Blood Pressure

ISSN: 0803-7051 (Print) 1651-1999 (Online) Journal homepage: www.tandfonline.com/journals/iblo20

Trends in hypertension prevalence (1990–2005) and mean blood pressure (1975–2005) in Portugal: a systematic review

Marta Pereira, Helena Carreira, Catarina Vales, Vânia Rocha, Ana Azevedo & Nuno Lunet

To cite this article: Marta Pereira, Helena Carreira, Catarina Vales, Vânia Rocha, Ana Azevedo & Nuno Lunet (2012) Trends in hypertension prevalence (1990–2005) and mean blood pressure (1975–2005) in Portugal: a systematic review, Blood Pressure, 21:4, 220-226, DOI: 10.3109/08037051.2012.666380

To link to this article: https://doi.org/10.3109/08037051.2012.666380

Blood Pressure, 2012; 21: 220–226

informa
healthcare

ORIGINAL ARTICLE

Trends in hypertension prevalence (1990–2005) and mean blood pressure (1975–2005) in Portugal: a systematic review

MARTA PEREIRA[1,2], HELENA CARREIRA[1,2], CATARINA VALES[1,2], VÂNIA ROCHA[1,2], ANA AZEVEDO[1,2] & NUNO LUNET[1,2]

[1]*Department of Clinical Epidemiology, Predictive Medicine and Public Health, University of Porto Medical School, Porto, Portugal; and* [2]*Institute of Public Health of the University of Porto (ISPUP), Porto, Portugal*

Abstract

Aims. We aimed to describe the temporal trends of the mean blood pressure and prevalence of hypertension in studies that evaluated Portuguese adults. *Methods.* Pubmed was searched and 42 eligible studies were identified. Reference screening and data extraction were conducted independently by two researchers. We fitted linear regression models to compute ecological estimates of hypertension prevalence and mean blood pressure, adjusting for sex, age and significant interaction terms. *Results.* Between 1990 and 2005, the prevalence of hypertension defined as blood pressure ≥ 140/90 mmHg and/or drug treatment remained approximately constant in young adults and decreased in middle-aged and older adults, whereas the prevalence of self-reported hypertension increased 0.4% per year (95% confidence interval 0.1–0.7) overall. Between 1975 and 2005, mean systolic and diastolic blood pressures decreased in middle-aged and older adults, reaching a 32-mmHg decrease in systolic blood pressure among women at average age 70. *Conclusion.* The trends in the last decades show a decrease in blood pressure levels, probably attributable to increasing awareness and a higher treatment proportion. Although this absolute trend in blood pressure parallels the observed in other high income European countries, Portugal maintains its position above the mean levels in other Western settings.

Key Words: *blood pressure, hypertension; Portugal, trends*

Introduction

Worldwide, 7.1 million deaths are attributable to hypertension each year (1). This modifiable risk factor is strongly associated with the risk of coronary heart disease (2), heart failure (3) and stroke (4), making it a leading cause of cardiovascular morbidity and mortality. Mortality by coronary and cerebrovascular diseases have been steadily declining in most developed countries (5) and the decrease in mean systolic blood pressure (SBP) is estimated to explain around 20% of the decline in coronary heart disease in the last quarter of the 20th century (6).

In Portugal, cardiovascular diseases were responsible for approximately one-third of all deaths in 2008 (7), but mortality rates have been decreasing since the mid 1970s (8). During the past 30 years, Portugal has been described as one of the countries with highest median blood pressure levels (9,10), and in 2003 three million adults (42.1%) had hypertension (11).

Data on trends of hypertension prevalence are important to predict the burden of cardiovascular outcomes as well as to understand the effect of determinants of hypertension and to monitor the impact of public health measures. The accurate estimation of the burden of hypertension and distribution of blood pressure in Portugal requires the best use of all available resources to obtain detailed information from different age groups and populations across the widest possible time span. This requires a comprehensive review and a synthesis of the results that takes into account methodological aspects such as the sampling strategy, selection and recruitment of participants, and the methods for assessment of hypertension, which may compromise the samples' representativeness and the studies' validity.

Correspondence: Marta Pereira, Department of Clinical Epidemiology, Predictive Medicine and Public Health, University of Porto Medical School, Al. Prof. Hernâni Monteiro, 4200-319 Porto, Portugal. Tel: +351 22 551 36 52. Fax: +351 22 551 36 53. E-mail: martasfp@med.up.pt

(Received 6 October 2011; accepted 12 January 2012)

ISSN 0803-7051 print/ISSN 1651-1999 online
DOI: 10.3109/08037051.2012.666380

We conducted a systematic review to critically summarize the evidence from studies that provide data on the distribution of blood pressure and hypertension in Portuguese adults, in order to analyze time trends.

Methods

The present systematic review was conducted as part of a more comprehensive review that addressed the distribution of six major cardiovascular risk factors, including diabetes mellitus, dyslipidemia, hypertension, obesity, physical inactivity and tobacco consumption, in Portuguese adults. The systematic review flowchart and a detailed description of the methodological characteristics and results of the studies considered in the systematic review, as well as their references, are presented in a Supplementary Appendix available online at http://www.informahealthcare.com/doi/abs/10.3109/08037051.2012.666380.

A Pubmed search was conducted, in January 2011, and 2887 publications were identified (Supplementary Appendix, Figure A1 available online at http://www.informahealthcare.com/doi/abs/10.3109/08037051.2012.666380). The reference lists of review articles addressing the distribution of cardiovascular risk factors were screened to identify potentially eligible original reports, adding 71 potentially relevant references to the original search. The current analysis only considers studies with data on hypertension.

Studies were excluded by *a priori* defined criteria: not written in Portuguese, English, Spanish, French or Italian; not involving humans (e.g. *in vitro* or animal research); case reports; editorials or comments; reports not providing data specifically for Portuguese subjects; studies not evaluating adult populations; studies evaluating samples of participants not expected to represent the general population regarding the frequency of the cardiovascular risk factors under study (e.g. subjects with diabetes, athletes, sedentary elderly); not presenting data on hypertension, mean SBP and/or diastolic blood pressure (DBP); not presenting data in an eligible format for extraction (e.g. studies that had Portuguese data but only presented it as joint estimates for Southern Europe); insufficient characterization of the methods (e.g. lack of information about the criteria for hypertension definition, not specifying the region where the sample was assembled). In case of multiple publications using data from the same sample, we considered the results provided in the analysis with the largest sample size or, in case of equal sample size, the one presenting more strata-specific information (e.g. sex and age stratification). The information on the study methods could be obtained from any of the publications referring to the same investigation.

For selection, studies were evaluated in three consecutive steps. In step 1, 1892 studies were excluded based on title and abstract assessment. When the abstract of a particular article was not available, the article was further assessed, except when the title unequivocally presented information for exclusion (e.g. case report). The full text of studies that were not excluded in the first step was then evaluated in step 2, applying the same criteria and 822 studies were excluded. In the third step, relevant data were extracted, with 161 further studies in which data were not presented in an eligible format being excluded. Of the remaining 88 studies, 46 presented exclusively data on other risk factors and we included in this systematic review 42 studies with data concerning hypertension (Supplementary Appendix, Figure A1 available online at http://www.informahealthcare.com/doi/abs/10.3109/08037051.2012.666380).

The decisions for studies' selection were made by two reviewers independently at all steps and the disagreements were discussed and resolved by consensus, involving a third researcher when necessary. The agreement between the reviewers increased with increasing available information, being 73.0%, 81.7% and 82.0%, in steps 1, 2 and 3, respectively.

Data from each report were extracted independently by two investigators and differences were resolved in consensus. To characterize the studies, we collected data on first author, year of publication, period of data collection, geographical coverage, population characteristics (e.g. general, primary health care users, volunteers, mixed), type of sampling (probability or non probability) and sample size. In studies presenting data from two or more regions independently, these were extracted separately. We also collected data on participants' sex and age. We extracted sex- and age-specific estimates of prevalence of hypertension and mean SBP and DBP, the source of this information (clinical records, physical measures, self-reported), the device used for blood pressure measurement, the number of measurements, the time of rest before the first measurement and between the measurements, the time of day and the criteria for hypertension definition. In an article that presented information about mean SBP and DBP at the first and third minutes after rest (12), we extracted the second evaluation. When data were presented only in graphics, we contacted the authors in order to obtain more reliable information. If no reply was obtained, we extracted data read from projection to axes, if possible; otherwise, the article was excluded since data were not presented in an eligible format. Data on prevalence of hypertension based on unknown criteria for its definition were not considered. We obtained age- and sex-specific estimates directly from the authors of five of the largest studies representing subjects within a wide age range (11,13–16).In order to summarize the evidence, when a study did not present the mean age of the participants in each stratum, we assumed it as

the mid-point of the age intervals. When an age group included subjects both aged less and more than 18 years (e.g. age group 17–20 years old), we excluded the data if the mid-point age was lower than 17.5 years old.

For analysis, because of the high heterogeneity of definitions of hypertension, we considered SBP/DBP $\geq$139/89mmHg and/or treated for hypertension, SBP/DBP $>$140/90 mmHg and/or treated for hypertension, and SBP/DBP $\geq$140/90 mmHg and/or in use of blood pressure lowering medication to be equivalent.

We fitted linear regression models to assess time trends in the prevalence of hypertension and mean blood pressure. Hypertension prevalence was analyzed using two dependent variables: objectively defined hypertension, defined as SBP/DBP $\geq$140/90 mmHg and/or drug treatment, and self-reported medical diagnosis of hypertension. In fitting models, we studied the role of age, sex and first-level interaction terms of survey year with sex and age. For mean DBP, we also included an interaction term of age as a continuous variable and age as dichotomous variable ($<$60 vs $\geq$60 years) to account for the fact that DBP increased with age up to 60 years and then decreased. The steps in model fitting are presented in Table I. For each outcome, we selected a final model including the year of the survey and the participants' age and sex, as well as the statistically significant interaction terms between the year of the survey and the participants' age or sex. When the outcome of interest was DBP, we also tested an interaction term between age and age group (using the age of 60 years as the cut-off) to account for the decrease in the mean DBP among the older subjects that is observed in Figure 2. Studies that did not present data stratified by sex were excluded from this analysis. As one or more estimates of the outcomes were extracted from each study, corresponding to different age strata, we analyzed them as a cluster defined by the identification of the study and computed robust standard error estimates. Given that the trends were confirmed to be linear and that the effect of time depends on age and sex, the most readable way of reporting trends was to provide an estimate from the adjusted models for two extreme calendar years in the range in which we found data for each outcome (1990 and 2005 for prevalence of hypertension and 1975 and 2005 for mean blood pressure) and at specific sex and age groups, covering young, middle-aged and older adults.

Results

We identified 42 studies eligible for the systematic review, of which 40 presented data on prevalence of hypertension and 13 on mean SBP and DBP.

The studies were published between 1974 and 2010, mostly covering only one region in the country (62%) and only seven using representative samples at national level, of which four were National Health Surveys. The samples were obtained from the general population in 14 studies, from primary health care centers users in 12 and from volunteers in seven. Data were obtained by physical measurement in 36 studies and self-report in 15. Of those that presented objectively defined hypertension, blood pressure was measured most frequently using a standard mercury sphygmomanometer (14 studies) and there was no information about the device used in 16 studies. Only three studies mentioned the time of the day when blood pressure was measured (two studies in the "morning" and one "all day") and 12 did not describe the number of measurements considered. Twelve studies did not present the results stratified by sex and 19 did not stratify the results by age groups (Supplementary Appendix, Table AI available online at http://www.informahealthcare.com/doi/abs/10.3109/08037051.2012.666380).

Prevalence of hypertension

In the 40 eligible studies with data on hypertension prevalence, 13 different criteria to define hypertension were reported (Supplementary Appendix, Table AII available online at http://www.informahealthcare.com/doi/abs/10.3109/08037051.2012.666380). The prevalence of hypertension defined as blood pressure $\geq$140/90 mmHg and/or drug treatment (10 studies) increased with age, both in men and women (Figure 1). The age- and year-adjusted prevalence was 6.8% (95% CI 0.7–12.2%) higher among men than women. Self-reported hypertension (seven studies) increased 0.7% (95% CI 0.6–0.9%) per year of age, independently of survey date and sex (Figure 1). The adjusted prevalence was 6.2% higher among women than men (95% CI 3.8–8.9%).

Between 1990 and 2005, the prevalence of objectively defined hypertension remained approximately constant in the younger adults, and decreased in middle-aged and older adults, reaching a decrease of 22% in 15 years, at average age 70 years. In the same period, the prevalence of self-reported hypertension increased 0.4% per year (95% CI 0.1–0.7%), adding up to a cumulative increase of 6.2% over the 15-year period (Table II).

Mean blood pressure

The variation of mean blood pressure with age is presented in Figure 2 (10 studies). While SBP increased linearly with age, DBP increased with age up to 60 years and then decreased.

Between 1975 and 2005, mean SBP decreased in men after middle-aged and in women at all ages (Table I), adding up to a cumulative decrease of 22 and 32 mmHg in SBP at average age 70 years, in men and women, respectively. DBP remained

Table I. Regression models for the variation of prevalence of hypertension (objectively measured and self-reported) and mean systolic (SBP) and diastolic blood pressure (DBP) with year of survey, taking into account participants' sex and average age.

	Constant	Year of survey β	*P*-value	Participants age (years) β	*P*-value	Participants sex[a] β	*P*-value	Age×year of survey β	*P*-value	Sex×year of survey β	*P*-value	Age×age 60[b] β	*P*-value	*R* squared
Prevalence of objectively defined hypertension[c] (10 studies, 77 estimates[d])														
Model 1	−2028.4	1.03	0.01											0.08
Model 2	130.2	−0.08	0.489	1.37	<0.001									0.84
Model 3	79.3	−0.05	0.698	1.37	<0.001	6.44	0.032							0.85
Model 4	**−3044.9**	**1.51**	**0.010**	**86.47**	**0.003**	**6.8**	**0.025**	**−0.04**	**0.003**					**0.87**
Model 5	−3266.3	1.62	0.001	88.52	0.001	253.23	0.619	−0.04	0.001	−0.12	0.629			0.87
Prevalence of self-reported hypertension (7 studies, 77 estimates[d])														
Model 1	−1268.1	0.65	0.001											0.05
Model 2	−813.9	0.4	0.011	0.74	<0.001									0.79
Model 3	**−825.9**	**0.41**	**0.012**	**0.74**	**<0.001**	**−6.16**	**0.002**							**0.83**
Model 4	−234.0	0.11	0.604	−11.18	0.382	−6.16	0.002	0.01	0.353					0.83
Model 5	−479.0	0.23	0.406	−11.22	0.384	480.44	0.233	0.01	0.354	−0.24	0.228			0.83
Mean SBP (10 studies, 89 estimates[d])														
Model 1	444.5	−0.16	0.1											0.02
Model 2	862.5	−0.38	0.001	0.68	<0.001									0.76
Model 3	863.2	−0.38	0.001	0.68	<0.001	0.2	0.922							0.76
Model 4	−1161.4	0.63	0.011	44.7	0.002	0.24	0.904	−0.02	0.002					0.85
Model 5	**−809.9**	**0.46**	**0.065**	**44.12**	**0.003**	**−656.44**	**<0.001**	**−0.02**	**0.003**	**0.33**	**<0.001**			**0.87**
Mean DBP (10 studies, 89 estimates[d])														
Model 1	313.2	0.12	0.114											0.06
Model 2	452.4	−0.19	0.009	0.23	0.008									0.47
Model 3	455.5	−0.19	0.008	0.23	0.008	0.84	0.385							0.47
Model 4	−969.5	0.52	0.023	31.2	0.002	0.87	0.255	0.02	0.003					0.7
Model 5	−904.0	0.49	0.05	31.1	0.003	−121.47	0.38	−0.02	0.003	0.06	0.375			0.7
Model 6	**−783.8**	**0.42**	**0.025**	**26.09**	**0.001**	**0.92**	**0.24**	**−0.01**	**0.001**			**−0.07**	**<0.001**	**0.74**

[a]Sex: women=0; men=1. [b]Age60:<60 years of age=0;≥60 years of age=1. [c]Defined as SBP/DBP≥140/90 mmHg or under drug treatment. [d]Age- and sex-specific estimates. For each outcome, the final model is presented in bold.

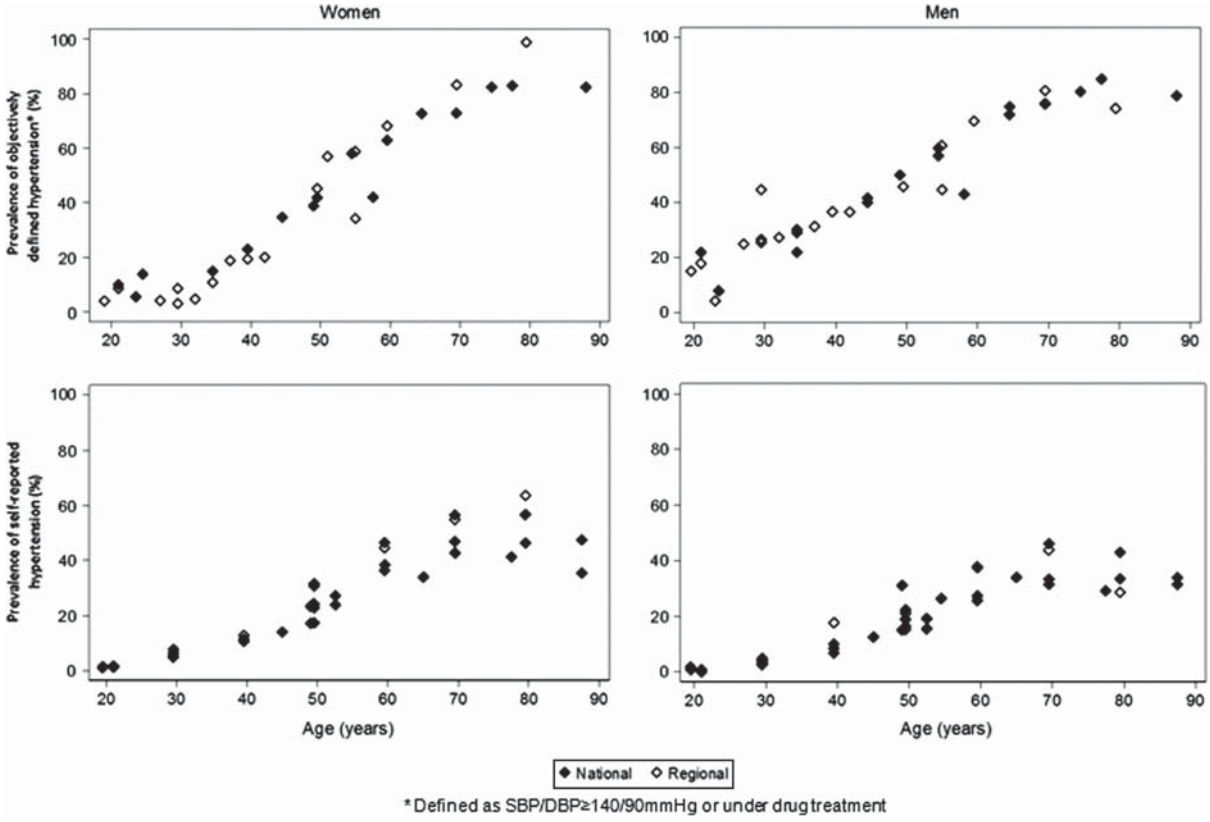

Figure 1. Prevalence of hypertension according to age, in men and women, by national or regional coverage.

approximately constant in young adults and decreased in middle-aged and older participants, up to 15 mmHg over the 30-year period, in older adults of both sexes (Table II).

Discussion

In Portugal, over the last 15 years, the prevalence of hypertension, defined as blood pressure ≥140/90 mmHg and/or drug treatment, remained stable in younger adults and decreased in middle-aged and older adults, whereas self-reported hypertension increased 6.2% in both sexes and all age groups. From 1975 to 2005, mean SBP decreased in men after middle-aged and women at all ages, reaching 32 mmHg at the average age of 70 years. DBP remained constant in younger adults and decreased in middle-aged and older adults, more strongly with advancing age.

Our results are consistent with studies of blood pressure trends in most developed countries, that observed a decrease in average SBP (17,18). A recent pooled analysis reported that average SBP decreased since 1980 in the world population, but trends varied significantly across regions and countries (9). Despite the heterogeneity of reported average annual trends in SBP among different populations, our estimate of the absolute change over time is within the range of most estimates from Western European countries (19). The increase in self-reported hypertension was already reported in other countries, both in men and women (19,20), and reflects higher awareness.

This review is to the best of our knowledge the most comprehensive analysis of estimates on hypertension prevalence and mean blood pressure in Portugal to date. The strengths of this study are the analysis of long-term trends of both prevalence (objectively measured and self-reported) and SBP and DBP, including as detailed description of the studies included as possible.

In general, the quality of the reporting options adopted in the primary sources of evidence was poor. The lack of important methodological information in many reports precluded an appropriate characterization of all studies (Supplementary Appendix, Table AI available online at http://www.informahealthcare.com/doi/abs/10.3109/08037051.2012.666380). Overall, we observed a considerable heterogeneity across the investigations, especially in methods for sample selection, target populations, methods for determining blood pressure and criteria for defining hypertension. For quantitative synthesis of data, we only included studies with estimates on hypertension defined as SBP/DBP ≥140/90 mmHg and/or drug treatment or self-reported, and that presented data stratified by sex. In most studies, hypertension was defined on the basis of blood pressure measurements taken in one visit, and thus the prevalence may have been overestimated, whereas in some others protocol details were not documented. We hypothesized that

Table II. Prevalence of hypertension and mean systolic (SBP) and diastolic blood pressure (DBP), estimated by linear regression models of individual stratum-specific estimates on sex, age and year of survey.

		Men			Women		
	Year	30 years	50 years	70 years	30 years	50 years	70 years
Prevalence of objectively defined hypertension[a], % (95% CI)	1990	20.2 (15.2–25.2)	58.3 (55.0–61.6)	96.4 (87.0–105.9)	13.4 (7.2–19.6)	51.5 (45.9–57.1)	89.6 (78.8–100.5)
	2005	23.7 (19.6–27.8)	49.1 (46.5–51.6)	74.5 (72.3–76.6)	16.7 (11.7–22.0)	42.3 (37.9–46.7)	67.6 (63.1–72.2)
Prevalence of self-reported hypertension, % (95% CI)	1990	0.8 (−3.2–4.9)	15.6 (10.9–20.2)	30.3 (24.0–36.7)	7.0 (5.0–8.9)	21.7 (18.4–25.1)	36.5 (30.9–42.1)
	2005	6.9 (5.5–8.3)	21.7 (19.4–24.0)	36.5 (31.8–41.2)	13.1 (10.5–15.7)	27.8 (24.4–31.3)	42.6 (37.0–48.2)
Mean SBP, mmHg (95% CI)	1975	122 (118–125)	145 (140–150)	168 (157–179)	127 (124–130)	151 (146–155)	174 (163–185)
	2005	126 (121–130)	136 (132–140)	146 (141–152)	121 (118–125)	132 (130–134)	142 (138–146)
Mean DBP, mmHg (95% CI)	1975	76 (72–80)	88 (86–89)	95 (91–98)	75 (70–80)	87 (85–89)	94 (91–97)
	2005	77 (75–79)	81 (79–83)	80 (79–82)	76 (74–78)	80 (78–82)	80 (77–82)

[a]Defined as SBP/DBP ≥ 140/90 mmHg or under drug treatment.
95% CI, 95% confidence interval.

studies on regional populations were more likely to have smaller samples and mostly from urban areas, and these factors would contribute to both random and systematic error. However, we found no differences between the estimates obtained from regional or national samples. We identified only one cross-sectional study reporting the prevalence of objectively defined hypertension in a representative sample of the Portuguese population, in 2003 (11). Given the high mortality from cerebrovascular disease in Portugal and being hypertension one of the main risk factors, good quality studies in representative samples of the country population should be performed over time.

The reliance on electronic literature search alone and utilization of one single search engine is an additional limitation of this study. However, publication bias should not be a major issue, because there was no analytical dimension in the hypothesis and successful publication likely does not depend on actual prevalence. We assumed that studies including larger samples and more thorough methods were more likely to be published in more highly ranked journals that are indexed in Medline. Additionally, inclusion of relevant studies identified in the bibliographic references of the review articles was important to identify older and non-Pubmed indexed publications.

Hypertension is involved in a complex web of causation, in which some factors are both its cause and consequence. Moreover, many of these risk factors interact with hypertension in the influence on cardiovascular risk. The lifestyle measures that are widely agreed to lower blood pressure are weight

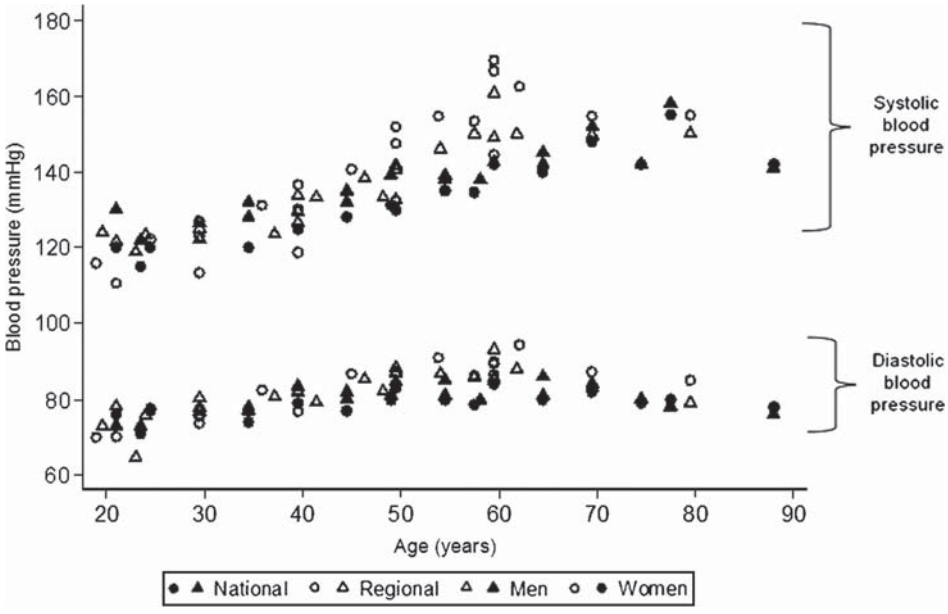

Figure 2. Mean values of systolic and diastolic blood pressure according to age, in men and women, by national or regional coverage.

reduction in the overweight or obese, moderation in alcohol consumption, physical activity, reduction of salt intake and increase in fruit and vegetables consumption (20). Despite the increasing awareness of the population to the problems caused by hypertension, this does not necessarily translate into healthier lifestyles. For instance, the mean body mass index increased approximately 0.5 kg/m^2 per decade in Western Europe, between 1980 and 2008, and specific data from Portugal followed the same trend (21). A report on food consumption in Porto, Portugal, reported that the adult population intakes about 9.2 g of salt per day (22), almost double the amount recommended by the World Health Organization (23). In 2009, a new public health law restricted the salt level in bread (24), but this law has not been implemented for long enough to be reflected in the overall levels of mean blood pressure in Portugal.

The trends in the last 15 years suggest that increasing awareness translates into a higher treatment proportion, resulting in a decrease in blood pressure level. Although Portugal is following the trends observed in other high-income European countries, further effort is needed because the parallel absolute trend in mean blood pressure results in Portugal maintaining its position above the mean levels in other Western European countries.

Acknowledgements

This study was funded by a grant from Fundação para a Ciência e a Tecnologia (PIC/IC/83006/2007)

Conflicts of interest: There are no conflicts of interest to disclose.

References

1. World Health Organization. Reducing risks, promoting healthy life. Geneva: WHO; 2002.
2. Kannel W, Schwartz M, McNamara P. Blood pressure and risk of coronary heart disease: The Framingham study. Dis Chest. 1969;56:43–52.
3. Tocci G, Sciarretta S, Volpe M. Development of heart failure in recent hypertension trials. J Hypertens. 2008;26:1477–1486.
4. MacMahon S, Peto R, Cutler J, Collins R, Sorlie P, Neaton J, et al. Blood pressure, stroke, and coronary heart disease. Part 1, Prolonged differences in blood pressure: Prospective observational studies corrected for the regression dilution bias. Lancet. 1990;335:765–774.
5. Levi F, Chatenoud L, Bertuccio P, Lucchini F, Negri E, La Vecchia C. Mortality from cardiovascular and cerebrovascular diseases in Europe and other areas of the world: An update. Eur J Cardiovasc Prev Rehabil. 2009;16:333–350.
6. Palmieri L, Bennett K, Giampaoli S, Capewell S. Explaining the decrease in coronary heart disease mortality in Italy between 1980 and 2000. Am J Public Health. 2010;100:684–692.
7. Instituto Nacional de Estatística. The demographic changes in Portugal. Lison: Instituto Nacional de Estatística; 2008.
8. European HFA Database [database on the Internet]; 2010.
9. Danaei G, Finucane M, Lin J, Singh G, Paciorek C, Cowan M, et al. National, regional, and global trends in systolic blood pressure since 1980: Systematic analysis of health examination surveys and epidemiological studies with 786 country-years and 5.4 million participants. Lancet. 2011;377:568–577.
10. The INTERSALT Co-operative Research Group. Appendix tables. Centre-specific results by age and sex. J Hum Hypertens. 1989;3:331–407.
11. Macedo M, Lima M, Silva A, Alcantara P, Ramalhinho V, Carmona J. Prevalence, awareness, treatment and control of hypertension in Portugal. The PAP study. Rev Port Cardiol. 2007;26:21–39.
12. Nogueira da Costa J, Ranchhod R, Braz Nogueira J, Leal da Costa L. Inquérito sobre hipertensão arterial em clínica geral (55.947 inquéritos). Rev Lat Cardiol. 1980;1:93–100.
13. Instituto Nacional de Estatística. Inquérito Nacional de Saúde 1995–1996. Instituto Nacional de Saúde Doutor Ricardo Jorge; 1997.
14. Instituto Nacional de Estatística. Inquérito Nacional de Saúde 1998–1999. Instituto Nacional de Saúde Doutor Ricardo Jorge; 2000.
15. Instituto Nacional de Estatística. Inquérito Nacional de Saúde 2005–2006. Instituto Nacional de Saúde Doutor Ricardo Jorge; 2009.
16. Pereira M, Azevedo A, Barros H. Determinants of awareness, treatment and control of hypertension in a Portuguese population. Rev Port Cardiol. 2010;29:1779–1792.
17. Lanti M, Menotti A, Nedeljkovic S, Nissinen A, Kafatos A, Kromhout D. Long-term trends in major cardiovascular risk factors in cohorts of aging men in the European cohorts of the Seven Countries Study. Aging Clin Exp Res. 2005;17:306–315.
18. Evans A, Tolonen H, Hense HW, Ferrario M, Sans S, Kuulasmaa K. Trends in coronary risk factors in the WHO MONICA project. Int J Epidemiol. 2001;30 Suppl 1:S35–40.
19. Tolonen H, Mahonen M, Asplund K, Rastenyte D, Kuulasmaa K, Vanuzzo D, Tuomilehto J. Do trends in population levels of blood pressure and other cardiovascular risk factors explain trends in stroke event rates? Comparisons of 15 populations in 9 countries within the WHO MONICA Stroke Project. World Health Organization Monitoring of Trends and Determinants in Cardiovascular Disease. Stroke. 2002;33:2367–2375.
20. Dickinson HO, Mason JM, Nicolson DJ, Campbell F, Beyer FR, Cook JV, et al. Lifestyle interventions to reduce raised blood pressure: A systematic review of randomized controlled trials. J Hypertens. 2006;24:215–233.
21. Finucane MM, Stevens GA, Cowan MJ, Danaei G, Lin JK, Paciorek CJ, et al. National, regional, and global trends in body-mass index since 1980: Systematic analysis of health examination surveys and epidemiological studies with 960 country-years and 9.1 million participants. Lancet. 2011;377:557–567.
22. Lopes C, Oliveira A, Santos A, Ramos E, Gaio A, Severo M, Barros H. Food consumption in Porto. Faculty of Medicine of the University of Porto;2006.
23. World Health Organization. Diet, nutrition and the prevention of chronic diseases. Report of a Joint WHO/FAO Expert Consultation; 2003.
24. Lei no. 75/2009 de 12 de Agosto: Estabelece normas com vista à redução do teor de sal no pão bem como informação na rotulagem de alimentos embalados destinados ao consumo humano. Diário da República; 2009.

Supplementary material available online

Supplementary Appendix