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Cardiovascular Epidemiological Transition in a Rural Habitat of Nigeria: The Case of Mangu Local Government Area

Transition Épidémiologique Cardiovasculaire Dans Un Milieu Rural Au Nigeria: Cas de la Zone Du Gouvernement Local de Mangu

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ABSTRACT

BACKGROUND: **Epidemiological transition is at various stages in different places. The true situation in sub-Saharan Africa (SSA) is largely unknown. Having studied this rural habitat 17 years ago, we returned there to study several cardiovascular disease (CVD) risk factors to see if any change had occurred.**

METHODS: **The communities studied in 1991 as part of the national CVD survey were returned to in 2008 and re-studied descriptively in a cross-sectional manner. All adults 15 years and above, apart from demographic and personal data had blood pressure (BP) and some blood indices determined.**

RESULTS: **Over the period, some changes occurred. The mean (SD) age increased from 34.1(16.9) to 45.5(18.2) years suggesting an ageing population. More people in 2008 than 1991 lived most of their last 5 years in the urban areas suggesting some influence of urbanisation. Significantly fewer people smoked and drank after 17 years. However mean (SD) of Body Mass Index rose [20.7(2.8) to 23.7(4.5) kg/m^2], as well as SBP and DBP. Prevalence of hypertension rose from 7.4% to 20.9%. Both total and HDL cholesterol rose, although atherogenic index dropped. Mean (SD) blood sugar interestingly dropped from 5.0(2.9) to 4.6(1.0) mmol/l.**

CONCLUSION: **Epidemiological transition is evident in this rural SSA habitat, and proactive steps to stem the tide and curb the consequences of CVD should be instituted. WAJM 2012; 31(1): 14–18.**

Keywords: **Epidemiological transition, Rural habitat, sub-Saharan Africa, Nigeria**

RÉSUMÉ

CONTEXTE: La transition épidémiologique existe à des degrés variables selon les lieux. La vraie situation en Afrique Sub Saharienne (ASS) demeure inconnue. Ayant étudié ce milieu rural il y'a de cela 17 ans, nous y sommes retournés pour étudier les facteurs de risque de plusieurs maladies cardiovasculaires (MCV) pour voir si des changements sont survenus.

MÉTHODES: Les communautés étudiées en 1991 dans le cadre de l'enquête nationale sur les MCV ont été ré étudiées en 2008 selon le mode descriptif transversal. Tous les adultes de 15 ans et plus avaient fourni des informations personnelles et démographiques et subi une mesure de la pression artérielle (PA) et quelques examens de sang.

RÉSULTATS: Au cours de la période, quelques changements sont survenus. La moyenne (écart type) d'âge avait augmenté de 34.1(16.9) à 45.5(18.2) ans suggérant un vieillissement de la population. Plus de personnes en 2008 qu'en 1911 ont vécu la plus part de leur 5 dernières années en zones urbaines suggérant une influence de l'urbanisation. De façon significative, moins de personnes fumaient et prenaient de l'alcool après 17 ans. Toutefois, la moyenne (écart type) de l'index de masse corporelle avait augmenté [20.7(2.8) à 23.7(4.5) kg/m^2], de même que les pressions artérielles systolique et diastolique. La prévalence de l'hypertension avait augmenté de 7.4% à 20.9%. Les taux de Cholestérol Total et HDL avaient augmenté bien que l'index athérogénique avait baissé. La moyenne (écart type) de la glycémie avait baissé de façon intéressante de 5.0(2.9) à 4.6(1.0) mmol/l.

CONCLUSION: La transition épidémiologique est évidente dans cette zone rurale d'ASS. Des mesures pro actives visant à endiguer la marrée et freiner les conséquences des MCV devraient être mises en œuvre. **WAJM 2012; 31(1): 14–18.**

Mots clés: Transition épidémiologique, Milieu Rural, Afrique sub-Saharien, Nigeria.

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Abbreviations: BMI, Body Mass Index; **BP,** Blood pressure; **CVD,** Cardiovascular disease; **PCV,** Packed cell volume; **SSA,** Sub-Saharan Africa

INTRODUCTION

Non communicable diseases (NCDs) have been branded the new pandemic of the 21st century,[1] and have been on the rise in sub-Saharan Africa (SSA). Late in the 20th century, many countries in SSA undertook population surveys of cardiovascular disease (CVD) risk factors as a base line for necessary health action. The one for Nigeria was published in 1997 by the Federal Ministry of Health and Social Services.[2] NCDs were said to have accounted for 14% of the total disease burden in SSA, but in absolute terms the probability of death from them is higher there than in the west.[3] Although more morbidity and mortality data are emerging from the region,[4,5] previous and common place estimates are based heavily on assumptions and extrapolations.[3]

The rise in CVD and atherosclerotic vascular disease in developing countries has been described as epidemiological transition.[6] At any given time, different countries and even different regions fall into different phases of transition. Expectedly, there would be a difference in phases between urban and rural areas. In 1991, the Nigerian Federal Ministry of Health and Social Services sent a team of cardiovascular experts to Mangu local government area to study some NCDs as part of a nation wide survey. The result of that study formed part of the publication of NCDs in Nigeria.[2]

Diseases especially non-communicable ones are known to vary with time.[7] As population ages in tandem with life expectancy, prevalence of diseases may change.[6] Nutrition, prevailing communicable diseases, socio-economic, political and weather changes may with time produce a different epidemiological picture.[8] The situation in SSA is largely unknown or in most cases conjectural. As longitudinal studies of representative communities provide one approach to filling the data gap,[9] we decided to re-survey this community after 17 years of the initial one. This will therefore be one of the few comparative cross sectional studies to compare changes in CVD burden in rural SSA, and probably among the earliest in Nigeria. Information derivable would be of immense value in health planning to stem the rise tide of CVD world wide. Essentially, we set out to determine the changes in CVD epidemiology in this Nigerian rural habitat after 17 years; largely in response to the need for such research as called for by Unwin *et al.* [10]

METHODS

Design: This was a descriptive and cross sectional study of adults 15 years and above which compared similar data generated in the 1991 Federal Ministry of Health and Social Services sponsored NCD survey in Nigeria; in the same locality in Mangu local government area of Plateau State, North Central Nigeria.

Data Collection: A series of contacts were made early in 2008 with the community leaders in the areas studied in 1991. This was to prepare the communities to accept another survey. The first contact was with the local government chairman followed by the district head and members of his cabinet. After satisfying them on the benefits of such surveys, we were given permission to enter the area for study. This was undertaken after the protocol was approved by the Ethics and Research Committee of Jos University Teaching Hospital by the principal investigator (BNO), who incidentally was the deputy team leader of the 1991 survey in this location. He was accompanied by CO, (the co-investigator with Community Health background and EKC (the only female co-investigator). In the course of this, Community Health Officers and Assistants were mobilized. This was to generate greater confidence since they were in regular contact with the community. They were briefed and trained on the tasks to be assigned, for uniformity with data collection. Resident doctors of Registrar and Senior Registrar cadres were mobilised from the Departments of Medicine and Community Health of Jos University Teaching Hospital and briefed on their data collecting roles. Data were collected on a slightly modified NCD Survey protocol of the Federal Ministry of Health and Social Services as used in 1991.

After consent at the community level, we mobilised to site and on each of the study days set up stations for the following tasks as follows. Station 1 – Registration after informed consent and randomization (1 in 3) for laboratory investigations. Station 2 – Self reported information on aspects of protocol related to personal and family history as well as socio-economic standing. Station 3 – First blood pressure measurement. Station 4 – Height and weight measurement. Station 5 – Second blood pressure measurement. Station 6 – Waist and hip circumference measurement. Station 7 – Third blood pressure measurement. Station 8 – For those so randomised, phlebotomy for blood tests and urine for urinalysis.

Measurements:

Registration – Undertaken by Community Health Officers.

History taking – Undertaken by Community Health Registrars

Blood pressure – This was taken by Registrars in Medicine after about 3 to 5 minutes of rest with mercury (ACCOSON BRAND) sphygmomanometers using appropriate adult size cuffs in standard fashion. The mean of the last 2 readings was used for analysis.

Height – This was measured using a stadiometer in metres to the nearest centimeter; with subjects standing feet together, without foot wears or head gears.

Weight – This was measured using weighing scales on flat firm surfaces to the nearest kilogram, with subjects in light clothing only. Body Mass Index (BMI) was derived from weight (kg) and height (m) using the formula weight divided by square of height.

Waist circumference – Taken using flexible tape at the level of the mid point between the ribs and the iliac crest from the front after exhalation.

Hip circumference – Taken using flexible tape at the point where the buttocks extended the most when viewed from the side. Waist and hip circumferences were not taken for pregnant women.

Urinalysis for protein and sugar – This was determined using appropriate Combi 2 dip stix methods on site by Laboratory Assistants.

Blood tests – Total cholesterol (TC), High density lipoprotein cholesterol (HDL), Sugar were determined in standard fashion using conventional enzymatic techniques. Creatinine and Uric acid were measured in the standard fashion using Jaffe's reaction and Caraway method respectively; while the microhaematocrit centrifugation method was used to determine the packed cell volume (PCV). All laboratory tests were run by IOI (the co-investigator with Medical Laboratory Science background).

Statistics: The data were analysed in the University of Jos computer centre using SPSS Version 17.0. Proportions were determined for categorical data (gender, habitation, smoking and alcohol use) and means for numerical data(age, BMI, SBP, DBP, TC, HDL, AI, Blood sugar). Similar data from 1991 and 2008 were compared using chi square statistic if they were proportions(gender, habitation, smoking and alcohol use) and t-test if they were means(Age, BMI, SBP, DBP, TC, HDL, AI, Blood sugar). A p value < 0.05 was used to define statistical significance.

RESULTS

A total of 806 subjects were studied in 1991 and 840 in 2008. Between 1991 and 2008, the proportion of the different genders had changed significantly. Males were significantly less while females were significantly more in proportion. From 41.7% in 1991, the males had gone down to 27.5% in 2008, while females went up from 58.3% in 1991 to 72.5% in 2008 .

There was evidence of ageing over the period. The age span in 2008 was 16 to 104 years with mean(SD) of 45.5(18.22). In 1991, it spanned 15 to 90 years with a mean(SD) of 34.7(16.9). There was a population shift in age with more people in the older age classes (60 years and above) in 2008, 28.6% than 1991, 11.8%. Whereas 2.1% of the population lived most of their last 5 years (despite being resident in the rural area at the time of the study) in the urban area as opposed to 97.9% in the rural area in 1991, the scenario was different in 2008. In 2008, 19.3% lived most of their last 5 years in the urban area, with 78.5% living most of their last 5 years in the rural area under survey. The difference in proportion was statistically significant.

Fewer people smoked. From 6.9% smoking in 1991 to 1.8% in 2008, the difference in proportion was statistically significant. Similarly more people (28.8%) were drinking alcoholic beverage in 1991 compared with 4.1% in 2008. The difference in proportion was also statistically significant. Mean(SD) BMI increased significantly from 20.7(2.8) in 1991 to 23.7(4.5) in 2008.

In 1991 systolic blood pressure (SBP) spanned from 50 to 228 mm Hg with a mean(SD) of 117(32.7) while in 2008, it spanned from 50 to 280 mm Hg with a mean(SD) of 130.3(26.9). The increase attained statistically significant difference. The trend for diastolic blood pressure (DBP) was similar. From a span of 30 to 160 mm Hg and mean(SD) of 71.3(11.9) in 1991, it rose to a span of 50 to 130 mm Hg with a mean of 79.9(12.6) in 2008. The rise again attained statistically significant difference. Using 140/90 mm Hg as cut off value, 7.4% of the population was hypertensive in 1991; rising to 20.9% in 2008.

TC rose from a mean(SD) of 2.7(0.9) mmol/l in 1991 to 4.4(1.1) mmol/l in 2008, a statistically significant rise. Similarly HDL rose from a mean(SD) of 0.7(0.4) mmol/l to 1.3(0.4) mmol/l between 1991 and 2008. The difference was statistically significant. The atherogenic index (AI) derived from the quotient of TC and HDL fell from a mean(SD) of 3.7(2.3) to 3.5(1.3). The difference was statistically significant. Interestingly, mean(SD) blood sugar fell over the two periods from 5.0(2.9) mmol/l in 1991 to 4.6(1.0) mmol/l in 2008. The difference was statistically significant. Table 1 shows the trend over the two periods.

DISCUSSION

The subjects were population based samples of Nigerian adult men and women (15 years and above) who live in North Central Nigeria rural communities of Langai and Gindiri in Mangu local government area of Plateau State. There were fewer males and more females in the population in 2008 compared with 1991 to a statistically significant level. This is probably a result of rural-urban migration. The males are less encumbered socio-culturally and hence constitute the more mobile segment of the society.[11,12] This phenomenon reflected in the habitation profile (Table 1). Fewer people in 2008 than in 1991 lived most of their last 5 years in the rural area under study, while more people in 2008 than 1991 lived most of their last 5 years in the urban area (despite being resident in the rural area during the study). The difference in proportions was statistically significant. The urban habitation status has been canvassed as a CVD risk factor[13] and could be contributing to the 2008 hypertension rates.

Blood pressure, both SBP and DBP rose in mean values with the differences attaining statistical significance over the 17 years intervening, between 1991 and 2008. In tandem with this was the rise in population prevalence of hypertension

Table 1: Contrasts of selected cardiovascular disease risk factors between the 1991 and 2008 study dates in Mangu L.G.A. of Plateau State, Nigeria

Index	1991 (n = 806) (%)	2008 (n = 840) (%)	p
Gender (M/F)	41.1/58.3	27.5/72.5	0.000(chi square:36.04)
Age (y)	34.1(16.9)	45.5(18.2)	0.000(t: 13.3)
Habitation (U/R)	2.1/97.9	19.3/80.7	0.000(chi square:123.4)
Smoking (Y/N)	6.9/92.8	1.8/98.2	0.000(chi square:25.33)
Alcohol use (Y/N)	28.8/71.2	4.1/95.9	0.000(chi square:183.9)
BMI (kg/m2)	20.7(2.8)	23.7(4.5)	0.000(t: 16.5)
SBP (mm Hg)	117.8(32.7)	130.3(26.9)	0.000(t: 8.3)
DBP (mm Hg)	71.3(11.9)	79.9(12.9)	0.000(t: 14.1)
TC (mmol/l)	2.7(0.9)	4.4(1.1)	0.000(t: 38.6)
HDL (mmol/l)	0.7(0.4)	1.3(0.4)	0.000(t: 18.2)
AI	3.7(2.3)	3.5(1.3)	0.03(t: 2.3)
Blood Sugar(mmol/l)	5.0(2.9)	4.6(1.0)	0.000(t: 3.6)

Data except when in percentage represent mean(SD).M/F, Male/Female, U/R, Urban/Rural, Y/N, Yes/No from 7.4% in 1991 to 20.9% in 2008. Hypertension is an established risk factor for all clinical manifestations of atherosclerosis and a powerful risk factor of CVD.[14] Since an increase in CVD and atherosclerotic disease in developing countries has been described as epidemiological transition,[6] one can use indices of hypertension to mirror epidemiological transition. This is because either as suggested by Gupta[15] or Yusuf *et al*,[16] epidemiological transition occurs when a community moves from rural stage (predominance of infections and malnutrition related CVD) to urban stage (life style changes that produce increase in hypertension and hypertension related atherosclerotic disease). In the former there is predominance of infection and malnutrition related CVDs while in the latter, life style changes that produce increases in hypertension and hypertension related atherosclerotic diseases abound. These include adoption of sedentary life style, increase in BMI and dietary changes among others. Consequently the rise in population prevalence of hypertension between 1991 and 2008 as well as significant rise in mean TC, BMI, SBP and DBP in this community implies epidemiological transition.

Since previous studies bordering on gender and hypertension did not suggest increased female predisposition,[17,18] it is unlikely that this significant change in gender proportion is responsible for the rising rates of hypertension. However the mean population age rose significantly. Increasing population age is one of the explanations for rising population prevalence of hypertension[19,20] It is known that as people age, varying degrees of intimal and medial changes occur in the large and medium sized arteries. The age related degeneration and sclerosis occurring in the media result in loss of arterial elasticity[21] causing arterial stiffness.[22] A rise in SBP is a major consequence of the foregoing.

Another cardiovascular risk factor that rose significantly in the population over the 17 year period was BMI. This factor is known to drive the rise in arterial hypertension. With rising BMI, there is a rise in sympathetic nervous system activity,[23] which by its effect on the heart and blood vessels result in an elevation of blood pressure. Where (and that is usually the case) the high BMI is part of the metabolic syndrome, there is hyperinsulinemia and insulin resistance. Insulin stimulates renal sodium re-absorption,[24] the consequence of which is increased blood volume and a volume dependent hypertension.

There was also a significant rise in TC over the period (Table 1). Hypertension frequently occurs in conjunction with metabolic disturbances (especially dyslipidaemia) in the metabolic syndrome. The combination often manifests concomitantly in the setting of obesity and hyper-insulinaemia.[25] This is in tandem with the finding of a significant rise in BMI over the period. Hypercholesterolaemia in the presence of arterial hypertension accelerates atherosclerosis which is related positively with population rates of hypertension. It also induces early endothelial dysfunction as well as dysfunctional vascular smooth muscle regulation. The consequence is onset and progression of arterial hyper-tension.[26] Interestingly, the HDL sub-fraction of cholesterol also rose significantly. Its ability to counter the atherosclerotic process[27] reflected in a reduction of atherogenic index over the 17 years. The implication is that though most CVD risk factors rose significantly in prevalence, atherosclerotic morbidity did not rise.

Finally and interestingly, the mean population blood sugar fell over the 17 year period to a statistically significant level. It is difficult to explain this with corresponding rise in BMI, blood pressure indices, mean age as well as mean cholesterol levels. Again from a prevalence of diabetes mellitus of 0.6% in 1991 to 3.5% in 2008, the only explanation would lie in the presumption that the few who were diabetic in 1991 had much higher blood sugar levels as a result of poor control status. The higher standard deviation in 1991 gives credence to this speculation. Evidently the rise in blood pressure and other CVD risk factors has little or nothing to do with cigarette smoking and alcohol use prevalence as these actually fell. The role of psychological stress of both global economic down turn and insecurity occasioned by recurrent socio-political strife in the area over the period cannot be quantified, but may be contributory. Stress especially when chronic initiates and sustains hypertension in those so disposed.[28]

In conclusion, cardiovascular epidemiological transition is already ongoing in SSA including the rural areas. In order to mitigate the looming catastrophe of increased morbidity and mortality from CVD, a multi-faceted approach to the problem is required. Health education for primary and secondary prevention strategies becomes imperative. Improvement of infrastructure for curative measures becomes compelling also.

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