

## The Impact of Income on the Echocardiographic Pattern of Heart Diseases in Kano, Nigeria

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### Abstract

**Background:** The aims of the present study were to assess the echocardiographic pattern of heart diseases, and to compare the pattern seen in a private echocardiography centre patronized by high income earners (group 1), with that in Murtala Mohammed Specialist Hospital patronized by low income earners (group 2), in Kano, Nigeria.

**Methods:** the study was retrospective in design. The records of patients aged  $\geq 15$  years for a one year period (July 2006-June 2007) were reviewed.

**Results:** Hypertensive heart disease (in 56.7%) was the most common heart disease, more common among group 1 patients ( $p=0.027$ ). Dilated cardiomyopathy was the 2<sup>nd</sup> most common heart disease (in 15.2%), more common among group 2 patients ( $p=0.037$ ). Ischemic Heart Disease (IHD) was the 3<sup>rd</sup> most common (in 8.7%) heart disease in the study, more common than rheumatic heart disease (in 8.3%). Peripartum cardiomyopathy was exclusively found among group 2 patients (4.3%).

**Conclusion:** The pattern of heart diseases in Kano differs between low and higher income earners. HHD was the commonest heart disease among both low income and higher income earners. The relatively high frequency of IHD might be a demonstration of the advanced stage of epidemiologic transition in Kano Nigeria.

**Key Words:** Income, Heart Disease, Echocardiography, Kano, Nigeria

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### Introduction

Demographic, economic and nutritional changes in developing countries have led to major changes in the pattern of human diseases, a phenomenon referred to as "Epidemiologic Transition". This is characterized by a progressive shift from a predominance of nutritional deficiencies and infectious diseases to those categorized as degenerative (including Cardiovascular Disease [CVD], cancer and diabetes mellitus).<sup>1</sup> As a result, CVD

now has no geographic, gender or socioeconomic boundaries. Nevertheless, the incidence and prevalence of CVD are still lower in Africa than what are obtained in more developed regions. Furthermore, the pattern of the CVD differs between the developed and developing nations as well as across social strata. These disparities are in the rapidity of the CVD and its occurrence in a milieu of limited health care infrastructure as well as widespread poverty and low levels of education.<sup>2</sup> In developing countries like Nigeria, the responses of individuals to CVD are restricted by low levels of education and limited personal resources.<sup>2</sup> Individuals have to pay for health care services directly out-of-pocket. The private expenditure on health in Nigeria was about 69.6% of the total expenditure on health, while the government expenditure on health was about 30.4%.<sup>3</sup> In contrast, private expenditure on health in Japan and United Kingdom (UK) were 18.7% and 13.7% respectively while the government expenditure was 81.3% and 86.3% respectively.<sup>3</sup> The pattern of heart disease (and other CVD) would then be expected to differ between the social strata in Nigeria, given that about 70% of Nigerians live below the poverty line, with high urban and rural unemployment rates of 12.4% and 23.2% respectively.<sup>4</sup>

The aims of the present study were to assess the echocardiographic pattern of heart diseases, and to compare the pattern seen in a private echocardiography centre patronized by high income earners, with that of a government general hospital patronized by low income earners, in Kano, Nigeria.

### Patients and Methods

The study was carried out in two echocardiography centers in the densely populated city of Kano, Nigeria. The first centre was privately operated and patronized by high income earners in Kano, receiving referrals mainly from private hospitals. The second centre was Murtala Mohammed Specialist Hospital (MMSH), a

general hospital sited in the old Kano City, patronized mainly by low income earners and the unemployed. In MMSH, Echocardiography services are restricted to patients registered with the Hospital. This is to allow for maximal utilization of the services by patients with little financial resources, as the cost is highly subsidized. The cost of echocardiography in the private centre was 3000 Nigerian Naira (NGN) (\$23.26) while the cost in MMSH was NGN500 (\$3.88).

The study was retrospective in design. The records of patients aged  $\geq 15$  years for a one year period (July 2006-June 2007) were reviewed. The following information was collated and analyzed: age, sex, occupation and other sources of income for each patient (or of parent/spouse), body surface area, referring hospital, clinical information, electrocardiographic and chest radiographic findings, and echocardiographic findings. Patients found to have heart diseases in the private centre were defined as group 1, while such patients in MMSH were defined as group 2.

Echocardiography was performed by the authors at each centre, using Toshiba Diagnostic Ultrasound Machine (model SSA 325A) in MMSH and ATL Ultramark 9 Ultrasound Machine at the private centre, with 3.75 MHz sector transducers. The procedure was carried out according to the recommendations of the American Society of Echocardiography<sup>5</sup>.

Approximate monthly income for each patient was estimated and recorded. Low income was defined as a monthly income of less than NGN10, 000 (\$76.92), while higher income was NGN10, 000 or more. In this definition, the following factors were taken into consideration: the minimum wage of the Kano State Civil Service (NGN7, 500) (\$57.69), the local purchasing power of the NGN and the national poverty line.

In patients with systemic hypertension, Hypertensive Heart Disease (HHD) was diagnosed if echocardiography had revealed abnormalities that are causally related to hypertension, and without alternative explanation. These abnormalities include concentric or eccentric Left Ventricular Hypertrophy (LVH), increased LV mass index, increased LV or Left Atrial (LA) size and volumes, and diastolic or systolic LV dysfunction.<sup>6</sup> Ischemic Heart Disease (IHD) was defined by the presence of ventricular Regional Wall Motion Abnormality (RWMA) on 2D echocardiography. Wall Motion Score Index was calculated for each patient with RWMA and their LV systolic and diastolic functions were evaluated.<sup>7,8</sup> Rheumatic Mitral Regurgitation (MR) and Aortic

Regurgitation (AR) were defined by the presence of valvular regurgitation in two planes on Doppler echocardiography and with the following features: thickened and retracted leaflets and subvalvar apparatus, restricted leaflet mobility, and poor coaptation of the leaflets in systole which could be worsened by the dilatation of the valve annulus.<sup>9,10</sup> Rheumatic Mitral Stenosis (MS) was defined by the presence of thickened and/or calcified mitral leaflets and subvalvar apparatus, decreased E-F slope (on M-Mode echocardiography), 'hockey-stick' appearance of the anterior mitral leaflet in diastole, immobility of the posterior mitral leaflet, and narrowed 'fish-mouth' orifice of the Mitral Valve (MV) in the short-axis view measurable with planimetry (with valve area of  $\leq 2.0\text{cm}^2$ ) or Doppler echocardiographic techniques (the diastolic pressure half-time method or the continuity equation).<sup>9,10</sup> Rheumatic Aortic Stenosis (AS) was defined by the presence of thickened or calcified and immobile Aortic Valve (AV) cusps, with commissural fusion causing a narrowed orifice (valve area of  $\leq 1.5\text{cm}^2$ ), and almost invariably occurring with rheumatic MV disease.<sup>9,10</sup> Dilated Cardiomyopathy (DCM) was defined by the presence of dilated LV (with or without dilatation of the other 3 cardiac chambers) with global systolic and diastolic dysfunctions.<sup>11</sup> Peripartum Cardiomyopathy (PPCM) was diagnosed if echocardiography revealed features of DCM (mentioned above) in the absence of a demonstrable cause or other structural heart disease, and if disease was identified for the first time within the last trimester of pregnancy or in the first 5 months postpartum.<sup>12</sup>

## Ethics

The identities of patients were respected, and approval for the study was obtained from the Ethical Committees of both study centers prior to the commencement of the study.

## Statistics

Data analysis was done using SPSS version 10.0. Means and standard deviations were computed for quantitative variables. The Chi-squared or Fisher's exact tests were used to test for significance of observed associations, and the Student's t-test was used to compare means. A p-value of  $<0.05$  was considered significant.

## Results

A total of 314 patients were studied in both centers; 135 of them (43%) in the private centre while the remaining 179 (57%) were studied in MMSH. There were 37

patients (11.8%) with normal echocardiograms, 22 of them (59.5%) were in the private centre while the remaining 15 (40.5%) in MMSH ( $p=0.031$ ). The remaining 277 patients (88.2%) were found to have various echocardiographic abnormalities; group 1 comprised of 113 patients (40.8%) while the remaining 164 (59.2%) were in group 2.

**Table I: Pattern of heart disease**

| Heart disease    | Total     | Group 1  | Group 2  | P value |
|------------------|-----------|----------|----------|---------|
|                  | N=277(%)  | N=113(%) | N=164(%) |         |
| HHD              | 157(56.7) | 73(64.6) | 84(51.2) | 0.027*  |
| DCM              | 42(15.2)  | 11(9.7)  | 31(18.9) | 0.037*  |
| IHD              | 24(8.7)   | 11(9.7)  | 13(7.9)  | 0.599   |
| RHD              | 23(8.3)   | 9(8.0)   | 14(8.5)  | 0.865   |
| AV Sclerosis     | 15(5.4)   | 8(7.1)   | 7(4.3)   | 0.310   |
| Eff pericarditis | 13(4.7)   | 4(3.5)   | 9(5.5)   | 0.451   |
| PPCM             | 12(4.3)   | 0(0)     | 12(7.3)  | —       |
| HCM              | 5(1.8)    | 3(2.7)   | 2(1.2)   | 0.378   |
| Corpulmonale     | 3(1.1)    | 1(0.9)   | 2(1.2)   | 0.792   |

Key: N, number of patients; HHD, Hypertensive Heart Disease; DCM, Dilated Cardiomyopathy; IHD, Ischemic Heart Disease; RHD, Rheumatic Heart Disease; AV, Aortic Valve; Eff, Effusive; PPCM, Peripartum Cardiomyopathy; HCM, Hypertrophic Cardiomyopathy; \* P value was statistically significant. Figures under Total and Groups were expressed as number of patients with percentages in parenthesis.

Low income was found among 21 patients (18.6%) in group 1 and 130 patients (79.3%) in group 2 ( $p<0.00001$ ). The remaining patients in both groups had higher income. The cost of echocardiography at MMSH (\$3.88) was waived by the Hospital's management for 11 patients (6.7%) in group 2 who could not afford it.

The mean age of all patients with heart disease was  $49.15\pm 17.81$  years, with a range of 15 to 90 years. There were slightly more females with a Male:Female ratio of 0.98:1.00. The mean age of patients in group 1 was  $51.45\pm 15.45$  years, which was higher than that of group 2 patients ( $47.54\pm 19.16$  years), but the difference was not statistically significant ( $p=0.074$ ). Analysis by group showed that there were more males in group 1 with a M:F ratio of 1.2:1, as opposed to group 2 with a M:F ratio of 0.8:1. At the time of presentation to the echocardiography centers, patients in group 2 were more symptomatic and had more co-morbid illnesses than group 1. Heart failure was more common among group 2 patients (29.9% Vs 23.9%), but this was not statistically significant ( $p=0.273$ ). Similarly, more patients in group 2 had stroke (10.4% Vs

5.3%) and atrial fibrillation (4.9% Vs 1.8%) compared to those in group 1. In both cases the difference was not statistically significant ( $p=0.134$  and 0.173 respectively). Twenty five patients (9%) had more than one heart disease; 12 of them were in group 1 while the remaining 13 in group 2.

The pattern of heart disease in both groups of patients is presented in Table I. HHD was the most frequent heart disease among all patients (56.7%) as well as among both groups of patients (64.6% and 51.2% in groups 1 and 2 respectively) ( $p=0.027$ ; significant). Patients with HHD had a mean age of  $55.99\pm 13.74$  years, and the disease was more frequent in males (51.6%) ( $p=0.417$ ; not significant). Among the 157 patients with HHD, a total of 46 patients (29.3%) had LV systolic dysfunction with LV Ejection Fraction (LVEF) of  $<50\%$ , 20 of them (27.4%) were in group 1 while the remaining 26 (31.0%) were in group 2 ( $p=0.625$ ; not significant). DCM was the second most frequent heart disease, significantly more common in group 2 ( $p=0.037$ ). The mean age of patients with DCM was  $42.62\pm 20.71$  years, and it appeared to be more common in males (54.8%) ( $p=0.456$ ; not significant). The 3<sup>rd</sup> most common heart disease was IHD without significant statistical difference between the groups ( $p=0.599$ ). The mean age of patients with IHD was  $52.21\pm 14.40$  years; 66.7% of them were males and the remaining 33.3% were females ( $p=0.078$ ). Patients with RHD were young with a mean age of  $30.86\pm 13.24$  years, and majority were females (69.6%) ( $p=0.057$ ). The commonest rheumatic valvular lesion was rheumatic MR found among a total of 12 patients (52.2%), 5 of them in group 1 and the remaining 7 in group 2 ( $p=0.950$ ; not significant). There were 5 patients with rheumatic MS, 2 of them in group 1 and 3 in group 2 ( $p=0.971$ ; not significant). Rheumatic AR was found among 4 patients, 1 of them in group 1 and 3 in group 2 ( $p=0.517$ ; not significant). Rheumatic AS was found in 2 patients, 1 in each group ( $p=0.790$ ; not significant). Patients with PPCM were also young with a mean age of  $22.08\pm 5.49$  years. All the 12 patients with the disease were in group 2. Effusive pericarditis was also more common among group 2 (5.5%) than group 1 (3.5%) patients, but the difference did not reach statistical significance ( $p=0.451$ ). The clinical suspicion was that of tuberculosis in 10 out of the 13 patients (76.9%) with the disease. There were 15 patients with aortic sclerosis with a mean age of  $67\pm 10.4$  years and majority of them (12 patients; 80%) also had HHD.

Heart diseases found in isolation include constrictive pericarditis (1 patient; 0.36%), alcoholic cardiomyopathy (1 patient; 0.36%), dissecting

aneurysm of the ascending aorta (1 patient; 0.36%), and mitral annular calcification (2 patients; 0.72%). LV apical thrombus was found in a patient with DCM, and in another with hypertensive cardiomyopathy. Furthermore, LV apical aneurysm was found in a patient with acute Myocardial Infarction (MI).

## Discussion

In non-Western countries, morbidity and mortality due to CVD tend to occur a decade or two earlier than they do in Western countries; nearly half occur before 70 years of age, whereas only one fifth occur so early in the West a difference attributable to both the earlier occurrence of cardiovascular events and the lower level of clinical care available.<sup>13</sup> Accordingly, patients in our study were young with a mean age of about 49 years, similar to the age of patients with heart disease in Port Harcourt (Nigeria) (mean age of about 44 years).<sup>14</sup> In the same vein, patients in group 2 (low income earners) were younger (mean age of 48 years) than those with higher income in group 1 (mean age of 52 years), though the difference did not reach statistical significance ( $p=0.074$ ).

Systemic hypertension is the most important contributor to CVD burden globally; including Africa.<sup>15</sup> Accordingly, many echocardiographic-studies in Nigeria have reported HHD as the most common heart disease among adults.<sup>14,16</sup> In our study, HHD was also the most common heart disease among all patients (56.7%) and both groups (64.6% and 51.2% in groups 1 and 2 respectively), significantly more common among higher income earners ( $p=0.027$ ). In contrast, RHD was reported to be the most prevalent heart disease (affecting 25.1%) among adults in Zimbabwe while HHD was the 4<sup>th</sup> (affecting 13.3%).<sup>17</sup> Another study carried out in Kenya also revealed that the commonest cardiac disease among patients referred for echocardiography was RHD (40.7%) followed by congenital heart disease (38.4%).<sup>18</sup> Hypertension is more prevalent in the developed than developing countries like Nigeria, affecting about 30% of the adult population of United States of America [USA] and 42% of adults in the UK.<sup>19,20</sup> The prevalence of hypertension in Nigeria is about 20% (by extrapolation from the 1997 nationwide study of non-communicable diseases), and is more common at the extreme ends of the socioeconomic strata.<sup>21</sup> In our series, HHD was more common among group 1 than group 2 patients, and the reasons for this finding are likely to be multiple. It may be that hypertension itself is more prevalent among individuals in the higher socioeconomic strata in Kano, or perhaps that echocardiographic screening for features of heart disease was carried out more frequently among the

higher income earners. Though HHD was more common among higher income earners, there was tendency for low income earners to have a more severe disease with higher frequency of LV systolic dysfunction (31% Vs 27.4% in groups 2 and 1 respectively) ( $p=0.625$ ; not significant). Left ventricular systolic dysfunction as assessed by LVEF is the single most important predictor of outcome among patients with symptomatic heart muscle disease.<sup>22</sup>

Dilated Cardiomyopathy was the second most common heart disease among all patients (15.2%), a similar finding to other recent echocardiographic studies in Nigeria where it was found among 17%-19.2% of patients.<sup>14,16</sup> The disease was the third most common heart disease among 22% patients referred for echocardiography in Zimbabwe.<sup>17</sup> In contrast however, cardiomyopathies were rare in a Kenyan Hospital, according to a retrospective study on referrals for echocardiography over 2 years.<sup>18</sup> In our study, DCM was more common among lower income earners ( $p=0.037$ ; significant). This finding is similar to that of a prospective study on DCM in New Zealand, where majority of the patients with DCM were unskilled laborers while executive, managerial and professional social classes were conspicuously absent and only one person had a university degree.<sup>23</sup> DCM was commoner in males in this study probably because patients with PPCM were grouped separately.

In this study, PPCM was the 5<sup>th</sup> most frequent heart disease among the low income earners but absent among higher income earners. Patients with PPCM were the youngest in the series with a mean age of  $22.08 \pm 5.49$  years. This finding is similar to that of a study reported from Dakar (Senegal) on patients with PPCM, where the mean age of patients was  $29.4 \pm 6.9$  years and 100% of them had low socio-economic status.<sup>24</sup>

Ischemic heart disease was the third most common heart disease in the present study among all patients (8.7%), 2nd most common among patients in group 1 (9.7%), and 4th most common among patients in group 2 (7.9%) ( $p=0.599$ ; not significant). About 30 years ago, this disease had been reported to be non-existent among Northern Nigerians.<sup>25,26</sup> However, a recent review of admissions into the medical wards of a tertiary medical centre in Kano revealed that 3.4% of all cardiovascular admissions were due to IHD.<sup>27</sup> The prevalence of IHD in this study is higher than this probably because of the superior sensitivity of

echocardiography in the diagnosis of IHD.<sup>7</sup> In comparison, IHD appears to be less common in other parts of Nigeria, found among 2.9% of cases referred for echocardiography in Benin City.<sup>16</sup> It was absent in the echocardiographic study reported from Port Harcourt, Nigeria.<sup>14</sup> The disparity may be because of the relatively higher prevalence of risk factors for IHD in Kano, where the highest prevalence of systemic hypertension and hypercholesterolemia were found in a nationwide survey.<sup>21</sup> The lack of significant statistical difference between the two groups in the present study suggests that IHD does not seem to be significantly associated with income, in Kano. However, it is possible that a larger sample size may demonstrate a significant difference between the groups.

Rheumatic heart disease was the fourth most common heart disease among all patients (8.3%), and 3<sup>rd</sup> most common among patients in groups 1 and 2 ( $p=0.865$ ; not significant). Most of these patients were females (69.6%) and young (mean age of  $30.86 \pm 13.24$  years), while the commonest valvular lesion was MR. Similar pattern has been reported from other parts of Nigeria.<sup>14,16</sup> In comparison, RHD has been reported to be the commonest heart disease as detected on echocardiography, in several African countries.<sup>17,18</sup> Rheumatic Heart Disease is a disease of poverty, largely affecting impoverished regions and populations of the world.<sup>28</sup> The disparity in prevalence of RHD between peoples of different socioeconomic status within the same country is clearly seen in Australia. The prevalence of the disease among the aboriginal people of Northern Australia is about 2%, while that of the white population is similar to what is obtained in other developed nations of Western Europe. The epidemiologic transition in Nigeria as it affects people in different socioeconomic strata is probably not complete, hence the lack of significant difference in the frequency of RHD between the 2 groups in our study.

The frequency of Aortic Sclerosis in our series was 5.4%, without significant statistical difference between the groups ( $p=0.310$ ). These patients were elderly with a mean age of  $67 \pm 10.4$  years. In contrast, the prevalence among elderly Caucasians in the USA was 29-42%, and up to 50% among those with chest pain.<sup>29</sup> In general, this

disease is common in the elderly and in a population with risk factors for coronary artery disease.<sup>29</sup> The disease is less common in our series. The reason for this is not clear. It is probably not directly linked to income per se.

Pericardial disease was found in a total of 14 patients (5.1%), 13 of these had effusive pericarditis. Though there was preponderance of effusive pericarditis among group 2 patients, the difference was not statistically significant ( $p=0.451$ ). Similarly, pericardial disease was found among 4.3% of patients referred for echocardiography in Port Harcourt (Nigeria),<sup>14</sup> and 5.1% of patients in Kenya.<sup>18</sup> In contrast, the disease was found on echocardiography in up to 12.3% of patients in Benin City (Nigeria),<sup>16</sup> 11.2% of patients in Ethiopia,<sup>30</sup> and 22.4% of patients in Zimbabwe.<sup>17</sup> The disease is less common in the developed countries where prevalence of infectious diseases is less. It was found among 3.8% of patients on echocardiography in Italy.<sup>31</sup> Tuberculosis is the most important cause of pericarditis in the world,<sup>32</sup> and majority of patients with pericardial disease in our study (76.9%) were rightly being evaluated for tuberculosis.

Other heart diseases such as hypertrophic and restrictive cardiomyopathies as well as cor pulmonale were not common in our series, in agreement with other studies in Nigeria and elsewhere.<sup>14,16,17,31</sup>

In conclusion, the pattern of heart disease in Kano differs in several respects between low and higher income earners. Hypertensive heart disease was the most common heart disease on echocardiography in Kano; more common among the higher income earners. However, DCM and PPCM were more common among low income earners. An important revelation is that IHD was more prevalent than was reported by other studies in the past, and affects both low income and higher income earners. The relatively high frequency of IHD might be a demonstration of the advanced stage of epidemiologic transition in Kano Nigeria. The relevant authorities should take note and put in place necessary measures to curtail the upcoming disaster of IHD. The findings from this study may also inform decisions on the CVD disparities that exist between the poor and the rich in the Nigerian society.

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