RESEARCH ARTICLE

ASSESSMENT OF NUTRITION KNOWLEDGE AMONG PATIENTS ATTENDING PRIMARY HEALTHCARE CENTERS.

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Manuscript Info

Abstract

Background: Inadequate eating behaviors may be associated with multiple disorders such as diabetes mellitus, cancer, and ischemic heart diseases. People’s nutritional knowledge (NK) regarding their healthy food may have a strong impact on their eating behavior and compliance with healthy diet for themselves and their children.

Objectives: To assess the NK and predictors of inadequate NK among the patients attending primary healthcare centers (PMC).

Settings and Design: A cross-sectional questionnaire-based study has been conducted in PMC in Jeddah, Saudi Arabia.

Methods and Material: A modified version of the General Nutrition Knowledge (GNK) questionnaire was used. The answers were scored from 0 to 1 proportional to the number of correct answers and three scores were calculated: healthy food knowledge (HFK), food composition knowledge (FCK) and GNK scores.

Statistical analysis: The association between NK scores and demographic and lifestyle factors was analyzed using nonparametric tests. Predictors of inadequate nutrition knowledge (GNK<66.7%) were analyzed by carrying out a binary logistic regression model.

Results: Among 397 participants, the mean scaled scores for GNK, HFK and FCK were 63.11%, 65.36%, and 61.62% respectively. FCK and GNK scores were significantly increased in females and people with high socioeconomic statuses, while all variables were elevated in those who received university-level education. Inadequate NK was significantly more observed in males, Saudis and the people with secondary school education level and less among individuals with personal interest in nutrition.

Conclusions: There is overall inadequate GNK among patients attending PMC, with significant association with educational and socioeconomic factors. It is necessary to conduct long-term nutrition educational programs targeted to patients having a disease requiring specific diet with focusing on the commitment to healthy food habits.

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Introduction:
There is substantial scientific evidence of relationship between dietary habits and health. Several chronic diseases such as cardiovascular diseases, diabetes mellitus, obesity and cancers are demonstrated to be associated with improper balance of food. An ecological study from Serbia showed several correlations between mortality from cancer, ischemic heart diseases (IHD) and diabetes mellitus and average annual consumption of common food groups and beverages per household’s member, over 20 years. Among the findings, consumption of vegetable oils, grains and beef were associated with lower cancer-related mortality rates; while high consumption of diary food and poultry was associated with higher cancer-related mortality rates. Similarly, mortality related to IHD was reduced by vegetables oils and grains and increased by dairy products. Diabetes mellitus-related mortality was associated with high consumption of dairy products, animal fats and poultry. Another report from a large cohort study in Japan, the Japan Collaborative Cohort (JACC) Study for Evaluation of Cancer Risk, demonstrated that there is a linear relationship between the amount of sodium intake and the risk of cancer of the stomach. In addition, excessive salt in food is associated to increased cancer-related mortality in the elderly. A meta-analysis of 4 case-control studies with more than 4,900 patients showed that high consumption of fried food increased by 35% the risk of prostate cancer.

Modern eating behaviors are associated with an increased incidence of diabetes and obesity. A study from UK suggested that the number of fast-foods in a city is predictive for the incidence of new cases of diabetes mellitus and obesity. Another study from Iran showed that modern changes in eating habits including over-eating, high fat and high dairy foods are also associated with increased gastric cancers.

On the other hand, people’s knowledge about dietary rules and healthy food may influence their eating behavior and compliance with healthy diet for themselves, as well as for their children. In addition, physicians often use generic terms when providing dietary advice to their patients. For example, several patients are advised to eat more fibers or starchy foods rather than sugars, or to avoid salty foods etc. However, poor literacy, unawareness or misconception about the foods and aliments that contain these types of nutrients may result in poor compliance with the provided dietary advice. All these data show the importance of people’s accurate knowledge about healthy eating and general dietetic rules, as well as their nutrition literacy.

The aim of this study is to assess the level of knowledge in nutrition and healthy dietary rules among patients attending primary healthcare centers (PHC) and to investigate factors associated with nutrition knowledge as well as predictors of inadequate knowledge.

Methods:
A descriptive cross-sectional study was carried out in PHC centers in Saudi Arabia from 20th Nov to 10th Dec 2017. A structured and anonymous questionnaire designed by authors was administered to all patients or visitors attending the PHC who accepted to participate. Participants were recruited using a stratified two-stage cluster sampling method. Jeddah was stratified into five primary healthcare sectors; each sector contains 7 to 13 centers. Within each sector, 2 primary care centers (clusters) were randomly selected. All patients attending the selected PHC during the study period will be invited to participate, until reaching the sample size.
Sample size (N=336) was calculated for a 95% confidence interval and 80% statistical power; to detect 67.8% of estimated proportion of participants with good or satisfactory nutrition knowledge, the outcome of interest. To adjust for eventual incomplete questionnaire filling, the sample size was increased by 20%, resulting in target sample size N=410 participations.

Single choice questions were scored 1 for correct and 0 for incorrect answers. Multiple-choice answers were scored from 0 to 1 proportional to the number of correct answers. Raw scores including GNK, and HFK and FCK dimensions, as well as score for the respective sub-dimensions (recommended amounts of food, discriminating healthy from unhealthy meals, etc.) were calculated by adding scores of the relating questions. Thus, the three main raw scores ranged from 0-28 for HFK, 0-42 for FCK and 0-70 for GNK. For practical reasons, scaled scores (%GNK, %HFK, %FCK) were calculated by percentage transformation of the three previous scores using the following formulas: %GNK=100 * GNK raw score/70; %HFK=100 * HFK raw score/28; %FCK=100 * FCK raw score/42.

Analysis of internal consistency for the whole questionnaire showed good reliability with Cronbach’s alpha=0.827. The two questionnaire subscales showed 0.584 and 0.822 Cronbach’s alpha for HFK and FCK, respectively.

The ethical approval of this study was obtained from the Medical Research and Studies Department, Directorate of Health Affairs, Ministry of Health–Jeddah. The confidentiality of participants’ information was preserved to protect their privacy. All participants were informed by a physician on the rationale and aims of the questionnaire.

Statistical Analysis:
Statistical analysis was performed with the Statistical Package for Social Sciences version 21.0 for Windows (SPSS Inc., Chicago, IL, USA). Score variables were analyzed regarding normality using Shapiro-Wilk and Kolmogorov-Smirnov and showed to be non-normally distributed. Consequently, association of GNK, HFK and FCK with demographic and lifestyle factors was analyzed using nonparametric tests including Mann-Whitney U test for factors with two categories and Kruskal-Wallis test for those with 3 or more categories. Results were presented as mean (standard deviation [SD]). Univariate and multivariate binary logistic regression model were carried out to analyze predictors of inadequate nutrition knowledge, which was defined as %GNK<66.7, the independent variable. Results were presented as odds-ratio (OR) and 95% confidence interval (CI). A p value of <0.05 was considered to reject the null hypothesis.

Results:
The study included 397 participants, 55.6% males, mean (SD) age=33.60 (10.20) years, 67.5% were married. Majority were highly educated (university+, 60.5%) and 20.7% had low income (<5K SAR, 20.7%) (Table 1).

Of the participants, 28.4% declared having health or nutrition qualification, 32.3% followed a diet and 19.5% had diseases that require a special diet. Further, half of the participants (49.9%) declared that their physicians provided them with dietary advice, 56.9% had personal interest in dietetics and 42.7% believed that they generally have healthy eating habits (Table 2).

The mean (SD) raw and scaled scores relating to the different questionnaire subscales are presented in Table 3. These showed a mean (SD) %GNK=63.11% (11.75), mean %HFK=65.36% (9.93) and mean (SD) %FCK=61.62% (16.04). On a scale from 0 to 10, discriminating between healthy from unhealthy foods (mean [SD] score=7.10 [1.93]) and food content of added sugar (mean [SD]=7.07 [2.26]) showed the highest scores among HFK and FCK subscales, respectively. Distribution of the participants in three knowledge levels showed 1.5% with poor (%GNK≤33.3), 56.7% with moderate (%GNK>33.3-66.7) and 41.8% with good (%GNK>66.7) nutrition knowledge (these results are not presented in tables).

Gender was significantly associated with both FCK (p=0.0001) and GNK (p=0.0007) showing higher scores among females by comparison to males; while it was not associated with HFK (p=0.419). Educational level was significantly associated with all three parameters showing highest scores among participants with university+ level including HFK (p=0.00006), FCK (p=0.030), and GNK (p=0.003) by comparison to their counterparts; while those with low educational level (illiterate) showed the lowest scores in all three parameters. Socioeconomic status was associated with FCK (p=0.046) and GNK (p=0.044) showing highest scores for category of participants with the highest economic status (monthly income>15K SAR) (Table 4).
Correlation of nutrition knowledge with lifestyle factors showed higher HFK, FCK and GNK scores among participants who declared following a diet (p=0.010, 0.011 and 0.006), receiving dietary advice from their physicians (p=0.016, 0.005 and 0.002), and having personal interest in dietetics (p=0.047, 0.019 and 0.009), by comparison to their counterparts. Participants who declared having healthy eating habits had higher FCK (p=0.00001) and GNK (p=0.00007) by comparison to their counterpart; whereas no difference was observed in HFK (p=0.264) (Table 5).

Univariate regression models showed that male gender (OR [95%CI]=1.51 [1.01, 2.27]; p=0.050), Saudi nationality (OR [95%CI]=1.83 [1.01, 3.33]; p=0.047), secondary school educational level (OR [95%CI]=1.94 [1.20, 3.14]; p=0.007), and residency in owned apartment (OR [95%CI]=0.47 [0.23, 0.96; p=0.039) were significant sociodemographic predictors of inadequate nutrition knowledge defined as %GNK<66.7 (Table 6). Regarding lifestyle predictors, following any diet (OR [95%CI]=0.61 [0.39, 0.94]; p=0.027), having personal interest in dietetics (OR [95%CI]=0.56 [0.37, 0.86; p=0.007), and having a healthy eating habit (OR [95%CI]=0.39 [0.25, 0.59; p=0.000011) were significant predictors of inadequate nutrition knowledge. Remarkably, participants with a disease requiring a special diet showed no superiority in nutrition knowledge compared to their counterparts (p=0.315). In multivariate model, having secondary school educational level (OR [95%CI]=1.85 [1.01, 3.41]; p=0.047), dwelling in owned apartment (OR [95%CI]=0.43 [0.19, 0.99; p=0.047), having personal interest in dietetics (OR [95%CI]=0.43 [0.23, 0.81; p=0.009), and believing to have healthy eating habits (OR [95%CI]=0.50 [0.28, 0.89; p=0.019) were the independent factors of inadequate nutrition knowledge.

Discussion:-

There have been several interchangeable factors affecting food-related behavior including socioeconomic, occupational, physiological, and lifestyle factors. In addition, nutritional knowledge and personal diet-related attitudes are considered core players in food behavior.11,12 The aim of this cross-sectional questionnaire-based study was to provide information about the nutritional knowledge among patients attending PMC in Jeddah, Saudi Arabia. Despite accomplishing an outstanding development and progress in Saudi Arabia in the last few decades, several studies have shown that there might be nutritional deficiencies among Saudis.13-15 Indeed, insufficient nutritional knowledge might be the main apparent reason since there was no food shortage during this period along with increased obesity prevalence among adults.16,17 In this study, Saudi people were at high risk of having inadequate nutritional knowledge as per assessment of its predictors. In spite of the recent changes related to enhanced social communication and interaction, the perception of personal health status and nutritional knowledge in middle-aged populations seems to be low particularly among obese individuals. However, such aspect may be different in diseased populations.

In this study, GNK and FCK were significantly higher in females than males. This observation was also reported in an adult Saudi population18, adolescents in United States19, and among high school students in Iran20. This may be due to the fact that females are more concerned with their general appearance and body image particularly those employed in the work field. However, it seems that females have weak attitudes related to the daily meal consumption and food grouping activities, a matter which may be attributable to their tendency to select certain food types with an estimated daily intake in spite of their proper nutritional awareness21. In Saudi Arabia, nutritional education at higher institutions is mainly provided to female students, providing another possible notion for this finding22.

Therefore, it was not surprising that the educational level impacted the nutritional knowledge in general. In our study, scores of HFK, FCK, and GNK were higher among patients with university degrees or higher. In addition, participants attending secondary schools were at high risk of having poor nutritional knowledge. Higher education introduces a considerable support of nutritional information if compared to younger children as the latter are more liable to be affected by family food patterns and the recommendations by their parents. Several studies have revealed similar results, indicating a positive association between the overall score of nutrition-related questionnaire and the educational level.22-24 Nonetheless, nutritional knowledge might be viewed as only a determinant factor of food consumption behavior. In fact, although their increased knowledge, the highly-educated students might not comply with the healthy food habits. Montero Bravo and co-authors25 have shown that the college students receiving health-related education materials were not in compliance with their provided food-related information. Likewise, Alissa and other researchers26 observed a lack of health and nutritional consciousness in the medical students, which might be explained by poor time management due to their busy study schedules.
Our data showed a significant association between high economic status and improved FCK and GNK. Among Lebanese adolescents, Nabhan-Zeidan and co-authors found significant associations between the socioeconomic status and total nutritional knowledge, particularly in terms of diet-disease relationship. Similarly, several European studies showed that the low economic status might result in consuming less healthy food due to lack of knowledge about proper food composition. The same findings were also reported in Iranian households. These observations could be possibly explained by the fact that diets with low-cost are usually rich in fat and sugar, while the increase in socioeconomic status contributed to more intake of fruit and vegetables. Indeed, diet quality can be essentially affected by personal food purchase selections due to variations in personal attitudes. Several integrating factors may be involved in nutritionally-low-knowledgeable people with low economic income such as low education and their care for food price. For participants' ages, it has been observed that sufficient knowledge about food composition and favorable nutritional habits could be obtained with age through media and social interaction. Collectively, all of the aforementioned findings are supported by other studies showing that the less educated male and young populations are more susceptible to be less knowledgeable about nutrition and food composition.

Our cohort showed high mean values of nutritional knowledge level. Obviously, this is because most of them (80.5%) have had diseases which required a special diet as they were attending healthcare centers. This could be clearly noticed in the reported high scores of FCK, especially those related to food content of added sugar which might be of a great concern for diabetic patients. Both salt and fat content in the food are of a particular importance for patients with hypertension. From another perspective, about one-third of our population (28.4%) have had health or nutritional qualifications, a matter which could clarify the generally-increased knowledge scores. However, the lack of confirmed evaluation of nutritional knowledge in our patients through targeted questions might render an incomplete framing of the problem. Actually, only a small percentage of cardiac patients in the study of Plous and colleagues showed a complete understanding of the received dietary education aimed at preventing the risk of disease complications. Further, more than one-third of hemodialysis patients were not compliant with their dietary limits in spite of their sufficient knowledge of the restrictions. On the other hand, it was apparently clear that long-term educational programs might be required for an optimal efficacy of dietary compliance as demonstrated in hypertensive patients.

Lifestyle factors might have a significant role in the nutritional knowledge of a given individual. Again, referring to the socioeconomic status, it has been found that the individuals with high economic levels have had high educational levels and this was accompanied with more frequent physical activity and less frequent unfavorable eating habits. The knowledge about physical activities was associated with an increase in awareness of healthy food composition although the participants might lack the deep knowledge about nutrient functions and macronutrients. However, our data did not reveal any significant difference between the exercise-performing participants and those without regular physical exercise patterns. It is necessary to mention that both the basic cultural patterns of Saudi population and the possibility of the existence of hindering diseases might contribute to this finding. All nutritional knowledge-related scores were increased significantly in those who followed special diets and those who received dietary advice from their physicians. In fact, patients are usually aware of gaining the adequate knowledge about food habits regardless their commitment to such instructions.

The relationship between some personal and environmental factors in the modern times and common eating habits should be considered especially in adolescents and younger populations. Meal frequency, time constraints, dieting, and food cost are all among the strongest lifestyle determinants of food selection and eating habits in adolescents as they might preferentially tend to snacking with a low intake of fruits and vegetables. As previously mentioned, nutritional knowledge might play a weak role in changing eating habits in this age group. Conversely, older populations usually consume food rich in fruits and vegetables with an increased frequency of weekly physical activities. Such differences between both age groups are attributed to variations in social influence. Furthermore, older people might have more polished nutritional knowledge with subsequent healthy food and lifestyle.

Overall, our study employed a small sample size which can be considered an important limitation. We included healthy subjects in our survey and this may render a difficult estimation of nutritional knowledge in unhealthy individuals. In conclusion, it seems that the general nutritional knowledge is still inadequate among Saudi patients, and being less educated, male, with low socioeconomic status, and young in age may indicate more susceptibility to low nutritional knowledge. Importantly, having a disease that requires specific dietary rules does not seem to be a pushing factor to seek for proper knowledge related to food habits, food composition, and healthy lifestyle.
Consequently, it is necessary to conduct efficient nutrition educational programs targeted for such populations, which are specifically designed and aimed at both enhancing the core information databases as well as focusing on the commitment to healthy food habits. This should be held for considerable periods particularly for patients with chronic diseases.

**Key message:** Nutrition educational programs should be targeted to patients having a disease requiring specific diet, along with systematic assessment of their nutrition knowledge and their commitment to healthy food habits. Long-term programs may be preferred for those with chronic illnesses, considering a special concern for individuals with low educational and socioeconomic levels.

**Table 1:** Demographic and socioeconomic characteristics of the study population

| Parameter          | Value            | Frequency / mean | Percentage/SD |
|--------------------|------------------|------------------|---------------|
| Gender             | Male             | 213              | 55.6          |
|                    | Female           | 170              | 44.4          |
| Age                | Mean (SD)        | 33.60            | 10.20         |
| Marital status     | Single           | 107              | 27.4          |
|                    | Married          | 264              | 67.5          |
|                    | Divorced         | 17               | 4.3           |
|                    | Widowed          | 3                | 0.8           |
| Nationality        | Saudi            | 303              | 85.6          |
|                    | Non-Saudi        | 51               | 14.4          |
|                    | Middle-Eastern   | 12               | 3.5           |
|                    | Asian            | 7                | 1.7           |
|                    | Unspecified      | 32               | 6.27          |
| Occupation         | Administration   | 59               | 17.3          |
|                    | Commercial       | 19               | 5.6           |
|                    | Services         | 29               | 8.5           |
|                    | Security/Police/Military | 31 | 9.1 |
|                    | Education        | 56               | 16.4          |
|                    | None             | 62               | 18.2          |
|                    | Other            | 85               | 24.9          |
| Educational level  | Illiterate       | 4                | 1             |
|                    | Primary          | 31               | 7.8           |
|                    | Secondary        | 107              | 27            |
|                    | University +     | 240              | 60.5          |
|                    | Unspecified      | 15               | 3.8           |
| Household type     | Villa            | 84               | 21.15         |
|                    | Apartment        | 258              | 64.98         |
|                    | Unspecified      | 55               | 13.9          |
| Household ownership| Owner            | 130              | 32.74         |
|                    | Rental           | 212              | 53.4          |
|                    | Other/Unspecified| 55               | 13.9          |
| Income             | <5,000 SAR       | 73               | 20.7          |
|                    | 5,000 – 10,000 SAR| 146              | 41.5          |
|                    | 10,000 – 15,000  | 86               | 24.4          |
|                    | >15,000          | 47               | 13.4          |

SD: Standard deviation; SAR: Saudi Arabian Riyal.

**Table 2:** Lifestyle characteristics of the study population

| Parameter                                           | Value | Frequency | Percentage |
|-----------------------------------------------------|-------|-----------|------------|
| Do you have Children below 18 years living with you? | Yes   | 210       | 56.8       |
|                                                     | No    | 160       | 43.2       |
| Do you have any health or nutrition qualifications? | Yes   | 104       | 28.4       |
|                                                     | No    | 262       | 71.6       |
Table 3: Nutrition knowledge level among the study population

| Parameter                                              | Raw score | Scaled score |
|--------------------------------------------------------|-----------|--------------|
|                                                       | Ref.      | Mean | SD | Scale | Mean | SD |
| Healthy food knowledge (HFK, %HFK)                    | 28        | 18.3 | 2.78 | 100   | 65.36 | 9.93 |
| Recommended amounts of foods                          | 8         | 4.29 | 1.73 | 10     | 5.36  | 2.16 |
| Discriminating healthy food from unhealthy foods      | 6         | 4.26 | 1.16 | 10     | 7.10  | 1.93 |
| Healthy choices                                       | 6         | 4.19 | 0.94 | 10     | 6.98  | 1.56 |
| Pathological correlations of nutrients                | 8         | 5.57 | 0.58 | 10     | 6.96  | 0.72 |
| Food Composition Knowledge (FCK, %FCK)                | 42        | 25.88 | 6.73 | 100   | 61.62 | 16.04 |
| Food content of added sugar                           | 7         | 4.95 | 1.58 | 10     | 7.07  | 2.26 |
| Food content of fat                                   | 7         | 3.79 | 1.6  | 10     | 5.42  | 2.29 |
| Food content of salt                                  | 7         | 4.25 | 1.6  | 10     | 6.08  | 2.28 |
| Food content of fibers                                | 7         | 4.01 | 1.79 | 10     | 5.73  | 2.56 |
| Food content of protein                               | 7         | 4.17 | 1.57 | 10     | 5.95  | 2.24 |
| Food content of starch                                | 7         | 4.71 | 1.68 | 10     | 6.73  | 2.40 |
| General Nutrition Knowledge (GNK, %GNK)               | 70        | 44.18 | 8.23 | 100   | 63.11 | 11.75 |

Ref. Reference value corresponding to the maximum possible raw score.

Table 4: Demographic and socioeconomic factors associated with nutrition knowledge

| Factor         | Category          | HFK score Mean | SD | p-value   | FCK score Mean | SD | p-value | GNK score Mean | SD | p-value |
|----------------|-------------------|----------------|----|-----------|----------------|----|----------|----------------|----|----------|
| Gender         | Male              | 18.21          | 2.72 | .419 $\text{\$}$ | 24.71          | 6.98 | .0001* $\text{\$}$ | 42.92          | 8.53 | .0007* $\text{\$}$ |
|                | Female            | 18.47          | 2.73 |           | 27.37          | 6.17 |           | 45.85          | 7.45 |           |
| Marital status | Single            | 18.17          | 2.71 | .721 $\text{\$}$ | 25.93          | 6.64 | .559 $\text{\$}$ | 44.11          | 8.08 | .566 $\text{\$}$ |
|                | Married           | 18.42          | 2.75 |           | 26.06          | 6.59 |           | 44.48          | 8.05 |           |
|                | Divorced          | 18.08          | 2.43 |           | 23.00          | 8.74 |           | 41.14          | 9.95 |           |
|                | Widowed           | 18.34          | 1.00 |           | 28.33          | 5.5  |           | 46.67          | 5.68 |           |
| Nationality    | Saudi             | 18.34          | 2.64 | .0052* $\text{\$}$ | 25.62          | 6.55 | .234 $\text{\$}$ | 43.96          | 7.97 | .068 $\text{\$}$ |
|                | Non-Saudi         | 19.36          | 2.61 |           | 26.27          | 7.99 |           | 45.64          | 9.59 |           |
| Job sector     | Administration    | 18.21          | 2.64 | .307$\text{\$}$ | 24.83          | 6.49 | .052$\text{\$}$ | 43.04          | 8.08 | .142$\text{\$}$ |
|                | Commercial        | 18.37          | 2.95 |           | 26.53          | 6.53 |           | 44.89          | 7.82 |           |
|                | Services          | 18.11          | 3.01 |           | 25.72          | 7.23 |           | 43.84          | 9.09 |           |
|                | Police/ Military  | 18.69          | 2.56 |           | 23.45          | 6.71 |           | 42.14          | 8.27 |           |
|                | Education         | 18.82          | 3.32 |           | 27.63          | 6.26 |           | 46.45          | 8.22 |           |
### Table 5: Lifestyle factors associated with nutrition knowledge

| Factor                                      | Category                          | HFK score | FCK score | GNK score |
|---------------------------------------------|-----------------------------------|-----------|-----------|-----------|
|                                             | (Mean, SD)                        | p-value   | (Mean, SD)| p-value   | (Mean, SD) | p-value |
| Children <18 years living with you?         | Yes                               | 18.55     | 2.72     | 0.95      | 26.84     | 6.33     | 0.109     | 45.40     | 7.80     | 0.079     |
|                                             | No                                | 17.98     | 2.95     |           | 25.71     | 6.48     |           | 43.70     | 8.17     |
| Health or nutrition qualifications?         | Yes                               | 18.43     | 2.88     | 0.522     | 27.19     | 6.07     | 0.201     | 45.62     | 7.577    | 0.241     |
|                                             | No                                | 18.26     | 2.83     |           | 26.07     | 6.47     |           | 44.33     | 8.10     |
| Follow any diet?                            | Yes                               | 18.68     | 3.08     | 0.010     | 27.42     | 6.65     | 0.011     | 46.10     | 8.49     | 0.006*    |
|                                             | No                                | 18.13     | 2.69     |           | 25.84     | 6.23     |           | 43.98     | 7.66     |           |
| Disease requiring a special diet?           | Yes                               | 18.21     | 3.32     | 0.942     | 26.56     | 5.59     | 0.934     | 44.77     | 7.72     | 0.896     |
|                                             | No                                | 18.33     | 2.71     |           | 26.28     | 6.61     |           | 44.62     | 8.08     |
| Close relative on a special diet            | Yes                               | 18.50     | 2.88     | 0.060     | 26.59     | 6.35     | 0.437     | 45.10     | 8.07     | 0.213     |
|                                             | No                                | 18.06     | 2.77     |           | 25.99     | 6.48     |           | 44.05     | 7.87     |
| physician provides dietary advice?          | Yes                               | 18.56     | 3.04     | 0.016     | 27.27     | 6.12     | 0.005     | 45.84     | 7.83     | 0.002*    |
|                                             | No                                | 18.05     | 2.6      |           | 25.42     | 6.55     |           | 43.48     | 7.98     |
| personal interest in eating dietetics?      | Yes                               | 18.53     | 2.75     | 0.047     | 27.02     | 6.14     | 0.019     | 45.56     | 7.69     | 0.009*    |
|                                             | No                                | 18.01     | 2.91     |           | 25.48     | 6.66     |           | 43.49     | 8.24     |
| Regular physical exercise                   | Yes                               | 18.28     | 3.16     | 0.521     | 26.79     | 6.48     | 0.299     | 45.07     | 8.43     | 0.324     |
|                                             | No                                | 18.32     | 2.62     |           | 26.09     | 6.36     |           | 44.42     | 7.72     |
| Smoking or substance abuse                  | Yes                               | 18.29     | 2.78     | 0.760     | 25.88     | 6.32     | 0.303     | 44.17     | 7.94     | 0.387     |
|                                             | No                                | 18.34     | 2.83     |           | 26.53     | 6.45     |           | 44.88     | 8.02     |
| Generally, do you consider your eating      | Yes                               | 18.38     | 3.17     | 0.264     | 27.86     | 6.38     | 0.0001    | 46.24     | 8.50     | 0.0007    |
|                                             | No                                | 18.27     | 2.55     |           | 25.22     | 6.22     |           | 43.49     | 7.41     |           |

¶ Using Mann-Whitney U Test; ¥ using Kruskal-Wallis Test, * statistically significant result (p<0.050); SD: Standard deviation. , SAR = Saudi Arabia Riyal; HFK: healthy food knowledge; FCK: food content knowledge; GNK: general nutrition knowledge.
habit as healthy?

Test used: Mann-Whitney U Test; * statistically significant result (p<0.050); SD: Standard deviation; HFK: healthy food knowledge; FCK: food content knowledge; GNK: general nutrition knowledge.

Table 6: Predictors of inadequate nutrition knowledge (%GNK score<66.7%): binary logistic regression

| Predictor | Category | Univariate models | Multivariate model |
|-----------|----------|-------------------|-------------------|
|           |          | OR    | 95% CI | p-value | OR    | 95% CI | p-value |
|           |          | Min.  | Max.   |         | Min.  | Max.   |         |
| Demographic predictors |          |        |        |         |        |        |         |
| Gender    | Male     | 1.51  | 1.01   | 2.27    | .050* | 1.25  | 0.73   | 2.12    | .414   |
|           | Age      | 1.01  | 0.98   | 1.03    | .643  | NI    | NI     | NI      | NI     |
|           | No. of Children | N  | 0.97  | 0.85   | 1.11   | .664  | NI    | NI     | NI      | NI     |
|           | Nationality | Saudi  | 1.83  | 1.01   | 3.33    | .047* | 2.12  | 0.99   | 4.55    | .054   |
|           | Educational level | Up to middle school  | 1.97  | 0.93   | 4.21    | .078  | 1.48  | 0.53   | 4.12    | .450   |
|           |           | Secondary  | 1.94  | 1.20   | 3.14    | .007* | 1.85  | 1.01   | 3.41    | .047*   |
|           |           | University (ref) | -  | -   | -    | .011* | -  | -   | -   | .130 |
| Family income (SAR) | <5K | 1.84  | 0.87   | 3.89    | .111  | NI    | NI     | NI      | NI     |
|           | 5-10K    | 1.16  | 0.60   | 2.24    | .656  | NI    | NI     | NI      | NI     |
|           | 10-15K   | 1.79  | 0.87   | 3.69    | .115  | NI    | NI     | NI      | NI     |
|           | >15K (ref) | -  | -   | -    | -    | NI    | NI     | NI      | NI     |
| Accommodation | Apartment rental | 0.69  | 0.38   | 1.23    | .210  | 0.71  | 0.35   | 1.43    | .340   |
|           | Apartment propriety | 0.47  | 0.23   | 0.96    | .039* | 0.43  | 0.19   | 0.99    | .047*   |
|           | House rental | 1.17  | 0.37   | 3.75    | .787  | 3.60  | 0.39   | 32.99   | .260   |
|           | House propriety (ref) | -  | -   | -    | .155  | -  | -   | -   | .090 |
| Lifestyle predictors | Having Children <18 years at home | 0.80  | 0.53   | 1.22    | .299  | NI    | NI     | NI      | NI     |
|           | Having health or nutrition qualifications | 0.85  | 0.54   | 1.34    | .489  | NI    | NI     | NI      | NI     |
|           | Following any diet | 0.61  | 0.39   | 0.94    | .027* | 1.05  | 0.55   | 2.01    | .871   |
|           | Having a disease requiring a special diet | 1.31  | 0.77   | 2.22    | .315  | NI    | NI     | NI      | NI     |
|           | Having a close relative on a special diet | 0.88  | 0.58   | 1.32    | .526  | NI    | NI     | NI      | NI     |
|           | Physician providing dietary advice | 0.68  | 0.45   | 1.03    | .068  | NI    | NI     | NI      | NI     |
|           | Personal interest in eating dietetics | 0.56  | 0.37   | 0.86    | .007* | 0.43  | 0.23   | 0.81    | .009*   |
|           | Regular physical exercise | 0.91  | 0.60   | 1.39    | .666  | NI    | NI     | NI      | NI     |
|           | Smoking or substance abuse | 1.34  | 0.82   | 2.19    | .240  | NI    | NI     | NI      | NI     |
|           | Considering own eating habit as healthy | 0.39  | 0.25   | 0.59    | .000011* | 0.50 | 0.28   | 0.89    | .019*   |

¶ Reference category: No; CI: Confidence interval; Min: minimum; Max: Maximum, p-value (*) is a significant p-value < 0.05; CI: Confidence interval; Min: minimum; Max: Maximum, p-value (*) is a significant p-value < 0.05; NI: not included in the model.
References:

1. Ilic M, Ilic I, Stojanovic G, Zivanovic-Macuzic I. Association of the consumption of common food groups and beverages with mortality from cancer, ischaemic heart disease and diabetes mellitus in Serbia, 1991–2010: an ecological study. BMJ Open. 2016;6(1):e008742.

2. Umesawa M, Iso H, Fujino Y, Kikuchi S, Tamakoshi A. Salty Food Preference and Intake and Risk of Gastric Cancer: The JACC Study. J Epidemiol. 2016;26(2):92-7.

3. Golledge J, Moxon JV, Jones RE, Hankey GJ, Yeap BB, Flicker L, et al. Reported amount of salt added to food is associated with increased all-cause and cancer-related mortality in older men in a prospective cohort study. J Nutr Health Aging. 2015;19(8):805-11.

4. Lippi G, Mattuazzi C. Fried food and prostate cancer risk: systematic review and meta-analysis. Int J Food Sci Nutr. 2015;66(5):587-9.

5. Bodicoat DH, Carter P, Comber A, Edwardson C, Gray LJ, Hill S, et al. Is the number of fast-food outlets in the neighbourhood related to screen-detected type 2 diabetes mellitus and associated risk factors? Public Health Nutr. 2014;18(09):1698-705.

6. Somi MH, Mousavi SM, Naghashi S, Faramarzi E, Jafarabadi MA, Ghojazade M, et al. Is there any Relationship between Food Habits in the Last Two Decades and Gastric Cancer in North-western Iran? Asian Pac J Cancer Prev. 2015;16(1):283-90.

7. Zarnowiecki D, Sinn N, Petkov J, Dollman J. Parental nutrition knowledge and attitudes as predictors of 5–6-year-old children’s healthy food knowledge. Public Health Nutr. 2011;15(07):1284-90.

8. Parmenter K, Wardle J. Development of a general nutrition knowledge questionnaire for adults. Eur J Clin Nutr. 1999;53(4):298-308.

9. Sedgwick P. Stratified cluster sampling. BMJ. 2013;347(nov22 3):f7016-f.

10. Zaborowicz K, Czarnocinska J, Galinski G, Kazmierczak P, Gorska K, Durczewski P. Evaluation of selected dietary behaviours of students according to gender and nutritional knowledge. Rocz Panstw Zakl Hig. 2016;67(1):45-50.

11. Hulshof K, Wedel M, Löwik M, Kok F, Kistemaker C, Hermus RJ, et al. Clustering of dietary variables and other lifestyle factors (Dutch Nutritional Surveillance System). J Epidemiol Community Health. 1992;46(4):417-24.

12. Martinez-Gonzalez M, Lopez-Azpiazu I, Kearney J, Kearney M, Gibney M, Martinez J. Definition of healthy eating in the Spanish adult population: a national sample in a pan-European survey. Public Health. 1998;112(2):95-101.

13. Al-Saleh I, Billedo G, El-Doush I, Mohamed GE-D, Yosef G. Selenium and vitamins status in Saudi children. Clin Chim Acta. 2006;368(1):99-109.

14. Al-Faris NA. High prevalence of vitamin D deficiency among pregnant Saudi women. Nutrients. 2016;8(2):77.

15. Abbag FI, Abu-Eshy SA, Mahfouz AA, Al-Fifi SA, El-Wadie H, Abdallah SM, et al. Iodine-deficiency disorders in the Aseer region, south-western Saudi Arabia: 20 years after the national survey and universal salt iodization. Public Health Nutr. 2015;18(14):2523-9.

16. Al-Nuaim AA, Bamboye EA, Al-Rubeaan KA, Al-Mazrou Y. Overweight and obesity in Saudi Arabian adult population, role of socioeconomic variables. J Community Health. 1997;22(3):211-23.

17. Al-Quwaidei AJ, Pearce MS, Critchley JA, Sobngwi E, O’Flaherty M. Trends and future projections of the prevalence of adult obesity in Saudi Arabia, 1992-2022. East Mediterr Health J. 2014;20(10):589-95.

18. Abualhamaal ASS, AlJdani MSH, AlJdani SSH, Alamoudi NAU, Alghamdi AO, Bahijri SM. Assessment of Knowledge, Attitude and Practice of Adults in Jeddah About Food Interaction. Current Research in Nutrition and Food Science. 2016;4(3):153.

19. Pirouznia M. The association between nutrition knowledge and eating behavior in male and female adolescents in the US. Int J Food Sci Nutr. 2001;52(2):127-32.

20. Naeeni MM, Jafari S, Fouladgar M, Heidari K, Farajzadegan Z, Fakhri M, et al. Nutritional Knowledge, Practice, and Dietary Habits among school Children and Adolescents. Int J Prev Med. 2014;5(Suppl 2):S171-88.

21. Peykari N, Tehrani FR, Eftekhari MB, Malekafzali H, Dejman M, Neot R, et al. A peer-based study on adolescence nutritional health: a lesson learned from Iran. J Pak Med Assoc. 2011;61(6):549-54.

22. Obayashi S, Bianchi LJ, Song WO. Reliability and validity of nutrition knowledge, social-psychological factors, and food label use scales from the 1995 Diet and Health Knowledge Survey. J Nutr Educ Behav. 2003;35(2):83-92.

23. Sapp SG, Jensen HH. Reliability and validity of nutrition knowledge and diet-health awareness tests developed from the 1989–1991 diet and health knowledge surveys. J Nutr Educ 1997;29(2):63-72.
24. Barbosa LB, Vasconcelos SML, Correia LOdS, Ferreira RC. Nutrition knowledge assessment studies in adults: a systematic review. Cien Saude Colet. 2016;21(2):449-62.
25. Montero Bravo A, Ubeda Martin N, Garcia Gonzalez A. Evaluation of dietary habits of a population of university students in relation with their nutritional knowledge. Nutr Hosp. 2006;21(4):466-73.
26. Alissa EM, Alsawadi H, Zedan A, Alqarni D, Bakry M, Hli NB. Knowledge, attitude and practice of dietary and lifestyle habits among medical students in King Abdulaziz University, Saudi Arabia. Int J Food Sci Nutr. 2015;66(6):650-5.
27. Nabhani-Zeidan M, Naja F, Nasreddine L. Dietary intake and nutrition-related knowledge in a sample of Lebanese adolescents of contrasting socioeconomic status. Food Nutr Bull. 2011;32(2):75-83.
28. McPherson KE, Turnbull JD. An exploration of nutritional knowledge in a sample of Scottish men of low socio-economic status. Nutr Bull. 2000;25(4):323-7.
29. Mazier MP, McLeod SL. University Science Students’: Knowledge of Fats. Can J Diet Pract Res. 2007;68(3):154-9.
30. Heshmat R, Salehi F, Qorbani M, Rostami M, Shafee G, Ahadi Z, et al. Economic inequality in nutritional knowledge, attitude and practice of Iranian households: The NUTRI-KAP study. Med J Islam Repub Iran. 2016;30:426-.
31. Dickson-Spillmann M, Siegrist M. Consumers' knowledge of healthy diets and its correlation with dietary behaviour. J Hum Nutr Diet. 2011;24(1):54-60.
32. Parmenter K, Waller J, Wardle J. Demographic variation in nutrition knowledge in England. Health Educ Res. 2000;15(2):163-74.
33. Hendrie GA, Coveney J, Cox D. Exploring nutrition knowledge and the demographic variation in knowledge levels in an Australian community sample. Public Health Nutr. 2008;11(12):1365-71.
34. Plous S, Chesne RB, McDowell AV, 3rd. Nutrition knowledge and attitudes of cardiac patients. J Am Diet Assoc. 1995;95(4):442-6.
35. Durose CL, Holdsworth M, Watson V, Przygrodzka F. Knowledge of dietary restrictions and the medical consequences of noncompliance by patients on hemodialysis are not predictive of dietary compliance. J Am Diet Assoc. 2004;104(1):35-41.
36. Yim KS. Evaluation of the effectiveness of a nutrition education program for hypertensive patients at the community level. Korean Journal of Community Nutrition. 2000;5(4):654-61.
37. Grosso G, Mistretta A, Turconi G, Cena H, Roggi C, Galvano F. Nutrition knowledge and other determinants of food intake and lifestyle habits in children and young adolescents living in a rural area of Sicily, South Italy. Public Health Nutr. 2013;16(10):1827-36.
38. Story M, Neumark-Sztainer D, French S. Individual and environmental influences on adolescent eating behaviors. J Am Diet Assoc. 2002;102(3):S40-S51.
39. Kusano-Tsunoh A, Nakatsuka H, Sato H, Shimizu H, Sato S, Ito I, et al. Effects of family-togetherness on the food selection by primary and junior high school students: family-togetherness means better food. Tohoku J Exp Med. 2001;194(2):121-7.