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Original Article

Patterns of heart disease at El-Obeid teaching hospital, North Kordofan State, Sudan

Profils des maladies cardiaques à l'hôpital universitaire El-Obeid, État du Kordofan du Nord, Soudan

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ABSTRACT

Introduction: Cardiovascular diseases (CVD) are a group of heart diseases and vascular systems such as ischaemic heart disease (IHD), hypertension, cerebrovascular disease (stroke), and congenital heart disease (CHD). The study aimed to examine the patterns of heart disease at El-Obeid teaching hospital. **Methods:** This is a retrospective cross-sectional descriptive hospital-based study of all patients admitted to the cardiology department at the El-Obeid teaching hospital from 2014 to 2017. The study covered all patients who had one or more indications for admission and diagnosis. The study was carried out from June 2017 to January 2018. Data was collected from the hospital records and analyzed using the statistical package of social sciences (SPSS) version (16.0) and Microsoft Excel (2010) software. **Results:** The total admissions from 2014 to 2017 were 779. There were 315 (40.4%) males and 464 (59.9%) females. The male to female ratio was 0.7:1. Females seriously suffered from Rheumatic heart disease (RHD), hypertensive heart disease (HHD), and atrial fibrillation (AF), which accounts for 10.6%, 7.3%, and 4.9% respectively. Males were more likely to suffer from congestive cardiac failure (CCF), myocardial infarction, dilated cardiomyopathies (DCM), and cardiogenic stroke; 17.5%, 17.8%, 12.1%, and 5.4% respectively. Cardiovascular diseases (CVD) was predominant among females with 59.9%. CVD reached its peak of 36.8% in the 45-65 years group, 35.2% in the 25 – 45 years group, and followed 15.5% by the 5 – 25 years group. The findings have shown that patients had CCF by 16.7%, myocardial infarction 13.1%, RHD 9.8%, DCM 9.1%, IHD 7.1%, and HHD 5.4%. There was more than a third 35.2% of patients who fell into the group aged between 25 – 45; whereas patients who autumn into the age range bracket, 45 – 65 represented 36.8% of patients. The mortality rate in the hospital was at 9.1%, whereas CCF was responsible for almost a quarter of in-hospital death. **Conclusion:** There is a need for early detection and treatment of CVD by identifying markers for early diseases in order to be able to provide good health care and decrease morbidity and mortality rates.

KEYWORDS: Patterns, Cardiovascular, Diseases, Hospital, El-Obeid



RESUME

Introduction : Les maladies cardiovasculaires (MCV) sont un groupe de maladies cardiaques et du système vasculaire telles que les cardiopathies ischémiques (CMI), l'hypertension, les maladies cérébro-vasculaires (MCV) et les cardiopathies congénitales (CC). Cette étude visait à étudier les caractéristiques des maladies cardiaques à Hôpital universitaire d'El-Obeid. **Méthodes :** il s'agit d'une étude hospitalière descriptive transversale rétrospective de tous les patients admis au service de cardiologie de l'hôpital universitaire El-Obeid de 2014 à 2017. Elle a été réalisée de juin 2017 à janvier 2018. L'étude a porté sur tous les patients qui avaient une ou plusieurs indications d'admission et de diagnostic. Les données ont été recueillies à partir des dossiers hospitaliers et analysées à l'aide du logiciel Statistical Package of Social Sciences (SPSS) (16.0) et du logiciel Microsoft Excel (2010). **Résultats :** Le nombre total d'admissions au cours de la période de 2014 à 2017 était de 779. Il y avait 315 (40,4 %) hommes et 464 (59,9 %) femmes. Le ratio homme/femme était de 0,7:1. Les femmes souffraient sérieusement de cardiopathie rhumatismale (CRhu), cardiopathie hypertensive (CH) et fibrillation auriculaire (FA) à 10,6%, 7,3% et 4,9% respectivement. Alors que les hommes se sont avérés plus touchés par l'insuffisance cardiaque congestive (ICC), l'infarctus du myocarde, de cardiomyopathie dilatée (CMD) et les accidents vasculaires cérébraux cardiogéniques (17,5%, 17,8%, 12,1% et 5,4% respectivement). Les MCV étaient prédominantes chez les femmes avec 59,9%. Les maladies cardiovasculaires ont atteint leur apogée à l'âge de 45-65 ans avec 36,8%, suivies de 25 à 45 ans avec 35,2% et de 5 à 25 ans avec 15,5%. Les résultats ont montré que les patients avaient une ICC 16,7 %, un infarctus du myocarde 13,1 %, CRhu 9,8 %, CMD 9,1 %, CMI 7,1 % et CH 5,4 %. Il y avait plus du tiers (35,2%) des patients dans le groupe de 25 à 45 ans où les patients du groupe de 45 à 65 ans représentaient 36,8% des patients. Le taux de mortalité à l'hôpital était de 9,1% alors que le ICC était responsable de près du quart des décès à l'hôpital. **Conclusion :** Il existe un besoin de détection précoce des maladies cardiovasculaires afin de pouvoir fournir des soins de santé et réduire les taux de mortalité.

MOTS CLES: Tendances, Cardiovasculaire, Maladies, Hôpital, El-Obeid.

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Introduction

Cardiovascular disease (CVD) is responsible for about 25% of the disability-adjusted life years (DALYs) loss due to non-communicable diseases (NCDs) in several countries [1]. CVD is mainly caused by atherosclerosis [2]. CVD is the leading cause of mortality worldwide and an important cause of disability [3]. The prevalence of CVD is reported to be 2-3 times higher among the urban population as compared to the rural population, [1]. Globally, there are more than 6 million new cases of CVD in the European Union (EU) and more than 11 million in Europe as a whole, yearly [4]. Almost 51% of American adults have at least one chronic condition, and 26% live with multiple chronic diseases. Heart disease and cancer account for 47% of all U.S death cases [5]. CHD accounted for 13% of deaths in the U.S in 2018, causing 365,744 death cases [6].

Interestingly, about 80% of CVD-related deaths and 87% of CVD-related disabilities worldwide are known to occur in low and middle-income countries [7]. By 2030, heart disease and stroke will become the leading cause of death and disability worldwide [8]. It is estimated that 54% of deaths from non-communicable

diseases in the Eastern Mediterranean region are due to CVD. Of total deaths, deaths attributed to CVD range from 49% in Oman to 13% in Somalia. The prevalence of CVD is due to sedentary lifestyles and common risk factors, such as hypertension (ranging from 28% in the United Arab Emirates to 41% in Libya and Morocco); diabetes (ranging from 4% in the Islamic Republic of Iran to 19% in Sudan) and hypercholesterolemia (ranging from 14% in Lebanon to 52% in the Islamic Republic of Iran) [9]. In sub-Saharan Africa, CVDs are the most frequent causes of NCDs deaths, responsible for 13% of all deaths and 37% of all NCDs death cases, [11].

In Sudan, hypertension is the most common cause of CVD and acts as a risk factor for stroke and CHD. The changing high rates of hypertension and CHD may be explained through the rapid changes that affected the Sudanese lifestyle. Traditional Sudanese food has been replaced by fast food containing high amounts of refined carbohydrates and saturated fats, besides rapid urbanization and adoption of urban lifestyle that affected rural communities [12]. The HD incidence in Khartoum, Aljazeera, White Nile, Red Sea, and west of

Sudan was 40%, 25%, 20%, 10%, and 5% respectively [13]. The Sudan household survey (SHHS) 2006 was questionnaire-based in all states of Sudan; 24,527 households and more than 55,000 Sudanese were surveyed. The self-reported prevalence of heart disease was 2.5% [3].

Deaths and disability from heart disease and stroke are influenced by modifiable risk factors such as cigarette smoking, physical inactivity, poor nutrition, high blood pressure, high cholesterol, and related conditions such as diabetes, overweight, and obesity [10]. Approximately 3.2 million people die each year due to physical inactivity. People who are insufficiently physically active have from 20% to 30% high risk of all-cause mortality [1]. Integrated chronic disease management (ICDM) is a model of managed care that provides integrated prevention, treatment, and care of chronic patients at the primary health care level (PHC) to ensure a seamless transition to chronic disease management (CDM). It is a model of managed “assisted” self-management within the community. ICDM aims to achieve optimal clinical outcomes for patients with chronic communicable and non-communicable diseases (NCDs) using the health system building blocks approach [14]. The prevention strategies include policy, environmental, and systems changes to support cardiovascular health and education that will increase awareness of the need for such changes [10].

Material and Methods

This is a retrospective cross-sectional descriptive hospital-based study of all patients admitted to the cardiology department at the El-Obeid teaching hospital from 2014 to 2017. The aim was to study the patterns of heart disease and age, gender, indication for admission, and hospital mortality. Most patients might have more than one indication for admission. El-Obeid teaching hospital was established in the forties of the last century, and it is one of the oldest hospitals in Sudan since the first colonial era. It was established in 1992. The area of the hospital is 66 thousand meters. The hospital has about 40 wards that differ in their clinical capacity. El-Obeid teaching hospital is the first public hospital located in the center of El-Obeid city. It has a dedicated casualty and receives referrals from all Kordofan states of Western Sudan.

Sample techniques

All cardiology patients attending between 2014 and 2017 were included. Sample Size covered 779 patients, where all patient charts were reviewed to collect data based on age, gender, indications for admission, etiological diagnosis, and in-hospital mortality. Data was obtained from the El-Obeid teaching hospital records over a period of 8 months, from June 2017 to January 2018.

Data collection

The researchers prepared the data collection form and checked for consistency. The form is used to collect data on basic information about cardiovascular diseases from cardiology department records. The final form included information related to cardiovascular diseases, in addition to demographic characteristics of the patients, including age and gender. Moreover, the form included information about indications for admission, etiological diagnosis, and in-hospital mortality.

Data processing and analysis

After taking samples, filling in the form and cleaning all data, data was collected from hospital records and analyzed using the statistical package of social sciences (SPSS) version (16.0) and Microsoft Excel software (2010).

Results

Total admissions from 2014 to 2017 were 779. Of the total admissions, there were 315 (40.4%) male and 464 (59.9%) female, about more than 1/3 (35.2%) of total admissions were in the 25 – 45 age bracket, 36% of them in the (45 – 65), 5.1% in (65– 85) and 7.4% in (5 – 25) age range bracket. The rate of heart diseases according to the age range, was 23.7%, 34.2%, 23.1%, and 18.2% in 2014, 2015, 2016, and 2017 respectively. According to etiological diagnosis and age group, this study has revealed that 55.8% of patients who had RHD at 0-5 age group, 27.3% at 5 – 25 age group, and IHD was 38.2% in the 25 – 45 age group, 36.4% in the 45 – 65 age group and 14.6% in the 65 - 85 age group. DCM, CS, and myocardial infarction were responsible for 14% and 9.9% of in-hospital death. The obtained result is below:

Figure 1 shows the distribution of total admissions according the etiological diagnosis, patients who had myocardial infarction, RHD, DCM, IHD, HHD, NSTEMI & CS and others were 13.1%, 9.8%, 9.1%, 7.7%, 7.1%, 5.4%, 4.4%, 4.4%, 3.9%,

7.1%, 5.4% and 4.4%, respectively; others include; angina equitant, myocarditis, IHD & CCF, RHD&AF, HHD & IHD and CHF.

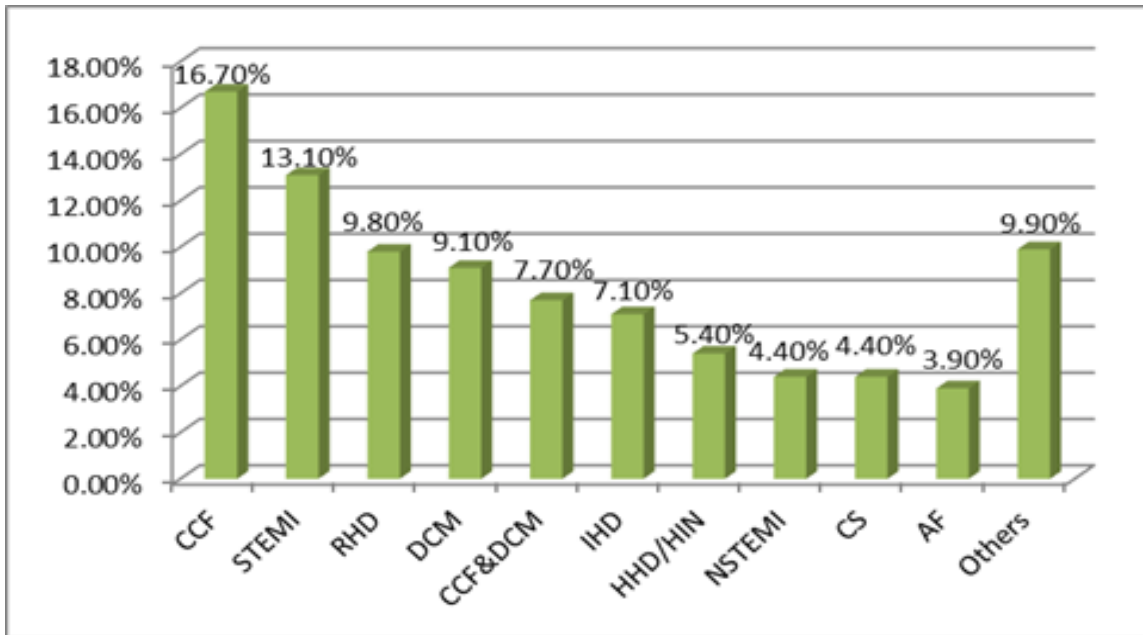


Figure 1: The distribution of total admissions according the etiological diagnosis, El-Obeid Teaching Hospital, (n=779)

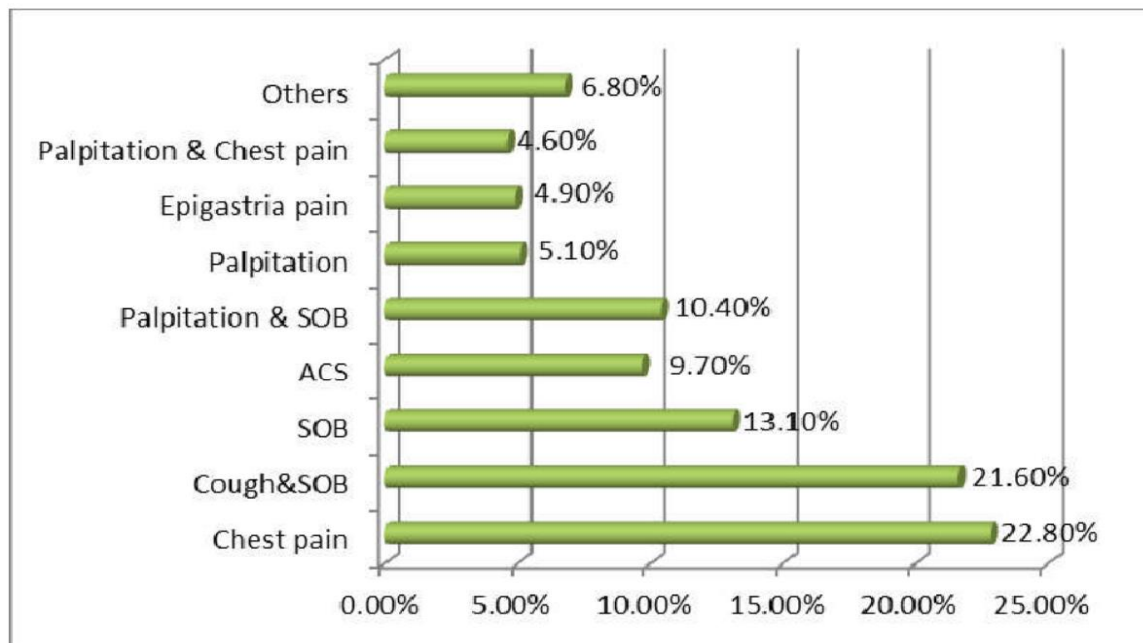


Figure 2: Indications for admission of total admissions, El-Obeid Teaching Hospital, (n=779)

Table (1): The distribution of the etiological diagnosis according to gender, El-Obeid Teaching Hospital, (n=779)

Diagnosis	Gender				Total	M:F
	Male		Female			
CCF	55	42.3%	75	57.7%	130	0.7:1
STEMI	56	54.9%	46	45.1%	102	1.2:1
RHD	28	36.4%	49	36.6%	77	0.6:1
DCM	38	53.5%	33	46.5%	71	1.2:1
CCF&DCM	14	23.3%	46	76.7%	60	0.3:1
IHD	21	38.2%	34	61.8%	55	0.6:1
HHD	8	25%	34	75%	42	0.2:1
IHD&CCF	7	20.6%	34	79.4%	41	0.2:1
NSTEMI	17	50%	17	50%	34	1.0:1
CCF&AF	16	47.1%	18	52.9%	34	0.9:1
CS	17	51.5%	16	48.5%	33	1.1:1
AF	8	25.8%	23	74.2%	31	0.3:1
Others	30	43.5%	39	56.5%	69	0.8:1
Total	315	40.4%	464	59.6%	779	0.7:1

Table 1 shows that females suffered seriously from RHD, IHD, HHD and AF as 36.6%, 61.8, 75% and 74.2% respectively. Whereas male were found to be more suffered from myocardial infarction, DCM

and cardiogenic stroke; 54.9%, 53.5% and 51.5%, respectively. Others include angina equitant, myocarditis, IHD & CCF, RHD&AF, CHF and HHD&IHD.

Table 2: The distribution of the etiological diagnosis according to age group, El-Obeid Teaching Hospital, (n=779)

Diagnosis	Age (years)										Total
	0 - 5		5 - 25		25 - 45		45 - 65		65 - 85		
	n	%	n	%	n	%	n	%	n	%	
CCF	6	4.6	13	10	35	26.9	67	51.5	6	4.6	130
STEMI	-	-	15	14.7	52	50.9	35	34.3	-	-	102
RHD	43	55.8	21	27.3	9	11.7	1	1.3	4	5.2	77
DCM	6	8.5	15	21.1	26	36.6	19	26.8	6	8.5	71
CCF&DCM	1	1.7	15	25	18	30	26	43.3	-	-	60
IHD	-	-	7	7.3	21	38.2	20	36.4	8	14.6	55
HHD/HIN	-	-	6	14.3	20	47.6	15	35.7	1	2.4	42
IHD&CCF	-	-	2	4.9	11	26.8	23	56.1	5	12.2	41
CCF&AF	-	-	1	2.9	9	26.5	21	61.8	3	8.8	34
NSTEMI	-	-	5	14.7	18	32.9	11	32.4	-	-	34
CS	1	3	8	24.2	10	30.3	11	33.3	3	9.1	33
AF	-	-	3	9.7	13	41.9	14	45.2	1	3.2	31
Others	1	1.4	9	13	32	46.4	24	34.8	3	4.3	69
Total	58	7.4	120	15.4	274	35.2	287	36.8	40	5.1	779
STDEV	11.78004		6.09855		12.566235		15.87693		2.628737		29.98183
AVERAGE	4.461538		9.230769		21.076923		22.07692		3.076923		59.92308

Table 2 above indicates that CVD reached its peak. 36.8% at the age 45-65 years, followed by 35.2% at the 25 – 45 age group, 15.5% at the 5 – 25 years old age bracket, 7.4% at the 0 -5 age group and 5.1% at the 65

– 85 age group. Others include; Myocarditis, AF and DCM, CCF and RHD, CCF and HHD, STEMT&IHD, HIN&IHD, HHD&DCM and CHF.

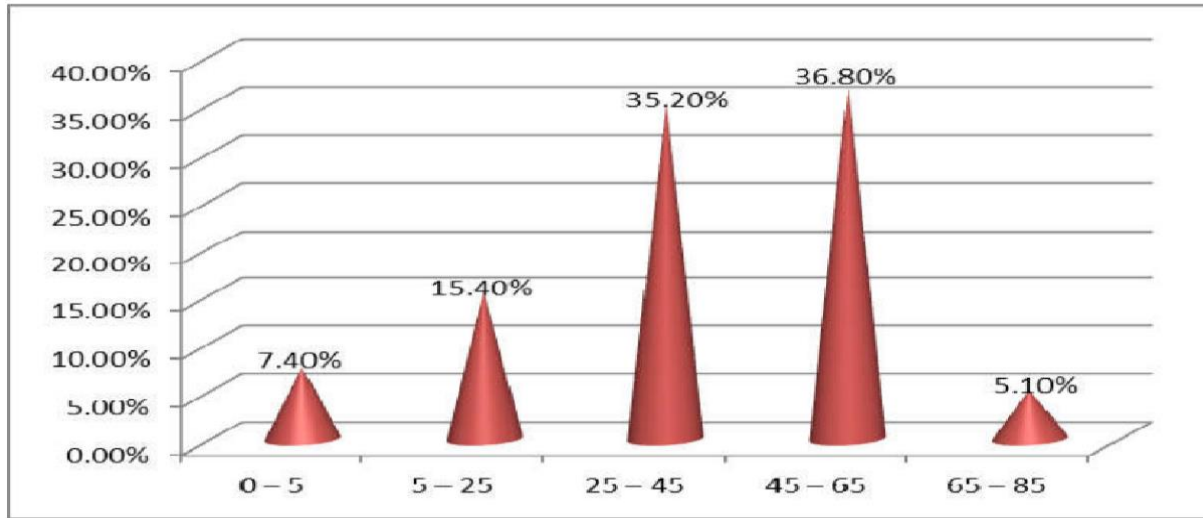


Figure 3: The distribution of admissions according to their age, El-Obeid Teaching Hospital, (n=779)

Figure 3 shows the distribution of admissions according to their age; about more than third 35.2% of total admissions autumn in the 25 – 45 years and 36%

of them in the 45 – 65 years age group, 5.1% in 65 –85 years and 7.4% in 5 – 25 years old.

Table 3: The distribution of the etiological diagnosis during (2104 – 2017), El-Obeid Teaching Hospital, (n= 779)

Diagnosis	Years								Total	
	2014		2015		2016		2017			
	N	%	n	%	n	%	n	%	n	%
CCF	33	25.4	40	30.8	29	22.3	28	21.5	130	16.7
STEMT	28	27.5	37	36.3	23	22.5	14	13.7	102	13
RHD	17	22.1	25	32.5	18	23.4	14	18.2	77	9.9
DCM	19	26.8	22	31	16	22.5	14	19.7	71	9.1
CCF & DCM	9	15	25	41.7	15	21.1	11	18.3	60	7.7
IHD	8	14.5	20	36.4	13	23.6	14	25.5	55	7.1
HHD	6	14.2	19	45.2	7	16.7	10	23.8	42	5.4
IHD & CCF	11	26.8	11	26.8	10	24.4	9	22	41	5.3
CCF & AF	8	23.5	12	35.3	10	29.4	4	11.8	34	4.4
NSTEMI	11	32.4	10	29.4	8	23.5	5	14.7	34	4.4
CS	9	27.3	11	33.3	6	18.2	10	30.3	33	4.2
AF	8	25.8	12	38.7	6	19.4	5	16.1	31	4
Others	18	26.1	13	18.8	19	27.5	4	5.8	59	7.6
Total	185	23.7	267	34.2	180	23.1	142	18.2	779	100
AVERAGE	8.397955		9.926008		7.057457		6.460928		29.85757	
STDEV	14.23077		19.76923		13.84615		10.92308		59.15385	

Table 3 shows the distribution of total admissions according during the years 2014, 2015, 2016 and 2017, was 23.7%, 34.2%, 23.1% and 18.2%, respectively. Others include; Myocarditis, Pneumonia, AF and DCM, CCF and RHD, CCF and HHD, RHD&AF, HHD&IHD and CHF.

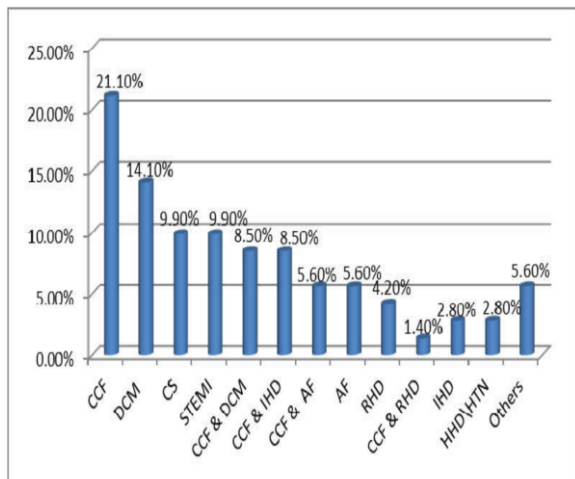


Figure 4: The distribution of total admissions according to in hospital mortality, El-Obeid Teaching Hospital, (n=71)

Figure 4 shows that DCM, CS and Myocardial Infarction were responsible for 14% and 9.9% of in-hospital death.

Discussion

This study included 779 patients attending the cardiology department at El-Obeid teaching hospital in North Kordofan, Sudan. There were 315 (40.4%) males and 464 (59.9%) females, where the male to female ratio was 0.7:1. The study has shown that 13.1% of total admissions have suffered from myocardial infarction; this finding is higher than what was achieved by Khalil et al, at the national heart referral center in Sudan; which showed that 11.6% have a myocardial infarction [15].

The results have revealed that 7.1% of patients suffered from IHD, the rate of ischemic heart disease is abnormally low; this may be attributed to the low rate of acute coronary syndrome cases, which registered at 9.7%. The current finding is lower than studies conducted in different areas; for example, there is a study conducted among the adult population in the Gulf region, where IHD was present among 32% of the studied population [19]. In Sudan, a study conducted at Al-Shab teaching hospital found that 65% suffer from ischemic heart diseases [17]. The present finding is relatively closer to the result presented in a similar study conducted at the cardiac center in Arar city, Northern Saudi Arabia, indicating that 8.9% of patients have IHD [16].

This study has shown that HHD (hypertensive heart disease) was 5.4%. The current finding is lower than a study conducted at Al-Shab teaching hospital in Sudan, which showed that (28%) of patients have HHD [17]. Also, a similar study conducted at the cardiac center in Arar city, Northern Saudi Arabia, showed that (42.5%) of the participants were hypertensive [16]. According to the current findings, 9.9% of patients suffered from RHD. However, a similar study conducted at Al-Shab teaching hospital in Sudan, found that 7% of patients suffered from the same disease [17]. The present study has revealed that 9.7% of indications for admissions were ACS. At the same time, a study conducted at Al-Shab teaching hospital in Sudan revealed that 47% of indications for admissions were ACS [17]. The current study shows that females seriously suffered from RHD, IHD, HHD, and AF 36.6%, 61.8, 75%, and 74.2%, respectively) compared to males (36.4%, 38.2%, 25%, and 25.8%, respectively). This figure means that these patterns of heart disease were predominant among females compared to males. The current study is in disagreement with another study conducted at the cardiac center in Arar city, Northern Saudi Arabia suggested that females more likely suffered from hypertension and arrhythmia (1%, 69.2% respectively compared to males 39%,30.8% respectively [16]. However, the Iowa heart disease and stroke program reported that the prevalence of heart attack and coronary heart diseases among females was 4.5% [10].

Conversely, males appeared to be more attained with myocardial infarction, DCM, and cardiogenic stroke, 54.9%, 53.5%, and 51.5%, respectively compared to females (45.1%, 46.5%, and 48.5%). These findings are in disagreement with a study conducted at the cardiac center in Arar city, Northern Saudi Arabia revealed that males were found more suffering from myocardial infarction and ischemic heart diseases 61.9%, 68.8% respectively, [16]. whereas the Iowa heart disease and stroke program reported that the prevalence of heart attack and coronary heart diseases among males was 8.2% [10]. According to our findings, 50.9% of total admissions suffered from myocardial infarction autumn in the 25-45 age group and 34.3% in the 45 - 65 age group. However, the results achieved by another study conducted at the cardiac center in Arar city, northern Saudi Arabia, showed that more than one third 1/3 (38.1%) of myocardial infarction patients were in the 70 -80 age group and patients who were < 60 age group represented (42.9%) of them [16]. In the current study, myocardial infarction was responsible for 34.3% of patients in the 45 - 65 age group. Moreover, the above study conducted at the cardiac center in Arar city, Northern Saudi Arabia; has shown that myocardial infarction was responsible for 42.9% of them [16].

According to the study conducted at Al-Shab teaching hospital in Sudan, the results have shown that RHD admissions peaked in the 21-30 age bracket, HHD and IHD in the 51- 60 age group [17]. But the present study has discovered that 55.8% of patients who had RHD in the 0-5 age group, 27.3% in the 5 - 25 age group, and IHD was 38.2% in the 25 – 45, 36.4% in the 45 - 65 and 14.6% in the 65 - 85 age group. This means that the age group is the main risk factor for CVD. The present study shows that the total in-hospital mortality rate was 9.1% compared to 3.5% that was discovered in a study conducted at Al-Shab teaching hospital in Sudan [17]. This study shows that IHD were responsible for 8.1% of hospital mortality, and 2.7% RHD (IHD/HHD). This finding is lower than that from a study conducted at Al-Shab teaching hospital in Sudan found that IHD was responsible for (48%) of total mortality, 24% RHD, and 1% HHD [17]. Center for disease control and prevention center reported that IHD was responsible for (43%) of deaths and stroke (33%), HHD (6%), and RHD (2%) [18].

Conclusion

CVD was predominant among females and reached its peak in the 45-65 years old age group and 25 – 45 years old age range bracket. RHD peaked among the 0 - 5 years age group, as was peaked in the 45 - 65 years old. RHD, IHD, HHD, and AF were predominant among females and peaked. Males were more seriously suffering from myocardial infarction, DCM, and cardiogenic stroke. DCM was responsible for (14%) of in-hospital death. There is a need for early detection of CVD to possibly provide health care and decrease mortality rates.

Conflicts of interest

The authors declare no conflict of interest. There was no role for donors in the study design; collecting, analyzing or interpreting data; or in writing the manuscript or in the decision to publish the results.

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Abbreviations

CVD; Cardiovascular diseases, **IHD**; ischaemic heart disease, **CHD**; congenital heart disease, **SPSS**; Statistical Package of Social Sciences, **RHD**; Rheumatic heart disease, **CCF**; Congestive cardiac failure, **STEMI**; ST Segment elevation Myocardial Infarction; **DCM**; Dilated cardiomyopathies, **HHD**; hypertensive heart disease, **CHF**; Congestive heart failure, **NSTEMI**; Non ST segment elevation Myocardial Infarction, **CS**; Cardiogenic stroke, **AF**; Atrial fibrillation, **SOB**; Short nuance of Breathe, **ACS**; acute coronary syndromes, **DALYs**; disability-adjusted life years, **NCDs**; non-communicable diseases, **EU**; European Union, **SSA**; Sub-Saharan Africa, **SEAR**; South-East Asia Region, **HD**; heart diseases, **SHHS**; The Sudan Household Survey, **ICDM**; Integrated Chronic Disease Management, **PHC**; Primary Health Care.

References

1. K. Park-Park's, Banarsidas Bhanot (2015). *Textbook of Preventive and Social Medicine*, 23 Edition, Jabalpur, India, pp: 365.
2. World Health Organization (2005). *Preventing Chronic Diseases; a vital investment*. 20 Avenue Appia, CH-1211 Geneva 27, Switzerland. PP; 36.
3. Suleiman A. (2011). The state of heart disease in Sudan, *cardiovascular journal of Africa*, Vol 22 (No. 4). DOI: 10.5830/CVJA–2010–054 pp: 191, 193.
4. European Society of Cardiology (2019); *Fact Sheets for Press*. <https://www.escardio.org/The-ESC/Press-Office/Fact-sheets>.
5. The National Conference of State Legislatures (2013); *Chronic Disease Prevention and Management*, East First Place 1 Denver, CO 80230 1 (303) 364-7700 1, www.ncsl.org. PP; 3.
6. American Heart Association (2021); *2021 Heart Disease and Stroke Statistics*. Update Fact Sheet
7. Asenso R. Ofori and Garcia Dairen (2015); Cardiovascular diseases in Ghana within the context of globalization. *Cardiovascular Diagnosis and Therapy*, Vol 6, No 1 February 2016 <http://dx.doi.org/10.3978/j>
8. American Heart Association (2004). *International Cardiovascular Disease Statistics*, Statistical Fact Sheet - Populations. americanheart.org. PP; 2.
9. WHO/EMRO; Health Topic; Cardiovascular diseases. <http://www.emro.who.int/health-topics/cardiovascular-diseases/index.html>.

10. Yumei Sun; Arlene Johnson (2009). *Heart Disease and Stroke in Iowa*; Burden Report 2009, Iowa Heart Disease and Stroke Program Iowa, Department of Public Health, 321 12th Street, Lucas State Office Building. PP; 11, 30.
11. Yuyun M. Fomonyuy, Sliwa K. et al, (2020). *Cardiovascular Diseases in Sub-Saharan Africa Compared to High-Income Countries*; An Epidemiological Perspective. *Global Heart*. 2020; 15(1): 15. DOI: <https://doi.org/10.5334/gh.403>
12. Khalil S. Ibrahim (2013): Cardiovascular disease in Sudan: Past, Present and Future Prospects, *Sudan Heart Journal*. <http://www.sudanheartjournal.com/>.
13. Southern Sudan Commission for Census (2006). *Statistics and Evaluation. Sudan Household Survey 2006*. Available at; <http://www.scccse.org/blog/surveys> (accessed 9 December 2006).
14. Asmall S., and Mahomed O. (2011); *Integrated Chronic Disease Management Manual*. National Department of Health, Republic of South Africa www.doh.gov.za. pp; 11
15. Khalil S.; Khalil S.; Albashir A.; (2015). Cardiovascular risk factors at a National Heart Referral Center in Sudan, *SudanMedical Journal* 2015; December 50 (3).
16. Altaleb F. Fahad; Alshammari O. Mashfi et al, (2017). Pattern and factors associated with cardiovascular diseases among patients attending the cardiac center in Arar City, Northern Saudi Arabia, *Electronic Physician* (ISSN: 2008-5842), October 2017, Volume: 9, Issue: 10, Pages: 5459-5464, DOI: <http://dx.doi.org/10.19082/5459>. <http://www.ephysician.ir>. PP; 5459.
17. Ahmed A. A Suliman (2011). Pattern of heart disease at AlShab Teaching Hospital; adecadeinto the new millennium. *SudanMedical Journal* 2011 Aug; 47(2). pp; 87,
18. National Center for Disease Control and Prevention (2016); *Heart Disease and Stroke*; Preventing the Nation's Leading Killers.
19. Aljefree N. and Ahmed F. (2015). Prevalence of Cardiovascular Disease and Associated Risk Factors among Adult Population in the Gulf Region: A Systematic Review. *Hindawi Publishing Corporation. Volume 2015*, Article ID 235101, 23 pages <http://dx.doi.org/10.1155/2015/23510>