## RESEARCH

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# Evaluating adherence of hospital meals to Mediterranean diet: the case of a developing country

Hussein F. Hassan<sup>1</sup>, Dana Malli<sup>2</sup>, Esraa Antar<sup>2</sup>, Maroun Khattar<sup>2</sup>, Nour Badereddine<sup>2</sup>, Ferial Fattouh<sup>2</sup>, Jana El Cheikh Mohamad<sup>2</sup>, Sami El Khatib<sup>3,4</sup>, Mohamad Abiad<sup>5,6\*</sup> and Maha Hoteit<sup>1,2,7\*</sup>

## Abstract

This study aimed to assess the nutritional composition of meals served to and consumed by patients in Lebanese hospitals and to evaluate the extent to which these meals adhere to Mediterranean diet guidelines. Conducted between April 2023 and September 2023, this cross-sectional study involved 155 in-patients from various departments across 16 hospitals in Lebanon. Food quantities served were measured, and nutritional analysis was performed to evaluate the nutritional content of meals provided and eaten by patients. On average, served meals weighed 1.24 kg (SD: 0.43), providing an average of 1489 kcal energy (SD: 546.55) and 72 g of protein per hospital bed per day. These meals typically met 79% of a patient's daily estimated energy requirement (EER). On the other hand, patients consumed an average of 0.85 kg of food, providing 1084.3 kcal energy (57.3% of EER) and 50 g of protein per day. The most served food group in hospitals was the 'grains and cereals' group. Compared to the Mediterranean diet, our results showed that hospitals exceeded the recommended servings for dairy and meat products, while they served less than the recommended amounts from the vegetables, fruits, legumes. Patients did not meet their daily requirements for almost all the macro- and micro-nutrients. This study highlights the importance of public health policies, interventions, and food service management strategies to ensure patients receive adequate diets aligned with their nutritional needs.

## **Keypoints**

• Menus served in Lebanese hospitals do not provide patients their requirements of energy, macro- and micro-nutrients.

- Menus served show low adherence to the Mediterranean diet principles.
- Patients in Lebanese hospitals do not meet their estimated daily energy, macro- and micro-nutrients requirements.
- Patients are at risk of malnutrition and hidden hunger.

Keywords Consumption, Hospitals, Foodservice, Mediterranean diet, Nutritional value

\*Correspondence: Mohamad Abiad ma192@aub.edu.lb Maha Hoteit m.hoteit@ul.edu.lb

Full list of author information is available at the end of the article



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## Introduction

Malnutrition encompasses a spectrum of nutritional imbalances, spanning both over-nutrition and undernutrition. It is widespread in developed and developing countries and hospitals and residential care facilities in developed nations. Globally, malnutrition affects between 20 and 50% of the population [1, 2]. It is frequently a multifaceted issue arising from inadequate nutrient intake, diminished nutrient absorption, heightened nutrient requirements, and metabolic alterations due to illness [2]. Studies have indicated that malnutrition is associated with prolonged hospital stays for patients grappling with acute or chronic conditions [3]. Research conducted by Sorensen et al. (2008) disclosed that 32.6% of hospitalized patients were at risk of malnutrition based on the Nutrition Risk Screening tool (NRS-2002), with 62% identified as at-risk due to compromised nutritional status [4]. Complications were more prevalent among at-risk patients, resulting in extended hospital stays and elevated mortality rates [4]. These findings underscore the pivotal role of hospital food services in the care of hospitalized patients. The hospital food service aims to furnish inpatients with nourishing meals tailored to their health requirements, bolstering their recovery and overall wellbeing. One productive approach involves adhering to the recommendations of the Mediterranean diet, renowned for its health-promoting properties and favorable effects on patient outcomes [5]. By prioritizing fresh fruits and vegetables, whole grains, lean proteins, and healthy fats, a menu inspired by the Mediterranean diet can facilitate patient recovery and aid in managing chronic conditions [5]. A study by Lampropoulos et al. (2020) in Argolidos, Greece, focusing on hospitalized patients over 65, demonstrated that integrating Mediterranean diet principles reduced hospital stays, diminished long-term mortality rates, and lowered costs [6]. Furthermore, the Mediterranean diet, acknowledged by UNESCO as a cultural heritage of countries bordering the Mediterranean Sea, reflects a harmonious interplay between agricultural and dietary practices and the environment [5-7].

Over time, numerous studies have consistently highlighted the considerable health advantages associated with this dietary pattern, particularly in the realms of preventing and managing cardiovascular disease, type 2 diabetes, metabolic syndrome, obesity, cancer, cognitive decline, and cardiovascular disease mortality [5]. The increase in diet-related chronic diseases in the Eastern Mediterranean Region (EMR) and other developing nations has been attributed to a departure from traditional dietary patterns towards those characterized by high-fat content, refined sugar, and processed foods [8]. As a result, the Mediterranean diet has garnered widespread acclaim for its diverse array of health benefits and its positive impact on overall well-being.

A study conducted in Lebanese hospitals revealed that 31.20% of participants were deemed "at risk of malnutrition," with 51% male and 49% female, according to the NRS-2002 tool [3]. Furthermore, 21.28% and 14.29% were categorized as "moderately" and "severely" malnourished, respectively, totaling 35.57% of malnourished participants based on the Global Leadership Initiative on Malnutrition (GLIM) [3]. It is evident that providing in-patients with nutritious and personalized meal plans is essential in hospitals to improve care quality, reduce length of stay, and enhance health outcomes. Notably, previous studies in Lebanon have not evaluated the nutritional content of meals provided in Lebanese hospitals, including energy, macro- and micro-nutrients, and adherence to the Mediterranean diet. This is significant given that 92.6% of hospitals in Lebanon do not routinely screen patients for malnutrition [9]. Therefore, the primary objectives of this study are to analyze the nutrient composition of food served and consumed in Lebanese hospitals and evaluate the alignment of hospital meals with Mediterranean diet recommendations.

## Methods

A cross-sectional study was conducted between April and September 2023. Hospitals were invited to participate by sending invitation letters explaining the study purpose. Overall, sixteen hospitals in Lebanon were enrolled in the investigation, where in-patients from cardiovascular, gastrointestinal, obstetrics-gynecology (OBGYN), and surgical wards were selected. The majority of hospitals were located in urban areas (13), while the rest (3) were located in rural areas. Figure 1 shows the distribution of the participating hospitals across the Lebanese governorates.

The participating hospitals had a total of 2575 occupied beds ranging from 24 to 325 for each hospital.

## **Study participants**

Patients were considered as the primary sampling units in this study. Using the convenience sampling technique, patients who met the eligibility criteria were selected and included based on their willingness to participate in the study. For recruiting patients, dietitians and the nurse in charge of each ward in the hospital identified patients who met the inclusion criteria. The dietitians then visited each eligible patient, inviting them to participate. The sampling approach aimed to ensure that a diverse range of perspectives (including age and sex differences) were considered from each study ward.

Patients who met the following inclusion criteria: aged 18–65 years, feeding initiation within the first 36 h after hospital admission, lack of enteral or parenteral nutritional support, not being Non per oral (NPO), being able to give written consent form [10], having spent at least



Fig. 1 Distribution of participating hospitals based on governorates. (Map template adapted from https://en.m.wikipedia.org/wiki/File:Lebanon\_distric ts.png)

one full day during their hospital stay [11], were eligible participants. Overall, 155 in-patients participated in the study, and informed consent was obtained individually from all included participants (Fig. 2). The response rate of the patients was 77.5% after excluding patients who were discharged before spending at least one full day during their hospital stay.

## **Ethical considerations**

This project was reviewed and approved by the Ethical Committee of the Lebanese American University (LAU), Beirut, Lebanon (approval number: LAU.SAS.HHI.2023). The anonymity of respondents was guaranteed throughout the process of data collection and analysis. Informed consent was obtained from all subjects involved in the study.

## Data collection

# Demographic, socioeconomic, clinical, and anthropometric data

Basic demographic, socioeconomic, clinical, and anthropometric data for each patient were collected in the first section of a questionnaire [12]. These included the patients' age, sex, weight and height, residency, marital status, house area, household size, number of rooms in the home, level of education, occupation, ward name, reason for hospital admission, and length of stay (LOS).

# Calculation of energy, macro- and micro-nutrients of served and consumed food

Dietitians were required to record the grams of food served and wasted by each patient at each meal, whether by weighing the food using a calibrated portable highprecision electronic kitchen scale or by estimating portions visually when weighing was not applicable, along with photos of the meals served. This allowed us to



Fig. 2 Flow diagram of patients' selection process

calculate the amount of food consumed by each patient using the following equation:

## Food Consumed = Food Served - Food Wasted.

To estimate the energy, macro-, and micronutrient composition of food served and consumed, we used the NutritionistPro software (Nutritionist Pro, Axxya Systems, San Bruno, CA, USA, version 5.1.0, 2018). This software was developed by Ms. Lorie North, a dietitian in Oregon, USA, and is used to extract food's energy, fiber, and macro- and micro-nutrient content, among many other purposes [13].

To evaluate the amount of food consumed, the questionnaire included the following question: "In which percentage did you consume your meals?". This question was asked regarding breakfast, lunch, dinner, and snacks (answered using a 5-point Likert scale: nothing/almost nothing, about 1/4, about half, about 3/4, all/almost all) [12].

## Comparison of hospitals' diets to the Mediterranean diet requirements

To assess the adherence of the diets served at hospitals to the Mediterranean diet, the hospitals provided recipes, and ingredients were divided into food groups according to the Mediterranean diet classification ('sweets,' 'potato,' 'legumes,' 'eggs,' 'meat', 'poultry', 'fish,' 'fats, olives, nuts, seeds,' 'dairy products,' 'fruits,' 'bread and cereals,' 'unsaturated oils' and 'vegetables') [14].

## Statistical analysis

All analyses were stratified by age and by gender. Based on this, the sample was divided into four age groups in line with the 'Food and Nutrition Board, Institute of Medicine, National Academies' (NIH) [15]. The age groups were 18 years, 19-30 years, 31-50 years; and 51-65 years. The nutritional values of the served and consumed food were compared to the age-specific Dietary Reference Intakes (DRIs) established by the 'Food and Nutrition Board, Institute of Medicine, National Academies' (NIH), including the Estimated Energy Requirement (EER), Recommended Dietary Allowance (RDAs) and the Acceptable Macronutrient Distribution Range (AMDR) [15]. Nutrient daily needs not available in the 'Food and Nutrition Board, Institute of Medicine, National Academies' were calculated from other sources: dietary cholesterol acceptable level [16], trans, saturated, and monounsaturated fats [17], and total sugars [18].

When applicable, analyses were also done for the entire sample.

The gathered data underwent thorough data cleansing and were subsequently transferred to the Statistical Package for the Social Sciences (SPSS; Version 25.0, IBM Corp: Armonk, NY, USA) for analysis at a 95% confidence interval (*P*-value < 0.05 is considered significant). Since plate waste data is highly variable, the data was not normally distributed and was explored using the Shapiro-Wilk test for normality. Frequencies (N) and percentages (%) were used for categorical variables like age and sociodemographic characteristics, whereas continuous variables such as the amount of food served and wasted, energy, macro- and micro-nutrients were summarized through means and standard deviations (SD). Differences between genders were explored using Mann-Whitney and chi-square tests, while differences among hospital wards and governorates were explored using the Kruskal-Wallis. Differences between two categorical variables (i.e., sex and marital status...) were assessed using a chisquare test.

## Results

## Characteristics of the study population

Out of 180 eligible patients, 25 were excluded because they were discharged before spending one full day at the hospital. The study thus included 155 in-patients from cardiovascular (n = 54), gastrointestinal (n = 21), OBGYN (n = 24) and surgical (n = 56) wards. Of the participants, 58.1% were females. Most participants were residing in Beirut & Mount Lebanon (n = 69, 44.5%).

The basic demographic and socioeconomic characteristics of the study participants and their hospital stay information are summarized in Table 1. Participants had a mean age of 49 years (SD: 15), and the majority (81.9%) had a hospital stay of less than seven days. Almost half of the participants (54.2%) were aged between 51 and 65 years. The mean Body Mass Index (BMI) was 25.38 (SD: 5.56) for male participants and 27.68 (SD: 6.44) for female participants, with female participants having a significantly higher BMI (*p*-value = 0.048). About one-third of participants reported having no chronic diseases. As for the ones who reported having chronic diseases, blood pressure was the most prevalent one (34.2%), followed by diabetes (25.8%). The prevalence of chronic diseases in the study participants is summarized in Fig. 3.

Most participants (75.5%) had a household monthly income of less than US\$500. Almost half of the participants (51%) had a crowding index below 1, which indicates a higher socioeconomic status. The crowding index is calculated by dividing the number of people living in a household by the number of rooms in the house (excluding bathrooms, balconies, porches, foyers, hallways, and half-rooms); values above 1 indicate a household is crowded, and eventually has a lower socioeconomic status [19].

A significant difference was found between genders when it comes to employment status (p-value < 0.001), marital status (p-value = 0.027), and household crowding index (p-value = 0.03).

## Nutritional value of food served in hospitals Energy content of food served

The mean weight of served food was 1.24 kg (SD: 0.43) and contained a mean of 1489 kcal energy (SD: 546.55) per hospital bed per day. The mean energy requirement for each patient was 1891.6 kcal per day, which means that on average, the food served accounted for 79% of the patient's daily estimated energy requirement (EER).

The mean daily estimated dietary energy content of food served in Lebanese hospitals and the percent contribution to estimated energy needs by different age groups and genders is shown in Table 2. Based on our findings, the mean energy content of food served for all age groups and genders was lower than the EER, and most participants were served food for which the energy content did not exceed their EER. For instance, the energy content of food served exceeded the EER for 29 participants in our study, accounting for only 19% of the study population.

## Macronutrient content of food served

The macronutrient content of food served in Lebanese hospitals is shown in Table 3. Our results showed that food served provided more than 70% of the percent daily value (% DV) for males in all age groups and more than 80% of the % DV for the females in all age groups, with females in the age group 51-65 being provided by 94% of their daily carbohydrates needs. The percent composition of carbohydrates in food served ranged from 51.7 to 62.8%. Concerning the fat content, the percent composition ranged from 19.3 to 30.6%, and patients were provided more than 55% of their % DV except for the 18-year-old age group, in which males and females were provided 50% and 42% of their % DV, respectively. As for proteins, the percent composition in the food served ranged from 17.65 to 21%, with patients of all ages and genders being provided more than 55% of their % DV. Furthermore, the food served provided less than 75% of the estimated dietary fiber requirements to patients of all ages and genders. None of the documented nutrient content in the food served reached 100% of the daily value requirements.

## Micronutrient content of food served

The micronutrient content of food served in Lebanese hospitals is shown in Table 4. Our results showed that the percent contribution of food served to daily value varied across micronutrients. For instance, the percent 
 Table 1
 Sociodemographic characteristics, hospital stay information, and anthropometric characteristics of the study population, overall and by gender

<table-container>SectorNe)Ne)Ne)Ne)Ne Group Years33<th></th><th>Overall (N=155)</th><th>Males (n=65; 41.9%)</th><th>Females (<i>n</i> = 90; 58.1%)</th><th>P-value</th></table-container>		Overall (N=155)	Males (n=65; 41.9%)	Females ( <i>n</i> = 90; 58.1%)	P-value	
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SourceSig Sig Sig Sig Sig Sig Sig Sig Sig Sig	Beqaa/Baalbeck-Hermel	2 (1.3)	1 (1.5)	1 (1.1)		
Married90 (83)10 (104)0.027Married109 (023)47 (2.3)62 (68.7)Married14 (90)11 (15)62 (68.7)Divored14 (90)11 (15)13 (14.4)Divored14 (90)11 (15)13 (14.4)Divored10 (20)15 (85.7)54 (60)60.3Stappen perroom (ac cowded)79 (10)52 (85.5)10 (17)60.3> 1 to 15 people perroom (accended)30 (23.2)10 (21)10 (21)60.3> 1 to 15 people perroom (accended)30 (20.2)10 (21)10 (21)10 (21)Stappen perroom (accended)79 (7).142 (36.9)49 (54.4)0.373 -5 children20 (20.0)31 (60.9)20 (22)10 (21)10 (21)3 -5 children10 (21)42 (20.1)10 (21)10 (21)10 (21)3 -5 children10 (21)42 (21)10 (21)10 (21)10 (21)-5 children10 (11)43 (69.2)20 (21)10 (21)10 (21)-5 children10 (21)10 (21)10 (21)10 (21)10 (21)-5 children10 (21)10 (21)10 (21)10 (21)10 (21)-6 children10 (21)10 (21)10 (21)10 (21)10 (21)-7 childr	South Lebanon/Nabatieh	55 (35.5)	18 (27.8)	37 (41.1)		
Single         29 (17,7)         16 (24,6)         13 (14,4)         0.027           Married         100 (70,3)         47 (72,3)         62 (68.9)           Widowed         14 (9.0)         1 (1.5)         2 (2.2)           Hourschold Crowding Index         -         -         -           s1 person per room (not cowded)         36 (2.2)         19 (2.9,2)         17 (18.9)         -           > 15 speaple per room (not cowded)         46 (2.2)         19 (2.3,2)         19 (5.4,2)         -         -           Number Of Children in Household         -	Marital Status					
Married         109 (70.3)         47 (72.3)         62 (68.9)           Widowed         14 (90)         11.5)         31 (14.4)           Divorced         3 (1.9)         11 (1.5)         2 (2.2)           Household Crowding Index         -         -         -           s1 person per room (not crowded)         36 (32.3)         19 (22.2)         7 (18.9)           > 1.5 os (1.5 people per room (rowded)         36 (23.2)         19 (21.3)         0.057           > 1.5 people per room (rowded)         37 (47.1)         24 (36.9)         49 (54.4)         0.057           3 - Schildren         62 (40.0)         33 (50.8)         29 (32.2)         -         5 children         0.057           3 - Schildren         62 (40.0)         33 (50.8)         29 (32.2)         -         5 children         0.057           3 - Schildren         62 (40.0)         33 (50.8)         29 (32.2)         -         5 children         0.055           School         95 (61.3)         45 ((89.2)         0.55.6)         0.25.6         -         -           Illiterate         21 (13.5)         8 (12.3)         13 (14.4)         0.646         -           School         16 (24.2)         12 (18.5)         23 (25.6)         - <td>Single</td> <td>29 (18.7)</td> <td>16 (24.6)</td> <td>13 (14.4)</td> <td>0.027</td>	Single	29 (18.7)	16 (24.6)	13 (14.4)	0.027	
Widowed         14 (9,0)         1 (1,5)         13 (14,4)           Divored         3 (1,9,0)         1 (15)         2 (22)           Husshold Crowding Index         -	Married	109 (70.3)	47 (72.3)	62 (68.9)		
Divorced         3(1.9)         1(1.5)         2(2)           Household Crowdend         79(50)         25(38.5)         54(600)         0.03           >1 to \$15 people per room (rowdend)         36(23.2)         19(29.2)         17(18.9)           >1 to \$15 people per room (rowdend)         30(25.8)         23(32.3)         19(21.1)           Number Of Childre in Household         20(23.2)         19(21.2)         20(23.2)           2 - Schildren         23 (40.0)         33 (50.8)         29 (22.2)           5 - Schildren         20 (12.9)         31 (23.0)         20 (23.2)           5 - Schildren         20 (12.9)         31 (23.0)         20 (23.2)           Educational Level         10 (12.9)         34 (20.9)         20 (23.2)         20 (23.2)           University         26 (31.0)         45 (69.2)         20 (33.3)         20 (23.2)           University         42 (27.1)         41 (21.5)         28 (31.1)         41 (21.5)           University         35 (23.6)         12 (13.8)         23 (25.6)         23 (25.6)           Not applicable         63 (23.0)         13 (24.6)         14 (21.5)         24 (28.1)         40 (27.1)         40 (27.1)           University         35 (25.6)         12 (28.3)	Widowed	14 (9.0)	1 (1.5)	13 (14.4)		
Household Crowding Index         F <td>Divorced</td> <td>3 (1.9)</td> <td>1 (1.5)</td> <td>2 (2.2)</td> <td></td>	Divorced	3 (1.9)	1 (1.5)	2 (2.2)		
s1 person per room (now crowded)         79 (51.0)         25 (38.5)         54 (60.0)         0.03           >1 to s1 5 pecple per room (crowded)         40 (23.8)         19 (29.2)         17 (18.9)           >1.5 pecple per room (crowded)         40 (25.8)         21 (32.3)         19 (21.1)           Number Of Children in Househol         24 (36.9)         49 (54.4)         0.057           3-5 children         20 (20.9)         8 (12.3)         12 (13.3)         20 (21.3)           Educational Level         11         42 (36.9)         20 (55.6)         0.20 (25.6)           University         42 (27.1)         14 (21.5)         28 (31.1)         20 (25.6)           University         42 (27.1)         14 (21.5)         28 (31.1)         20 (25.6)           University         35 (22.6)         12 (18.5)         23 (25.6)         12 (18.5)           School         66 (42.6)         29 (44.6)         37 (41.1)         0.646           School         56 (25.6)         12 (18.5)         23 (25.6)         12 (18.5)         23 (25.6)           More table status         32 (25.6)         12 (18.5)         24 (8.1)         40 (71.1)         40.001           University         36 (26.9)         24 (8.1)         64 (71.1)         40.051 <td>Household Crowding Index</td> <td></td> <td></td> <td></td> <td></td>	Household Crowding Index					
> 1 to ≤ 1 5 people per room (crowded)         36 (23.2)         19 (29.2)         17 (18.9)           > 1 5 people per room (severely crowded)         40 (25.8)         21 (32.3)         19 (21.1)           Number Of Children in Household         2         44 (36.9)         49 (54.4)         0.057           3-5 children         20 (12.9)         81 (23.3)         29 (32.2)         5         5           > 5 children         20 (12.9)         81 (23.3)         12 (13.3)         0.26           School         20 (12.9)         45 (69.2)         50 (55.6)         0.26           University         42 (27.1)         45 (69.2)         28 (31.1)         646           School         40 (27.6)         29 (44.6)         37 (41.1)         0.646           University         32 (25.6)         32 (25.6)         32 (25.6)         32 (25.6)           Not applicable         32 (25.6)         17 (18.9)         40 (0.01         40 (0.01           Employed         92 (59.4)         28 (43.1)         64 (71.1)         <0.001	≤ 1 person per room (not crowded)	79 (51.0)	25 (38.5)	54 (60.0)	0.03	
> 1.5 people per noom (severely crowded)         40 (25.8)         21 (32.3)         19 (21.1)           Number Of Children in Household               < 3 children	> 1 to $\leq$ 1.5 people per room (crowded)	36 (23.2)	19 (29.2)	17 (18.9)		
Number Of Children in Household73 (47.1)24 (36.9)49 (54.4)0.0573-5 children26 (240.0)33 (50.8)29 (32.)55 children20 (12.9)8 (12.3)12 (13.3)20Eturational LevelIllterate18 (11.6)6 (92.1)12 (13.3)0.26 (12.5)School45 (69.2)16 (05.6)0.10 (12.5)28 (31.1)Partice HouseinsJunct for All (13.5)8 (12.3)13 (14.4)0.64 (13.5)School29 (44.6)29 (44.6)29 (44.6)University23 (22.6)12 (18.5)23 (25.6)Na palicable29 (24.6)12 (18.9)24 (27.1)University35 (22.6)12 (18.5)26 (28.9)University35 (22.6)12 (18.5)26 (28.9)Employed26 (30.6)26 (30.6)26 (28.9)Employed38 (24.5)11 (16.9)26 (28.9)Employed38 (24.5)11 (16.9)27 (30.0)Define Inte Montly Income57 (37.7)79 (87.9)27 (30.0)EmployedJunct colspan="2">Junct colspan=	> 1.5 people per room (severely crowded)	40 (25.8)	21 (32.3)	19 (21.1)		
< 3 children	Number Of Children in Household					
3-5 children         62 (40.0)         33 (50.8)         29 (32.2)           > 5 children         20 (12.9)         8 (12.3)         12 (13.3)           Educational Level         1         12 (13.3)         0.26 (13.3)         0.26 (13.3)           Illiterate         18 (11.6)         6 (9.2)         50 (55.6)         0.26 (13.3)         0.26 (13.3)           Partner Educational Level         42 (27.1)         14 (21.5)         28 (31.1)         0.46 (13.3)           Partner Educational Level         11 (13.5)         8 (12.3)         13 (14.4)         0.66 (3.5)           School         66 (42.6)         29 (44.6)         37 (41.1)         0.46 (13.5)           University         35 (22.6)         12 (18.5)         23 (25.6)         0.7 (13.9)           Employment Status         10 (24.6)         37 (41.1)         <0.001	< 3 children	73 (47.1)	24 (36.9)	49 (54.4)	0.057	
> 5 children         2012.9         8 10.3         12 (13.3)           Educational Level            Illiterate         18 (11.6)         6 (9.2)         12 (13.3)         0.226           School         95 (61.3)         45 (69.2)         0.28 (31.1)         0.226           University         42 (27.1)         14 (21.5)         28 (31.1)         0.226           Partner Educational Level           0.66 (42.6)         29 (44.6)         37 (41.1)         0.646           University         55 (22.6)         12 (18.5)         23 (25.6)             University         35 (22.6)         12 (18.5)         24 (27.1)         40 (24.6)         37 (41.1)         0.646           University         35 (22.6)         12 (18.5)         24 (25.6)         70 (41.7)         <0.001           University         35 (22.6)         12 (18.5)         24 (27.1)         <0.001         <0.001           Imployed         36 (24.6)         37 (65.9)         26 (28.9)         <0.001           Unemployed         10 (75.5)         54 (83.1)         63 (70.0)         0.062           More than \$500         117 (75.5)         57 (87.7)         79 (87.8)         0.002	3–5 children	62 (40.0)	33 (50.8)	29 (32.2)		
Educational Level         Note Note Note Note Note Note Note Note	> 5 children	20 (12.9)	8 (12.3)	12 (13.3)		
Illiterate18 (11.6)6 (9.2)12 (13.3)0.226School95 (61.3)45 (69.2)50 (55.6)University42 (27.1)14 (21.5)28 (31.1)Partner Educational Level11 (13.5)8 (12.3)13 (14.4)0.646School66 (42.6)29 (44.6)37 (41.1)0.646School66 (42.6)29 (44.6)37 (41.1)0.646University35 (22.6)12 (18.5)23 (25.6)0.601Not applicable32 (3.3)16 (26.6)23 (25.6)0.601Employment StatusU28 (43.1)64 (71.1)<0.001	Educational Level					
School         95 (61.3)         45 (69.2)         50 (55.6)           University         42 (27.1)         14 (21.5)         28 (31.1)           Partner Educational Level             Illiterate         21 (13.5)         8 (12.3)         13 (14.4)         0.646           School         66 (42.6)         29 (44.6)         37 (41.1)         0.647           University         35 (22.6)         12 (18.5)         23 (25.6)         10 (18.9)           Not applicable         33 (21.3)         16 (24.6)         17 (18.9)            Employment Status         v         v         v         v         v           Umenployed         63 (60.0)         28 (43.1)         63 (70.0)         0.062           Monthy Household Income (USS)         v         v         v         v           Less than \$500         117 (75.5)         54 (83.1)         63 (70.0)         0.062           More than \$500         38 (24.5)         11 (16.9)         27 (30.0)         v         v           Persital Stay Information         v         v         v         v         v         v           Yes, my household income did not change         19 (12.3)         8 (12.3)         11 (12.2)	Illiterate	18 (11.6)	6 (9.2)	12 (13.3)	0.226	
University         42 (27.)         14 (21.5)         26 (31.)           Partner Educational Level            Illiterate         21 (13.5)         8 (12.3)         13 (14.4)         0.646           School         66 (42.6)         29 (44.6)         37 (41.1)         0.646           University         35 (22.6)         12 (18.5)         23 (25.6)         23 (25.6)           Not applicable         33 (21.3)         16 (24.6)         37 (41.1)             Employment Status         Unemployed         26 (25.9)         23 (25.6)         23 (25.6)            Unemployed         92 (59.4)         28 (43.1)         64 (71.1)         <0.001           Employment Status         Unemployed         63 (40.6)         37 (56.9)         26 (28.9)           Monthly Household Income (USS)         Eust shan \$500         117 (75.5)         54 (83.1)         63 (70.0)         0.062           Decline In the Monthly Income         Unemployed         10 (20.3)         8 (12.3)         11 (12.2)         0.987           Yes, my household income did not change         19 (12.3)         8 (12.3)         11 (12.2)         0.987           Yes, days         127 (81.9)         49 (75.4)         78 (86.7)         0.185	School	95 (61.3)	45 (69.2)	50 (55.6)		
Partner Educational Level         Intervention         Intervention           Illiterate         21 (13.5)         8 (12.3)         13 (14.4)         0.646           School         66 (42.6)         29 (44.6)         37 (41.1)         University           University         35 (22.6)         12 (18.5)         23 (25.6)         12 (18.5)         23 (25.6)           Not applicable         33 (21.3)         16 (24.6)         17 (18.9)         2           Employment Status         Unemployed         64 (71.1)         <0.001	University	42 (27.1)	14 (21.5)	28 (31.1)		
Illiterate       21 (13.5)       8 (12.3)       13 (14.4)       0.646         School       66 (42.6)       29 (44.6)       37 (41.1)       1         University       35 (22.6)       12 (18.5)       23 (25.6)       1         Not applicable       33 (21.3)       16 (24.6)       17 (18.9)       1         Employment Status       5       28 (43.1)       64 (71.1)       <0.001	Partner Educational Level	, , ,	, , , , , , , , , , , , , , , , , , ,			
Initial         Initial         Initial         Initial         Initial           School         66 (42.6)         29 (44.6)         37 (41.1)         Initial           University         35 (22.6)         12 (18.5)         23 (25.6)         Initial           Not applicable         33 (21.3)         16 (24.6)         17 (18.9)         Employment Status         Initial         <0.001	Illiterate	21 (13.5)	8 (12.3)	13 (14.4)	0.646	
Intersity         35 (22.6)         12 (18.5)         23 (25.6)           Not applicable         33 (21.3)         16 (24.6)         17 (18.9)           Employment Status	School	66 (42.6)	29 (44.6)	37 (41.1)		
Not applicable         33 (21.3)         16 (24.6)         17 (18.9)           Employment Status	University	35 (22.6)	12 (18.5)	23 (25.6)		
Employment Status         Unemployed         92 (59.4)         28 (43.1)         64 (71.1)         <0.001           Employed         63 (40.6)         37 (56.9)         26 (28.9)   <	Not applicable	33 (21.3)	16 (24.6)	17 (18.9)		
Unemployed         92 (59.4)         28 (43.1)         64 (71.1)         <0.001           Employed         63 (40.6)         37 (56.9)         26 (28.9)            Monthly Household Income (US\$)               Less than \$500         117 (75.5)         54 (83.1)         63 (70.0)         0.062           More than \$500         38 (24.5)         11 (16.9)         27 (30.0)            Decline In the Monthly Income                No, my household income did not change         19 (12.3)         8 (12.3)         11 (12.2)         0.987           Yes, my household income did change         19 (12.3)         8 (12.3)         79 (87.8)            Hospital Stay Information                 Length Of Hospital Stay         127 (81.9)         49 (75.4)         78 (86.7)         0.185           7-30 days         25 (16.1)         14 (21.5)         11 (12.2)         30 days         25 (16.1)         14 (21.5)         11 (12.2)         30 days         27 (30.0)         -*           Cardiovascular         54 (34.8.8)         27 (41.5)         27 (30.0)         -*         30	Employment Status	()	,			
Employed         Factors         Factors         Factors         Factors           Employed         63 (40.6)         37 (56.9)         26 (28.9)           Monthly Household Income (US\$)         U         U         U           Less than \$500         117 (75.5)         54 (83.1)         63 (70.0)         0.062           More than \$500         38 (24.5)         11 (16.9)         27 (30.0)         Output           Decline In the Monthly Income         U         U         0.987         Output         Output         0.987         Output         Output         0.987         Output         Output <td>Unemployed</td> <td>92 (59.4)</td> <td>28 (43.1)</td> <td>64 (71.1)</td> <td>&lt; 0.001</td>	Unemployed	92 (59.4)	28 (43.1)	64 (71.1)	< 0.001	
Monthly Household Income (US\$)       I17 (75.5)       54 (83.1)       63 (70.0)       0.062         More than \$500       38 (24.5)       11 (16.9)       27 (30.0)         Decline In the Monthly Income       III (12.2)       0.987         Yes, my household income did not change       19 (12.3)       8 (12.3)       11 (12.2)       0.987         Yes, my household income did change       136 (87.7)       57 (87.7)       79 (87.8)       0.185         Hospital Stay Information       III (12.2)       0.987       11 (12.2)       0.987         < 7 days	Employed	63 (40.6)	37 (56.9)	26 (28.9)		
Less than \$500       117 (75.5)       54 (83.1)       63 (70.0)       0.062         More than \$500       38 (24.5)       11 (16.9)       27 (30.0)         Decline In the Monthly Income         No, my household income did not change       19 (12.3)       8 (12.3)       11 (12.2)       0.987         Yes, my household income did change       136 (87.7)       57 (87.7)       79 (87.8)       0.185         Hospital Stay Information       Image: State St	Monthly Household Income (US\$)			()		
More than \$500       38 (24.5)       11 (16.9)       27 (30.0)         Decline In the Monthly Income       38 (24.5)       11 (16.9)       27 (30.0)         No, my household income did not change       19 (12.3)       8 (12.3)       11 (12.2)       0.987         Yes, my household income did change       19 (12.3)       8 (12.3)       11 (12.2)       0.987         Hospital Stay Information       E       E       E       E         Length Of Hospital Stay       127 (81.9)       49 (75.4)       78 (86.7)       0.185         7-30 days       25 (16.1)       14 (21.5)       11 (12.2)       0.185         > 30 days       3 (1.9)       2 (3.1)       1 (1.1)       E         Department       E       E       E       E         Gastrointestinal       21 (13.5)       9 (13.8)       12 (13.3)       -*         OBGYN       24 (15.5)       0 (0.0)       24 (26.7)       -*	Less than \$500	117 (75.5)	54 (83.1)	63 (70.0)	0.062	
Decline In the Monthly Income       In (cal.)       In (cal.)         No, my household income did not change       19 (12.3)       8 (12.3)       11 (12.2)       0.987         Yes, my household income did change       136 (87.7)       57 (87.7)       79 (87.8)       10         Hospital Stay Information         Length Of Hospital Stay         < 7 days	More than \$500	38 (24.5)	11 (16.9)	27 (30.0)		
No, my household income did not change         19 (12.3)         8 (12.3)         11 (12.2)         0.987           Yes, my household income did change         136 (87.7)         57 (87.7)         79 (87.8)         79 (87.8)           Hospital Stay Information         Length Of Hospital Stay         127 (81.9)         49 (75.4)         78 (86.7)         0.185           7-30 days         25 (16.1)         14 (21.5)         11 (12.2)         0.987           > 30 days         3 (1.9)         2 (3.1)         1 (1.1)         11 (12.2)           Department         Z         Z         Z         Z         Z         Z           Cardiovascular         54 (34.8)         27 (41.5)         27 (30.0)         -*           Gastrointestinal         21 (13.5)         9 (13.8)         12 (13.3)         2           OBGYN         24 (15.5)         0 (0.0)         24 (26.7)         2	Decline In the Monthly Income					
Yes, my household income did change       136 (87.7)       57 (87.7)       79 (87.8)         Hospital Stay Information       2       49 (75.4)       78 (86.7)       0.185         Zength Of Hospital Stay       25 (16.1)       14 (21.5)       11 (12.2)       0.185         Z-30 days       25 (16.1)       14 (21.5)       11 (12.2)       0.185         Z-30 days       3 (1.9)       2 (3.1)       1 (1.1)	No my household income did not change	19 (12 3)	8 (12 3)	11 (12 2)	0 987	
Hospital Stay Information       127 (81.9)       49 (75.4)       78 (86.7)       0.185         7-30 days       25 (16.1)       14 (21.5)       11 (12.2)         >30 days       3 (1.9)       2 (3.1)       1 (1.1)         Department         Cardiovascular       54 (34.8)       27 (41.5)       27 (30.0)         Gastrointestinal       21 (13.5)       9 (13.8)       12 (13.3)         OBGYN       24 (15.5)       0 (0.0)       24 (26.7)	Yes, my household income did change	136 (87 7)	57 (87 7)	79 (87 8)	0.507	
Length Of Hospital Stay       127 (81.9)       49 (75.4)       78 (86.7)       0.185         7-30 days       25 (16.1)       14 (21.5)       11 (12.2)         > 30 days       3 (1.9)       2 (3.1)       1 (1.1)         Department         Cardiovascular       54 (34.8)       27 (41.5)       27 (30.0)         Gastrointestinal       21 (13.5)       9 (13.8)       12 (13.3)         OBGYN       24 (15.5)       0 (0.0)       24 (26.7)	Hospital Stay Information	100 (07.17)	57 (07.17)	, , (, , , , , , , , , , , , , , , , ,		
<7 days	Length Of Hospital Stav					
7-30 days       25 (16.1)       14 (21.5)       11 (12.2)         > 30 days       3 (1.9)       2 (3.1)       1 (1.1)         Department         Cardiovascular       54 (34.8)       27 (41.5)       27 (30.0)       -*         Gastrointestinal       21 (13.5)       9 (13.8)       12 (13.3)       -*         OBGYN       24 (15.5)       0 (0.0)       24 (26.7)         Surgery       56 (36.1)       29 (44.6)       27 (30.0)	< 7 days	127 (81 9)	49 (75 4)	78 (86 7)	0 185	
> 30 days       3 (1.9)       2 (3.1)       1 (12.2)         Department      *         Cardiovascular       54 (34.8)       27 (41.5)       27 (30.0)         Gastrointestinal       21 (13.5)       9 (13.8)       12 (13.3)         OBGYN       24 (15.5)       0 (0.0)       24 (26.7)         Surgery       56 (36.1)       29 (44.6)       27 (30.0)	7-30 days	25 (16 1)	14 (21 5)	11 (12 2)	0.105	
Department       27 (41.5)       27 (30.0)       -*         Gastrointestinal       21 (13.5)       9 (13.8)       12 (13.3)         OBGYN       24 (15.5)       0 (0.0)       24 (26.7)         Surgery       56 (36.1)       29 (44.6)       27 (30.0)	> 30 days	3 (1 9)	2 (3 1)	1 (1 1)		
Cardiovascular       54 (34.8)       27 (41.5)       27 (30.0)       -*         Gastrointestinal       21 (13.5)       9 (13.8)       12 (13.3)         OBGYN       24 (15.5)       0 (0.0)       24 (26.7)         Surgery       56 (36.1)       29 (44.6)       27 (30.0)	Department	5 (1.2)	2 (J.1)	. (1.17		
Gastrointestinal     21 (13.5)     9 (13.8)     12 (13.3)       OBGYN     24 (15.5)     0 (0.0)     24 (26.7)       Surgery     56 (36.1)     29 (44.6)     27 (30.0)	Cardiovascular	54 (34 8)	27 (41 5)	27 (30.0)	_*	
OBGYN         24 (15.5)         9 (13.6)         12 (13.5)           Surgery         56 (36.1)         29 (44.6)         27 (30.0)	Gastrointestinal	21 (13 5)	9 (13.8)	12 (13 3)		
Surgery 56 (36.1) 29 (44.6) 27 (30.0)	OBGYN	24 (15 5)	0 (0 0)	24 (26 7)		
	Surgery	56 (36 1)	29 (44 6)	27 (30.0)		

## Table 1 (continued)

	Overall (N = 155)	Males (n=65; 41.9%)	Females ( <i>n</i> =90; 58.1%)	P-value
Sociodemographic Characteristics	N (%)	N (%)	N (%)	
Hospital admission in the last 3 years				
No	71 (45.8)	30 (46.2)	41 (45.6)	0.941
Yes	84 (54.2)	35 (53.8)	49 (54.4)	
Anthropometric Characteristics				
Weight (kg)	74±18	77.15±18.814	71.87±16.817	0.114
Height (cm)	166±10	174.23±7.283	160.89±7.572	< 0.001
BMI (kg/m <sup>2</sup> )	$26.8 \pm 6.2$	$25.379 \pm 5.5652$	27.679±6.4432	0.048

P-value < 0.05 is significant. Statistical tests used: Mann-Whitney test was used when the variable compared based on gender is continuous (weight, height, BMI) and chi-square test when the variable compared based on sex is categorical (Educational level, employment status...)

\*No P-value for the departments because OBGYN cannot be compared based on gender

Abbreviations: N number of inpatients; Kg kilogram; cm centimeter; kg/m^2 kilogram per meter square



## **Prevalence of Chronic Diseases**

Fig. 3 Medical characteristics of study participants

Table 2	Estimated	dietary en	ergy content c	of food serv	ed to adult	: patients in	Lebanese	hospitals and	d percent	contributio	on to
estimate	ed energy n	eeds by aq	e and gender								

Estimated Energy Content	Age Group				P-value^
	18 years (n=2 M, n=1 F)	19–30 years (n=8 M, n=17 F)	31–50 years (n = 17 M, n = 26 F)	51–65 years (n=38 M, n=46 F)	0.255
	Mean±SD	<u> </u>	, , , , , , , , , , , , , , , , ,	<u>`                                  </u>	
Energy in Food Served (Kcal)	M: 1453±149 F: 1152*	M: 1629±337 F: 1710±525	M: 1466±492 F: 1384±564	M: 1512±523 F: 1449±638	0.689
EER (Kcal)	M: 2200 F: 1800	M: 2400 F: 2000	M: 2200 F: 1800	M: 2000 F: 1600	
Food served as %EER	M: 66% F: 64%	M: 68% F: 85%	M: 67% F: 77%	M: 76% F: 91%	
	Energy Inadequacy	/ n (%)			
% below EER	M: 2 (100%) F: 1 (100%)	M: 8 (100%) F: 13 (76%)	M: 16 (94%) F: 23 (88.5%)	M: 30 (79%) F: 33 (72%)	
% above EER	M: 0 (0%) F: 0 (0%)	M: 0 (0%) F: 4 (24%)	M: 1 (6%) F: 3 (11.5%)	M: 8 (21%) F: 13 (28%)	

%EER = Energy in Food Served/EER x 100. ^No significant differences in energy intake among age groups (*p*-value = 0.261) and between genders (*p*-value = 0.689). \*No SD for the females in the 18 years group because only 1 female participant aged 18 was included in the study. Abbreviations: *EER* Estimated energy requirement, *SD* standard deviation, *M* male, *F* female

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Age group	18 years ( <i>n</i> =3)						19–30 year: ( <i>n</i> = 25)	S				
Gender	Male $(n=2)$			Female ( <i>n</i> =	=1)		Male $(n=8)$			Female ( <i>n</i> =	:17)	
Nutrient	DRI	Mean±SD	% DV	DRI	Mean±SD*	% DV	DRI	Mean±SD	% DV	DRI	Mean±SD	% DV
	(RDA			(RDA			(RDA			(RDA		
	(AMDR)			/AMDR)			(AMDR)			(AMDR)		
Macronutrients												
Total Fat (g/d)	73	36.4±1.95	49.90%	60	25	41.70%	80	48.9±14.2	61.00%	66.7	58.4±29.74	87.60%
Cholesterol (mg/d) <sup>a</sup>	< 300	194.9±42.3	64.97%	< 300	111	37%	< 300	267.2±145.4	89%	< 300	232.76±82.35	77.58%
Saturated fat (g/d) <sup>b</sup>	22	$14.16 \pm 5.88$	64.36%	18	10	55.55%	24	17.38±4.32	86.90%	20	21.57±10.12	107.85%
Monounsaturated fat (g/d) <sup>b</sup>	48.4	9.24±2.49	19%	39.6	6	22.72%	52.8	16.82 ± 5.93	31.85%	44	$16.75 \pm 7.29$	38%
Polyunsaturated fat (g/d)	16	5.79±4.55	36.20%	11	m	27.30%	17	$8.25 \pm 3.8$	48.53%	12	9.37±4.3	78%
Linoleic acid (g/d)	16	5.51±4.94	34.40%	11	2	18.20%	17	6.44±2,98	37.88%	12	7.84±3.87	65.30%
Alpha linolenic acid (g/d)	1.6	$0.7 \pm 0.42$	43.80%	1.1	0	%0	1.6	$0.54 \pm 0.49$	33.75%	1.1	$0.99 \pm 0.64$	90.00%
Trans Fat (g/d) <sup>b</sup>	2.42	$0.02 \pm 0.02$	%0	1.98	0	%0	2.64	$0.36 \pm 0.46$	13.63%	2.2	0.14±0.31	6.36%
Carbohydrate (g/d)	275	205.67 ±57	74.80%	225	183	81.30%	300	$217.44 \pm 63.5$	72.48%	250	222.27±71.97	88.90%
Total sugar (g/d) <sup>c</sup>	71.5	38.39±9.35	55%	58.5	46	78.60%	78	42.34±18.7	54.28%	65	64.19±28.98	98.75%
Protein (g/d)	110	$68.8 \pm 6.78$	62.50%	06	52	57.80%	120	78.1±17.71	65%	100	75.8±21.9	75.80%
Dietary fiber (g/d)	38	$19.51 \pm 6.35$	51.30%	26	16	61.50%	38	$21.29 \pm 7.96$	56%	25	$18.52 \pm 7.76$	74%
As percentage of El												
Total Fat (%)	25-30%	23%	Less than	25-30%	19.30%	Less than	20-35%	27%	Within	20–35%	30.60%	Within
			required			required			range			range
Saturated fat (%) <sup>b</sup>	< 10%	8.90%	Didn't	< 10%	7.70%	Didn't	< 10%	9.64%	Didn't	< 10%	11.30%	Exceed-
			exceed			exceed			exceed			ed
Carbohydrate (%)	45-65%	57.70%	Within	45-65%	62.80%	Within	45-65%	53.70%	Within	45–65%	51.75%	Within
			range			range			range			range
Total sugar (%) <sup>c</sup>	< 13%	10.77%	Didn't exceed	< 13%	15.80%	Exceeded	< 13%	10.44%	Didn't exceed	< 13%	14.94%	Exceed- ed
Protein (%)	10–30%	19.30%	Within	10–30%	17.90%	Within	10-35%	19.30%	Within	10–35%	17.65%	Within
			range			range			range			range
Age group	31–50 years ( <i>n</i> = 43)						51–65 year: ( <i>n</i> =84)	S				
Gender	Male ( <i>n</i> = 17	(		Female ( <i>n</i> =	= 26)		<b>Male (</b> <i>n</i> =38	(8)		Female ( <i>n</i> =	:46)	
Nutrient	DRI (RDA/	Mean±SD	% DV	DRI (RDA/	Mean±SD	% DV	DRI (RDA/	Mean±SD	% DV	DRI (RDA	Mean±SD	% DV
	AMDR)			AMDR)			AMDR)			(AMDR)		
Macronutrients												
Total Fat (g/d)	73	$41.11 \pm 20.2$	56.30%	60	$41.93 \pm 22.57$	69.88%	66.7	$46.4 \pm 20.73$	69.56%	53	41±19.92	77.35%
Cholesterol (mg/d) <sup>a</sup>	< 300	$182.3 \pm 121$	60.76%	< 300	$182 \pm 105$	60.67%	< 300	$225.3 \pm 84$	75.10%	< 300	219±124.7	73%
Saturated fat (g/d) <sup>b</sup>	22	15.74±6.72	71.54%	18	16.8±9.61	93%	20	$16.98 \pm 8.5$	84.90%	16	14.97±8.7	93.56%

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Age group	18 years ( <i>n</i> = 3)						19–30 years ( <i>n</i> = 25)					
Gender	Male $(n=2)$			Female ( <i>n</i> =	-1)		Male ( <i>n</i> =8)			Female ( <i>n</i> =	17)	
Monounsaturated fat (g/d) <sup>b</sup>	48.4	13.14±6.29	27.15%	39.6	13.8±7.98	34.84%	44	15.89±8.1	36.11%	35.2	14.54±7.96	41.30%
Polyunsaturated fat (g/d)	17	7.27±4.8	42.80%	12	6.23±3.79	51.91%	14	$7.65 \pm 3.8$	54.64%	11	7±3.77	63.63%
Linoleic acid (g/d)	17	5.62±4.33	33%	12	$5.03 \pm 3.35$	41.91%	14	$5.94 \pm 3.25$	42.43%	11	$15.71 \pm 68.55$	143%
Alpha linolenic acid (g/d)	1.6	$0.37 \pm 0.45$	23%	1.1	$0.46 \pm 0.58$	41.81%	1.6	$0.53 \pm 0.39$	33%	1.1	$1.45 \pm 7.02$	132%
Trans Fat (g/d) <sup>b</sup>	2.42	0.16±0.4	6.67%	1.98	$0.15 \pm 0.34$	7.50%	2.2	$0.42 \pm 0.68$	19%	1.76	$0.1 \pm 0.72$	5.68%
Carbohydrate (g/d)	275	$206.18 \pm 62.7$	75%	225	$184.66 \pm 78.6$	82%	250	$196.79 \pm 78.48$	78.70%	200	$188.35 \pm 103.15$	94.20%
Total sugar (g/d) <sup>c</sup>	71.5	47.12±19.19	65.90%	58.5	$48.77 \pm 30.64$	83.36%	65	41±18	63.07%	52	39.29±19.56	75.55%
Protein (g/d)	110	$67.25 \pm 26.34$	61.13%	90	$61.48 \pm 27.16$	68.30%	100	74.39±27.17	74.39%	80	74.89±31.92	93.60%
Dietary fiber (g/d)	38	$16.94 \pm 8.77$	44.57%	25	$16.98 \pm 9.97$	68%	30	$16.94 \pm 7.81$	56.47%	21	13.74±6.15	65.43%
As percentage of El												
Total Fat (%)	20-35%	25.30%	Within	20-35%	27.70%	Within	20-35%	27.80%	Within	20-35%	26%	Within
			range			range			range			range
Saturated fat (%) <sup>b</sup>	< 10%	9.67%	Didn't	< 10%	11.10%	Exceeded	< 10%	10.17%	Exceeded	< 10%	9.47%	Didn't
			exceed									Exceed
Carbohydrate (%)	45–65%	56.30%	Within	45–65%	54.30%	Within	45–65%	52.40%	Within	45-65%	53%	Within
			range			range			range			range
Total sugar (%) <sup>c</sup>	<13%	12.90%	Didn't	< 13%	14.30%	Exceeded	< 13%	10.92%	Didn't	<13%	11%	Didn't
			exceed						exceed			exceed
Protein (%)	10–35%	18.40%	Within	10–35%	18%	Within	10-35%	19.80%	Within	10–35%	21%	Within
			range			range			range			range
Abbreviations: AMDR Accep	itable Macronu	trient Distributio	n Range, <i>d</i> da	<i>y, DRI</i> Dietary Re	ference Intake, <i>D</i> \	/ Daily Value, g	grams, <i>n</i> numb	er of participants, R	DA Recommer	ded Dietary All	owance, SD Standa	rd Deviation
Values in bold are AMDR (50%	% carbohydrate	s, 20% proteins, 3	30% fat) based	d on the estimat	ed energy require	ement of each a	ge group					
*Only 1 female aged 18 years	participated ir	the study so no	SD for this age	e group								

<sup>a</sup> [16], <sup>b</sup> [17] (Values were extracted based on a 2000 kcal-diet then adjusted to each age group's estimated energy requirements), <sup>c</sup> [18]

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Age group	18 years (n=3)						19–30 years (n=25)					
Gender	Male (n=2)			Female (n = 1)			Male (n=8)			Female (n = 17)		
Nutrient	DRI (RDA)	Mean±SD	% DV	DRI (RDA)	Mean±SD	% DV	DRI (RDA)	Mean±SD	% DV	DRI (RDA)	Mean±SD	% DV
Antioxidants												
Vitamin C (mg/d)	75	$55 \pm 7.8$	73%	65	31	48%	90	51.4±24.5	57%	75	$80.3 \pm 38.8$	107%
B vitamins												
Thiamin (mg/d)	1.2	$1.3 \pm 0.98$	108%	-	<i>—</i>	100%	1.2	$1.21 \pm 0.357$	100.83%	1.1	$1.16 \pm 0.395$	105.45%
Riboflavin (mg/d)	1.3	$1.08 \pm 0.11$	83%	-	<i>—</i>	100%	1.3	1.18±0.42	90.76%	1.1	$1.26 \pm 0.558$	114.54%
Niacin (mg/d)	16	$16.2 \pm 3.86$	101%	14	11	78.5	16	19.9±8.5	124.37%	14	$19.1 \pm 6.59$	136.43%
Vitamin B-6 (mg/d)	1.3	$0.97 \pm 0.036$	74.61%	1.2	<i>—</i>	83%	1.3	$1.48 \pm 0.552$	113.84%	1.3	$1.64 \pm 0.536$	126.15%
Folate (µg dietary folate equivalent/d)	400	$409.7 \pm 305.9$	102%	400	155	39%	400	346±148.77	86.50%	400	335±121.99	83.75%
Vitamin B-12 (µg/d)	2.4	1.34±0.49	56%	2.4	<i>—</i>	42%	2.4	2.17±1.23	90.42%	2.4	$2.58 \pm 0.89$	107.50%
Biotin (µg/d)	25	14.2±12.3	57%	25	11	44%	30	18.9±12.1	63%	30	$15.5 \pm 6.74$	51.67%
Pantothenic Acid (mg/d)	5	4±1.4	80%	5	£	60%	5	4.22±1.12	84.40%	5	4.22±1.27	84.40%
Bone-related nutrients												
Calcium (mg/d)	1300	667±97	51%	1300	492	38%	1000	$603.98 \pm 187$	60.39%	1000	818.3±394.13	81.83%
Phosphorus (mg/d)	1250	809±247	65%	1250	597	48%	700	904.97 ± 207	129.28%	700	$1014.5 \pm 278$	144.85%
Magnesium (mg/d)	410	194.4±94	47%	360	172	48%	400	$196.3 \pm 58.6$	49%	310	232.8±62.9	75%
Vitamin D (IU/d)	600	51.3±8.9	9%	600	77	13%	600	$66.5 \pm 36.3$	11%	600	$114.45 \pm 82$	19%
Other micronutrients												
Vitamin A (µg retinol activity equivalent/d)	006	393±11.1	44%	700	325	46%	006	$401.66 \pm 198.8$	44.62%	700	$464.18 \pm 409.79$	66.31%
Vitamin E of alpha-Tocopherol Equivalents	15	7.57±8.62	50%	15	0	%0	15	3.36±5.79	22.40%	15	$2.65 \pm 5$	17.67%
(mg/d)												
Vitamin K (µg/d)	75	141.2±48	188%	75	31	41%	120	90.4±90.9	75.33%	90	114.7±86	127.44%
Iron (mg/d)	11	$10.7 \pm 5.98$	97%	15	9	40%	8	$11.56 \pm 3.77$	144.50%	18	14.4±6.49	80%
Zinc (mg/d)	11	$11.6 \pm 5.1$	105%	6	5	55.50%	11	7.98±2	72.54%	80	7.89±2.18	98.62%
Sodium (g/d)	1.5	$1.92 \pm 0.42$	128%	1.5	1.75	117%	1.5	$2.23 \pm 1.2$	148.67%	1.5	$2.47 \pm 0.99$	164.67%
Potassium (g/d)	4.7	1.79±1	38%	4.7	1.79	38%	4.7	$2 \pm 0.85$	42.55%	4.7	$2.68 \pm 0.91$	57%
lodine (µg/d)	150	0	%0	150	0	%0	150	0	%0	150	0	%0
Copper (mcg/d)	890	739±368	83%	890	1000	112%	900	$1020 \pm 102$	113.33%	006	$1150 \pm 385$	127.78%
Manganese (mg/d)	2.2	2.68±1.86	122%	1.6	2	125%	2.3	$2.51 \pm 0.556$	109%	1.8	$2.58 \pm 0.91$	143.33%
Selenium (µg/d)	55	59.57±20.4	108%	55	26	47%	55	$69.1 \pm 27.9$	125.63%	55	82.3 ± 31	149.63%
Fluoride (mg/d)	ſ	$0.11 \pm 0.099$	4%	m	0.184	6%	4	$0.18 \pm 0.15$	4.50%	m	$0.23 \pm 0.21$	7.70%
Chromium (mcg/d)	35	$16.5 \pm 23.3$	47%	24	0	%0	35	20±29	57%	25	$49 \pm 49$	196%
Molybdenum (µg/d)	43	9.59±4.8	22%	43	11	26%	45	$39.3 \pm 51.2$	87.33%	45	$16.9 \pm 9.75$	37.56%
Age group	31–50						51–65 years					
	years						(n = 84)					
	(n = 43)											

Table 4 (continued)												
Age group	18 years (n=3)						19–30 years (n=25)					
Gender	Male			Female			Male (n=8)			Female		
	(n=2)			(n=1)						(n = 17)		
Nutrient	DRI (RDA)	Mean±SD	NU%	DRI (RDA)	Mean±SD	% DV	DRI (RDA)	Mean±SD	NO %	(RDA)	Mean±5D	NO %
Gender	Male (n=17)			Female			Male (n = 38)			Female (n = 46)		
Nutrient	DRI (RDA)	Mean + SD	\U %	DRI (RDA)	Mean+SD	% DV		Mean + SD	% DV		Mean + SD	% DV
Antioxidants						2			2			2
Vitamin C (mg/d)	06	$48.5 \pm 28.8$	54%	75	51.9±37.4	69.20%	06	49.1±21.9	54.56%	75	$49.2 \pm 26.5$	65.60%
B vitamins												
Thiamin (mg/d)	1.2	$1.07 \pm 0.31$	89.17%	1.1	$1.01 \pm 0.44$	91.81%	1.2	$1.16 \pm 0.54$	96.67%	1.1	$0.978 \pm 0.539$	88.90%
Riboflavin (mg/d)	1.3	$1.03 \pm 0.32$	79.23%	1.1	$1.04 \pm 0.52$	94.54%	1.3	$0.96 \pm 0.31$	73.84%	1.1	$0.981 \pm 0.44$	89.18%
Niacin (mg/d)	16	$17.5 \pm 9.07$	109.37%	14	$16.8 \pm 9.22$	120%	16	17.7±6.51	110.62%	14	21.2±11.2	151.43%
Vitamin B-6 (mg/d)	1.3	$1.33 \pm 0.53$	102.30%	1.3	$1.36 \pm 0.72$	104.60%	1.7	$1.37 \pm 0.53$	80.59%	1.5	$1.41 \pm 0.59$	94%
Folate (µg dietary folate equivalent/d)	400	$267 \pm 137$	66.75%	400	$265 \pm 151$	66.25%	400	$309 \pm 167$	77.25%	400	$266 \pm 163$	66.50%
Vitamin B-12 (µg/d)	2.4	$1.79 \pm 0.763$	74.58%	2.4	$1.96 \pm 1.53$	81.67%	2.4	2.34±1.33	97.50%	2.4	$2.43 \pm 5.74$	101.25%
Biotin (µg/d)	30	$11.7 \pm 7.75$	39%	30	11.3±8	37.67%	30	14.4±9.5	48%	30	$10.4 \pm 8.1$	34.67%
Pantothenic Acid (mg/d)	5	$3.25 \pm 1.06$	65%	5	3.29 ± 1.54	65.80%	5	3.9±1.22	78%	5	$4.75 \pm 8.45$	95%
Bone-related nutrients												
Calcium (mg/d)	1000	$588 \pm 286$	58.80%	1000	$608 \pm 359$	60.80%	1000	647.6±294	64.76%	1200	$580 \pm 295$	48.33%
Phosphorus (mg/d)	700	$804 \pm 287$	114.85%	700	781±390	111.57%	700	883±326	126.14%	700	803.4±336.8	114.77%
Magnesium (mg/d)	420	$179.54 \pm 68$	42.75%	320	187±129	58.43%	420	$190.84\pm64.3$	45.43%	320	$169.83 \pm 72$	53%
Vitamin D (IU/d)	600	62±50.6	10.33%	600	82±99.9	13.67%	600	83.7±59.5	13.95%	600	$59.7 \pm 52.3$	9.95%
Other micronutrients												
Vitamin A (µg retinol activity equivalent/d)	006	$446 \pm 232$	49.56%	700	329±109	47%	006	367.84 ± 157.9	40.87%	700	360±164	51.43%
Vitamin E of alpha-Tocopherol Equivalents (mg/d)	15	7.36±12.79	49%	15	3.51 ±5.3	23.40%	15	4.77±8.14	31.80%	15	6.41 ± 7.76	42.73%
Vitamin K (µg/d)	120	111.4±109	92.83%	06	$88.5 \pm 69.3$	98.33%	120	$121.18 \pm 109.6$	100.98%	90	125±212	138.90%
Iron (mg/d)	00	9.49±3.98	118.62%	18	$10.8 \pm 8.09$	60%	8	$10.23 \pm 4.26$	127.87%	∞	9.28±4.18	116%
Zinc (mg/d)	11	5.99±2.14	54.45%	00	$6.32 \pm 3.94$	79%	11	7.1±3.29	64.54%	∞	$5.68 \pm 2.27$	71%
Sodium (g/d)	1.5	2.27±1.34	151.33%	1.5	$2.08 \pm 1.52$	138.67%	1.3	$2.15 \pm 0.91$	165.30%	1.3	$1.95 \pm 1.05$	150%
Potassium (g/d)	4.7	$1.8 \pm 0.79$	38.30%	4.7	2.07 ± 1.27	44%	4.7	$2 \pm 0.67$	42.55%	4.7	$1.83 \pm 0.74$	38.93%
lodine (µg/d)	150	0	%0	150	$1.04 \pm 0.48$	%0	150	0	%0	150	6±41.1	4%
Copper (mcg/d)	006	964±410	107.11%	006	949±543	105.44%	006	$910 \pm 395$	101.11%	006	826±750	91.78%
Manganese (mg/d)	2.3	$2.1 \pm 0.77$	91.30%	1.8	2.11±1.19	117.22%	2.3	$2.28 \pm 0.96$	99.10%	1.8	2.41 ± 2.39	134%
Selenium (µg/d)	55	$57.2 \pm 35.3$	104%	55	$57.4 \pm 38.8$	104.36%	55	76.8±38.6	139%	55	67.9±32.4	123%
Fluoride (mg/d)	4	0.1±0.08	2.50%	с	$0.23 \pm 0.23$	7.70%	4	0.18±0.16	4.50%	e	$0.23 \pm 0.19$	7.70%

(n=3)						19–30 years (n=25)					
Gender Male (n = 2)			Female (n = 1)			Male (n=8)			Female (n=17)		
Nutrient DRI (RDA) Mi	Mean±SD	% DV	DRI (RDA)	Mean±SD	% DV	DRI (RDA)	Mean±SD	% DV	DRI (RDA)	Mean±SD	% DV
Chromium (mcg/d) 35 10	10±20	28.57%	25	42±67	168%	30	21±26	70%	20	30±31	150%
Molybdenum (µg/d) 45 11.	$11.8 \pm 7.93$	26.22%	45	$15 \pm 11.2$	33.33%	45	$17.5 \pm 21.9$	38.89%	45	$17.8 \pm 16.9$	39.56%

**Table 4** (continued)

Only 1 female aged 18 years participated in the study so no SD for this age group

contribution of food served to daily needs exceeded 75% for most B vitamins in all age groups and genders, especially thiamin, riboflavin, niacin, and B6. As for folate and B12, it exceeded 65% in all age groups and genders except for the female in the 18 years age group, where it provided less than 50% for both vitamins and less than 60% of B12 for the males in this age group. As for vitamin C, patients in all age groups and genders were provided more than 50% of their estimated daily needs except the females in the 18 years age group (48%). In addition, females in the age group 19-30 years were provided more than 100% of their estimated daily value (107%). Bonerelated nutrients include calcium, phosphorus, magnesium, and vitamin D. The calcium content in the meals served to patients was below 85% of the recommended daily intake requirements, with the lowest amount in the female patients aged 18 years and those aged 51–65 years, being 38% and 48.33%, respectively. The percentage daily value of phosphorus exceeded 100% for the majority of patients of all genders except for 18-year-old patients, where the recorded values were lower than 70% for both age groups. As for vitamin D, food served provided less than 20% of the daily needs of all patients. Moreover, our results revealed that patients in all age groups and genders were provided less than 55% of their daily vitamin A and vitamin E requirements, except for vitamin A in the females belonging to the 19-30 age group (66%). Additionally, patients in all age groups and genders were provided 60% or more of their daily iron needs except for the female in the 18 years age group (40%).

## Food groups served based on the Mediterranean diet classification

Based on our findings, the most served food group in hospitals was the 'grains and cereals' group from which a patient was served on average 4.51 servings per day, followed by 3.92 servings from the 'meat, poultry and fish' group, and 3.52 servings from the 'dairy products' group.

Compared to the Mediterranean diet, our results showed that hospitals' diets showed low adherence to the Mediterranean diet when it comes to many food group. For instance, per day, hospitals served more than the recommended amounts of the following: sweets (3.47 servings served vs. 0.28 servings recommended); dairy products (3.52 servings served vs. 2 servings recommended); meat (1.57 servings served vs. a maxium of 0.57 serving recommended); poultry (1.57 serving served vs. 0.57 serving recommended). On the other hand, hospitals served less than the recommended amounts of the following groups: Vegetables (3 servings served vs. 6 servings recommended); fruits (0.7 serving served vs. 3 servings recommended); legumes (0.11 serving served vs. at least 0.57 serving recommended). 'Fish' and 'grains and cereals' groups were within the recommendations.



## Hospital Diet

Fig. 4 Pyramid comparing the diets served in Lebanese hospitals to the Mediterranean diet recommendations (The value for meat is the maximum recommended daily intake; values of fish and legumes are the minimum recommended daily intake)



Fig. 5 Energy content and percent EER of food served, wasted, and consumed

A pyramid showing the comparison of the food groups served at hospitals to the Mediterranean diet is shown in Fig. 4.

## Composition of food consumed by patients in terms of energy, macronutrients and micronutrients Energy consumption

Our results revealed that, on average, a patient consumed 0.85 kg of food (68% of the amount served), which contained a mean of 1084 kcal per day, equivalent to 57% of a patient's daily energy requirements. Energy content and contribution to EER of food served at hospitals and wasted/consumed by patients is shown in Fig. 5.

# Estimated macronutrient values of food consumed by hospitalized patients

The mean estimated daily carbohydrate intake for 18-year-old hospitalized male and female patients is equivalent to 111.37 g per day (g/day) and 95 g/day, respectively, less than 45% of the required carbohydrate

intake per day. A lower percentage of carbohydrate intake is noticed in males aged 19 to 30 years, equivalent to 82.5 g/day (27.5% of the estimated daily needs). Intake of carbohydrates did not exceed 70% for all age groups and genders, and none of the patients who participated consumed their required carbohydrate daily intake. As for proteins, the consumed food provided less than 70% of the daily required protein intake for all patients. Our results revealed that the females in the 18-year-old group consumed the least amount of protein (19 g/day), representing only 21.2% of the total daily protein needs. As for total fat, based on our findings, the amount consumed by hospitalized patients varied between different ages and genders and ranged from 8 g/day for females in the 18 years age group to 83.13 g/day for females aged 19-30 years. Plus, we found that consumption of saturated fat exceeded 40% of the limit for all age groups and genders except the females in the 18-year-old group (22%), with females in the 19-30 age group exceeding 90% of the limit. In addition, consumption of monounsaturated

	Age Group (Male:	s)										
	18 years (n=2)			19–30 years (n=8)	_		31–50 years (n=17	7)		51–65 years (n=38,	_	
Macronutrients	DRI	Consumed	%DV	DRI (RDA/ AMDR)	Consumed	%DV	DRI (RDA/ AMDR)	Consumed	%DV	DRI (RDA/ AMDR)	Consumed	%DV
	(RDA/ AMDR)											
Total Fat (g/d)	73	26.43	36.21%	80	28.2	35.25%	73	30.3	41.50%	66.7	38.1	57.12%
Cholesterol (mg/d) <sup>a</sup>	< 300	104.7	34.90%	< 300	132.6	44.20%	< 300	144.4	48.13%	< 300	188.9	62.96%
Saturated fat (g/d) <sup>b</sup>	22	11.16	50.72%	24	9.8	40.83%	22	11.5	52.27%	20	14	70%
Monounsaturated fat (g/d) <sup>b</sup>	48.4	6.24	12.89%	52.8	9.7	18.30%	48.4	9.8	20.24%	44	13.4	30.45%
Polyunsaturated fat (g/d)	16	3.21	20.06%	17	5.3	31.76%	17	5.7	33.50%	14	6.2	38.60%
Linoleic acid (g/d)	16	3.01	18.81%	17	3.9	22.94%	17	4.5	26.47%	14	4.7	29.60%
Alpha linolenic acid (g/d)	1.6	0.658	41.13%	1.6	0.4	25%	1.6	0.2	12.50%	1.6	0.5	31.25%
Trans Fat (g/d) <sup>b</sup>	2.42	0.005	%0	2.64	0.4	15.1%5	2.42	0.1	4.10%	2.2	0.4	18.18%
Carbohydrate (g/d)	275	111.37	40.50%	300	82.5	27.50%	275	140.7	51.20%	250	152	60.80%
Protein (g/d)	110	46.6	42.36%	120	37	30.83%	110	50.3	45.70%	100	60	60%
Dietary fiber (g/d)	38	11.51	30.29%	38	1.6	4.20%	38	4.9	13%	30	12.6	42%
	Age Group (Fema	iles)										
	18 years (n = 1)			19–30 years (n=1	7)		31-50 years (n=26	2)		51–65 years (n=46	_	
Macronutrients	DRI (RDA/ AMDR)	Consumed	%DV	DRI (RDA/ AMDR)	Consumed	%DV	DRI (RDA/ AMDR)	Consumed	%DV	DRI (RDA/ AMDR)	Consumed	%DV
Total Fat (g/d)	60	8	13.33%	66.7	49.88	74.78%	60	32.83	54.72%	53	36.07	68%
Cholesterol (mg/d) <sup>a</sup>	< 300	44	14.67%	< 300	196.76	65.58%	< 300	142.3	47.40%	< 300	175	58.33%
Saturated fat (g/d) <sup>b</sup>	18	4	22.22%	20	18.77	93.85%	18	13.45	74.72%	16	11.17	69.81%
Monounsaturated fat (g/d) <sup>b</sup>	39.6	2	5%	44	14.65	33.29%	39.6	11.14	28.13%	35.2	11.04	31.36%
Polyunsaturated fat (g/d)	11	<del>, -</del>	%60.6	12	7.27	60.58%	12	4.74	39.50%	11	0.34	3.09%
Linoleic acid (g/d)	11	0	%0	12	5.9	49.16%	12	3.85	32%	11	13.71	124.64%
Alpha linolenic acid (g/d)	1.1	0	%0	1.1	0.81	73.63%	1.1	0.29	26.36%	1.1	1.34	121.80%
Trans Fat (g/d) <sup>b</sup>	1.98	0	%0	2.2	0.11	5%	1.98	0.15	7.57%	1.76	0.01	%0
Carbohydrate (g/d)	225	95	42.22%	250	168.03	67.21%	225	133.02	59.12%	200	127.76	63.88%
Protein (g/d)	06	19	21.11%	100	61.2	61.20%	90	44.88	49.87%	80	52.93	66.16%
Dietary fiber (g/d)	26	8	30.77%	25	14.82	59.28%	25	12.18	48.72%	21	5.1	24.28%
*Values in <b>bold</b> are AMDR												

Table 5 Macronutrient content of food consumed by patients, per age and per gender

<sup>a</sup> [16], <sup>b</sup> [17] Values were extracted based on a 2000 kcal-diet then adjusted to each age group's estimated energy requirements)

fat was less than 35% of the recommended amount in all age groups and genders. As for dietary fiber intake, we found that patients consumed less than 60% of their daily requirements. The detailed estimated macronutrient intake of hospitalized Lebanese patients across different age groups and genders is shown in Table 5.

## Estimated micronutrient value of food consumed by hospitalized patients

The highest amount of vitamin C consumed among patients was observed in males of the 18-year-old group, totaling an average of 38 milligrams per day (mg/day), accounting for 51% of their daily dietary requirements. A low vitamin C intake was noticed in males in the 19-30 age group, in which, on average, as little as 5.3 mg/day was consumed, accounting for 7% of their daily needs. As for B vitamins, it is noteworthy that none of the patients of all age categories and genders met their recommended intake levels for these vitamins. Moreover, it was observed that patients were consuming less than 65% of their recommended daily folate intake, with the least amount of folate being consumed by the female in the 18 years age group, equivalent to 79 micrograms per day ( $\mu$ g/day), covering only 19.7% of their daily needs. As for vitamin B12, consumption varied between patients, with the highest amount consumed in 19 to 30-yearold females (2.21 µg/day representing 92% of their daily needs) and the lowest in the females aged 18 years old who did not consume vitamin B12. As for calcium, patients in all age groups and genders consumed less than 55% of their estimated daily needs, except females in the 19-30 age group, who consumed, on average, 688.38 mg/ day, representing 69% of their required daily needs. The amounts of other micronutrients, such as iron, zinc, vitamin A, vitamin K, etc. consumed by hospitalized Lebanese patients are shown in Table 6.

## Consumption of meals and snacks

The consumption of every meal and snack by patients is shown in Table 7. Our results showed that patients consumed 36.8%, 28.4%, 27.7%, and 43.9% of the provided breakfast, lunch, dinner, and snacks, respectively. A significant difference in consumption between genders existed for lunch (*P*-value = 0.045) and snacks (*P*-value = 0.029), with more males consuming all of the provided meals than females. Most patients (71%) reported not bringing food from outside during their hospital stay.

## Discussion

This is the first study to evaluate hospital diets and assess their adherence to the Mediterranean diet recommendations in Lebanon and the Arab Region. Our findings showed that menus served at Lebanese hospitals do not provide patients with enough calories and macro- and micro-nutrients to meet their estimated daily needs; in addition, a portion of the served amount is also wasted. Thus, none of the patients in our study were found to consume enough energy macro- and micro-nutrients during their hospital stay. This is concerning because it is evidenced that nutritional needs during illness and recovery (e.g., stress, fever, wound healing) increase due to a hypermetabolic state, which results in elevated energy expenditure (EE) and increased risk of malnutrition among patients [20].

## Meals served in Lebanese hospitals Energy content of food served and consumed

Based on our findings, the served food accounted for 79% of the daily estimated energy requirement (EER), where the mean energy content of food served to adult hospitalized patients was 1489 kcal energy (SD: 546.55) per hospital bed per day. In addition, on average, the energy content of food consumed by a patient in our study was 1084.3 kcal per day, accounting for 57% of a patient's needs. A study done in Denmark by Almdal et al. [21] showed almost a similar amount to our study and reported that, on average, the energy in food consumed by a patient was 1075.5 kcal (reported as 4.5 MJ in the study), accounting for 60-65% of the needs. Another study done in the Netherlands [11] showed that, on average, the food served contained a mean of  $1809 \pm 143$  kcal, which is higher than the energy content found in our study. This same study also showed a slightly higher mean of energy in food consumed by patients  $(1105 \pm 594 \text{ kcal})$ compared to our study. Additionally, in Switzerland [22], significant disparities were noted in the caloric content of patient menus, with an average range of 1981 ± 454 kcal, which is also higher than the caloric content of food served in our study. In Australia [23], a patient was served, on average, food containing 1396 kcal per day and consumed 977 kcal per day, lower than the energy contents found in our study.

Similarly to our findings, a study done in Germany [24] showed that the energy content of meals was below the recommended levels, and Rattray M et al. reported that the mean energy of food served to patients was significantly lower than their estimated requirements [23]. On the other hand, a study done in Spain revealed that the energy contribution of food served satisfied the energy needs of the patients [25].

## Macro- and micro-nutrient content of food served

Studies that have assessed the nutritional value of food served and consumed in hospitals regarding macro- and micro-nutrients are scarce. In addition, no previous studies stratified the nutrition needs of patients based on different age categories. Based on our findings, on average, a

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Table 6

						ge Group (Male:	()					
	18 yea	nrs (n=2)		19–30 years ( <i>n</i> =8)			31-50 y	rears (n=17)		51-65	years ( <i>n</i> =38	()
Micronutrients	DRI (RDA)	Consumed	1 %DV	DRI (RDA)	Consumed	% DV	DRI (RDA)	Consume	4 %DV	DRI (RDA)	Consumed	ND%
Antioxidants												
Vitamin C (mg/d)	75	38	50.67%	90	5.3	7.07%	06	15.5	20.7%	06	35.1	46.8%
B vitamins												
Thiamin (mg/d)	1.2	0.5	41.67%	1.2	0.34	28.33%	1.2	0.8	65%	1.2	1.02	85%
Riboflavin (mg/d)	1.3	0.45	34.62%	1.3	0.68	52.31%	1.3	0.8	62.3%	1.3	0.85	65.38%
Niacin (mg/d)	16	9.95	62.19%	16	10.53	65.81%	16	13.5	84.5%	16	14.23	88.94%
Vitamin B-6 (mg/d)	1.3	0.4	30.77%	1.3	0.86	66.15%	1.3	1.1	83.8%	1.7	1.21	71.17%
Folate (µg dietary folate equivalent/d)	400	215.7	53.93%	400	92.4	23.1%	400	191.2	47.8%	400	238.12	59.53%
Vitamin B-12 (µg/d)	2.4	0.725	30.21%	2.4	0.47	19.58%	2.4	1.3	55.4%	2.4	1.91	79.58%
Biotin (µg/d)	25	7.67	30.68	30	6.15	20.5%	30	8.6	28.66%	30	11.51	38.36%
Pantothenic Acid (mg/d)	5	2.625	52.5%	5	1.72	34.4%	Ŝ	2.4	47.4%	Ŝ	3.2	64%
Bone-related nutrients												
Calcium (mg/d)	1300	489.2	37.63%	1 000	257.73	25.73%	1000	398.7	39.87%	1000	509.6	50.96
Phosphorus (mg/d)	1250	489.5	39.16%	700	365.1	52.15%	700	606	86.57%	700	707.32	101%
Magnesium (mg/d)	410	111.9	27.29%	400	72.93	18.23%	420	128	30.47%	420	149.54	35.6%
Vitamin D (IU/d)	600	36.35	6.06%	600	22	3.67%	009	43.2	7.2%	600	69.24	11.54%
Other micronutrients												
Vitamin A (µg retinol activity equivalent/d)	006	282	31.33%	006	147.54	16.39%	006	284.7	31.6%	006	285.24	31.7%
Vitamin E of alpha-Tocopherol Equivalents (mg/d)	15	7.07	47.13%	15	3.24	21.6%	15	7.26	48.4%	15	4.7	31.3%
Vitamin K (µg/d)	75	77.3	103.07%	120	19.42	16.18%	120	74.81	62.34%	120	90.58	75.48%
Iron (mg/d)	11	5.95	54.09%	8	1.69	21.12%	00	6.77	84.62%	00	7.18	89.75%
Zinc (mg/d)	11	8.35	75.91%	11	2.53	23%	11	4.2	38.18%	11	5.42	49.27%
Sodium (g/d)	1.5	1.37	91.33%	1.5	0.82	54.67%	1.5	1.53	102%	1.3	1.67	128.46%
Potassium (g/d)	4.7	1.08	22.98%	4.7	0.7	14.89%	4.7	1.24	26.38%	4.7	1.58	33.62%
lodine (µg/d)	150	0	0%	150	0	%0	150	0	%0	150	0	%0
Copper (mcg/d)	890	578	64.94%	006	302	33.55%	006	794	88.22%	006	774	86%
Manganese (mg/d)	2.2	0.18	8.18%	2.3	1.01	43.91%	2.3	1.44	62.6%	2.3	1.73	75.21%
Selenium (µg/d)	55	42.37	77.04%	55	32.48	59.05%	55	46.32	84.22%	55	63.8	115.95%
Fluoride (mg/d)	c	0.095	3.17%	4	0.093	2.3%	4	0.066	1.65%	4	0.1	2.5%
Chromium (mcg/d)	35	13.5	38.57%	35	20	57.14%	35	9.998	28.57%	30	21.0	70%
Molybdenum (µg/d)	43	5.42	12.60%	45	4.68	10.4%	45	8.25	18.33%	45	13.84	30.75%
Age Group (Females)												
		18 years (r	1=1)	19–30 years ( <i>n</i> =17	7) 3	1–50 years ( <i>n</i> =2	(9)	51–65 yea	ırs ( <i>n</i> =46)			

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Micronutrients         DRI         Consumed         % DV         DRI         Consumed         % DV         DRI           Micronutrients         (RDA)         Consumed         % DV         PRI         Consumed         % DV         PRI           Micronutrients         (RDA)         Consumed         % DV         PRI         Consumed         % DV         PRI           Micronutrients         RDA)         Consumed         % DV         PRI         Consumed         % DV         PRI           Mitroming/di         1         1         1         1         1000%         11         0.223%         11         0.81         73           Mitroming/di         1         1         1         1         0.00%         13         13         103         033         73           Mitroming/di         1         1         1         1         1         0.00%         13         133         1	19-30  years  (n=8)		81–50 years ( <i>n</i> = 17)		51–65 years ( <i>n</i> =38)
Micronuctients         DRI (RDA)         Consumed         % DV         DRI         Consumed         % DV<	DRI Consumed (RDA)	% DV	JRI Consumec RDA)	ND %	DRI Consumed %DV (RDA)
Artioxidants         Artioxidants         5         15         23%         75         56.2         36.2         48.           Viramin (mg/d)         1         1         1         1         00%         1.1         1.13         10.273%         1.1         081         73           Nitamin (mg/d)         1         1         1         1         1         00%         1.1         1.13         10.273%         1.1         081         73           Nitamin (mg/d)         14         2         14.29%         14         15.51         110.79%         1.1         087         73           Namin (mg/d)         14         2         14.29%         14         15.51         110.79%         1.1         087         73           Namin (mg/d)         12         0         0%         2.4         2.1         2.2         2.4         103         087         73         73           Bioin (ug/d)         12.5         0         0%         2.4         2.1         2.2         2.4         3.0         37         33           Bioin (ug/d)         12.5         13.00         13.12         43.7%         103.06%         47         103.06%         47	% DV DRI Consumed % DV DRI (RDA) (RDA)	Consumed	% DV DRI (RDA)	Consumed	%DV
Warmin C(mg/d)         65         15         23%         75         58.5         78%         75         36.2         48.           Bittamin         Itamin (mg/d)         1         1         1         0006         1.1         0.32         71.09%         1.1         08.1           Bittamins         Ntamin (mg/d)         1         1         1         0006         1.1         1.23         0.273%         1.0         0.8         7.3           Biblio (mg/d)         1.2         0         0.9         1.3         1.34         10.308%         1.3         10.3         7.3           Folate (up gletary folate equivalent/d)         400         79         9.37%         400         2.44         0         9.2         2.44         0         9.2         2.43         48.           Routin mg/d)         24         0         0.9         2.44         2.211         9.2.9%         46.         47.         48.           Boin refaited nutrients         3         31.3         60.3%         5         2.43         48.           Boin regraphic (mg/d)         5         1.13.5%         70.0         88.3         88.34%         100.3         47.         48.					
B vitamins         Nitamin (mg/d)         1 <td>23% 75 58.5 78% 75</td> <td>36.2</td> <td>48.27% 75</td> <td>20.20</td> <td>26.93%</td>	23% 75 58.5 78% 75	36.2	48.27% 75	20.20	26.93%
Thiamin (mg/d)         1         1         1         100%         11         0.782         7109%         11         0.81         73           Wahmin (mg/d)         1         1         1         100%         11         113         10273%         11         0.81         73           Nacch (mg/d)         1         1         1         1         100%         11         133         10273%         110         28         24         25         24         26         24         25         24         26         67         28         24         165         67         28         24         26         67         28         24         165         24         125         47         28         46         27         28         47         28         47         28         47         28         47         28         47         28         47         28         47         28         47         28         47         28         47         28         48         28         28         48         28         28         48         28         28         48         28         28         48         28         28         48         28					
Riboflavin (mg/d)         1         1         1         100%         11         11         1         087         73           Niacin (mg/d)         14         2         14.29%         14         1551         110.79%         14         1185         84.           Vitarini B-6 (mg/d)         12         0         0%         13         13.44         103.08%         13         103.08%         13         103.08%         13         103.08%         13         103.08%         13         103.08%         13         103.08%         13         103.08%         13         103.08%         103         103.08%         103         103.08%         13         103.08%         103.08%         103.08%         13         103.08%         13         103.08%         103         103.08%         103         103.08%         103         103.08%         103         103.08%         103         103.08%         103.08%         103.08%         103.08%         116.08%         103.08%         103.08%         103.08%         103.08%         103.08%         103.08%         103.08%         103.08%         103.08%         103.08%         103.08%         103.08%         103.08%         103.08%         103.08%         103.08%         103.08%	100% 1.1 0.782 71.09% 1.1	0.81	73.64% 1.1	0.66	59.82%
Niacin (mg/d)         14         2         14,29%         14         1551         110,79%         14         1185         84.           Vitamin B6 (mg/d)         12         0         0%         13         134         1033.08%         13         133         1033.08%         13         133         103         73         73           Feble (ug dreary folate equivalent/d)         20         0%         24         2         21         92.08%         24         16.2         67         78           Pantothenic Acid (mg/d)         25         1         20         0%         1312         437.3%         50         85         47         66         47         67         48           Pantothenic Acid (mg/d)         5         1         20%         5         313         46         46         46         47         67         47         67         48           Pantothenic Acid (mg/d)         5         1         1315%         100         483         88         48         48         48           Relow (mg/d)         11250         60         131         13142         1323         41         45           Matamicronutionts         500         11315% <td>100% 1.1 1.13 102.73% 1.1</td> <td>0.87</td> <td>79.09% 1.1</td> <td>0.42</td> <td>38.27%</td>	100% 1.1 1.13 102.73% 1.1	0.87	79.09% 1.1	0.42	38.27%
Vitamin $\theta \in (mg/d)$ 1.2         0 $0\%$ 1.3         1.34         103.08%         1.3         1.03         73           Folate ( $\mu g d [etary folate equivalent/d)$ 400         79         19.75%         400         24.44         61.10         400         192.57         48           Vitamin $B - 7 (\mu g/d)$ 24         0         0%         24         221         92.98%         24         182         48           Biotin ( $\mu g/d$ )         25         1         20%         30         13.12         43.73%         30         851         28           Boncrelated nutrients         1         1300         171         13.15%         1000         68.83         68.34%         1000         47.50         41           Calcium ( $mg/d$ )         360         79         21.94%         310         184.26         54.44%         50         11.2           Phosphorus ( $mg/d$ )         360         50         184.45         1000         47.50         43.70         43.70           Vitamin D ( $U/d$ )         500         50         21.94%         310         184.26         54.44%         50         110           Vitamin D ( $U/d$ )         500         11 <td>14.29% 14 15.51 110.79% 14</td> <td>11.85</td> <td>34.64% 14</td> <td>15.61</td> <td>111.5%</td>	14.29% 14 15.51 110.79% 14	11.85	34.64% 14	15.61	111.5%
	0% 1.3 1.34 103.08% 1.3	1.03	79.23% 1.5	1.00	66.66%
Vitamin B-12 (ug/d) $24$ $0$ $0\%$ $24$ $21$ $92.08\%$ $24$ $162$ $67$ Biotin (ug/d) $25$ $5$ $20\%$ $30$ $13.12$ $43.73\%$ $30$ $851$ $28$ Pantothenic Acid (mg/d) $5$ $1$ $20\%$ $5$ $3319$ $6638\%$ $6538\%$ $851$ $48.7$ Phosphous (mg/d) $1250$ $215$ $17.2\%$ $300$ $84.457$ $12065\%$ $70$ $87.7$ $48.7$ Phosphous (mg/d) $360$ $79$ $2194\%$ $310$ $84.457$ $12065\%$ $700$ $47.7$ $60.7$ $41.7$ Magnetind $100$ $770$ $84.457$ $12065\%$ $700$ $87.4\%$ $700$ $700$ $710.7$ $11.1$ Vitamin C (U/d) $500$ $150$ $81.4.6\%$ $700$ $81.4.6\%$ $700$ $226.78$ $32.72$ $22.73$ Vitamin E (u/d) $15$ $16.5\%$ $16.5\%$ $16.5\%$	19.75% 400 244.4 61.10 400	192.57	18.14% 400	165.98	41.50%
	0% 2.4 2.21 92.08% 2.4	1.62 (	57.5% 2.4	2.07	86.25%
Pantothenic Acid (mg/d)         5         1 $20\%$ 5         3319 $6633\%$ 5         243         48.           Bone-related nutrients         Imagination (mg/d)         13300         171         1315%         1000 $6833$ $6884\%$ 1000 $475.06$ 47.           Calcium (mg/d)         13200         171         13.15%         1000 $68833$ $6884\%$ 1000 $475.06$ 47.           Phosphorus (mg/d)         250         215         17.2%         700 $8843\%$ 700 $475.06$ 47.           Magnesium (mg/d)         360         70         50         8445%         320         133.52         41.           Magnesium (mg/d)         360         70         86.33         68.84%         700         47.02         47.           Other micronutrients         700         118         16.866%         700         415.463         32.2         41.           Other micronutrients         700         118         16.866%         700         415.463         32.2         41.           Other micronutrients         700         115.463         700         216.446         700	20% 30 13.12 43.73% 30	8.51	28.37% 30	6.08	20.27%
Bome-related nutrients         Image: Second S	20% 5 3.319 66.38% 5	2.43	48.6% 5	3.28	65.6%
Calcium (mg/d)         1300         171         13.15%         1000         688.38         68.84%         1000         475.06         47.           Phosphorus (mg/d)         1250         215         17.2%         700         84.57         120.65%         700         605.04         86.           Magnesium (mg/d)         360         79         21.94%         310         184.26         59.44%         320         133.52         41.           Vitamin D (U/d)         600         50         8.33%         600         108.08         18.01%         600         71.02         11.           Vitamin D (U/d)         600         50         8.33%         600         18.81         18.01%         600         71.02         11.           Vitamin D (U/d)         600         50         8.33%         600         415.48         53.54%         700         256.78         32           Vitamin K (ug/d)         700         118         16.86%         700         417.48%         15         342         24           Vitamin K (ug/d)         75         8         106.7%         90         60.71         67         47           Vitamin K (ug/d)         15         2         117.4%					
$ \begin{array}{llllllllllllllllllllllllllllllllllll$	13.15% 1000 688.38 68.84% 1000	475.06	47.51% 1200	406.53	33.87%
Magnesium (mg/d) $360$ $79$ $21.94\%$ $310$ $18.126$ $59.44\%$ $320$ $133.52$ $41$ Vitamin D (U/d) $600$ $50$ $8.33\%$ $600$ $108.08$ $18.01\%$ $600$ $71.02$ $11.1$ Other micronutients $700$ $118$ $16.86\%$ $700$ $415.48$ $59.35\%$ $700$ $226.78$ $32.$ Vitamin A (ug retinol activity $700$ $118$ $16.86\%$ $700$ $415.48$ $59.35\%$ $700$ $226.78$ $32.$ Vitamin E of alpha-Tocopherol Equiva- 15 $0$ $0\%$ $15$ $2.61$ $17.4\%$ $15$ $3.42$ $2.2$ Vitamin K ( $\mu g/d$ ) $75$ $8$ $10.67\%$ $90$ $60.71$ $67.7$ Vitamin K ( $\mu g/d$ ) $75$ $8$ $10.67\%$ $91.266.7\%$ $8.22$ $47.6$ $59$ Vitamin K ( $\mu g/d$ ) $15$ $0.226.7\%$ $18$ $10.226.7\%$ $47.6$ $59$ Com (mg/d) $15$	17.2% 700 844.57 120.65% 700	605.04	36.43% 700	544.38	77.77%
Vitamin D (U/d)         600         50 $8.33\%$ 600         18.01%         600         71.02         11.           Other micronutrients         Other micronutrients         1         16.86%         700         415.48         59.35%         700         226.78         32.           Other micronutrients         700         118         16.86%         700         415.48         59.35%         700         226.78         32.           Vitamin K (up/d)         75         8         10.67%         90         92.16         17.4%         15         3.42         22.           Vitamin K (up/d)         75         8         10.67%         90         92.16         102.4%         90         60.71         67           Vitamin K (up/d)         75         8         10.67%         90         92.16         102.4%         90         60.71         67           Vitamin K (up/d)         75         8         10.67%         90         92.16         102.4%         90         60.71         67           Vitamin K (up/d)         15         3         33.33%         8         6.44         80.50%         4.76         59           Scolum (g/d)         15         1.5 <td>21.94% 310 184.26 59.44% 320</td> <td>133.52</td> <td>41.72% 320</td> <td>108.65</td> <td>33.95%</td>	21.94% 310 184.26 59.44% 320	133.52	41.72% 320	108.65	33.95%
Other micronutrients         Vitamin A (ug retinol activity         Z00         118         16.86%         Z00         415.48         59.35%         Z00         226.78         32.           vitamin A (ug retinol activity         Z00         118         16.86%         Z00         415.48         59.35%         Z00         226.78         32.           vitamin E of alpha-Tocopherol Equiva-         15         0         0%         15         Z.61         17.4%         15         3.42         22.           Vitamin K (ug/d)         75         8         10.67%         90         92.16         102.4%         90         60.71         67.           Vitamin K (ug/d)         75         8         10.67%         90         92.16         102.4%         90         60.71         67.           Solitor (mg/d)         15         3         20%         1.8         10.82         60.11%         18         82.22         45.5           Sodium (g/d)         15         0         0.75         50%         1.5         1.67         11           Sodium (g/d)         150         0         0.75         1.55         1.67         1.155         32           Odine (ug/d)         150         0	8.33% 600 108.08 18.01% 600	71.02	1.84% 600	46.20	7.7%
Vitamin A (µg retinol activity         700         118         16.86%         700         415.48         59.35%         700         226.78         32.           equivalent/d)         vitamin E of alpha-Tocopherol Equiva-         15         0         0%         15         2.61         17.4%         15         3.42         22.2           vitamin E of alpha-Tocopherol Equiva-         15         0         0%         15         2.61         17.4%         15         3.42         22.2           vitamin K (µg/d)         75         8         10.67%         90         92.16         102.4%         90         60.71         67.           Vitamin K (µg/d)         75         8         10.67%         90         92.16         102.4%         90         60.71         67.           Zinc (mg/d)         15         3         2.0%         18         10.82         60.11%         18         8.22         45.5           Zinc (mg/d)         15         0         0.75         50%         15         167         11         17           Zinc (mg/d)         15         0         0.75         15         167         15         167         167         167         167           D					
Vitamin E of alpha-Tocopherol Equiva-       15       0       0%       15       2.61       17.4%       15       3.42       2.2         lents (mg/d)       75       8       10.67%       90       92.16       102.4%       90       60.71       67.         Vitamin K (µg/d)       75       8       10.67%       90       92.16       102.4%       90       60.71       67.         Iron (mg/d)       15       3       20%       18       10.82       60.11%       18       8.22       45.         Zinc (mg/d)       15       0       75       1.9       126.67%       15       1.67       11         Sodium (g/d)       1.5       0.75       50%       1.5       1.67       11       11         Potassium (g/d)       1.5       0.75       50%       4.7       2.05       0%       157       167       11         Potassium (g/d)       1.50       0       0.76       0       0.66       167       1.55       32         Iotine (µg/d)       1.50       0       0.76       0       0       0       1.126.67%       18       1.55       0%         Manganese (mg/d)       1.6       1       62	16.86% 700 415.48 59.35% 700	226.78	32.4% 700	283.43	40.49%
Vitamin K (µg/d)         75         8         10.67%         90         92.16         102.4%         90         60.71         67.           Iron (mg/d)         15         3         20%         18         10.82         60.11%         18         8.22         45.           Zinc (mg/d)         15         3         20%         18         10.82         60.11%         18         8.22         45.           Sodium (g/d)         1.5         0.75         50%         1.5         1.9         126.67%         15         1.67         11           Potassium (g/d)         1.5         0.75         50%         1.5         1.9         126.67%         15         1.67         11           Potassium (g/d)         150         0         0.75         50%         4.7         2.05         43.62%         4.7         1.57         32.           Potassium (g/d)         150         0         0.66         126.67%         15         1.67         11           Optime (µg/d)         150         0         0.75         43.62%         4.7         1.55         32.           Mangarese (mg/d)         1.6         1         1.50         0         69.7         48.64% <td>0% 15 2.61 17.4% 15</td> <td>3.42</td> <td>22.8% 15</td> <td>6.15</td> <td>41%</td>	0% 15 2.61 17.4% 15	3.42	22.8% 15	6.15	41%
Iron (mg/d)         15         3         20%         18         10.82         60.11%         18         8.22         45.           Zinc (mg/d)         9         3         33.33%         8         6.44         80.50%         8         4.76         59.           Sodium (g/d)         1.5         0.75         50%         1.5         1.9         126.67%         1.5         1.67         111           Potassium (g/d)         1.5         0.75         50%         1.5         1.9         126.67%         1.5         1.67         111           Potassium (g/d)         1.5         0.75         50%         4.7         2.05         4.7         1.55         32.           Iodine (ug/d)         150         0         0%         150         0         0%         74         1.55         32.           Manganese (mg/d)         1.6         1         6.2.5%         1.8         1.99         110.56%         18         1.52         84           Selenium (ug/d)         55         8         1.455%         55         57.65         104.82%         55         45.55         82           Chomium (mg/d)         3         0.102         3.4%         3	10.67% 90 92.16 102.4% 90	60.71 6	57.46% 90	84.97	94.41%
Zinc (mg/d)         9         3         3333%         8         6.44         80.50%         8         4.76         59           Sodium (g/d)         1.5         0.75         50%         1.5         1.9         126.67%         1.5         1.67         11           Sodium (g/d)         1.5         0.75         50%         1.5         1.9         126.67%         1.5         1.67         11           Potassium (g/d)         1.50         0.85         18.09%         4.7         2.05         4.36.2%         4.7         1.55         32.           Iodine (µg/d)         150         0         0%         150         0         0%         150         0.85         0%           Manganese (mg/d)         1.6         1         62.5%         1.8         1.99         110.56%         18         1.52         84           Selenium (µg/d)         55         8         14.55%         55         57.65         104.82%         55         45.55         82           Chromium (mc/d)         3         0.102         3.4%         3         0.183         61	20% 18 10.82 60.11% 18	8.22	ł5.67% 8	5.32	66.5%
Sodium (g/d)         1.5         0.75         50%         1.5         1.9         126,67%         1.5         1.67         11           Potassium (g/d)         4.7         0.85         18.09%         4.7         2.05         43.62%         4.7         1.55         32.           Iodine (µg/d)         150         0         0%         150         0         0%         74.         32.         32.           Manganese (mg/d)         150         0         0%         150         0%         74.         32.         34.         3         32.           Manganese (mg/d)         1.6         1         62.5%         1.8         1.99         110.56%         1.8         1.52         84           Selenium (µg/d)         55         8         14.55%         55         57.65         104.82%         55         45.55         82           Chromium (mg/d)         3         0.102         3.4%         3         0.183         6.1	33.33% 8 6.44 80.50% 8	4.76	59.5% 8	3.75	46.88%
Potassium (g/d)         4.7         0.85         18.09%         4.7         2.05         43.62%         4.7         1.55         32.           Iodine (µg/d)         150         0         0%         150         0         0%         150         085         0%           Copper (mcg/d)         890         1000         11.235%         900         854         94.89%         900         668         74.           Manganese (mg/d)         1.6         1         6.2.5%         1.8         1.99         110.56%         1.8         1.52         84           Selenium (µg/d)         55         8         14.55%         55         57.65         104.82%         55         45.55         82           Fluoride (mg/d)         3         0.102         3.4%         3         0.183         6.1	50% 1.5 1.9 126.67% 1.5	1.67	11.33% 1.3	1.3	100%
Iodine (µg/d)         150         0         0%         150         0.85         0%           Copper (mcg/d)         890         1000         112.35%         900         854         94.89%         900         668         74.           Manganese (mg/d)         1.6         1         62.5%         1.8         1.99         110.56%         1.8         1.52         84.           Selenium (µg/d)         55         8         14.55%         55         57.65         104.82%         55         45.55         82           Fluoride (mg/d)         3         0.102         3.4%         3         0.194         6.47%         3         0.183         6.1	18.09% 4.7 2.05 43.62% 4.7	1.55	32.98% 4.7	1.12	23.83%
Copper (mcg/d)         890         1000         11.2.35%         900         854         94.89%         900         668         74.           Manganese (mg/d)         1.6         1         62.5%         1.8         1.99         110.56%         1.8         1.52         84.           Selenium (µg/d)         55         8         14.55%         55         57.65         104.82%         55         45.55         82           Fluoride (mg/d)         3         0.102         3.4%         3         0.194         6.47%         3         0.183         6.1	0% 150 0 0% 150	0.85 (	150 150	00.00	0%
Manganese (mg/d)         1.6         1         62.5%         1.8         1.99         110.56%         1.8         1.52         84.           Selenium (µg/d)         55         8         14.55%         55         57.65         104.82%         55         45.55         82.           Fluoride (mg/d)         3         0.102         3.4%         3         0.194         6.47%         3         0.183         6.1           Chromium (mcc/d)         24         0         0%         25         49.00         195.68%         75         41.813         16	112.35% 900 854 94.89% 900	668	74.22% 900	624.00	69.33%
Selenium (µg/d)         55         8         14.55%         55         57.65         104.82%         55         45.55         82.           Fluoride (mg/d)         3         0.102         3.4%         3         0.194         6.47%         3         0.183         6.1           Chromium (mcc/d)         24         0         0%         75         49.00         195.58%         55         41.813         16	62.5% 1.8 1.99 110.56% 1.8	1.52 8	34.44% 1.8	1.69	93.89%
Fluoride (mg/d) 3 0.102 3.4% 3 0.194 6.47% 3 0.183 6.1 Chromium (mcc/d) 24 0 0% 25 49.00 195.88% 25 41.813 16	14.55% 55 57.65 104.82% 55	45.55 8	32.82% 55	50.11	91.11%
Chromium (mcc/d) 24 0 0% 25 49.00 195.98% 25 41.813 16	3.4% 3 0.194 6.47% 3	0.183 (	5.1% 3	0.13	4.33%
	0% 25 49.00 195.98% 25	41.813	67.2% 20	29.88	149.4%
Molybdenum (µg/d) 43 2 4.65% 45 13.56 30.13% 45 12.25 27,	4.65% 45 13.56 30.13% 45	12.25	27.22% 45	8.54	18.98%

		Overall (N=155)	Males (n = 65; 41.9%)	Females ( <i>n</i> = 90; 58.1%)	P-value
		N (%)	N (%)	N (%)	
Breakfast	Nothing / almost nothing	14 (9.0)	7 (10.8)	7 (7.8)	0.080
	About ¼	15 (9.7)	3 (4.6)	12 (13.3)	
	About half	32 (20.6)	14 (21.5)	18 (20.0)	
	About ¾	37 (23.9)	11 (16.9)	26 (28.9)	
	All / almost everything	57 (36.8)	30 (46.2)	27 (30.0)	
Lunch	Nothing / almost nothing	16 (10.3)	8 (12.3)	8 (8.9)	0.045
	About ¼	19 (12.3)	5 (7.7)	14 (15.6)	
	About half	41 (26.5)	15 (23.1)	26 (28.9)	
	About ¾	35 (22.6)	11 (16.9)	24 (26.7)	
	All / almost everything	44 (28.4)	26 (40.0)	18 (20.0)	
Dinner	Nothing / almost nothing	18 (11.6)	7 (10.8)	11 (12.2)	0.067
Snack	About ¼	19 (12.3)	6 (9.2)	13 (14.4)	
	About half	35 (22.6)	13 (20.0)	22 (24.4)	
	About ¾	40 (25.8)	13 (20.0)	27 (30.0)	
	All / almost everything	43 (27.7)	26 (40.0)	17 (18.9)	
Snack	Nothing / almost nothing	26 (16.8)	12 (18.5)	14 (15.6)	0.029
Snack	About ¼	13 (8.4)	3 (4.6)	10 (11.1)	
	About half	22 (14.2)	6 (9.2)	16 (17.8)	
	About ¾	26 (16.8)	7 (10.8)	19 (21.1)	
	All / almost everything	68 (43.9)	37 (56.9)	31 (34.4)	
Bringing food from	Not always	110 (71.0)	41 (63.1)	69 (76.7)	0.066
outside	Always	45 (29.0)	24 (36.9)	21 (23.3)	
Frequency of order-	At least once per day	34 (21.9)	20 (30.8)	14 (15.6)	0.070
ing food from outside	once every two days	13 (8.4)	7 (10.8)	6 (6.7)	
	once every three days or less	14 (9.0)	4 (6.2)	10 (11.1)	
	Not applicable	94 (60.6)	34 (52.3)	60 (66.7)	

<b>Table 7</b> Meals and snacks consumption at hospitals among study particip	pants, overal	land	by gend	ler
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*P*-value in **Bold** is significant

patient was served 72 g of proteins and consumed 50 g of this amount per day. A slightly higher proportion of proteins was served to a patient in the Netherlands (76 g per day) [11]; however, a slightly lower amount (47 g per day) was consumed compared to our study. Similarly, in Denmark [21], a patient consumed 46 g of proteins per day, slightly lower than the amount consumed by a patient in our study. Also, a study done in Spain [25] showed higher amounts (321.1 g carbohydrates, 107.1 g proteins, 73 g fat) in the food served compared to those in our study (196 g carbohydrates, 72 g proteins, 44.6 g fat). In general, the total carbohydrate, protein, and fat content of food served failed to meet the daily intake requirements of the hospitalized patients in our study.

As for micronutrients, no previous studies reported the nutritional value of food served to and consumed by patients based on gender and age categories. The study done in Spain [25] showed that food served did not provide sufficient amounts of micronutrients, especially of vitamins D and E, similar to our results.

In general, our findings revealed that patients did not meet their daily requirements for almost all the macroand micro-nutrients, and this is concerning as it puts patients at risk of hidden hunger and malnutrition. Thus, to prevent hidden hunger and malnutrition, the dietary consumption of hospitalized patients is crucial and should be monitored regularly. This can be accomplished by ensuring that the menus provided to patients are adequate regarding energy and protein content.

## Adherence to the hospitals' diet to the Mediterranean diet

Mediterranean diet is a long-established nutritional regimen linked to a positive impact on health, quality of life, and lifespan [26]. Our findings revealed that Lebanese hospitals' diets show low adherence to the Mediterranean diet. This came in alignment with a study conducted by Aridi et al. on breast cancer female patients in Beirut, Lebanon, where low adherence to the Mediterranean diet was observed [27]. Low adherence to the Mediterranean diet was also observed in diets provided to older adults in Turkish hospitals [28] and to elderly patients in Italy [26].

Based on our results, we recommend that Lebanese hospitals as low adherence to the Mediterranean diet are found to be associated with high levels of several circulating inflammatory markers in both adults and adolescents and even elderly patients, increased hospitalization length of stay, changes in body composition, and poor nutritional state, which could contribute to worse clinical outcomes [26]. Adherence to the Mediterranean diet principles can thus improve patients' nutritional status and help prevent hidden hunger and malnutrition.

## Consumption of meals and snacks

Based on our findings, among the meals, patients consumed the highest percentage (43.9%) of snacks, followed by breakfast (36.8%), lunch (28.4%), and dinner (27.7%). Our findings also revealed that most patients consumed half and more of their meals, similar to a study done in Iran by Simzari et al. [10]. Furthermore, our study showed that in Lebanese hospitals, males exhibited a higher consumption rate for provided meals than females, which aligns with the findings of Schiavone et al., who reported that females tend to waste food more than males in hospitals [12].

## **Strengths and limitations**

Recent studies evaluated the food waste generation among Lebanese hospitals [29-31]. However, this is the first study of its kind in Lebanon and the Arab region to investigate the composition of food served and consumed at hospitals and the adherence of the menus provided to the Mediterranean diet. Thus, our study is significant as it contributes to the literature by addressing an area that has not yet been assessed in the country and the region. Our findings can be used to inform hospitals' food service managers and dietitians about the importance of this topic to take progressive steps to improve the diets provided in Lebanese hospitals and make sure they provide sufficient energy and macro- and micro-nutrients to avoid nutrition inadequacy and its related complications in patients and to implement effective strategies to increase plates' appeal and improve their consumption by patients.

Despite that, the current study has some limitations. Initially, being a cross-sectional study, this limits the ability to establish a cause-effect relationship. In addition, no previous studies assessed the nutritional value of diets in hospitals by stratifying the sample into age categories, making it impossible to compare our results from this perspective. Moreover, the study did not adequately represent some of the governorates, like Akkar and Beqaa/ Baalbek-Hermel.

## Conclusion

In conclusion, hospital foodservice play an important role in patients' recovery during hospitalization; thus, ensuring they provide adequate diets that provide sufficient energy and macro- and micro-nutrients is crucial to avoid hidden hunger and malnutrition in patients and even death. The study results call for public health policies, interventions, and foodservice management strategies to provide adequate diets and increase their acceptance and appeal by patients. This would require implementing interventions such as adherence to the Mediterranean diet, as it is proven to be one of the healthiest diets.

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#### Author contributions

H.H., M.H. and M.A. conceptualized the project, managed it, analyzed and validated the resultsM.K., D.M., F.F., S.K., J.E., E. (A) and N. (B) collected and analyzed the dataAll authors wrote and reviewed the manuscript.

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#### Data availability

Data is provided within the manuscript or supplementary information files.

## Declarations

#### Ethics approval and consent to participate

This project was reviewed and approved by the Ethical Committee of the Lebanese American University (LAU), Beirut, Lebanon (approval number: LAU. SAS.HHI.2023). The anonymity of respondents was guaranteed throughout the process of data collection and analysis. Informed consent was obtained from all subjects involved in the study.

## **Consent for publication**

Not applicable.

#### **Competing interests**

The authors declare no competing interests.

#### Author details

<sup>1</sup>Department of Nutrition and Food Science, School of Arts and Sciences, Lebanese American University, Beirut, Lebanon

<sup>2</sup>Faculty of Public Health, Lebanese University, Section I, Hadath, Beirut, Lebanon

<sup>3</sup>Department of Food Sciences and Technology, School of Arts and Sciences, Lebanese International University, P.O. Box 146404, Bekaa, Lebanon

<sup>4</sup>Center for Applied Mathematics and Bioinformatics (CAMB), Gulf University for Science and Technology, P.O. Box 7207, Hawally 32093, Kuwait

<sup>5</sup>Department of Nutrition and Food Sciences, Faculty of Agricultural and Food Sciences, American University of Beirut, Beirut, Lebanon

<sup>6</sup>Laboratories for the Environment, Agriculture, and Food (LEAF), Faculty of Agricultural and Food Sciences, American University of Beirut, Beirut, Lebanon

 $^7\mathrm{Food}$  Sciences Unit, National Council for Scientific Research of Lebanon (CNRS-L), Beirut, Lebanon

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