Notre Dame University-Louaize
Faculty of Nursing & Health Sciences

Associations of Dietary patterns, socio-demographic, lifestyle characteristics and stressful life events with Severity of Depressive Symptoms among NDU Students in Lebanon: A Cross-Sectional Study

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NDU-Lebanon

Approval Certificate

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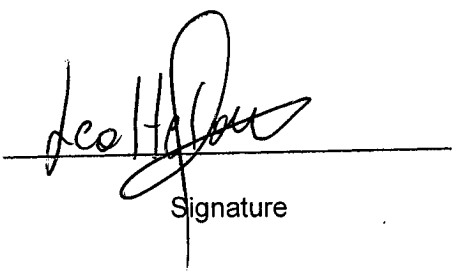

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Abstract

Background: Major depression is classified as a global health priority and burden on societies. Lately, the role of diet and lifestyle factors in aggravating or attenuating depressive symptoms has started to gain interest among the scientific community worldwide.

Objective: The purpose of this study is to identify the association of dietary patterns, socio-demographic, lifestyle factors, and stressful life events, with severity of depressive symptoms among NDU students.

Methods: This is a cross-sectional study of 457 randomly selected undergraduate students at NDU who were asked to complete a self-administered survey constructed of four sections; FFQ, background questionnaire, IPAQ - short form and PHQ-9. Height, weight, WC, and blood pressure of all subjects were measured following standard techniques.

Statistical analysis: Dietary patterns were identified by factor analysis. Multivariate linear regression was used to assess determinants of the various patterns and their association with severity of depressive symptoms.

Results: The sample consisted of 457 undergraduate students with a mean age of 21.28 (63% males). Five patterns were identified: 'Traditional Lebanese', 'Western fast food', 'Dairy', 'Lebanese fast food' and 'Fruits'. The Western fast food diet was positively associated with male gender, reduced number of meals/day, reduced frequency of breakfast consumption and snacking. The Lebanese fast food pattern was positively associated with consuming meals while watching TV. The scores of both traditional Lebanese and fruits patterns were significantly associated with increased

number of meals/day, breakfast consumption and non-smoking. In addition, the Western and Lebanese fast food patterns, along with the Dairy pattern, were also positively associated with increased frequency of alcohol consumption. None of these patterns showed a significant association with depressive symptoms after controlling for confounders.

Conclusion: Severity of depression was found to be associated with unhealthy lifestyle habits / behaviors, stressful life events and but not with the different identified dietary patterns.

Keywords: dietary patterns, lifestyle, depression, university students

Table of Contents

Abbreviations

CVD: Cardiovascular diseases

DA: Dopamine

DM-II: Diabetes Mellitus type 2

DPA: Docosapentaenoic acid

EPA: Eicosapentaenoic acid

FFQ: Food Frequency Questionnaire

HTN: Hypertension

IPAQ: International Physical Activity Questionnaire

MUFA: Monounsaturated Fatty Acids

MDD: Major depressive disorders

NE: Norepinephrine

PHQ-9: Patient Health Questionnaire-9

PUFA: Polyunsaturated Fatty Acids

RCT: Randomized clinical trials

WC: Waist Circumference

5-HT: Serotonin

LITERATURE REVIEW

Dietary patterns in Lebanon

Types

Lebanon is part of the Mediterranean region where the basic diet of local people is the "Mediterranean diet". Scientific evidence, however, suggests that people in this region rather adopt multiple dietary patterns, with the traditional dietary pattern being possibly different among countries of this region but highly congruous with the Mediterranean diet (Hwalla & Tannous Die el Khoury, 2007; Naja et al., 2011, 2013). In the Lebanese population, multiple dietary patterns were identified in many studies; these patterns include "Traditional Lebanese", "Prudent", "Western", "Fastfood/Dessert", "High Protein", and 'Fish and Alcohol' (Naja et al., 2011, 2013).Two cross sectional studies performed in Lebanon assessed the dietary patterns of the general adult population (Naja et al., 2011, 2013). Only one study assessed dietary patterns among Lebanese university students. This study, however, has several limitations including use of a short FFQ that was not validated and did not look into portion size/servings (Salameh et al., 2014).

Characteristics

The Mediterranean diet is characterized by a wide consumption of complex carbohydrates (plant foods, cereals, legumes) with low glycemic index, fish, olive oil, as the main source of fat, and moderate consumption of red wine. It contains high amounts of antioxidants, polyunsaturated (PUFA) and monounsaturated (MUFA) fats.

In addition, it includes polyphenols (can be found in red wine, grapes, apple) (Bonaccio et al., 2013), amino acids (tyrosine, tryptophan, glutamine), minerals (zinc, copper, iron, magnesium) and B-complex vitamins (B6, B12, folic acid) (Popa et al., 2012). These nutrients are found in whole grains (zinc, copper, magnesium), eggs, cheese, yogurt (tyrosine, glutamine, zinc, magnesium),vegetables, especially green leafy ones such as spinach and broccoli, fish, poultry, corn, and beans (Popa et al., 2012). The Traditional Lebanese pattern generally goes well with Mediterranean diet (Hwalla & Tannous Die el Khoury, 2007; Naja et al., 2011, 2013). It consists mostly of dairy products, olives, fruits, legumes, grains, eggs, vegetable oil, dried fruits, and traditional sweets (Naja et al., 2011, 2013). The "Prudent" pattern primarily includes foods recognized as healthy such as whole bread, low-fat dairy and light soda and excludes refined grains, fats and oils, and regular soda (Jacka et al., 2014; Naja et al., 2011). On the other hand, the "Western" pattern is characterized by high consumption of fast, processed, canned and frozen foods, and low intake of fruits and vegetables. Examples include pies and pizzas, fast food sandwiches, fried potatoes, regular soda, bottled juices, meat and poultry, cured meats, nuts and seeds, refined grains, mayonnaise, ice cream and sweets. Compared to the Mediterranean diet, the Western dietary pattern supplies the body with high amounts of "bad" fats (saturated and trans-fat), and low amounts of "good" fats (PUFA & MUFA) and antioxidants (Jacka et al., 2010). The Fast Food/Dessert pattern is similar to the Western pattern and is characterized by high intake of fast food sandwiches including hamburger, shawarma, falafel, in addition to pizzas, pies, desserts, carbonated beverages and juices, and mayonnaise (Jacka et al., 2014; Naja et al., 2011, 2013).The High Protein pattern is characterized by high intakes

of fish, chicken, meat, and low-fat dairy products (Naja et al., 2013). The 'Fish and Alcohol' pattern is mainly composed of fish and alcohol (Naja et al., 2011).

Health benefits versus health risks

Each of the above-mentioned dietary patterns has been demonstrated to have either health benefits and/or risks. Adherence to the Mediterranean diet, for example, has been linked with lower incidence rates of cardiovascular diseases (CVD) (9%),and neurological diseases such as Parkinson's disease and Alzheimer's disease (13%), as well as reduced mortality risk (9%) and reduced mortality from cancer (6%) as compared with non-adherence to the Mediterranean diet (Scarboroujh et al., 2012; Sofi et al., 2008). A randomized clinical trial (RCT), PERIMED, found the Mediterranean diet to have a significant protective role in CVD. After 1-y follow-up, participants in the MeDiet(Mediterranean diet) + nuts group showed a 13.7% reduction in prevalence of metabolic syndrome, a risk factor for CVD, compared with reductions of 6.7% and 2.0% in the MeDiet + EVOO (Extra virgin olive oil) and control groups (advice on low-fat diet), respectively (Ros et al., 2014). On the other hand, other dietary patterns were found to be positively associated with increased risk of CVD. For example, the "Fast Food/Dessert", the "Western" and the "High Protein" patterns were found to be positively associated with cardiovascular risk factors: Fast Food/Dessert pattern, had higher odds for MetS (OR, 3.13; 95% CI: 1.36-7.22) and hyperglycemia (OR, 3.81; 95% CI: 159-9.14); High Protein pattern had an increased risk for hypertension (OR, 2.98; 95% CI: 1.26-7.02) (Naja et al., 2013);Western pattern was associated with higher BMI (Body mass index), WC (waist circumference) and higher risk of obesity (Jacka et al., 2014). Apart from physical health the different dietary patterns mentioned (e.g.

traditional, western…) also showed an association with mental illnesses, mainly depression (Jacka et al., 2014; Popa & Ladea, 2012).

Depressive disorders-Major depression

Prevalence and definition

Major depression is recognized as a global health priority and burden on societies (Ferrari et al., 2010; Karam et al., 2006). Depression is a common mental health disorder and is now estimated to affect 350 million people worldwide of all ages. It is expected to be the world's second leading cause of disease burden by the year 2020 (WHO, 2015).The burden of depressive disorders in the Mediterranean region, including Lebanon, is substantial (Ferrari et al., 2010). A national study on mental health in Lebanon, referred to as "Lebanese Evaluation of the Burden of Ailments and Needs Of the Nation (L.E.B.A.N.O.N.)", showed that 12-month prevalence estimates are high (17% of respondents) to place mental disorders among the most commonly occurring health problems in the Lebanese population, with the most common being specific phobia (8.2%) and major depression (4.9%) (Karam et al., 2006). This could be partially attributed to frequent war exposures along with persistent social, economic, and political disputes that have dominated this region for decades (Benedek & Ursano, 2008; Ferrari et al., 2010; Karam et al., 2008). Another study conducted among a nationally-representative sample of adult Lebanese between 18-64 years found out that the lifetime prevalence rate of mental illness is 25.8%, with major depressive disorder being the most prevalent mental disorder (9.9%) (Karam et al., 2008). A study performed on Lebanese university students reported a prevalence rate of depression of ~ 28% (Ibrahim, et al. 2013; Karam et al., 2008; Mehanna and Richa, 2006).

Symptoms

Major Depression, also known as Major Depressive Disorder (MDD), is a mood disorder that causes persistent feelings of sadness, hopelessness and lack of motivation. People suffering from MDD can experience many symptoms, including constant feelings of sadness, anger, frustration, guilt, worthlessness, anhedonia, suicidal ideation and attempts, loss of concentration, in addition to changes in eating and sleeping patterns (APA, 2013; DSM-V).

Risk factors-correlates

MDD is commonly linked to many risk factors including family history, female gender, stressful life events (such as wars, natural disasters, financial problems, etc.) and chronic medical conditions (cancer, heart disease, diabetes mellitus, cystic fibrosis) (Benedek & Ursano, 2008; Campayo et al., 2010; Fragkos & Frangos, 2013; Karam et al., 2008; Kiyohara & Yoshimasu, 2009; Popa & Ladea, 2012; Quirk et al., 2013; Van de Velde et al., 2010).

Pathogenicity

MDD may result from an imbalance of brain chemicals that regulate mood such as serotonin (5-HT), norepinephrine (NE) and dopamine (DA) (Rahola, 2012; Ruhé et al., 2007). The amino acids tryptophan, tyrosine and glutamine, which cannot be synthesized by the body and must be obtained from food, are precursors needed for neurotransmitters production 5-HT, DA and NE and amino acids glutamate, aspartate respectively. An imbalance of these neurotransmitters has been associated with depression. However, it is possible that these monoamine transmitters' (e.g. 5-HT, DA, NE) deficiency has only a marginal contribution to MDD compared to genetic vulnerability (Rahola, 2012; Ruhé et al., 2007). In a meta-analysis, monoamine

depletion studies found out that monoamine deficiency causes depressed mood in subjects with a family history of MDD and in drug-free patients with MDD in remission, but not in healthy humans (Ruhé et al., 2007).

Burden

Health

MDD increases the risk for several life- threatening chronic conditions such as cardiovascular diseases (CVDs), hypertension, dyslipidemia, type 2 diabetes mellitus (DM II) and obesity (Baune et al., 2012; Rahola, 2012; Vogelzangs et al., 2010). A systematic review revealed that depression independently increases the risk of CVD 1.5-fold on average: patients with coronary artery disease and depression have a two- to three-fold increased risk of future cardiac events compared with patients with coronary artery disease but without depression (Baune et al., 2012). A 2-year study of cardiac events in patients with stable coronary artery disease reported a high likelihood of major adverse cardiac events in those with depression (Frasure-Smith et al., 2009) Clinical depression was associated with a 65% increased risk of diabetes in elderly people (Campayo et al., 2010).

Social/Economic

MDD has significant social and economic burden that is equally present in developed and developing countries (Quirk et al., 2013). MDD is a major cause of absenteeism and productivity loss among working-age adults and students (Kiyohara & Yoshimasu, 2009; Popa & Ladea, 2012). Moreover, it is a major cause of relationship problems and social isolation which increases a person's risk of suicide (Kiyohara & Yoshimasu, 2009).

Treatment-drawbacks

MDD is commonly treated by a combination of medications (antidepressants) and psychotherapy, which proved effective in attenuating depressive symptoms in many patients. However, these treatment options have shortcomings. Intake of antidepressants has been associated with numerous side effects and places patients at high risk of addiction and relapse (Lewis et al., 2013). Psychotherapy may fail to identify and address the underlying cause of depression (Goldman et al., 1999). For the most part, antidepressants and psychotherapy can be effective for treatment of depression but do not help in prevention of depression.

Relationship between single nutrients and depressive disorders

The role of diet in the etiology of depression started to gain interest of the scientific community worldwide in the past decade. This is in view of research findings revealing an association between adequate intake of various dietary nutrients such as zinc, magnesium, B-group vitamins (folate), MUFA, PUFA and decreased risk of depression (Jacka et al., 2011; Popa & Ladea, 2012; Quirk et al., 2013) and/or improved depressive symptoms (Bottiglieri, 2005; Lewis et al., 2013; Ranjbar et al., 2013; Sanchez-Villegas et al., 2007). In a RCT, 44 Iranian patients with major depression showed better improvement when combining zinc supplementation with antidepressants than taking antidepressants alone (Ranjbar et al., 2013). In another RCT done in the US among 60 adult participants diagnosed with major depression, supplementation with vitamin B complex for 2 months was associated with improvement in depressive symptoms and quality of life (Lewis et al., 2013). A cohort study done in Spain including 7,903 participants showed a negative association between fish (or long chain ω-3 PUFA) consumption and mental disorders .Subjects

with a moderate consumption of fish (83.3 to 112 g/day) had a relative risk reduction of more than 30%,as compared to lowest consumption of fish (reference), However, the linear trend for quintiles of w-3 PUFA intake was not statistically significant(Sanchez-Villegas et al., 2007). Higher ω-3 PUFA concentrations in blood were linked to increased serotonin transport and possible inhibition of some cytokines, known to be associated with depression (Sanchez-Villegas et al., 2007). A study composed of 1,190 men and women (>65 years) in various Greek islands and in Cyprus found that one portion increase of fish consumption per week was associated with 0.58 times (95% confidence interval: 0.45-0.73) lower likelihood of having depressive symptoms after adjusting for various confounding factors (Bountziouka et al., 2009). A review article on the role of dietary folate in preventing/treating depression, concluded that folate deficiency was associated with a higher incidence of depression, reduced serotonergic and/or neurotransmitter function and poorer response to antidepressant medications (Bottiglieri, 2005).

Relationship between "Traditional" or "healthy" dietary patterns and depressive disorders

Findings of cross-sectional studies

Multiple cross-sectional studies demonstrated a negative association between adherence to the Mediterranean or "Traditional" or healthy diets and mental disorders (e.g. depression) (Bonaccio et al., 2013; Martinez-Gonzalez & Bes-Rastrollo, 2014). A cross-sectional study done in Norway, with 5731 adult participants (46 to 49 and 70 to 74 years) found out that the "Norwegian traditional dietary pattern", a diet that is characterized by high intakes of fish, fruit, vegetables, and dairy products, was

associated with lower rates of depression after adjusting for age, education, income, physical activity, smoking, and alcohol consumption (Jacka et al., 2011). A cross-sectional study carried out in Australia consisting of 10, 986 adult participants, 18 to 79 years old showed that people with high intakes of meat, poultry, vegetables and EPA (Eicosapentaenoic acid, long- chain omega- 3 PUFA) which constitute part of their "traditional" diet have lower odds of depression, whereas increased intakes of non-alcoholic beverages, milk products and dishes, and docosapentaenoic acid (DPA) are associated with an increase in the odds of having depression both after controlling for age and sex (Meyer et al., 2013). Likewise, another cross sectional study carried out in Australia among 1,046 women aged between 30-93 years found an inverse association between the "Australian traditional dietary pattern" (vegetables, fruit, meat, fish, and whole grains) and mental disorders, mainly presence of depressive and anxiety disorders, after adjusting for age, education and socioeconomic status (Jacka et al. 2010;). Moreover, a cross-sectional study in USA consisting of 1,118 adults, aged 30 to 64 years, found that "high" diet quality, according to the *Dietary Guidelines for Americans, 2005*, and the Healthy Diet Indicator based on World Health Organization guidelines, is characterized by limited intake of saturated and trans fats, cholesterol, added sugars, salt, alcohol and adequate consumption of fruits, vegetables and whole-grains, to be significantly and inversely associated with depressive symptoms after adjusting for various confounding factors; income, education, sex and race. (Kuczmarski et al., 2010).

Findings of cohort and randomized clinical trials

Multiple longitudinal studies and randomized clinical trials also supported this association. A cohort study performed on 6,060 Australian middle-age women (50-55years) found that , after adjusting for socio-demographic and lifestyle factors (not specified), the 'Mediterranean-style' dietary pattern to have a 17% reduction in the odds of reporting incidence of depressive symptoms three years later (Rienks et al., 2013). Similarly, Melbourne Collaborative Prospective Cohort Study, comprising a total of 8,660 Australian healthy adults, aged 50–69 years, found that both adherence to the Mediterranean Diet Score (MDS) and to a traditional Australian-style eating pattern were inversely associated with psychological distress (level of anxiety and depressive symptoms) ; with the odds ratio in the top-scoring group of MDS relative to the lowest scoring group being 0.72 (95% confidence interval = 0.54-0.95) and with the odds ratio for the top 20% scorers on adherence to the traditional Australian pattern relative to the lowest scorers being 0.61 (95% confidence interval = 0.40-0.91), respectively after adjusting for physical activity, education, smoking status, history of arthritis, asthma, kidney stones or gallstones, dietary energy intake, and Socio-Economic factors . (Hodge et al., 2013). A study of 3,502 community-dwelling participants from the Chicago Health and Aging Project aged 65years and above, found that adherence to a diet comprised of vegetables, fruits, whole grains, fish, and legumes was associated with decreased likelihood of developing depressive symptoms over an average of 7.2 years after adjusting for age, sex, race, education, income, widowhood, antidepressant use, total calorie intake, body mass index, smoking, alcohol consumption, number of self-reported medical conditions, cognitive function, and physical disability. (Skarupski et al., 2013). The SUN study, a cohort study carried out in Spain, found out an inverse

association between the level of adherence to the "Spanish traditional dietary pattern" and the risk for developing depression in 10,094 adults after adjusting for many confounders: sex, marital status, number of children, employment status, number of work hours per week, BMI, energy, physical activity, smoking, alcohol consumption and some correlates of health consciousness or proxies of an overall healthier lifestyle, such as days per week of use of seat belt, use of sunscreen periodic dental checkups and periodic medical checkups (Sanchez-Villegas et al., 2009). Another more recent study also from the SUN project reported that better adherence to high quality diets by way of obtaining high scores on the Mediterranean Diet Score (MDS), Pro-vegetarian Dietary Pattern (PDP), and Alternative Healthy Eating Index-2010 (AHEI-2010), was associated with a reduced risk of depression among Spanish adults adjusting for sex, age, BMI, smoking, physical activity, use of vitamin supplements, energy and the presence of several diseases at baseline (CVD, T2DM, HTA & dyslipidemia) (Sánchez-Villegas et al., 2015). A cohort study performed in France (GAZEL) among 12,404 adults, aged 45–60 years found that adopting a traditional diet pattern based on fish and fruit consumption and regularity of meals was associated with a reduced probability of depressive symptoms adjusted for age, job position, marital status, physical activity, BMI, smoking status and alcohol consumption (Le Port et al., 2012). Similarly the "Traditional" diet of other regions or "healthy" diet also demonstrated a negative association with depression. The Whitehall II Study, a cohort study in UK, consisting of 4,215 participants aged 35–55 years found that women with greater adherence to a healthy diet (fruits, vegetables, seafood, fiber), which is defined by a high Alternative Healthy Eating Index (AHEI) score, had 65% lower odds of subsequent recurrent depressive symptoms than women who maintained low AHEI scores after a 10 year

period adjusted for age, ethnicity, energy intake, SES, retirement, living alone, smoking behavior, physical activity, HDL cholesterol, type 2 diabetes, CAD, hypertension, use of lipid lowering drugs, central obesity, and cognitive impairment assessed (Akbaraly et al., 2013). Only 1 randomized controlled trial (RCT) was performed on the association between Mediterranean dietary pattern and risk of depression. (Sanchez- Villegas et al., 2013). The PREDIMED study done in Spain on a community- based sample of men (55-89 years) and women (60- 80 years) with risk factors for CVD (diabetes mellitus type 2, hypertension, obesity) found that the Mediterranean diet with nuts reduced the risk of depression in patients with type 2 diabetes mellitus by 40% compared to control group (advised to follow a low-fat diet) after adjusting for various confounders: age, sex, intervention group, recruiting center, smoking, educational level, marital status, prevalence of various chronic diseases at baseline, BMI, alcohol intake (except wine - this item was included in the 14-item MD adherence questionnaire), energy intake, and physical activity after 3 years of follow-up. However, non-diabetic subjects in the experimental group (prescribed a Med diet) did not show a significantly reduced risk of depression compared to non-diabetics in the control group (advised to follow a low-fat diet), which could have possibly been attributed to the low number of new cases of depression and the relatively small variability in adherence to the Mediterranean diet between the experimental and control groups (Sanchez- Villegas et al., 2013).

Relationship between "Western" or "unhealthy" dietary patterns and depressive disorders

On the other hand, multiple studies showed a positive association between adherence to unhealthy dietary patterns and depression/severity of depressive symptoms. A cross-sectional population-based sample of 1,046 women, aged 20–93 years, found that "Western" diet (characterized by high intake of saturated fat, refined grains, sodium, sugar and beer) was associated with more severe depressive symptoms after adjusting for age, socioeconomic status, education, or other health behaviors (physical activity, alcohol consumption, and smoking) and energy (Jacka et al., 2010). In a cross-sectional study on 161 women diagnosed with MDD and obesity, higher intakes of saturated fat, sodium, and sugar were associated with more severe depressive symptoms controlling for age, BMI, antidepressant medication use, education, household income, depression-related appetite change, and DSM-IV BED (Appelhans et al., 2012). A cohort study done in Spain on 8,964 participants found consumption of fast food (hamburgers, sausages, pizza), processed pastries (muffins, doughnuts, croissants) and baked goods to be associated with 48 % increased risk of depression after adjusting for sex, baseline BMI, energy physical activity and smoking (Sanchez-Villegas & Toledo, 2012). Similarly, a recent longitudinal study including 3,663 community-dwelling Australian adults found an association between the highest tertile of the Western dietary pattern scores and increased likelihood of depressive symptoms, after adjusting for socioeconomic status, age, physical activity and other health-behavior variables in adults following three age cohorts (20+; 40+; 60+yrs) (Jacka et al., 2014). Another cohort study (GAZEL) performed in France surveying 12,404, men and women, aged 45–60 years showed that the Western diet had significant association

with an increased probability of depressive symptoms in men adjusted for age, job position, marital status, physical activity, BMI, smoking status and alcohol consumption (Le Port et al., 2012).

Rationale and research question

These findings lead us to an important question: Could certain dietary patterns adopted by the Lebanese population play a role in prevention of depression or attenuation of depressive symptoms? Examining this association is worthy because of the huge burden of depression, therefore changing dietary habits or patterns, found to associate with increased risk for MDD, can be a cost-effective stand alone/complementary intervention against depression and is a measure that can be easily implemented with adequate professional supervision and support from family. Some studies done is Lebanon assessed the associations of different dietary patterns identified and health outcomes such as, BMI, WC, metabolic syndrome, obesity… but they fail to address the associations of dietary patterns adopted in the Lebanese population and mental health outcome, specifically depression. Our study is the first, to our knowledge, in Lebanon that aims to assess the link between identified dietary patterns and severity of depressive symptoms among a sample of Notre Dame University (NDU) students.

Study objectives

Primary objectives:

1) To identify the different dietary patterns among a sample of NDU students

2) To assess the prevalence of each of the identified dietary patterns in the selected sample of NDU students
3) To measure the severity of depressive symptoms in the sample and by dietary pattern
4) To examine the association between each of the identified dietary patterns and severity of depressive symptoms

Secondary objective:

- To examine the association between socio-demographic, lifestyle factors and stressful life events and severity of depressive symptoms

METHODS

Study design and recruitment methods

The study is a cross-sectional survey that was conducted among NDU undergraduate students. Subjects were recruited by targeting particular GER courses (ENL 215, 230, MUS 201, PHL211...). GER courses include a relatively random sample of students from each of NDU's faculties. After obtaining the approval of the concerned dean, the chairperson and instructors of each course, researchers visited the classrooms, as per date and time set by the course instructor, to recruit subjects and perform data collection.

Data collection procedure

During class visit (about 50 minutes), researchers briefed the students about the study's objectives and procedures, answered all the questions students had about the study or the consent form and then obtained written consent of students who expressed willingness to participate. Data collection entailed completion of four questionnaires: Food Frequency Questionnaire (FFQ), Background questionnaire, Patient Health Questionnaire-9 (PHQ-9), and the International Physical Activity Questionnaire (IPAQ) - Short Form. Trained dietitians helped participating students in completing the FFQ. The remaining three questionnaires were given to students for completion at home and then submission to the research staff within a period of two weeks in a sealed envelope. Students were asked to come in person to the nutrition research lab (FNHS, HA318, third floor, pink building), on Mondays, Wednesdays and Fridays from 12-1, or Tuesdays & Thursdays from 12:30-1:30, for weight, height, waist circumference and blood pressure measurements (3 measurements in 10-minute interval each).

Collection of data took place during a 2-month interval in the summer term. Data were collected in an anonymous manner (i.e. no names, ID#s, or any other personal identifiers were requested) to avoid participants' attempt to hide sensitive information from researchers. All data forms were maintained in a locked cabinet, nutrition research lab, and access was strictly limited to study investigators. Likewise, computerized data were stored on a password protected computer in a locked office of the research team.

Exposure assessment

Dietary Patterns

Dietary patterns were identified through administering the semi-quantitative FFQ. The FFQ comprises of 73- items pooled into 9 groups. For each food item listed on the FFQ, participants were asked to mark their frequency of intake of a designated serving/ portion size in days, weeks, months or rarely/never during the past year. The FFQ included Lebanese items, composite dishes (e.g. Chawarma, Falafel, Labneh…), full-fat/low-fat dairy products and regular/diet beverages. The FFQ-73 was adjusted and modified similarly to the one used and developed at the American University of Beirut (AUB) and had been deployed in multiple pertinent studies including one that targeted a nationally representative sample of Lebanese adults (Naja et al., 2011; Naja et al., 2013).

Dietary Intake

Estimates of macro/micro-nutrient intake and energy intake of each participant were generated using the Nutritionist Pro-Diet Analysis software developed by Axxya

systems. Lebanese dishes and recipes were composed and entered using this software according to Food Composition Tables for Use in the Middle East by Pellet and Shadarevian (Pellet & Shadarevian, 2013).

Socio-Demographic and Lifestyle Factors

The Background questionnaire included questions on socio-demographic and, lifestyle characteristics and stressful life events as well as questions that determine eligibility of a participant. Examples on questions include: (i) socio-demographic: Age? Do you currently have a job in addition to your studies? Where are you staying at present time? (ii) Lifestyle factors: How many meals do you have per day? Do you drink alcohol? How often do you have your meals while watching TV during a week? (iii) Stressful life events: Have you had experienced any of the following stressful life events during the past year? This questionnaire also included questions on anthropometric and blood pressure (BP) measurements. Researchers a measured body weight, height, waist circumference (WC) and BP of all participants. Body weight was measured to the nearest 0.1 kg using an electronic portable scale with subjects dressed in minimal clothing and without shoes. Height was measured to the nearest 0.1 cm using a portable stadiometer according to the following protocol: no shoes, heels together and head touching the ruler with line aligned horizontally. BMI was calculated as: Weight (kg)/ Height (m^2). BMI categories were classified as (1) underweight (UNDWT): BMI <18.5 kg/m^2, (2) normal weight (NW): 18.5 kg/m^2 <BMI<24.9 kg/m^2, (3) OVWT: 25.0 kg/m^2 <BMI< 29.9 kg/m^2, and (4) obese (OB): BMI≥ 30.0 kg/m^2 (WHO, 2004). Blood pressure protocol: Patient should be seated comfortably, with back supported, legs uncrossed, and upper arm bared. Patient's arm should be

supported at heart level. Cuff bladder should encircle 80 percent or more of the patient's arm circumference. Mercury column should be deflated at 2 to3 mm per second. The first and last audible sounds should be recorded as systolic and diastolic pressure, respectively. Measurements should be given to the nearest 2 mm Hg. Neither the patient nor the person taking the measurement should talk during the procedure (AHA, 2005). Blood pressure in adults was classified according to the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC7) as: (1) normal: systolic blood pressure (SBP) < 120 mmHg and diastolic blood pressure (DBP) < 80 mmHg, (2) pre-hypertension (pre-HTN): SBP between 120–139 mmHg and/or DBP between 80–89 mmHg, (3) stage 1 hypertension (HTN): SBP between 140-159 mmHg and/or DBP between 90-99 mmHg, (4) stage 2 HTN: ≥ 160 SBP and/or ≥ 100 DBP mmHg) (JNC7, 2003) .WC values were classified according to the National Heart, Lung, and Blood Institute Guidelines, whereby a WC > 102 cm in men, or > 88 cm in women, is considered an indicator of increased cardio-metabolic disease risk (CDC, 2007).

Physical Activity Levels

The International Physical Activity Questionnaire (IPAQ) - Short Form, a 7-item self-administered questionnaire, tested for use in assessing physical activity (PA) among adults, was used to assess PA level of our study participants. IPAQ asks about three specific types of activity: walking, moderate and vigorous physical activities and time spent by an individual (Booth, 2000). The items were structured to provide separate scores on each of these activities. Using the following values, Walking = 3.3

METs, Moderate PA = 4.0 METs and Vigorous PA = 8.0 METs (*Med Sci Sports Med* 2000), four continuous scores were calculated:

- Walking MET-minutes/week = 3.3 * walking minutes * walking days
- Moderate MET-minutes/week = 4.0 * moderate-intensity activity minutes * moderate-intensity days
- Vigorous MET-minutes/week = 8.0 * vigorous-intensity activity minutes * vigorous-intensity days
- Total physical activity MET-minutes/week = sum of Walking + Moderate + Vigorous MET-minutes/ week scores

Low-level, moderate-level and high-level PA were defined by scores of less than 600 MET-minutes per week, between 600 to less than 3000 MET-minutes per week, and of 3000 or more MET-minutes per week, respectively.

Outcome assessment

Severity of Depressive Symptoms

The Patient Health Questionnaire-9 (PHQ-9), a valid and reliable tool for screening depressive symptoms (Kroenke & Spitzer, 2002; Löwe et al., 2004), was used to assess severity of depressive symptoms in our study sample. PHQ-9 is a 9-item self-administered questionnaire. Each of the 9 items is scored 0 to 3, providing a 0 to 27 severity score. Higher total scores indicate more severe depressive symptoms, with scores of 5, 10, 15, and 20 representing cut-off points for mild, moderate, moderately severe and severe depression, respectively.

Pilot testing

The questionnaires were pre-tested during the month of May 2015. The draft questionnaires were tried out on a random sample of 45 NDU students (~ 14% of the calculated sample size) that is similar in makeup to the one that ultimately was sampled (i.e., from the targeted GER courses in our study). Pilot testing was performed to measure how much time it takes to complete each questionnaire, analyze the information provided to clarify directions, question wording, or response categories where necessary and then revise as needed. Revision and corrections were done before launching of the study. This sample was not included in data analyses.

Sample size and statistical analyses

Based on a reported prevalence rate of depression of ~ 28% among Lebanese University students (Ibrahim, et al. 2013; Mehanna and Richa, 2006), the sample size was calculated and found to be 310 students.

All filled-out questionnaires were reviewed for completion immediately after collecting them from the students. Data were entered, and checked to ensure that errors in the data file are corrected. Quantitative and qualitative measurements were summarized as mean ± standard deviation/Median (Interquartile range) and n (%), respectively. Comparisons of continuous and categorical variables were performed using independent two-sample T Test/ Mann-Whitney-U-test/Analysis of variance and the chi square test /Fisher's exact test, respectively.

In order to identify dietary patterns, exploratory factor analysis based on the inter-correlation among the FFQ food items was used. As a first step, a spherical representation of the correlation matrix was plotted to visualize any apparent correlation of the 73 items, then a scree plot was generated in order to estimate possible number of factors. An exploratory factor analysis with varimax rotation was performed. The number of factors retained (five) was based on: (i) plotted Eigenvalues and their corresponding inflection points in the screeplot and (ii) interpretability of factors. The derived patterns were labeled on the basis of food groups having a rotated factor loading larger than 0.4. Factor scores were produced by calculating the weighted average of the items comprising each factor/pattern, using factor loadings as weight. A pair wise correlation matrix was then produced to test the correlation among the factor scores of the five emerging patterns.

To study the association between dietary patterns and nutrient intake, Spearman's correlation coefficients were calculated between the factor scores of each of the identified dietary patterns and energy-adjusted nutrient intakes. Multiple linear regression analysis was used to assess the associations of the identified dietary patterns, with factor scores of each as the dependent variable and socio-demographic and lifestyle factors and stressful life event as independent variables. The associations between severity of depressive symptoms and dietary patterns were evaluated using multivariate linear regression analyses adjusted for age, gender, income, physical activity, BMI, intake of anti-depressants, alcohol consumption, number of stressful life events and people who worry a lot on how much they eat. Age, gender, income, physical activity, BMI, intake of anti-depressants and family history of mental illness were forced into the model, the other covariates that were found to be associated with

severity of depressive symptoms in bivariate analyses ($P<0.05$) were entered using the stepwise method. Normality of the variables was assessed and transformations were performed when needed.

The correlation between each of the independent variables included in the regression models and tolerance/VIF values were examined to pick up problems with multicollinearity (Tolerance < 0.1, VIF > 10). Normality of the residuals was assessed by inspecting the normal probability plot of the regression standardized residual and the residuals scatterplot. Statistical analyses were performed using the Statistical Package for Social Sciences (SPSS) version 22 for Windows. A p-value less than 0.05 was considered statistically significant.

RESULTS

Sample characteristics

The sample consisted of 457 undergraduate students aged 18-33 years with a mean age of 21.3±1.9 years with men being significantly older than women (287 men with a mean age 21.5 (±2.0) years and 170 women with a mean age of 20.9 (±1.7) years). A significantly higher percentage of men were overweight/obese, smokers, alcohol drinkers, had a job and moderate/high physical activity levels. Overall, about two-thirds of the study participants had mild to severe symptoms of depression (63.7%) with one-fourth having moderate to severe depression (24.1%) (Table 1).

Associations of socio-demographic, anthropometric, lifestyle characteristics and stressful life events with severity of depression

Severity of depression was found to be associated with unhealthy lifestyle habits/behaviors and stressful life events. Specifically, a significant difference in mean PHQ-9 score was found among those who reported to eat meals rarely, occasionally and often, with higher mean score being among those who reported to eat meals rarely (10.29, 7.6, 6.52 , respectively p=0.019). Mean PHQ-9 score was also found to be significantly higher among those who reported to eat 2 meals/day than those who reported to eat 3 meals/day (7.72 vs. 6.15, p=0.029, respectively), among students who reported to eat breakfast rarely than students who reported to eat breakfast daily (8.15 vs. 6.18 respectively p=0.004), among previous smokers than non-smokers (8.96 vs. 6.52, p=0.044) and among students who reported to drink at least 1 drink /day than those who reported to drink alcohol occasionally (8.28 vs. 6.32, p=0.039, respectively). Mean PHQ-9 score was found to be significantly higher among students who reported taking care of a family member with physical disability (p=0.039), parental conflicts

(0.019), serious conflicts with parents (p=0.004), serious financial difficulties (p=0.006), with the greatest mean difference being for those who reported loss of a friend due to death (p=0.000) and serious academic difficulties (p=0.000) (Table 2).

Dietary patterns analysis

Principal component analysis revealed five dietary patterns, which together explained 50.0% of the variance in dietary intake. Factor loadings of the five patterns are shown in Table 3. The patterns were named according to the food groups loading highest on the respective dietary pattern. Therefore, the patterns obtained were classified as follows: (i) the 'Traditional Lebanese' pattern, which was positively associated with Lebanese traditional/typical food such as bulgur, wheat, low fat dairy products like cheeses and labneh, fruits mainly bananas and apples, vegetables like celery, spinach and tomatoes, legumes, broccoli, potatoes, proteins, eggs and olive oil; (ii) the 'Western Fast food' pattern was positively associated with sweetened fruit drinks, energy drinks, mayonnaise, cake, cookies, donuts, ice cream, chocolate, burgers, pizza, manaeesh and French fries; (iii) the 'Dairy' pattern was associated with regular bread, rice, whole-fat dairy products and ice cream; (iv) the 'Lebanese fast food' pattern was associated with Lebanese foods that are mainly high in fat/junk such as nuts and seeds, organ meats, sausages and makanek, falafel and chawarma sandwiches; (v) the 'Fruits' pattern was only associated with fruits, dried fruits and fresh juices.

Table 4 describes the associations of the factor scores of various dietary patterns with energy and energy-adjusted nutrient intakes. Scores of the Western pattern had the strongest positive associations with energy (r=0.69), saturated fat (r=0.43) and fat

(r=0.22) and negatively correlated with proteins (r=-0.33) total fiber (r=-0.35) and potassium (r=0.31). The Traditional Lebanese diet scores were positively correlated with protein (r=0.27), MUFA (Monounsaturated Fatty Acids) (r=0.16), PUFA (Polyunsaturated Fatty Acids) (r=0.23), cholesterol (r=0.20), potassium (r=0.31) and total fiber (r=0.19) and negatively correlated with carbohydrates (r=-0.27). The dairy scores were positively correlated with saturated fat (r=0.35), sodium (r=0.27) and negatively correlated with carbohydrates (r=-0.23), potassium (r=-0.31), and total fiber (r=-0.27). The Lebanese fast food scores were positively correlated with MUFA (r=0.48), PUFA (r=0.64) and negatively correlated with, protein (r=-0.16), carbohydrates (r=-0.39), potassium (r=-0.24) and total fiber (-0.15). The fruits pattern scores were positively correlated with carbohydrates (r=0.17), potassium (r=0.47), total fiber (r=0.35) and negatively associated with total fat (r=-0.17), and sodium (r=-0.18).

Multiple linear regression models were applied to examine the independent associations of selected socio-demographic and lifestyle characteristics and stressful life events with the scores of the five dietary patterns identified in this study. When examined, gender was not shown to be an effect modifier of the association between the various patterns and severity of depressive symptoms; hence, the results for both gender groups together are presented in Tables 5 and 6 represents the regression coefficients and the corresponding 95% confidence intervals (95% CI) of the above-mentioned models. The Traditional Lebanese pattern was positively associated with absence of family history of mental illness, the number of meals/day, breakfast consumption and non-smoking. The Western fast food diet was positively associated with male gender, reduced number of meals/day, reduced frequency of breakfast

consumption, snacking and increased frequency of alcohol consumption. The dairy pattern was positively associated with hypertension, non-smoking and increased frequency of alcohol consumption. The Lebanese fast food pattern was positively associated with absence of family history of mental illness, consuming meals while watching TV and increased frequency of alcohol consumption. The fruits pattern was associated with male gender, increased number of meals/day, breakfast consumption and non-smoking. Table 6 showed no significant association of depressive symptoms with the scores of any of the five dietary patterns identified, as assessed by multivariate linear regression analyses adjusted for age, gender, income, physical activity, BMI, intake of anti-depressants, family history of mental illness, alcohol consumption, number of stressful life events and worrying they lost control over how much they eat.

Table 1

Sample characteristics (socio-demographic, anthropometric, and lifestyle factors) and severity of depression among the study population

	Total (n=457)		Men (n=287)		Women (n=170)		
	n or mean	% or SD	n or mean	% or SD	n or mean	% or SD	Significance
Age (years)	21.28	1.91	21.51	2.0	20.91	1.71	P <0.05
Marital status							
Single	448	99.3	283	99.6	165	98.8	
Married	2	0.4	0	0.0	2	1.2	
Divorced	1	0.2	1	0.4	0	0.0	X^2=3.99;p>0.05
Employment							
No	284	62.4	155	54.4	129	75.9	
Part-time	127	27.9	93	32.6	34	20.0	
Full-time	44	9.7	37	13.0	7	4.1	X^2=22.62;p<0.001
Residence							
With parents	374	82.2	231	81.1	143	84.1	
In dormitories	39	8.6	23	8.1	16	9.4	
Own apartment	31	6.8	23	8.1	8	4.7	
Other	11	2.4	8	2.8	3	1.8	X^2=2.59;p>0.05
BMI(kg/m^2)							
Underweight	26	5.7	8	2.8	18	10.6	
Normal	252	55.3	133	45.5	119	70.0	
Overweight	129	28.3	103	36.0	26	15.3	
Obese	49	10.7	42	14.7	7	4.1	X^2=49.26;p<0.001
WC (cm)							
Normal	412	91.2	253	89.7	159	93.5	
Risky	40	8.8	29	10.3	11	6.5	X^2=1.47;p>0.05
Meals per day							
1 meal	7	1.5	4	1.4	3	1.8	
2 meals	114	25	70	24.5	44	25.9	
3 meals	223	48.9	136	47.6	87	51.2	X^2=1.73;p>0.05
4 meals or more	112	24.6	76	26.6	36	21.2	
Frequency of meals							
Often	322	71.6	200	70.9	122	72.6	
Occasionally	121	26.9	77	27.3	44	26.2	
Rarely	7	1.6	5	1.8	2	1.2	X^2=0.32;p>0.05
Breakfast consumption							
Daily	208	45.5	127	44.3	81	47.6	
Occasionally	153	33.5	96	33.4	57	33.5	
Rarely	96	21	64	22.3	32	18.8	X^2=0.89;p>0.05
Meals while watching TV/ week							
Often	131	28.8	81	28.3	50	29.6	
Occasionally	156	34.3	105	36.7	51	30.2	
Rarely	168	36.9	100	35.0	68	40.2	X^2=2.18;p>0.05
Snacks/day							
1 Snack	125	27.7	83	29.1	42	25.3	

2 Snacks	210	46.6	133	46.7	77	46.4	
3 Snacks	83	18.4	46	16.1	37	22.3	
4 Snacks or more	33	7.3	23	8.1	10	6.0	X^2=3.31;p>0.05
Intake of dietary supplement							
Yes	79	17.4	56	19.5	23	13.7	
No	376	82.6	231	80.5	145	86.3	X^2=2.11;p>0.05
Following a special diet							
Yes	70	15.4	44	15.3	26	15.5	
No	385	84.6	243	84.7	142	84.5	X^2=0.00;p>0.05
Unhealthy eating behaviors in the past 3 months							
Yes	57	12.7	39	13.8	18	10.8	
No	392	87.3	244	86.2	148	89.2	X^2=0.57;p>0.05
Smoking habits							
Non-smoker	272	59.9	148	52.1	124	72.9	
Previous smoker	31	6.8	22	7.7	9	5.3	
Current smoker	151	33.3	114	40.1	37	21.8	X^2=19.43; p<0.001
Alcohol drinking							
Occasionally	212	47.1	108	38.3	104	61.9	
1-2 drinks/week	195	43.3	136	48.2	59	35.1	
1-2 drinks/day	25	5.6	21	7.4	4	2.4	
>2 drinks/day	18	4	17	6.0	1	0.6	X^2=29.26; p<0.001
Physical activity level							
Low	79	23.2	40	18.6	39	31.2	
Moderate	138	40.6	82	38.1	56	44.8	
High	123	36.2	93	43.3	30	24.0	X^2=14.36;p<0.001
Severity of depression							
None	143	36.3	96	38.2	47	32.9	
Mild	156	39.6	93	37.1	63	44.1	
Moderate	68	17.3	45	17.9	23	16.1	
Moderate-severe	17	4.3	11	4.4	6	4.2	
Severe	10	2.5	6	2.4	4	2.8	X^2=2.10; p>0.05

Table 2

Associations of socio-demographic, anthropometric, lifestyle characteristics and stressful life events with severity of depression

	n	Severity of depressive symptoms mean (±SD)
Gender		
Male	251	6.79 (4.59)
Female	143	6.99 (4.77)
Employment		
No	244	6.66 (4.51)
Part-time	112	6.97 (4.58)
Full-time	36	7.89 (5.64)
BMI		
Normal	220	6.81 (4.76)
Overweight	112	6.51 (4.25)
Obesity (class 1)	30	8.17 (5.35)
Obesity (class 2)	9	8.44 (5.66)
WC		
Normal	354	6.68 (4.54)
Risky	35	8.49 (5.48)
Meals per day		
1 meal	5	9.80 (7.33)
2 meals*	101	7.72 (5.29)
3 meals*	191	6.15 (4.14)
4 meals or more	96	7.17 (4.55)
Frequency of meals*		
Often	273	6.52 (4.35)
Occasionally	109	7.60 (5.25)
Rarely	7	10.29 (5.15)
Frequency of Breakfast		
Daily*	181	6.18 (4.36)
Occasionally	132	7.02 (4.48)
Rarely*	81	8.15 (5.28)
Meals while watching TV/week		
Often	120	7.00 (4.46)
Occasionally	135	6.67 (4.59)
Rarely	137	6.99 (4.91)
Snacks/day		
1 snack	105	7.12 (4.64)

2 snacks	185	6.44 (4.58)
3 snacks	73	7.85 (4.50)
4 snacks or more	28	5.96 (5.35)
Smoking habits *		
Non-smoker*	237	6.52 (4.59)
Previous smoker*	23	8.96 (5.10)
Current smoker	131	7.12 (4.65)
Alcohol drinking		
Occasionally*	180	6.32 (4.64)
1-2 drinks/week	169	7.09 (4.49)
≥1 drink/day*	40	8.28 (4.54)
Loss of parents due to death		
Yes	19	8.32 (4.68)
No	375	6.79 (4.64)
Loss of a close family member due to death		
Yes	70	7.04 (4.30)
No	324	6.82 (4.73)
Loss of a close friend due to death**		
Yes	41	9.32 (4.98)
No	353	6.58 (4.53)
Taking care of a family member with physical disability*		
Yes	21	8.90 (4.71)
No	373	6.75 (4.63)
Parental divorce		
Yes	6	7.00 (3.29)
No	388	6.86 (4.67)
Parental conflicts*		
Yes	31	8.74 (4.75)
No	363	6.70 (4.61)
Serious conflicts with parents**		
Yes	40	8.85 (3.87)
No	354	6.64 (4.68)
Serious financial difficulties**		
Yes	43	8.70 (4.63)
No	351	6.64 (4.61)
Serious academic difficulties**		
Yes	65	8.75 (5.10)
No	329	6.49 (4.47)
Physical abuse		
Yes	6	10.50 (2.59)
No	388	6.81 (4.66)
Sexual abuse		
Yes	3	11.00 (1.73)
No	391	6.83 (4.65)

*P<0.05, **P<0.01

Table 3

Factor loading matrix for the five dietary patterns identified in the study population

Food items	Traditional Lebanese	Western fast food	Dairy	Lebanese fast food	Fruits
Eggs, whole, large	0.54				
Legumes: lentils, broad beans, chickpeas, etc., cooked	0.54				
Cauliflower/ Cabbage/ broccoli	0.54				
Others: Banana (medium)/ Apple, fresh (small)	0.52				0.42
Dark green or deep yellow vegetables (ex. spinach, hindbeh, carrots , ...)	0.51				
Poultry (3 oz = ½ chicken breast)	0.50				
Red Meat (3 oz = meat burger size)	0.49				
Fish, (including Tuna)	0.48				
Cheese, low fat, white	0.48				
Salad – green: lettuce, celery, green peppers, cucumber	0.46				
Wheat, whole, cooked / Bulgur	0.42				
Potato, baked / boiled / mashed	0.39				
Tomatoes, fresh, medium	0.39				
Squash, summer (kussa), Eggplant /cooked	0.34				
Labneh, low fat	0.34				
Cheese, low fat, yellow	0.32		0.53		
Oil: corn / sunflower / soy/olive	0.32			0.31	
Fruit drinks: canned/ bottled , sugar – sweetened		0.64			
Burgers(Beef, chicken, fish)		0.62			
Energy drinks, sports drinks, regular		0.57			
French fries		0.56			
Hot chocolate or cocoa, with sugar		0.55			
Chocolate bar		0.54			
Mayonnaise		0.54			
Manaeesh, zaatar, cheese		0.45			
Cake, cookies , donuts,		0.40			

muffin, croissant				
Pizza	0.35		0.32	
Ice cream	0.34	0.32		
Cheese, regular, yellow		0.64		
Labneh, regular		0.63		
Whole fat yogurt		0.63		
Cheese, regular, white		0.61		
Rice, white, cooked		0.32		
White bread		0.31		
Sausages, makanek, hot dogs			0.50	
Falafel sandwich, medium			0.46	
Organ Meats (liver, kidneys, brain)			0.45	
Chawarma sandwich, medium			0.44	
Nuts & seeds (peanuts, almonds, sunflower seeds, etc.), roasted			0.36	
Citrus Orange (1 item) / Grapefruit (1/2 item)				0.57
Deep Yellow or Orange (1 small peach, 2 plums, etc.)				0.51
Strawberry (12)				0.50
Grapes (15)				0.47
Dried fruits: raisins (2 Tablespoon), dates (2), apricots (4)				0.45
Fresh fruit juice				0.41

*Total variance explained by the 5 factors 0.50

*Absolute values <0.3 were excluded from the table

Table 4

Spearman's correlation coefficients of dietary pattern scores with total energy and energy-adjusted nutrient intakes

	Dietary pattern				
	Traditional Lebanese diet	**Western fast food**	**Dairy**	**Lebanese fast food**	**Fruits**
Energy	0.559**	0.692**	0.525**	0.684**	0.301*
Protein (g)	0.273**	-0.334**	0.026	-0.163**	0.052
Carbohydrate (g)	-0.273**	-0.067	-0.234**	-0.395**	0.169**
Fat, total (g)	0.197**	0.218**	0.202**	0.525**	-0.172**
Cholesterol (mg)	0.202**	0.024	0.043	0.051	0.019
Saturated fat(g)	-0.041	0.426**	0.346**	0.098	-0.200**
MUFA (g)	0.164**	0.178**	-0.024	0.480**	-0.063
PUFA (g)	0.227**	0.081	-0.061	0.635**	-0.110*
Sodium (mg)	-0.073	-0.038	0.267**	-0.056	-0.179**
Potassium (mg)	0.313**	-0.309**	-0.305**	-0.242**	0.469**
Fibers (g)	0.187**	-0.352**	-0.269**	-0.148**	0.352**

MUFA, Monounsaturated Fatty Acids; PUFA, Polyunsaturated Fatty Acids
Correlation is significant at *P<0.005 and **P<0.01
- Variables were log transformed
-Adjustment for energy was carried out as nutrient intake per 1000Kcal per day for all nutrients

Table 5

Associations of socio-demographic, anthropometric characteristics, lifestyle factors and number of stressful life events with various dietary patterns in the study population as assessed by multivariate linear regression

	Traditional Lebanese diet			Western fast food			Dairy			Lebanese fast food			Fruits		
	β	95% CI		β	95% CI		β	95% CI		β	95% CI		β	95% CI	
Age (years)	0.066	-0.008	0.027	-0.105	-0.044	0.001	0.021	-0.021	0.031	-0.007	-0.024	0.021	0.045	-0.016	0.037
Gender	-0.062	-0.119	0.046	-0.246*	-0.307	-0.095	-0.058	-0.172	0.071	-0.063	-0.154	0.057	-0.145*	-0.252	-0.006
Waist Circumference	-0.034	-0.004	0.003	-0.012	-0.005	0.004	0.012	-0.005	0.005	-0.018	-0.005	0.004	-0.028	-0.006	0.004
Hypertension	0.035	-0.037	0.064	0.009	-0.059	0.069	0.136*	0.004	0.151	0.109	-0.010	0.119	0.055	-0.043	0.106
Family history of Mental illness	-0.116*	-0.266	-0.005	-0.101	-0.331	0.004	-0.097	-0.359	0.025	-0.118*	-0.346	-0.012	-0.045	-0.275	0.114
Meals per day	0.138*	0.005	0.100	-0.122*	-0.126	-0.004	0.030	-0.053	0.087	0.047	-0.037	0.084	0.135*	0.008	0.149
Meal frequency	-0.049	-0.093	0.037	0.076	-0.022	0.145	0.100	-0.010	0.181	0.032	-0.059	0.107	0.014	-0.084	0.109
Breakfast frequency	-0.143*	-0.096	-0.008	0.126*	0.007	0.121	-0.014	-0.072	0.057	-0.023	-0.067	0.045	-0.126*	-0.135	-0.004
Meals while watching TV	-0.076	-0.065	0.012	-0.056	-0.077	0.121	-0.077	-0.097	0.016	-0.110*	-0.100	-0.001	0.022	-0.046	0.070
Snacks per day	0.000	-0.037	0.037	0.259*	0.071	0.166	0.106	-0.003	0.106	0.039	-0.030	0.064	0.083	-0.014	0.097
Unhealthy eating behaviors in the past 3 months	-0.014	-0.109	0.084	0.079	-0.030	0.217	0.034	-0.098	0.185	-0.034	-0.161	0.085	0.007	-0.134	0.152
Smoking habits	-0.143*	-0.081	-0.007	-0.094	-0.088	0.008	-0.229*	-0.159	-0.049	-0.117	-0.095	0.001	-0.132*	-0.117	-0.006
Alcohol drinking	-0.002	-0.043	0.045	0.136*	0.015	0.127	0.132*	0.009	0.138	0.158*	0.021	0.133	-0.004	-0.067	0.063
Number of stressful life events	0.106	-0.002	0.053	0.059	-0.016	0.055	-0.012	-0.044	0.036	0.110	-0.001	0.069	0.040	-0.026	0.055
Physical activity	0.102	-0.005	0.081	-0.092	-0.104	0.008	-0.060	-0.097	0.030	0.001	-0.055	0.056	0.006	-0.061	0.068

*β and 95% CI are significant at P<0.05
- Variables are log transformed.

Table 6

Association of severity of depressive symptoms of study participants with the scores of the five dietary patterns identified as assessed by multivariate linear regression

	Depressive symptoms		
	β	95% CI	
Traditional Lebanese diet	0.036	-0.073	0.121
Western fast food	0.092	-0.044	0.190
Dairy	0.053	-0.037	0.080
Lebanese fast food	0.075	-0.055	0.1745
Fruits	0.004	-0.107	0.1024

*β and 95% CI are significant at P<0.05.
- Variables are log transformed.
-The multivariate regression model was adjusted for age, gender, income, physical activity, BMI, intake of anti-depressants, family history of mental illness, alcohol consumption, number of stressful life events, and worrying they lost control over how much they eat.

DISCUSSION & CONCLUSION

The primary aim of the study was to assess the relationship between dietary patterns prevalent among a sample of Lebanese university students and severity of depressive symptoms. Five dietary patterns were identified in our sample. The Traditional Lebanese diet was characterized by intake of eggs, legumes, vegetables, bananas, apples, poultry, meat, fish, low-fat dairy, bulgur, and oils. The Western Fast food diet was typified by consumption of sugar-sweetened fruit drinks and hot chocolate, energy drinks, burgers, French fries, mayonnaise, pizza, manaeesh, cake, cookies, donuts, muffins, and ice cream. The dairy pattern was distinguished mainly by intake of whole-fat cheese, labneh, yogurt and ice cream. The Lebanese fast food pattern was characterized by consumption of organ meat, sausages and makanek, falafel and chawarma sandwiches, and nuts and seeds. Fruits pattern was described by intake of fruits, dried fruits and fresh fruit juice. The traditional Lebanese and Western fast food patterns identified in our sample are similar to previously reported ones among a nationally representative sample of 2048 Lebanese adults aged 20-55 years (Naja et al., 2011, 2013), another sample of 174 Lebanese adults aged 40-77 years (Naja et al., 2012), and among a large sample (n= 3307) of Lebanese university students (Salameh et al., 2014). Although the dairy and fruits patterns, and Lebanese fast food pattern, emerged as distinct in our study, they were recognized as food items included in: the traditional Lebanese pattern, and Western and fast food patterns, respectively, as per findings of Naja et al. (2011, 2013).

Our findings on energy intake and energy-adjusted nutrient profile of traditional Lebanese diet were comparable to those reported in previous studies as far as high intake of energy, protein, fat (primarily unsaturated), cholesterol and fiber.

Nonetheless, they differed on intake of carbohydrate: in our sample, traditional Lebanese diet showed an unexpected significant negative association with carbohydrate consumption. Still, the Western fast food pattern correlated with high intake of energy and fat (essentially saturated fat), low intake of carbohydrate, and very low intake of protein and fiber in our study, as well as in previously reported findings (Naja et al., 2011, Naja et al., 2013). Evidently, the Western fast food and Lebanese fast food patterns were similar with regard to high energy and total fat intake and low consumption of protein, carbohydrate and fiber. However, they diverged on the type of fat: predominantly unsaturated for the Lebanese fast food versus a predominant intake of saturated fat for Western fast food. Of note our traditional Lebanese dietary factor is similar to the mixed diet (a combination of plant foods, composite dishes, and bread) recognized in the study on Lebanese university students published by Salameh et al. (2014).

For the most part, our findings with regard to associations of socio-demographic and lifestyle factors with identified dietary patterns in our sample agree with those reported in the literature. We found a strong positive association between traditional Lebanese diet pattern and healthy lifestyle habits such as frequent breakfast and regular meal consumption and non-smoking. A similar finding with regard to association of traditional Lebanese diet with frequent breakfast consumption among a nationally representative Lebanese adults sample was reported by Naja et al. (2011). Noticeably, many studies showed positive association of regular breakfast consumption with healthier eating habits and lower levels of overweight and obesity (Szajewska et al., 2010; Veltsista et al., 2010). The association between the Western fast food diet and male gender was consistent among all studies that looked at dietary patterns among

Lebanese subjects (Naja et al., 2011; Salameh et al. 2014). Likewise, the positive association of the Western fast food diet with snacking was analogous to that cited by Naja et al. (2011, 2013). More than that, the Western fast food diet showed significant positive association with less frequent breakfast consumption and intake of fewer meals per day in our sample. Of interest in our study was the observation that Western fast food and Lebanese fast food patterns associated significantly with more alcohol consumption. In addition, subjects with high scores on the Lebanese fast food pattern were more likely to eat their meals while watching TV. Notwithstanding the finding of significant positive association between traditional Lebanese diet and physical activity level as per Naja et al. (2011), and the significant negative association between Western diet and physical activity level as per Salameh et al. (2014), none of the dietary patterns identified in our study associated with physical activity level. For the most part, our findings echo the strong relationship between selected food pattern and global individual lifestyle choices (Jacka et al., 2014; Kourlaba et al., 2009); thereupon, interventions aimed at changing unhealthy food patterns shall take into account an expanded look at individuals' lifestyle.

None of the five dietary patterns showed significant association with depression severity scores after controlling for age, gender, income, physical activity, BMI, intake of anti-depressants, alcohol consumption, number of stressful life events, family history of mental illness, and worrying about loss of control of how much they eat. Much as we expected to find out significant associations between one or more dietary pattern, in particular traditional Lebanese diet and the Western fast food diet, our results were not fully unanticipated for.

Despite an emerging link among different dietary patterns and risk of depression, current evidence is not yet conclusive as per published pertinent systematic reviews. Findings from the first systematic review examining the literature on the association between dietary patterns and depression revealed limited evidence supporting an association between traditional Mediterranean diet and depression, and conflicting evidence with regard to an association between "healthy dietary pattern", and "Western dietary pattern", and depression (Quirk et al, 2013). Another systematic review and meta-analysis of pertinent research reported that a healthy dietary pattern characterized by high intake of whole grain, fruits, vegetables, low-fat dairy products, poultry and fish, had significant positive association with a reduced risk for depression, whereas the Western diet pattern had a positive association with increased risk of depression, though statistically insignificant (Lai et al., 2014). A third systematic review by Rahe et al. (2014) suggested a protective effect of healthy and Mediterranean diet patterns with regard to depression, and a potential positive association of the Western diet pattern with depression, while drawing no firm conclusion.

Furthermore, multiple study variables, particularly methodological limitations, could have influenced our findings. Assessment of dietary patterns in our study was carried out only once by way of meeting with groups of subjects (students) and explaining the FFQ and showing food models for clarification of portion size. Dietary intake assessment should have been repeated at least once and conducted on one-to-one basis to better capture long term food intake pattern and precise food portion size. Besides, though our FFQ was composed of 73 items and prompted individuals to add items that were not on the list, still it is restrictive, many details of dietary intake are not measured and the quantification of intake is not as accurate as with recalls and records

(Coulston et al., 2013). Moreover, although dietary patterns named "healthy diet", "traditional Lebanese", Mediterranean", "Western diet", "Western fast food" as per literature have comparable food items/ groups, the actual food items within the same dietary pattern, for instance "Mediterranean diet", were never identical between studies, bearing in mind that their grouping depends on the statistical method used to define dietary patterns. Even though we used the PHQ-9 to assess for severity of depression in our sample, which was used in health surveys of nationally representative US samples to assess for depression (NHANES, 2009, 2013-2014), findings on depression symptoms severity and their association with dietary patterns were reported to differ by validity of the tool used to assess depression severity. Furthermore, inconsistent findings with regard to the association of food patterns and depression can be attributed to the variation in controlling for different sets of potential confounders among studies.

Study strengths and limitations, and future directions

Our study explored association between depressive symptoms severity and food patterns hence taking into consideration the complex cumulative effect/ interactions between nutrients that may influence risk of depression. Moreover, many socio-demographic and lifestyle factors known to influence depression severity were assessed and controlled for when exploring the relationship of dietary patterns with depressive symptoms severity.

Still, we adopted a cross-sectional study design, hence temporal association of food intake and severity of depression cannot be established. Our small sample size may have been a limiting factor to see any significant association of dietary pattern with depression severity in our sample. Besides, although our sample is quite likely

representative of the general population of NDU students; yet it is not representative of the general population of university students in Lebanon. Another study limitation relates to assessment of dietary pattern, as per explanation stated in preceding part. Bearing in mind that diet assessment by way of the 73-items FFQ was conducted in group sessions and by two trained dietitians, collection of valid information on diet pattern was liable to inconsistent interpretations, lower than desired response and completion rates, and under- or over- estimation of subjects' usual dietary intake (Caan et al., 1999; Shim J-S et al., 2014). Despite the discussed limitations, FFQs are still widely used as the primary dietary assessment tool in epidemiological studies (Shim J-S et al., 2014).

In conclusion, the present study provides a better understanding of dietary patterns adopted by Lebanese university (NDU) students. Five dietary patterns were identified namely Traditional Lebanese Diet, Western Fast Food, Dairy, Lebanese Fast Food and Fruits. Severity of depressive symptoms was found to be associated with unhealthy lifestyle habits and stressful life events, but showed no association with the identified dietary patterns. Our findings highlight the importance of implementing carefully designed health interventions on campus targeting students most-at- risk for developing depression and affecting change of unhealthy lifestyle eating habits, smoking and alcohol drinking, in addition to developing stress management and interpersonal conflict resolution skills.

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APPENDICES

Appendix A: Consent form

Faculty of Nursing & Health Sciences- Notre Dame University-Louaize (NDU)
Consent Form to Participate in a Research Study

This is a consent form to participate in a research study. If you decide to participate, you will have to mark your consent below and return this form to the study investigators.

Who are we?
We are a group of researchers from the Faculty of Nursing & Health Sciences and the Faculty of Humanities, NDU.

What is the purpose of the study?
We are interested to study the association between dietary patterns & several health outcomes primarily depressive symptoms and high blood pressure among Lebanese University students.

What does the study entail?
Participants will be asked to complete a total of 4 questionnaires including a food frequency questionnaire (FFQ). Trained nutritionists/ dietitians will visit classrooms for about 50 minutes and assist participating students in completing the FFQ. The remaining 3 questionnaires (background information, measurement of physical activity, and depressive symptoms) will be given to students for completion at home and later on submission to the research staff within a period of one week in a sealed envelope. Students will be asked to come in person to the nutrition research lab (HA318, third floor, pink building), Tuesday July 14 to Friday July 24 from 9:00am- 2:00pm, for weight, height, waist circumference, and blood pressure measurements. Students who provide complete data will be rewarded a free body composition assessment (worth $30), and a free nutrition consultation.

Is there any risk to participants in the study?
There is no risk in participating in this study. The information collected will be used only for the purpose described in this form.

What about anonymity, and/ or confidentiality?
You will not be asked to provide your name, ID#, or any other personal identifier. All data from this study will be maintained in a secure location, and access will be strictly limited to study investigators.

What are my rights as a study participant?
Taking part in this research is voluntary and declining to participate will not bear any academic/ nonacademic consequences.

Whom do I call if I have questions?
For questions about the study, contact the researchers: 03-423443, 03-871916, or 71-991331.

STATEMENT OF CONSENT:
I have read this form. I have had the opportunity to ask questions and have had them answered to my satisfaction. In addition, I have been assured that any future questions that I may have will also be answered by the research investigators.

☐ By checking this box I indicate that I voluntarily agree to participate in this study.

☐ By checking this box, I indicate that I am not interested in participating in this study.

Date: _____

Appendix B: Food Frequency Questionnaire ***(73 items; 3 pages)***

Think about your eating patterns during the past year while answering this questionnaire. Please indicate your usual intake of each of the following food items per Day, Week, or Month.
For example: Apple. If you consume 3 apples daily, write 3 in the "Day" column. If you think you average 3 apples a week over the year, write 3 in the "Week" column. However, if you rarely consume a food, let's say once or twice a year, then tick below "Rarely/Never". Please be precise as much as you can.
Remember! The accuracy of the study results depends on the accuracy of your answers.

Food item	Serving size	Day	Week	Month	Rarely /Never
Example: Apple	1 item		3		
Bread & Cereals					
1. White bread	1 slice (30g)				
2. Brown or whole wheat bread	1 slice				
3. Breakfast cereals, regular/ bran	1 cup				
4. Rice, white, cooked	1 cup				
5. Pasta, plain, cooked	1 cup				
6. Wheat, whole, cooked / Bulgur	1 cup				
Dairy Products					
7. Low- fat milk (2% fat)	1 cup				
8. Whole fat milk	1 cup				
9. Fat-free/ low-fat yogurt	1 cup				
10. Whole fat yogurt	1 cup				
11. Cheese, regular, white	1 slice (30g)				
12. Cheese, regular, yellow	1 slice (30g)				
13. Cheese, low fat, white	1 slice (30g)				
14. Cheese, low fat, yellow	1 slice (30g)				
15. Labneh, regular	2 Tablespoon				
16. Labneh, low fat	2 Tablespoon				
Fruits & Juices					
17. Citrus Orange (1 item) / Grapefruit (1/2 item)	1 serving				
18. Deep Yellow or Orange (1 small peach, 2 plums, etc.)	1 item				
19. Strawberry (12)	1 cup				
20. Grapes (15)	1 cup				
21. Others: Banana (medium)/ Apple, fresh (small)	1 item				
22. Dried fruits: raisins (2 Tablespoon), dates (2), apricots (4)	1 serving				
23. Fresh fruit juice	1 cup				
24. Fruit drinks: canned/ bottled , sugar –sweetened	1 cup				
25. Fruit drinks: canned/ bottled, no added sugar	1 cup				
Vegetables					

26. Salad – green: lettuce, celery, green peppers, cucumber	1 cup				
27. Dark green or deep yellow vegetables (ex. spinach, hindbeh, carrots , …)	1 cup				
28. Tomatoes, fresh, medium	1 item				
29. Corn / green peas, cooked	1 cup				
30. Potato, baked / boiled / mashed	1 item				
31. Squash, summer (kussa), Eggplant /cooked	1 cup				
32. Cauliflower/ Cabbage/ broccoli	1 cup				
Meat & Alternates	**Serving size**	**Day**	**Week**	**Month**	**Rarely /Never**
33. Legumes: lentils, broad beans, chickpeas, etc., cooked	1 cup				
34. Nuts & seeds (peanuts, almonds, sunflower seeds, etc.), raw	1 cup				
35. Nuts & seeds (peanuts, almonds, sunflower seeds, etc.), roasted	1 cup				
36. Red Meat (3 oz = meat burger size)	1 item (3 oz)				
37. Poultry (3 oz = ½ chicken breast)	1 item (3 oz)				
38. Fish, (including Tuna)	1 serving (3 oz)				
39. Eggs, whole, large	1 item				
40. Organ Meats (liver, kidneys, brain)	1 cup				
41. Luncheon meats: Mortadell, Jambon, salami, turkey, etc.	1 slice (20g)				
42. Sausages, makanek, hot dogs	1 item (30g)				
Fats & Oils					
43. Oil: corn / sunflower / soy/olive	1 Tablespoon				
44. Olives (1 item = 6 olives)	1 item				
45. Butter (زبدة)/ ghee (السمن)	1 Tablespoon				
46. Mayonnaise	1 Tablespoon				
Sweets & Desserts					
47. Cake, cookies , donuts, muffin, croissant	1 item				
48. Ice cream	1 cup (2 scoops)				
49. Chocolate bar	1 item				
50. Sugar, , honey, jam, molasses	1 Tablespoon				
51. Arabic sweets, baklawa, maamoul, knefeh (1 item= 2 baklawa= small piece knefeh)	1 item (40g)				
Beverages					
52. Water	1 cup				
53. Soft drinks, regular (1 can = 1½ cup)	1½ cup (11 fl oz)				
54. Soft drinks, diet (1 can = 1½ cup)	1½ cup (11 fl oz)				
55. Turkish coffee, with sugar	¼ cup (2 fl oz)				
56. Turkish coffee, no added sugar	¼ cup (2 fl oz)				
57. Coffee/Nescafe or Tea, with sugar and/ or cream	1 cup				
58. Coffee/Nescafe or Tea, no sugar or cream	1 cup				
59. Hot chocolate or cocoa, with sugar	1 cup				
60. Hot chocolate or cocoa, no added sugar	1 cup				

61. Energy drinks, sports drinks, regular	1 can= 1 cup				
62. Energy drinks, diet (sugar-free)	1 can= 1 cup				
63. Beer, regular	1 can = 1½ cup				
64. Wine (red, white, or blush)	½ cup (4 fl oz)				
65. Liquor (whiskey, vodka, gin, rum)	1/6 cup (1.5 fl oz)				
66. Other (list):					
Miscellaneous					
67. Manaeesh, zaatar, cheese	1 large				
68. French fries	1 cup				
69. Chips: potato, corn, tortilla	1 cup				
70. Falafel sandwich, medium	1 item				
71. Chawarma sandwich, medium	1 item				
72. Burgers(Beef, chicken, fish)	1 item				
73. Pizza	1 slice				

Are there any other foods not mentioned above that you usually eat at least once per week?

Other foods that you usually eat at least once /week	Usual serving size	Servings/week

Appendix C: Background Questionnaire ***(41 Q, 5 pages)***

Please check one box for each question where there are check boxes. If you do not wish to answer a question, please draw a line through it.

Medical history- I

1. **Have you been recently diagnosed by a doctor with a <u>mental illness other than depression</u> [for instance any of anxiety disorders, bipolar disorder, eating disorders, impulse control disorder (ADHD), substance abuse/ dependence (alcoholic, drug)]?**

هل عانيت مؤخرا بحسب تشخيص الطبيب المختص من أي إضطراب عقلي غير الكآبة ، (كالقلق، إضطراب المزاج، الخلل في الأكل ، الخلل في التحكم بالإندفاع، الإدمان على الأدوية أو الكحول)

☐ No
☐ Yes, Specify: _____

2. **Have you been diagnosed by a doctor with any of the following chronic medical conditions? (Check all applicable)**

☐ Cardiovascular disease (أمراض القلب والشرايين)	☐ Obesity (البدانة)
☐ Stroke (السكتة الدماغي)	☐ Cancer (السرطان)
☐ Hypertension (إرتفاع ضغط الدم)	☐ Neurological disease (multiple sclerosis…) أمراض في الجهاز العصبي (التصلب اللويحي (...)
☐ Diabetes (السكري)	☐ Kidney disease (أمراض الكلى)
☐ Hyperthyroidism (فرط نشاط الغدة الدرقية)	☐ Cushing's syndrome
☐ Obstructive sleep apnea (توقف التنفس أثناء النوم)	☐ Adrenal gland disorders

3. **If your answer is yes to question # 2, have you been taking any medication?**
☐ No
☐ Yes, Specify name of medication:
_____

4. **Are you pregnant or breastfeeding?**
☐ No ☐ Yes

5. **Are you a professional athlete (لاعب رياضي محترف) who is following specific nutrition requirements (متطلبات تغذية محددة)?**
   ☐ No ☐ Yes

6. **Do you have any physical disability (إعاقة جسدية)?**
   ☐ No
   ☐ Yes, Specify: _____

Medical history- II

7. **Has any member of your family (parents, siblings) been diagnosed by a doctor with depression or any other mental illness (bipolar, schizophrenia…)?**

هل يعاني أحد من أفراد العائلة (الأهل أو الأخوة) من مشاكل نفسية (إضطراب المزاج ، فصام...)

   ☐ No
   ☐ Yes, Specify: _____

8. **Have you been recently diagnosed by a doctor with <u>depression</u>?**

هل عانيت مؤخرا من حالات كآبة بحسب تشخيص الطبيب المختص

   ☐ No
   ☐ Yes, Indicate if you have been taking any antidepressant medication?
   ☐ No ☐ Yes, Specify name of medication:

   _____

9. **Has any member of your family been diagnosed by a doctor with hypertension (high blood pressure)?**
   ☐ No ☐ Yes

10. **Has any member of your family been diagnosed by a doctor with heart disease?**
    ☐ No ☐ Yes

11. **Does your doctor measure your blood pressure during each health care encounter (visit)?**
    ☐ No ☐ Yes

Sociodemographic, plus anthropometric measurements

12. Gender:

☐ Male ☐ Female

13. Age: _____

14. Body weight (kg)/Height (cm)

REPORTED BY STUDENT
MEASURED BY RESEARCHER

Body weight (kg) _____ Body weight (kg) _____

Height (cm) _____ Height (cm) _____

15. Blood pressure measurement (mmHg): *(leave it empty)* _____

16. Waist circumference (cm): *(leave it empty)* _____

17. Body composition (total body fat %): *(leave it empty)* _____

18. Which faculty you are currently enrolled in?

☐ Faculty of Architecture, Art & Design
☐ Faculty of Business Administration & Economics
☐ Faculty of Engineering
☐ Faculty of Humanities
☐ Faculty of Law & Political Science
☐ Faculty of Natural & Applied Sciences
☐ Faculty of Nursing & Health Sciences

Major_____

19. Class:

☐ Sophomore ☐ Junior ☐ Senior

20. Cumulative GPA: _____

21. Marital status:

☐ Single
☐ Married
☐ Separated
☐ Divorced

22. Do you have children?

☐ No
☐ Yes, How many? _____

23. Do you currently have a job in addition to your studies?

☐ No

☐ Yes, Indicate if: ☐ Part-time ☐ Full-time

24. Where are you staying at present time?

☐ With parents ☐ Own apartment

☐ In dormitories ☐ Other

25. Annual Household Income (دخل الأسرة) (i.e. income generated by all adults in the household) in Lebanese pounds (If you do not know the exact income, please provide an estimate): ----------

Lifestyle questions

26. How many meals do you have per day?

☐ One ☐ Three

☐ Two ☐ Four or more

27. How often do you have your meals?

☐ Often ☐ Occasionally ☐ Rarely

28. How often you have a breakfast?

☐ Daily ☐ Occasionally ☐ Rarely

29. How often do you have your meals while watching TV during a week?

☐ Often ☐ Occasionally ☐ Rarely

30. How many snacks (apart from regular meals) do you have per day?

☐ One ☐ Three

☐ Two ☐ Four or more

31. Have you been recently taking any dietary supplement (herbal supplements, weight loss pills, energy yielding supplements, vitamins and minerals, caffeine containing pills, etc.)?

☐ No

☐ Yes; Specify: _____

32. Have you been recently following a special diet (نظام غذائي خاص)?

☐ No

☐ Yes, Specify: _____

33. Do you have any of unhealthy eating behaviors [for instance binge eating (consumption of an abnormally large amount of food in a relatively short

period of time), compulsive overeating (non-stop eating), extreme dieting...] in the past 3 months?

☐ No

☐ Yes; Specify: _____

34. Smoking habits

☐ Non-smoker ☐ Previous Smoker ☐ Current smoker

35. Do you drink alcohol?

☐ Occasionally ☐ 1-2 drinks per day

☐ 1-2 drinks per week ☐ More than 2 drinks per day

36. Do you make yourself sick (throw up) because you feel uncomfortably full?

☐ No ☐ Yes

37. Do you worry you have lost control over how much you eat?

☐ No ☐ Yes

38. Have you recently lost more than one stone (6.35kg) in a 3 month period?

☐ No ☐ Yes

39. Do you believe yourself to be fat when others say you are too thin?

☐ No ☐ Yes

40. Would you say that food dominates your life?

☐ No ☐ Yes

Stressful life events

41. Have you had experienced any of the following stressful life events <u>during the past year</u> (check all applicable answers)?

☐ Loss of parent(s) due to death

☐ Loss of a close family member due to death

☐ Loss of a close friend due to death

☐Taking care of a family member with physical disability

☐ Parental divorce

☐ Parental conflicts

☐ Serious conflicts with parents

☐ Serious financial difficulties

☐ Serious academic difficulties

☐ Physical abuse (during a lifetime)

☐ Sexual abuse (during a lifetime)

Thank you for taking the time to complete this survey.

Appendix D: International Physical Activity Questionnaire

INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

1. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?

   _____ **days per week**

   ☐ No vigorous physical activities → ***Skip to question 3***

2. How much time did you usually spend doing **vigorous** physical activities on one of those days?

   _____ **hours per day**

   _____ **minutes per day**

   ☐ Don't know/Not sure

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

3. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

   _____ **days per week**

   ☐ No moderate physical activities → ***Skip to question 5***

SHORT LAST 7 DAYS SELF-ADMINISTERED version of the IPAQ. Revised August 2002.

4. How much time did you usually spend doing **moderate** physical activities on one of those days?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you might do solely for recreation, sport, exercise, or leisure.

5. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

_____ **days per week**

☐ No walking → ***Skip to question 7***

6. How much time did you usually spend **walking** on one of those days?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

The last question is about the time you spent **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

7. During the **last 7 days**, how much time did you spend **sitting** on a **week day**?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

This is the end of the questionnaire, thank you for participating.

Appendix E: Patient Health Questionnaire-9

PATIENT HEALTH QUESTIONNAIRE-9 (PHQ-9)

Over the last 2 weeks, how often have you been bothered by any of the following problems? *(Use "✓" to indicate your answer)*	Not at all	Several days	More than half the days	Nearly every day
1. Little interest or pleasure in doing things	0	1	2	3
2. Feeling down, depressed, or hopeless	0	1	2	3
3. Trouble falling or staying asleep, or sleeping too much	0	1	2	3
4. Feeling tired or having little energy	0	1	2	3
5. Poor appetite or overeating	0	1	2	3
6. Feeling bad about yourself — or that you are a failure or have let yourself or your family down	0	1	2	3
7. Trouble concentrating on things, such as reading the newspaper or watching television	0	1	2	3
8. Moving or speaking so slowly that other people could have noticed? Or the opposite — being so fidgety or restless that you have been moving around a lot more than usual	0	1	2	3
9. Thoughts that you would be better off dead or of hurting yourself in some way	0	1	2	3

FOR OFFICE CODING 0 + _____ + _____ + _____

=Total Score: _____

If you checked off any problems, how difficult have these problems made it for you to do your work, take care of things at home, or get along with other people?

Not difficult at all	Somewhat difficult	Very difficult	Extremely difficult
☐	☐	☐	☐

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