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Assessment of dietary pattern among coronary heart disease outpatients attended El-Shaap teaching hospital, Khartoum state

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ABSTRACT

This study is an observational complete-coverage, hospital-based study. Focusing on the assessment of the dietary pattern among Sudanese coronary heart disease outpatients, who attended El-Shaap Teaching Hospital, Khartoum State, during the period from July 2011 to February 2012. The primary data were collected using questionnaire survey, food frequency questionnaire and 24-hour

food recall were used to interviews 72 respondents. Secondary data were obtained from books, news papers, previous published and non published research, online papers and articles. Results revealed that cholesterol level, triglycerides and low density lipoproteins were higher in patients compared to the control group ($p<0.001$). It was also observed that BMI was significantly higher in coronary heart disease patient than in control group (<0.001).The results also showed no significant association of daily consumption of milk, egg poultry, legumes, and weekly consumption of fresh vegetables and fruits with risk of coronary heart disease. OR for consuming poultry, legumes, fresh vegetables and milk were 0.56(0.3-1.5) 0.5(0.32-1.30), 0.7(0.4-1.23) 0.61(0.32-1.25) respectively. On the other hand, consumption of white bread, beef, stew vegetables and tea was associated with higher risk of coronary heart disease (OR=2.81(2.5-5.53)2.42 (1.8-5.19), 2.33(1.30-4.01) respectively. Nutrients that had higher prediction of CHD were energy (OR 3.71), carbohydrates (OR 3.15) and saturated fat, (OR 3.68). The study concluded that, there were relationships between some dietary components and coronary heart disease. Effective awareness should be raise among Sundance population for healthy dietary intake to reduce the risk of coronary heart disease.

Key Words: CHD, DIET, LDL-C, HDL-C, TC, TG

Abbreviation: BMI - Body Mass Index; CAD - Coronary Artery Disease; CHD - Coronary Heart Disease, FFQ - Food Frequency Questionnaire, HDL-C - High Density Lipoprotein cholesterol; LDL-C - Low Density lipoprotein Cholesterol; MI - Myocardial Infarction; OR - Odd Ratio; SFA's - Saturated Fatty Acids; SPSS - Statistical Package for Social Science; TG's – Triglycerides.

1. INTRODUCTION

1.1. Background

Coronary Heart Disease (CHD) is one of chronic disease often begin by atherosclerosis that occurs due to the deposition of fatty fibrous substance mainly cholesterol in the inside lining of the arteries wall, which causes plaque accumulation resulting in the narrowing of arteries and increases the risk of Myocardial Infarction (MI) and ischemic stroke (Mcgill, et al., 2000). Dietary pattern has emerged as an alternative and complementary approach to study the relationship between diet and the risk of CHD. Instead of looking at individual nutrients or food, pattern analysis examines the effects of overall diet (Millen, et al., 2001). CHD is mostly caused by improper eating or eating too much fat or sugar (Moreira-Andres, 1999; Barry, 2002). Some foods increase the risk of CHD while others may protect against it (Moreira-Andres, 1999). Foods containing Saturated Fatty Acids (SFA's) should be restricted to reduce the risk of CHD (Dayton, et al., 1968). Certain amount of high quality protein supply, sufficient vitamins, minerals, and enough complex carbohydrates may protect against CHD (Krauss, et al., 2000). Previous study recommended that, more consumption of fruits and vegetables with less consumption of meats, especially red meat or non-lean meats may protect against CHD (Krauss, et al., 2000). Globally 16.7 million people round the world die of Cardiovascular Diseases (CVD) each year, this represents about one third of deaths round the world (Stephen, 2005; Reddy and Yusuf, 1998).

In African regions, the proportions of death from CHD accounted 9.2% of total deaths in the year 2001 (World Health Organization, 2002). In developing countries, the problem of CHD and its related diseases is caused by diet shifts, such as changing from simple and traditional diet to a diet that depends on processed foods, foods from animal sources, fats and sugars. This shift is due to internationalization and commercialization of food trade (Barry, 2002). Sudan like other developing countries had high prevalence of CHD but epidemiological data concerning dietary intake and CHD are scarce (Clin, 1996). According to recent statistic in 2011, CHD deaths in Sudan reached 39.326 or 10.67% of total deaths. The total Sudanese populations were 41,087,825. CHD is the top cause of death in Sudan, worldwide it ranks number 24 among the countries with high prevalence of CHD. The statistics found CHD was the top of 20 cause of death among Sudanese populations (Esmaillzadeh and Azadbakht, 2008). This draws the researcher attention to assess dietary pattern among CHD outpatients.

2. SCOPE OF THE STUDY

CHD is the leading cause of death among adults in developing countries. It's also called Coronary Artery Disease (CAD), (Williams et al., 1998). Diet plays an important determinant role of chronic diseases risk, including heart disease. Much of the focus from last century was concentrating on the contribution of diet especially dietary fat to heart disease. However, it is now realized that, this relation is only one aspect of the contribution of diet to CHD (Haskell, 2003).

2.1. Objective

To assess the dietary pattern among Sudanese coronary heart disease outpatients who attended El-Sheep Teaching Hospital.

2.2. Methodology

An observational complete coverage –hospital based research design was used in this study. The study area was El-Shaap Teaching Hospital in Khartoum State. Study population includes outpatient diagnosed with CHD, in both males and females. The sample size was 72 from patients with coronary heart disease and 72 ,control group with gender-and age-matched was selected from the respondents come for check up in laboratory found in hospital and have no CHD. Different tools were used to obtain data and information about the respondents such as questionnaire survey, Nutrient Food Frequency Questionnaire (FFQ) and 24-hours food recall. Secondary data were acquired from various types of literature including books, newspapers, previous published, non-published research and online papers and articles. The study was carried out during the period July 2011to February 2012. Statistical data analysis was been done using Statistical Package for Social Science (SPSS) program version 16 (Statistical Package for Social sciences, 2007). 24- Hours recall was been analyzed using computer program NS version 2007 (Erhardt, 2007).

3. RESULTS

3.1. Demographic Characteristics

Table 1 shows the socio-demographic variables of the respondents from cases and control group.

3.2. Respondents' blood lipid profile

Table 2 reveals that, the level of lipid profile among the cases were higher than control group.

3.3. Mean and standard deviation of some variable

Table 3 shows that cholesterol level was higher in patients ($p<0.001$) and all. Patients had high Triglycerides (TG's) and Low Density lipoprotein Cholesterol (LDL-C) level. Control group showed lower lipid profiles compared with established cut of points. It was also observed that BMI was significantly higher in CHD patient than in control group (<0.001).

3.4. Food Habits

3.4.1. Food Frequency

Table 4 frequency of food items dietary pattern of CHD patients and health control based on FFQ. No significant association of daily consumption of milk, egg poultry, legumes, and weekly consumption of fresh vegetables and fruits with risk of CHD. OR's for consuming poultry, legumes, fresh vegetables and milk were 0.56 (0.3-1.5) 0.5 (0.32-1.30), 0.7 (0.4-1.23) 0.61 (0.32-1.25) respectively. On the other hand, consumption of white bread, beef, stew vegetables and tea was associated with higher risk of CHD (OR=2.81(2.5-5.53)2.42(1.8-5.19), 2.33(1.30-4.01) respectively.

3.4.2. Respondents' Macronutrients

Table 5 shows the result of respondent's macronutrients.

3.4.3. Respondents' Micronutrients

Table 6 shows the result of respondent's micronutrients.

3.5 Logistic regression predicting of coronary heart disease

Summary of the raw score binary logistic regression coefficient and Wald statistic indicates that energy, carbohydrates, income, age, saturated fat rice and were significantly predict increase lipid profile with CHD patients.

3.6. Odds Ratio (OR)

Using the OR for the prediction of the presence of CHD risk factors among case group, the nutrients that had higher prediction of CHD were energy (OR3.71), carbohydrates (OR 3.15) and saturated fat, (OR3.68).

Table 1 Respondents' anthropometric measure

Gender	case	%	Control	%
Male	43	59.7 %	35	48.6%
Female	29	40.3 %	37	51.4%
Total	72	100.0 %	72	100%

Age	case	%	Control	%
30-40 Years	4	5.6 %	8	30.5%
41-50 Years	9	12.5 %	22	11.11%
> 50 Years	59	81.9 %	42	58.33%
Total	72	100.0 %	72	100%
Education Level	**case**	**%**	**Control**	**%**
Illiterate	20	27.8 %	15	16.6%
Khalwa	6	8.3 %	4	5.56%
Primary school	19	26.4 %	25	34.72%
Secondary school	16	22.2 %	10	13.8%
University	6	8.3 %	6	8.3%
Postgraduate	5	6.9 %	12	16.67%
Total	72	100.0 %	72	100%
Marital Statues	**case**	**%**	**Control**	**%**
Married	49	68.1 %	41	56.94%
Single	5	6.9 %	22	30.5%
Divorced	4	5.6 %	-	-
Widow	14	19.4 %	9	12.5%
Total	72	100.0 %	72	100%
Occupation	**case**	**%**	**Control**	**%**
Business	5	6.9 %	8	11.11%
Professional	4	5.6 %	2	2.78%
Labor	24	33.3 %	15	20.8%
Housewife	22	30.6 %	10	13.8%
Government Employee	17	23.6 %	37	551.38%
Total	72	100.0 %	72	100%
Monthly Income	**case**	**%**	**Control**	**%**
<100 pounds	2	2.8 %	4	5.56%
100- 399 pounds	3	4.2 %	14	19.44%
400- 699 pounds	14	19.4 %	22	30.5%
700- 999 pounds	19	26.4 %	20	27.78%
≥ 1000pounds	34	47.2 %	12	16.67%
Total	72	100.0 %	72	100%

Table 2 Blood lipid profile

Cholesterol/mg/dl	Case	%	Control	%
Normal < 200	9	12.5%	64	88.89%
Border line 200-239	47	65.3%	8	11.11%
High ≥ 240	16	22.2%	-	-
Total	72	100.0%	72	100%
TGs/mg/dl	**Case**	**%**	**Control**	**%**
Normal < 150	5	7.0%	71	98.61%
Border line 150-200	59	82.0%	1	1.38%
High > 200	8	11.0%	-	-
Total	72	100.0%	72	100%
LDL-C/mg/dl	**Case**	**%**	**Control**	**%**
Normal <130	3	4.2%	61	84.72%

Border line 130-159	50	69.4%	11	15.27%
High ≥160	19	26.4%	-	-
Total	72	100.0%	72	100%
HDL-C/mg/dl	**Case**	**%**	**Control**	**%**
High risk < 60	43	59.7%	-	-
Moderate risk 90-70	27	37.5%	65	90.27%
No risk > 90	2	2.8%	7	9.72%
total	72	100%	72	100

Table 3 Mean ±standard deviation of some variables

Variables	Mean ± SD /cases	Mean ± SD /control	P value
Age	54.5 ± 3.5	52.8±2.9	<0.002
BMI	26.98 ± 5.57	24.37±4	<0.001
Cholesterol	237 ± 15.3	155±9	<0.001
TGs	192 ± 12.4	77.3±5	<0.001
LDL –C	148.8 ± 12.1	100±7	<0.001
HDL –C	38.7 ± 12.3	60.21±13	<0.002

Table 4 Dietary pattern of CHD cases and health control based on FFQ

Food item	Most Frequency consumption	Cases %	Control%	Odd ratio(c1 95%	p. value
White bread	daily	65(90.3%)	40(55.5)	2.81(2.5-5.53)	0.002
legumes	daily	54 (70)	46(63.8)	0.5(0.32-1.30)	0.14
beef	2-3times/week	24(33.3)	34(47)	2.42(1.8-5.19)	0.003
poultry	weekly	22(30.6)	70(97)	0.56(0.3-1.5)	0.14
Milk	daily	35(38.9)	31(18.5)	0.61(0.32-1.25)	0.53
egg	daily	26(36.1)	20(27.7)	0.89(0.49-1.57)	0.63
Stew veg.	daily	27(37.5)	25(34.7)	2.33(1.30-4.01)	0.004
Fresh veg.	2-3 times /weeks	37(51.4)	43(59.7)	0.7(0.4-1.23)	0.24
fruits	2-3 times /weeks	32(44.9)	55(76.3)	0.9(0.53-1.68)	0.89
coffee	daily	30 (41.7)	45(62.5)	0.82(0.43-1.60)	0.72
Tea	daily	46(63.9)	67(93)	2.11(1.23-3.45)	0.005

Table 5 Respondents' Macronutrients

Energy/ Kcal	cases	%	control	%
< 2000	24	33.3%	18	25%
2000 - < 2500	14	19.4%	31	43.05%
2500 - < 3000	12	16.7%	23	31.94%
≥ 3000	22	30.6%	-	-

Total	72	100%	72	100%
Carbohydrate/ g	**cases**	**%**	**control**	**%**
< 250	47	65.3%	50	69.44%
250 - < 300	13	18.1%	12	16.67%
300 - < 350	7	9.6%	10	13.89%
≥ 350	5	7.0%	-	-
Total	72	100%	72	100%
Fibers/ g	**cases**	**%**	**control**	**%**
< 20	38	52.8%	5	6.94%
20 - < 30	21	29.2%	30	41.67%
30 - < 40	9	12.5%	13	18.05%
≥ 40	4	5.5%	24	33.33%
Total	72	100%	72	100%
Proteins/ g	**cases**	**%**	**control**	**%**
< 75	19	26.4%	10	13.89%
75 - < 80	3	4.1%	12	16.67%
80 - < 85	4	5.6%	5	6.94%
≥ 85	46	63.9%	45	62.5%
Total	72	100%	72	100%
Fat/ g	**cases**	**%**	**control**	**%**
< 65	12	16.7%	41	56.94%
65- < 70	3	4.1%	12	16.67%
70 - <75	2	2.8%	14	19.44%
≥ 75	55	76.4%	5	6.94%
Total	72	100%	72	100%
Cholesterol/ mg	**cases**	**%**	**control**	**%**
< 200	23	31.9%	42	58.33%
200 - < 250	6	8.3%	20	72.78%
250 - < 300	4	5.6%	7	9.72%
≥ 300	39	54.2%	3	4.16%
Total	72	100%	72	100%
Saturated Fat/ g	**cases**	**%**	**control**	**%**
< 15.5	4	5.5%	33	45.83%
15.5 - < 20	21	29.2%	37	51.38%
20 - < 25	38	52.8%	2	2.77%
≥ 25	9	12.5%	-	-
Total	72	100%	72	100%

Table 6 Respondents' Micronutrients

Niacin/ mg	**cases**	**%**	**control**	**%**
< 20	11	15.%	3	4%
20 - < 25	33	46%	9	13
25 - < 30	28	39%	60	83
Total	72	100%	72	**100%**
Vitamin C/ mg	**cases**	**%**	**control**	**%**
< 60	28	38.9%	13	18.05%
60- < 65	3	4.1%	20	27.78%

65 - < 70	0	0.0%	2	2.78%
≥ 70	41	57.0%	37	51.38%
Total	72	100%	72	**100%**
Vitamin E/ mg	**cases**	**%**	**control**	**%**
< 20	47	65.2%	9	12.5%
20- < 25	2	2.8%	16	22.2%
25 - < 30	2	2.8%	40	55.56%
≥ 30	21	29.2%	7	9.72%
Total	72	100%	72	100%
Sodium/ mg	**cases**	**%**	**control**	**%**
< 2400	4	5.6%	33	45.8%
2400- < 2900	10	13.8%	39	54.16%
2900 - <3400	14	19.5%	-	-
≥ 3400	44	61.1%	-	-
Total	72	100%	72	100%
Potassium/ mg	**cases**	**%**	**control**	**%**
< 3500	63	87.5%	2	2.78%
3500- < 4000	4	5.6%	55	76.38%
4500 - < 5000	0	0.0%	9	12.5
≥ 5000	5	6.9%	6	8.33
Total	72	100%	72	100%
Calcium/ mg	**cases**	**%**	**control**	**%**
< 1000	53	73.6%	2	2.78%
1000- < 1500	8	11.1%	41	56.94%
1500 - < 2000	3	4.2%	29	40.27%
≥ 2000	8	11.1%	-	-
Total	72	100%	72	100%
Magnesium/ mg	**cases**	**%**	**control**	**%**
< 400	59	81.9%	5	6.94%
400- < 450	4	5.6%	22	30.55%
450 - < 500	2	2.8%	42	58.33%
≥ 5000	7	9.7%	3	4.16%
Total	72	100%	72	100%
Zinc/ mg	**cases**	**%**	**control**	**%**
< 15	38	52.8%	14	19.44%
15 - < 20	8	11.1%	45	62.5%
20 - < 25	9	12.5	8	11.11%
≥ 25	17	23.6	5	6.9%
Total	72	100%	72	100%
Iron/mg	**cases**	**%**	**control**	**%**
< 18	33	45.9%	29	40.2%
18 - < 23	14	19.4%	30	41.67%
23- < 28	7	9.7%	13	18.05%
≥ 28	18	25.0%	-	-
Total	72	100%	72	100%

Table 7 Logistic regression predicting of coronary heart disease

	B	SE	WALD	DEF	P
Cholesterol					
INCOME	2.217	.802	7.640	1	0.006
LENTILS	1.432	.650	4.789	1	0.029
TG					
RICE	.786	.321	5.708	1	0.017
LENTILS	.792	.382	4.320	1	0.038
LDL-C					
Energy	.126	.078	45.36	1	0.003
Saturate fats	1.62	.23	77.75	1	0.002
HDL-C					
Age	2.425	.902	7.225	1	0.007

Table 8 Odds Ratios

Nutrients	**Cases**		**control**	
	Mean ± Standard deviation	**Odds ratios (95%confidence interval)**	**Mean± Standard deviation**	**Odds ratios (95%confidence interval)**
Energy	1849±43	3.71(0.61-5.1)	1720±8	0.96(0.8-1.1)
Protein	134.7±13	1.41(0.52-6.2	120±12	1.14(1.04-1.25)
Fat	136.39±12	1.26(0.8-7.84	68±4	0.57(0.01-1.21)
Carbohydrates	232.58±15	3.15(0.8-10.9	217±4	0.23(0.1-13.1)
Fiber	16.17±4	0.01(1.1-1.52)	28±19	0.91(0.19-1.81)
Cholesterol	501.8±2	1.76(0.98-11.1)	259±5	0.23 (0.11-13.3)
Saturated fat	22±4	3.68(035-15-1)	24±3	0.5 (0.16-1.98)
Potassium	1962.26±44	1.43(032-3.29)	3644±23	0.67(0.6-4.12)
Vitamin c	118.75±112	0.77(0.54-1.51)	80±31	0.06(6.3-5.45)
Niacin	24.29±24	0.1(0.3-1.12)	22±5	1.28(0.2-8.12)
Vitamin E	10.26±3	1.67(1.02-2.65)	18±7	0.9(0.31-2.81)
Calcium	895.53±14	1.82(0.60-5.4)	1750±14	1.02(0.78-4.2)
Magnesium	330.38±18	091(0.56-1.70)	443±10	0.32(0.21-3.12)
Iron	16.14±4	0.01(0.00-.147)	33±17	0.078(0.08-3.6)
Zinc	12.10±47	075(0.16-4.01)	17±22	0.21(0.1-13.3)
Sodium	4340.36±65	0.70(0.09-3.5)	2645±4	0.77(0.6-3.7)

4. DISCUSSIONS

4.1 Socio-demographic data and lipid profile

The study was conducted on 72patients who had coronary artery disease out of which 59.7 were male, 40.3 were female, and 72.Control with 48.6 males and 51.4% females. All of them from El-Shaap Hospital in Khartoum State. It is clear that, in this study, the disease was more abundant among males than females in patients group. Previous study demonstrated that, the increase in CHD among males was explained by unhealthy behaviors that were more socially acceptable for males than females such as smoking, heavy alcohol intake, lamp meat intake and fewer fruits and vegetables (Wingard, et al., 1983).

4.1.1. Age and CHD

81.9% of the patients' age was more than 50 years old; this indicates that the risk of CHD increases gradually with increase in age in both males and females. Previous studies found that CHD risk factor such as LDL-C, is higher in older than in younger people (National Cholesterol Education Program, 2002).

4.1.2. Education level and CHD

Regarding education, 27.8% of patient, 34.7% of control present study was illiterate. It is obvious that the level of education is related to the knowledge attitude, and practices towards food intake which may contribute to CHD. A cohort study in line with the present study showed that, the relative risk of CHD increased with lower educational level (Falkstedt and Hemmingsson, 1968).

4.1.3. Marital Status and CHD

68.1% of the patient's and 65.94% of the control group was married. It is important to mention that, married patients in the present were more likely to have CHD. Evidence from a previous study revealed that, marital communication, conflict and strain were strongly associated with CHD (Elaine et al., 2007).

4.1.4. Occupation and CHD

Labor represented the majority of patients in present study (30.3% patients, 51.8% control) while housewives represented (30.6 % cases, 13.8% control) government employees were found to be (23.6%cases, 20.8 control) business and professional represented (6.9, 11.11%, 5.6%, 2.87%) respectively. Long periods spent in work place can be related to CHD by increasing the chance of exposure to harmful bad habits such as smoking, stress, physical inactivity, eating fatty and fried foods (Breucker and Schroer, 1996).

4.1.5. Monthly Income and CHD

47.2 % from patients and 30.5% from control earned1000 pounds or more per month and the rest of respondents earned less than 1000 pounds. Previous study revealed that, prevalence of CHD was more common among middle and high income group as compared to the lowest income ones (Kawachi, et al., 1996).

4.2. Anthropometric measure and CHD

4.2.1. BMI and CHD

It was observed that BMI was significantly higher in CHD patient than in control group (<0.001). Many studies had shown that obesity is a major pre-disposing factor for diseases related to the heart. Patients with CHD should reduce their weight to decrease heart work load (Mcgill, et al., 2000).

4.2.2. Lipid Profile and CHD

The result shows, cholesterol level was higher in patients ($p<0.001$) and all Patients had high TG and LDL-C level. Control group showed lower lipid profiles compared with established cut of points and patients group. Despite the fact that patients were under medications, the majority were in the border line for high blood cholesterol, TGs and LDL-C, and with low level of High Density Lipoprotein cholesterol (HDL-C), (59.7%). This can be attributed to many factors in the present study such as high BMI, increased consumption of meat, low consumption of fruits, vegetables, high consumption of foods containing high cholesterol and saturated fat. High level of lipid profile lead may to the developing CHD risk such as MI and stroke.

4.3. Dietary intake, food habits and CHD

4.3.1. Frequency of food items

No significant association of daily consumption of milk, egg poultry, legumes, and weekly consumption of fresh vegetables and fruits with risk of CHD. OR for consuming poultry, legumes, fresh vegetables and milk were 0.56 (0.3-1.5) 0.5 (0.32-1.30), 0.7 (0.4-1.23) 0.61(0.32-1.25) respectively. On the other hand, consumption of white bread, beef, stew vegetables and tea was associated with higher risk of CHD (OR=2.81 (2.5-5.53) 2.42 (1.8-5.19), 2.33 (1.30-4.01) respectively. A more recent work on dietary pattern of 468 middle age women in Isfahan, Iran revealed that, Iranian dietary pattern is significantly associated with a greater risk of dyslipidemia (OR = 1.73). In food frequency sheet, White bread consumed more than other type of cereals products among both control and patients group. Consumption of white bread among Sudanese population is extremely high; this may be due to lack of knowledge about the nutritive value of the whole meal of wheat bread. Evidence from epidemiological study revealed that whole wheat bread is associated with a lower risk of CHD and it may decrease serum TGs concentrations in the body (Pruce, et al., 2000).

Red meat, beef was more consumed by patients compared to control group. Despite the high price of meat, Sudanese population like eating meat and do not reduce their consumption of meat and they don't consider the risk behind excessive consumption of meat. Patients in present study consumed vegetable stew more than the control group. The potential of cardio-protective effect of fresh fruits and vegetables for CHD had been examined and the results showed that they reduced the risk of disease (Gillman, 1995). Consumption of tea was higher among patients compared with control group in the present study. Epidemiological observations of caffeine containing drinks demonstrated that, caffeine raised cholesterol level only at a high intake (Rim et al., 1996). High daily consumption of eggs was reported among CHD patients compared to the control group. In literature, the consumption of 2 eggs per day with usual meals for 3 weeks resulted in a significantly elevated plasma cholesterol level mainly due to increased plasma LDL-C level (Levy and Presser, 1996).

4.3.2. Macronutrients consumption and CHD

Regarding macronutrients consumption, the result demonstrated that, 33.3% of the patients and 25% of control group consumed less than 2000 Kcal/day. Sudanese Study revealed that people with high income consumed 3270 Kcal from energy which was over twice than that of the lowest income group of (1370 kcal) this clarify that per capita income control energy intake of Sudanese individuals (Rim, et al., 1996). CHD patients should take balanced energy from the foods with physical activity to prevent weight gain, achieve and maintain healthy body weight. A previous study demonstrated that the increase in energy intake was inversely related to increase of CHD (Morris et al., 1977; Lee and Paffenbarger, 2000).

4.3.4. Dietary fibers consumption and CHD

Low consumption of foods contain dietary fiber were observed among half of the CHD patients. This may attributed to their low intake of fruits and vegetables.

4.3.5. Dietary protein consumption and CHD

Almost two thirds of the respondents (CHD cases and control group) consumed high protein diet ≥ 85g. High protein diet with low carbohydrates had been found to have positive effect on the reduction of serum TGs and the improvement HDL-C in the blood (Layman, et al., 2008). Replacing animal proteins with plant proteins may protect from CHD. Evidence from an epidemiological study showed strong correlation between consumption of animals' proteins and CHD (Stampfer, et al., 1999).

4.3.6. Dietary fat consumption and CHD

High consumption of foods contains high dietary fat among patients. Intake of food that contain low amount of dietary fat is require for CHD patient to avoid lipoproteins abnormalities.

4.3.7. Dietary cholesterol consumption and CHD

Almost half of patients consumed foods containing high dietary cholesterol compared to the control group. Excessive intake of dietary cholesterol is associated with the risk of atherosclerosis and CHD (Friedman, 1997).

4.3.8. Dietary SFA's consumption and CHD

The study revealed high consumption of SFA's by patients compared to the control group. Excessive amounts of saturated fat increase blood cholesterol, the risk factor of CHD (Lands and William, 2005).

4.3.9. Respondents' Micronutrients Niacin consumption and CHD

85% of the patients and 96% of control group consumed foods rich in niacin. Niacin it is an important vitamin that reduced LDL-C and TGs levels in the blood and raises the levels of HDL-C by 30% to 35% (Sanyal, et al., 2007). Evidence from a previous study demonstrated that, people with high cholesterol levels and who consumed foods rich in niacin had a lower risk of heart attack and stroke (Brown et al., 2001). The way that Sudanese people prepared their food lead to reduction of the important nutrients in food, so despite the high consumption of food contain niacin, but no change appear in patients' lipid profile.

4.3.10. Vitamin C consumption and CHD

Vitamin C considered one of the important antioxidant which helps in reducing the amount of lipid in the body. It is the predominant plasma antioxidant. This vitamin scavenges plasma free radicals and prevents their entry into LDL-C particles. Vitamin C regenerates active vitamin E and increases cholesterol elimination from the body (Knekt and Coauthors, 2004). Despite that 57.0% of

patients consumed foods that containing vitamin C but they had CHD, this may be attributed to the Sudanese method of preparing food containing vitamin C which is known to be very sensitive to heat and high cooking temperature which contributes to its severe reduction in the food. Sudanese people famous by cooking food to the point that most of the nutrients reduced or lost by prolonged and high exposure to heat.

4.3.11. Vitamin E consumption and CHD

65.2% of the patients consumed less dietary vitamin E than control group. Vitamin E is an antioxidant that prevents the oxidation of LDL-C (Knekt and Coauthors, 2004). Epidemiological studies suggested that, people with heart disease and consumed foods rich in vitamin E had relatively fewer atherosclerotic plaques and low rates of death from heart disease (Iannuzzi, 2004).

4.3.12. Dietary sodium consumption and CHD

Higher intake of sodium reported by the patients compared to the control group. High intake of dietary sodium damage the blood vessels walls over time, causing scarring and narrowing of blood vessels that promotes hypertension, the major CHD risk factor causing the build-up of fatty plaque which eventually block arteries (www.heartandstroke.com, 2009; Carel et al., 1984).

4.3.13. Dietary potassium consumption and CHD

Law intake of potassium was observed among the patients (87.5%). Potassium is extremely important to proper heart function and muscles contraction. It also controls the muscular fuel supply. Potassium deficiency in the diet affects all muscles, leading to muscles' weakness those including heart muscles (Shils, et al., 1997).

4.3.14. Dietary calcium consumption and CHD

73.6% of the patients consumed foods containing low dietary calcium. Calcium reduces total cholesterol, LDL-C and prevents blood clots. It is essential for muscle' health. Calcium deficiency correlates with higher level of cholesterol, a major risk factor of heart disease (www.ehow.com).

4.3.15. Dietary magnesium consumption and CHD

Low magnesium intake reported by the patients (36.1%). Magnesium decreases heart disease risk and sudden death and has very strong effect in the prevention of blood pressure. Evidence from previous study suggested that high blood pressure significantly lowered by a diet that contains fruits, vegetables, and low in dietary fat. A diet should be high in magnesium, potassium, calcium and low in sodium and fat to reduce blood pressure risk (Adams, 2009; Sacks, et al., 1995).

4.3.16. Dietary zinc consumption and CHD

Almost half of the patients (52.8%) consumed foods contain less than 15 milligram of zinc. Zinc is important for heart health; it affects the level of lipid profile in the blood. Low serum zinc increases LDL-C and decreases the level of HDL-C. Evidence from epidemiological study revealed that, low serum concentration of zinc is associated with CHD (Singh, et al., 1997; Shen, 2007).

4.3.17. Dietary iron consumption and CHD

45.9% of the patients consumed foods contain low iron. Iron has an important role in carrying oxygen in the blood and contributes in the process of lipid per-oxidation. Low amount of iron on the diet cause anemia and affect heart health. Some experimental data supported the role of iron in the process of lipid per-oxidation and formation of atherosclerotic lesions (Valk and Marx, 1999). Summary of the raw score binary logistic regression coefficient and Wald statistic Wald statistic indicates that energy, carbohydrates, income, age, saturated fat and rice were significantly predict increase lipid profile with coronary heart disease patients. Using the OR for the prediction of the presence of CHD risk factors among patients. The nutrients that had higher prediction for CHD were energy (OR 3.71), carbohydrates (OR 3.15) and saturated fat, (OR 3.68). In general, compared to the control group it was observed high intake of most of nutrients among the patients in the present study such as cholesterol, saturated fat and sodium which contributed to CHD, with lower intake of some nutrients required for improving cardiac health such as vitamins and minerals. This may be attributed to patients' food habits, method of food preparation and lack of knowledge about foods that contribute to CHD.

5. CONCLUSION

The study showed relationship between some nutrients with CHD. Nutrition education was needed for Sudanese populations regarding type of diet, obesity and physical inactivity, and education should be undertaken to curb the CHD disease.

FUTURE ISSUES

More research must be conduct regarding assessment of dietary Pattern and other types of cardiovascular diseases in Sudan.

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