

Diet-nutrition-related cancer prevention knowledge and beliefs of Sudanese in Khartoum: A descriptive study

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ABSTRACT

Cancer appears to pose a major threat to the health of the Sudanese population. It is the third leading cause of death in the Sudan after malaria and pneumonia, accounting for 5% of all deaths. In 2005, approximately 22,000 people in the Sudan died from cancer and 17,000 of these people were less than 70 years old. This study was designed to: 1) assess nutrition knowledge and selected dietary beliefs related to cancer in Sudanese residing in Khartoum; 2) identify perceived barriers to the adoption of eating behaviors consistent with those recommended for cancer prevention; and 3) describe the food preferences and dietary practices in Sudanese residing in Khartoum. An interviewer-administered questionnaire elicited demographic information, cancer-related food and nutrition knowledge, food preferences, selected dietary beliefs, barriers to healthy eating and food practices from 182 participants between the ages of 18 and 35 years. More than 50% of females and males correctly identified the food lowest in fiber from a given list. Respondents were knowledgeable about the fat content of their traditional foods, but unaware of the different types of fat. Only 8.8% of the respondents thought that consumption of fruits and vegetables reduced cancer risk. Respondents perceived nutritionists as the most reliable source of information about nutrition and cancer, and the media as the best source of information on nutrition and healthy cooking. "Samin", feta cheese, a variety of stews, "Zalabia", lean meat, brown bread, sesame oil, dried okra, fried fish, and chicken were described as preferred food items by respondents. Daily salt/

sodium intake was described by 44% and 39% of the male and female respondents, respectively, as "high" (>2400 mg/day). The findings of this study have clear implications for aggressive nutrition education intervention programs with emphasis on the traditional foods of the Sudan.

Keywords: Food and Nutrition Knowledge; Cancer Prevention; Dietary Beliefs; Food Preferences; Food Practices and Purchasing Patterns

1. INTRODUCTION

According to the World Health Organization (WHO), chronic diseases, including cancer are the major causes of death and disability worldwide. Cancer is the third leading cause of death in the Sudan after malaria and pneumonia, accounting for 5% of all deaths [1]. It is worth noting that this apparently low figure is reflective of scantiness in cancer diagnosis and data [2,3]. In 2005, approximately 22,000 people in the Sudan died from cancer, and 17,000 of these people were less than 70 years old. Although it is argued that accurate data regarding the incidence of cancer in the Sudan are scarce, reports from El Hassan *et al.* [4] and the World Health Organization (WHO) have indicated that breast, mouth and oropharynx cancers are the leading causes of cancer mortality in the Sudan. Ahmed *et al.* and Elgaili *et al.* [5,6] determined that breast cancer mortality in the Sudan is high. Cancer of the breast was responsible for 20% and 30% of cancer in Sudanese women between 1999 and 2004, and 2006, respectively [2,5]. Therefore, cancer appears to pose a major threat to the health of the Sudanese population.

Overweight and obesity are important risk factors for cancer. According to the WHO, in 2005, 23% and 37% of men and women, respectively, in the Sudan were over-

weight. The prevalence of overweight and obesity in males and females in the Sudan is expected to increase further over the next five years. By 2015, 29% and 44% of Sudanese men and women, respectively, will be overweight [7]. Dietary factors are estimated to account for approximately 20% of cancers in developing countries [8]. It is known that circa 40% of cancers could be prevented through healthy diet and sustained regular physical activity.

In the United States (US), individuals described as “African Americans or Blacks” have many subcultures based on linguistics, dietary habits, nutrition knowledge and cancer-related beliefs. African Americans or Blacks in the US cannot be characterized as a homogeneous group because they come from a myriad of socioeconomic, educational and cultural circumstances. In the US, it has been demonstrated that the various subcultures within the African American population have different nutritional knowledge and dietary practices. For example, Bovell-Benjamin *et al.* [9] have described the dietary practices of a subculture of African Americans or Blacks in the rural South very differently from Elmubarak *et al.* [10] who articulated the cancer-related nutrition knowledge and dietary practices of a Sudanese-American subculture in the same environment.

Nutrition knowledge, beliefs, food preferences, food purchasing, consumption and preparation practices are usually shaped by indigenous cultural background, which influence eating behaviors through generations [11]. Although Sudanese-Americans have changed continents and countries, they have brought with them their cultural heritage. Laverentz *et al.* [12] reported that women of the Nuer culture of the Sudan residing in Iowa faced cultural issues and barriers regarding diet and nutrition. Elmubarak *et al.* [10] raised concerns about the Sudanese-Americans’ knowledge regarding the role of diet, nutrition and lifestyle choices in cancer prevention.

This study was one phase of a larger study, which aims to better understand the dietary habits and barriers that prevent “African Americans or Blacks” from adopting eating habits consistent with the National Cancer Institute’s (NCI) dietary guidelines. We hypothesized that if the Sudanese-American subculture is to receive effective culturally relevant dietary interventions to reduce cancer risk, it is important to thoroughly understand their dietary habits from the Sudanese and US context. Additionally, Ahmed *et al.* [5] contended that Sudan is undergoing a cancer epidemic, which warrants aggressive prevention measures. Also, from their study of prognostic characteristics of breast cancer in women in Khartoum, Awadelkarim *et al.* [3] suggested relevant implications for breast cancer prevention and treatment. Altogether, the above findings, Elmubarak *et al.*’s [10], and the fact that cultural background influences eating behaviors provide the evidence for urgent diet-cancer-prevention-related research

in the Sudan. An additional benefit of this research is that the findings will enable us to better understand the Sudanese-American dietary practices. It was against this backdrop that the study was designed to: 1) assess nutrition knowledge and selected dietary beliefs related to cancer in Sudanese residing in Khartoum; 2) identify perceived barriers to the adoption of the eating behaviors consistent with those recommended for cancer prevention; and 3) describe the food preferences and dietary practices in Sudanese residing in Khartoum.

2. MATERIALS AND METHODS

2.1. Research Setting

The Sudan is located in Northern Africa, bordering the Red Sea, between Egypt and Eritrea. It is the largest country in Africa and the tenth largest in the world. It has a total area of 2,505,810 km² (967,499 mi²) and is slightly >25% the size of the US. The population is 4,100,887 with 44% under 15 years of age. Khartoum is the capital of the Sudan. It is a tripartite metropolis consisting of Khartoum proper, and linked by bridges to Khartoum North and Omdurman to the west. According to the GeoNames geographical database, the population of Khartoum as estimated in 2010 was 1,947,647. The study was confined to Khartoum. The recruitment and data collection period was prior to South Sudan becoming an independent country in 2011.

2.2. Participants

Participants were recruited through advertisements in local newspapers, flyers, through personal contact, and with some assistance from the local radio stations. Inclusion criteria were:

- Willingness to participate in the study;
- Age 18 years and older;
- Ability to conduct an oral interview;
- Ability to give verbal consent.

2.3. Study Design

A cross-sectional survey was conducted in Khartoum using in-person (face-to-face), in-depth structured interviews to elicit the required information. In-depth interviews have long been recognized as one of the most penetrating methods available for assessing a person’s knowledge and/or attitudes [13]. The sample (N = 182) was self-selected, that is, volunteers who responded were enrolled once they met the criteria.

2.4. Ethical Considerations and Informed Consent

Approval to conduct the study was received from the

Human Participants Review Committee at Tuskegee University and the Health Department, Khartoum. Agreement to be interviewed was obtained from all potential participants. The purpose of the study was explained and confidentiality of the information collected assured. Potential participants were informed that participation in the study was voluntary, and they were then required to give verbal consent.

2.5. Questionnaire Development

A preliminary questionnaire was generated through consideration of the study objectives; a review of the relevant literature; the assistance of the Northern Sudanese graduate student involved in the project; and the responses from focus groups conducted with Sudanese-Americans [10]. Questions were ordered and arranged based on recommendations by Smith and Morrow [14]. The questions were refined to address some predisposing factors of the PRECEDE model for health promotion planning. PRECEDE, which is the acronym for Predisposing, Reinforcing, Enabling, Constructs is described elsewhere [15].

The questionnaire contained a mixture of closed and open-ended questions with closed questions predominating. Most questionnaire items were pre-coded, and coding manuals were developed for the open-ended questions. Once the questionnaire (survey instrument) was developed, it was reviewed for clarity, ease of completion, length, format, cultural appropriateness, and its overall presentation. The questionnaire was then translated into Arabic. The survey instrument was pilot-tested on a convenience sample of adults in Khartoum to help identify sensitive, ambiguous and/or poorly understood questions.

2.6. Questionnaire Content

The questionnaire was divided into six distinct sections. The demographics section elicited information regarding education level, gender, age and income. The knowledge section contained questions regarding cancer-related food and nutrition information. Food preferences (liking or the affective response to the sensory properties of food) is an important determinant of eating behavior, therefore, food preference questions, based on Wardle's [16] approach were included. Questions to elicit selected dietary beliefs, barriers to eat healthy and food practices were also included.

2.7. Questionnaire Administration

The questionnaires were interviewer-administered to ensure completion of all questions, enhance response rate, facilitate cooperation and clarify misunderstandings [17].

Furthermore, interviews allow the facilitator to repeat; permit standardization and control of the environment and the question order; and observation of nonverbal behavior and recording of spontaneous responses [18]. In an effort to minimize interviewer bias, and increase the survey's cultural sensitivity, a Sudanese graduate student from Khartoum was trained to administer the survey [19, 20]. At the end of the study, each participant was given a copy of the correct answers to the knowledge questions, and appropriate nutrition education material as necessary.

2.8. Statistical Analyses

Most questionnaire items were pre-coded, and code books were developed for the open-ended questions. Descriptive statistics were used to summarize the data.

3. RESULTS

3.1. Respondents' Characteristics

A total of 182 adults from Khartoum, Northern Sudan participated in the study. In **Table 1**, the main characteristics of the respondents show that 59 (32.4%) and 123 (67.6%) were males and females, respectively. Forty-four percent of the respondents were between the ages of 18 and 24 years (**Table 1**). More than half (53.6%) of the respondents indicated that they completed university,

Table 1. Demographic characteristics of the respondents (n = 182).

Gender (n = 182)	Number	Percent
Male	59	32.4
Female	123	67.6
Age Distribution (n = 169)		
18 to 24 years	75	44.4
25 to 30 years	51	30.2
>30 years	43	25.4
Education Level (n = 179)		
Primary School	12	6.7
High School	63	35.2
University	96	53.6
Graduate School	8	4.5
Annual Income Range (SDG*) (n = 166)		
<125,000	55	33.0
126,000 - 160,000	22	13.3
161,000 - 170,000	26	15.7
171,000 - 320,000	30	18.1
321,000 - 500,000	16	9.6
>500,000	17	10.2

*SDG—The Sudanese Pound (SDG) is the national currency in the Sudan. One United States dollar (USD) = 237.19 SDG. Each pound is divided into 100 qirsh or piastres, which are the equivalent of pennies.

while 4.5% completed graduate school.

3.2. Cancer-Related Food and Nutrition Knowledge

More than half (52%) the female respondents answered correctly when asked to select from a list, the food item(s) with the lowest fiber content. Roughly 32% and 20% of the females chose white bread and white rice, respectively. However, 19% of the females incorrectly indicated wheat bread, and 16% did not know which food was lowest in fiber. For the males, 31% incorrectly identified wheat bread as lowest in fiber, while 53% correctly identified the food lowest in fiber.

The respondents were given a list of foods (feta cheese, *kissra*, *samin* and *rob*) to select the one lowest in fat; the majority (86%) correctly selected *kissra* as the food lowest in fat. The Sudanese food items are described in **Table 2**. When asked consumption of which foods lowered their chances of getting cancer, 59% and 65% of the males and females, respectively, said foods high in fat. Males (22%) and females (20%) mentioned that consumption of foods high in fiber reduced one's chances of getting cancer. Only 16 respondents (8.8%) thought that consumption of fruits and vegetables reduced cancer risk.

When asked to relate increased risk of some types of cancer to certain foods, 73% of the male respondents associated it with high intakes of fat; 8% and 3% related it to high intakes of vegetables and fruits, respectively. A slightly higher percentage of female (76.4%) than male respondents (73%) associated higher cancer risk with high intakes of fats. Likewise, more than three quarters of all the respondents agreed with the statement that consumption of high fat foods is associated with cancer. As in the case of the males, six percent of the female respondents associated higher cancer risk to high intakes of vegetables; and 3% of the females indicated that high intakes of fruits were related to higher cancer risk.

Both male (54%) and female (56%) respondents believed that the highest incidence of cancer in the Sudan occurred among women; while 31% and 12% of females and males, respectively, indicated that they did not know. None of the females, and 3% of the males believed that the highest incidence of cancer was among Sudanese children. Roughly 19% of the males and 12% of the females believed that the highest incidence of cancer in the Sudan was among men.

The respondents were asked whether nutrition counseling and specific instructions about how to make dietary changes to prevent cancer would help them modify their eating behaviors. Most male respondents (76.4%) and 84% of the females agreed that this would. When asked whether saturated fats associated with cancers are found in red meats, 34% and 20% of the males indicated true and false, respectively. Twenty nine percent of the

males said that they did not know. More than and less than half the female (58%) and male (46%) respondents, respectively, knew that saturated fats associated with cancers are found in *samin*. Forty-one percent of the male respondents did not answer whether saturated fats associated with cancer are found in cow, sheep or camel milk. Fifty six, 54%, 22% and 10% of the males indicated that they heard cancer is related to how much fat, saturated fat, fiber and fruits/vegetables, respectively, one consumes.

For the females, 52%, 74%, and 27% indicated that they heard some types of cancers are related to how much fat, saturated fat, fiber and fruits/vegetables, respectively, one consumes.

3.3. Selected Dietary Beliefs

In terms of beliefs, the majority of males (88.0%) and females (87.0%) believed that there is a relationship between what people consume and some types of cancer. On the other hand, 51% of the males and 41% of females believed that some types of cancer were related to what people drink. A high percentage of male (59.3%) and female (41.0%) respondents primarily believed that tobacco/marijuana/snuff and eating fatty foods can increase one's chances of getting cancer. *Snuff* is a product made from ground or pulverised tobacco leaves; it is the local type of smokeless tobacco. Other things perceived to increase one's chances for some types of cancer included: poor nutrition habits, pollution/environment, chemicals/pesticides and atomic rays/microwaves.

Respondents were asked to name specific foods, which they believed increased the risk of some types of cancer. For the males, the main three foods given were fatty foods (47%), lean meat (27%) and starchy foods (24%). The females believed that fatty foods (70%), foods with chemicals/artificial flavors/canned (21%) and fiber (13%) increased one's cancer risk. The majority of respondents (roughly 98%) believed that nothing would happen if they reduced their present intake of feta cheese, *samin*, sesame oil or *Zalabia* (**Table 2**). However, when asked about reducing fat in the diet, 81% and 76% of the males and females, respectively, believed it would be good for their health. Male and female respondents believed that increased vegetable intake would result in good health. Almost all the respondents (97%) believed that it is important to learn about nutrition and cancer. The nutritionist was perceived to be the most reliable source of information about nutrition and cancer, while the media was perceived as the best source of information on nutrition and healthy cooking (**Table 3**). Less than half of the males (49%) and females (39%) disagreed with the statement, "there is nothing one can do to prevent cancer".

Table 2. Description of Sudanese food items.

Food Item	Description
Asida or (Asseeda, Aceda)	A stiff porridge or pudding-like dish made from wheat or fermented sorghum in most parts of the Sudan or from pearl millet in western Sudan [31]. It substitutes for bread, and is usually eaten with one of many difference sauces (<i>mullah</i> , <i>mulaah</i> or <i>molah</i>). Mostly, the sauce consists of dried meat with fried onions, water, and some dried okra powder, or of sour milk. Depending on availability and money, fresh meat or fresh vegetables may be added to the sauce (Joachim, 1991). The National Health Laboratories at Khartoum reported the nutritional value of <i>Asida</i> as: 78.6% water, 17.1% carbohydrates, 2.4% crude protein, 0.2% fat, 0.8% crude fiber and 0.5% ash, 21 mg calcium and 0.2 mg iron. Similar results were also reported by Sukker <i>et al.</i> [32].
Samin (“dihin” or “dihn”)	Also known as “ <i>dihin</i> ” or “ <i>dihn</i> ” (Arabic for fat), it is probably the most cherished single food item in the rural Sudan [25]. <i>Samin</i> is a traditional butter, processed by putting souring milk into a leather bag and rolling it manually until butter extraction (<i>samin</i>); the remaining sour milk is the traditional yoghurt (<i>Rob</i>) [33].
Kissra (Kisra)	Kissra, a staple in the Sudanese diet, is a pancake or thin bread prepared from fermented sorghum. Its nutritive value is similar to sorghum or millet [31,34-35]. It is commonly eaten with a sauce called “ <i>Mulaah</i> ” served with vegetables, meat or fish. Used as a scoop to accompany main meals.
Fooul (Ful)	Fooul is a lightly mashed bean (usually dried Fava beans [<i>Vicia faba</i>]) dish garnished with olive oil and cheese. Usually served at breakfast.
Rob (Roub), (Roob)	<i>Rob</i> , the traditional yogurt, is the major fermented milk product in the Sudan; it is the by-product of butter production. Most <i>Rob</i> is usually made from cow’s milk but sheep or goat’s milk is also used [25,36].
Zabadi	In its preparation, cow’s milk is boiled, cooled and inoculated by back-slopping from a previous lot. It is then incubated in a warm carrier where it sours and sets in 8 - 12 h. At the retail shop it is usually refrigerated and consumed with fruits or sugar as a desert or to eat wheat bread with. Sometimes it is fed to babies and often turned into sauce for <i>aceda</i> .
Zalabia	A doughnut-like, deep-fried sweet, which is used in the morning.
Aich	Bread
Atrun	A chemical substance used in cooking vegetables to retain its natural color.
Combo (Kaowal)	A chemical substance used in cooking vegetables to retain its natural color.
Kushaf	Dessert made with two local Sudanese fruits. In general desserts tend to be fruit or milk-based puddings with dried fruits.

Table 3. Sources of information about nutrition, cancer and healthy cooking* (n = 182).

Source	Number of Respondents
Nutrition and Cancer	
Habits	03
Education System	15
Media	38
Nutritionist (Dietitian)	70
Medical Doctor	50
Family Members	04
Nutrition and Healthy Cooking	
Habits	28
Education System	39
Media	75
Nutritionist (Dietitian)	60
Medical Doctor	45
Family Members	45

*Participants were asked, “Which do you believe is the most reliable source of information about nutrition and cancer; and “which do you believe is the most reliable source of information about nutrition and healthy cooking?”

3.4. Barriers

Cost was the most frequently mentioned barrier to including fruits and vegetables in their daily diets (Table

4). Other frequently reported barriers included health issues, taste preferences, and family habits, which affected respondents’ decision as to which foods to eat. Respondents were asked about the problems related to purchasing, preparing and consuming healthy foods. Again, the respondents cited income, availability, lack of time, quality of foods, lack of support from family members and convenience as the problems. More than 50% and 46% of the males and females, respectively, indicated that it was not difficult to get reliable information about nutrition and cancer from a nutritionist or dietitian. However, when asked if they ever tried to get information from a nutritionist or dietitian, fewer males (54%) than females (66%) said yes.

3.5. Food Preferences

Male respondents (39%) expressed a preference for stews while females (38%) preferred grilled foods. Male respondents (37%) also expressed preference for grilled foods. Of the male respondents, 48% and 39% revealed that they consumed “*fooul*” once and twice per day, respectively (Table 2). Females (49%) indicated that they ate “*fooul*” twice per day. The responses revealed that 46% of the males and 41% of females consumed “*Rob*” weekly, while 36% and 26% males and females, respectively, consumed it daily. Monthly consumption of

Table 4. Perceived barriers for not eating the way they would like to.

Reason
Income limitation/cost Availability
Health condition/weight problem
No problem
Time constraint
Appetite/Social situation
Environment
Quality
Custom/Tradition/Family habits
Taste
Convenience
No family support

“*samin*” was 41% for males and 44% for females. Feta cheese, a variety of stews, “*Zalabia*”, lean meat, brown bread, sesame oil, dried okra, fried fish, and chicken were also commonly favored food items.

3.6. Food Practices and Purchasing Patterns

Many respondents (64%) said they preferred their vegetables cooked without fat most of the time. When asked, “*when you eat chicken, do you eat the skin?*” Forty six, 26.9%, 13.2%, and 13.2% of the respondents replied, never, rarely, always and most times, respectively. More than half the respondents indicated that they always got rid of fat off meat before cooking. Roughly 76% of the respondents said they consumed dark, green vegetables daily, while 28% said weekly. Fewer respondents (57%) stated that they consumed vegetables that are yellow and orange daily and 38% said weekly. According to the respondents (79%), red vegetables were consumed daily. A low 39% of the respondents indicated daily fruit consumption and 20% said once per week. Females (41%), and 39% of males stated that they consumed fried food most frequently.

When asked where they got drinking water from, most respondents (80%) stated that it was pipe-borne, and 76% said they never boiled it before drinking. “*Atrun*” was never used when cooking vegetables by 37% of respondents, while an equal percentage of respondents (25%) said they rarely or sometimes used it. Similarly, 72% of the respondents indicated that “*combo*” was never used when cooking vegetables. Slightly more females (37%) than males (31%) said that white bread would be typically found on their plates when eating a meal at home. Typical desserts reported by the respondents were fruit-based (“*Kushaf*”) and custard pudding, 62% and 14%, respectively. **Table 5** shows a typical breakfast as reported by the respondents.

Respondents were asked about their fast food practices;

Table 5. Typical Sudanese breakfast items as described by the respondents.

Food Item	Number of Respondents
Fooul w/onions, garlic, tomatoes, sesame oil, eggs, feta cheese	117
White bread (Aich)	17
Wheat bread (Aich)	12
Red tea with plenty sugar	11
Red tea without sugar	4

more than half the males (51%) and fewer females (49%) said they consumed fast food once per day. Sixty female respondents (49%) reported spending 500 to 400,000 Sudanese Pounds (SDG) daily on fast food, while 30 males (51%) said they spent between 200 to 10,000 SDG. One SDG is equivalent to US \$0.23. When asked to describe their daily sugar intake, 46% of the respondents said “neither high nor low”; 14.3% said “very high”; 21% said “high”; 15.4% said “low”; and 3.3% said “very low”.

Daily salt intake was described by male (44%) and female (39%) respondents as “high”. Male and female respondents consumed <3 cups tea and coffee daily.

4. DISCUSSION

This study elicited descriptive information about nutrition/diet-cancer-related knowledge, dietary beliefs; perceived barriers to the adoption of eating behaviors consistent with those recommended for cancer prevention; and described food preferences and dietary practices in Sudanese residing in Khartoum. When Hamad [1] discussed the cancer initiatives taken in the Sudan to prevent, detect and treat cancer, none of these included diet, nutrition or physical activity, which have important roles in cancer prevention and treatment. Therefore, our study also identified potential gaps, which need to be filled for future diet-cancer related studies in the Sudan and US.

Dietary fiber was always a significant part of the human diet, but its intake has decreased over the past two centuries, partly due to consumption of increasing quantities of processed foods [21]. According to Musaiger [22], the traditional diet of the Sudan was characterized by high-fiber content and low fat, cholesterol and sodium, but has been replaced with one high in fat, cholesterol, sodium, sugar and low in fiber. Currently, the importance of the preventive and management effects of dietary fiber in cancer, and other chronic disease prevention is receiving renewed interest [23]. According to WCRF/AICR [24], foods containing dietary fiber in all probability protect against colorectal cancer.

In the current study, from the food list given, more respondents than expected were incapable of identifying foods low in dietary fiber. These respondents’ choices

clearly indicated limited knowledge about dietary fiber; they could not differentiate between high-fiber and highly processed or refined foods such as white rice. Too many respondents were unaware that high intakes of fiber-rich foods reduced one's chances for some types of cancer. The public health goals of WCRF/AICR [24] indicate that relatively unprocessed cereals (grains) and/or pulses (legumes), and other foods that are a natural source of dietary fiber, should contribute to a population average intake of at least 25 g non-starch polysaccharide daily. Further, very few respondents knew that regular daily consumption of fruits and vegetables reduced cancer risk. Fruits, vegetables, unprocessed grains and cereals are usually rich sources of dietary fiber. The WCRF/AICR [24] has recommended eating at least five portions/servings (at least 400 g) of a variety of non-starchy vegetables and of fruits daily. A high percentage of males were unaware of the relationships among saturated fats, red meats, different types of milk (cow, sheep, camel) "samin" and cancer, although milk is integral to the life of the Sudanese [25].

Harnack *et al.* [26] examined the relationship of cancer prevention-related nutrition knowledge, beliefs, and attitudes to cancer prevention dietary behavior; and concluded that those who believe that it is difficult to eat a more healthful diet are less likely to do so. The current study queried the prevalence of the belief that there is a relationship between what one consumes and cancer, an issue of tremendous importance for cancer education. Optimistically, most respondents believed that there is a relationship between what people consume and cancer; and it is important to learn about nutrition and cancer. This is gratifying, given concern that nutrition is not considered in cancer prevention, detection and treatment initiatives. However, it should be noted that although respondents agreed to this, their responses to other questions suggested a range of beliefs about nutrition and cancer causation also exist.

Our findings indicated that the most frequently reported reliable source of information on nutrition and healthy cooking was the media. According to Charlton *et al.* [27], such findings have both positive and negative connotations. In terms of negativity, there is the possibility that the information could be unscientific and presented in a misleading manner. On the positive side, this provides a wide reaching opportunity for qualified nutritionists and dietitians to use the media to disseminate messages on nutrition and healthy cooking. In this study, a high percentage of the respondents indicated frequent consumption of fried foods. Stott-Miller *et al.* [28] concluded that regular consumption of select deep-fried foods such as French fries, fried chicken, and doughnuts is associated with an increased risk of prostate cancer.

Unaffordable food prices usually impact negatively on

healthy choices. On average, Sudanese spend 61% of their income on food [29]. Cost was the most frequently mentioned barrier to healthy eating in this study. It has been reported that in the Sudan, vegetables cost too much, for example, one kilogram of tomatoes cost 20 SDG [30]. Traditional foods such as "Ful", partly imported from Egypt; and sorghum, one of the staple foods of the Sudan have experienced increased prices. Sudanese are forced to choose less healthy alternatives, for example, eating two meals per day instead of three; and using less vegetables and meat because they are so expensive. Interventions to educate the Sudanese about healthy food choices on limited food budgets are needed. Programs regarding policy changes to address rising food prices and the other barriers mentioned are also needed.

Sudanese in Khartoum were asked to describe their daily sugar intake including honey and *zalabia*. Recommended daily intakes of sugar for women and men are five teaspoons or 20 - 25 g and nine teaspoons or 36 - 38 g, respectively; that is, if there is no health condition, which requires lower intakes. In the US, the recommended daily sodium intake for adults without health restriction is 2400 mg. Responses were recorded on a five-point intake level, which ranged from "very high" through "neither high nor low" to "very low" (Table 6). When compared with recommended daily sodium intake, a large number of the respondents reported exceeding the requirements daily. It can be speculated, however, that intakes for people in the Sudan may be higher than the recommendation for people in the US because of the hot and humid climate in the country. It has been reported by Abdelgadir *et al.* [25] that in the Sudan "samin", other milk products, animal fat, honey and sugar are highly cherished and integral to life. This is apparent in the reported consumption practices, sugar and sodium intakes, even though it is highly likely that there was under-

Table 6. Intake levels used to describe daily sugar and sodium intake in Sudanese in Khartoum, Sudan.*

Daily Sugar Intake	Females	Males
Very High	>37 g	>50 g
High	26 - 36 g	39 - 49 g
Neither High nor Low	20 - 25 g	36 - 38 g
Low	19 - 24 g	30 - 35 g
Very Low	<18 g	<30 g

Daily Sodium Intake	Females and Males
Very High	>3500 mg
High	2400 - 3400 mg
Neither High nor Low	2300 mg (1 teaspoon)
Low	1500 - 2200 mg
Very Low	<1500 mg

*Based on the recommended daily sugar and sodium intakes in the US.

reporting.

Elmubarak *et al.* [10] conducted focus groups with Sudanese-Americans to generate background information for a pre-conceptualized diet, nutrition and cancer-related survey instrument to be administered to Sudanese-Americans. This instrument (with some modifications) was tested on Sudanese in Khartoum. Although our sample in Khartoum was predominantly younger Sudanese, their responses indicated preference for their indigenous foods, such as “fooul”, “rob”, “samin”, and “Zalabia”. Similar preferences were expressed by the Sudanese-Americans. The typical breakfast (**Table 5**) described by the Sudanese in Khartoum was similar to that described by Sudanese-Americans residing for several years in Alabama, United States [10]. Similarly, cost was also perceived as the most common barrier to healthy eating by the Sudanese-Americans and Sudanese in Khartoum [10].

Study Limitations and Strengths

A limitation of this type of study is that the findings cannot be generalized across the broader Sudanese population because the sample size was small, restricted to the Khartoum area; was cross-sectional, and most respondents had high levels of education. However, our focus was on versatility of the findings, rather than generalizations. Like any self-reported description of nutrition knowledge, dietary patterns and preferences, responses in this study could have been influenced by social desirability; there is always the possibility that participants reported their diets, preferences and dietary preparation methods as healthier than they were in reality. However, the findings in this study could be generalized to other chronic diseases such as diabetes. Overall, this study adds to the existing literature in that relatively few qualitative studies have focused on nutrition knowledge and dietary practices of Sudanese in relation to cancer prevention. The findings provide information that could be useful in the designs of interventions for Sudanese-Americans regarding the role of diet and nutrition choices in cancer prevention.

5. CONCLUSION

The evidence is clear that the Sudan is undergoing a cancer epidemic, which calls for compelling prevention policies and programs. The findings of this study have clear implications for aggressive nutrition education intervention programs with emphasis on the traditional foods of the Sudan. Furthermore, interventions should aim at the following: 1) educating the Sudanese population about healthy food preparation methods, healthy food choices on limited food budgets, acceptable levels of sodium, fat and sugar consumption, general increase in the consumption of high fiber foods, fruits and vegetables; 2) addressing rising food prices and other barriers, which prevent

healthy eating; and 3) qualified nutritionists and dietitians in the Sudan should utilize the media to disseminate messages on diet, nutrition, healthy cooking and cancer prevention.

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