Hypertension prevalence and age-related changes of blood-pressure in semi-nomadic and urban Oromos of Ethiopia

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Abstract. We evaluated the prevalence of hypertension and the age-related behaviour of systolic blood pressure (SBP) and diastolic blood pressure (DBP) in a wide sample of male and female Ethiopian Oromos living in rural or pre-industrial urbanized settings. Blood pressure (BP) was measured in the sitting position after 5 min rest in 5277 Oromos. In the group, 4928 were semi-nomadic shepherds, while 349 came from a town of 60,000 inhabitants where they were involved in low-technology jobs. The first subgroup was composed of 2482 men and 2446 women. All subjects were divided into 3 age groups: 15–44, 45–64, and ≥ 65 years. Body weight (BW) and the Quetelet index (QI) were matched to BP levels using Pearson's method. In semi-nomadic men, SBP was 121.4 ± 8.4 mmHg versus 132.4 ± 10.4 mmHg in urban men ($p < 0.001$). In women, SBP was 120.5 ± 7.9 mmHg versus 128.1 ± 10.1 mmHg ($p < 0.001$). The prevalence of hypertension was 0.40% in the semi-nomadic and 3.15% in the urban population. In the latter, significant increases in BW and QI were found, which were significantly correlated to both SBP and DBP. In semi-nomadic

men, a 5.33% increase in SBP and a 5.22% in DBP was found between age groups 1 and 2 ($p < 0.001$ in both). In urban men the increase was 4.77% and 3.41% respectively ($p < 0.001$). In both male populations no difference in SBP and DBP was observed between age groups 2 and 3. In semi-nomadic women however, a progressive rise in SBP (4.84% between age groups 1 and 2, $p < 0.001$; 1.86% between groups 2 and 3, $p < 0.001$) and DBP (4.26% between age groups 1 and 2, $p < 0.001$; 2.72% between groups 2 and 3, $p < 0.001$) was present. Similar differences in SBP and DBP were evident between urban women of age groups 1 and 2. Due to social reasons, women for group 3 were not available in the urban setting. In conclusion, this study shows a very low prevalence of hypertension in a semi-nomadic group and about an 8-fold increase in the urban population. SBP and DBP are significantly higher in the urban setting and in both men and women the increase is related to BW. Moreover, SBP and DBP progressively increase with age in women but not in men.

Introduction

While cardiovascular diseases are the leading cause of death in Western countries [1], in most developing countries they are still a secondary public health problem because malnutrition and infectious diseases are much more pressing. However, with increasing urbanization and the adoption of Western ways of life and food habits, many populations of developing countries tend to be exposed to the well-known risk factors for atherosclerosis, and show an increasing incidence of ischemic heart disease [2].

Hypertension seems to be more important than other risk factors in these populations [3]. In most, blood pressure increases with age [4, 5] but in some blood pressure does not change with age and hypertension is almost absent [6, 7]. The main characteristics of these communities, as the Intersalt study has recently shown [8], are that they are far from Western

ways of life and lacking the well-known factors favouring the development of hypertension. However, the prevalence of hypertension may vary considerably even among different unacculturated tribal populations.

The present study was carried out in southern Ethiopia to evaluate the prevalence of hypertension and the changes of blood pressure in semi-nomadic Oromo shepherds, using a far greater sample than that reported until now in the literature. The results obtained from semi-nomads were compared to a group of people of the same population living in an urban area. As the study was carried out in a rural hospital in a country with poor economic conditions and health care organization, no extensive laboratory evaluation could be performed. Investigations were limited to a careful clinical examination and to the determination of urinary albumin and sediment of individuals with moderate to severe hypertension.

Subjects and methods

Study population and methods. This study was conducted from September 1990 to May 1991 at the Outpatient Department of the General Rural Hospital of Gambo, in the Arssi area, Ethiopia – in the context of the Technical Cooperation Programme N.654/CUAMM/ET – and at the Shashamane Health Centre, South Shoa, Ethiopia, both situated about 300 km south of the capital, Addis Ababa.

A total of 5277 persons, all belonging to the Oromo-Galla ethnic group (see Appendix), were studied. The semi-nomadic group consisted of 2482 men, 2038 women, and 408 women in the first and second trimester of pregnancy checked at the Prenatal Clinic of Gambo Hospital. The urban group living in the city of Shashamane (approximately 60,000 inhabitants) consisted of 257 men and 92 women.

None of the subjects were taking medication. All of them had come to the health centre for the first time, either as patients in the case of pregnant women or as relatives/accompanying persons of patients admitted to the hospital.

Blood pressure was measured using a Riva-Rocci sphygmomanometer always by the same doctor or, in pregnant women, by the same qualified nurse. Systolic and diastolic pressures (Korotkoff Phase V) were measured on the right arm, after sitting for five minutes in a comfortable and quiet environment. According to WHO recommendations [9], 140/90 mmHg was taken as the upper normal limit of blood pressure and a value above 160/95 mmHg was considered as the limit for definite hypertension. Age, sex, height, body weight, the Quetelet index (weight/height^2) and the basic diet (staple food) were also recorded.

Analysis of data. Subjects were divided into three age groups: 15–44, 45–64, and $\geqslant$ 65 years. Systolic and diastolic blood pressure, body weight and Quetelet index were compared by using the Student's t-test for non-matched data. The correlations between body weight and systolic and diastolic blood pressures, between Quetelet index and systolic/diastolic blood pressures were evaluated by applying Pearson's method.

Results

Tables 1 and 2 show the mean values of systolic and diastolic pressure, height, body weight and Quetelet index in the rural, semi-nomadic and urban Oromo populations. In subjects with high blood pressure, the urinary sediment was negative and albumin was not detectable.

Blood pressure differences between the two oromo populations. In the urban Oromo population, both systolic (SBP) and diastolic (DBP) blood pressures were significantly higher than in the semi-nomadic population in all age groups, both in men and women (Tables 1, 2; Figure 1). The distribution of systolic and diastolic blood pressure values follows a Gaussian pattern in both the semi-nomadic and urban populations (not shown). In the semi-nomadic population a 0.40% prevalence of hypertension was observed versus 3.15% in the urban population, that is, 18 cases out of 4520 in the semi-nomadic population and 11 cases out of 349 in the urban population, without any prevalence differences between men and women.

Body weight and blood pressure in the two oromo populations. In men and women of each age group, body weight – not height – was significantly lower ($p < 0.001$ for each age group) in the semi-nomadic than in the urban population (Tables 1, 2). The average body weight increase was 14.1% in urban men and 14.9% in urban women. The same trend was observed for the Quetelet index (Tables 1, 2). A significant correlation was found between body weight, the Quetelet index and both SBP and DBP. This correlation was observed in all groups both in the semi-nomadic and urban populations, but it was more evident in men than in women, especially urban women (Table 3).

Blood pressure differences between the different age groups. In semi-nomadic men, SBP and DBP mean values were 5.33% and 5.22% higher in the second than in the first age group ($p < 0.001$ both) (Table 1). On the contrary, there was no significant difference between the second and the third groups (Table 1). A similar blood pressure trend was present in the urban men (Table 2) in which the increase from the first to the second age group was 4.77% for SBP and 3.41% for DBP ($p < 0.001$ both). Again, a further increase in BP was not observed in older men (Table 2). Unlike in men, blood pressure significantly increased in semi-nomadic women throughout all three age groups (Table 1). SBP increased by 4.84% between age groups 1 and 2 ($p < 0.001$) and 1.86% between age groups 2 and 3 ($p < 0.001$); DBP increased 4.26% between age groups 1 and 2 ($p < 0.001$) and 2.72% between age groups 2 and 3 ($p < 0.001$). Comparable differences in SBP and DBP were evident between women of age groups 1 and 2. Unfortunately, women over 65 were not found in the urban setting, so that comparison with the other age groups was not possible.

Differences in blood pressure values between men and women. In the rural setting, on average a 0.75% difference in SBP between men and women was found with significantly higher levels in men of all age groups ($p < 0.001$). The DBP values were also 0.83% higher in men than in women, but the statis-

Table 1. Blood pressure, height, body weight, Quetelet index in semi-nomadic Oromos

Age (years)	No. of subjects	SBP (mmHg)	DBP (mmHg)	Height (cm)	Weight[a] (kg)	Quetelet index[a] (kg/m^2)
Men						
15–44	1273	⌐118.3 ± 6.9	⌐70.8 ± 6.3	171.5 ± 6.7	54.7 ± 7.3	18.4 ± 2.0
		*	*			
45–64	861	* 124.6 ± 6.3	* 74.5 ± 6.8	171.7 ± 6.4	56.6 ± 8.1	19.1 ± 2.3
		n.s.	n.s.			
≥65	348	⌐124.6 ± 9.3	⌐74.3 ±6.3	170.8 ±6.3	55.5 ± 7.3	19.0 ± 2.2
Total	2482	121.4 ± 8.4	72.6 ± 6.7	171.5 ± 6.6	55.5 ± 7.6	18.8 ± 2.2
Women						
15–44	1153	⌐117.8 ± 7.2	⌐70.5 ±6.5	157.7 ± 6.0	48.7 ± 6.3	19.5 ± 2.4
		*	*			
45–64	683	* 123.5 ± 7.4	* 73.5 ± 6.4	158.6 ± 6.0	49.3 ± 6.5	19.6 ± 2.4
		*	*			
≥65	202	⌐125.8 ± 7.3	⌐75.5 ± 6.4	157.8 ± 6.1	49.1 ± 6.4	19.7 ± 2.6
Total	2038	120.5 ± 7.9	72.0 ± 6.0	158.0 ± 6.0	48.9 ± 6.4	19.6 ± 2.4
Pregnant women						
15–44	408	104.3 ± 9.2	65.5 ± 7.1	158.6 ± 5.8	53.5 ± 6.3	21.2 ± 2.2

SBP = systolic blood pressure; DBP = diastolic blood pressure. Mean ± SD is reported.
[a] Body weight and Quetelet index values are significantly lower ($p < 0.001$ for each group) than those of the corresponding urban population (see data reported in Table 2 for comparison).
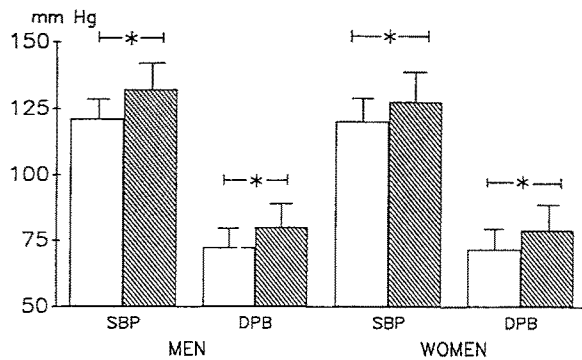* $p < 0.001$.

Table 2. Blood pressure, height, body weight, Quetelet index in urban Oromos

| Age (years)	No. of subjects	SBP (mmHg)	DBP (mmHg)	Height (cm)	Weight[a] (kg)	Quetelet index[a] (kg/m^2)
Men						
15–44	138	⌐130.0 ± 10.1	79.1 ± 8.2	172.8 ± 6.4	60.3 ± 9.4	20.1 ± 2.6
		*	*			
45–64	89	* 136.2 ± 9.7	81.8 ± 8.3	172.5 ± 6.7	65.4 ± 10.5	21.9 ± 3.3
		n.s.	n.s.			
≥65	30	⌐133.3 ± 5.0	80.0 ± 3.0	169.3 ± 4.0	60.6 ± 4.5	21.1 ± 3.6
Total	257	132.4 ± 10.4	80.2 ± 8.3	172.6 ± 6.5	63.3 ± 10.1	20.8 ± 3.0
Women						
15–44	70	126.6 ± 10.4	78.6 ± 9.3	159.1 ± 5.1	56.1 ± 9.9	22.1 ± 3.9
		*	*			
45–64	22	132.9 ± 6.2	80.9 ± 6.1	160.5 ± 4.4	56.7 ± 7.9	22.0 ± 2.8
≥65	0	–	–	–	–	–
Total	92	128.1 ± 10.1	79.1 ± 8.7	159.5 ± 4.9	56.2 ± 9.5	22.1 ± 3.6

Legend as in Table 1.

tical significance was not as strong ($p < 0.01$) (Tables 1, 2; Figure 2). In pregnant rural women, both SBP and DBP mean values were significantly lower than in the rural women of the same age and nearly 10% of the physiological fall in pressure which is usually seen in the first months of pregnancy. In the urban setting, probably due to the smaller population sample, a significant difference between men and women was present only for SBP (Table 2; Figure 2). Nevertheless, the difference between men and women was wider than in the rural population, i.e. 3.36% for SBP and 1.39% for DBP. Both SBP and DBP of urban women were higher than those of the semi-nomadic men (Tables 1, 2).

Figure 1. Comparison of blood pressure levels (mean ± SD) recorded in semi-nomadic (open bars) and urban (dashed bars) Oromos. SBP = systolic blood pressure; DBP = diastolic blood pressure. * $p < 0.001$.
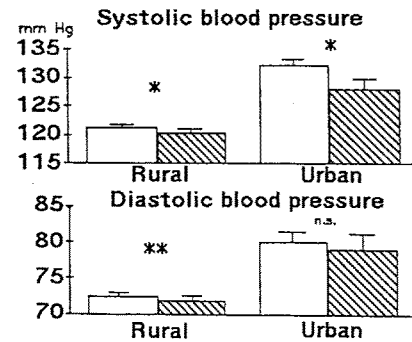
Figure 2. Comparison of systolic blood pressure and diastolic blood pressure of men (open bars) and women (dashed bars) in semi-nomadic and urban Oromos. Mean ± SEM is reported. *$p < 0.001$; **$p < 0.01$.

Table 3. Coefficients of correlation between systolic and diastolic blood pressure, body weight, and Quetelet index in the Oromo population

Group	Blood pressure	Body weight	Quetelet index
Semi-nomadic male (n = 2482)	Systolic	0.19[a]	0.18[a]
	Diastolic	0.14[a]	0.11[a]
Urban male (n = 257)	Systolic	0.49[a]	0.35[a]
	Diastolic	0.45[a]	0.33[a]
Semi-nomadic women (n = 2308)	Systolic	0.13[a]	0.9[a]
	Diastolic	0.13[a]	0.4[b]
Urban women (n = 92)	Systolic	0.26[b]	0.23[b]
	Diastolic	0.23[b]	0.22[b]

[a] $p < 0.001$.
[b] $p < 0.01$.

Discussion

This study is one of the largest carried out so far on blood pressure and hypertension prevalence in developing countries. With the exception of pregnant women, the population sample seems to be the most unselected possible in this setting and, therefore, the most representative of the entire Oromo population. In fact, the rural hospital where the study was carried out represents the only clinical resource for all the Oromos, providing facilities for children up to the elderly. For a semi-nomadic population, the study of accompanying persons may represent a more reliable approach than selecting among different groups of migrating or non-migrating people. The same approach seems to be valid for the urban population as the incidence of infectious diseases, and hence the hospitalization rate, overlaps that of semi-nomads. It is worthwhile noting that by following this sampling method the height and the age distribution within each age category was homogeneous for the two groups.

This study shows that: (1) hypertension prevalence is very low in semi-nomads and it strongly increases in the urban population, (2) a significant increase in average blood pressure levels occurs in the urban population in comparison with the semi-nomads, (3) in both populations, a direct relationship exists between blood pressure levels and body mass, and (4) blood pressure levels increase throughout all age groups in women but not in men.

It is interesting that in the semi-nomadic Oromo shepherds the prevalence of hypertension is very low compared not only with the Western world, but also with most developing countries. The 0.40% prevalence of hypertension in the rural Oromo population is even lower than the 0.82% recorded in another rural Ethiopian population, namely the Ethiopian Jews [10]. Differences in obesity prevalence might play a role. In fact, in other rural populations of East Africa, overweight subjects range between 9.6% and 11.8% [11], whereas they are virtually absent within the Oromo shepherds. Moreover, the prevalence of hypertension is much higher in other tribal popula-

tions of Africa in which it ranges between about 3% and 14.2% [11–15]. Hence, a striking difference in hypertension prevalence occurs among the different communities of Africa. The lowest prevalence is observed in Ethiopia [10] and generally in East Africa [11, 16], whereas the highest occurs in South and West Africa [3, 4, 7, 12, 13, 15]. Despite the 8-fold increase in comparison with the semi-nomadic population (from 0.40% to 3.15%), hypertension was at least three times less prevalent in the Oromo urban population than in other urban populations of developing countries, where it ranges between 9.9% and 28% [11–13]. A tentative explanation might be that Ethiopian towns, not massively involved in the process of technological modernization, still present a pre-industrial social and physical environment. The low prevalence of hypertension both in the rural and urban population might also be explained by the low salt and high potassium content of the typical Ethiopian diet [17] and the absence of renal diseases observed in other populations of Africa [12].

Another interesting result of this study is that blood pressure increases throughout the three age groups in the rural female population, but not in the semi-nomadic nor in the urban male populations. Unfortunately, urban women in the age group over 65 were not found, as jobs and a favourable environment are not available for them in the urban setting. This made it impossible to verify whether or not the same trend was present in urban women. The possible explanation for the rise in blood pressure observed in aging rural women might be, at least in older women, the hormonal rearrangement caused by menopause. The lack of any age-related increase of blood pressure both in semi-nomads and urbanized men is quite puzzling, especially in the latter. It is unlikely to reflect a selection factor associated with a reduced survival rate among men with relatively higher blood pressures because of the very low prevalence of hypertension and cardiovascular disease in the Oromos from all age groups. Instead, this behaviour of blood pressure in men seems to be attributable to the smaller increase of body weight with age and urbanization compared to women. A longitudinal study would better clarify these aspects but it seems that it would be quite impossible to carry this out in semi-nomads.

The relationship between body weight, Quetelet index and blood pressure levels is well established [18, 19] and, also, helps explain the higher blood pressure levels observed in the Oromo urban population. The increase in body weight of the urban population seems to be due to better nutrition. Both the higher average blood pressure and the greater prevalence of hypertension could be a simple consequence of greater body mass. Since a correlation between body weight and blood pressure is also present in the semi-nomadic population, it might be inferred that such parameters are linked by a precise and common

pathophysiological mechanism and not just by chance, as previously hypothesized by others [19]. Finally, it is important to point out that, for unknown reasons, blood pressure is not higher in the urban than in the corresponding rural population in all communities of Africa [12].

In conclusion, this study confirms the correlation between indices of body mass and blood pressure. However, the behaviour of blood pressure with age in men and the very low prevalence of hypertension are surprising and indicate that in developing countries these parameters are much more variable than in the Western world.

Acknowledgement

Appendix: The Oromo people and their food habits

The Oromos of the Arssi region belong to the Cushitic family and come from the Arabic peninsula (Aden Gulf) from which they migrated to Ethiopia about 2,000 years ago [20]. Though belonging to the black race, they do not have the facial characteristics of the African Kaffirs; they are of medium height with a lighter skin colour. The exact number of Oromos living in Ethiopia is unknown; it is estimated that they represent about 43% of the population with an urbanization rate of approximately 5%. The Oromos are nomads living mainly on the plateaus, exclusively on sheep-breeding. Animals represent for them not only social prestige but they also have a spiritual meaning, since they are sacrificed only during religious rituals or at important events such as weddings and funerals.

Oromos' staple food (both rural and urban) consists of: (1) 'kitta', a bread of Indian meal; (2) 'enset', a mash obtained from false banana leaves after a long process of extraction followed by a period of fermentation and consecutive cooking; and (3) 'injera', a sort of bread obtained from the teff flour (Eragrostis Teff), porous, mildly acidic, 2 cm thick, 55 cm in diameter, weighing 250 to 700 g. The teff is the most important cereal in Ethiopia and its use as staple food is restricted to this nation. This cereal was originally a wild plant (Eragrostis pilosa) consumed during periods of famine. The calorie content of these three basic foods has been established in previous studies [17].

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