An analysis of Dietary Micronutrient Intakes in Two Age Groups of Black South African Women

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ABSTRACT

Objective: *To assess micronutrient intake of black women living in Mangaung, South Africa.*
Subjects and Method: *A sample of 500 pre-menopausal black South African women (496 qualified to participate) from two age groups (25–34 and 35–44 years) were selected randomly in Mangaung, the black residential area of Bloemfontein. A validated Quantitative Food Frequency Questionnaire (QFFQ) was used to determine dietary intake of participants. Data were categorized into the two age groups. Median micronutrient intakes were compared to the Recommended Dietary Allowance (RDA) and Adequate Intake (AI). The prevalence of women with intakes ≤ 67% of the RDA was calculated.*
Results: *Median calcium and vitamin D intakes were lower than the AI. Of all women, 46.2% to 62.2% consumed ≤ 67% of the RDA for total iron, selenium, folate and vitamin C, and more than 94% consumed ≤ 67% of the RDA for selenium. At least 25% of all women consumed ≤ 67% of the RDA for vitamin A and E. The vitamin B_6 intake of older women was inadequate and a fairly large percentage of the total sample consumed ≤ 67% of the RDA.*
Conclusion: *Generally, micronutrient intakes were adequate in this population. Attention should be given to those micronutrients where median intakes were ≤ 67% of the RDA and those that were not at or above the respective AI in these groups of women.*

Un Análisis de las Ingestas de Micronutrientes Dietéticos en dos Grupos Etáreos de Mujeres Negras de Sudáfrica

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RESUMEN

Objetivo: *Evaluar la ingesta de micronutrientes en mujeres negras de Mangaung, Sudáfrica.*
Sujetos y Método: *Una muestra de 500 mujeres surafricanas negras premenopáusicas (496 clasificaron para participar) de dos grupos etarios (25–34 y 35–44 años) se seleccionó aleatoriamente en Mangaung, el área residencial negra de Bloemfontein.* *Un cuestionario cuantitativo de frecuencia alimenticia (CCFA) validado, fue usado para determinar la ingesta dietética de las participantes. Los datos fueron clasificados en dos grupos etarios. Se comparó la mediana de las ingestas de micronutrientes con la ración dietética recomendada (RDR), y la ingesta adecuada (IA). Se calculó la prevalencia de mujeres con ingestas ≤ 67% de la RDR.*
Resultados: *La mediana de la ingesta de vitamina D y calcio estuvo por debajo de la IA. De todas las mujeres, 46.2% a 62.2% consumieron ≤ 67% de la RDR para el total de hierro, selenio, folato y vitamina C, y más del 94% consumieron ≤ 67% de la RDR para el selenio.*
Por lo menos 25% de todas las mujeres consumieron ≤ 67% de la RDR para la vitamina A y E. El consumo de vitamina B_6 de las mujeres de mayor edad fue inadecuado y un porcentaje bastante grande de la muestra total consumió ≤ 67% de la RDR.
Conclusión: *Generalmente, las ingestas de micronutrientes eran adecuadas en esta población. Debe prestarse la atención a los micronutrientes cuyas ingestas medianas fueron ≤ 67% de la RDR y aquellos que no correspondieron o estuvieron por encima del IA respectivo en estos grupos de mujeres.*

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INTRODUCTION

While clinical manifestations of micronutrient deficiencies have been known for many years, the public health burden of micronutrient deficiencies in developing countries has only been fully recognized in the last two decades. Globally, more than 2 billion people are at risk of iron, vitamin A, iodine and other micronutrient deficiencies. While progress has been made to reduce the prevalence of childhood malnutrition, micronutrient deficiencies remain significant nutritional and public health problems. These deficiencies impair function and increases the severity of common infections (*eg* measles, diarrhoea) while compromising intellectual potential, growth, development and adult productivity of women especially (1)

The development of appropriate health services for women is now prioritized in most developed countries. Data on the health status of black women living in urban areas in developing countries such as South Africa, are however limited (2), in particular, the influence of urbanization on the micronutrient status of these women (3). The health of black South African women is being influenced by the political transition from apartheid to democracy, rapid urbanization and the internationally growing awareness of the need for healthcare. The process of urbanization in countries including South Africa has been predicted to increase to 75% of the population, affecting mainly the black population (2). This leads to considerable urban poverty and the growth of informal settlements (3) which have a profound effect on the population's health status as these previous rural dwellers now adopt new ways of life (3).

Measuring and analysing what people eat can provide valuable information on their nutritional status. Nutrient intake data can be used to evaluate the adequacy of diets in order to establish goals for food and nutrition policy decisions and to study the relationship between nutrient intakes and health and disease. This cross-sectional study was therefore designed to determine the micronutrient intake of women (25–44 years) in Mangaung, South Africa.

SUBJECTS AND METHODS

Five hundred women from Mangaung, the urban black residential area of Bloemfontein, South Africa, were selected to participate in the study. The respondents were from formal settlements (Phahameng and Botchabela) and two informal settlements (Joe Slovo and Namibia). Pre-menopausal women were randomly selected from two age groups (25–34 and 35–44 years respectively) using township maps. The residential plots in the four selected areas were counted and numbered. Namibia had 2995 plots, Phahameng 1711, Joe Slovo 1359 and Botchabela had 2308. A proportionate number of respondents were selected randomly from these plots. The size of the sample was considered representative of the population of Mangaung by the Department of Biostatistics of the University of the Free State. Subjects were recruited by trained community health-workers who were given detailed instructions about the recruitment process as well as a detailed map of twenty of the plots that had to be selected on a weekly basis. The assigned community health-workers screened one woman from each plot for eligibility. The community health-workers explained the purpose of the study to possible participants. Each recruited subject was required to provide written informed consent. The Ethics Committee of the Faculty of Health Sciences, University of the Free State, approved the study (ETOVS No 02/00).

Micronutrient intake was determined using a culture-sensitive, validated Quantitative Food Frequency Questionnaire (QFFQ) that was developed for the Transition and Health during Urbanization of South Africans (THUSA) study conducted by the University of North West in South Africa (5). This measuring instrument is considered good for describing dietary intake of groups rather than individuals and is commonly used in epidemiological research on diet and/or disease (6–7). Furthermore, it provides an overall picture of food intake which may be more representative of the usual intake of the individual than a few days of diet records (6, 8) and is relatively inexpensive to use for large sample sizes (6, 9). The QFFQ used in the present study included typical South African foods as well as foods traditionally included in the diet of black inhabitants of the region. Prior to the study, the reliability of the QFFQ was tested by completing it in thirty subjects similar to those included in the main study. Reliability was found to be good. The QFFQ was administered during individual interviews by five trained interviewers enrolled for postgraduate qualifications in either nutrition or dietetics. Training of the interviewers was done prior to the study by a dietitian with experience in epidemiological research. Interviews were conducted in English and the interviewers were assisted by Sotho and Xhosa (the black languages spoken in the region) interpreters where language problems were encountered.

Prior to each interviewing session, the procedures for reporting dietary intake were explained to the respondents. Household measuring cups and spoons, empty labelled food containers and real snack foods weighed on an analytical scale to determine the weight for commonly used portion sizes and food models were used to assist the interviewees in determining food choices and portion sizes.

Data were categorized into the age groups 25–34 years and 35–44 years. The quantities of food items recorded were converted to gram weights using the Food Quantities Manual (10) and the data were processed using the Food Composition Database of the South African Medical Research Council (11) and the SAS software package (12). For each age group, minimums, medians and maximums of micronutrient intake were calculated. Micronutrient intakes were compared with the Recommended Daily Allowance (RDA) for all micronutrients except for calcium, chromium, vitamin D, vitamin K, pantothenic acid and biotin where the Adequate Intake (AI) was used (13, 14). The prevalence of respondents with intakes ≤ 67% of the RDA as recommended by Kohrs *et* *al* (15) and used in other South African studies (3) was calculated and described for each age group.

RESULTS

A total of 500 subjects were recruited for this study, of which 496 were eligible for participation. Of those who qualified, 279 were 25–34 years of age and 217 were 35–44 years old. Four women were found to be pregnant when examined by a medical practitioner as part of the larger study and were excluded from the study.

Tables 1 and 2 show the mineral and trace element intakes of younger (25–34 years) and older women (35–44 years). The median calcium intake of younger and older women fell below the AI of 1000 mg/day. Median intakes of both age groups exceeded the AI for chromium and the RDA for potassium, manganese, copper, magnesium, zinc and phosphorus, with phosphorus intakes in both age groups almost double that of the RDA of 700 mg/day. The profile of total iron, selenium and iodine reflects intakes (both age groups) ≤ 67% the respective RDAs. From the younger group, 49.1%, and from the older group, 53.5% showed total iron intakes ≤ 67% of the RDA. For iodine, 94.6% of the women in the younger group and 96.8% of the women in the older group ingested ≤ 67% of the RDA. Approximately 50% of all women showed selenium intakes ≤ 67% of the RDA.

Tables 3 and 4 indicate the vitamin intake of the respondents. The median intakes of vitamins A and D were slightly lower than recommendations for both age groups. However, more than 25% of all women consumed ≤ 67% of the RDA for vitamins A and E. For all water-soluble vitamins excluding folate and vitamin C, median intakes were higher than recommendations, with small percentages of both age

Table 1: Mineral and trace element intake of women aged 25–34 years (n = 279)

Nutrient	Minimum	Median	Maximum	RDA/AI	≤ 67% of RDA (%)
Calcium (mg)	113.4	626.9	2 855.4	1 000[b]	
Chromium (µg)	0.9	41.4	294.3	25[b]	
Copper (mg)	0.2	1.5	8.1	0.9[a]	0
Iron haem (mg)	0	0.4	5.6		
Iron non-haem (mg)	0	3.6	16.5		
Total iron (mg)	2.2	12.2	65.8	18[a]	49.1
Iodine (µg)	1.1	40.5	187.7	150[a]	94.6
Potassium (mg)	388.7	2 902.3	10 053.7	2 000[a]	
Magnesium (mg)	40.2	365.5	1 364.9	320[a]	12.2
Manganese (µg)	145.5	3053.1	14 023.7	1 800[a]	6.5
Phosphorus (mg)	191.2	1 331.2	4 903.6	700[a]	3.2
Selenium (µg)	1.1	37.3	232.6	55[a]	49.1
Zinc (mg)	0.5	10.3	38	8[a]	11.1

[a] RDA
[b] AI
[c] Recommended guideline

Table 2: Mineral and trace element intake of women aged 35–44 years (n = 217)

Nutrient	Minimum	Median	Maximum	RDA/AI	≤ 67% of RDA (%)
Calcium (mg)	72.8	636.4	2 890.3	1 000[b]	
Chromium (µg)	0.8	41	227.8	25[b]	
Copper (mg)	0.3	1.4	5	0.9[a]	0
Iron haem (mg)	0	0.3	4		
Iron non-haem (mg)	0	3.4	15.4		
Total iron (mg)	2.1	11.4	73.1	18[a]	53.5
Iodine (µg)	0.9	36.7	241.1	150[a]	96.8
Potassium (mg)	651.3	2 731.7	6 982.5	2 000[a]	
Magnesium (mg)	75.4	365.6	954.1	320[a]	13.8
Manganese (µg)	448.5	2 795.2	9 973	1 800[a]	7.8
Phosphorus (mg)	289.6	1 294.5	3 430	700[a]	1.8
Selenium (µg)	2	35.9	176.9	55[a]	52
Zinc (mg)	1.2	9.6	36.5	8[a]	11.5

[a] RDA
[b] AI
[c] Recommended guideline

Table 3: Vitamin intake of women aged 25–34 years (n = 279)

Nutrient	**Minimum**	**Median**	**Maximum**	**RDA/AI**	**≤ 67% of RDA (%)**
Vitamin A RE (µg)	48.8	687.3	5 933.8	700[a]	30.1
Vitamin D (µg)	0	4.9	36.3	5[b]	
Vitamin E (mg)	0.8	15.3	74.4	15[a]	27.2
Vitamin K (µg)	0.1	123	1 289.2	90[b]	
Thiamin (mg)	0.3	1.7	10.3	1.1[a]	9.3
Riboflavine (mg)	0.3	2.1	3 776	1.1[a]	5
Niacin (mg)	4	20.5	94	14[a]	8.6
Vitamin B_6 (mg)	0.3	1.5	9.4	1.3[a]	19.4
Folate (µg)	31.1	241.5	1 525.3	400[a]	56.6
Vitamin B_{12} (µg)	0.2	5.1	50.2	2.4[a]	7.5
Vitamin C (mg)	3.2	54.8	1 424.4	75[a]	46.2
Pantothenic acid (mg)	0.4	5.5	21.6	5[b]	
Biotin (µg)	1.9	35.7	325.1	30[b]	

RE = Retinol equivalents

[a] RDA

[b] AI

Table 4: Vitamin intake of women aged 35–44 years (n = 217)

Nutrient	**Minimum**	**Median**	**Maximum**	**RDA/AI**	**≤ 67% of RDA (%)**
Vitamin A RE (µg)	85	697.5	5 197.8	700[a]	25.4
Vitamin D (µg)	0.3	4.5	31.8	5[b]	
Vitamin E (mg)	1.3	13.6	92.6	15[a]	29
Vitamin K (µg)	0.2	126.6	1 992	90[b]	
Thiamine (mg)	0.3	1.5	8.6	1.1[a]	9.7
Riboflavine (mg)	0.2	1.8	9.8	1.1[a]	6.5
Niacin (mg)	2.2	18.6	106.1	14[a]	11.5
Vitamin B_6 (mg)	0.2	1.2	12	1.3[a]	24.9
Folate (µg)	40.8	234.3	1 467.2	400[a]	62.2
Vitamin B_{12} (µg)	0.1	4.6	30.7	2.4[a]	6.9
Vitamin C (mg)	3.5	45.4	1 690.7	75[a]	53.9
Pantothenic acid (mg)	0.6	5.3	16.8	5[b]	
Biotin (µg)	4	33.4	154.2	30[b]	

RE = Retinol equivalents

[a] RDA

[b] AI

groups consuming ≤ 67% of the RDA. More than 56% of all respondents showed median folate intakes ≤ 67% of the RDA and more than 46% reported vitamin C intakes ≤ RDA.

DISCUSSION

This study was designed to determine the micronutrient intake of urban black South African women. The migration of rural people to urban areas in order to find jobs and better living conditions has become a global trend, depriving previous rural dwellers of the opportunity to obtain their own food by hunting, fishing, foraging or gardening (16). In South Africa, people living in informal settlements may experience considerable poverty, food insecurity and malnutrition. It has been documented that black women living in such areas (4) and urban blacks living in Cape Town in South Africa followed a diet depleted of micronutrients (17). However, a positive impact of urbanization on micronutrient intake became evident in the THUSA study, with an improvement in micronutrient intake of black women, as they consume a more diverse diet, with higher fruit and vegetable intakes. Despite these improvements, most micronutrients in that study were still consumed in inadequate amounts (18).

With the exception of total iron, iodine and selenium in the present study, median intakes of the other minerals for both age groups met the RDAs (Tables 1 and 2), with small percentages of women consuming ≤ 67% of the RDA for magnesium, phosphorus and zinc. Other local studies reported inadequate intakes of calcium for urban black South African women (4, 19–20). In the present study, calcium intake was lower than the AI of 1000 mg/day. Cultural habits and taboos that regulate milk consumption, the known lactose intolerance of black South Africans as well as financial constraints, could contribute to a calcium-depleted diet (19). Non-dairy coffee creamers which are convenient to use in households without refrigerators and often replace real dairy products, could have influenced the calcium intake in this study. Changes in diet and physical activity that are typical of urbanization could increase the risk for osteoporosis and may also occur in this sample (21).

Iron deficiency affects about one-third of the world's women and children, and is one of the most common causes of anaemia. Globally, 20% of maternal mortality, 22% of prenatal mortality and 18% of mental retardation can be attributed to iron deficiency (1). A local study revealed that 50% of black pregnant women and 83.3% of black lactating women were anaemic. In that study, the inadequate total iron intakes were related to the high cost of iron-containing food such as meat, poultry and seafood (22). Total iron intake of women participating in the present study also reflected a pattern of low intake. Of particular concern is the relatively high proportion (49.1% and 53.5% of younger and older women respectively) of women consuming ≤ 67% of the RDA for iron. This finding corresponds with results of total iron intake previously noted for black South African women (3–4, 17, 19). Despite higher mean intakes of iron by urban than rural women in the THUSA study, intakes were still below RDA recommendations (20). The dietary inclusion of iron absorption inhibitors such as phytates and polyphenols present in unrefined cereals and popular foods of black South Africans of the region, such as spinach, tea and coffee, may further contribute to poor iron status. The inclusion of vitamin C-rich food sources that can enhance iron absorption (23) as well as the regular consumption of lean meat should thus be promoted.

Although more than two-thirds of household salt is iodized worldwide, iodine deficiency still remains the leading cause of preventable mental impairment, with women not totally spared from this deficiency (1). The median intake of iodine was markedly low in both age groups of women in the present study. The inadequate intake of iodine may be due to the fact that respondents were not queried on the use of table salt and the amount of salt added during food preparation when the QFFQ was administered. Hence, there is the possibility that intakes reported were not a true reflection of intake. This is considered a limitation as the mandatory iodization of table salt came into effect in 1995 in South Africa (3). It is therefore probably unlikely that the intake of iodine of these women was inadequate. However, low iodine intakes have also been documented for informal settlement dwellers in the Vaal Triangle in South Africa (4).

The inadequate intake of selenium in this study could be related to a core diet of maize products, a poor source of this nutrient and results are similar to those previously reported for black South African women living in low socio-economic urban area (4). The results from the QFFQ in the present study showed that meat and eggs were chosen on a fairly regular basis by the women who participated. Portions were, however, small and should thus be increased in order to improve the selenium intake of these women.

Low zinc intakes have been documented for black South African women (17, 19–20). However, in the present study, the adequate intake of zinc by women of both age groups could possibly be ascribed to the fairly regular inclusion of poultry, legumes, liver and meat as reported when the QFFQ was administered.

The relatively small percentage of women with inadequate intakes of thiamine, riboflavin, niacin and vitamin B_{12} is commendable. Yet, a fairly large percentage of the total respondents consumed ≤ 67% of the RDA for vitamin B_6. The inclusion of more meat, poultry, liver, whole grains and bananas in the diet may help in counteracting this (24). Our results for thiamine and riboflavin intake are in line with national experience (19–20). Other national studies, however, reported deficient intakes for black women (4). People eating a diet predominantly of maize, with few other foods, might develop a niacin deficiency (25). Maize-meal has been fortified with niacin in South Africa for many years (26). Without any doubt, this fortification would have contributed to the adequate intake of this vitamin in the present study.

Inadequate folate intake was prominent in the diets of a large percentage of the women in the study. In the women of reproductive age, low folate intake may be associated with an increased incidence of the well-described neural tube defects. Special attention should therefore be focussed on the inclusion of adequate folate-rich foods. Considering the current RDA of 400 μg/day, the insufficient consumption of folate seems to be a problem among urban and rural black South Africans and other racial groups (19). However, the recent fortification of some staple foods implemented in South Africa could in future have a positive effect on the folate status of women of childbearing age (27).

A prominent feature of the present study was the large number of women with low vitamin C intakes. These results are in accordance with those reported for black women in other national studies (4, 17, 20). In addition, the large proportion of women who smoked cigarettes (unreported data) could have a negative influence on plasma concentrations of vitamin C. A corrective diet, including the consumption of more vitamin C-rich food sources should thus be advocated (28).

The adult population group currently at highest risk for vitamin A deficiency is pregnant and lactating women, particularly women of lower to middle social class (29) such as those in this study. Of the women in our study, 25–30% consumed diets containing ≤ 67% of the RDA for vitamins A and E. Reported vitamin A intake ranged from inadequate intakes by black women from informal settlements (4, 20) to adequate intakes by black women from rural and urban areas (19). Fruit such as yellow peaches, vegetables, including pumpkin and sweet potato, as well as eggs and liver, can all contribute significantly to vitamin A status (24) but financial constraints and availability may hamper regular intake of these in this community. Vitamin E-containing foods such as those high in fats, particularly poly-unsaturated fats, are expensive and seldom form part of the diet of this study group. Peanuts, a popular and fairly cheap source of vitamin E, are sold by food vendors in Mangaung and consumption should be encouraged.

The random selection of participants in the study probably reduced bias. The use of a culture-sensitive validated QFFQ possibly reduced errors in dietary intake report. Reliability of dietary intake was confirmed in the pilot study. Limitations may be experienced with dietary assessment methods such as the QFFQ. However, no single dietary assessment method can be considered as the best and over- or under-reporting may occur with any assessment method. The successful administering of the questionnaire depends on the ability of the subject to recall his/her diet. In this study, trained interviewers, assisted by Xhosa and Sotho interpreters were used to complete the QFFQ in a face-to-face interview with each respondent. Subjects responded positively towards administering of the QFFQ. The fact that most respondents still followed a diet consisting mainly of individual foods or simple food combinations possibly made it easier to administer the questionnaire. Therefore, the QFFQ was considered as a good method to determine the actual dietary intake of the women included in this study.

In summary, this study provides data on the dietary micronutrient intake of black women in Mangaung, South Africa. For some nutrients, the median micronutrient intakes either met or exceeded their respective RDAs while for others, intakes were inadequate. Attention should be given to those micronutrients where median intakes were ≤ 67% of the RDA and those that were not at or above the respective AI. The recent legislation on maize and wheat product fortification with folic acid, iron, vitamin A, thiamine, riboflavin, niacin, pyridoxine and zinc in South Africa will likely assist in addressing micronutrient deficiencies in this country (30).

It is recommended that to ensure optimal health of these women, supporting strategies such as ongoing nutrition education and poverty alleviation to improve the quality of the urban diet, should be prioritized.

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