

Research Article

The Prevalence and Predictors of Dietary Patterns Consumption among Population Living in Makkah City, Saudi Arabia: A Cross-sectional Study

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ABSTRACT

Background: People tend to follow specific dietary patterns that might pose a risk that might threaten their health, such as diabetes and cardiovascular diseases (CVDs). The aim is to identify the food consumption patterns of the adult population living in the Makkah region to identify higher-risk groups. Until today, no research has been done in this area.

Methods: A cross-sectional study was conducted between October 2017 and March 2018 on 895 healthy males and females from Makkah, aged 19 to 60. A structured questionnaire included socio-demographic status, and 24-hour sheets of dietary intake were measured. Results were analyzed by SPSS to present the dietary patterns using factor analysis. Principle component analysis (PCA) was the chosen technique. Data are presented as mean and SD.

Results: Females were found to consume three dietary patterns: 1) close to healthy eating; 2) a group that eats sweets and carbohydrates but not fruits and vegetables; and 3) a group of high meat and sweet consumers without fruits and grains. Meanwhile, males had two patterns: 1) traditional and 2) almost healthy (no grain). In this population, dietary guidelines like the Saudi Palm Guidelines or the American Dietary Association have not been followed.

Conclusions: The study showed that in Makkah, females had more unhealthy dietary patterns than men. Traditional dietary patterns with high loadings of fat, grains, meat, beans, and discretionary calories occurred predominantly in men.

INTRODUCTION

Since the last decade in Saudi Arabia, non-communicable diseases have been soaring due to the changes in the dietary intake of the Saudi population. Dietary recommendations aim to promote good health and prevent diet-related diseases. In addition, the dietary guidelines for Americans (2015-2020) are to follow a healthy eating pattern. Concentrate on variety, nutrient density, and how much; briefly reduce calories from sugar and saturated fatty acids (SFA); and decrease sodium intake to follow a healthy eating pattern (Stoody & Casavale, 2027).

In most nutritional research, the focus is on studying the nutrients in isolation. Hence, clarify the role of the nutritional element in protection against some, if not all, diseases and the limits of their outbreak (Mazidi et al., 2017). However, one of the essential methods of studying

dietary intake, which is associated with increased diabetes, CVDs, and other non-communicable illness risk, is dietary pattern analysis (FAO/WHO, 1998). Undeniably, in the past ten years or so, numerous diseases have been associated with the whole dietary patterns intake, leading to a higher rate of morbidity and mortality (Mazidi et al., 2017; Ax et al., 2015). Risk groups of the population with characteristics such as lifestyles and demographic factors could be outstanding based on an understanding of their dietary habits, which is valuable for setting up strategic implementations (Ax et al., 2015).

The Makkah region is the meeting point of many ethnicities and backgrounds that migrated long ago to be near the holy lands. Thus, they brought up their dietary intake habits, leading to rich multinationals and rich dishes and cuisines becoming common foods as time passed. This has become a traditional food for Makkah's citizens for generations. However, in the last 20 years, many people

have become used to following specific dietary patterns without knowing their risks. Eating fast food, chips, desserts, and processed foods can directly affect our health and nutritional status (U.S. Department of Health and Human Services et al., 2015).

Many factors affect people's dietary patterns, including living status, economic, social, and environmental factors, and nutrition knowledge. Similarly, there are four common types of dietary patterns: Western, Mediterranean, vegetarian, and prudent. The Western dietary pattern is a dietary habit chosen by many people in some developed countries and increasingly in developing countries. It was defined as an unhealthy dietary pattern that may cause many diseases, such as diabetes, hypertension, and coronary vascular diseases. It is high in red meat, sugary sweets, high-fat foods, and refined cereals. Those foods also contain high-fat dairy products, high-sugar beverages, and the highest processed meat intake (Azam, 2020).

In contrast, the prudent dietary pattern is rich in fruit, vegetables, nuts, whole grains, legumes, low-fat dairy products, fish, and lean cuts of meats. Such a prudent diet should begin at age 2 and be continued indefinitely. In the 15-year follow-up of the Whitehall II study (106,633 person-years at risk), the healthy, prudent diet pattern reduced the risk of coronary death or heart attack by 29% and diabetes by 26% compared with the unhealthy pattern (WHO, 2020).

In the last 20 years, Saudi Arabia has endured significant and dramatic changes in demographics and lifestyles towards fast and convenient food habits, which dramatically entice food choices for the entire population (Adam et al., 2014). Therefore, the dietary intake changes to a higher energy-density diet rich in SFA (mostly from animal sources) and added sugars. This is combined with reduced intakes of complex carbohydrates, dietary fibre and various fruit and vegetable intakes (Adam et al., 2014). A report by the Saudi Health Interview Survey (SHIS) showed that 5.2% of individuals only met the recommendations for fruits and vegetables (Moradi-Lakeh, 2016).

However, no study has been conducted on dietary habits in samples from the Makkah region. Thus, the aim is to investigate the most common and different dietary patterns in Makkah in Saudi Arabia.

MATERIALS AND METHODS

Study subjects: The study included 895 healthy volunteers, male and female, and no one was excluded from the study as data was fully collected unless they did not speak Arabic. They were between 19 and 60 years old and all from Makkah, Saudi Arabia.

Sample size calculation: The population of Saudi Arabia in 2016 was about 32,443,442, of which about 9 million live in the Makkah region (Kemp, 2017). This study required a sample size of at least 385 from the Makkah region, with a confidence level of 95% and a margin of error of 5%. This means the 895 or more respondents obtained were sufficient (<https://www.calculator.net/sample-size-calculator.html>).

Study design: A cross-sectional study design was chosen during the academic year (10-2017 to 3-2018). Data were collected with a structured and validated questionnaire, including three sections: sociodemographic data, anthropometric data, and dietary intake in the form of a 24-hour recall sheet. However, only the 24hr 24-hour recall data analysis was included in the current project. The questionnaire was filled out under the team's supervision during the interview of each participant and included socio-demographic status and dietary intake. A team of nutrition experts formed the questionnaire, and then run as a pilot survey of 20 persons to collect feedback. Hence, the project PI applied and approved modifications that have been used in the study. The 24-hour recall sheet was used for dietary intake for one day. However, the 24-hour recall sheet might have some limitations, particularly if it is run for one day. It was run only once, with a recall approach to simplify and make it easy for the participants to complete the study.

Food group analysis: From the 24-hour recall, the food group analysis was performed according to the guidelines approved by the Committee on Diet and Health (Com. on Diet and Health, 1992). For the study, individual quantities of intake are not required, and the focus is on estimating the average intake of food groups. The 24-hour recall could be used to measure the dietary pattern (FAO/WHO, 1998).

Seven food groups were classified based on similarities in ingredients and/or nutrient profiles to efficiently run the dietary intake analysis.

- (1) Fruit: This group includes all fruit types.
- (2) Vegetables: This group comprises all vegetable types.
- (3) Grain: This group includes rice, pasta, and bread.
- (4) Meat and beans: This category has all types of red meat, poultry, beef, fish, beans, lentils, and chickpeas.
- (5) Dairy: includes all types of milk, cheese, and yogurt.
- (6) Cooking fats and oils: butter, vegetable oil such as olive, corn and corn.
- (7) The discretionary calories: high-fat food like processed products such as cheeses and meat, and high-sugary toppings such as sugar, sauce, soda, candy, and sweets.

In short, if the participant eats bread, cheese, and orange juice to create the food group, their food group consumption would be considered grain, dairy, and fruit groups (Kennedy et al., 2013).

Statistical analysis and identification of dietary patterns by factor analysis: All collected data were tabulated, and

statistical analysis was performed using the Statistical Package for Social Science (SPSS) version 26. Quantitative data are presented as the mean \pm standard deviation, and qualitative data are expressed as percentages.

Dietary pattern identifications by factor analysis: The statistical technique of factor analysis reduces many variables into a few. Principle component analysis (PCA) is the most common method for identifying patterns. PCA extracts the maximum variance and puts it into the first factor. After that, the variance explained by the first factor is removed, and the maximum variance for the second factor is extracted. For the sample size needed to run PCA, it was suggested that over 300 respondents would be enough (Chetty & Datt, 2015). The sample size in this study was 895, which is very good and sufficient to run PCA.

Rotation method: Varimax with Kaiser-Meyer-Olkin Measure of Sampling Adequacy – This measure varies between 0 and 1, and values closer to 1 are better. The level of correlation to form the most strong and common dietary patterns is interpreted as shown below:

- a) Around 0.3 or less is a low correlation.
- b) A value of 0.3 and above is considered a good correlation.
- c) Around 0.4 is a medium correlation.
- d) A value of 0.6 is considered a strong correlation.

Eigenvalues are the correlation factors to be used to show the variance explained by that particular factor out of the total variance. For example, if our first factor explains 68% of the variation out of the total, this means that the other factors will explain 32% of the conflict will explain 32% of the conflict. The rotation converged in four iterations.

RESULTS

In this study, 52.5% of the participants were male and 47.5% female (Table 1). Females tend to be older; more than half of the participants are graduates, followed by 30% holding secondary education, and only 0.4% were illiterate in the male group. In this study, the total income of participants was concentrated into three groups: low income (<1500 SR), high income (7000-<10,000 SR), and very high income (10,000 SR and above) as follows: 22, 18; and 27%, respectively. All variables are significantly different between males and females (Table 1).

To identify the dietary patterns for the male and female Table (2) respondents, we have identified three dietary pattern groups. In factor 1 (dietary pattern 1), high correlations occur between fat, grain, meat and beans, dairy, fruit, and vegetable groups but not to the sweet group. The fat and dairy groups were correlated more highly than others to this factor (0.83 and 0.77 vs 0.50 or less), respectively. Thus, it was (“close to a healthy eating dietary pattern”) consumed from all food groups and avoided the sweet and hidden fat in the discretionary calories group. This factor (1) explained 29.5% of the variance (Table 2).

Factor (2) for the female was labelled as a dietary pattern (*sweet and carbohydrate eaters, fruit and vegetable haters*). This was because a high loading of discretionary calories occurred when combined with the grain groups alone. In contrast, they do not eat vegetables or fruits (scores -0.6 and -0.34), respectively. This factor (2) explained 20.2% of all variances.

The third factor (3) for the female dietary pattern was labelled as “*high meat, some sweet, who hate fruits and grains*”. This dietary pattern had high meat and low sweet group consumption (0.78 and 0.34, respectively), compared to the medium opposite loading of grain and fruits (-0.45 and -0.55). This factor explained 17.5% of all variances, and the three factors summed up 67.4% of all variances for female dietary patterns.

Two factors or dietary patterns exist for male dietary patterns. (*The traditional nutritional pattern*), which occurs in element (1), has a high loading of fat, meat, beans, grains, and discretionary calories consumed. However, this group consumed no fruit, vegetables, or dairy products. Thus, it was not a healthy pattern. This factor explained 22% of the variance.

The other factor (2) has a high loading for fruits and dairy groups, a low loading for vegetables (0.37), and a low opposite loading for the sweet and hidden fat groups (-0.38), which again was about (*healthy eating pattern but without grain or fat at all*). This has explained 18.5% of the variance.

DISCUSSION

This article reviews the dietary patterns of 895 Saudi adults living in the Makkah region. It uses a 24-hour food recall to identify the dietary patterns of males and females.

In this study, males were more likely than females to consume healthier eating patterns per day, with more excellent preferences for healthy foods (i.e., vegetables, fresh fruits, and grilled meats). In this study, about five dietary patterns were present in Makkah’s population.

Al-Othaimeen et al. reported that the population of Saudi Arabia is going through a nutrition transition where customary and traditional food is being replaced by fast food that is high in fat, sugar, and salt (Al-Othaimeen et al., 2007). However, very few people follow WHO recommendations for fruit and vegetable intake as many dietary patterns hate eating fruits and vegetables, and lower consumption of fruits and vegetables is more prevalent in women than in men (WHO, 2019).

This might be because some women may follow fad diets that do not allow them to eat fruits and vegetables, like Atkins’s diet. Our findings parallel similar studies conducted on female Saudi students (Alsunni & Badar, 2015)

Table 1: Socio-demographics parameters of the study participants.

Gender Variables		Male		Female	
		Frequency	%	Frequency	%
Age/year	< 25	133	28.3	85	20.0
	25:50	323	68.7	306	72.0
	> 50	14	3.0	34	8.0
	Total	470	100.0	425	100.0
Educational level	Illiterate	2	.4	0	0
	Primary	20	4.3	0	0
	Intermediate	35	7.5	68	17.4
	Secondary	144	30.8	85	21.7
	Graduate	248	53.1	221	56.5
	Postgraduate	18	3.9	17	4.3
	Total	467	100.0	391	100.0
Total income (SR)	<1500	103	22.8	34	9.1
	1500 - <3500	65	14.4	136	36.4
	3500 - <5000	45	10.0	34	9.1
	5000 - <7000	34	7.5	17	4.5
	7000 - <10000	82	18.1	68	18.2
	up to 10000	123	27.2	85	22.7
	Total	452	100.0	374	100.0

Table 2: The dietary patterns of the participants for males and females in Makkah

Gender	Female			Male	
	Factor -1	Factor -2	Factor -3	Factor -1	Factor -2
Dietary Patterns	Close to healthy eating	Sweet and CHO eater f&v hater	High meat, some sweet, hate fruits and grains	Traditional	Almost healthy (no grain)
fat group	0.83	-	-	0.72	-
grain group	0.47	0.53	-0.45	0.54	-
meat and bean group	0.37	-	0.70	0.62	-
discretionary calories	-	0.78	0.34	0.54	-0.38
fruits group	0.50	+0.34	-0.55	-	0.69
dairy group	0.77	-	-	-	0.67
vegrtables group	0.34	-0.60	-	-	0.37

*Factor analysis and loading from PCA for food groups divided by gender; + the negative correlation (-) means opposite loading factor

and a similar survey in the Riyadh area by Bawazeer et al. (Bawazeer et al., 2021). This was also clarified by the notion that many Saudis have changed their dietary patterns to either healthier dietary habits or a fashion dietary intake to lose weight and, finally, as a fast and convenient dietary habit (Bawazeer et al., 2021; Garawi et al., 2015). Furthermore, the enormous increase in fast food chains, which are local or international cuisines, encourages Saudis from all age groups to consume outside-home foods more often (AlTamimi et al., 2022).

There was a group of respondents whose dietary pattern was labelled sweet and carbohydrate eaters and fruit and vegetable haters. This was because high consumption of discretionary calories occurred combined with the grain group only. In contrast, they do not eat vegetables and fruits at all. This was explained by the findings of Spronk et al. (Spronk et al., 2014), which indicated the reverse relationship between nutritional knowledge and dietary intake.

The third factor (3) shows that the female dietary category was labelled as high meat, with some sweet consumers who hate fruits and grains. This dietary pattern had high meat and low sweet group consumption compared to the medium opposite loading of grain and fruits. Moreover, a study was conducted in Jeddah and Makkah, Saudi Arabia, for total protein intake tended to be lower for Saudi women, about 16% and 15% for females in Jeddah and Makkah, respectively (Moraie & Tyne, 2014).

For male dietary patterns, the traditional dietary pattern is characterised by high fat, meat and beans, grains, and discretionary calorie consumption. However, this group consumed no fruit, vegetables, or dairy products. Thus, it was not a healthy pattern and might lead to obesity, which is translated to a Western diet, as shown by Khan and al-Kanhal (Khan & Al Kanhal, 1998).

In a large study about the prevalence of obesity in Saudi Arabia, the results revealed that among military personnel in Saudi Arabia, obesity is a major health problem associated with physical inactivity and unhealthy dietary

habits (Al-Othaimeen et al., 2007). Males are found to be significantly more overweight, while females have been obese. The poor nutritional patterns found in the current study agreed with the conclusions from Al-Otaibi et al. study (2015), as women tend to have more sweets and empty calories and less healthy eating (Al-Otaibi & Basuny, 2015).

CONCLUSION

This study showed that there were many dietary patterns in Makkah populations. Females had an unhealthier dietary pattern than males. Traditional dietary habits with high consumption of fat, grains, meat and beans, and discretionary calories occurred predominantly in men.

It was found that women had three patterns: healthy eating, sweet and CHO eaters and fruit and vegetable haters. In this population, the dietary guidelines of the American Dietary Association have not been followed.

The results of this study are limited to using a sample of 895 healthy volunteers, male and female; their ages are between 19 and 60 years old, and all are from Makkah, Saudi Arabia, which may not be representative of the population of the KSA. Dietary patterns will likely vary according to age, health status, marital status, educational level, socioeconomic status, ethnic group, and culture. However, it was not measured in the current study. It is thus necessary to replicate the results in diverse populations. The use of 24-hour-recall might also have its limitations. The results must be repeated for several days or checked by comparing them to more accurate methods, such as biomarkers such as nitrogen in 24-hour 24hr 24-hour urine samples.

AUTHOR CONTRIBUTIONS

HMB: Concept, design, data collection, analysis, and writing. EH: Statistical analysis, result tables, and revision of the final version before submission.

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DECLARATIONS

Statement of Ethics

The faculty's ethics committee from Applied Medical Sciences has approved the project and provided the approval number (HAPO-02-K-06-2017-12-901). Written informed consent was obtained from the study participants.

Participants Consent

All participants were provided with a consent form that they signed and approved the use of the data provided, with the right to withdraw at any time and keep data confidential at all project stages.

Source of Funding

No funding has been obtained for this study.

Conflict of Interest

All authors have declared that no financial support was received from any organisation for the submitted work. All authors have declared that no other relationships or activities could appear to have influenced the submitted work.

Data Availability Statement

The primary data used to present the findings of this study are available from the corresponding author upon request.

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