ORIGINAL ARTICLE

PREVALENCE AND RISK FACTORS OF ARTERIAL HYPERTENSION AMONG URBAN AFRICANS IN WORKPLACE: THE OBSOLETE ROLE OF BODY MASS INDEX

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ABSTRACT

Background: *Studies on the prevalence of hypertension among Africans in workplace did not deal with risk factors of hypertension. Thus there is a need to screen urban central Africans at workplace for environmental risk factors of hypertension.*

Method: *A cross-sectional survey was conducted at the Kinshasa National Company of Electricity. A representative sample of 333 employees was screened. Tobacco, alcohol use and level of physical activity measures were obtained. Weight, height, BMI, waist, hip, conicity, blood pressure, pulse pressure and pulse rate were measured. Data were analysed using univariate and multivariate statistics.*

Results: *The prevalence of hypertension was 21.3%. Hypertension was associated with aging, higher professional position, eastern origin, migration, alcohol use, wider pulse pressure >60mmHg, wider waist >90cm, wider hip >97cm, obesity, and left ventricle hypertrophy. Independent predictors of hypertension were age, wider waist, wider hip, alcohol intake, and left ventricle hypertrophy. In another logistic regression model, only waist>90 cm (OR=2.5 CI95% 1.3-4.9; p<0.01) and age=55 years were identified as significant predictors of hypertension.*

Conclusion: *There is a need to stop this high prevalence of hypertension significantly predicted by higher waist and age. BMI is inefficient to predict hypertension.*

Keywords: Hypertension, prevalence, risk factors, abdominal obesity, Africans.

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INTRODUCTION

High blood pressure (BP) is a principal risk factor for morbidity and mortality worldwide. High BP is also one of the most important modifiable risk factors for cardiovascular diseases (CVD) which are considered the most prominent cause of premature death in developed countries[1]. However, there is a myth that CVD, frequently associated with hypertension, is a minor problem amongst Sub-Saharan Africans as compared with Caucasians and Africans in diaspora[2-6].

Epidemiological studies from industrialized and democratic countries with a high standard of living, have shown that the reduction of high BP decreased the risk for CVD, including stroke, coronary heart disease and end-stage renal disease[1,7]. The Sub Saharan countries on the other hand, were affected by rural-urban migration, chaotic urbanization, industrialization, dramatic economic, political and lifestyle changes during the post-Independencies and Apartheid years of 1960 1994. It is evident that hypertension and CVD will increase so rapidly in Africa as an epidemic cause of the global burden of disease by the year 2020[8] as is the case in other developing countries[9,10]. Thus, we hypothesized that affluent black Congolese employees who had been adapted to typical Westernized lifestyles during the progression of the epidemiological transition, will experience higher rates of hypertension greater than 9.9% hypertensives observed in the general population[11]. Consequently, primary prevention of hypertension should focus on screening and lowering of high BP levels. Nevertheless, scanty data have shown that screening for hypertension is uncommon in Africans in workplaces[12,13] than would be desirable and that the prevalence of hypertension estimated at 29.7% among certain workers[12] is high and greater than that of many developing general populations[14,15]. Furthermore, the management of hypertension is frequently insufficient and inadequate, resulting in persistent low rates of controlled BP.

However, the available information on the prevalence of hypertension among Africans at workplace[12,13] did not consider the other associated modifiable CVD risk factors. Indeed, it is now well established that the determinants of CVD in hypertensive patients are obviously multifactorial and the guidelines about the management of those hypertensive patients are not based on the level of BP alone, but also on the presence of other risk factors[16]. In order to obtain more direct

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evidence about the pathophysiology of hypertension in working African populations, this survey aims to determine the prevalence of hypertension and its biosocial and environmental risk factors.

METHOD

Sample design

This survey was a working community-based cross-sectional study conducted at the Kinshasa Division of the National Company of Electricity (NCE), a 2666 employee structure providing electricity to Kinshasa city, the capital of the Democratic Republic of Congo (DRC). Kinshasa has 10 million residents since the 1997 war of liberation. It includes colonial planned and westernized inner cities and chaotic eccentric rural areas[17]. The period of the investigation was from 15 October 2001 to 15 February 2002.

In accordance with the Declaration of Helsinki II, Human subject approval for the project was granted by the Research Ethics Committee of the Department of Internal Medicine of the Kinshasa University Clinics, Faculty of Medicine. Consent was also obtained from the Human Resources Department of NCE, the company medical service, and the employees. Confidentiality was retained. All patients with BP> 160/95mmHg were encouraged to meet the company Doctor for appropriate hypertension care.

Survey Operations

The Ministry in charge of National Companies employing multi-ethnic populations of DRC provided a list of 10 companies involved both in industry and commerce. The choice of those companies was influenced by geographical accessibility to the Department of Internal Medicine, and the desire to draw a representative sample from each province. NCE was randomly drawn from that list of companies. Prior to commencement of the study, a resident doctor (NK. B.) of our Department of Internal Medicine visited the NCE medical centre in order to familiarise the staff with the study protocol.

We selected a stratified random sample of 404 adults (age = 26 years) from the 4 professional categories of the Kinshasa Division of the NCE where the number of study subjects from each professional category was proportionate to the size of the category: Executive with 216 members, Deputy Executive with 492 members, Sub-chief with 879 members and simple employees with 1079 members. The details of sample size calculation, sample selection and pilot test have been presented in details elsewhere[18]. Letters of invitation with times of appointment were sent approximately two weeks in advance, to the people selected. People who failed to respond to the first letter of invitation received a further letter with a new time of appointment, or were contacted by telephone.

Study population

On the arrival of a participant at the Company medical centre, the resident explained briefly the concept behind the study and asked the participant to complete the anonymous questionnaire. Vigorous effort was made in this study to maximise the response rate in order to minimise the potential for bias.

Selected subjects were black Congolese citizens from all eleven provinces of DRC. For this study, participants were divided into 4 cultural and lingual ethnic groups (Ethnicity): Kongo, Ngala, Luba and Swahili. This ethnicity reflected all 432 tribes of DRC.

People out of the city or absent for medical reason were excluded.

Data collection

Standardized examinations at both study visits included an interview on demographic information, medical history and other factors, blood pressure, pulse rate and anthropometric measurements. Comprehensive questionnaires were prepared in French, sometimes translated in all four official languages in DRC for un-educated people. Information regarding prior diagnosis of hypertension determined by a health professional, family medical history, personal medical history, pharmacological treatment, occupational health, current smoking(coded as yes/no), ex-smokers, alcohol intake(coded as yes/no), and lifestyle/environmental factors education level, marital status defined as married (coded as yes/no), employment variables as professional categories, monthly income and socio-economic status/SES, rural-urban migration as yes/no, residence (urban versus rural), characteristics of housing, crowding, ownership of house or car, physical activity in leisure time and getting the workplace, means of transportation to the workplace). Demographic data such as gender, age and self-reported ethnicity were also obtained.

The resident assessed anthropometric measurements that included measuring the participant's height, weight, waist circumference and hip circumference. Weight was measured to the nearest 100g by calibrated balance beam scale, height by a wall-mounted height measure,

and body mass index (BMI in kg/m^2) calculated. The waist (W) circumference was determined with a tape at the level of the umbilicus on the unclothed abdomen and measurements recorded to the nearest 0.5 cm. The hip (H) circumference in cm was measured at the level of the external margins of the anterior superior iliac spines to the nearest 0.5 cm; the waist-hip ratio (WHR) being calculated for each subject. Conicity, an index of central adiposity[19], was also calculated as (W(cm)/0.109).

BP measurement

BP was recorded by the resident doctor using a standardized protocol as the average of the last three measurements in participants in the supine position after a rest of 5 min as recommended by the WHO guidelines 16, after placement of an appropriate sized cuff of a standard mercury sphygmomanometer on the right arm, which was kept at heart level. The pulse rate was also taken three times. Systolic BP (SBP) was defined as the point of auscultation of the first Korotkoff sound, and diastolic BP (DBP) at the fifth sound. Hypertension was defined as a SBP > 140 mmHg and/or a DBP> 90 mmHg according to WHO-ISH guidelines [16] and /or a history of antihypertensive treatment. Quality control of BP was assessed by ongoing serial replicate evaluations, as well as assessment of digit preference, with retraining if needed. The pulse pressure (PP) of each participant was calculated as the difference between the mean SBP and DBP. BP < 140/90 mmHg was considered controlled hypertension for known and treated hypertensives.

Definition of cardiovascular risk factors

Socio-economic status (SES) was judged from scores given to each element of lifestyles. Combined values of scores were transformed into tertile defined as follows: low SES for tertile I, moderate SES for tertile II, and high SES for tertile III.

Nutrition was defined according to BMI values: Underweight/denutrition (BMI < 18.5 kg/m^2), Normal weight (BMI = 18.5 24.9 kg/m2), overweight (BMI = 25 29.9 kg/m^2), obesity (BMI>30 kg/m2), and overweight/obesity (BMI>25kg/m^2). Fat distribution was defined by continuous values of waist, WHR and conicity for abdominal obesity, and Hip for peripheral obesity.

Physical activity (a median continuous index derived from hours of walking for relaxation or exercise, on the way to and from work) was grouped into the following categories: inactive category (sedentary lifestyle, <60 min) and active (≥60 min).

Gender, age and family history of hypertension were considered non modifiable (genetic) CVD risk factors. Smoking habit, alcohol intake and high pulse rate (= median) were defined as modifiable CVD risk factors. The prevalence of hypertension was age standardized against the World Standard [22]. Individuals with hypertension were classified into categories of hypertension awareness, treatment and control, as follows: awareness (positive response to the question "did a health professional tell you that you have hypertension"); treatment (use of any antihypertensive medication) and control (BP< 140/90 mmHg). Participants unknown hypertensive but with angina pectoris treated by either beta-blockers or long-acting calcium channel blockers were excluded from the hypertension definition. Electrocardiography was performed for defining left ventricle hypertrophy (LVH) according to Sokolow criterium (SV2 + RV5 > 35 mm).

Statistical analyses

Concerning reliability of estimates, the statistics from the survey were subject to sampling errors and non-sampling errors. For sampling errors, estimates of standard errors (SE) for SBP and DBP were calculated using the Taylor expansion method based on a linear approximation for the estimator and the variance, to estimate the variance of the estimate itself [20, 21]. Every effort was made to minimise non-sampling errors in this study by an extensively pilot-tested questionnaire, instruction of staff in standard procedures and intensive efforts made to minimise the non-response rate within each stratum.

The statistical Packages for the social sciences (SPSS 10.0) were used to conduct descriptive analysis, which considered mainly of frequency distributions and cross-classification tables (chi-square analysis) comparing variables. Mean, SE, standard deviation (SD) and percentages were estimated. To compare percentages from categorical data, the Mantel-Haenszel chi-square test was used. To compare means of symmetric continuous variables, the two-sample t-test was used.

One-way analysis of variance (ANOVA) was used to test for any difference in characteristics between groups. Within-group comparisons were made using a t-test with Bonferonni adjustment for multiple tests. If the distribution of the continuous variables was skewed, the non-parametric Kruskall-Wallis test (H) was used.

Odds ratios (OR) for hypertension were calculated with confidence interval at 95% (CI 95%) using logistic regression. A P-value < 0.05 was considered as statistically significant.

RESULTS

A sample of 404 adult employees was selected. Overall, 334 employees (response rate = 82.7%) participated in the study: 275 men (82.3%) and 59 women (17.7%), sex ratio of 4.7: 1 M/F. The mean age of the study population was 47.8± 9.1 years (26-72 years). Figure 1 shows the age-specific distribution of the study population.

In respect to the geographic origin (Figure 2), the ethnicity of the subjects was made up of 55% Kongo (n= 187), 21% Luba (n= 69), 17% Ngala (n=56) and 7% Swahili (n= 22).

Rural Urban migration was self-reported by 76.9% subjects (n=257). In Kinshasa city environment, 55.1% of the whole population (n=184) and 44.9% (n=150) reside in westernized urban area and chaotic rural area, respectively.

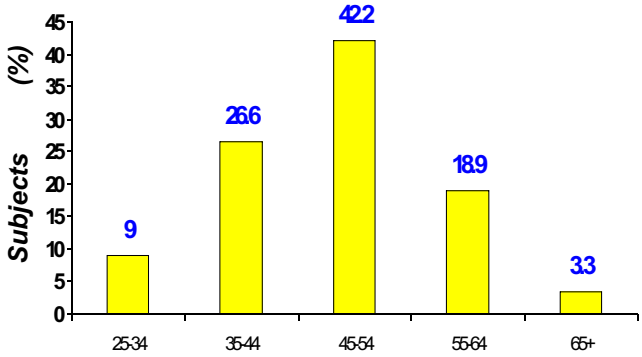

Figure 1. Age-specific distribution of the study population.

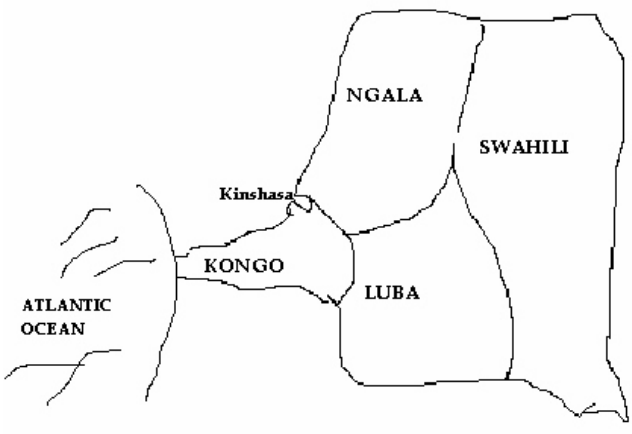

Figure 2. Definition of ethnicity according to the geographic origin of the subjects.

Table I shows the characteristics of the occupational status at the CNE where the mean monthly income was 150 ± 148 USD (41 USD 878 USD) and highly unequal (Figure 3). Combinations of the city lifestyle and environmental factors presented 108(32.3%), 101 (30.2%) and 125 (37.4%) employees in low, moderate and high SES, respectively. Prevalence of current cigarette smoking was 9.3% (n=31/334) in the study with mean daily cigarettes smoked of 10.6 ± 10.4 and a median consumption of 5 cigarettes per day; 16.5% (n=50/303) were ex-smokers. Alcohol intake was self-reported by 61.4% of the study population. Out of those 205 drinkers, 97.6% (n=200) and 2.4% (n=5) drank beer and palm wine, respectively.

Table I. Professional rank of subjects

Professional rank	n	%
Executive	34	10.2
Deputy-executive	75	22.5
Master	99	29.6
Simple agent	126	37.7

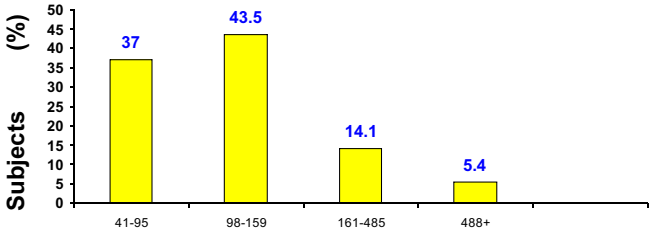

Figure 3. The monthly income-specific asymmetric distribution (media=110 USD;

Table II displays family and personal history of CVD. Among 330 participants with recorded BP, 73 (21.3% as global prevalence) were hypertensive. Despite 35 hypertensives reported being aware (48%), only 10.9% (n=8) received regular antihypertensive treatment and 24.7% (n=18) had controlled hypertension. The prevalence rates of diastolic hypertension and isolated systolic hypertension were 23.1% and 22.8%, respectively. Prevalence of electrocardiographic LVH was 27.2% (n=91/334).

Table II. History of cardiovascular disease

Variables	n	%
Family history of 333 subjects		
* Hypertension of parents	93	27.9
- fathers	34	
- mothers	63	
* Hypertension	77	23.1
* Diabetes of parents	39	11.7
* Diabetes of collaterals	29	8.7
* Stroke of parents	7	2.1
Personal history of hypertension	35	10.6

In univariate analysis, fat distribution (waist for abdominal and hip for peripheral), older age =55years, Eastern part of Democratic Republic of Congo, migration, alcohol intake, overweight/obesity and LVH were significantly associated with the global prevalence of hypertension (Table III). However, socioeconomic status (low + moderate versus high), residence (urban versus rural), physical activity (<60 min versus =60 min walking duration), gender (males versus females), cigarette smoking, family history of hypertension, pulse rate (=94 bpm versus < 94 bpm) and ethnicity were not significantly associated with the prevalence of hypertension (results not presented). History of hypertension in siblings (brothers, sisters) was more (p<0.0001) reported by hypertensives (43.6%, n=24; OR = 3.2; 1.7 5.6) than by normotensives (19.3%, n=53). When professional conditions were considered, a social gradient was defined for global prevalence of hypertension among employees (Figure 4): the highest rate being among executive members.

Table IV shows the results of the first logistic regression model: after adjusting for ethnicity, pulse rate, socioeconomic status, and hip circumference, the only larger waist circumference (abdominal adiposity) and older age were isolated as independent predictors of arterial hypertension. Moreover, after adjusting for migration, overweight/obesity defined by BMI, socioeconomic status and physical activity, only larger hip circumference, older age, LVH and alcohol intake were the independent predictors of arterial hypertension (Table V).

Table III. Univariate Odds ratio (OR) being hypertensive for employees in workplace

Variable of interest	Hypertension prevalence n (%)	OR (95% CI)	Pvalue
Age, years = 55 vs <55	26 (35.1) vs 47 (18.1)	2.5 (1.4 4.3)	<0.001
Geographic origine East vs West	28 (30.8) vs 47 (18.5)	2 (1.1 3.4)	<0.01
Migration Yes vs No	66 (25.7) vs 7 (9.1)	3.5 (1.6 8.5)	<0.01
Alcohol intake Yes vs No	53 (25.9) vs 20 (15.5)	2.5 (1.4 4.3)	<0.05
Overweight/obesity Yes vs No	36 (26.9) vs 37 (19.2)	1.6 (0.9 2.6)	<0.06
LVH Yes vs No	26 (38.2) vs 55 (24)	2 (1.1 3.5)	<0.05
Waist, cm = 90 vs < 90	28 (27.7) vs 26 (11.6)	2.9 (1.5 2.6)	<0.001
Hip, cm = 97 vs 97		2.2 (1.2 4.2)	<0.01

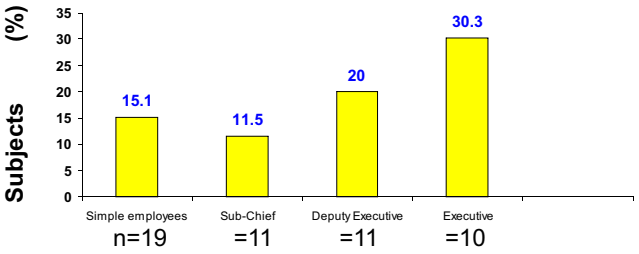

Figure 4. Prevalence rates of hypertension according to the professional position of employees.

Table IV. Determinants of arterial hypertension in Workplace for Central Africans

Variables (Units)	OR (95%CI)	P Value
Waist (cm) = 90 versus < 90	2.5 (1.3 to 4.9)	< 0.006
Age (years) = 55 versus <55	3.1 (1.6 to 6)	< 0.001

Table V. Independent predictors of arterial hypertension for Central Africans in workplace

Variables (Units)	OR (95%CI)	P Value
Hip circumference (cm) ≥97 versus < 97	5.9 (2.7 to 12.9)	< 0.0001
Age (years) ≥55 versus <55	3.3 (1.5 to 7.4)	< 0.01
LVH Presence versus absence	3 (1.4 to 6.4)	<0.01
Alcohol intake Yes versus No	2.3 (1.1 to 5)	<0.05

DISCUSSION

The present study demonstrates that the affluent black Congolese employees in the course of westernization and epidemiologic transition[2,6]do have an increase in the prevalence of hypertension of 21.3% (WHO/ISH guidelines). This prevalence of hypertension in the workplace is greater than that of 9.9% in the general population of the same town [11] and lower than 28.7% amongst workers from West Africa [12]. However, the prevalence of hypertension among Central Africans in workplace is equivalent to the general population from western industrialized countries [23] and South Africa [24]. With the majority of the study population now rapidly adopting Western lifestyle habits (alcohol intake, cigarette smoking) after rural-urban migration, it is likely that the prevalence rates will continue to increase with time. Indeed, the development of hypertension among Africans is favoured by the degree of urbanization [24.25].

Age-standardization of the prevalence rate to the world population standard was necessary for comparison with the level of hypertension in other areas.

These findings show that levels of awareness, treatment and control of hypertension are dramatically low as frequently reported in most developing countries [15]. Despite the presence of occupational Medical Centre within the company, the present study shows that the management of hypertension and compliance are insufficient and inadequate. Efforts need to be focussed on Africans in workplaces of work, to achieve higher success in awareness, treatment and control.

The present study confirms that hypertension and CVD will increase among Africans in workplaces as a "second wave" epidemic, and it will lead to an increase in the global burden of disease by the year 2020 according to WHO/Afro [8]. Since the determinants of CVD in hypertensive patients are substantially multifactorial [16], the multiparameric approach of WHO [17] was applied in

high pulse pressure in our previous [36] and present findings could be used. With regard to the future CVD epidemic in these African workers, we must critically evaluate the factors that led to the rise and recent decline of the CVD epidemic in developed countries [1] and isolate elements that are specific to our black populations. By the foregoing, there is an obvious need for early public health interventions as recommended by WHO/ISH [16] for limiting the spread of CVD, preventing their effect on the working black populations. This emphasizes the need to treat hypertension together with environmental factors by lifestyle modification (weight reduction, reduction in salt and alcohol intake, increased physical activity and to quit smoking) and/or medical treatment.

CONCLUSION

Prevalence of hypertension in Central Africans at workplace was comparable to reported rates in similar working populations in other African countries. The team of medical personnel of the company need to be trained in accordance with WHO/ISH guidelines on management of hypertension.

We therefore recommend an educational programme targeted towards the work force aimed at elimination of the socio-environmental determinants hypertension.

REFERENCES

1. THE PRICIPAL INVIGATORS OF THE MONICAPROJECT. WHO-MONICA PROJECT.
   Geographical variation in mortality from cardiovascular diseases-baseline data on selected population characteristics and cardiovascular mortality. World Health Stat Q 1987; 40: 171-184.
2. REPORT OF A WHO EXPERT COMMITEE.
   Hypertension control. WHO Technical Report series 862. Geneva : WHO; 1996: 1-83
3. HOLDER Y, LEWIW M J.
   Epidemiological overview of morbidity and mortality. In : Health conditions in Caribbean.
   Pan American Health Organization Scientific Publication N°561. 1997 : 22-61.
4. HARRIS JE. Global dimensions of African diaspora.
   2nd ed. Washington DC : Howard University Press, 1993: 90-100.
5. COOPER R, ROTIMI C, ATAMAN S, et al. The prevalence of hypertension in seven populations of West African origin.
   Am J Public Health 1997; 160-168.
6. GILLIUM R F. The epidemiology of cardiovascular diseases in black Americans.
   N Engl JMed 1996; 335 : 1597-1598.
7. THE SIXTH REPORT OF JOINT NATIONAL COMMITTEE on prevention, detection, evaluation and treatment of high blood pressure (JNC VI).
   Arch Intern Med 1997; 17 : 2413-2446.
8. WORLD HEALTH ORGANIZATION. Non communicable diseases : A strategy for the African region. WHO Regional Office for Africa. Harare, 2000.
9. MURRAY CJL, LOPEZ AD.
   The global burden of disease: a comprehensive assessment of mortality and disability from diseases, injuries, and risk factors in 1990 and projected to 2020. Geneva:World Health Organization, 1996.
10. REDDY KS, YUSUF S. Emerging Epidemic of cardiovascular disease in developing countries. Circulation 1998; 97 : 596-601.
11. M'BUYAMBA-KABANGU JR, FAGARD R , STAESSEN J, LIJNEN P, AMERY A.
    Correlates of blood pressure in rural and urban Zaïre. J Hypertens 1987; 5 : 371- 375.
12. KOFFI NM, SALLY J, KOUAME P, DIARRA NANA AJ. Faciès de l (hypertension artérielle en milieu professionnel à Abijan.
    Médecine d'Afrique Noire 2001; 48 : 257-260.
13. LANG T.
    Social professional conditions and arterial hypertension: an epidemiological study in Dakar, Senegal.
    J Hypertens 1988; 6 :271-276.
14. STEYN K, GAZIANO TA, BRADSHAW D , LAUBSCHER R , FOURIE J for the South African Demographic and Health Coordinating Team.
    Hypertension in South African Adults : results from the Demographic and Health Survey, 1998.
    J Hypertens 2001; 19 : 1717-1725.
15. FUENTES R, LLMANIEMI N, LAURIKAINEN E, TUOMILEHO J, NISSINE A.
    Hypertension in developing economies : a review of population-based studies carried out

from 1980 to 1998.
J Hypertens 2000; 18 : 521-529.

16. GUIDELINES SUBCOMMITEE. 1999 World Health Organization International Society of Hypertension guidelines for the management of hypertension.
J Hypertens 1999; 17: 151-183.
17. INSTITUT NATIONAL DE STATISTIQUE. Etide socio-démographique de Kinshasa 1967, Rapport général 1969.
18. NKOY BELILA J. Facteurs de risque cardiovasculaire, maladies cardiovasculaires et gradient social en milieu professionnel (cas de la SNEL) M s Degree Thesis, Kinshasa University, 2002.
19. VALDEZ R, SEIDELL JC, AHN YI, WEISS KM. A new index of abdominal adiposity as an indicator of risk for cardiovascular disease: a cross-population study.
Int J Obesity 1992; 16 : 77-82.
20. WOODRUFF RS. A simple method for approximating the variance of a complicated estimates. JAMA 1971; 66 : 411-414.
21. FULLER WA. Regression analysis for sample survey.
Sankhyâ 1975; 37 : 117-132.
22. DOLL R, SMITH PG. Comparison between registries : age-standardized rates. In: Waterfhouse J, Muir C, Shanksnmugaratnam K, Powell J (editors) : Cancer incidence in five continents, vol.IV Lyon : International Agency for Research on Cancer; 1982. P p 671-674.