African Journal of Biotechnology Vol. 7 (22), pp. 4019-4024, 19 November, 2008
Available online at http://www.academicjournals.org/AJB
ISSN 1684–5315 © 2008 Academic Journals

Full Length Research Paper

Evaluation of energy and macronutrient intake of black women in Bloemfontein: A cross-sectional study

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Accepted 22 August, 2008

There is growing evidence that urbanization of black South Africans is associated with changes in the structure of dietary intake. The urban diet is more diverse than the rural diet, and includes more animal foods, refined carbohydrates and fats, posing a potential risk to the health of urbanized populations. The objective of this cross-sectional study was to determine the macronutrient intake of non-pregnant, pre-menopausal black women living in Bloemfontein in South Africa. A representative group of 500 participants was randomly selected to participate. Women were divided into two age groups. Younger women were 25 - 34 years old and older women 35 - 44 years old. Macronutrient intake was determined using a validated Quantitative Food Frequency Questionnaire (QFFQ). Median macronutrient intake was compared with the Dietary Reference Intakes (DRI) as applicable. Median energy, macronutrient and cholesterol intake of younger and older women was compared using non-parametric 95% confidence intervals (CI's). P-value less than 0.05 was considered significant. Median energy distribution of macronutrients was determined and compared with standard references. After being screened for eligibility, four pregnant women were excluded from the study, and 496 women qualified for participation. Median total energy, protein and carbohydrate intakes of all women exceeded the DRI. Median intakes of fibre were low, while median fat intakes were high. Younger women had significantly higher intakes of total fat (p = 0.034), saturated fat (p = 0.046) and PUFA (p = 0.015). Median energy distribution was 12% protein (both age groups), 32% fat (younger women) and 31% fat (older women) and 51% carbohydrates (younger women) and 53% carbohydrates (older women). The high median energy and macronutrient intakes may pose a potential risk for the development of chronic lifestyle diseases. The main focus of intervention should be to improve the quality of the diet, by decreasing fat intake and replacing this with fruit and vegetables. The benefits of a low glycaemic index and high fibre diet need to be emphasized.

Key words: Black women, energy intake, macronutrient intake, South Africa.

INTRODUCTION

The general health and nutrition profile world-wide has changed profoundly towards the 21st century (Popkin, 2006). Whereas research and policies in many lower-income countries previously mainly focused on under-nutrition, diet-related chronic diseases are now becoming increasingly prevalent (Popkin, 2006; Kim et al., 2000; Oguntibeju et al., 2005). These degenerative diseases such as type 2 diabetes mellitus and cardiovascular disease have emerged as major health threats around the world, especially among populations that have been subjected to changes in lifestyle (Popkin and Gordon-Larsen, 2004; Compher, 2006). Within this context, the influence of the environment on food choice and energy balance cannot be ignored (Popkin, 2005). Many developing countries are, however, experiencing a health crisis where the battle between chronic and infectious diseases, including HIV and AIDS, remains unconquered (WHO, 1998).

South Africa, like other countries, is a country in transition, and has recently undergone major political,

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demographic and socio-economic changes, affecting mainly the black population (Vorster et al., 2005; Steyn et al., 2006). This new era is also associated with a shift from the traditional prudent diet and active lifestyle (Steyn et al., 2006; Vorster et al., 1999), towards a more inactive and affluent western lifestyle with unhealthy eating habits, and a consequent increase in non-communicable diseases (Steyn et al., 2006; MacIntyre et al., 2002). However, in overcrowded black settlements, considerable urban poverty and food insecurity, impacting radically on the general health status of urban blacks, now dominate the scene (Oldewage-Theron et al., 2006). This scenario has been drastically compounded by the raging HIV and AIDS epidemic (Rutengwe, 2004) particularly among black women in Bloemfontein, where 61% of younger women and 38% of older women were found to be infected with HIV (Oguntibeju et al., 2006).

Measuring and analysing what people eat may impart valuable information on the nutritional status of populations, and can provide an opportunity to determine the potential health risk associated with dietary intake. An increasing trend in the prevalence of chronic lifestyle diseases has been reported among black women living in Bloemfontein (Mollentze et al., 1995) and other urban black South Africans (Steyn et al., 1997). This study was therefore designed to explore the macronutrient intake of black women in Bloemfontein, Free State Province, South Africa.

MATERIALS AND METHODS

This cross-sectional study was conducted in Bloemfontein, the capital city of the Free State Province, South Africa. A representative sample of 500 non-pregnant, pre-menopausal women was randomly selected from the two age groups 25 - 34 and 35 - 44 years. The sampling strategy was designed specifically to compare (as part of the larger study) the two age categories to render the study results comparable with those of another study in the same geographical area (Mollentze et al., 1995). Township maps from two built-up areas and two informal settlements in Bloemfontein were used to make the selection. The residential plots in the four selected areas were counted and numbered. Namibia had 2 995 plots, Phahameng 1 711, Joe Slovo 1 359 and Botchabela had 2 308. A proportionate number of respondents were selected randomly from these plots. The size of the sample was considered representative of the population of the selected area by the Department of Biostatistics of the University of the Free State. For practical reasons, twenty subjects were recruited per week over a 25 week period. A randomly selected residence was approached by a trained community health care worker. One woman per selected residence was screened for eligibility. If no one was at home, the residence to the right was targeted and if still unsuccessful, the residence to the left of the original address was approached. If all attempts failed, another plot was randomly selected. The community health worker explained the purpose of the study to possible participants. The 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). Respondents were transported to the campus of the Central University of Technology, Free State, where all interviews were conducted.

A validated, culture-sensitive Quantitative Food Frequency Questionnaire (QFFQ) that was developed for the Transition and Health during Urbanisation of South Africans (THUSA) study conducted by the University of North West in South Africa was used to determine dietary intake (MacIntyre et al., 2000). As part of the larger study, six questionnaires were completed, of which the QFFQ was one. The QFFQ included typical South African foods as well as foods traditionally included in the diet of black inhabitants of the region. Food choices and portion sizes were determined by using food models, household measuring equipment, labelled empty food containers, and real snack foods weighed on an analytical scale to determine the weight for commonly used portion sizes. 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. For this purpose, the QFFQ was completed on two occasions, three weeks apart. Reliability was found to be good. This addressed the issue of recall bias and interview bias.

The QFFQ was administered during individual interviews by five trained interviewers enrolled for post-graduate qualifications in either nutrition or dietetics. Each participant was interviewed once during the study period for data collection. Training of the interviewers was done prior to the study by a qualified dietician 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.

The quantities of food items recorded on the QFFQ were converted to gram weights using the Food Quantities Manual (Langenhoven et al., 1991) and were processed by using the Food Composition Database from the South African Medical Research Council (Langenhoven et al., 1998) and the SAS software package (SAS, 2003). Nutrient intakes were compared with the Estimated Energy Requirement (EER) for energy, the Recommended Dietary Allowance (RDA) for protein and carbohydrate, and the Adequate Intake (AI) for fibre, of the Institute of Medicine, Food and Nutrition Board, USA, as summarised by the Nutrition Information Centre, University of Stellenbosch (NICUS) (Nutrition Information Centre, University of Stellenosch (NICUS), 2003).

Statistical analyses

Data were categorised into the age groups 25 - 34 years and 35 - 44 years. Within each age group, macronutrient intake was described using medians. To evaluate clinical relevance, the median energy, macronutrient and cholesterol intake of younger and older women was compared using non-parametric 95% confidence intervals (CI's). P-value less than 0.05 were considered significant. The prevalence of respondents with intakes ≤ 67% of the Dietary Reference Intake (DRI) was calculated and described for each age group. The minimum, median and maximum contribution of proteins, carbohydrates and fats to the total energy intake was calculated and expressed as percentage of total energy intake. Saturated fat (SF), monounsaturated fat (MUFA) and polyunsaturated fat (PUFA) intakes were expressed as percentages of total fat intake.

RESULTS

From the original sample of 500, 496 women qualified to participate. 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. None of the qualifying women resisted participation.

Table 1 indicates the median intake of energy, macro-

Table 1. Energy, macronutrient and cholesterol intake of women 25 - 34 years (N = 279) and women 35 - 44 years (N = 217).

Parameter	Age group (year)	Median	95% CI for median difference	p-value	DRI	≤ 67% DRI (%)
Energy (kJ)	25 - 34	11 475	-52.77;1712.38	0.065	10 093[a]	11.5
	35 - 44	10 780				
Total protein (g)	25 - 34	80.5	-1.58; 11.29	0.140	46[b]	4.3
	35 - 44	77.9				
Plant protein (g)	25 - 34	34.4	-1.04; 5.00	0.207		
	35 - 44	32.2				
Animal protein (g)	25 - 34	40.5	-2.24; 5.90	0.385		
	35 - 44	40.6				
Total CHO (g)	25 - 34	339.4	-6.15; 48.1	0.130	130[b]	
	35 - 44	317.3				
Sucrose (g)	25 - 34	53.5	-6.9; 4.67	0.710		
	35 - 44	53.3				
Total dietary fibre (g)	25 - 34	21.9	-0.19; 3.67	0.079	25[c]	
	35 - 44	20.9				
Total fat (g)	25 - 34	99.4	0.6; 18.15	0.034		
	35 - 44	88.5				
Saturated fat (g)	25 - 34	28	0.04; 5.13	0.046		
	35 - 44	26				
MUFA (g)	25 - 34	32.1	-0.18; 5.63	0.066		
	35 - 44	29.6				
PUFA (g)	25 - 34	26.7	0.6; 5.67	0.015		
	35 - 44	23.2				
Cholesterol (mg)	25 - 34	317.9	-4.92; 64.17	0.098	≤300[d]	
	35 - 44	296				

CI indicates confidence interval.
DRI indicates Dietary Reference Intakes.
[a] EER indicates Estimated Energy Requirement.
[b] RDA indicates Recommended Dietary Allowance.
[c] AI indicates Adequate Intake.
[d] Recommended guideline.

nutrients and cholesterol of the two age groups. The median total energy intake of both age groups exceeded the EER of 10 093 kJ/day. Only 11.5% of the younger group and 12% of the older group of women showed intakes ≤ 67% of this allowance. The median total protein intake was higher than the RDA of 46 g/day for women of both age groups, with only 4.3% of women in the younger group and 6% in the older age group consuming ≤ 67% of the RDA. Women from both age groups consumed plant proteins in slightly smaller quantities than animal proteins.

In both age groups the median carbohydrate intake was almost three times higher than the RDA of 130 g/day. Median fibre intake of women from both age groups was lower than the AI of 25 g/day. Median intakes of total fat and cholesterol in both age groups were high.

Younger women had significantly higher intakes of total fat ($p = 0.034$), saturated fat ($p = 0.046$) and PUFA ($p = 0.015$). Differences in MUFA intake were close to significant ($p = 0.066$).

The median macronutrient intake expressed as percentage of total energy intake for the two age groups as indicated in Tables 2 and 3, shows that women of both age groups reported a median total protein intake of 12%. Animal and plant proteins contributed median figures of 6 and 5% of total energy intake for younger women and older women respectively. Median total fat intake contributed 32 and 31% to the total energy intake for the younger and older age groups in that sequence. For both age groups, SF contributed 9% of the total fat intake, MUFA 10%, and PUFA 9% for the younger age group and 8% for the older age group. Median total carbohydrate intake expressed as percentage of total energy intake constituted 51% for the younger women and 53% for the older women.

DISCUSSION

Urban black South Africans are typically exposed to a

Table 2. Macronutrient intake as percentage of total energy intake of women 25 - 34 years.

Parameter	Min (%)	Median (%)	Max (%)	Recommended (%)
Total protein	7	12	22	10 - 15
Plant protein	2	5	10	
Animal protein	0.4	6	19	
Total fat (g)	10	32	54	15 - 30
SF	2	9	18	<10
MUFA	3	10	21	>10
PUFA	3	9	26	6 - 10
Total CHO	33	51	77	55 - 75
Total sucrose	1	12	39	

Table 3. Macronutrient intake as percentage of total energy intake of women 35 - 44 years.

Parameters	Min (%)	Median (%)	Max (%)	Recommended (%)
Total protein	4	12	24	10 - 15
Plant protein	2	5	11	
Animal protein	0.5	6	20	
Total fat	8	31	53	15 - 30
SF	2	9	17	<10
MUFA	3	10	19	>10
PUFA	2	8	23	6 - 10
Total CHO	31	53	83	55 - 75
Total sucrose	2	13	37	

more diverse diet than their rural counterparts (Vorster et al., 2005) and this may explain the high median total energy intakes reported for women in the present study (Table 1). The increasing number of street food vendors in townships such as Bloemfontein, offering various snack foods high in energy, possibly made a significant contribution to the high total energy intakes demonstrated in the present study.

When expressed as percentage of total energy intake (Tables 2 and 3), the median total protein intake of women of both age groups fell within recommendations (Nutrition Information Centre, University of Stellenosch (NICUS), 2003) and was similar to those reported by others (MacIntyre et al., 2002). In contrast, rural blacks still derive most of their dietary protein from plant sources (Vorster et al., 1997). In the present study, the consumption of cheaper vegetable proteins, including a combination of samp and dried beans typical of the diet of black South Africans of the region, commercial baked beans and flavoured texturized vegetable protein products used to substitute meat, probably contributed to the fairly balanced intake of animal and plant proteins. However, total protein intake in grams was excessive in this study. A review of South African studies confirmed that the total protein intakes of adult white, black and Indian women and those of mixed ethnic origin either met or exceeded recommended intakes (Vorster et al., 1997). In the present study, women of both age groups included more protein in the diet than those reported for other black South African women (MacIntyre et al., 2002; Oldewage-Theron et al., 2006). Urban black populations such as the women in the present study have access to a wider range of foods than those living in rural areas and consequently, include meat, fish, eggs and cheese in the diet more often (Vorster et al., 2005).

The median total carbohydrate intake of women of both age groups exceeded the RDA of 130 g/day (Nutrition Information Centre, University of Stellenosch (NICUS), 2003). Results from the QFFQ showed that the majority of participants consumed large portions of the staple, maize porridge, on a daily basis. Although lower carbohydrate intakes have been documented for urban and rural black South African women (MacIntyre et al., 2002; Vorster, 1997), black women living in an informal settlement in the Vaal Triangle in South Africa, showed inadequate intakes of all nutrients except for carbohydrates (Nutrition Information Centre, University of Stellenosch (NICUS), 2003). The high prevalence of overweight and obesity found in women in the present study (unpublished data) may be partially associated with the high energy and carbohydrate intakes reported.

Fibre intakes are decreasing globally (Popkin, 2006). Dietary guidelines for fibre intake were previously met by rural, but not by urban black South African women (Vorster, 1997), while other studies confirmed low fibre intakes by black women from rural and urban communi-

ties (MacIntyre et al., 2002). Although fruit and vegetables are commonly sold by street vendors in Bloemfontein, these commodities cannot always be afforded by those surviving on a limited budget, and could be accountable for the inadequate fibre intakes. In addition, results from the QFFQ showed that many of the cereals and grains consumed by these women were in the refined form. The beneficial metabolic effects of a high-fibre diet (Insel et al., 2001) are widely advocated, and the deficient intake may reflect in the health profile of those participating in the present study.

The consumption of vegetable oils (Popkin and Gordon-Larsen, 2004), animal fats and hard margarine (Popkin, 2006) is increasing worldwide. From a chronic disease viewpoint, excessive dietary fat intake may be detrimental to health (Steyn et al., 2006). Younger women also consumed significantly more total fat, SF and PUFA than older women. When total fat intake was expressed as a percentage of total energy intake in the present study, median intakes exceeded the recommended level (Nutrition Information Centre, University of Stellenosch (NICUS), 2003). Furthermore, the actual intake of fats (in gram) was high compared to results from other local studies (MacIntyre et al., 2002; Oldewage-Theron et al., 2006; Vorster et al., 1997). With urbanization, fat intake of black South Africans may increase to about 40% of the diet (Vorster et al., 1997). A mean total fat intake of 31.8% has been reported for upper class urban black women (MacIntyre et al., 2002), which was similar to our findings. SF and PUFA intakes for women of both age groups were within the set goals, while the recommended MUFA intake was almost met (Tables 2 and 3). MUFA's, known as good fats, are found in foods such as peanuts, sold by local street vendors, and in some vegetable oils used in cooking by the studied women. The high median total fat intake of the studied group of women could lead to chronic lifestyle diseases such as obesity and cardiovascular-related problems. The consumption of cheaper, fatty red meat, eggs, offal and organ meat may account for the high median cholesterol intake reported for the younger women, and could possibly increase their risk for cardiovascular disease.

In this study, the random selection of participants 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 underreporting 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 the administration 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. The QFFQ was considered as a good method to determine the actual dietary intake of the women participating in this study.

Conclusion

This study provides data on the energy and macronutrient intake of black women living in an urban town in South Africa. It is most likely that the diverse eating pattern followed by these women has led to the consumption of an energy-dense diet, high in proteins and fats. The cereal and grain-based diet followed by these women contributed to the high median total carbohydrate intake. However, many of these foods were consumed in the refined form and could be considered as one of the major factors that contributed to the inadequate fibre intake. The high total fat intake may be related to the dietary inclusion of fatty animal foods, hydrogenated fats and vegetable oils, and the selection of fried snacks and convenience foods. It is clear that although the food consumption pattern of the studied group of women indicated the dietary inclusion of western foods, traditional foods such as maize porridge and plant proteins have not been eliminated from the diet.

The main focus of intervention should be to improve the quality of the urban diet by decreasing fat intake and replacing this with healthier options such as fruit and vegetables. In addition, the benefits of a low glycaemic index and high fibre diet need to be advocated.

ACKNOWLEDGEMENTS

The National Research Foundation is acknowledged for financial support of this study. The authors would like to thank the women who participated in the study, the community health workers for contacting the participants, and the research team who collected the data.

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