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RESEARCH ARTICLE

ASSESSMENT OF NUTRITION KNOWLEDGE AMONG PATIENTS ATTENDING PRIMARY HEALTHCARE CENTERS.

Abdullah Hamdan Al.Shehri, Awadh Mohammed Al.Ghanmi, Saad Mohammed Al.Shehri, Haitham Ahmed Al.wael and Wadha Traheeb Al.Otaibi.
Primary health care, Jeddah, Kingdom of Saudi Arabia.

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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.

Corresponding Author:- Abdullah Hamdan Al.Shehri.
Address:-Primary health care, Jeddah, Kingdom of Saudi Arabia.

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[1]. 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[2]. In addition, excessive salt in food is associated to increased cancer-related mortality in the elderly[3]. 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[4].

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[5]. 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[6].

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[7]. 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. Patients with mental health disorders were excluded.

The questionnaire is a modified and adapted version of the General Nutrition Knowledge (GNK) Questionnaire, which was developed in 1999 by Parmenter& Wardle[8]. The adapted version of questionnaire was divided into 4 parts: 1) demographic and socioeconomic data such as age, gender, household incomes, etc.; 2) healthy food knowledge (HFK) including knowledge about recommended amounts of food (8 items), discriminating healthy from unhealthy meals (6 items), healthy choices (6 items), and nutrients-disease associations such as nutrients associated to hypertension, obesity, cancer…etc.(8 items); 3) food composition knowledge (FCK) including recognition of foods that contain 6 common nutrients including fibers, protein, added sugar, salt, fat, and starch (7 items by nutrient = 42 items); 4) lifestyle and other factors that may impact nutrition knowledge, such as having a disease that requires special diet, having any health or nutrition-related qualification, personal interest in dietetics…etc.(10 items). The questionnaire underwent face and content validity and was tested for internal consistency by calculation of Cronbach' Alpha.

Participants were recruited using a stratified two-stage cluster sampling method[9]. 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 [10]. 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 socio-demographic 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 accomplishingan 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 population[18], adolescents in United States[19], and among high school students in Iran[20]. This may be due to the fact that females are more concerned with their general appearance and body imageparticularly 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 intakein spite of their proper nutritional awareness[21]. In Saudi Arabia, nutritional education at higher institutions is mainly providedto female students, providing another possible notion for this finding[18].

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-authors[25] 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 researchers[26]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, Nabhani-Zeidan and co-authors[27] 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[28, 29]. The same findings were also reported in Iranian households[30]. 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 contributesto 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 thata 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[31-33].

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[34].Further, more than one-third of hemodialysis patients were not compliant with their dietary limits in spite of their sufficient knowledgeof the restrictions[35].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[36].

Lifestyle factors might have a significant role in the nutritional knowledgeof a givenindividual. 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[37]. 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 preferably tend to snacking with a low intake of fruits and vegetables[38]. 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[37].Such differences between both age groups are attributed to variations in social influence[39]. 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 inadequateamong 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 rulesdoes 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*	*23.5*
	Asian	*7*	*13.7*
	Unspecified	*32*	*62.74*
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

Do you follow any diet?	Yes	120	32.3
	No	251	67.7
Do you have any disease requiring a special diet?	Yes	72	19.5
	No	297	80.5
Do you have a close relative who is on a special diet	Yes	206	55.8
	No	163	44.2
Does your physician provide you with dietary advice?	Yes	184	49.9
	No	185	50.1
Do you have personal interest in eating habits and dietetics?	Yes	211	56.9
	No	160	43.1
Do you practice physical exercise regularly?	Yes	138	37.2
	No	233	62.8
Do you smoke of use any substance (drug)?	Yes	87	23.6
	No	281	76.4
Generally, do you consider your eating habit as healthy?	Yes	158	42.7
	No	212	57.3

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**		**p-value**	**FCK score**		**p-value**	**GNK score**		**p-value**
		Mean	**SD**		**Mean**	**SD**		**Mean**	**SD**	
Gender	Male	18.21	2.72	.419 ¶	24.71	6.98	.0001* ¶	42.92	8.53	.0007* ¶
	Female	18.47	2.73		27.37	6.17		45.85	7.45	
Marital status	Single	18.17	2.71	.721 ¥	25.93	6.64	.559 ¥	44.11	8.08	.566 ¥
	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* ¶	25.62	6.55	.234¶	43.96	7.97	.068 ¶
	Non-Saudi	19.36	2.61		26.27	7.99		45.64	9.59	
Job sector	Administration	18.21	2.64	.307¥	24.83	6.49	.052¥	43.04	8.08	.142¥
	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	

	None	18.19	2.04		26.35	6.05		44.54	7.12	
	Other	18.37	2.46		26.91	6.81		45.28	8.16	
Educational level	Illiterate	15.47	3.61	.00006*¥	22.50	9.00	.030*¥	37.71	12.08	.003*¥
	Elementary / Middle	18.50	2.29		24.25	7.75		42.75	8.94	
	Secondary	17.55	2.56		24.61	6.71		42.17	7.86	
	University+	18.71	2.75		26.75	6.39		45.46	7.84	
Accommodation	Apartment rental	18.67	2.63	.359¥	25.90	6.15	.378¥	44.58	7.64	.356¥
	Apartment propriety	18.18	3.00		25.93	7.81		44.11	9.17	
	House rental	18.32	2.41		23.47	6.82		41.79	7.07	
	House propriety	17.89	2.86		25.17	7.10		43.07	8.99	
Household income (SAR)	<5K	18.04	2.98	.209¥	24.68	7.28	.046*¥	42.72	8.96	.044*¥
	5-10K	18.56	2.56		26.28	6.50		44.84	8.01	
	10-15K	18.20	2.63		24.53	6.54		42.74	7.92	
	>15K	18.92	2.89		27.00	7.14		45.92	8.52	

¶ 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.

Table 5:-Lifestyle factors associated with nutrition knowledge

Factor	**Category**	**HFK score**		**p-value**	**FCK score**		**p-value**	**GNK score**		**p-value**
		Mean	**SD**		**Mean**	**SD**		**Mean**	**SD**	
Children <18 years living with you?	Yes	18.55	2.72	.095	26.84	6.33	.109	45.40	7.80	.079
	No	17.98	2.95		25.71	6.48		43.70	8.17	
Health or nutrition qualifications?	Yes	18.43	2.88	.522	27.19	6.07	.201	45.62	7.577	.241
	No	18.26	2.83		26.07	6.47		44.33	8.10	
Follow any diet?	Yes	18.68	3.08	.010 *	27.42	6.65	.011 *	46.10	8.49	.006 *
	No	18.13	2.69		25.84	6.23		43.98	7.66	
Disease requiring a special diet?	Yes	18.21	3.32	.942	26.56	5.59	.934	44.77	7.72	.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	.060	26.59	6.35	.437	45.10	8.07	.213
	No	18.06	2.77		25.99	6.48		44.05	7.87	
physician provides dietary advice?	Yes	18.56	3.04	.016 *	27.27	6.12	.005 *	45.84	7.83	.002 *
	No	18.05	2.6		25.42	6.55		43.48	7.98	
personal interest in eating dietetics?	Yes	18.53	2.75	.047 *	27.02	6.14	.019 *	45.56	7.69	.009 *
	No	18.01	2.91		25.48	6.66		43.49	8.24	
Regular physical exercise	Yes	18.28	3.16	.521	26.79	6.48	.299	45.07	8.43	.324
	No	18.32	2.62		26.09	6.36		44.42	7.72	
Smoking or substance abuse	Yes	18.29	2.78	.760	25.88	6.32	.303	44.17	7.94	.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	.264	27.86	6.38	.00001 *	46.24	8.50	.00007 *
	No	18.27	2.55		25.22	6.22		43.49	7.41	

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	(years)	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*)	-	-	.174	*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.

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