International Journal of Medical Toxicology & Legal Medicine **Volume 27, No. 4S, 2024**
e-ISSN: 0974-4614
p-ISSN: 0972-0448
https://doi.org/10.47059/ijmtlm/V27I4S/127

The Consumption Patterns of Hassawi Rice and the Saudi Population Awareness of Its Nutritional Value

Ahlam Saleh Alhajri[1], Maha Loutfi Hadid[2]

[1]Department of Food Science and Nutrition, College of Agricultural and Food Sciences, King Faisal University, Al Ahsa, Saudi Arabia, Email: aalhajri@kfu.edu.sa
[2]Agribusiness and Consumer Sciences Department, College of Agricultural and Food Sciences, King Faisal University, Al Ahsa, Saudi Arabia, Email:mhadid@kfu.edu.sa

Received: 10.09.2024 Revised: 18.10.2024 Accepted: 24.11.2024

ABSTRACT
This study examines the consumption patterns of Hassawi rice among citizens of Saudi Arabia, emphasizing their awareness of its nutritional benefits. 67.4% of 1,017 respondents to a standardized questionnaire reported eating Hassawi rice. Younger and married participants consumed more ($p = 0.008$ and 0.000, respectively). 92.4% of Eastern respondents ate rice, compared to lower percentages in other regions ($p = 0.000$). Awareness of the nutritional benefits was notably elevated; 56% of participants recognized Hassawi rice as possessing greater nutritional value relative to other rice kinds ($p = 0.000$). Furthermore, health-related factors affected consumption, with individuals suffering from obesity or diabetes indicating reduced intake ($p < 0.05$). The favored culinary techniques encompassed classic meals like Kabsa and Madroba, primarily employing plant oils or butter for their preparation. Participants recognized the principal nutrients of Hassawi rice as antioxidants, carbs, and vitamins. Notwithstanding its popularity, obstacles to consumption encompassed perceptions of elevated pricing and lack of availability in specific places. This study emphasizes the need to promote Hassawi rice for Saudi dietary diversity and health, especially in low-consumption areas. Hassawi rice's cultural significance and possible benefits in normal diets are highlighted. More research is needed on the long-term health effects of Hassawi rice.

Keywords: Hassawi Rice, Nutrition, Dietary habits, Saudi Arabia, Awareness.

INTRODUCTION

Food preferences and consumption patterns are shaped by a complex interaction of physiological, psychological, social, and cultural factors that influence eating behavior. Rice is a fundamental component of Saudi Arabian cuisine, especially in the Eastern Province, where Hassawi rice (Oryza sativa L.) holds particular cultural importance. In contrast to more commonly consumed refined white rice varieties, hasadi rice is a unique, indigenous type characterized by its reddish-brown hue, nutty flavor, and elevated nutritional value. Hassawi rice, unlike polished rice, retains its bran and germ, resulting in more fiber, vitamins, and minerals, particularly iron and magnesium, so rendering it a nutrient-dense option for individuals concerned about dietary quality (Al-Mssallem et al., 2011; Al-Mssallem et al., 2024a). Despite its recognized health benefits, there is increasing concern that more processed, less nutritious grains such as Hassawi rice are replacing traditional grains in the typical Saudi diet. This is partially attributable to evolving lifestyles and dietary environments. In recent decades, Saudi Arabia has experienced significant alterations in its eating practices within the Gulf region. The primary causes of these changes include urbanization, economic growth, and the influence of Western dietary practices. These alterations have resulted in an increased consumption of processed meals, fast food, and refined grains, to the detriment of traditional, whole foods such as Hassawi rice (Al-Othaimeen et al., 2007). The heightened incidence of chronic diet-related conditions such as obesity, type 2 diabetes, and cardiovascular illnesses is apparent due to these alterations (Alqarni, 2016). Consequently, it is essential to reevaluate the role of traditional, nutrient-rich foods in modern diets, particularly considering Saudi Arabia's public health challenges.

Beyond its flavor and texture, Hassawi rice has historically been esteemed in the region for its association with heritage and cultural identity. Traditional dishes such as "Kabsa" and "Jareesh," prepared with Hassawi rice, are integral to family feasts and social gatherings. The modernization of the Saudi food environment may have resulted in diminished awareness of the nutritional benefits of Hassawi rice among the populace. Previous research indicates that Saudi Arabians are increasingly disinclined to consume whole grains and traditional

cuisine due to convenience, cost, and exposure to global dietary trends (Musaiger et al., 2012).Currently, there is scant information regarding the nutritional value of Hassawi rice. The degree of consumer awareness of its health advantages and the impact of this information on their dietary choices is inadequately researched. To inform health promotion programs aimed at enhancing the intake of nutrient-dense foods, it is crucialto understand the dynamics of eating behavior and the nutritional profile of Hassawi rice. This information may be utilized by public health campaigns in Saudi Arabia to promote the incorporation of traditional grains, such as Hassawi rice, into a balanced diet, perhaps reducing the incidence of food-related chronic diseases.This study aims to investigate the dietary habits of Saudi Arabians concerning Hassawi rice consumption, focusing on their awareness of the rice's nutritional advantages. The project will provide insights that can promote healthier eating habits in the region by examining how dietary behaviors, cultural preferences, and nutritional awareness influence the use of Hassawi rice. This research will assess any deficiencies in nutritional understanding that could be addressed by public health and educational initiatives.

Methods

Study Design and Population

This descriptive, cross-sectional, community-based study was conducted from June to September 2024 among 1,017 participants in Saudi Arabia.The study population comprises all adult residents of Saudi Arabia country. Inclusion criteria required participants to be adults over 18 years old with a stable internet connection, all participants of the pilot study were excluded. The sample size was calculated using the formula; (n = {z^2 P(1-P)}/{e^2})(Krejcie, 1970)with a 95% confidence level, a 5% margin of error, and a 50% response distribution, resulting in a minimum required sample size of 384. A convenient non-probability sampling method was employed, ultimately including 1017 participants in the study. The sample included individuals of various ages, genders, and socioeconomic backgrounds to ensure a representative analysis of the population. Participants were recruited through online platforms, ensuring a diverse demographic representation.

Data Collection

A structured questionnaire was developed by the authors after revising similar published literature. To assess reliability, a pilot survey was conducted with 35 participants, and the questionnaire items were refined iteratively until a Cronbach's alpha of 0.8 was achieved. The final questionnaire comprises a demographic information (age, sex, nationality, marital status), socioeconomic status (education level, monthly income), dietary habits (frequency and type of rice consumption, cooking methods), and health status (self-reported diseases). It was subsequently formatted into an online Google Form and disseminated through various social media platforms (Whatsapp, Facebook, X, etc) The questionnaire was validated by experts in nutrition and public health to ensure its reliability and relevance. Participants were asked to provide their height and weight, which were used to calculate their BMI. The BMI categories were classified according to the World Health Organization guidelines (2020).

Human Ethics and Consent to Participate declarations

Ethical approval was obtained from King Faisal University, Research Ethics Committee (KFU-REC-2023-MAR-ETHICS658). The participants were informed about the details of the research. A written Informed consent was obtained from the participants, and all the responses were kept completely confidential and used only for the purpose of research.

Statistical Analysis

The collected data was checked for its completeness, consistency and accuracy before analysis. Data were analyzed using SPSS software version 26. Descriptive statistics were used to summarize the characteristics of the study population. Crosstabulations and chi-square tests were conducted to examine the associations between Hassawi rice consumption and various demographic and health-related factors. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Participant Characteristics

Table 1 analyzes participants' demographic and socioeconomic characteristics and Hassawi rice use. Of the 1,017 participants, 685 (67.4%) reported eating Hassawi rice, while 332 (32.6%) did not. Males make up 37.5% (381) of the sample and females 62.5% (636). The consumption rates of men (69.8%) and women (65.9%) are not statistically different (p-value 0.110).

Due to age, people aged 18-29 consume 64.9% less than those aged 40-50, who consume 78.1% more. The p-value of 0.008 shows that older people are more likely to eat Hassawi rice. A p-value of 0.369 suggests that education does not affect consumption rates. In basic or secondary education, 70.4% of participants consume, whereas in higher education, 58.7% do.

Marital status and consumption are significantly related (p-value 0.000). At 74.5%, married people consume the most, while single people consume 60.5%. This implies that marital status may significantly impact Hassawi rice diet. Employment status had no statistically significant effect on spending (p = 0.135). Unemployed people consume the most at 71.4%, followed by students at 68.0%, showing different dietary tendencies. A 0.000 p-value shows that socioeconomic position affects expenditure. At 70.7%, individuals earning less than 5,000 SAR consume more, while those earning 5,000–10,000 SAR consume less at 54.8%. This suggests that low-income people may eat more Hassawi rice.

Geographic location affects consumption (0.000 p-value). Eastern participants consume the most (92.4%), while Northern participants consume the least (46.9%). This shows that regional preferences and availability may greatly impact Hassawi rice use. The examination of BMI categories suggests a link between rice consumption and obesity. The Obesity Class I consumption rate is 77.5%, however the p-value of 0.075 implies it is not statistically significant.

Table 1: Crosstabulation between general characteristics of the research participant and Hassawi rice consumption

Parameter		**Total; n (%)**	**Eat Hassawi Rice; n (% with row)**		**P Value**
			Yes; 685 (67.4)	**No; 332 (32.6)**	
Sex	Male	381 (37.5)	266 (69.8)	115 (30.2)	0.110
	Female	636 (62.5)	419 (65.9)	217 (34.1)	
Age (Years)	18 – 29	561 (55.2)	364 (64.9)	197 (35.1)	0.008
	30 -39	173 (17.0)	110 (63.6)	63 (36.4)	
	40 – 50	155 (15.2)	121 (78.1)	34 (21.9)	
	More than 50	128 (12.6)	90 (70.3)	38 (29.7)	
Educational level	Primary/ Secondary school	226 (22.2)	159 (70.4)	67 (29.6)	0.369
	Diploma	166 (16.3)	110 (66.3)	56 (33.7)	
	Bachelor	562 (55.3)	379 (67.4)	183 (32.6)	
	Higher studies	63 (6.2)	37 (58.7)	26 (41.3)	
Marital Status	Single	448 (44.1)	271 (60.5)	177 (39.5)	0.000
	Married	513 (50.4)	382 (74.5)	131 (25.5)	
	Divorced	40 (3.9)	22 (55.0)	18 (45.0)	
	Widow	16 (1.6)	10 (62.5)	6 (37.5)	
Working status	Unemployed	185 (18.2)	132 (71.4)	53 (28.6)	0.135
	Employed	360 (35.4)	241 (66.9)	119 (33.1)	
	Student	391 (38.4)	266 (68.0)	125 (32.0)	
	Free job	81 (8.0)	46 (56.8)	35 (43.2)	
Regions	Central area	192 (18.9)	131 (68.2)	61 (31.8)	0.000
	Northern area	147 (14.5)	69 (46.9)	78 (53.1)	
	Western area	151 (14.8)	83 (55.0)	68 (45.0)	
	Eastern area	370 (36.4)	342 (92.4)	28 (7.6)	
	Southern area	157 (15.4)	60 (38.2)	97 (61.8)	
Socioeconomic status	Less than 5,000 SAR	518 (50.9)	366 (70.7)	152 (29.3)	0.000
	5.000-10,000 SAR	241 (23.7)	132 (54.8)	109 (45.2)	
	10.000-15,000 SAR	122 (12.0)	88 (72.1)	34 (27.9)	
	More than 15,000 SAR	136 (13.4)	99 (72.8)	37 (27.2)	
BMI categories	Underweight	87 (8.6)	53 (60.9)	34 (39.1)	0.075
	Normal	467 (45.9)	302 (64.7)	165 (35.3)	
	Overweight	294 (28.9)	205 (69.7)	89 (30.3)	
	Obesity class I	111 (10.9)	86 (77.5)	25 (22.5)	
	Obesity class II	49 (4.8)	34 (69.4)	15 (30.6)	
	Obesity class III	9 (0.9)	5 (55.6)	4 (44.4)	

Data are presented as frequencies and percentages
P-values were determined by chi-squared test

Health Implication

Table 2 shows the prevalence of particular diseases in Hassawi rice consumers compared to non-consumers. Disease type, sample sizes, percentages, and statistical significance p-values classify the outcomes.
Obesity was found in 57.9% of Hassawi rice consumers and 42.1% of non-consumers (p = 0.022). This suggests that this rice may increase obesity. Hyperlipidaemia was 47.3% in Hassawi rice users and 52.7% in non-consumers (p = 0.001). Hassawi rice may lower hyperlipidaemia, as this link is statistically significant.
57.0% of rice consumers had hypertension, compared to 43.0% of non-consumers (p = 0.023). This implies that Hassawi rice may increase hypertension. Diabetes prevalence is 56.1% among Hassawi rice consumers compared to 43.9% in non-consumers (p = 0.017), indicating a strong association between rice intake and diabetes. No customers reported cancer, while all non-consumers did (p = 0.011). This suggests Hassawi rice may prevent cancer.
No significant correlations existed between conditions. Thyroid issues were equally common among consumers and non-consumers (p = 0.485). Asthma, atherosclerosis, and irritable bowel syndrome showed no significant differences (p = 0.606, 0.605). Consumer health is good, with 73.6% reporting no illness. Consumers reported good health at 69.0%, while non-consumers reported 31.0% (p = 0.035). This suggests Hassawi rice consumers may be healthier than their counterparts.

Table 2: Cross tabulation between disease suffering among the research participant and Hassawi rice
Data are presented as frequencies and percentages

Parameter		**Total; n (%)**	**Eat Hassawi Rice; n (% with row)**		**P Value**
			Yes; n (% with row)	**No; n (% with row)**	
Did you suffer from any disease?	Obesity	114 (11.2)	66 (57.9)	48 (42.1)	**0.022**
	Thyroid disorders	8 (0.8)	6 (75.0)	2 (25.0)	0.485
	Hyperlipidemia	55 (5.4)	26 (47.3)	29 (52.7)	**0.001**
	Asthma	9 (0.9)	6 (66.7)	3 (33.3)	0.606
	Atherosclerosis	9 (0.9)	6 (66.7)	3 (33.3)	0.606
	Hypertension	86 (8.5)	49 (57.0)	37 (43.0)	**0.023**
	Diabetes	82 (8.1)	46 (56.1)	36 (43.9)	**0.017**
	Irritable bowel syndrome	4 (0.4)	3 (75.0)	1 (25.0)	0.605
	Anemia	18 (1.8)	16 (88.9)	2 (11.1)	**0.036**
	Cancer	4 (0.4)	0 (0.00)	4 (100.0)	**0.011**
	I don't suffer from any disease.	749 (73.6)	517 (69.0)	232 (31.0)	**0.035**

P-values were determined by chi-squared test

Preferences, availability, and consumption patterns of Hassawi rice
Table 3 delineates data regarding rice consumption trends throughout diverse geographical regions, emphasizing the type of rice consumed, its availability, frequency of intake, and quantity each meal.
Basmati rice was the predominant kind consumed throughout all regions, particularly in the Eastern region (39.7%). In contrast, Hassawi rice was the least favored in the Central (14.9%) and Southern (12.9%) regions, while its liking significantly increased in the Eastern region (36.6%). The pronounced regional disparities (P < 0.001) demonstrate a robust correlation between rice variety and geographic location, suggesting that local availability and cultural inclinations markedly affect rice choice.
The prevalence of Hassawi rice was predominantly noted in the Eastern region (59.1%), in contrast to lesser proportions in other areas, such as the Northern region (7.5%). A significant proportion of respondents in the Central (14.5%) and Southern (7.7%) regions reported its availability, whereas a considerable number expressed uncertainty, especially in the Northern region (26.4%). The disparity in availability answers was statistically significant (P < 0.001). A significant percentage of participants (up to 30.2% in the Southern region) expressed doubt regarding the availability of Hassawi rice. This indicates a deficiency in awareness or uneven distribution, especially in areas with diminished reported availability.

The consumption frequency of Hassawi rice varies considerably by area. In the Eastern region, approximately 49.9% reported consuming it regularly, whilst only 10.1% from the Northern region did the same. The statistical significance (P = 0.000) underscores that geographic factors significantly affect the frequency of this rice's consumption among individuals.
The reasons for not consuming Hassawi rice varied considerably by location. Significantly, elevated prices were primarily reported in the Eastern region (60%), but market unavailability was a prevalent issue in the Northern

(27.9%) and Western regions (29.1%). A P value of 0.000 signifies a substantial association between these explanations and regional disparities.

The quantity of Hassawi rice consumed per meal exhibits regional diversity. In the Eastern region, 45% reported consuming less than one cup per meal, while 53.8% claimed they normally consume one or two cups; both statistics are much higher than those from other regions. A P value of 0.000 indicates that these changes in amount are statistically significant.

Table 3: Rice Consumption preferences, availability and patterns of Hassawi Rice by the region

Parameter		**Residence; n (% with row)**					**P value**
		Central area	**Northern area**	**Western area**	**Easternarea**	**Southern area**	
What type of rice did you frequently eat?	Hassawi rice	15 (14.9)	18 (17.8)	18 (17.8)	37 (36.6)	13 (12.9)	**0.000**
	American rice	6 (13.0)	5 (10.9)	12 (26.1)	6 (13.0)	17 (37.0)	
	Basmati rice	157 (19.7)	106 (13.3)	116 (14.6)	316 (39.7)	101 (12.7)	
	Brown rice	3 (21.4)	6 (42.9)	0 (0.0)	2 (14.3)	3 (21.4)	
	Egyptian rice	11 (18.3)	12 (20.0)	5 (8.3)	9 (15.0)	23 (38.3)	
Did the Hassawi rice available in your region?	Yes	85 (14.5)	44 (7.5)	66 (11.2)	347 (59.1)	45 (7.7)	**0.000**
	No	45 (23.1)	50 (25.6)	50 (25.6)	9 (4.6)	41 (21.0)	
	I don't Know	62 (26.4)	53 (22.6)	35 (14.9)	14 (6.0)	71 (30.2)	
Did you eat the Hassawi rice?	Yes	131 (19.1)	69 (10.1)	83 (12.1)	342 (49.9)	60 (8.8)	**0.000**
	No	61 (18.4)	78 (23.5)	68 (20.5)	28 (8.4)	97 (29.2)	
Why didn't you eat the Hassawi rice?	High price	1 (20.0)	1 (20.0)	0 (0.0)	3 (60.0)	0 (0.0)	**0.000**
	Needs a long time to cook	1 (20.0)	0 (0.0)	2 (40.0)	2 (40.0)	0 (0.0)	
	Unavailable in markets	15 (17.4)	24 (27.9)	25 (29.1)	5 (5.8)	17 (19.8)	
	Undesirable taste	2 (10.0)	1 (5.0)	4 (20.0)	9 (45.0)	4 (20.0)	
	I don't know	42 (19.4)	52 (24.1)	37 (17.1)	9 (4.2)	76 (35.2)	
How many times did you eat the Hassawi rice?	Rarely	75 (21.4)	41 (11.7)	48 (13.7)	142 (40.6)	44 (12.6)	**0.000**
	Less than on time per month	0 (0.0)	0 (0.0)	0 (0.0)	5 (100.0)	0 (0.0)	
	Once or twice per month	45 (18.7)	20 (8.3)	24 (10.0)	138 (57.3)	14 (5.8)	
	Three or more times per month	11 (12.4)	8 (9.0)	11 (12.4)	57 (64.0)	2 (2.2)	
How many cups (240 g) did you eat from Hassawi rice in one meal?	Less than on cup	69 (22.3)	33 (10.7)	32 (10.4)	139 (45.0)	36 (11.7)	**0.000**
	One or two cup	48 (14.8)	31 (9.5)	49 (15.1)	175 (53.8)	22 (6.8)	
	Three cups or more	14 (27.5)	5 (9.8)	2 (3.9)	28 (54.9)	2 (3.9)	

Data are presented as frequencies and percentages

P-values were determined by chi-squared test

Consumption of Hassawi rice and favourite cooking methods by the region

Table 4 displays survey findings concerning preferences for preparing and consuming Hassawi rice in various geographical regions. The predominant cooking method for Hassawi rice was Kabsa, especially in the Eastern region (53.9%), although alternative methods such as Rice Kofta and Madroba exhibited lesser overall preferences. The substantial P value (0.000) signifies a robust correlation between residency and the selection of cooking methods.

In terms of preferred types of fats and meats, butter (55.3%) and plant oil (49.5%) were the most desired in the Eastern region (49.5%). Regional disparities were substantial ($P < 0.001$). Red meat was predominantly chosen in the Eastern region (55.2%), while chicken was preferred in the Central region (30.2%). The importance of these disparities indicates robust regional culinary traditions ($P < 0.001$). Lamb was the predominant selection of red meat, particularly in the Eastern region (56.0%). The inclination towards camel meat was significant in the Central and Eastern region, reflecting regional specialties ($P < 0.001$).

Garlic was particularly preferred as an added component across all regions, notably in the Eastern region (53.4%). Additional ingredients such as Fenugreek and Lobbia shown regional preferences, with high P values denoting substantial disparities in ingredient selections.

The indigenous rice variety was primarily favoured in the Eastern region (57.1%), indicating a significant cultural preference ($P < 0.001$). Hassawi rice was commonly taken during pregnancy and the puerperium in the Eastern region, accounting for 51.9% of instances. Family gatherings exhibited notable consumption patterns (44.9%), underscoring social circumstances ($P < 0.001$). Lunch was indicated as the predominant meal for consuming Hassawi rice, accounting for 54.1% of preferences. Breakfast exhibited significantly low consumption overall ($P < 0.001$).

Health advantages and palatability were identified as the principal incentives for the consumption of Hassawi rice, especially in the Eastern region, where 51.9% of respondents indicated taste as a reason for their choice. The P values indicate substantial geographical disparities in motivations, highlighting differences in health beliefs and gastronomic satisfaction (Figure 1).

Table 4: Hassawi Rice preferred Cooking Methods and consumption by the region

Parameter		**Residence; n (% with row)**					**P value**
		Central area	**Northern area**	**Western area**	**Eastern area**	**Southern area**	
What's your favorable type to cook the Hassawi rice?	Kabsa	90 (17.1)	43 (8.2)	65 (12.3)	284 (53.9)	45 (8.5)	**0.000**
	Rice Kofta (Kabba)	3 (23.1)	3 (23.10	0 (0.0)	4 (30.8)	3 (23.1)	
	Madroba	21 (24.7)	18 (21.2)	12 (14.1)	29 (34.1)	5 (5.90	
	Boiled	17 (28.3)	5 (8.3)	6 (10.0)	25 (41.7)	7 (11.7)	
Which type of fats did you preferred to cook the Hassawi rice?	Plant oil	44 (22.0)	16 (8.0)	23 (11.5)	99 (49.5)	18 (9.0)	**0.000**
	Plant margarine	15 (21.7)	10 (14.5)	17 (24.6)	20 (29.0)	7 (10.1)	
	Municipal margarine	23 (19.8)	13 (11.2)	12 (10.3)	57 (49.1)	11 (9.5)	
	Butter	49 (16.3)	30 (10.0)	31 (10.3)	166 (55.3)	24 (8.0)	
Which type of meat did you preferred to eat with the Hassawi rice?	Chicken	39 (30.2)	18 (14.0)	22 (17.1)	39 (30.2)	11 (8.5)	**0.000**
	Fish	3 (30.0)	2 (20.0)	2 (20.0)	3 (30.0)	0 (0.0)	
	Red meat	86 (16.1)	49 (9.2)	58 (10.9)	295 (55.2)	46 (8.6)	
	Seafood (Shrimp)	3 (25.0)	0 (0.0)	1 (8.3)	5 (41.7)	3 (25.0)	
Which type of red meats did you preferred to eat with Hassawi	Camel meat	34 (33.3)	7 (6.9)	16 (15.7)	35 (34.3)	10 (9.8)	**0.000**
	Beef	13 (14.1)	14 (15.2)	14 (15.2)	32 (34.8)	19 (20.7)	

rice?	Lamb	84 (17.1)	48 (9.8)	53 (10.8)	275 (56.0)	31 (6.3)	
When you eat the Hassawi rice, what's your preferred addition?	Lobbia	27 (15.2)	14 (7.9)	19 (10.7)	105 (59.0)	13 (7.3)	**0.000**
	Fenugreek (Helba)	28 (13.7)	23 (11.3)	19 (9.3)	118 (57.8)	16 (7.8)	**0.000**
	Garlic	65 (19.9)	27 (8.3)	34 (10.4)	174 (53.4)	26 (8.0)	**0.000**
	Kamoon	0 (0.0)	1 (8.3)	0 (0.0)	11 (91.7)	0 (0.0)	**0.002**
	Nothings	47 (20.0)	20 (8.5)	34 (14.5)	110 (46.8)	24 (10.2)	**0.000**
What type of Hassawi rice did you preferred?	Excellent hybrid	31 (29.8)	16 (15.4)	10 (9.6)	36 (34.6)	11 (10.6)	**0.000**
	Local original	89 (17.2)	40 (7.7)	60 (11.6)	295 (57.1)	33 (6.4)	
	Medium hybrid	11 (17.2)	13 (20.3)	13 (20.3)	11 (17.2)	16 (25.0)	
In which special occasion the Hassawi rice eaten?	Pregnancy and puerperium	46 (16.0)	31 (10.8)	32 (11.1)	149 (51.9)	29 (10.1)	**0.000**
	Family gatherings	65 (22.6)	29 (10.1)	38 (13.2)	129 (44.9)	26 (9.1)	
	In marriage	1 (25.0)	0 (0.0)	0 (0.0)	2 (50.0)	1 (25.0)	
	In Ramadan	19 (23.2)	9 (11.0)	11 (13.4)	40 (48.8)	3 (3.7)	
	No special occasion	0 (0.0)	0 (0.0)	2 (9.1)	19 (86.4)	1 (4.5)	
In which meal did you preferred to eat the Hassawi rice?	Breakfast	7 (53.8)	3 (23.1)	2 (15.4)	0 (0.0)	1 (7.7)	**0.000**
	Lunch	110 (19.6)	53 (9.5)	62 (11.1)	303 (54.1)	32 (5.7)	
	Dinner	14 (12.5)	13 (11.6)	19 (17.0)	39 (34.8)	27 (24.1)	

Data are presented as frequencies and percentages

P-values were determined by chi-squared test

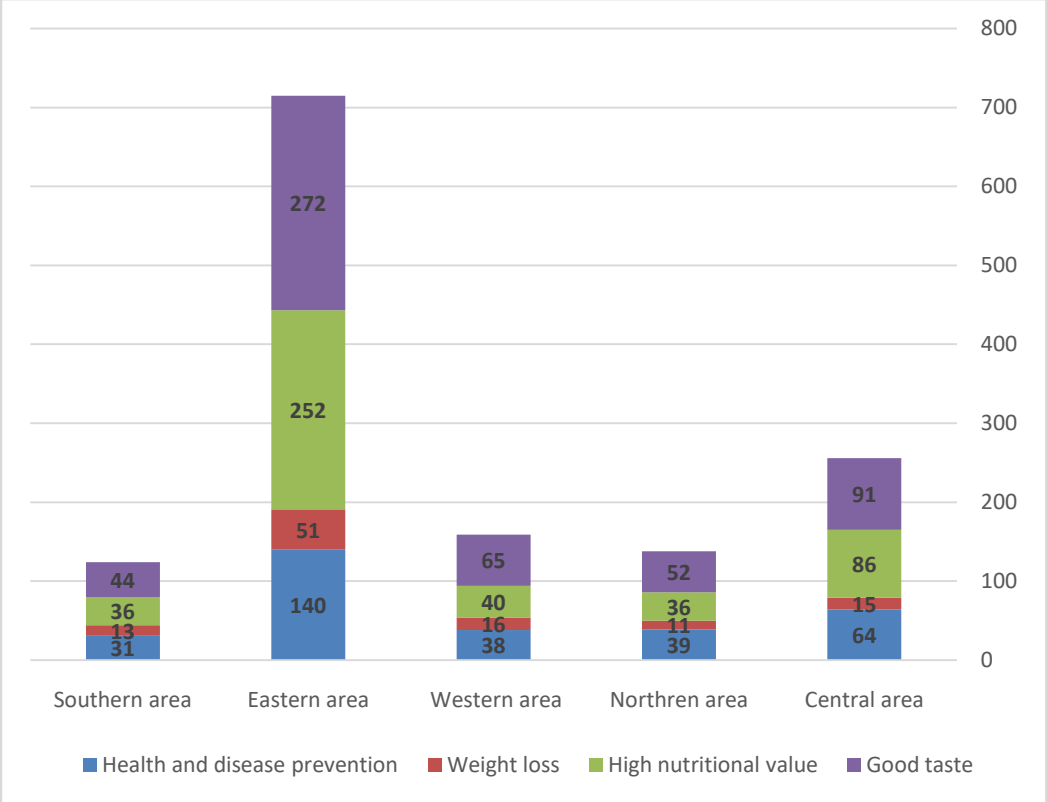

Figure 1: Desire to eat the Hassawi rice according to region.

Consumption of foodstuffs made from Hassawi rice and knowledge of its nutritional value

Table 5 displays survey findings concerning the consumption and perception of food products derived from Hassawi rice. The data indicates that a substantial majority of respondents in the Eastern region (51.8%) reported consuming products derived from Hassawi rice, in contrast to smaller numbers in other areas. The P value of 0.000 signifies a statistically significant disparity in consumption patterns among different regions, indicating that local culinary traditions may affect the utilization of Hassawi rice in meal preparation.

Among consumers of products derived from Hassawi rice, bread was the most favoured item, especially in the Eastern region (51.6%). Kabba was only favoured in the Eastern region (100%), signifying a pronounced regional specificity. The substantial diversity ($P < 0.001$) indicates diverse culinary applications of Hassawi rice among locales, mirroring local gastronomic traditions and preferences.

The majority perceived Hassawi rice as being the best nutritious value, particularly in the Eastern region (50.6%). This impression highlights its cultural importance and possible health advantages, evidenced by substantial regional variations ($P < 0.001$).

Respondents were requested to specify the characteristics that differentiate Hassawi rice from other types. A plurality identified qualities such as flavor (50.9%), nutritional quality (52.0%), and health advantages (51.1%) as distinctive characteristics, especially in the Eastern region. Although rice size and color were acknowledged, the perceived differences were not statistically significant ($P = 0.168$), suggesting a potential consensus on its qualitative characteristics ($P < 0.001$).

The poll evaluated which nutrients respondents considered most prevalent in Hassawi rice. Respondents recognized Fibers (50.7%) and vitamins and minerals (52.0%) as essential components in Hassawi rice, especially in the Eastern region. All nutrient categories, including antioxidants (51.1%) and carbs (51.1%), exhibited substantial regional disparities ($P < 0.001$), indicating an understanding of the health advantages linked to Hassawi rice.

Table 5: Eating foodstuffs made from Hassawi rice and knowledge of its nutritional value

Parameter		**Residence; n (% with row)**					**P value**
		Central area	**Northern area**	**Western area**	**Eastern area**	**Southern area**	
Did you eat foodstuffs made from the Hassawi rice?	Yes	47 (18.6)	24 (9.5)	28 (11.1)	131 (51.8)	23 (9.1)	**0.000**
	No	84 (19.5)	45 (10.4)	54 (12.5)	212 (49.0)	37 (8.6)	

Which foodstuffs made from the Hassawi rice did you preferred more?	Bread	37 (19.5)	20 (10.5)	19 (10.0)	99 (51.6)	16 (8.4)	**0.000**
	Kabba	0 (0.0)	0 (0.0)	0 (0.0)	3 (100.0)	0 (0.0)	
	Cake	14 (25.0)	3 (5.4)	7 (12.5)	30 (53.6)	2 (3.6)	
	Waffles	7 (13.0)	5 (9.3)	5 (9.3)	28 (51.9)	9 (16.7)	
	No things	2 (9.1)	2 (9.1)	4 (18.2)	13 (59.1)	1 (4.5)	
In your opinion, which type of rice had the highest nutritional values?	Hassawi rice	114 (18.2)	64 (10.2)	77 (12.3)	318 (50.6)	55 (8.8)	**0.000**
	White rice	17 (30.4)	5 (8.9)	5 (8.9)	25 (8.9)	5 (8.9)	
What distinguishes thew Hassawi rice from the other rice?	No difference	6 (18.8)	2 (6.3)	5 (15.6)	17 (53.1)	2 (6.3)	**0.168**
	Rice size and color	55 (19.8)	28 (10.1)	30 (10.8)	136 (48.9)	29 (10.4)	**0.000**
	Taste	85 (20.1)	44 (10.4)	47 (11.1)	215 (50.9)	31 (7.3)	**0.000**
	The nutritional value	90 (18.4)	50 (10.2)	53 (10.9)	254 (52.0)	41 (8.4)	**0.000**
	The health benefits	97 (19.8)	47 (9.60	51 (10.4)	251 (51.1)	45 (9.2)	**0.000**
What are the most prominent nutrients contained in the Hassawi rice?	Antioxidants	45 (19.5)	18 (7.8)	29 (12.6)	118 (51.1)	21 (9.1)	**0.000**
	Carbohydrates	60 (19.5)	30 (9.8)	33 (10.7)	157 (51.1)	27 (8.8)	**0.000**
	Vitamins and mineral salt	66 (18.9)	34 (9.7)	41 (11.7)	182 (52.0)	27 (7.7)	**0.000**
	Fibers	77 (19.2)	37 (9.2)	45 (11.2)	204 (50.7)	39 (9.7)	**0.000**
	I don't know	23 (19.3)	14 (11.8)	14 (11.8)	11 (9.2)	57 (47.9)	**0.088**

Data are presented as frequencies and percentages
P-values were determined by chi-squared test

Cross tabulation of Body Mass Index categories with the timing and quantity of Hassawi rice consumption

Table 6 examines the correlation between Body Mass Index (BMI) categories and the consumption patterns of Hassawi rice. The analysis classifies people into distinct BMI categories: underweight, normal weight, overweight, and various obesity classes, while evaluating their rice consumption frequency and the amount ingested per meal.

The frequency of Hassawi rice consumption among participants demonstrates notable variations among BMI groups. A significant observation is that a greater proportion of persons within the normal weight category reported seldom consumption of Hassawi rice (44.9%) in comparison to other groups. In contrast, individuals categorized as overweight and obese displayed significant percentages in the "rarely" category, although these statistics were markedly lower than those of the normal weight group. The p-value of 0.022 underscores the statistical significance of these findings, demonstrating a substantial association between consumption frequency and BMI classification. This indicates that dietary practices concerning Hassawi rice may be affected by an individual's BMI status.

Analysis of the quantity of Hassawi rice consumed every meal reveals a distinct trend: persons with elevated BMI classifications typically take greater portions. For example, among individuals who consumed less than one cup of rice, a substantial percentage (51.5%) were categorized as having normal weight, but merely 2.0% were classified as class III obese. In sharp contrast, among people drinking three or more cups, 47.1% were categorized as overweight, and 13.7% were classified as having class II obesity. The p-value for this parameter

is significantly low at 0.000, indicating a robust association between rice consumption and BMI status. This discovery underscores the significance of food selections in weight regulation and the incidence of obesity.

Table 6: Crosstabulation between Body mass indexed categories and Hassawi rice consumption time and amount

Parameter		BMI categories; n (% with row)						P Value
		Under weight	Normal	Over weight	Obesity			
					Class I	Class II	Class III	
How many times did you eat the Hassawirice?	Rarely	23 (6.6)	157 (44.9)	95 (27.1)	52 (14.9)	18 (5.1)	5 (1.4)	0.022
	Less than on time per month	0 (0.0)	5 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
	Once or twice per month	24 (10.0)	104 (43.2)	75 (31.1)	27 (11.2)	11 (4.6)	0 (0.0)	
	Three or more times per month	6 (6.7)	36 (40.4)	35 (39.3)	7 (7.9)	5 (5.6)	0 (0.0)	
How many cups (240 g) did you eat from Hassawi rice in one meal?	Less than on cup	26 (8.4)	159 (51.5)	86 (27.8)	27 (8.7)	9 (2.9)	2 (0.6)	0.000
	One or two cup	26 (8.0)	131 (40.3)	95 (29.2)	52 (16.0)	19 (5.8)	2 (0.6)	
	Three cups or more	1 (2.0)	12 (23.5)	24 (47.1)	7 (13.7)	6 (11.8)	1 (2.0)	

Data are presented as frequencies and percentages
P-values were determined by chi-squared test

DISCUSSION

The findings of this study provide valuable insights into the consumption patterns and perceptions of Hassawi rice among a varied cohort of 1,017 participants. The data reveals substantial disparities in consumption influenced by demographic characteristics, health status, and regional preferences, which should guide dietary treatments and public health measures.

Younger people (ages 18-29) consume less Hassawi rice than older people, especially those aged 40-50 (78.1%) ($p = 0.008$). This supports previous findings that health awareness and lifestyle changes affect dietary choices with age (Bawazeer et al., 2021). Younger generations tend to choose convenience meals over traditional staples and have more globalized diets (Baker et al., 2020). Married respondents consumed more (74.5%) than single (60.5%) and divorced (55.0%) respondents ($p = 0.000$). This suggests that families like making traditional dishes, especially Hassawi rice dishes, at community events (Yannakoulia et al., 2008).

The health status of participants exhibited a strong correlation with their use of Hassawi rice, especially in persons with obesity and diabetes ($p = 0.022$ and $p = 0.017$, respectively). Participants exhibiting these circumstances demonstrated an increased inclination to consume Hassawi rice, perhaps attributable to its perceived health advantages. The nutritional composition of Hassawi rice, abundant in fiber and antioxidants, facilitates weight management and glycaemic regulation (Rebello et al., 2014). This organization underscores the need of health education concerning traditional foods that can provide viable alternatives to processed options, particularly for persons with chronic health concerns.

Notably, participants' understanding of the nutritional benefits of Hassawi rice was favourably correlated with its consumption. Individuals who recognized the excellent nutritional value of Hassawi rice were more inclined to include it in their diets ($p = 0.000$). This indicates that increasing awareness of the nutritional advantages of traditional grains could substantially influence dietary selections, fostering healthy eating practices. Prior studies indicate that enhanced nutritional awareness is associated with improved dietary habits (Shoyemi et al., 2024), underscoring the necessity for extensive educational initiatives.

Regional disparities markedly affected Hassawi rice intake, with 92.4% of persons in the Eastern region reporting its consumption, in contrast to merely 46.9% in the Northern region ($p = 0.000$). These discrepancies may reflect local agricultural techniques, availability, and the cultural value of Hassawi rice in different places. In areas where Hassawi rice is a staple, its culinary versatility is acknowledged, as seen by the diverse cooking

methods and accompanying foods (Al-Mssallem et al., 2024a). Comprehending these regional patterns is crucial for formulating customized therapies that take into account local eating behaviors and preferences.

The Al-Ahsa region, located in Saudi Arabia's Eastern Province, has long been acknowledged as the major producer of Hassawi rice. Their distinctive capacity to thrive in the region's hot and humid climate is well established (Al-Mssallem et al., 2024b). A study by Sedeek et al. (2024) emphasizes that regional eating practices in Saudi Arabia are intricately connected to locally cultivated goods. The research demonstrates that the Eastern Region's populace consumes markedly more Hassawi rice than other regions due to its local availability, historical importance, and cultural affinity. The results indicate that almost 80% of Hassawi rice is consumed domestically, as the residents of Al-Ahsafavor locally cultivated rice for its superior nutritional content and its association with local heritage.

Al-Mssallem et al. (2024a) analyze how Hassawi rice production has affected Eastern Region cuisine and culture. The study found that more than 60% of Al-Ahsa families eat Hassawi rice weekly, compared to lower consumption rates in Riyadh and Jeddah, where imported rice is more common. The reason for avoiding Hassawi rice revealed potential challenges. The main characteristics were high cost, cooking time, and unavailability ($p = 0.000$). Subsidization, speedy preparatory training, and market accessibility could boost Hassawi rice consumption, especially in unfavorable regions. Economic, cultural, and practical barriers may reduce Hassawi rice use outside the Eastern Region of Saudi Arabia. Research and publications highlight various barriers to Hassawi rice consumption in other societies.

A major obstacle to the extensive consumption of Hassawi rice beyond the Eastern Region is its elevated cost relative to imported rice varieties, such as basmati or jasmine. Hassawi rice is produced in limited numbers and requires significant work, resulting in elevated costs. This renders it less accessible to middle- and lower-income families in many locations of Saudi Arabia. Zhang et al. (2012) study indicates that the price of Hassawi rice is considerably greater than that of imported rice, with consumers in areas such as Riyadh and Jeddah favouring more economical options.

Hassawi rice is predominantly cultivated in the Al-Ahsa oasis located in the Eastern Region, with its production being comparatively limited. The distribution networks for Hassawi rice are constrained. This complicates its availability in grocery stores and markets beyond the Eastern Region, diminishing accessibility for the broader Saudi populace. Metwally et al. (2022) identified restricted market availability as a primary obstacle to the consumption of Hassawi rice in various regions of Saudi Arabia. Retailers and distributors prioritize imported types, which are more readily available in substantial quantities and typically possess established supply chains. An additional significant obstacle is the disparity in flavour, texture, and culinary techniques between Hassawi rice and the more widely accessible imported rice. Hassawi rice possesses a unique reddish-brown hue and a denser texture, which may be unfamiliar to certain consumers beyond the Eastern Region. Research conducted by Cabral et al. (2024) revealed that customer preferences in the canter and western regions of Saudi Arabia favor lighter, more refined rice varieties, such as basmati, which are characterized by a softer flavour and perceived versatility for several culinary applications established (Al-Mssallem et al., 2024b).

This study's results offer valuable data on the preferences and consumption patterns of Hassawi rice in various geographical regions. The data indicate considerable geographical disparities in preferred cooking methods, types of fats utilized, meat combinations, and related nutritional attitudes. The inclination to prepare Hassawi rice in Kabsa, particularly in the Eastern region, signifies a profound cultural connection to this rice variety (53.9%, $p = 0.000$), consistent with traditional Saudi Arabian culinary practices where rice is a fundamental element (Mariod et al., 2024). This cultural significance indicates that health promotion programs must emphasize nutritional advantages while also honoring and integrating traditional culinary practices. The study revealed that plant-based fats were favored for cooking, with 49.5% of respondents in the Eastern region selecting these healthier alternatives ($p = 0.000$). This indicates a rising trend in healthier culinary habits, potentially associated with heightened health consciousness.

In the context of meat selections accompanying Hassawi rice, red meat is the predominant preference, especially in the Eastern region, where 55.2% of respondents expressed this inclination. This aligns with prevalent dietary trends in the Middle East, which frequently prioritize red meat consumption due to its cultural and historical importance (Montagnese et al., 2019). Camel meat is particularly favored in the Central region, underscoring its distinctive role in local cuisine and possible ramifications for sustainable livestock operations in arid areas (Lobefaro et al., 2021).

The statistics reveal a significant preference for accompaniments to Hassawi rice, especially in the Eastern region, where 59% of respondents favoredLobbia. This preference may indicate local culinary traditions and practices that prioritize particular flavors and textures, so enriching the overall dining experience. Conversely, the Central area displayed a varied assortment of accompaniments, with garlic emerging as a prominent preference (19.9%). This discovery aligns with prior studies highlighting the significance of regional cuisine and flavor profiles in food choices (Savvaidis et al., 2022).

The consumption of Hassawi rice at significant events, such as Ramadan (48.8%) and family reunions (44.9%), illustrates its cultural importance. The discovery that most respondents consume this rice during Ramadan

corresponds with historic customs prevalent in numerous societies, wherein particular meals are designated for religious observances (Shadman et al., 2014). The data reveals that 51.9% of respondents take it during pregnancy and the puerperium, indicating its significance as a staple diet associated with health. Research on Hassawi rice demonstrated that it elicits reduced glycemic and insulin responses relative to conventional rice varieties, which is advantageous during pregnancy for sustaining optimal glucose levels. This rice is abundant in phenolic compounds and antioxidants, which may enhance maternal health by mitigating oxidative stress and fostering overall well-being during pregnancy (Al-Mssallem and Alqurashi, 2021).

The motivations behind the use of Hassawi rice provide substantial insights into consumer behavior. Fifty-six percent of respondents in the Eastern region identified high nutritional content as a motivation for consumption, indicating a growing awareness of health and nutrition among consumers. This aligns with global trends in which health knowledge affects dietary selections (Micha et al., 2017). The focus on health and disease prevention highlights the significance of dietary choices in public health discourse, especially with chronic illnesses.

The analysis indicates that 51.8% of respondents from the Eastern region reported consuming products derived from Hassawi rice, markedly surpassing other regions. This choice may indicate the availability of Hassawi rice products and the cultural culinary traditions in this region. The inclination towards bread derived from Hassawi rice (51.6% in the Eastern region), followed by Kabba, indicates a robust incorporation of this grain into conventional diets. Prior research has demonstrated that regional culinary customs substantially affect grain consumption and preparation techniques (Mariod et al., 2024).

Participants exhibited diverse understanding of the nutritional value of Hassawi rice. A substantial proportion (50.6%, $p < 0.001$) regarded it as possessing superior nutritional content relative to white rice, reflecting a favorable impression of its health advantages. This viewpoint corresponds with literature indicating that whole grains, including Hassawi rice, provide enhanced health advantages owing to their elevated fiber and nutritional composition (Al-Mssallem et al., 2024a).

When queried about the distinguishing features of Hassawi rice compared to other varieties, respondents emphasized elements such as flavor (50.9%) and nutritional benefits (52.0%), demonstrating a significant awareness of its distinctive qualities. The statistics indicate that the unique flavor and perceived health advantages may enhance its popularity. This finding aligns with research demonstrating that sensory qualities and health perceptions are essential in consumer food product selection (Pohjanheimo, 2010). The low number of respondents who perceived "no difference" between Hassawi rice and other rice varieties indicates that Hassawi rice is esteemed and acknowledged for its distinctive attributes.

The participants also recognized essential components present in Hassawi rice, emphasizing fibers (50.7%), vitamins and minerals (52.0%), and antioxidants (51.1%). This awareness underscores a critical facet of public health nutrition: the necessity of informing consumers about the nutritional elements of traditional meals. Prior studies highlight the significance of consumer awareness in fostering healthy eating habits and improving public health (Al-Mssallem et al., 2024a). A significant proportion of respondents (47.9%) reported a lack of knowledge of the key nutrients in Hassawi rice, highlighting a potential deficiency in nutritional education that may be remedied by community outreach programs.

This study investigates the correlation between Body Mass Index (BMI) categories and the consumption patterns of Hassawi rice among participants. The results reveal notable disparities in the frequency and volume of Hassawi rice consumption among different BMI groups, offering insights into dietary patterns and their possible health implications. The statistics indicate that persons classified as overweight and obese consume Hassawi rice more often than those in the underweight or normal weight groups. Specifically, 44.9% of individuals with normal weight reported infrequent eating of Hassawi rice, whereas a significant percentage of overweight (27.1%) and obese participants (14.9%) exhibited analogous consumption behaviors. The statistical significance ($p = 0.022$) indicates a significant association between BMI and the frequency of rice eating. This corresponds with current data indicating that food habits might change markedly among various weight categories (Micha et al., 2017).

The prevalence of rice eating among overweight and obese persons may indicate dietary habits that lead to increased calorie intake and, subsequently, elevated BMI. Studies demonstrate that elevated intake of carbohydrates, especially from refined sources, is frequently linked to greater body weight (Wan et al., 2023). It is crucial to acknowledge that Hassawi rice, recognized for its nutritional properties, may provide health advantages over more processed carbohydrate sources

The data further demonstrates that persons with elevated BMI levels typically consume greater amounts of Hassawi rice per meal. A majority of normal-weight participants (51.5%) reported consuming fewer than one cup of rice, while a substantial proportion of obese participants (47.1%) suggested consuming three cups or more. The statistical significance of this data ($p < 0.001$) indicates that an increase in BMI correlates with a rise in rice consumption.

This trend is alarming, as larger portion sizes have been associated with overeating and weight gain. The correlation between portion size and caloric intake is extensively proven; larger servings typically result in

heightened energy consumption, potentially worsening weight-related concerns (Papagiannaki, and Kerr, 2024). This indicates that therapies focused on portion management may be advantageous, especially for persons with elevated BMI levels.

CONCLUSION

This study underscores notable regional disparities in the consumption patterns and preferences for Hassawi rice throughout several regions in Saudi Arabia. The statistics indicate a pronounced preference for Hassawi rice in the Eastern region, characterized by greater availability and consumption frequency. Consumption is influenced by factors such as flavor, cooking techniques, and perceived nutritional advantages, with participants expressing a preference for traditional meals like Kabsa. The data indicate that individuals across different BMI groups have diverse frequency of consumption and portion sizes of Hassawi rice. Participants exhibited a comprehensive understanding of the nutritional benefits of Hassawi rice, recognizing its abundance of antioxidants, vitamins, and minerals. This understanding may significantly impact their dietary selections and inclinations. These observations highlight the significance of cultural and geographical factors in dietary selections, which can guide future nutritional treatments and marketing tactics to promote Hassawi rice as a staple food.

REFERENCES

1. Al-Mssallem, M. Q., Al-Khayri, J. M., Alessa, F. M., & Al-Shalan, H. Z. (2024a). Contribution of Hassawi Rice to Food and Nutritional Security in Saudi Arabia. In Food and Nutrition Security in the Kingdom of Saudi Arabia, Vol. 2: Macroeconomic Policy and Its Implication on Food and Nutrition Security (pp. 321-336). Cham: Springer International Publishing.
2. Al Mssallem, M. Q., Ingle, K. P., Narkhede, G. W., Jain, S. M., Suprasanna, P., Abdi, G., & Al-Khayri, J. M. (2024b). Hassawi Rice (Oryza Sativa L.) Nutraceutical Properties, In Vitro Culture and Genomics. In Vitro Propagation and Secondary Metabolite Production from Medicinal Plants: Current Trends (Part 1), 142-168.
3. Al-Mssallem, M. Q., Hampton, S. M., Frost, G. S., & Brown, J. E. (2011). A study of Hassawi rice (Oryza sativa L.) in terms of its carbohydrate hydrolysis (in vitro) and glycaemic and insulinaemic indices (in vivo). European journal of clinical nutrition, 65(5), 627-634.
4. Al-Mssallem, M., &Alqurashi, R. (2021). Nutrient components and antioxidant activity in Hassawi rice and Basmati rice varieties. Scientific Journal of King Faisal University, 22(1), 54-57.
5. Al-Othaimeen, A. I., Al-Nozha, M., & Osman, A. K. (2007). Obesity: An emerging problem in Saudi Arabia. International Journal of Obesity, 31(S1), S1-S3.
6. Alqarni, S. S. M. (2016). A review of prevalence of obesity in Saudi Arabia. Journal of Obesity & Eating Disorders, 2(2), 25.
7. Baker, P., Machado, P., Santos, T., Sievert, K., Backholer, K., Hadjikakou, M., ... & Lawrence, M. (2020). Ultra-processed foods and the nutrition transition: Global, regional and national trends, food systems transformations and political economy drivers. Obesity Reviews, 21(12), e13126.
8. Bawazeer, N. M., Al-Qahtani, S. J., &Alzaben, A. S. (2021). The association between dietary patterns and socio-demographic and lifestyle characteristics: a sample of Saudi Arabia. Current Research in Nutrition and Food Science Journal, 9(3), 1046-1057.
9. Cabral, D., Moura, A. P., Fonseca, S. C., Oliveira, J. C., & Cunha, L. M. (2024). Exploring rice consumption habits and determinants of choice, aiming for the development and promotion of rice products with a low glycaemic index. Foods, 13(2), 301.
10. Krejcie, R. V. (1970). Determining sample size for research activities. Educational PsycholMeast, 30, 607-610.
11. Lobefaro, S., Piciocchi, C., Luisi, F., Miraglia, L., Romito, N., Luneia, R., ... &Donini, L. M. (2021). Cooking techniques and nutritional quality of food: A comparison between traditional and innovative ways of cooking. International Journal of Gastronomy and Food Science, 25, 100381.
12. Mariod, A., Tahir, H. E., & Salama, S. (2024). Food consumption patterns in Saudi Arabia. In Food and Nutrition Security in the Kingdom of Saudi Arabia, Vol. 2: Macroeconomic Policy and Its Implication on Food and Nutrition Security (pp. 303-319). Cham: Springer International Publishing.
13. Metwally, T., Al-Daej, M., El-Malky, M., & Ragab, A. (2022). Genetic analysis for rice seedling vigor and yeildcharacterestics of Hassawi landrace compared with some rice varaiteis. Fresenius Environ. Bull, 31, 3793-3804.
14. Micha, R., Peñalvo, J. L., Cudhea, F., Imamura, F., Rehm, C. D., &Mozaffarian, D. (2017). Association between dietary factors and mortality from heart disease, stroke, and type 2 diabetes in the United States. JAMA Internal Medicine, 177(10), 1516-1527.

15. Montagnese, C., Santarpia, L., Iavarone, F., Strangio, F., Sangiovanni, B., Buonifacio, M., ... &Pasanisi, F. (2019). Food-based dietary guidelines around the world: eastern Mediterranean and Middle Eastern countries. Nutrients, 11(6), 1325.
16. Musaiger, A. O., Al-Hazzaa, H. M., Takruri, H. R., &Mokhatar, N. (2012). Change in nutrition and lifestyle in the Eastern Mediterranean Region: Health impact. J NutrMetab, 2012, 436762.
17. Papagiannaki, M., & Kerr, M. A. (2024). Food portion sizes: trends and drivers in an obesogenic environment. Nutrition Research Reviews, 1-41.
18. Pohjanheimo, T. (2010). Sensory and non-sensory factors behind the liking and choice of healthy food products. Functional Foods Forum; Department of Biochemistry and Food Chemistry, University of Turku.
19. Rebello, C. J., Greenway, F. L., & Finley, J. W. (2014). Whole grains and pulses: A comparison of the nutritional and health benefits. Journal of agricultural and food chemistry, 62(29), 7029-7049.
20. Savvaidis, I. N., Al Katheeri, A., Lim, S. H. E., Lai, K. S., &Abushelaibi, A. (2022). Traditional foods, food safety practices, and food culture in the Middle East. In Food safety in the Middle East (pp. 1-31). Academic Press.
21. Sedeek, K., Mohammed, N., Zhou, Y., Zuccolo, A., Sanikommu, K., Kantharajappa, S., ... & Mahfouz, M. M. (2024). Multitrait engineering of Hassawi red rice for sustainable cultivation. Plant Science, 341, 112018.
22. Shadman, Z., Poorsoltan, N., Akhoundan, M., Larijani, B., Soleymanzadeh, M., Zhand, C. A., ... &Nikoo, M. K. (2014). Ramadan major dietary patterns. Iranian Red Crescent Medical Journal, 16(9).
23. Shoyemi, O. S., Abdulsalam, A., Oni, I. F. D., Hassan, A. I., & Oladele, T. A. R. O. (2024). Examination of the Effectiveness of Health Education Programs in Preventing Chronic Diseases. Med Discoveries, 3(3), 1134.
24. Wan, Y., Tobias, D. K., Dennis, K. K., Guasch-Ferré, M., Sun, Q., Rimm, E. B., ... & Willett, W. C. (2023). Association between changes in carbohydrate intake and long-term weight changes: prospective cohort study. bmj, 382.
25. World Health Organization. (2020). Body mass index - BMI. Retrieved from https://www.who.int/data/gho/data/themes/theme-details/GHO/body-mass-index
26. Yannakoulia, M., Panagiotakos, D., Pitsavos, C., Skoumas, Y., &Stafanadis, C. (2008). Eating patterns may mediate the association between marital status, body mass index, and blood cholesterol levels in apparently healthy men and women from the ATTICA study. Social science & medicine, 66(11), 2230-2239.
27. Zhang, T., Hu, S., Zhang, G., Pan, L., Zhang, X., Al-Mssallem, I. S., & Yu, J. (2012). The organelle genomes of Hassawi rice (Oryza sativa L.) and its hybrid in saudiarabia: genome variation, rearrangement, and origins.