ISSN 0871-3413 • ©*ArquiMed*, 2008

Challenges for the Control of Hypertension at the Populational Level

Marta Pereira, Ana Azevedo
Serviço de Higiene e Epidemiologia, Faculdade de Medicina da Universidade do Porto; Unidade de Investigação e Desenvolvimento Cardiovascular do Porto; Instituto de Saúde Pública da Universidade do Porto (ISPUP)

Hypertension is a leading cause of cardiovascular morbidity and mortality and its prevention and appropriate treatment are the key components of the management of this condition. The authors briefly comment on main differences in the definition of hypertension and classification of blood pressure between guidelines for the management of this condition. Then, a critical review is offered on estimates of the prevalence, awareness, treatment and control of hypertension worldwide. Despite a large body of evidence on effective therapies with proven benefits, the proportion of hypertensive patients whose blood pressure is controlled is disappointingly low. The reasons for inadequate blood pressure control are complex and arise from a combination of factors mainly related to patients' and physicians' "inertia". It is unlikely that current management strategies will lead to major improvements. Time limitations, costs and other factors have been pointed out as reasons for the unfeasibility of a sustained closer follow-up with an improvement in patient-physician feedback and information exchange. Research is warranted for the identification of main barriers and usefulness of alternative strategies to improve blood pressure control, such as, for example, the effectiveness of involving other health professionals.
Key-words: hypertension; blood pressure; control; management; prevention; barriers.

ARQUIVOS DE MEDICINA, 22(4/5):147-53

Annually, approximately 7.1 million deaths are attributable to hypertension (HT) (1). It is a leading cause of cardiovascular morbidity and mortality and its prevention and appropriate treatment are the key components of the management of this condition (2,3).

The emergence of chronic diseases epidemiology, and particularly of cardiovascular epidemiology, after World War II, was followed by the development of effective pharmacologic treatments in the 1950s and their testing in randomized trials starting in the 1960s. Epidemiological research of cardiovascular diseases started in 1950 with the Framingham study (4) in the United States of America (USA) and later on with the multinational Seven Countries Study (5). The concept of multifactorial origin of coronary heart disease was proposed during the 1960s. The fields of HT epidemiology, treatment, and control in populations began to take their modern forms.

Numerous observational studies have demonstrated a strong association between high blood pressure (BP) and the risk of CHD (6,7). The relationship between BP and risk of CVD events is continuous, consistent and independent of other risk factors (8). This association exists for men and women, younger and older people, in all races (9). Hypertension is also a major risk factor for heart failure (10), peripheral arterial disease (11), stroke (6) and kidney disease (12).

In Portugal the number of individuals in whom HT should be prevented to avoid one case of CHD, according to the Framingham risk prediction models, is 15 among men and 25 among women (13).

DEFINITION OF HYPERTENSION AND CLASSIFICATION OF BLOOD PRESSURE

High BP is rarely the only risk factor for an outcome, but is almost always part of a multifaceted pattern of risk. Nonetheless, practitioners need precise criteria for the diagnosis of HT, even if arbitrary. To consider a BP of 138/88 mmHg as normal and not in need of treatment and one of 140/90 mmHg as abnormal and in need of treatment is obviously inappropriate, but medical practice requires decisional criteria to be used for workup and therapy.

The conceptual definition of HT incorporates the increased risk for cardiovascular diseases and should be based on benefits, risks, costs, death, disability and quality of life.

Guidelines for treatment of arterial HT were first published in 1977 (14), and were regularly updated since then. National and international guidelines have been increasingly standardized and unified in fewer versions. However, there still exist different definitions according to scientific societies (Table 1). In Europe, the currently used definition (2007 Guidelines for the management of arterial HT by The Task Force for the Management of Arterial Hypertension of the European Society of Hyper-

Table 1 - **Definition of hypertension according to three different societies.**

Guideline definition	2007 ESH/ESC		British Hypertension Society		JNC 7	
Blood pressure (mm Hg)	**Systolic**	**Diastolic**	**Systolic**	**Diastolic**	**Systolic**	**Diastolic**
Optimal	<120	<80	<120	<80	-	-
Normal	120-129	80-84	<130	<85	<120	<80
High normal	130-139	85-89	130-139	85-89	-	-
Pre-hypertension	-	-	-	-	120-139	80-89
Hypertension						
Grade 1 (mild)	140-159	90-99	140-159	90-99	140-159	90-99
Grade 2 (moderate)	160-179	100-109	160-179	100-109	≥160	≥100
Grade 3 (severe)	≥180	≥110	≥180	≥110	-	-
Isolated systolic hypertension	≥140	<90	-	-	-	-
Grade 1	-	-	140-159	<90	-	-
Grade 2	-	-	≥160	<90	-	-

ESH/ESC - European Society of Hypertension/European Society of Cardiology; JNC - Joint National Committee.

tension and of the European Society of Cardiology (2007 ESH/ESC) (15)) was retained from the previous version of the same document in 2003. The most recent USA recommendations are presented on The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7) (16). Within Europe, some countries have their own guidelines, such as the guidelines from the British Hypertension Society (17).

The main difference between existing guidelines is the name of categories and not the cut-off points. All definitions consider HT as systolic BP ≥140 and/or diastolic BP ≥90 mmHg, but the American guidelines abandoned the term “optimal” and included the term “pre-hypertension”. This new designation intended to disclose the recognition that early intervention by adoption of healthy lifestyles could reduce BP and decrease the rate of its progression to hypertensive levels in these individuals. This is based on the fact that even below categorical HT, subjects with high-normal BP (130–139 mmHg systolic and/or 85–89 mmHg diastolic) are at increased risk for CHD compared with those with optimal values (9,18,19). However, the most striking novelty in these recent guidelines is the focus on addressing total absolute cardiovascular risk more than looking only at the BP level.

FACTORS INFLUENCING BLOOD PRESSURE LEVEL

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 HT in the influence on cardiovascular risk. A number of important causal factors for HT have been identified, some of them modifiable but others not.

Age, a non-modifiable risk factor, is strongly associated with increasing BP. The prevalence of HT increases with advancing age to the point where more than half of people 60-69 years of age and approximately three-fourths of those 70 years of age and older are affected (20).

Substantial evidence documented that body weight is directly associated with BP and that excess body fat predisposes to HT (21). In a meta-analysis of randomized controlled trials, mean systolic and diastolic BP reductions associated with an average weight loss of 5.1 kg were 4.4 and 3.6 mmHg, respectively (22).

Some studies have shown a U- or J-shaped association of mortality with alcohol consumption, suggesting that low and moderate drinking results in a reduced mortality compared with non-drinkers, while heavy drinkers have a rising death rate (23). However, this relationship has recently been challenged, based on a meta-analysis, which showed a linear relationship between alcohol consumption, BP levels and prevalence of HT in populations (24).

Dietary salt intake is a contributor to BP elevation and therefore to the prevalence of HT (25,26). According to randomized controlled trials in hypertensive patients (27), reducing sodium intake by 4.7-5.8 g per day reduces BP by an average of 4-6 mmHg.

Lack of physical exercise is a strong predictor of car-

diovascular mortality, independently of BP and other risk factors (28). A recent meta-analysis concluded that dynamic aerobic endurance training reduces resting systolic and diastolic BP by 3.0/2.4 mmHg (29). Even moderate levels of exercise lower BP and contribute also to reduce other risk factors for cardiovascular diseases (30).

The nicotine in cigarette smoke acutely raises BP, even in addicted smokers (31). However, cross-sectional data on smokers and non-smokers are not consistent. Some studies find smokers to have a higher BP (32), whereas others find to have lower BP (33). Regardless of this putative effect, all smokers should be strongly advised to quit, because smoking is associated with multiple effects and contributes to major cardiovascular damage.

Multiple studies suggest that people exposed to repeated psychological stress may develop HT more frequently than would otherwise similar people who are not stressed (34). Exposure to major catastrophes, such as earthquakes and massive explosions, leads to higher levels of BP that may persist for months (35).

It has been clearly established that HT and diabetes (36) coexist more commonly than could be expected by chance. In patients with type 2 diabetes, almost all of whom are obese, HT is more common than among obese people without diabetes (35).

The prevalence of all the above-mentioned characteristics is high, so in order to prevent BP levels from rising, primary prevention measures should be introduced to reduce or minimize these causal factors in the population.

PREVALENCE OF HIGH BLOOD PRESSURE

Global assumptions about the prevalence of HT are difficult due to heterogeneity between countries. According to a systematic review of studies reporting data from 1980 to 2003, the overall worldwide prevalence of HT was approximately 26% in the adult population (37).

In the USA, the prevalence of HT has increased from 50 million in 1990 to 65 million in 2000 (38). Reported differences by gender and race are small. The increasing prevalence is primarily a consequence of trends for the population to become older and more obese, and of increasing survival of hypertensive patients as a result of improved lifestyles or more effective drug therapy.

Research from WHO MONICA Project found inverse trends in HT prevalence in a sample of 24 populations from different countries worldwide (39). The global analysis found that age-adjusted prevalence of HT decreased, during a 10-year period, from the mid-1980s to mid-1990s. This decrease is explained by the introduction of new drugs and non-pharmacological measures for the prevention and management of HT. However, this is not true for all countries. Finland, Poland, Russia, Germany, Italy are examples of countries with an increasing HT prevalence. The highest prevalence was reported in Finland among men and in Russia among women, while the lowest prevalence was found in Spain in both genders. It is very important to refer that the WHO MONICA Project sample mainly represents populations from developed countries.

Data from national surveys in six European countries (40), performed in the 1990s, using similar sampling and reporting techniques, estimated the prevalence of HT as 38% in Italy, 38% in Sweden, 42% in England, 47% in Spain, 49% in Finland and 55% in Germany. In Portugal, 3,311,830 people have HT (42.1%) (41).

As a result of progressive urbanization and westernization of lifestyles, developing countries are now undergoing an epidemiological transition. These changes are leading to a new epidemiological situation with a decline in infectious diseases and emergence of cardiovascular diseases. Good quality data on HT prevalence and incidence based on large population-based studies that use standardized and validated protocols are lacking for most developing countries. However, the reported HT prevalence was 27.2 in India (42), 40.6% in Syria (43), 23.9% among men and 13.7% among women in Vietnam (44) and 27.1% among men and 30.2% among women in Tanzania (45). These values are lower compared with HT prevalence in developed world, but the global tendency is for these values to increase (46).

Differences in HT prevalence are not only present between countries, but also between racial or ethnic groups. The prevalence among U.S. Blacks is higher than in Whites and Mexican-Americans in both genders and all ages (38). A systematic review including studies from 1995 to present confirms that in most studies HT was significantly higher in Blacks than Whites (47).

Although differences in prevalence between countries invite for immediate attempts of interpretation, several important questions remain. Survey data for HT are difficult to standardize, and mean differences in the range observed here might be artificial. However, the possibility that the pattern of bias would be completely regional seems remote.

AWARENESS OF HYPERTENSION

Early detection and adequate treatment of arterial HT improve prognosis and may contribute to cost containment for health care providers. The first barrier is that nearly one-half of hypertensive persons are unaware of their condition (39,48). This could reflect insufficient contact with health care professionals to allow an accurate diagnosis and communication of the findings to the person. In developing countries, contact between the health care system and the community is limited. Mass screening could provide a useful approach to increase awareness of the diagnosis but would have to be repeated frequently for sustained effects. Such screening should, additionally, be closely linked to diagnostic and treatment opportunities. In most developed societies, adults come in contact with the health care community and can have their BP measured on a relatively frequent basis. Under this circumstance, the challenge is that clinicians do not

disregard even slightly elevated BP and to ensure communication of the diagnosis in a way that the individual with HT can understand.

On the other hand, the initial step for optimal management of patients with arterial HT is the recognition and acceptance of updated recommendations by the physicians themselves. The translation from scientific data to improvement in patient care can be disturbed and interrupted in many ways. Compliance with guidelines by physicians is influenced by knowledge and acceptance of guidelines (guideline awareness) which may lead to changes in clinical practice. Some studies have evaluated the awareness of physicians in respect to arterial HT. In the Hypertension Evaluation Project (HEP) (49), only about a quarter of participating physicians had sufficient guideline conforming knowledge about diagnosis and treatment of arterial HT. Data of Hyman and Pavlik (50) showed that a substantial proportion of physicians would not start antihypertensive treatment unless the BP exceeded values of 160/95 mmHg, which is in contrast to the recommendations of the guidelines. These results suggest that further improvements in population HT control will require changes in physicians' behavior. Data support the hypothesis that the physician and his guideline awareness for the treatment process could be the origin of the unacceptable poor treatment results of patients with arterial HT, more than poor patient compliance.

Worldwide, patients' awareness of their HT varies from 25.2% to 75.0% (37), and in Portugal 46.1% are aware of their high BP (41).

TREATMENT AND CONTROL OF HYPERTENSION

After the right diagnosis and assessment, the next step should be the implementation of a correct treatment in order to achieve control. The primary goal of treatment is to achieve the maximum reduction in long-term total risk of cardiovascular morbidity and mortality. This requires, besides the appropriate treatment for raised BP *per se*, the treatment of all reversible risk factors identified, including smoking, dyslipidaemia, abdominal obesity and diabetes.

Epidemiological studies provide scientific evidence on the distribution and determinants of high BP, establish the role of high BP as a risk factor and quantify the potential value of treating and preventing HT in the general population. Clinical trials have established that BP reduction in people with HT reduces the risk of a variety of BP related endpoints (51-53). It is estimated that antihypertensive therapy has been associated with reductions in 30-40% in stroke incidence, 20-25% in myocardial infarction and >50% in heart failure (54). However, the proportion of treatment among hypertensives is very low. It ranges from 10.7% to 66% worldwide (37) and is 39.0% in Portugal.

The recent guidelines recommend rational combinations of antihypertensives and highlight the importance of lifestyle interventions (15,16). These should be implemented, whenever appropriate, in all patients, including subjects with high-normal BP and all patients who require drug treatment. Weight reduction (55), adoption of a healthy diet (56) (rich in fruits, vegetables and low-fat dairy products), sodium intake reduction (57), physical activity (58) and moderation of alcohol consumption (59) contribute to reduce BP. Adoption of these lifestyles may even decrease the number and doses of antihypertensive drugs and the overall cardiovascular risk. A large number of drugs are currently available to lower BP. More than two-thirds of hypertensive individuals cannot be controlled with only one drug and will require two or more antihypertensive agents selected from different drug classes (60). Lifestyle measures should never be abandoned with the initiation of drug treatment, especially in patients at high levels of risk.

The decision to start treatment should be based both on the level of systolic and diastolic BP and in the level of total cardiovascular risk. According to the 2007 ESH/ESC Guidelines (15), it is recommended that BP be lowered at least to below 140/90 mmHg in all hypertensive patients. However, treatment should be more aggressive in specific conditions, like in diabetics in whom the target BP is <130/80 mmHg.

Only a minority of hypertensive patients are effectively managed, suggesting that the guidelines are not being strictly followed, or the adherence to lifestyle changes and long-term compliance with multiple drugs are major problems. According to a recent systematic review that summarizes studies from 1980 through 2003 (37), the proportion of hypertensives that are controlled varies from 0.9% in Korea, 5.0% in Spain, 9.3% in the UK, 16.0% in Canada, 31.0% in the USA to 38.0% in Barbados. In Portugal 11.2% have their BP controlled (<140/90 mmHg) (41).

The low proportion of awareness by hypertensive subjects, the poor guideline awareness by physicians and non-compliance by patients may contribute significantly to these disappointing results, and explain why HT remains a leading cause of death worldwide.

SPECIFIC FEATURES OF PORTUGAL

Current international guidelines recommend that they should be adapted at national level, depending on local cultural background, socioeconomic situations, and heath care organization. *Sociedade Portuguesa de Hipertensão* has issued its own recommendations (61). Similarly to the European document, the authors emphasize the assessment of total absolute cardiovascular risk before prescription of individual treatment, modification of lifestyles before/with pharmacological treatment and the importance of follow-up of the patients. However, blood pressure categories are different from the 2007 ESH/ESC guidelines. The Portuguese guidelines recommend fewer categories, excluding "optimal blood pressure", "grade 3 hypertension" and "isolated systolic hypertension".

In Portugal, barriers that preclude an effective primary prevention, treatment and control of HT are mostly shared

by other societies, starting from an insufficient attention to health education by health care professionals, lack of access to places to engage in physical activity, increasing habits of eating out, large amounts of sodium added to foods by the food industry and restaurants, higher costs of food products that are poor in sodium and calories and lack of exercise programs in adolescence. Overcoming these barriers will require a large program directed not only at high-risk populations, but also to communities, schools, worksites, and the food industry.

The "National program for prevention and control of cardiovascular diseases" (62), emphasizes the need to inform and educate the population, to explain in a way that each person understands the message, allowing people to choose to adapt and take more healthy and desirable options within their own lifestyle. For HT, the aims are to increase the proportion of hypertensives diagnosed and controlled, by introducing technical guidelines, based on international consensus adopted by the scientific community on diagnosis and treatment of HT for health professionals, a self-help manual for surveillance and control of BP, for the hypertensive patient and to develop studies on prevalence, awareness and control of HT.

CONCLUSION

Despite a large body of evidence on effective therapies with proven benefits, the proportion of hypertensive patients whose BP is controlled is disappointingly low. The reasons for inadequate blood pressure control are complex and arise from a combination of factors mainly related to patients and physicians, eloquently referred to as patients' and physicians' "inertia". It is unlikely that current management strategies will lead to major improvements. Time limitations, costs and other factors have been pointed out as reasons for the unfeasibility of a sustained closer follow-up with an improvement in patient-physician feedback and information exchange. The importance of lifestyle modifications, which play a critical role in both prevention and treatment of HT, ends up disregarded in everyday practice essentially for the same reasons. Research is warranted for the identification of main barriers and usefulness of alternative strategies to improve BP control, such as, for example, the effectiveness of involving other health professionals (nurses, pharmacists).

REFERENCES

1 - World Health Report 2002: Reducing risks, promoting healthy life. Geneva, Switzerland: 2002.
2 - Rodgers A, Ezzati M, Vander Hoorn S, Lopez AD, Lin RB, Murray CJ. Distribution of major health risks: findings from the Global Burden of Disease study. PLoS Med 2004;1:e27.
3 - Ezzati M, Lopez AD, Rodgers A, Vander Hoorn S, Murray CJL. Selected major risk factors and global and regional burden of disease. Lancet 2002;360:1347-60.
4 - Dawber TR, Meadors GF, Moore FE, Jr. Epidemiological approaches to heart disease: the Framingham Study. Am J Public Health Nations Health 1951;41:279-81.
5 - Coronary heart disease in seven countries. I. The study program and objectives. Circulation 1970;41:I1-8.
6 - MacMahon S, Peto R, Cutler 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;335:765-74.
7 - Lawes CM, Vander Hoorn S, Rodgers A. Global burden of blood-pressure-related disease, 2001. Lancet 2008;371:1513-8.
8 - Stokes J, 3rd. , Kannel WB, Wolf PA, D'Agostino RB, Cupples LA. Blood pressure as a risk factor for cardiovascular disease. The Framingham Study--30 years of follow-up. Hypertension 1989;13:I13-8.
9 - Vasan RS, Larson MG, Leip EP, et al. Impact of high-normal blood pressure on the risk of cardiovascular disease. N Engl J Med 2001;345:1291-7.
10 - Tocci G, Sciarretta S, Volpe M. Development of heart failure in recent hypertension trials. J Hypertens 2008;26:1477-1486.
11 - Jager A, Kostense PJ, Ruhe HG, et al. Microalbuminuria and Peripheral Arterial Disease Are Independent Predictors of Cardiovascular and All-Cause Mortality, Especially Among Hypertensive Subjects: Five-year Follow-up of the Hoorn Study. Arterioscler Thromb Vasc Biol 1999;19:617-24.
12 - Klag MJ, Whelton PK, Randall BL, et al. Blood pressure and end-stage renal disease in men. N Engl J Med 1996;334:13-8.
13 - Frioes F, Azevedo A, Castro A, Alvelos M, Pimenta J, Vazquez B, Bettencourt P, Barros H. Impact of cardiovascular risk factors in an urban sample of Portuguese adults according to the Framingham risk prediction models. Rev Port Cardiol 2003;22:511-20.
14 - Report of the Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure. A cooperative study. JAMA 1977;237:255-61.
15 - Mancia G, De Backer G, Dominiczak A, et al. 2007 ESH-ESC Practice Guidelines for the Management of Arterial Hypertension: ESH-ESC Task Force on the Management of Arterial Hypertension. J Hypertens 2007;25:1751-62.
16 - Chobanian AV, Bakris GL, Black HR, et al. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC 7 report. JAMA 2003;289:2560-72.
17 - Williams B, Poulter NR, Brown MJ, et al. British Hypertension Society guidelines for hypertension management 2004 (BHS-IV): summary. BMJ 2004;328:634-40.
18 - Rodgers A, MacMahon S. Blood pressure and the global burden of cardiovascular disease. Clin Exp Hypertens 1999;21:543-52.
19 - Lewington S, Clarke R, Qizilbash N, Peto R, Collins R. Age-specific relevance of usual blood pressure to vascular mortality: a meta-analysis of individual data for one million adults in 61 prospective studies. Lancet 2002;360:1903-13.
20 - Burt VL, Whelton P, Roccella EJ, et al. Prevalence of hypertension in the US adult population. Results from the Third National Health and Nutrition Examination Survey, 1988-1991. Hypertension 1995;25:305-13.
21 - Stamler J. Epidemiologic findings on body mass and blood pressure in adults. Ann Epidemiol 1991;1:347-62.

22 - Neter JE, Stam BE, Kok FJ, Grobbee DE, Geleijnse JM. Influence of weight reduction on blood pressure: a meta-analysis of randomized controlled trials. Hypertension 2003;42:878-84.
23 - Jackson R, Stewart A, Beaglehole R, Scragg R. Alcohol consumption and blood pressure. Am J Epidemiol 1985;122:1037-44.
24 - Fillmore KM, Stockwell T, Chikritzhs T, Bostrom A, Kerr W. Moderate alcohol use and reduced mortality risk: systematic error in prospective studies and new hypotheses. Ann Epidemiol 2007;17:S16-23.
25 - Adrogue HJ, Madias NE. Sodium and potassium in the pathogenesis of hypertension. N Engl J Med 2007;356:1966-78.
26 - Law MR. Epidemiologic evidence on salt and blood pressure. Am J Hypertens 1997;10:42S-45S.
27 - Dickinson HO, Mason JM, Nicolson DJ, et al. Lifestyle interventions to reduce raised blood pressure: a systematic review of randomized controlled trials. J Hypertens 2006;24:215-33.
28 - Sandvik L, Erikssen J, Thaulow E, Erikssen G, Mundal R, Rodahl K. Physical fitness as a predictor of mortality among healthy, middle-aged Norwegian men. N Engl J Med 1993;328:533-7.
29 - Cornelissen VA, Fagard RH. Effects of endurance training on blood pressure, blood pressure-regulating mechanisms, and cardiovascular risk factors. Hypertension 2005;46:667--75.
30 - Fagard RH. Exercise characteristics and the blood pressure response to dynamic physical training. Med Sci Sports Exerc 2001;33:S484-92; discussion S493-4.
31 - Groppelli A, Giorgi DM, Omboni S, Parati G, Mancia G. Persistent blood pressure increase induced by heavy smoking. J Hypertens 1992;10:495-9.
32 - Poulsen PL, Ebbehoj E, Hansen KW, Mogensen CE. Effects of smoking on 24-h ambulatory blood pressure and autonomic function in normoalbuminuric insulin-dependent diabetes mellitus patients. Am J Hypertens 1998;11:1093--9.
33 - Bolinder G, de Faire U. Ambulatory 24-h blood pressure monitoring in healthy, middle-aged smokeless tobacco users, smokers, and nontobacco users. Am J Hypertens 1998;11:1153-63.
34 - Peters JL, Kubzansky L, McNeely E, et al. Stress as a potential modifier of the impact of lead levels on blood pressure: the normative aging study. Environ Health Perspect 2007;115:1154-9.
35 - Gerin W, Chaplin W, Schwartz JE, et al. Sustained blood pressure increase after an acute stressor: the effects of the 11 September 2001 attack on the New York City World Trade Center. J Hypertens 2005;23:279-84.
36 - Schutta MH. Diabetes and hypertension: epidemiology of the relationship and pathophysiology of factors associated with these comorbid conditions. J Cardiometab Syndr 2007;2:124-30.
37 - Kearney PM, Whelton M, Reynolds K, Whelton PK, He J. Worldwide prevalence of hypertension: a systematic review. J Hypertens 2004;22:11-9.
38 - Fields LE, Burt VL, Cutler JA, Hughes J, Roccella EJ, Sorlie P. The burden of adult hypertension in the United States 1999 to 2000: a rising tide. Hypertension 2004;44:398-404.
39 - Antikainen RL, Moltchanov VA, Chukwuma C, et al. Trends in the prevalence, awareness, treatment and control of hypertension: the WHO MONICA Project. Eur J Cardiovasc Prev Rehabil 2006;13:13-29.
40 - Wolf-Maier K, Cooper RS, Banegas JR, et al. Hypertension Prevalence and Blood Pressure Levels in 6 European Countries, Canada, and the United States. JAMA 2003;289:2363-9.
41 - Macedo ME, Lima MJ, Silva AO, Alcantara P, Ramalhinho V, Carmona J. Prevalence, awareness, treatment and control of hypertension in Portugal: the PAP study. J Hypertens 2005;23:1661-6.
42 - Kaur P, Rao TV, Sankarasubbaiyan S, et al. Prevalence and distribution of cardiovascular risk factors in an urban industrial population in south India: a cross-sectional study. J Assoc Physicians India 2007;55:771-6.
43 - Maziak W, Rastam S, Mzayek F, Ward KD, Eissenberg T, Keil U. Cardiovascular health among adults in Syria: a model from developing countries. Ann Epidemiol 2007;17:713-20.
44 - Hoang VM, Byass P, Dao LH, Nguyen TK, Wall S. Risk factors for chronic disease among rural Vietnamese adults and the association of these factors with sociodemographic variables: findings from the WHO STEPS survey in rural Vietnam, 2005. Prev Chronic Dis 2007;4:A22.
45 - Bovet P, Ross AG, Gervasoni JP, et al. Distribution of blood pressure, body mass index and smoking habits in the urban population of Dar es Salaam, Tanzania, and associations with socioeconomic status. Int J Epidemiol 2002;31:240-7.
46 - Mensah GA. Epidemiology of stroke and high blood pressure in Africa. Heart 2008;94:697-705.
47 - Kurian AK, Cardarelli KM. Racial and ethnic differences in cardiovascular disease risk factors: a systematic review. Ethn Dis 2007;17:143-52.
48 - Burt VL, Cutler JA, Higgins M, et al. Trends in the prevalence, awareness, treatment, and control of hypertension in the adult US population. Data from the health examination surveys, 1960 to 1991. Hypertension 1995;26:60-9.
49 - Hagemeister J, Schneider CA, Barabas S, et al. Hypertension guidelines and their limitations--the impact of physicians' compliance as evaluated by guideline awareness. J Hypertens 2001;19:2079-86.
50 - Hyman DJ, Pavlik VN. Self-reported hypertension treatment practices among primary care physicians: blood pressure thresholds, drug choices, and the role of guidelines and evidence-based medicine. Arch Intern Med 2000;160:2281--6.
51 - Kostis JB, Davis BR, Cutler J, et al. Prevention of heart failure by antihypertensive drug treatment in older persons with isolated systolic hypertension. SHEP Cooperative Research Group. JAMA 1997;278:212-6.
52 - Psaty BM, Lumley T, Furberg CD, et al. Health Outcomes Associated With Various Antihypertensive Therapies Used as First-Line Agents: A Network Meta-analysis. JAMA 2003;289:2534-2544.
53 - Prevention of stroke by antihypertensive drug treatment in older persons with isolated systolic hypertension. Final results of the Systolic Hypertension in the Elderly Program (SHEP). SHEP Cooperative Research Group. JAMA 1991;265:3255-64.
54 - Neal B, MacMahon S, Chapman N. Effects of ACE inhibitors, calcium antagonists, and other blood-pressure-lowering drugs: results of prospectively designed overviews of randomised trials. Blood Pressure Lowering Treatment Trialists' Collaboration. Lancet 2000;356:1955-64.
55 - He J, Whelton PK. Epidemiology and prevention of hypertension. Med Clin North Am 1997;81:1077-97.

56 - Sacks FM, Svetkey LP, Vollmer WM, et al. Effects on blood pressure of reduced dietary sodium and the Dietary Approaches to Stop Hypertension (DASH) diet. DASH-Sodium Collaborative Research Group. N Engl J Med 2001;344:3-10.
57 - Sacks FM, Svetkey LP, Vollmer WM, et al. Effects on Blood Pressure of Reduced Dietary Sodium and the Dietary Approaches to Stop Hypertension (DASH) Diet. N Engl J Med 2001;344:3-10.
58 - Whelton SP, Chin A, Xin X, He J. Effect of aerobic exercise on blood pressure: a meta-analysis of randomized, controlled trials. Ann Intern Med 2002;136:493-503.
59 - Xin X, He J, Frontini MG, Ogden LG, Motsamai OI, Whelton PK. Effects of alcohol reduction on blood pressure: a meta-analysis of randomized controlled trials. Hypertension2001;38:1112-7.
60 - Materson BJ, Reda DJ, Cushman WC, et al. Single-drug therapy for hypertension in men. A comparison of six antihypertensive agents with placebo. The Department of Veterans Affairs Cooperative Study Group on Antihypertensive Agents. N Engl J Med 1993;328:914-21.
61 - Polonia J, Ramalhinho V, Martins L, Saavedra J. Portuguese Society of Cardiology recomendations, assessment and treatment of hypertension. Rev Port Cardiol 2006;25:649--60.
62 - Direcção Geral da Saúde. Programa Nacional de Prevenção e Controlo das Doenças Cardiovasculares. Ministério da Saúde; 2006.

Correspondência:
Dr.ª Marta Pereira
Serviço de Higiene e Epidemiologia
Faculdade de Medicina da Universidade do Porto
Alameda Prof. Hernâni Monteiro
4200-319 Porto

e-mail: martasfp@med.up.pt