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Research Article
Assessment of the Minimum Dietary Diversity of Reproductive Women in Saudi Arabia

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Abstract

Objective: The objective of this study was to assess the adequacy of micronutrients in the diets of reproductive women in Saudi Arabia using the Food and Agriculture Organization and the United States Agency for International Development Guidelines for Minimum Dietary Diversity for Women. **Materials and Methods:** A sample of 1,700 mothers, aged 15-49 years, was selected from five major regions in Saudi Arabia. The 24 h recall method was used to record food consumed in the last 24 h. **Results:** The results revealed that in the Kingdom of Saudi Arabia (KSA), 54% of mothers achieved the Minimum Dietary Diversity for Women (MDD-W) and consumed an adequate intake of micronutrients, whereas 46% of mothers of infants did not. Food groups that contributed significantly to the MDD were grains (100%); meat, poultry and fish (91%) and dairy products (78%). Those that contributed moderately were other vegetables (49%), pulses (44%) and other fruits (41%). The food groups that contributed minimally were eggs (28%); other fruits and vegetables rich in vitamin A (23%); dark green leafy vegetables (20%) and nuts and seeds (17%). There was a positive relationship between the MDD score achieved and the mothers' level of education, income and age. The nutritional messages, information and counseling provided to reproductive women increased the percentage of mothers who achieved adequate micronutrients. These results are essential in visualizing the problem of insufficient consumption of micronutrients and specific food groups in reproductive women's diets. **Conclusion:** There is a need for formulating strategies to develop programs and interventions to improve and enhance the consumption of adequate micronutrient intake in reproductive women's diets in the KSA.

Key words: Food groups, micronutrient intake, minimum dietary diversity, reproductive women, Saudi Arabia

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Micronutrient malnutrition affects a large percentage of the world's population; as such, micronutrient deficiency is a significant health problem in the Middle East. However, in the last three decades, the region has undergone substantial demographic, economic, political and social changes that present challenges related to diet, nutrition and health[1].

The World Health Organization (WHO) has divided the Middle East into overlapping country clusters, concerning nutrition stages and dominant nutrition problems as well as significant risk factors and underlying causes, program interventions and gaps in response to these problems[2]. Countries rapid transitions in nutrition, including the Kingdom of Saudi Arabia (KSA), have a high prevalence of overweight and obese citizens and a moderate prevalence of undernutrition and micronutrient deficiencies in some population subgroups[1]. Maternal and pediatric malnutrition is highly prevalent in low- and middle-income countries, resulting in a substantial increase in mortality and the overall burden of disease[3]. Dietary diversification is one of the main strategies promoted internationally to improve micronutrient intake and status[4].

The consequences of micronutrient malnutrition are omnipresent, damaging and often irreversible, contributing directly and indirectly to the morbidity and mortality of billions of people worldwide[5]. One of the most important causes leading to maternal micronutrient deficiency is a poor diet that lacks diversity[6].

Achieving the MDD-W is an indicator of adequate micronutrient intake in reproductive women. According to the FAO. and USAID[7], the micronutrient content of the different MMD-W food groups varies in type and quantity. For example, starchy grains, white roots and tubers provide energy and varying amounts of micronutrients and anti-nutrients. Pulses are high in protein and B-vitamins and contain different amounts of anti-nutrients that inhibit the absorption of specific nutrients. Nuts and seeds are rich in unsaturated fatty acids, protein, fiber and minerals. Dairy is an important source of high-quality protein, potassium and calcium as well as vitamin B_{12} and other micronutrients. Meat is an important source of high-quality protein and bioavailable micronutrients, especially iron, zinc and vitamin B_{12}. Eggs are an excellent source of protein, vitamin B_{12} and a range of bioavailable micronutrients. Dark green leafy vegetables, some fruits and other vegetables are rich in vitamin A. The objective of this study was to evaluate the adequacy of micronutrients in the diets of reproductive women in the KSA using MDD-W guidelines.

MATERIALS AND METHODS

Commonly used methods for collecting food consumption data, such as 24 h conservative quantitative surveys, are costly and difficult to perform and analyze with limited resources[8]. Accordingly, a simple score was used as an indirect indicator of food intake adequacy. This score can be used in large surveys, such as the Demographic and Health Surveys and National Nutrition Surveys, to estimate the intake of micronutrients with ease, speed and precision[9].

The MDD-W is defined as the consumption of at least five out of ten food groups during the previous 24 h. Accordingly, any women who consumed food from five or more of the ten selected food groups were expected to meet their micronutrient requirements[10]. Currently, the MDD-W is used as a global indicator to monitor nutrition-sensitive action programs aimed at improving the diet of women of reproductive age[10].

This study adopted and modified the guidelines of the Food and Agriculture Organization (FAO) of the United Nations and the United States Agency for International Development (USAID)[7] in measuring the MDD-W in the KSA. The 24 h open recall method was used for mothers to record the food and beverages consumed during the previous 24 h. Each food group was assigned to one of fourteen food subgroups and thereafter assigned to one of ten major food groups used to calculate the MDD-W.

The fourteen food subgroups included (1) Foods made from grains; (2) white roots and tubers, (3) Pulses (beans, peas and lentils), (4) Nuts and seeds, (5) Milk and milk products, (6) Organ meat, (7) Meat and poultry, (8) Fish and seafood, (9) Eggs, (10) Dark green leafy vegetables, (11) Vegetables, roots and tubers rich in vitamin A, (12) Fruits rich in vitamin A, (13) Other vegetables and (14) Other fruits.

To get the ten main food groups used to calculate the MDD-W in the KSA, approximately seven food subgroups were assigned to only three major food groups. Foods made from grains, white roots and tubers were combined into a group called grains, white roots and tubers. Organ meat, meat and poultry and fish and seafood were combined into a group called meat, poultry and fish. Vitamin-A-rich vegetables, roots and tubers and vitamin-A-rich fruits were combined into a group called vitamin-A-rich fruits and vegetables. The FAO and USAID[7] efforts to estimate the MDD-W provide detailed definitions for each subgroup and major food group, as well as a list of the foods that make up each.

The MMD-W was calculated by dividing the number of infant mothers aged 15-49 years who consumed foods from

Table 1: Percentage of consumption of subgroups and food groups for estimating the minimum dietary diversity for women (MDD-W) in the Kingdom of Saudi Arabia (KSA)

Food subgroup	Frequency	Percentage	MDD-W FOOD GROUP	Frequency	Percentage
Food made from grains	1653	97	Grain, white roots and tuber	1693	100
White roots and tuber	1309	77			
Pulses (beans, peas and lentils)	753	44	Pulses (beans, peas and lentils)	753	44
Nuts and seeds	288	17	Nuts and seeds	288	17
Milk and milk products	1332	78	Dairy	1332	78
Organ meat	324	19	Meat, poultry and fish	1551	91
Meat and poultry	1527	90			
Fish and seafood	275	16			
Eggs	484	28	Eggs	484	28
Dark green leafy vegetables	341	20	Dark green leafy vegetables	341	20
Vitamin-A-rich vegetables, roots and tubers	388	23	Other vitamin-A-rich fruits and vegetables	388	23
Vitamin A-rich fruits	385	23	Other Vegetables	830	49
Other vegetables	830	49	Other Fruits	703	41
Other fruits	703	41			

Table 2: Percentage distribution of mothers of infants according to the number of food groups consumed in the KSA

No. of food groups	1	2	3	4	5	6	7	8	9	10
Percentage	0.4	5	19	21	18	16	11	6	2	1

greater than or equal to five food groups from the ten major food groups during the previous day by the total number of mothers (15-49 years of age) in the study sample.

Approximately 165 Primary Health Care Centers (PHCCs) were selected from five major regions in the KSA. The selected regions were the Middle (Riyadh), Northern (Hail), Southern (Jazan) Western (Jeddah) and Eastern (Dammam) regions. In total, 33 PHCCs were selected from each region, of which 20% were rural and 80% were urban. The selection of the PHCCs was designed to cover the different urban and rural sites in each region. Concerning the population size and the number of PHCCs, 500 respondents were selected from the Middle region, while only 300 respondents were selected from the rest of the regions. Health workers, including doctors, nutritionists, nurses and technicians, were trained to administer both infant and young child feeding and infant mothers' food intake questionnaires.

RESULTS

Table 1 shows the frequency and percentage of infant mothers' consumption of food from the 14 food subgroups and the ten food groups required to calculate the MDD-W score for women in the KSA.

Table 2 reveals the percentage distribution of the mothers of infants according to the number of food groups in the KSA.

The percentages of reproductive women who achieved the MDD-W in the Middle, Western, Eastern, Northern and Southern regions of the KSA are presented in Table 3.

Table 4 shows the percentage of the urban and rural infant mothers who consumed above and below the threshold of five food groups.

Table 3: Percentage of infant mothers who achieved minimum dietary diversity of the reproductive women (MDD-W) diets in the Kingdom of Saudi Arabia (KSA) (according to region)

	Urban	Rural	Total
Middle (Riyadh)	61.5	52	59.6
Northern (Hail)	46.0	52	47.0
Western (Jeddah)	53.0	48	53.0
Eastern (Dammam)	51.0	65	53.0
Southern (Jazan)	55.0	50	54.0
KSA	54.0	53	54.0

Table 5 presents infant mothers' sociodemographic characteristics, knowledge of reproductive women's diets and prenatal and postnatal care factors, which were expected to influence the consumption of the various food groups and, hence, influence the realization of adequate micronutrient intake for reproductive women in the KSA.

DISCUSSION

Food Group Patterns of Reproductive Women's Diets in the KSA: Foods rich in starch, meat and dairy products are more frequently consumed in the diets of reproductive women in the KSA (Table 1). The consumption of grains and white roots and tubers ranged from 77-97% and reached 100% when the two food subgroups were combined. Al-Jaroudi[11] found that the majority of Saudi women believed that a healthy diet consisted of regular meals of fruits, vegetables, proteins and grains. She concluded that providing women with prenatal education regarding health and nutrition could potentially improve their children's future nutritional status. Interestingly, many studies in developing countries have documented that diet in these countries is predominantly cereal-based[12,13].

Table 4: Percentage of food consumption from various food groups above and below the threshold of five food groups (according to location)

	Urban		Rural	
Percentage	<5 groups	≥5 groups	<5 groups	≥5 groups
Grains, white roots and tubers	12	54	46	53
Pulses (beans, peas and lentils)	12	34	10	31
Nuts and seeds	4	12	4	18
Dairy	32	46	34	47
Meat, poultry and fish	41	51	39	50
Eggs	4	25	3	23
Dark green leafy vegetables	4	25	3	23
Vitamin-A-rich vegetables and fruits	4	19	3	17
Other vegetables	5	44	7	42
Other fruits	2	40	2	37

Foods of animal origin such as meat, poultry, organ meat, fresh and dried fish and shellfish, eggs and dairy products were consumed in varying percentages in the diets of reproductive women in the KSA. More than 90% of the reproductive women consumed poultry and meat, while the consumption of fish, seafood and eggs varied between 16 and 28%. The rate of consumption of products in the dairy group was 78% (Table 1). The dairy group included almost all liquid and solid dairy products from cows, goats, buffaloes, sheep or camels; canned, powdered or ultra-high temperature (UHT) milk; soft and hard cheeses and yogurt[7].

Fruit and vegetable food groups included five food subgroups: dark green leafy vegetables; vegetables rich in vitamin A (other than dark green leafy vegetables); fruits rich in vitamin A; other vegetables and other fruits. The consumption of these five food subgroups varied between 20 and 49% in the diets of reproductive women in the KSA. Only 20% of the population studied consumed dark green leafy vegetables during the previous 24 h and 23% consumed fruits and vegetables rich in vitamin A. The consumption of both fruits (41%) and vegetables (49%) was higher than the rate of consumption of the other three food subgroups of fruits and vegetables. The other vegetables food group included vegetables not counted as dark green leafy vegetables or vegetables rich in vitamin A and the other fruits food group included most fruits, excluding fruits rich in vitamin A. According to the FAO and FHI[14], different fruit and vegetable groups have different nutrient profiles, so consumption of a variety of fruits and vegetables best ensures adequate intake of micronutrients as well as of other phytochemicals and fiber. Moreover, the World Health Organization (WHO) reported that a healthy diet contains fruits, vegetables, legumes, nuts and whole grains[15].

The consumption of pulses, such as beans, peas and lentils, amounted to 44% in the total sample of the study. The nuts and seeds food group, which included tree nuts, peanuts and certain seeds that were consumed in substantial amounts, had the lowest consumption (17%) by the KSA reproductive women.

Table 2 shows the results of the percentage distribution of the mothers of infants according to the number of groups of foods consumed. Mothers who consumed three to four food groups accounted for approximately 40% of the study sample and were below the threshold for the estimated MDD-W for women in the KSA (Table 2).

Different dietary diversity indicators have been developed to reflect household food security, infant and young child feeding practices and micronutrient adequacy for women of reproductive age[15].

Food groups that contributed significantly to the MDD-W were grains, white roots and tubers (100%); meat, poultry and fish (91%) and dairy products (78%). Food groups that contributed moderately were other vegetables (49%), pulses (44%) and other fruits (41%). Food groups that contributed minimally were eggs (28%), other fruits and vegetables rich in vitamin A (23%), dark green leafy vegetables (20%) and nuts and seeds (17%) (Table 1). A similar study about the determinants of dietary diversity among pregnant women in Kenya found that the most commonly eaten foods were cereals (99%), oils and fats (93%), other vegetables (93%) and milk and milk products (92%), while foods of animal origin were minimally consumed[16].

The consumption of food groups rich in micronutrients, such as eggs, other vitamin-A-rich fruits and vegetables, dark green leafy vegetables and nuts and seeds, was infrequent among the diets of reproductive women in the KSA.

Adequate intake of micronutrients: In Saudi Arabia, approximately 54% of breastfeeding mothers achieved the MDD and were more likely to consume a higher or adequate intake of micronutrients compared to 46% of mothers who did

Table 5: Factors associated with achieving the minimum dietary diversity for women (MDD-W) Score

Mothers of Infants	Percentage achieving MDD-W (N = 920)	Trend equation
Level of education		Y = 33.9+7.6X R^2 = 0.53)
Illiterate	48.5	
Primary	50.7	
Intermediate	56.9	
Secondary	52.1	
Graduate	55.5	
M.Sc. Degree	100.0	
Occupation		
Student	54.0	
Administrative	58.0	
Nurse	62.0	
Physician or pharmacist	69.0	
Teacher	56.0	
Housewife	52.0	
Age (years)		Y=45.49+2.23X (R^2 = 0.6)
15-20	48.0	
20-25	48.0	
25-30	57.0	
30-35	52.0	
>35	57.0	
Monthly income (SR)		Y= 45.11+2.6 X (R^2 = 0.51)
0	49.0	
800-300	54.0	
3000-5000	62.0	
6000-8000	53.0	
8000-10000	56.0	
>10000	68.0	
Knew that there are many natural foods and medicines that can promote the production of breast milk		
Yes	53.0	
No	47.0	
Received antenatal care		
Yes	55.0	
No	46.0	
Received messages on maternal nutrition during antennal care		
Yes	56.0	
No	48.0	
Received messages, information, or consultation about diet during postnatal care		
Yes	55.0	
No	51.0	
Encouraged to eat a certain type of food during postnatal care		
Yes	57.0	
No	51.0	
Breastfeeding cessation		
0-7 days	51.0	
8-30 days	53.0	
31-60 days	46.0	
61-120 days	52.0	
121-180 days	71.0	
181-360 days	66.0	
361-540 days	92.0	
>540 days	66.0	

not (Table 3). Micronutrient malnutrition is a widespread, yet largely neglected, nutritional challenge faced by women living in the developing world, the consequences of which affect not only the health and survival of women but also their offspring[15]. Other research has shown that poor nutritional status during pregnancy is associated with adverse birth outcomes, such as low birth weight babies, intrauterine growth restriction and preterm delivery[17].

The regional comparison showed that the highest consumption of micronutrients in the urban sites was in the Riyadh region (61.5%), while the highest percentage of consumption in the rural sites was in the Eastern (Dammam) region (65%) and the lowest micronutrient intake was in the Northern (Hail) region (47%). On average, there appears to be no difference between infant mothers who achieved the MDD in urban and rural settings. This finding could be attributed to the availability of an equitable distribution of services between urban and rural areas of the KSA. Such availability of services made no apparent difference between rural and urban site food consumption. Findings of this study are not in agreement with findings of several other studies; for example, Chakona and Shackleton[18] reported that food security and the MDD-W were significantly higher in urban locations than in periurban or rural locations.

The difference in the consumption of food groups between those who achieved the MDD-W and those who did not is reflected in Table 3. The main food groups consumed by mothers who achieved the MDD in both urban and rural sites in the KSA were grains, white roots and tubers; meat, poultry and fish and dairy and other vegetables.

For rural women who did not achieve the MDD-W, the main food groups consumed were meat, poultry and fish (41%) and dairy products (32%). Contrary to expectations, grains, white roots and tubers (12%) were not considered among the main food groups consumed by mothers below the threshold in urban sites. Rural mothers who were below the threshold consumed mainly grains, white roots and tubers; meat, poultry and fish and dairy products.

Factors Associated with the MDD-W: Eating healthy is especially important when you are breastfeeding, as the body has a greater need for most foods. Some of the additional energy required for breastfeeding comes from stored body fat during pregnancy[19]. The most frequent causes of maternal malnutrition are inadequate food intake, poor quality diets, regular infections and short intervals between pregnancies. These causes originate from broader contextual factors, such as socioeconomic status, cultural beliefs, agricultural practices, national policies and food insecurity[20].

Many factors were expected to influence the consumption of various food groups in reproductive women's diets and therefore affected the achievement of adequate consumption of micronutrients. These factors included the sociodemographic characteristics of the mothers, mothers' knowledge of lactating mother diets and breastfeeding practices and receipt of prenatal and postnatal care, messages and information. In this study, the sociodemographic characteristics of mothers included their level of education, age, occupation and income. Prenatal and postnatal factors included whether or not the mother received both prenatal and postnatal care as well as messages and information about the diet of lactating mothers, the types of foods that promote breast milk production and the appropriate time for weaning. The trend equations showed a positive relationship between the MDD score and the level of education, income and age of the mother. Educated mothers were expected to be well-informed about the importance and benefits of dietary diversity for both the lactating mother and her infant. Similar studies found a positive association between the education level and dietary diversity of mothers[21,22]. Another study concluded that women who had tertiary and secondary education had greater odds of achieving the MDD compared to those who had never attended school[16].

Approximately 17% of the study sample were aged 15-25 years, indicating that in the KSA, early marriage of girls is permissible as soon as girls reach puberty. Young married women were expected to be less informed about breastfeeding practices and types of food groups to consume. The results indicate that the percentage of mothers who reach the MDD threshold increases with age (Table 5). The portion of mothers aged 15-25 years who reached the MDD threshold was only 48%, while the portion who were below the threshold of five food groups was 52%. In the 25-30-year age group, the percentage of mothers who consumed five or more food groups reached 57%. This finding is in line with Gitagia *et al.*[22], who found that head of household gender, women's education level, women's age and family size influenced dietary diversity in high potential areas in Kenya.

It is no surprise that women in the health field are expected to be well-informed about healthy food. Thus, mothers in health occupations (physicians, pharmacists and nurses) achieved a higher percentage of micronutrient intake than other professions (Table 5).

The potential for malnutrition is compounded by a lack of knowledge and information on essential nutrition. A higher level of nutritional knowledge has been positively and significantly associated with better dietary quality[23].

The nutritional messages, information and counseling provided to reproductive women (regarding their diets and the types of food to be consumed) during prenatal and postnatal care improved the percentage of mothers who reached adequate micronutrient intake in comparison to

those who were not provided these resources (Table 5). Thus, nutritional counseling, messages and information for reproductive women improved the level of micronutrient intake in the KSA.

Early termination of breastfeeding was inversely related to the percentage of women consuming five or more food groups, the threshold for adequate micronutrient intake. For example, only half of the mothers who ceased breastfeeding during the first week consumed sufficient micronutrients; however, the percentage reached 92% for those who ceased breastfeeding after 361-540 days. This finding could be justified by the fact that lactating women were expected to diversify their food considerably to stimulate and increase breast milk production.

CONCLUSIONS AND RECOMMENDATIONS

In the KSA, approximately 54% of breastfeeding mothers achieved the MDD and were more likely to consume higher or adequate micronutrients, while 46% of infant mothers were not. There were regional variations among the five selected regions concerning sufficient intake of micronutrients from the mothers' reproductive diets. Food groups that minimally contributed to the achievement of adequate intake of micronutrients in the KSA were eggs; other fruits and vegetables rich in vitamin A; dark green leafy vegetables and nuts and seeds. The trend equations showed a positive relationship between the MDD score and the level of education, income and age of the mother. Nutritional messages, information and counseling provided to women during prenatal and postnatal care concerning women's reproductive diets increased the percentage of mothers who achieved adequate micronutrients compared to those who were not provided these resources. These results are significant and necessary to visualize the problem of inadequate consumption of micronutrients in the diets of reproductive women, poor consumption of specific food groups and the need for nutritional counseling and messages during prenatal and postnatal care. It is therefore necessary to formulate strategies to develop programs and intervention measures to improve and increase the intake of adequate micronutrients in the diets of reproductive women in the KSA.

Ethics approval and consent to participate: The Institutional Review Board (IRB) of King Saud University (KSU) approved the study. An official letter produced from the Federal Ministry of Health directed to all its regional and state-level offices supported the research and requests for participation. Participants were fully informed about their rights to participate and withdraw, without any consequence, at any time before or at any point during or after the start of the study. Participants were assured that any information provided would be used only for research purposes.

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