NUTRITIONAL STATUS OF REPRODUCTIVE AGE WOMEN LIVING IN THE URBAN AREA OF MOROCCO

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ABSTRACT
Micronutrient deficiencies are a public health problem at the national and the international levels. The purpose of this study is to evaluate the status of minerals and vitamins in women's population of reproductive age living in an urban area in Morocco. The study involved 542 women aged 19-49 recruited in several health centers. Socio-economic (SES) and demographic status were collected. Anthropometric parameters including body mass index (BMI), waist circumference, hip circumference and waist-to-hip ratio (WHR) are measured. Nutritional data for the following micronutrients: iron, iodine, zinc, sodium, calcium, vitamins A, B9 and D were processed by Nutrilog software (with Moroccan Food Composition Table) and analyzed by statistical software (SPSS version 13.0).The analysis of the results revealed that 34.3% of women were overweight and 22.7% were obese. A deficiency compared to the nutritional reference intake (ANR) of iron, iodine, calcium, zinc, vitamin A, and B9 was respectively also noted in women with proportions of 100%, 97% 98.7%, 71.2%, 96.5% and 81.7%. Regarding sodium, all women had an excess of intake. The monthly expenditure was less than 3000$ in half of the population and more than half spend less than 272.32$ per month. Our study clearly showed that micronutrient status was very low among Moroccan women. It is therefore urgent to put in place specific strategies, in particular to raise awareness and improve nutrition education programs for the benefit of this vulnerable population.

KEYWORDS: Micronutrient, Women of Childbearing Age, Urban, Recall 24-h.

INTRODUCTION

Micronutrient deficiencies remain one of public health challenges in developing countries.[1,2] They affect more than two billion people worldwide.[3] Micronutrients include vitamins and minerals that help the body to produce hormones, enzymes and other substances that are essential for the growth, development and function of the body.[4] Micronutrients malnutrition is at the root of a wide range of non-specific physiological disorders leading to decreased resistance to infection, metabolic disorders and delays or abnormalities in physical and psychomotor development.[5] Therefore, these deficiencies affect people's life quality and productivity.[6] The micronutrients that are most likely to be missed in the diet are: iron, vitamin A, iodine, and zinc.[7,8] To these deficiencies are added deficiencies of calcium and vitamins (vitamin B9 or folic acid).[9]

Deficiencies in these same nutrients are most common among women of childbearing age. They are associated with adverse consequences such as maternal anemia and mortality, and congenital malformations.[4] They are still reported in many countries of the Eastern Mediterranean region, particularly in vulnerable groups, such as children and women of childbearing age.[10]

In Morocco, micronutrient deficiencies are also a health problem, particularly in vitamin A vitamin D, iron and iodine.[11] Indeed, surveys conducted by Ministry of Health in recent years on micronutrient deficiencies have shown that anemia affect 37.2% of pregnant women, 31.5% of children aged 6 months to 5 years, 32.6% of women and 18% of men.[12] 10% of women of reproductive age and 40.9% of children aged 6 to 72 months suffer from vitamin A deficiency.[13] 63% of

children aged 6 to 12 years have iodine deficiency, of which 22% have goiter.[14] In contrast, micronutrients status of zinc, sodium, calcium and vitamin B9 has been a neglected area of research in Moroccan region of Rabat – Salé – Kénitra.

No articles by Moroccan medical researchers in this area have been submitted for publication. This study aims therefore to focus on this aspect and to assess the vitamin and mineral status of women of childbearing age living in this region.

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MATERIALS AND METHODS
Population: This study is a descriptive cross-sectional survey. It was carried out on healthy women aged from 19 to 49years, recruited from health centers located in Rabat and its regions.

A total of 542 were randomly recruited, with no permanent medical treatment. Pregnant and lactating women, women with mental illness or those who participated in the pilot study were excluded.

Data Collection
At recruitment, socio-economic and demographic status of each participant was collected using a questionnaire. Anthropometric parameters including weight, height, waist and hip circumference were measured. BMI and WHR were used to assess abdominal and general obesity. Food intake data were collected following a cross-sectional survey conducted by dietitians using a 24-hour recall questionnaire. The 24 hour recall was repeated twice at 48 h intervals.

Socioeconomic Questionnaire (SES)
The data on socioeconomic and demographic standards and living conditions of the women were collected at the beginning of the study by interviewing them. We used an adequate questionnaire that was adapted from other ones used nationally to serve the purpose of our survey.[15] Informations collected included the level women's education, marital status, occupation, number of children, household size, household monthly global expenses, and alimentary expenses.

2.4.2. Anthropometric parameters
The anthropometric parameters of each participant were measured and followed according to the WHO standard procedures.[16] Body weight was measured to within 0.1 kg using a scale (Seca 750) with a minimum of clothing and no shoes. The height was measured to the nearest 0.1

cm using a stadiometer (Seca). BMI was calculated as the ratio of weight in kg to square height in m2. Women were classified into four groups according to BMI.[16,17] Women with underweight whose BMI is less than 18.5 kg / m2; women in a normal range with a BMI of 18.5 kg / m2 and 24.99 kg / m2; Overweight women with a BMI between 25 kg / m2 and 29.99 kg / m2; Obese women with BMI greater than or equal to 30 Kg / m².

Waist circumference was measured midway between the lower edge of the last palpable rib and the top of the iliac crest.[18] The hip circumference was measured at the widest point on the buttocks of the study participants. For abdominal obesity, WHR was obtained by dividing the average waist circumference by the average hip circumference. Women with WHR ≥ 0.85 were classified as obese.[16]

Dietary Intake Assessment
The 24-hour recall questionnaire: Food intake data are collected following a cross-sectional survey using a 24-hour recall questionnaire, rapid and inexpensive method that could be used for nutrition surveys in large groups.[19] This questionnaire covers names, first names, age, sex, address, quantity and nature of food ingested: bread, tomato, tea... for breakfast, lunch, afternoon tea and dinner.

In this study, the multi-pass approach was used to validate the 24-hour recall questionnaire. The principle of this method consists of 5 steps[20,21]
1) Quick list: To collect a list of foods consumed the previous day.

2) Forgotten foods list: To collect foods that may have been forgotten during the Quick List. Questions probe for foods by categories: nonalcoholic beverages; alcoholic beverages; sweets; savory snacks; fruits, vegetables, cheese; breads and rolls; other foods.

3) Time and occasion: To collect time and name of eating occasion for each food. Used to sort foods chronologically and group into eating occasions.

4) Detail and review: To collect a detailed description of each food consumed, including amount eaten and additions to the food. Also, to review eating occasions and times between occasions to elicit forgotten foods.

5) Final review: To collect additional foods not remembered earlier.
Women were solicited to collect all information about foods and drinks consumed for separated 2 days[21] using visuals aids to approximate the serving sizes of various foods.

A Photo Manual (SU.VI.MAX) for estimating consumed portions of food and drink.[22]
A Food book: tools to estimate food consumption: Food and typical preparations of the Moroccan population.[23]

The quantities consumed were converted using the Food Quantification Table, available in the corresponding book, then entered into the Nutrilog Food Information Software (SAS, version: 2.31, with Moroccan Food Composition Table), which was used to translate each food in nutrients and vitamins. At the same time, all the details of the vitamin and mineral supplements consumed during the investigation period were noted and the average micronutrient intake over 2 days was reported, in order to estimate the exact quantities permitting a comparison with the recommended dietary intakes.

The Nurtilog version 2.31 software
It is an analysis system based on L'ANSES nutritional references[24], which provides information on the individual food profile. The Moroccan food composition table has been integrated into the software database containing the Ciqual food table. France 2012; USD SR24; USA 201[24] provided by the supplier. The added table is the first one of the food composition developed in Morocco. This table concerns 424 foods consumed in Morocco. It is used to obtain the reality of micronutrient intakes of women of childbearing in our country.

Statistical Analysis
The data matrix compiled by the NUTRILOG software, combined with socio-economic questionnaire data, was analyzed statistically with statistical software for the social sciences (SPSS version 13.0). The normality of the distribution of anthropometric and nutritional variables was assessed using the Kolmogorov-Smirnov (KS) test[25], but was rejected at $p < 0.05$. Thus, quantitative variables with Gaussian distribution were expressed as mean and standard deviations, while non-Gaussian distribution variables were expressed in median and interquartile range (IQR). Qualitative variables were expressed in count and percentage.

Ethics of the study
The study received the approval of the Ethics Board of the Medicine and Pharmacy Faculty, University of Rabat, Morocco (Ethics no. 69 delivered on 31 January 2017). The purpose and the protocol of the study were presented and explained to the participants. Subsequently, oral and written consent was obtained from women, before the beginning of the survey.

RESULTS
Table. 1: Socioeconomic characteristics among reproductive age women.

Characteristics	Women's population N = 542	95% confidence interval (CI)
Age strata		
19 à 29 ans	240(44.3)	40.4 – 48.5
30 à 40 ans	203(37.5)	33.4 – 41.3
41 ans et plus	99(18.3)	15.1 – 21.6
Culture		
Arabe	418(77.1)	73.8- 80.6
Amazigh	96(17.7)	14.6 – 20.7
Sahraoui	12(2.2)	1.1 – 3.5
Rifain	9(1.7)	0.7 – 2.8
Jebli	7(1.3)	0.2 – 2.4
Level of education		
Illiterate	93(17.2)	14 – 20.3
Primary	113(20.8)	17.2 – 24.5
Secondary	208(38.4)	34.3 – 42.8
Higher education	128(23.6)	19.9 – 27.3
Marital status		
Single	111(20.5)	17.3 – 24.2
Married	405(74.7)	70.8– 78.2
Divorced	22(4.1)	2.6 – 5.5
Widowed	4(0.7)	0.2 – 1.5
Occupation of women		
Without job	383(70.7)	66.6 – 74.5
Student	52(9.6)	7.4 – 12.2
With job	107(19.7)	16.6 – 23.1
Occupation of the household head		
Without job	16(3)	1.7 – 4.4
With job	516(95.2)	93.4 – 96.9
Retired	10(1.8)	0.7-3.1
Number of children		
No child	133(24.5)	20.8 – 28.6
1 to 2 children	271(50)	45.6 – 53.7

3 and more	138(25.5)	22.1 – 29.3
Housing type		
Cement	498(91.9)	89.3 – 94.1
Hard	44(8.1)	5.9 – 10.7
Monthly expenses (US$)		
Lower than 122	4(0.7)	0.2 -1.7
122 to 195	39(7.2)	5 – 9.4
196 to 244	144(26.6)	22.9 – 30.4
244 to 366	119(22)	18.5 – 25.3
Higher than 3000	124(22.9)	19.2 - 26.4
Not known	112(20.7)	17.3 – 24
Monthly expenses for food (US$)		
Lower than 65.36	21(3.9)	2.4 -5.5
65.47 to 98.03	55(10.1)	7.7 - 12.7
98.14 to 130.71	56(10.3)	7.8 - 12.7
130.82 to 174.28	132(24.4)	21 - 28
174.39 to 272.32	97(17.9)	14.8 - 21.4
Higher than 272.32	69(12.7)	10.1 - 15.7
Not known	112(20.7)	17.3 – 24
Access time to h / c (min)		
< 15	437(80.6)	77.1 – 83.8
15 to 30	74(13.7)	10.9 - 16.4
30 to 60	28(5.2)	3.5 – 7.0
> 60	3(0.6)	0 - 1.3
Household size		
< 4 people	107(19.7)	16.6 – 23.2
4 to 7 people	390(72.0)	68.1 – 75.6
>7 people	45(8.3)	6.1 – 10.7

Note: Values are expressed in count and percentage, min: minute; h/c: the health center

Analysis of table 1 representing distribution of women according socio-economic characteristics showed that the majority of women were Arab, over two-thirds were not working. A third of population were illiteracy or with a primary level of education. Families are mainly composed of 4 to 7 people. The monthly expenditure was less than 3000$ in half of the population and more than half spend monthly for food less than 272.32$.

Table 2: Anthropometric characteristics of reproductive age women.

	Moyenne	**Standard error**	**95% confidence interval**	**Minimum-maximum**
Age (years)	31.96±8.42	0.36	-	19-49
Weight(Kg)	67.84±13.64	0.59	-	39-128
Height(cm)	1.60±0.06	0.01	-	1.42-1.78
BMI (Kg/m2)	26.35±5.21	0.22	-	15.73-42.06
BMI group				
Underweight group	29(5.4)	1.0	3.7-7.4	
Normal group	204(37,6)	2.1	33.4-41.7	
Overweight group	186(34.3)	2.1	30.3-38.4	
Obesity group	123(22.7)	1.8	19.2-26.4	
WC (cm)	87.60±12.98	0.56	-	57-128
HC (cm)	101.68±12.98	0.47	-	43-135
WHR	0.86±0.08	0.01	-	0.64-1.52

Notes: Values are expressed as mean ± standard deviation or count and percentage .For body mass index (BMI) groups: underweight BMI ≤18.5 kg/m2; normal BMI = 18.5 to <25 kg/m2; overweight BMI = 25 to <30 kg/m2; obese BMI ≥30 kg/m2. WC: waist circumference < 80 Cm ; HC: hip circumference < 88cm; WHR: waist-to-hip ratio≥ 0.85.

The anthropometric parameters of the participants are shown in Table 2. The average weight was 67.84 ± 13.64 kg and the average height was 1.60 ± 0.06. The mean values for BMI, waist circumference, hip circumference, and waist-to-hip ratio were respectively 26.35 ± 5.21 kg / m2, 87.60 ± 12.98 m, 101.68 ± 12.980 and 86 ± 0.08 cm.

Analysis of the BMI group showed that 37.6% of the women were of normal weight, 34.3% wereoverweight and 22.7% were obese (TABLE 2). In addition, we found that average abdominal obesity exceeds the value defined by WHO.[16]

Table. 3: Nutritional status of population.

Nutrients	Average ± SD of daily intakes	ANC	Prevalence of the insufficiencies of the daily contributions <ANC (%)
Iron (mg)	10.02±5.196	58.8	100
Iodine (mg)$^\beta$	35.10 [21.37-56.42]	150	97
Zinc (mg)$^\alpha$	8.48± 4.87	9.8	71.2
Calcium (mg)$^\alpha$	404.51±209.65	1000	98.7
Sodium (mg)$^\alpha$	3616.30 ±807.93	2000	Daily intake> 2g 100
Vitamine A (µg)$^\beta$	84.6 [37.90-164.00]	500	96.5
Vitamine D (µg)$^\alpha$	8.97±3.56	5	0
Vitamine B9 (µg)$^\alpha$	295.20 ± 170	400	81.7

Note: daily intakes are expressed as mean ± standard deviation (α) or median and quartiles (β).

Daily trace element intakes
Analysis of nutrient intakes revealed the following findings: The daily intake average of iron was 10.02 ± 5.196 mg / d. It was very lower than the recommended dose established by WHO and FAO.[26] All women (100%) had iron deficiency.

For iodine, the mean daily intake for participants was 35.10 [21.37-56.42] mg / d. the prevalence of insufficient iodine intake was 97%.

The average daily intake of calcium was 404.51 ± 209.65 mg / d. The prevalence of insufficient calcium intake was 98.7% (Table 3).

The average daily intake of zinc in women was 8.48± 4.87 mg d, while the ANC is 9.8 mg / d. The prevalence of insufficient daily intake of zinc was 71.2%. Regarding sodium, we found an excess of daily intake in all women.

Daily vitamin intakes
Result analysis also showed that the daily intake of vitamin A and vitamin B9 was 84.6 [37.90-164.00]µg/d and 295.20 ± 170 µg / d, respectively. On the basis of a recommended consumption of 500 µg per day (vitamin A) and 400 µg per day (vitamin B9), these intakes remain lower than those recommended. 96.5% and 81.7% had inadequate intake of vitamin A and vitamin B respectively. Regarding vitamin D, we found no insufficiency of daily intake in the studied population.

DISCUSSION
The present study planned to evaluate the nutritional status in a sample of Moroccan women of reproductive age. Our results showed that the majority of women were Arab and over two-thirds were not working. A third of population were illiterate or with a primary level of education. Families are mainly composed of 4 to 7 people. The monthly expenditure was less than 3000$ in half of the population and more than half spend less than 272.32$ monthly for food.

Analysis of distribution of women according to BMI (table 2) showed that (34.3%) of women are overweight and (22.7%) are obese. These prevalences are considered to be higher than those reported in the 2003-2004 survey.[15] Similarly, the prevalence of obesity exceeds the one that was reported by Haut commissariat au plan (HCP), in 2016 (19.97%)[27], but remains lower than those of other regions of Morocco[28,29] as well as in Tunisia.[30] Furthermore, we found that the average abdominal obesity exceeds the value defined by WHO.[16] This result is consistent with a similar Moroccan study.[31] Today, excess weight is identified as an important risk factor for many non-communicable diseases.[32] These are also increasing in Morocco, whose expenditures represent about 14% of total expenditure on health.[33]

The study population had a very inadequate dietary intake of iron, iodine, zinc, calcium, vitamin A and vitamin B9 with a prevalence of insufficient intakes, respectively of 100%, 97%, 71.2%, 98.7%, 96.5% and

81.7% below the ANR.[26] For iron, the average iron intake was 10.02 ± 5.196, which is higher than that reported for women of childbearing age in India and South Africa with respective intakes of (9.9 mg / d) and 7, 68 mg / day [34;35]. This can be explained by the consumption of certain foods rich in tannins (tea), which inhibit the absorption of iron.[36] Women are exposed to iron deficiency anemia, a major consequence of iron deficiency.[37] Iron deficiency, as a risk factor for maternal mortality caused 115 000 deaths and 0·4% of global total disability-adjusted life-years (DALYS).[38]

About the value of iodine, median consumption recorded in this study population was 35.10 mg [21.37-56.42] (table 3), it remains lower than that found in O'Kane et al in the United Kingdom and Ireland for women of childbearing age with a daily intake of 152 μg / d and the one found in Ireland with an intake of 104 μg / d.[39,40] This result can be explained by high consumption of bread among the Moroccans population. Bread is rich in phytate which reduces the availability of iron and zinc. This could be a major etiological factor for these deficiencies.[41]

The average zinc consumption was 8.48 ± 4.87 mg (table 3), which was approximately the same as that found by Guansheng, and al in 2007 among women of childbearing age in urban China (8.9 mg/d)[42] and in Nepal (8.6 ±6 3.3mg).[43]

In addition, the calcium intake recorded in this study population was 404.51 ± 209.65 mg / d (Table 3), it remains well below that reported in Inuit women by Schaefer et al in 2011 (1261, 6 ± 627.3)[44] as well as that reported for women in Kuwait (695 mg / d) by Balk et al 2017 in a systematic review.[45] Low calcium intake leads to osteoporosis rather than osteomalacia, due to secondary hyperparathyroidism and increased bone remodeling.[46] The role of calcium is not limited to the development and maintenance of bones, but it remains to be seen what effects calcium may have on the prevention of other health problems, such as colon cancer, hypertension, ovaries polycystic and obesity.[46,47] With regard to daily sodium intake, all women of childbearing age have a daily intake of sodium greater than that recommended by WHO, which equates to 2000 mg / day (5 g of salt / day).[48] As a result, the study population had an increased risk of hypertension associated with cardiovascular disease, stroke, and renal failure secondary to a high sodium diet.[32,49]

Concerning daily vitamin A intake, studies with women of childbearing age in other African countries and Nigeria report a very satisfactory daily vitamin A intake of 436-2645 μg / day and 2441 μg / day respectively The results found in our study (84.6 [37.90-164.00], (Table 3) are much lower than those found by Harika and al in 2017 and De Moura and al in 2015.[50,51] The mean Folate intake of women in our study was higher than the Folate intake of women in Iran 198.3 (185.4–211.3), but it was lower than the Folate intake of women in Lebanon (275μg/d).[52,53] Folate deficiency has a well established teratogenic effect, leading to an increased risk of neural tube defects.[26] The situation of the neural tube malformation in Morocco remains alarming. Indeed, in a multicenter prospective study conducted in 20 Moroccan public hospitals, the prevalence of this malformation was 63%.[54]

CONCLUSION
The population studied is characterized by a high prevalence of insufficient daily intakes of iron, iodine, zinc, calcium, vitamin B9 and vitamin A. However, for sodium, the daily intake remains excessive compared to the recommended nutritional value. In term of this work, the micronutrient status was very low compared to the recommended dietary intakes for Moroccan women. It is therefore urgent to put in place specific strategies, in particular to raise awareness and improve nutrition education programs for the benefit of this vulnerable population.

ACKNOWLEDGEMENTS

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