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RESEARCH LETTER

Incidence of hypertension in Porto Alegre, Brazil: a population-based study

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Studies describing the incidence of hypertension in populations, particularly in individuals with pre-hypertension, are uncommon. In this population-based cohort study, we demonstrated that it was 39 cases per 1000 person-years among adults living in a large city in southern Brazil. Four out of five individuals in the age range of 40–49 years with pre-hypertension would have hypertension in 10 years.

Prevalence rates of hypertension vary from 1 to 65% worldwide.[1] In Brazil, about one-third of adult population has blood pressure equal to or greater than 140/90 mm Hg or is being treated for high blood pressure.[2,3] The incidence of hypertension, however, has been infrequently reported in developing countries. In Brazil, there is only one cohort study presenting the incidence of hypertension in tannery workers.[3]

The baseline evaluation of the participants of this population-based cohort was carried out from 1989 to 1991.[4,5] In total, 1089 individuals were interviewed at home, after obtaining informed consent. Assessment of demographic data, education (number of years at school), cigarette smoking, alcoholic beverage consumption and other characteristics was made with a structured and pre-tested questionnaire. The average daily alcohol intake was calculated, taking into account the concentration of ethanol in the beverages. Sitting blood pressure was measured twice in daily interviews after 5 min of rest, using periodically calibrated aneroid sphygmomanometers. Hypertension was defined as the average of two measurements equal to or greater than 140/90 mm Hg or use of blood pressure-lowering medication. The follow-up was conducted between 1996 and 1998, which localized 819 individuals of the original cohort. A total of 71 individuals had deceased and 199 were lost to follow-up. A new questionnaire was applied and the measurements carried out at the baseline visit were repeated. After excluding 227 who had hypertension in the first visit and two participants because of uncompleted blood pressure data, 589 individuals (77% of all 765 individuals with normal BP at baseline) were included in this analysis. The mean age of the individuals of the cohort of normotensive individuals was 38.5 ± 14.7 years. Most were women (56.7%) and whites (90%), with a body mass index (BMI) of $24.5 \pm 4.3\,kg/m^2$. They had an average education of 8.7 ± 3.7 years, and 11.7% used to consume more than 30 g of alcohol per day from alcoholic beverages. The proportion of current or past smokers was 51.8%.

During a mean follow-up period of 5.6 ± 1.1 years, generating 3254 person-years, 127 individuals developed hypertension, corresponding to a cumulative incidence of 21.6%. The incidence rate was 39 new cases per 1000 person-years. The incident rates by sex–age intervals are presented in Table 1. The incidence rate was higher in men aged less than 35 years and higher in women older than 55 years in comparison with the other gender at the same age stratum. The incidence in individuals with pre-hypertension irrespective of gender was 59 (56–61) cases per 1000 person-years. The incidence in individuals with pre-hypertension with 40–49 years of age at the baseline evaluation was 79 (74–83) cases per 1000 person-years. This incidence means that roughly 80 of 100 individuals of this age stratum with pre-hypertension would have hypertension in 10 years.

In a Cox regression hazard model, age (risk ratio (RR) 1.03, 95% CI 1.02–1.04) and waist/height index (RR 1.029, 1.002–1.057) were independently associated with the incidence of hypertension. The RR for BMI, replacing waist/height index in the model, was not significant (RR 1.04, 95% CI 0.99–1.09, $P = 0.066$). Only 27 (21.3%) of the subjects with hypertension diagnosed in the follow-up visit were taking blood pressure drugs, and 13 (48%) of those taking medication had blood pressure within the normal range.

Our investigation provided estimates for incidence of hypertension in a sample of adults of the general population of our city. The incidence increased up to 55 years of age and stabilized thereafter. The trends for men older than 55 years were similar to that observed in Framingham cohort,[6] but not for women of this age. In the Nurses Health Study,[7] the 4-year cumulative incidence of hypertension increased from 2.8% in women aged 35–39 years to 8.9% in women aged 55–59 years. The overall incidence rate of our study was higher than the incidence rate described in the Framingham Study[6] and other cohorts. The incidence of hypertension among individuals with pre-hypertension is noteworthy and quite similar to the incidence described in the TROPHY study.[8] In the placebo arm of this trial, 40% of pre-hypertensive individuals developed hypertension over 2 years of follow-up.

Table 1 Incidence of hypertension by 1000 person-years, stratified by gender and age intervals

Age at baseline	*Men (95% CI)*	*Women (95% CI)*	*Overall (95% CI)*
⩽35	32 (19–45)	12 (5–19)	22 (15–29)
36–45	44 (22–66)	40 (20–60)	42 (27–57)
46–55	74 (32–116)	64 (36–92)	68 (45–91)
>55	43 (13–73)	82 (48–116)	66 (42–90)
Overall	42 (32–53)	37 (28–46)	39 (32–46)

In our cohort, about 80% of the individuals aged 40–49 years would become hypertensive in 10 years, demonstrating that pre-hypertension is an age-dependent intermediate stage between normal blood pressure and fully established hypertension. Moreover pre-hypertension carries an independent risk for cardiovascular events.[9]

Among the known risk factors for hypertension, only waist/height ratio was associated with the incidence of hypertension, while BMI reached borderline significance. Excess of adiposity, particularly with a central distribution, has been recognized as a major cause of hypertension. We have previously demonstrated in this cohort that waist circumference was more consistently associated with the incidence of hypertension than the BMI,[5] and that the correction of waist by the stature of the individual increased its predictive performance.[10]

A consistent positive association between alcohol intake and blood pressure has been established in populations throughout the world.[11] In the baseline data of our study, we identified an association between alcohol consumption and blood pressure that was influenced by the time since the last alcohol intake.[4] The overall absence of longitudinal association between the consumption of ethanol and the incidence of hypertension observed in this report conceals a risk restricted to non-white individuals.[12] Only 21.3% of the subjects classified as hypertensive were taking blood pressure-lowering medication, and about a half of these individuals had controlled blood pressure. Therefore, only 10% of the participants with hypertension were adequately controlled, a figure that is worse than that presented in the United States and other countries.

Our study has some limitations that deserve to be addressed. The number of individuals lost to follow-up, who were younger than the individuals from the original cohort, may have overestimated the incidence of hypertension for the whole city. It did not influence, however, the risks for hypertension in older ages and particularly among individuals with pre-hypertension. Lack of statistical power may be responsible for the absence of some associations, such as the risk of alcohol consumption in white population and of fewer years of education.

In conclusion, we showed that the incidence of hypertension in a Brazilian population tends to be higher than that described in other countries. Most individuals with pre-hypertension would become hypertensive in 10 years, particularly in the age range of 40–49 years. Age and body waist/height ratio are independent risk factors for hypertension, and only a small proportion of the new cases of hypertension is adequately treated.

What is known about this topic

- The incidence of hypertension was scarcely described in developed countries and is unknown in developing countries.
- The diagnosis of pre-hypertension increases the risk for incident hypertension.
- Patients with hypertension are frequently under-diagnosed and under-treated.

What this study adds

- The incidence of hypertension in Brazil tends to be higher than the incidence described in developed countries.
- Most individuals with pre-hypertension would become hypertensive in 10 years, particularly at the age range of 40–49 years.
- Age and body waist/height ratio are independent risk factors for hypertension, and only a small proportion of the new cases of hypertension is adequately treated.

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References

1 Kearney PM, Whelton M, Reynolds K, Whelton PK, He J. Worldwide prevalence of hypertension: a systematic review. *J Hypertens* 2004; **22**: 11–19.

2 Fuchs FD, Moreira LB, Moraes RS, Bredemeier M, Cardozo SC. Prevalence of hypertension and associated factors in Porto Alegre: a population-based study. *Arq Bras Cardiol* 1995; **63**: 473–479.

3 Cordeiro R, Penaloza ER, Donalisio MR. Incidence of high blood pressure in a group of tannery workers in Brazil. *Cad Saude Publica* 2004; **20**: 1121–1124.

4 Moreira LB, Fuchs FD, Moraes RS, Bredemeier M, Duncan BB. Alcohol intake and blood pressure: the importance of time elapsed since last drink. *J Hypertens* 1998; **16**: 175–180.

5 Gus M, Fuchs SC, Moreira LB, Moraes RS, Wiehe M, Silva AF *et al.* Association between different measurements of obesity and the incidence of hypertension. *Am J Hypertens* 2004; **17**: 50–53.

6 Leitschuh M, Cupples LA, Kannel W, Gagnon D, Chobanian A. High-normal blood pressure progression to hypertension in the Framingham Heart Study. *Hypertension* 1991; **17**: 22–27.
7 Witteman JCM, Willett WC, Stampfer MJ, Colditz GA, Kok FJ, Sacks FM *et al.* Relation of moderate alcohol consumption and risk of systemic hypertension in women. *Am J Cardiol* 1990; **65**: 633–637.
8 Julius S, Nesbitt SD, Egan BM, Weber MA, Michelson EL, Kaciroti N *et al.*, for the Trial of Preventing Hypertension (TROPHY) Study Investigators. Feasibility of treating pre-hypertension with an angiotensin-receptor blocker. *N Engl J Med* 2006; **354**: 1685–1697.
9 Hsia J, Margolis KL, Eaton CB, Wenger NK, Allison M, Wu L *et al.*, Women's Health Initiative Investigators. Pre-hypertension and cardiovascular disease risk in the women's health initiative. *Circulation* 2007; **115**: 855–860.
10 Fuchs FD, Gus M, Moreira LB, Moraes RS, Wiehe M, Pereira GM *et al.* Anthropometric indices and the incidence of hypertension: a comparative analysis. *Obes Res* 2005; **13**: 1515–1517.
11 Beilin LJ, Puddey IB, Burke V. Lifestyle and hypertension. *Am J Hypertens* 1999; **12**: 934–945.
12 Steffens AA, Moreira LB, Fuchs SC, Wiehe M, Gus M, Fuchs FD. Incidence of hypertension by alcohol consumption: is it modified by race? *J Hypertens* 2006; **24**: 1489–1492.