (64.4)	12 (16.4)	
Agree	16 (15.2)	73 (69.5)	16 (15.2)	
Often bought food items placed next to the cash registers				0.228
Disagree	42 (22.1)	121 (63.7)	27 (14.2)	
Neither agree nor disagree	12 (15.4)	47 (60.3)	19 (24.4)	
Agree	10 (17.2)	40 (69)	8 (13.8)	
Marketing perception: food promotions				
Used to see signs that encouraged me to buy healthy food				0.502
Disagree	24 (21.1)	75 (65.8)	15 (13.2)	
Neither agree nor disagree	14 (19.2)	49 (67.1)	10 (13.7)	
Agree	26 (18.7)	84 (60.4)	29 (20.9)	
Used to see signs that encouraged me to buy unhealthy food				0.976
Disagree	24 (20.5)	74 (63.2)	19 (16.2)	
Neither agree nor disagree	17 (17.3)	64 (65.3)	17 (17.3)	
Agree	23 (20.7)	70 (63.1)	18 (16.2)	
Most pre-packed foods had a nutrition facts label				0.579
Disagree	9 (22.5)	23 (57.5)	8 (20)	
Neither agree nor disagree	13 (15.7)	59 (71.1)	11 (13.3)	
Agree	42 (20.7)	126 (62.1)	35 (17.2)	
When shopping for food, how important is				
Taste				0.281

Not important	3 (37.5)	5 (62.5)	0 (0)	
Important	61 (19.2)	203 (63.8)	54 (17)	
Nutrition (healthy food)				0.629
Not important	5 (25)	11 (55)	4 (20)	
Important	59 (19.3)	197 (64.4)	50 (16.3)	
Price				0.241
Not important	9 (32.1)	15 (53.6)	4 (14.3)	
Important	55 (18.5)	193 (64.8)	50 (16.8)	
Convenience				0.039
Not important	13 (33.3)	23 (59)	3 (7.7)	
Important	51 (17.8)	185 (64.5)	51 (17.8)	
Weight control				0.229
Not important	10 (17.2)	34 (58.6)	14 (24.1)	
Important	54 (20.1)	174 (64.9)	40 (14.9)	
Use shopping list				0.806
Never	8 (28.6)	15 (53.6)	5 (17.9)	
Occasionally	9 (18.4)	34 (69.4)	6 (12.2)	
Sometimes	28 (20)	87 (62.1)	25 (17.9)	
Usually or always	19 (17.4)	72 (66.1)	18 16.5)	

* Significant at p<0.05

Association of home food environment with MD score in the study population, as assessed by multivariable linear regression is presented in **Table 6**. Before adjustment for the effects of individual characteristics, there were significant associations between availability of whole wheat pasta, rice or flour; whole grain or brown bread; fish at home and a borderline significant association regular between availability of regular soft drinks at home and MD score. Specifically, unavailability of whole wheat pasta, rice or flour; wholegrain or brown bread; fish, and at home were found to be associated with a decrease of 0.747, 0.541 and 1.137 in the MD score, respectively **(Model 1).** However, unavailability of regular soft drinks was found to be associated with an increase of 0.475 in the MD score. After controlling for the effects of individual characteristics, availability of whole wheat pasta, rice or flour and fish at home remained to be significantly associated with MD score whereas the associations between availability of whole grain or brown bread and regular soft drinks at home and MD score vanished. Specifically, unavailability of whole wheat pasta, rice or flour and fish at home were

found to be associated with a decrease of 0.714 and 1.084 points in the MD score, respectively

(Model 2).

Table 6. Association of home food environment with Mediterranean diet score in the study population, as assessed by multivariable linear regression.

	Unstandardized β	SE	Standardized β	95% CI	
Model 1					
Whole wheat pasta, rice or flour	-0.747*	0.247	-0.165	-1.232	-0.261
Wholegrain or brown bread	-0.541*	0.260	-0.112	-1.052	-0.031
Fresh/frozen fish	-1.137*	0.238	-0.254	-1.606	-0.668
Low-fat or non-fat dairy	-0.053	0.248	-0.012	-0.542	0.436
Sweets and pastries	0.444	0.336	0.071	-0.218	1.105
Regular soft drinks	0.475*	0.240	0.107	0.002	0.947
Model 2					
Whole wheat pasta, rice or flour	-0.714*	0.249	-0.158	-1.204	-0.223
Wholegrain or brown bread	-0.450	0.259	-0.093	-0.959	0.059
Fresh/frozen fish	-1.084*	0.237	-0.243	-1.551	-0.617
Low-fat or non-fat dairy	0.177	0.254	0.039	-0.324	0.678
Sweets and pastries	0.437	0.339	0.070	-0.230	1.104
Regular soft drinks	0.312	0.248	0.070	-0.177	0.801

Significant at $p<0.05$

Model 1: Effects of availability of whole wheat pasta, rice or flour, whole grain or brown bread, fresh/frozen fish, low-fat or non-fat dairy, sweets and pastries and regular soft drinks on MD diet score.

Model 2: Effects of availability of the same variables as those in Model 1 after adjustment for the effects of individual characteristics (age, gender, children, educational level, health-related major, smoking and physical activity).

Association of food store environment with MD score in the study population, as assessed by multivariable linear regression is presented in **Table 7.** Before adjustment for the effects of individual characteristics, there was a borderline significant association between perception of availability of easy to cook foods at food stores as important and MD adherence score. Specifically, perception of availability of easy to cook foods as important was found to be associated with a decrease of 0.783 points in the MD score **(Model 1)**. After controlling for the effects of the individual characteristics, perception of availability of easy to cook foods as important remained to be significantly associated with MD score. Specifically, perception of availability of easy to cook foods as important was found to be associated with a decrease of 0.765 points in the MD score **(Model 2).**

Table 7. Association of food store environment with Mediterranean diet score in the study population, as assessed by multivariable linear regression.

	Unstandardized β	SE	Standardized β	95% CI	
Model 1					
Motivation to select place of food shopping					
Variety	0.024	0.382	0.004	-0.727	0.774
Quality	-0.762	0.563	-0.093	-1.870	0.346
Price	-0.538	0.487	-0.068	-1.497	0.421
When shopping for food, how important is					
Taste	-0.415	0.862	-0.029	-2.111	1.280
Nutrition	0.208	0.542	0.022	-0.859	1.275
Price	-0.098	0.437	-0.015	-0.957	0.761
Convenience	-0.783*	0.397	-0.115	-1.564	-0.001
Model 2					

Motivation to select place of food shopping					
Variety	0.017	0.379	0.003	-0.729	0.763
Quality	-0.725	0.546	-0.089	-1.799	0.349
Price	-0.094	0.426	-0.014	-0.932	0.745
When shopping for food, how important is					
Taste	-0.669	0.855	-0.047	-2.351	1.012
Nutrition	-0.177	0.528	-0.019	-1.216	0.863
Price	-0.513	0.478	-0.065	-1.453	0.427
Convenience	-0.765*	0.385	-0.112	-1.524	-0.007

* Significant at p<0.05

Model 1: Effects of food store environment (e.g., motivation to select place of food shopping (variety, quality and price) and importance of taste, nutrition, price and convenience when shopping for food) on MD score.

Model 2: Effects of the same variables as those in Model 1 on MD score, after adjustment for the effects of individual characteristics (age, gender, children, educational level, health-related major, smoking and physical activity).

IV. DISCUSSION

1. MD Adherence

The present study aimed to assess the level of adherence to the MD among Lebanese adults and to investigate its major home and food store environment determinants. Overall, 64% participants had a moderate-to-fair adherence to the MD, and 20% had good adherence consistent with previous research among adult populations in Mediterranean countries such as Portugal (mean age=36.5±13.6, 72% females) (Andrade et al., 2020), Italy (25-64 years, 100% females) (Maugeri et al., 2019), Italy (mean age=42.6±9.7, 54% females) (Vitale et al., 2018); and Lebanon (≥20 years, 54% females) (Naja et al., 2019). One factor that could have contributed to this good level of adherence is our study sample's individual characteristics in

which the majority of the participants were young females (mean age=37±11.84, 79% females) with high level of education and health-consciousness. However, it is worth noting that the tools used to assess MD adherence differed among the earlier cited research.

With respect to individual 14-MEDAS items, the study findings revealed a higher intake of sofrito sauce (made of tomato, garlic, onion and olive oil), fruits, vegetables, legumes, red processed meat, nuts and SSBs relative to the MD recommendations, consistent with findings reported among 525 Lebanese university students (47% females), also using the 14-MEDAS tool (Karam et al., 2020). However, compared to the latter study, a higher percentage of participants meeting the recommended intake for baked goods and a lower percentage of participants meeting the recommended intake for olive oil use as main cooking fat, fish, wine, animal fat and for preferring low-fat/lean meats (e.g., chicken or turkey) over high-fat meats (beef or pork) were observed in our study. Similarly, the above results were found in a study done among 411 Italian adults but adherence to the recommended intake in the latter sample was lower for fruits, vegetables and legumes (Vitale et al., 2018). The low consumption of fish and wine are in line with previous findings among 615 Lebanese adults (19-70 years, 70% females) (Farhat et al., 2016) and 220 Lebanese university students (56.4% females) (Yahia et al., 2008). It is worth noting that the tools used to assess healthy eating and/or MD adherence in the above findings differed from 14-MEDAS.

2. Home Food Environment

Our results showed that the availability and accessibility to both healthy and unhealthy foods was high in the majority of homes, with availability being higher in terms of unhealthy foods (e.g., refined grains, full-fat dairy, sweets, and chips and snacks), in line with findings on home food environment among 4,942 U.S. adults (mean age=44.4±15.4, 52% females) (Kegler et al., 2020)

and 95 Spanish adults (mean age=41.54±14.30, 56% females) (Martínez-García et al., 2020). Moreover, a moderate percentage of participants reported social-environmental influences within the home such as having meals with the family all the time and parental/sibling support to make healthy dietary choices, in line with two studies on home food environment carried out among 18,031 U.S. adults (mean age~25, % females not reported) (Newman et al., 2015) and 882 U.S. adults (mean age ~ 50, 54% females) (Sobal & Hanson, 2011).

3. Food Environment in Stores

Supermarkets were found to be the most visited place for food shopping compared to small grocery stores or minimarkets. When selecting place of food shopping, most of the participants gave more importance to quality, variety and price than to proximity of the food store to their home or to other places they go to. This could be due to the fact that Mediterranean neighborhoods have a dense urban nucleus where it is easy to walk/commute to food stores without using public transportation (Díez et al., 2018). It could also be explained by the fact that the study sample was highly educated and 30% earned a specialization in a health-related field. With respect to ease of purchase of foods in stores, the majority of the participants perceived that it was easy to buy a wide selection of both healthy and unhealthy foods, similar to findings by Martínez-García et al. (2020). They agreed to no apparent predominance of promotion of either healthy or unhealthy food in stores where they used to buy most of their foods, similar to previous findings in Spain (Díez, 2018; Martínez-García, 2020).

4. Relationship Between Home Food Environment and MD Adherence

Studies examining the association of home food environment with MD adherence particularly among adults living in Mediterranean countries are very few. Our finding that the availability of healthy foods (whole wheat pasta, rice or flour, whole grain or brown bread, fresh/frozen fish,

low-fat or non-fat dairy) and unavailability of unhealthy foods (sweets and pastries, chips and snacks, regular soft drinks) in the home were significantly associated with higher MD adherence is consistent with previous findings which revealed positive associations between fruit and vegetables available at home and healthy eating/fruit and vegetable intake in adults, proxies for the MD (Alber, 2017; mean age=45.1±11.07, 70% females) (Karpyn, 2020 mean age=46.93±15.24, 69% females). Moreover, our findings were in line with previous studies that reported negative associations between salty snacks and sweets available at home and healthy eating/fruit and vegetable intake in adults, proxies for the MD (Kegler et al., 2021; mean age=44.4±15.4, 52% females). The availability of whole wheat pasta, rice or flour and fish at home remained significantly positively associated with MD score after controlling for the effects of individual characteristics, whereas the associations between availability of whole grain or brown bread and regular soft drinks at home and MD score became insignificant.

Moreover, inverse significant association was found between accessibility of unhealthy foods (e.g., sweets and pastries on kitchen counter) and MD adherence level in concert with previous findings on accessibility of fruits and vegetables in the home and increased consumption (Alber, 2017; Kegler, 2021).

In addition, social-environmental influences within the home such as parents and siblings' support to make healthy food choices and frequent family meals were not found to be significantly associated with MD adherence level. No previous data to support/contradict these associations are available among adults; however, studies on children and adolescents reported significant positive associations which may be attributed to the relatively young age of the participants, implying that these participants were still highly influenced by their family with regards to their dietary choices (McCormick et al., 2021).

5. <u>Relationship Between Food Environment in Stores and MD Adherence</u>

Our study found a significant association between those who perceived no importance of food stores' proximity to their houses and higher MD adherence level, contrary to previous findings that reported insignificant associations with dietary guidelines index and fruit/vegetable consumption (Lucan 2014; Sexton-Dhamu, 2021 (mean age= 24.2±3.5, 73% females), possibly due to either Lebanese neighborhoods having a dense urban nucleus where it is easy to walk to food stores without using public transportation, or the Lebanese's preference to purchase high-quality, nutritious foods even if outside the neighborhood than to purchase low-quality, calorie-dense foods somewhere close to their neighborhood. Moreover, there was a significant association between ease of buying canned fruits and vegetables in stores and lower MD adherence level, which can only be explained by the inconsistent findings of the relationship between ease of buying fresh fruits and vegetables in stores and increased fruit and vegetable consumption (Alber, 2017; Karpyn, 2020; Lucan, 2014; Sexton-Dhamu, 2021).

In addition, our study found that participants who perceived importance of food quality in selecting place of food shopping were shown to have lower MD adherence level; however, this association became insignificant as per output from regression analyses. Similarly, participants who perceived importance of food variety in selecting place of food shopping were shown to have lower MD adherence level; however, this association was marginally significant and became insignificant as per output from regression analyses. The above associations are in line with inconsistent findings of associations between perceived quality of fruits and vegetables (Alber, 2017; Chor, 2016; Lucan, 2014) and variety of fruits and vegetables (Alber, 2017; Chor, 2016; de Menezes, 2018; Karpyn, 2020) with the recommended intake of fruits and vegetables. Our study also found no association between perceiving food price as an important factor in

selecting place of food shopping and MD adherence. This association is in contrast with findings by Schröder et al. (2006) reporting a significantly higher cost of food (1.5$/day more) among Spanish adults (mean age~50, 51% females) who closely adhered to the MD.

No significant associations were found between participants' perceptions of food marketing (food promotions or placements) in stores and MD adherence, which may be due to the highly educated sample studied. No previous findings were found to support or contradict the following marginally significant association in our study: perceived importance of convenience or easy to cook meals when shopping in food stores and low MD adherence score/level (which remained significantly associated with MD score after controlling for individual characteristics) and reporting to go to the food store with a neighbor and low MD adherence level. A possible explanation for the latter would be that participants may be prone to be negatively influenced by their neighbor's food purchases if they mainly purchase unhealthy foods. As to the former association, a possible explanation would be participants who do not find preparation of meals as easy would rather not follow the MD.

6. <u>Strengths and Limitations</u>

To the best of our knowledge, this study is the first to examine the relationship between food environment at home and in food stores and adherence to MD among Lebanese adults. In our study, we collected data on a large number of covariates reported to have associations with MD adherence level, hence exploring link between food environment and MD adherence, before and after controlling for confounding variables.

The findings of this study ought to be considered in light of a few limitations. First, the cross-sectional design of the study allowed us only to examine associations rather than potential causal relationships between home and store food environment and MD adherence. Second, the target

sample was a convenient sample. A link to the online questionnaire was disseminated through colleagues, family, and friends. Hence, oversampling of a particular network cannot be ruled out. Our study sample emerged came out as young adult women with high level of education. The uneven gender distribution in our sample (80% females) can be explained by the fact that women are more likely than men to do most of the food shopping in the majority of Lebanese households. Hence, the findings are exploratory, specific to the study sample profile, and cannot be generalized. One must not disregard common biases associated with collecting data through online surveys (e.g., sampling, self-selection and response biases) (Wright KB, 2006); however, previous research by Ekman et al. (2006) stated that these biases were not greater than those caused by paper questionnaires. Fourth, the questionnaires were self-administered which may have led to misreporting and data bias: the use of self-filled frequency questionnaires to assess food intake, may have introduced an overestimation of foods considered healthy and underestimation of foods considered non-healthy. Furthermore, the interpretation of frequencies such as "always" and "often", and importance such as "a little important", "somewhat important" and "very important" may be different among participants, while responding to questions about the food environment. Fifth, individuals were asked to reflect on the conditions prior to February 2020, preceding the COVID-19 pandemic and the economic crisis. This raises possibility of recall bias among participants. Also, the survey questionnaires were self-administered, which may cause the respondents to over-report socially desirable responses (social desirability response bias). Sixth, we modified some of the sections of the NEMS-P-MED questionnaire; therefore, the validity and reliability of the original tool might be affected. Moreover, the latter tool was validated for the Spanish population, but not in Lebanese samples. Seventh, the applied questionnaire of 14-MEDAS adherence score represents a valid and easy tool for a rapid

screening rather than exact assessment of the adherence to the Mediterranean dietary pattern in different population groups; the tool didn't include questions on usual intake of cereals, eggs, potatoes, and dairy products that are part of the MD pyramid. In addition, the 14-MEDAS tool was validated for the Spanish population, but not in Lebanese samples.

Lastly, the literature provides inconsistent findings on difference in associations between perceived and observed food environment; Alber et al. (2017) reported significant positive relationship between perceived and observed availability of fruits and vegetables in the neighborhood among U.S. adults, contrary to findings by Lucan et al. (2014) and Yamaguchi et al. (2019) which reported no association between self-reported and objective neighborhood measures among U.S. adults and Japanese older adults (mean age= 73.9±6.2, ~54% females) respectively. Hence, our findings may have differed should we have carried out actual observation of the food environment. Based on the above limitations, it is possible that we might have missed the actual association between MEDAS scores and some of the factors that influence adoption of or adherence to the MD.

V. CONCLUSION

The present study is the first to examine the independent associations between home environment and food environment in stores and MD adherence among Lebanese adults. Overall, this study showed a moderate-to-fair adherence (64%) to the MD among these adults. Home environment was identified as the most influential environmental factor associated with MD adherence. As such, participants with increased availability and accessibility to healthy foods in their homes had higher MD adherence levels. Specifically, availability of fish at home was found to be the strongest predictor of the MD score. As far as food environment in stores is concerned, perceived importance of easy to cook foods when shopping for food in stores was found to be the

strongest predictor of the MD score. However, the scarcity of findings reporting associations of food environment with MD adherence, the unique profile of our sample (young highly educated females) and the multiplicity of instruments for measuring MD adherence limit comparison among studies and may partly explain the lack of expected associations between other variables of the home and food environment in stores and MD adherence. The findings of our study, taken together, emphasize the need for addressing availability of healthy foods at home and individual cooking skills so that to improve the MD adherence in Lebanon. Further larger experimental studies among the general Lebanese population may be needed to validate our findings and understand the mechanisms underlying the effect of food environment on MD adherence.

APPENDICES

Appendix A-Consent Form (Arabic)

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كلّيّة التّمريض والعلوم الصّحّيّة في جامعة سيّدة اللّويزة (NDU)
استمارة الموافقة على المشاركة في دراسة بحثيّة

إنّ هذه الورقة استمارة موافقة على المشاركة في دراسة بحثيّة. إذا قرّرت المشاركة في الدّراسة، سيتعيّن عليك التّعبير عن موافقتك أدناه وإعادة الاستمارة إلى الباحثين.

من نحن؟

مجموعة من الباحثين من كلّيّة التّمريض والعلوم الصّحّيّة في جامعة سيّدة اللّويزة (NDU).

ما الغرض من الدّراسة؟

يهدف هذا البحث إلى دراسة العناصر الّتي تحدّد مدى التزام اللّبنانيّين البالغين الّذين يتمتّعون بصحّة جيّدة بالنّظام الغذائي لمنطقة البحر الأبيض المتوسّط (المعروف أيضًا بإسم حميّة البحر الأبيض المتوسّط) قبل الوباء والأزمة الاقتصادية، قبل فبراير 2020.

علامَ تنطوي المشاركة في الدّراسة؟ ما هي إجراءات المشاركة في الدّراسة؟

سيُطلَب من المشارك ملء استبيان على الإنترنت يحتوي على أسئلة عن معلومات خلفيّة واسئلة لفحص الالتزام بحمية البحر الأبيض المتوسط (MEDAS)، كما على استبيان لقياس كيفية إدراك البيئة الغذائيّة (NEMS-P-MED-AR). تستغرق المشاركة في هذه الدّراسة البحثيّة حوالي 10 دقائق.

هل تنطوي المشاركة في الدّراسة على أيّ مخاطر محتملة؟

لا تنطوي المشاركة في الدّراسة على أيّ مخاطر محتملة، وسيتمّ استخدام المعلومات الّتي يتمّ جمعها فقط للغرض الموضّح أعلاه في الاستمارة.

هل تحفظ هذه الدّراسة هويّة المشارك وسرّيّة المعلومات؟

لن يُطلَب من المشارك ذكر اسمه أو رقم بطاقة هويّته أو أي معلومات أخرى تفضح هويّته. وسيتمّ حفظ كلّ البيانات المجمّعة في هذه الدّراسة في مكان آمن، كما ستقتصر إمكانيّة الوصول إلى البيانات والمعلومات على الباحثين المشاركين في الدّراسة.

</div>

ما هي حقوق المشارِك في الدّراسة؟

إنّ المشاركة في هذه الدّراسة طوعيّة تمامًا، وللمشارك الحق في رفض المشاركة في بعض أقسام الدراسة ورفض الإجابة عن أيّ سؤال، كما ويجوز له الانسحاب من الدراسة في أي وقت كان ولأي سبب كان عن طريق الاتصال بأيّ من الباحثين.

بمن يجب الاتّصال للاستفسار أو طرح الأسئلة؟

للأسئلة المتعلّقة بالدّراسة، يُمكن الاتّصال بأيّ من الباحثين على الأرقام التّالية: ٤٢٣٤٤٣/٠٣ أو ٢٢٢٤١٣/٧١   أو ٧٨٢٠٢٠/٧٨ أو ٨٧٧١٢١/٠٣

بيان الموافقة على المشاركة:

لقد قرأت هذه الاستمارة، وقد أُتيحَت لي إمكانيّة طرح الأسئلة والحصول على إجابات مرضية في ما يتعلّق بالدّراسة، كما وأنّ الباحثين قد أكّدوا لي أنّه يمكنني طرح أيّ أسئلة حول الدّراسة في المستقبل وسيقومون بالإجابة عليها.

☐ من خلال وضع علامة في هذا المربّع، أعلن أنّني أوافق طوعًا على المشاركة في الدّراسة.

☐ من خلال وضع علامة في هذا المربّع، أعلن أنّني غير مهتمّ بالمشاركة في الدّراسة.

التّاريخ: ــــــــــــــــــــ

Appendix A'- Mediterranean Diet Flyer (Arabic)

محددات الالتزام بحمية البحر الابيض المتوسط
دراسة بحثية عبر الانترنت

من نحن؟

مجموعة من الباحثين من كليّة التّمريض والعلوم الصّحّيّة في جامعة سيّدة اللّويزة (NDU).

ما الغرض من الدّراسة؟

يهدف هذا البحث إلى دراسة العناصر الّتي تحدّد مدى التزام اللّبنانيّين البالغين الّذين يتمتّعون بصحّة جيّدة بحميّة البحر الأبيض المتوسّط، *قبل الوباء والأزمة الاقتصادية (قبل فبراير ٢٠٢٠).*

الوقت المطلوب لملء الاستبيان:

حوالي ١٠ دقائق

* **لن** يُطلَب من المشارك ذكر اسمه أو رقم بطاقة هويّته أو أي معلومات أخرى تفضح هويّته وسوف تُستخدم المعلومات الّتي يتمّ جمعها فقط للغرض الموضّح أعلاه.

لتتأهل/ي للمشاركة في هذه الدراسة يجب ان تكون/ي، قبل فبراير ٢٠٢٠:

- لبناني/ة ، مقيم/ة في لبنان
- ١٨ سنة و ما فوق
- مسؤول/ة عن تسوق المواد الغذائية
- غير حامل او مرضعة في ذلك الوقت
- لا تعاني من مشاكل صحية تستدعي التزامك بنظام غذائي خاص

للاستفسار أو طرح الأسئلة، يُمكن الاتّصال بأي من الباحثين على الأرقام التّالية:

٧٨/ ٨٧٢٠٢٠ أو ٧١/ ٢٢٢٤١٣

الرجاء الضغط على هذا الرابط لملء الاستبيان https://forms.gle/mBH1myrZcnb4Qh5d8

شكرا للمشاركة!

Appendix B-Background Questionnaire (Arabic)

استبيان المعلومات العامة

يرجى تقديم إجابتك بناءً على الفترة الزمنية السابقة للوباء والأزمة الاقتصادية

الوضع الاجتماعي – الديموغرافي

1. **الجنس :**

   ↗ أنثى   ↗ ذكر

2. **العمر :** -------------- سنة (مثال: ٣٥ سنة)   (قبل فبراير ٢٠٢٠)

3. **الوزن:** -------------- كلغ) شهر يناير ٢٠٢٠(
   الطول: -------------- سنتم)شهر يناير ٢٠٢٠ (

4. **في اي منطقة في لبنان كنت تسكن قبل فبراير ٢٠٢٠؟**

   ↗ البقاع   ↗ جنوب لبنان   ↗ بيروت
                     ↗ شمال لبنان   ↗ جبل لبنان

5. **الوضع العائلي (قبل فبراير ٢٠٢٠):**

   ↗ منفصل(ة)/مطلّق(ة)   ↗ أعزب/عزباء
   ↗ أرمل/أرملة   ↗ متزوج/متزوجة

6. **هل كان لديك أولاد؟**

   ↗ كلا
   ↗ نعم
   ↗ لا ينطبق

7. **حدد درجة تحصيلك العلميّ (قبل فبراير ٢٠٢٠):**

↗ إجازة جامعيّة او ما يعادلها   ↗ تعليم ما قبل الثانوي او ما يعادله

↗ تعليم ثانوي او ما يعادله

8. هل تخصصت في مجال متعلق بالصحة (الطب، علم الأحياء، الصحة العامة، التغذية، الصيدلة...)؟

↗ نعم   ↗ لا ينطبق

↗ لا

9. كيف تصف وضعك الوظيفي (قبل فبراير ٢٠٢٠)؟

↗ موظف(ة) بدوام كامل   ↗ عاطل(ة) عن العمل ولكن كنت ابحث عن عمل

↗ موظف(ة) بدوام جزئي   ↗ عاطل(ة) عن العمل ولكنّني لم أكن أبحث عن عمل (طالب(ة)، ربة منزل، متقاعد(ة)، من ذوي الاحتياجات الخاصّة)

أسئلة عن نمط الحياة

يرجى تقديم إجابتك بناءً على الفترة الزمنية السابقة للوباء والأزمة الاقتصادية (قبل فبراير ٢٠٢٠)

10. كم عدد الوجبات (بما فيها الوجبات الخفيفة) التي كنت تتناولها في اليوم الواحد؟

↗ أربع وجبات او اكثر   ↗ وجبتين

↗ ثلاث وجبات   ↗ وجبة واحدة

11. كم مرة في الأسبوع كنت تتناول كلّ وجبات الطّعام الرئيسية (الافطار والغداء والعشاء)؟

↗ ست إلى سبع مرات في الأسبوع   ↗ مرتين أو أقل في الأسبوع

↗ ثلاث إلى خمس مرات في الأسبوع

12. كم مرة في الأسبوع تقريبًا كنت تتناول وجبة الافطار؟

↗ ست إلى سبع مرات في الأسبوع   ↗ مرتين أو أقل في الأسبوع

↗ ثلاث إلى خمس مرات في
الأسبوع

13. كم مرة في الأسبوع تقريبًا كنت تأكل في المطعم؟

↗ ست إلى سبع مرات في الأسبوع   ↗ مرتين أو أقل في الأسبوع

↗ ثلاث إلى خمس مرات في
الأسبوع

14. هل كنت تدخن (سجار ، سجائر، اركيلة...) قبل فبراير ٢,٢٠ ؟

↗ لا

↗ نعم

15. هل كنت تتبع روتينًا منتظمًا للتمارين البدنية قبل فبراير ٢,٢٠ ؟

↗ نعم

↗ لا

16. هل تعتقد ان الازمة الاقتصادية/ جائحة فيروس كورونا كان لهما تاثيرًا سلبيًا على عاداتك الغذائية؟

↗ نعم   ↗ لا

↗ جزئيًا

17. كيف تقيّم جودة نومك بشكل عام؟ (قبل فبراير ٢,٢٠)

↗ جيدة جدًا   ↗ سيّئة إلى حد ما

↗ جيدة إلى حد ما   ↗ سيّئة جدًا

18. بشكل عام، قبل فبراير ٢,٢٠، تصف صحتك بأنها:

↗ ممتازة   ↗ جيدة   ↗ سيئة

↗ جيدة جدًا   ↗ مقبولة

Appendix C-14-item-Mediterranean Diet Adherence Screener (14-MEDAS) (Arabic)

فحص الالتزام بحمية البحر الأبيض المتوسط

للتذكير: يرجى تقديم إجابتك بناءً على الفترة الزمنية السابقة للوباء والأزمة الاقتصادية (قبل فبراير ٢٠٢٠)

1. هل كنت تستخدم زيت الزيتون في الطهي كمصدر رئيسي للدهون؟

نعم ↗   لا ↗

2. هل كنت تتناول٤ ملاعق طعام كبيرة (١ ملعقة طعام كبيرة = ١٥ مل) أو أكثر من <u>زيت الزيتون</u> كل يوم؟
(بما في ذلك الزيت المستخدم للقلي، والسلطات، والوجبات خارج المنزل، وما إلى ذلك)؟

نعم ↗   لا ↗

3. هل كنت تتناول حصتين أو أكثر من الخضار كل يوم؟

(حصة واحدة = ½ كوب من الخضار المطبوخة أو ١ كوب من السلطة الخضراء النيئة)

نعم ↗   لا ↗

٤. هل كنت تتناول ٣ حصص أو أكثر من الفاكهة (بما في ذلك عصائر الفاكهة الطبيعية) كل يوم؟

(حصة واحدة = فاكهة متوسطة الحجم أو ½ كوب عصير)

نعم ↗   لا ↗

٥. هل كنت تتناول أقل من حصة واحدة (= أقل من ١٥٠جرام، حجم كف يد شخص بالغ) من اللحوم المطبوخة مثلاً اللحوم الحمراء، الهامبرغر، اللحوم المصنعة (لحم الخنزير، السجق، النقانق) يوميًا؟

نعم ↗   لا ↗

6. هل كنت تتناول أقل من ملعقة كبيرة (١٢ جرام) من الزبدة أو السمن أو الكريمة كاملة الدسم للطبخ كل يوم؟

نعم ↗   لا ↗

7. هل كنت تشرب أقل من علبة واحدة (٣٥٥ مل) من المشروبات الغازية أو المحلاة بالسكر كل يوم؟

نعم ↗   لا ↗

٨. هل كنت تشرب كأس إلى كأسين في اليوم أي ٧ـ١٤ كأس من النبيذ في الأسبوع؟

(كاس واحد= ١٥٠مل)

نعم ↗   لا ↗

9. هل كنت تتناول ٣ حصص أو أكثر من البقوليات (البازلاء، الفاصوليا، أو العدس) في الأسبوع؟

(الحصة الواحدة تساوي كوب واحد مطبوخ أو ١٥٠جرام)

نعم ↗   لا ↗

١٠. هل كنت تتناول ٣ حصص أو أكثر من الأسماك أو المأكولات البحرية (قريدس، اخطبوط، سلطعون، كركند...) أو

المحار في الأسبوع؟ (الحصة الواحدة ١٠٠-١٥٠جرام سمك مطبوخ، ٤-٥ قطع من المأكولات البحرية المطبوخة،

٢٠٠جرام محار مطبوخ)

نعم ↗   لا ↗

١١. هل كنت تأكل المخبوزات الغير المصنوعة في المنزل (مثل البسكويت أو الكعك أو الكيك...) أقل من ٣ مرات في

الأسبوع؟

نعم ↗   لا ↗

١٢. هل كنت تأكل المكسرات الغير مملحة (بما في ذلك الفول السوداني) ٣ مرات أو أكثر في الأسبوع؟

(الحصة الواحدة تساوي ربع كوب أو مقدار قبضة يد شخص بالغ أو ٣٠ جرام)

نعم ↗   لا ↗

13. هل كنت تفضل تناول الدجاج أو الديك الرومي بدلاً من لحم البقر أو لحم الخنزير أو الهامبرغر أو النقانق؟

نعم ↗   لا ↗

١٤. هل كنت تستهلك الخضار أو المعكرونة أو الأرز أو غيرها من الأطباق المتبلة بصلصة مصنوعة من الطماطم

وبصل أو ثوم مطهو بزيت الزيتون مرتين أو أكثر في الأسبوع؟

نعم ↗   لا ↗

Appendix D-Perceived Nutrition Environment Measures Survey (NEMS-P-MED-AR)

استبيان لقياس كيفية إدراك البيئة الغذائيّة في سياق منطقة البحر الأبيض المتوسّط

(13 سؤالًا، 6 صفحات)

للتذكير: يرجى تقديم إجابتك بناءً على الفترة الزمنية السابقة للوباء والأزمة الاقتصادية (قبل فبراير ٢٠٢٠)

أ. البيئة الغذائيّة في المنزل

لا	نعم	**1. يرجى تحديد ما إذا كانت العناصر الغذائيّة/عناصر الطعام التّالية كانت متوفّرة في المنزل:**
		أ. فاكهة
		ب. خضار
		ت. الحلويات والمخبوزات والكعك (كوكيز) والبسكويت
		ث. رقائق البطاطا المقليّة أو الوجبات الخفيفة
		ج. اللحوم الباردة والشاركوتري
		ح. المشروبات الغازيّة العاديّة (ليست دايت، أو لايت، أو قليلة السّكّر)
		خ. المشروبات الغازيّة الدّايت
		د. المعكرونة البيضاء أو الأرز الأبيض أو الطحين الأبيض
		ذ. معكرونة قمحة كاملة (سمراء) أو أرز قمحة كاملة (أسمر) أو طحين قمحة كاملة (أسمر)
		ر. خبز أبيض
		ز. خبز أسمر (قمحة كاملة)
		س. **البقوليات/الحبوب**
		ش. اللّحوم (الدّجاج، لحم الخنزير أو لحم البقر أو لحم العجل...)
		ص. الأسماك الطّازجة أو المجمّدة
		ض. الحليب كامل الدّسم
		ط. حليب نصف منزوع الدّسم (قليل الدسم) أو منزوع الدّسم (خالي الدّسم)
		ظ. مشتقات الحليب كاملة الدّسم
		ع. مشتقات الحليب نصف منزوعة الدّسم (قليل الدسم) أو منزوعة الدّسم (خالي الدّسم)

دائمًا	غالبًا	أحيانًا	أبدًا أو نادرًا	**2. بأي وتيرة كانت تتوفّر العناصر الغذائيّة التالثة في منزلك (قبل فبراير ٢٠٢٠):**
				أ. الفواكه والخضار في البراد
				ب. الفواكه والخضار على طاولة المطبخ
				ت. الحلويات والمخبوزات والكعك والبسكويت ورقائق البطاطا المقلية وغيرها من الوجبات

				الخفيفة على طاولة المطبخ

3. بأي وتيرة كنت تتشارك وجبات الطّعام مع أفراد الأسرة في المنزل؟ (قبل فبراير ٢٠٢٠)

أ. دائمًا

ب. أحيانًا

ت. أبدًا/نادرًا

4. بأي وتيرة كان يشجعك والداك/إخوتك على تناول خيارات غذائيّة صحّية (فواكه، خضار، بقول...) بدلًا من الوجبات السريعة غير الصّحّيّة الغنية بالدهون و السكر الّتي كنت ترغب في تناولها؟

أ. دائمًا

ب. أحيانًا

ت. أبدًا/نادرًا

ب. أسئلة متعلّقة بالتّسوّق للمواد الغذائيّة / كيفية إدراك البيئة الغذائيّة في المتاجر

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5. أين كنت تقوم بالتّسوّق لمعظم المواد الغذائيّة والبقالة؟ (إختر كلّ الإجابات الّتي تنطبق)

أ. متجر صغير/محل بقالة صغير

ب. ميني ماركت

ت. سوبر ماركت

مهمّ جدًا	مهمّ بعض الشّيء	قليل الأهمّيّة	غير مهم على الإطلاق	**6. يرجى تحديد مدى أهمّيّة كلّ من العوامل التّالية في اختيارك للمكان الّذي كنت تقوم فيه بالتّسوّق لمعظم المواد الغذائية والبقالة؟ (قبل فبراير ٢٠٢٠)**
				أ. المكان قريب من منزلي
				ب. المكان قريب من أو على نفس طريق الأماكن الأخرى الّتي أذهب إليها
				ت. أصدقائي وأقاربي يقومون بالتّسوّق للمواد الغذائيّة في هذا المكان
				ث. تنوّع المواد الغذائيّة المعروضة
				ج. نوعيّة/جودة المواد الغذائيّة المعروضة
				ح. أسعار المواد الغذائيّة المعروضة

7. كيف كنت تقيّم أسعار الفواكه والخضار الطّازجة، قبل فبراير ٢٠٢٠، في المتجر حيث تشتري معظم المواد الغذائيّة لمنزلك مقارنةً بالمتاجر الأخرى؟

أ. رخيصة

ب. غير باهظة (مقارنةً بالمتاجر الأخرى)

ت. باهظة

ث. باهظة جدًا

ج. لا أعلم

8. يرجى تحديد مدى موافقتك أو عدم موافقتك على العبارات التّالية:

أوافق بشدّة		أوافق	لا أوافق ولا أعارض	لا أوافق	لا أوافق أبدًا	في المتجر حيث أشتري معظم المواد الغذائية لمنزلي، كان من السّهل أن أشتري:
						أ. الفواكه والخضار الطّازجة
						ب. مجموعة متنوّعة من المنتجات
						ت. الفواكه والخضار المعلّبة
						ث. المنتجات قليلة الدّسم
						ج. اللّحوم قليلة الدّهون (الدّجاج والحبش...)
						ح. الحلويات والمخبوزات والكعك والبسكويت
						خ. رقائق البطاطا المقليّة و/أو الوجبات الخفيفة
						د. المشروبات الغازيّة و/أو المشروبات الّتي تحتوي على نسبة عالية من السّكّر (المشروبات الرّياضيّة الّتي تحتوي على عصائر فاكهة مركّزة)

9. فكّر في المتجر حيث تشتري معظم المواد الغذائية/البقالة لمنزلك، وحدّد كيف تذهب عادةً إليه (إختر كلّ الإجابات الّتي تنطبق).

أ. سيرًا على الأقدام

ب. في سيّارتي الخاصّة

ت. أذهب في السيّارة مع جاري

ث. أتّصل وأطلب توصيل المنتجات إلى منزلي

ج. طريقة أخرى (يرجى التّحديد): _____

في السّؤال 10، يشير المصطلحان "أغذية صحّيّة" و"أغذية غير صحّيّة" إلى التّالي:

الأغذية الصّحّيّة: الفاكهة والخضار واللّحوم والسّمك والبيض والبقول وزيت الزّيتون البكر الممتاز...

الأغذية غير الصّحيّة: الحلويات/السّكريّات ورقائق البطاطا المقليّة والمشروبات الغازيّة والكورن فليكس الّتي تحتوي على سكّر مضاف المعجنات المنتجة في المصنع ...

10. يرجى تحديد مدى موافقتك أو عدم موافقتك على العبارات التّالية:

أوافق بشدّة	أوافق	لا أوافق ولا أعارض	لا أوافق	لا أوافق أبدًا	في المتجر حيث كنت أشتري **معظم المواد** الغذائية لمنزلي:
					أ. أرى علامات تشجعني على شراء أغذية صحّية.
					ب. توضع الأغذية غير الصّحيّة عادةً في أواخر الممرّات او الرّفوف.
					ت. أشتري المنتجات المعروضة على مستوى العين على الرّفوف.
					ث. **هنالك علامات** تشجعني على شراء أغذية غير صحّية.
					ج. غالبًا ما أشتري المنتجات الغذائيّة المعروضة بالقرب من الصّندوق.
					ح. عادةً ما تكون المنتجات الغذائيّة المعروضة بالقرب من الصّندوق غير صحّية.
					خ. تحتوي المنتجات الغذائيّة المعلّبة مسبقًا على ملصقات المعلومات الغذائيّة.
					د. في الكثير من الأحيان، أقرأ ملصقات المعلومات الغذائيّة.
					ذ. أجد أنّه من السّهل فهم ملصقات المعلومات الغذائيّة.

11. لماذا كنت تقرأ ملصقات المعلومات الغذائيّة، اذ ينطبق؟

أ. تساعدني على اتّخاذ خيارات غذائيّة صحّية

ب. الطّبيب/أخصّائي التّغذية أوصى بذلك

ت. لخسارة أو ضبط الوزن

ث. بداعي الحشريّة (المقارنة بين المنتجات الغذائيّة المختلفة)

ج. لا ينطبق

ت. عاداتك الغذائيّة وأفكارك في ما يتعلّق بالغذاء والطّعام

مهمّ جدًّا	مهمّ بعض الشّيء	مهمّ على الإطلاق	غير مهمّ	12. ما مدى أهمّيّة كلّ من العوامل التّالية في تحديد خياراتك عندما كنت تتسوّق للمواد الغذائيّة/الطّعام؟
				أ. الطّعم/ المذاق
				ب. الخصائص التّغذويّة الصحية
				ت. السّعر

			ث. سهولة الطّهي والتّحضير
			ج. ضبط الوزن

13. عندما كنت تذهب للتَّسوّق للمواد الغذائيّة/البقالة، ما كانت وتيرة استخدامك للائحة/قائمة بالمشتريات؟

<div dir="rtl">

أ. أبدًا

ب. نادرًا

ت. في بعض الأحيان

ث. دائمًا أو في أغلب الأحيان

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