

Blood pressure and heart murmurs in a rural population in the United Republic of Tanzania*

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Hypertension, congestive heart failure, and valvular heart disease are frequently seen among hospital inpatients in the United Republic of Tanzania. A population survey was therefore carried out to determine the prevalence of hypertension and cardiac murmurs in a random sample of people aged 25-64 years living in an undeveloped rural area. Standard cardiovascular survey methods as recommended by WHO were used. Only mean systolic blood pressure in women increased with age; even so, the difference in mean levels between those aged 25-34 and 55-64 years was only about 1.6 kPa (12 mmHg). Hypertension was found to be uncommon, only 2% of subjects having blood pressures >21.3/12.7 kPa (>160/95 mmHg). By means of multiple regression analysis, less than 10% of the variance in blood pressure levels could be explained by age and anthropometric measurements. Murmurs of grade 2 or more were detected in 17% of the men and 22% of the women, being most commonly heard at the apex (54%) and the left lower border of the sternum (31%). Mitral valve diastolic murmurs were heard in 4 of 275 women and these were asymptomatic. The cause of the high prevalence of systolic murmurs is unknown.

A number of reports of blood pressure studies on "primitive" people living in developing countries have suggested that there is little or no rise in mean blood pressure with age and that hypertension is rare (1-3). In African Negro populations, however, most hospital studies have suggested that hypertension is by no means uncommon (4) and most community blood pressure surveys have found that mean blood pressure levels at different ages are similar to those for Europeans (5-8).

In the United Republic of Tanzania, cardiovascular diseases are consistently among the main causes of death in hospital and, next to nutritional disorders, they are important chronic diseases owing to the morbidity and mortality that they cause, mainly in adults.

Cardiac murmurs are commonly heard in patients in the United Republic of Tanzania but most of them are of doubtful or no apparent clinical significance. However, chronic rheumatic heart disease and endomyocardial fibrosis are relatively common in

hospital patients (9, 10) and congestive heart failure is a common syndrome. An analysis of discharge diagnoses from Tanzanian hospitals for 1966-68 showed that half of all cardiovascular admissions (nearly 2% of all admissions) were classified under "other heart diseases", suggesting difficulty in establishing the diagnosis (11).

This cross-sectional survey was undertaken to:

1. Measure blood pressure levels and obtain data on the prevalence of hypertension in a community living under subsistence conditions in a rural area. If the general hypothesis is true that hypertension is commoner in more developed communities and urban populations, it should be much less common in such a rural population.

2. Obtain an estimate of the prevalence of cardiac murmurs and valvular heart disease in a general population living under undeveloped conditions in a rural area.

The information obtained was compared with the available hospital information for the United Republic of Tanzania and other parts of Africa (12).

METHODS

A random sample of local political leaders (Ten House Chairmen) was made and adults aged 25-64

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years in their areas were selected. The people were living on a rural subsistence farming economy and were scattered in small villages in Handeni District, Tanga Region. The total population of a defined area of approximately 12×25 km had been recorded over the previous 4 years as part of a demographic survey. Nearly all the people were from a single tribe and the diet consisted mainly of maize, rice, and cassava with a few beans, vegetables, coconuts, and occasional meat or fish. There appeared to be a low intake of salt and some seasonal variation in the availability of food supplies. The natural vegetation was typical rolling grassland, bushland, and thicket just inland from the coastal belt.

Blood pressure was measured in the sitting position

after 10 min of rest, by means of a random zero sphygmomanometer (13) and standard cardiovascular survey techniques (14). Diastolic blood pressure levels were recorded for phase IV and V. Two separate readings were taken, each to the nearest 2 mmHg. The observers were trained and supervised during the survey by the author and by a more objective method developed by Rose (15); all the observers were very competent at measuring systolic levels but slightly less so at taking diastolic readings. Each observer saw an approximately equal number of subjects from each age group. Anthropological measurements were carried out according to standard procedures (14).

The subjects were examined lying down and the

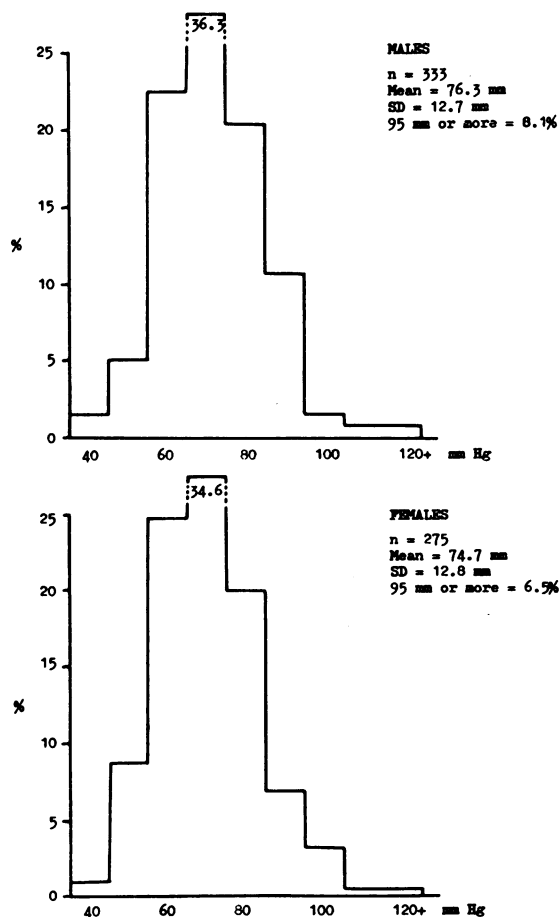
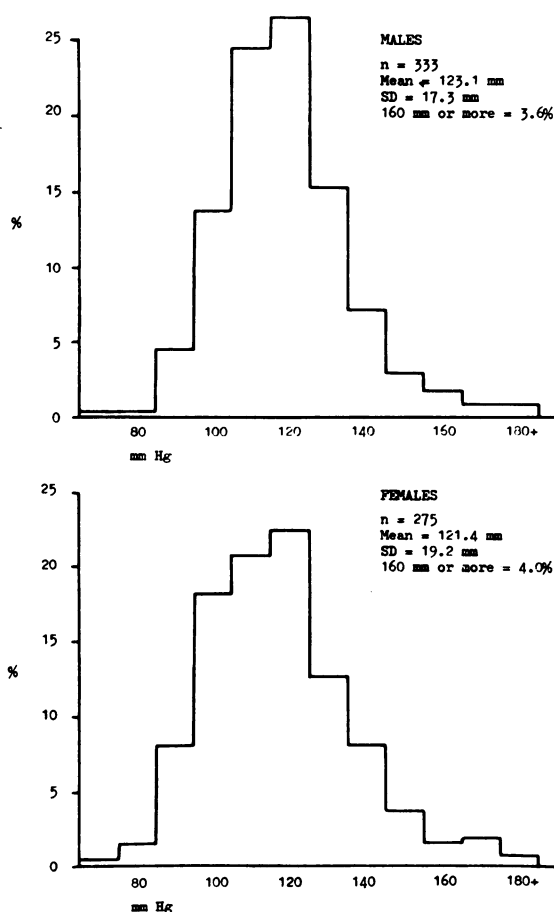


Fig. 1. The distribution of the systolic blood pressures for males and females separately, by 10-mmHg groupings (1 mmHg = 0.133 kPa).

Fig. 2. The distribution of the diastolic blood pressures for males and females separately, by 10-mmHg groupings (1 mmHg = 0.133 kPa).

apex beat was recorded as being palpable or not, and the intercostal space in which it was located was noted. Cardiac murmurs were classified according to their intensity as recommended by Rose & Blackburn (14). No distinction was made between ejection and pansystolic murmurs. Murmurs were also classified according to their area of maximum intensity as apex and mitral, left lower border of sternum (LLBS), pulmonary, aortic, or other.

The age given by the subject was accepted if it did not differ by more than 5 years from that previously recorded at census. If the difference was more than 5 years, the person was questioned on important dates in the Republic's recent past; one fifth of the subjects were placed in a different age group from that determined by the census.

RESULTS

In all, 608 persons were examined (333 men and 275 women), the overall response rate being 86%.

These appeared to be no significant differences with regard to age, sex, or geographical location among those who did not respond. Ninety-five percent of the subjects had been resident in the area for 5 years or more, over 90% were farmers, and 79% of the women and 48% of the men had had no formal primary education.

The distributions of systolic and diastolic blood pressures for all males and all females (Fig. 1 and 2) were approximately normal, with close similarities between males and females. The skew to the right is slight but is more marked for systolic than for diastolic blood pressure.

The mean systolic and diastolic blood pressure levels according to age and sex are given in Table 1 and Fig. 3.

Systolic blood pressure

The men showed no significant rise in mean systolic blood pressure level with age, whereas for women there was a consistent rise starting below

Table 1. Mean systolic and diastolic blood pressures in mmHg by age and sex (pressures in kPa in parentheses)

Age group (years)	Men			Women ^a		
	Mean blood pressure	SD ^b	Number	Mean blood pressure	SD	Number
<i>Systolic</i>						
25-34	120.1 (16.0)	11.2	81	117.6 (15.6)	15.5	66
35-44	124.6 (16.6)	15.5	88	119.0 (15.8)	20.1	94
45-54	122.7 (16.3)	21.8	75	124.3 (16.5)	19.1	58
55-64	124.6 (16.6)	19.1	89	126.9 (16.9)	20.7	57
Total	123.1 (16.4)	17.3	333	121.4 (16.1)	19.2	275
<i>Diastolic</i>						
25-34	74.4 (9.9)	11.4	81	72.3 (9.6)	11.9	66
35-44	77.0 (10.2)	11.6	88	74.8 (9.9)	11.3	94
45-54	76.1 (10.1)	14.8	75	76.2 (10.1)	15.1	58
55-64	77.5 (10.3)	13.2	89	75.9 (10.1)	13.5	57
Total	76.3 (10.1)	12.7	333	74.7 (9.9)	12.8	275

^a Difference in mean blood pressure between women aged 25-34 years and those aged 55-64 years by the Student *t* test = 0.01 > *P* > 0.005.

^b SD = standard deviation.

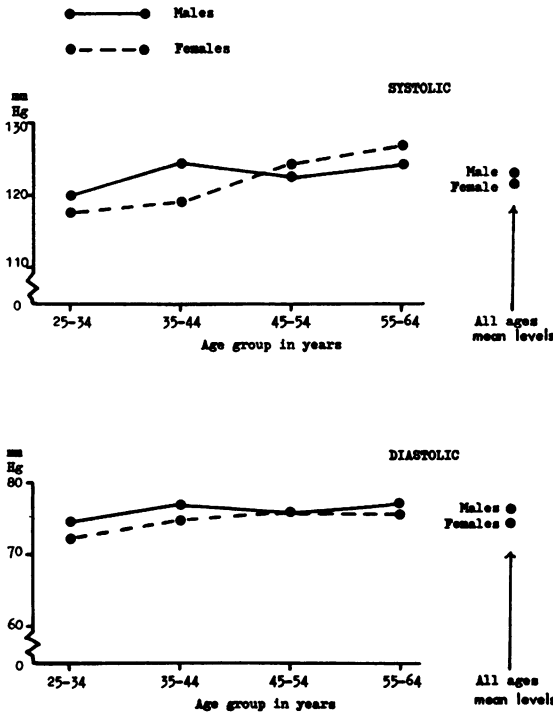


Fig. 3. The mean systolic and diastolic blood pressure levels for males and females separately and by age groups.

and finishing above the range of levels for men. In women, there was a significant difference between the mean level of 15.68 kPa (117.6 mmHg) for those aged 25–34 years and the mean level of 17.32 kPa (129.9 mmHg) for those 55–64 years of age ($P < 0.01$). The difference between the sexes was also shown by the correlation coefficient of systolic blood pressure with age, which was small and not significant in

men ($r = 0.08$, $P > 0.05$) whereas, although it was still low for women, it was significant ($r = 0.20$, $P < 0.001$).

Diastolic blood pressure

The mean diastolic IV levels averaged about 10.0 kPa (75 mmHg) and showed no apparent rise with age in either sex. There were no significant differences between mean diastolic levels for all males and all females. The differences between the mean values for diastolic IV and V blood pressure levels for all males and all females was 0.41 and 0.48 kPa (3.6 and 3.1 mmHg), respectively.

Hypertension

The numbers of persons with diastolic blood pressures of 12.6 kPa (95 mmHg), or more and/or systolic blood pressures of 21.3 kPa (160 mmHg) are shown in Table 2. If hypertension is taken to occur at a blood pressure of 21.3/12.7 kPa (160/95 mmHg) or more (16), then only 12 (2%) of the 608 subjects were hypertensive. No person less than 35 years of age was found to have hypertension. Only 12 out of 333 men (3.6%) and 12 out of 275 women (4.0%) had systolic blood pressures of 21.3 kPa (160 mmHg) or more, whereas 27 men (8.1%) and 18 women (6.5%) had diastolic pressures of 12.7 kPa (95 mmHg) or more. These latter figures may be partly accounted for by observer bias, as two observers were found to be recording higher diastolic levels than the others.

Multiple regression of age and anthropometric measurements on blood pressure

The independent variables were age, height, weight, Quetelet's index (weight/height²), arm girth, triceps skinfold thickness, subscapular skinfold thickness and, for women only, the total number of children born. The sexes were analysed separately.

Table 2. Numbers of persons with raised diastolic or systolic blood pressures, or with hypertension, by age and sex

Blood pressure	Sex	Age group (years)				Total
		25-34	35-44	45-54	55-64	
Diastolic \geq 12.6 kPa (\geq 95 mmHg)	Men	4	4	6	13	27
	Women	4	5	4	5	18
Systolic \geq 21.3 kPa (\geq 160 mmHg)	Men	0	3	5	4	12
	Women	1	5	1	5	12
Diastolic \geq 12.6 kPa and systolic \geq 21.3 kPa	Men	0	2	2	3	7
	Women	0	2	0	3	5

A stepwise multiple regression approach was used and a lower level of $P < 0.05$ was used for an independent variable being accepted as playing a significant part in explaining some of the variance.

In men, only subscapular skinfold thickness showed a significant association with systolic blood pressure and this variable explained only 6.3% of the variance (multiple $r = 0.25$, $P < 0.01$). For diastolic blood pressure, subscapular skinfold thickness was again significant, but weight also became significant at the 5% level, giving multiple $r = 0.31$ and explaining 9.7% of the variance.

In women, for systolic blood pressure, age and arm girth gave multiple $r = 0.31$, $P < 0.01$. For diastolic blood pressure, triceps skinfold thickness and age were associated (multiple $r = 0.24$, $P < 0.01$), explaining only 5.8% of the variance. There was no association of either systolic or diastolic blood pressure with the total number of children born.

Age therefore appears to be an associated variable for systolic and diastolic blood pressure in women but not in men. However, skinfold thickness appeared to be important in both sexes and for both blood pressure levels. In neither men nor women could more than 10% of the variance be explained by means of these independent variables.

Systolic murmurs

An analysis of the systolic murmurs according to their grade showed that 37% of men and 43% of women had a murmur of Grade 1 (barely audible) or more, 17% and 22%, respectively, had murmurs of Grade 2 (faint) or more, and 3% and 4%, respectively, had murmurs of Grade 3 (moderate) or more (Table 3).

Since Grade 1 murmurs are by definition barely audible, it was decided to determine the prevalence of systolic murmurs of Grade 2 or more by age and

Table 3. The percentages of men and women with systolic murmurs, by grade, out of a total of 333 men and 275 women

	Grade					Total with murmur	
	None	1	2	3	4		
Males (%)	63.4	19.5	13.8	3.3	0.0	36.6	
Females (%)	56.7	21.1	18.2	3.6	0.4	43.3	
Total	No.	367	123	96	21	1	241
	%	60.4	20.2	15.8	3.5	0.2	39.7

Table 4. The proportions of persons with a systolic murmur of Grade 2 or more, by age and sex

	Age group				Total
	25-34	35-44	45-54	55-64	
Men	21/81 (25.9%)	17/88 (19.3%)	11/75 (14.7%)	8/89 (9.0%)	57/333 (17.1%)
Women	20/66 (30.3%)	21/94 (22.3%)	12/58 (20.7%)	8/57 (14.1%)	61/275 (22.2%)

sex (Table 4). Both sexes showed a fall with increasing age, which was significant for men ($P < 0.05$) but not for women.

Classification of murmurs according to their site of maximum intensity showed that those at the apex and LLBS clearly accounted for the majority, being 53% and 31% of all systolic murmurs, respectively. When analysed by age/sex groups, the proportion of subjects with a murmur maximum in the apex or mitral areas remained fairly constant with age and was 21% and 22% overall for all men and all women, respectively (Fig. 4). By contrast, the proportion of persons with a systolic murmur maximum in the LLBS area fell with age (women $P < 0.05$, men $P > 0.05$). The decreasing prevalence with age of all systolic murmurs is probably explained, therefore, by the smaller proportion of older persons who had murmurs maximum in the LLBS area of the praecordium.

Further analysis of these persons showed a palpable apex beat to be strongly associated with systolic murmurs, 26% of all those with a palpable apex beat having a systolic murmur of Grade 2 or more compared with 9.0% of those without a palpable apex beat ($P < 0.001$). The haemoglobin level was significantly lower, in both sexes, in those with systolic murmurs compared with those without ($P < 0.01$), but the actual difference between the mean values of the two groups was not more than 10 g/l.

There were no associations demonstrated between systolic murmurs and blood pressure, the presence of sickle-cell trait or, in women, the total number of children born.

Diastolic murmurs

Five persons were found to have a diastolic murmur (Grades 3-5); all were women and asymp-

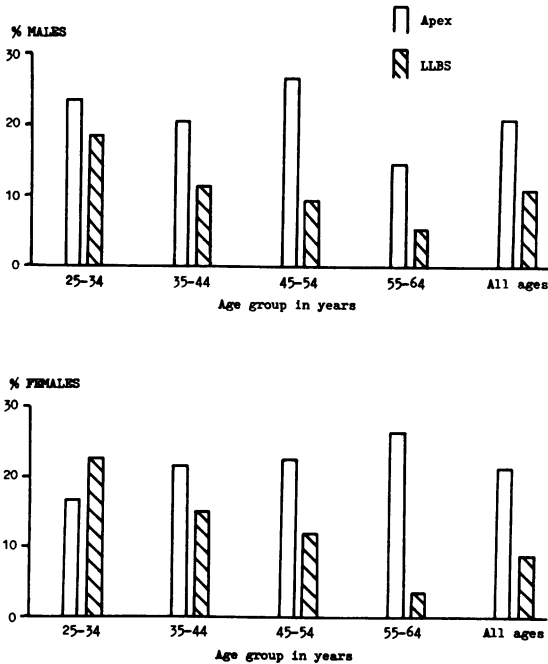


Fig. 4. The percentage of all subjects in each age/sex group with systolic murmurs (Grade 1 or more) with maximum intensity at the apex or the left lower border of the sternum.

tomatic. Four were diagnosed as having pure mitral stenosis with no evidence of mitral incompetence or involvement of the other heart valves. None had cardiac failure and none had had hospital treatment for heart complaints. The fifth person had a soft, blowing, early diastolic Grade 2 murmur maximum in the LLBS, suggesting aortic incompetence. The prevalence of clinically detected mitral valvular disease among women 25–64 years of age was, therefore, 4 out of 275 (1.45%).

DISCUSSION

The survey area was chosen because the population was typical of the undeveloped rural areas of the United Republic of Tanzania. The sample was random and the response rate high, with no evidence for bias in the non-responders with regard to age, sex, or geographical area. The survey methods followed standard recommended techniques and observers were supervised and monitored for variation and bias. The only significant bias was found to be a tendency by two observers to read higher diastolic pressures. All these factors suggest the

population was typical of a rural area and that the survey itself was sound.

In the present survey, a rise in blood pressure with age occurred only in women and even this rise was a comparatively small one. Two surveys carried out in Nigeria (6, 7) showed that mean blood pressures rose with age in both men and women, and Shaper & Saxton (8) found very similar findings among the Baganda tribe in Uganda. However, none of these three surveys were carried out in a truly rural population.

The present survey is one of very few to reveal low blood pressures in Africa, particularly in African Negro subsistence farming communities. Huizinga (2) mentions five communities in Africa in which blood pressure did not appear to rise with age. Two were investigated by the author: the Fali (northern Cameroon) and the Kurumba (Upper Volta); two others are the Ituri Forest pygmies in Zaire (17) and the Kalahari bushmen (18). The fifth was a small mixed group of immigrants examined by Shaper & Saxton (8). Similar findings have been reported in a rural population in the Gambia (19), and reports from Papua New Guinea have suggested an actual fall in mean blood pressure with age (20, 21).

The 2% prevalence for hypertension in this survey is very low compared with other surveys in Africa, such as 23% in the Baganda in Uganda (8), 34% among persons 45 years old or more in Uganda (22), 5% among tuberculosis outpatients in Ethiopia (23) and 20–30% in the inhabitants of Lagos city, Nigeria (7). In an analysis of inpatient admissions reported by all hospitals in the United Republic of Tanzania for 1966–68, hypertension accounted for 0.4% of all admissions (not including normal childbirth) and for 20% of cardiovascular admissions. One quarter of all admissions for hypertension were in fact reported from a region with 7% of the total population of the country plus the capital city (4). Similar urban/rural differences have been reported from South Africa, where hypertension was found to be rare in the rural areas and considerably more common in the urban populations (24, 25). Studies in Papua New Guinea and the Pacific area have also revealed an almost total absence of hypertension in the adult population (26, 27) and a review of communities without apparent hypertension has recently been published (3).

Age has been found to be the most important explanatory variable in large studies employing multiple regression analysis of cross-sectional data

in the United States of America (28–30), Israel (31), Belgium (32), and India (33). In the present study, age was found to be an “explanatory” variable only in women. Some measure of body mass, such as weight or relative weight, was also found to be important in these studies.

Acheson & Florey (28) were able to explain about 40% of the variance in blood pressure levels in their analysis of national data from the USA, whereas the other studies mentioned above only explained between 10% (32) and 23% (29, 30). The present study explained less than 10% of the variance.

The problems of diagnosing mitral valve lesions in the tropics are common and great; Brockington & Edington (34) remarked in their clinicopathological study of heart disease in western Nigeria that they were a “... major source of diagnostic difficulty in wards and postmortem rooms”. However, the persons in this survey who were found to have a diastolic murmur most probably had some organic valvular lesion and the prevalence rate for mitral valve disease of 1.45% in women aged 25–64 years is quite a high but not unlikely rate (moreover, it is based on only four cases). There was a notable absence of diastolic murmurs in men.

Systolic murmurs present quite a different picture. All the persons were examined by the author and the prevalence figures for the presence of murmurs might be explained by observer error or bias. However, although this might partly account for the high prevalence figures, it is unlikely to be the entire explanation because the figures themselves were very high, the observations were consistent between men and women, and the age prevalence rates for apical murmurs remained constant whereas those for murmurs maximum at the left lower border of the sternum fell. Even if Grade 1 murmurs are ignored, the proportion with Grade 2 or more was still surprisingly high; men 17% and women 22%. All

these persons were apparently well. This contrasts markedly with hospital studies, where patients are usually given a diagnostic category. There are very few references in the literature to such “benign” systolic murmurs among hospital patients. However, Parker (35) found in Nairobi that in 6% of his cardiac outpatients there was a systolic murmur and nothing else abnormal to be found.

In community surveys, similar findings were obtained by Mann et al. (17) in Ituri Forest pygmies in Zaire, in whom 16% of 186 subjects had a Grade 2 murmur or higher. Also, a cardiovascular survey in the vicinity of the Albert Schweitzer Hospital in Gabon revealed that “... a large amount of unexplained cardiac disease exists, manifested mainly by “organic” systolic murmurs, cardiomegaly or abnormal ECG’s” (36).

In the present survey, the prevalence of systolic murmurs was similar in the two sexes, which suggests that causal factors are probably environmental rather than genetic. Anaemia is not common or severe enough to explain the high prevalence. In the tropics streptococcal infections are frequent, high ASO titres are commonly found, acute rheumatic fever appears to take on clinically mild forms, and there is a high prevalence of chronic rheumatic heart disease (37, 38). Could these systolic murmurs represent the subclinical aftermath of such a pathological process?

Why the proportion of LLBS murmurs decreased in the older age groups is not clear. It might be explained by affected persons dying earlier, the ‘lesion’ (whatever it might be) healing, or a cohort phenomenon showing itself by rising prevalence rates in younger age groups. There is no way of differentiating among these possibilities with the present data. Some follow-up information on the persons surveyed might reveal the significance of such murmurs and also what happens to them with time.

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RÉSUMÉ

PRESSION ARTÉRIELLE ET SOUFFLES CARDIAQUES DANS UNE POPULATION RURALE
DE LA RÉPUBLIQUE-UNIE DE TANZANIE

L'hypertension est fréquemment constatée chez les malades soignés dans les hôpitaux tanzaniens, et la plupart des enquêtes sur la pression artérielle menées au sein d'autres populations d'Afrique noire confirment que la moyenne de celle-ci pour les différents groupes d'âge ne diffère pas de celle qui s'établit dans des populations européennes. L'insuffisance cardiaque globale et les cardiopathies valvulaires sont également couramment diagnostiquées chez les malades adultes; quant aux souffles cardiaques souvent perçus à l'auscultation, ils présentent, pour la plupart, un caractère bénin et il est généralement difficile de les associer à un trouble organique déterminé. La présente étude a été faite pour établir la prévalence de l'hypertension et des souffles cardiaques dans une population rurale à économie agricole de subsistance. Elle a porté sur un échantillon aléatoire de 608 individus âgés de 25 à 64 ans qui ont été examinés en appliquant les méthodes habituelles de contrôle cardio-vasculaire.

Chez les femmes, la moyenne de la pression artérielle systolique s'accroît légèrement avec l'âge, mais non la pression diastolique; chez les hommes, on n'a pas constaté d'élévation avec l'âge de la pression soit systolique, soit diastolique. Deux pour cent des sujets présentaient de l'hypertension (pression égale ou supérieure à 160/95). L'analyse par régression multiple a montré que l'âge constituait une variable significative en ce qui concerne la pression systolique et diastolique chez les femmes, mais non chez les hommes. Elle a aussi

permis d'établir que l'épaisseur du pli cutané figurait parmi les variables en relation avec le niveau de la pression artérielle chez les individus des deux sexes. Quoi qu'il en soit, ni l'âge ni les mesures anthropométriques n'ont pu expliquer plus de 10% de la variance chez les hommes ou chez les femmes.

Un souffle systolique de degré égal ou supérieur à 2 a été perçu chez 17% des hommes et 22% des femmes. Son intensité maximale se situait à l'apex et dans la région mitrale (pour 53% des cas) et dans la partie inférieure du bord gauche du sternum (pour 31% des cas). La proportion de sujets présentant un souffle apexien n'a pas paru varier en fonction du groupe d'âge, alors que la perception d'un souffle au bord inférieur gauche du sternum diminuait de manière appréciable avec l'âge. On a constaté une forte corrélation entre la présence d'un battement de l'apex contre la cage thoracique et celle d'un souffle systolique du degré 2 ou plus, ainsi que celle d'un certain déficit du taux d'hémoglobine. Un souffle diastolique a été perçu chez 4 des 275 femmes examinées et 4 d'entre elles présentaient une cardiopathie mitrale asymptomatique, le taux de morbidité par cette maladie s'établissant ainsi à 15 pour 1000 femmes âgées de 25 à 64 ans. La cause de la forte prévalence du souffle systolique n'est pas connue, mais on peut se demander s'il ne constitue pas souvent une séquelle d'infection streptococcique.

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