European Journal of Epidemiology (2005) 20: 421–427
DOI 10.1007/s10654-005-1752-x

Marital differences in blood pressure and the risk of hypertension among Polish men

Anna Lipowicz & Monika Lopuszanska
Institute of Anthropology, Polish Academy of Sciences, Wrocław, Poland

Accepted in revised form 2 February 2005

Abstract. The aim of the study was to evaluate the relationship between marital status and blood pressure, and to assess the risk of hypertension in adult Polish men, after adjustment for BMI. Material comprised the data of 2,271 healthy men, aged 25–60, occupationally active inhabitants of Wroclaw (south-western Poland). Arterial hypertension was diagnosed when systolic blood pressure (SBP) ≥140 mm Hg and/or diastolic blood pressure (DBP) ≥90 mm Hg. The following categories of marital status and educational level were applied: never married vs. currently married, and well-educated vs. poorly educated, respectively. The data on lifestyle elements were obtained from questionnaires. Multifactorial analyses of covariance (ANCOVA) were used to compare mean values of SBP and DBP in married vs. never married in subsequent age categories with BMI as a covariate. Independent effects of marital status, life-style variables and body mass index (BMI) on the risk of hypertension in men were analysed using the multifactorial models of logistic regression. In our analysis an interesting epidemiological phenomenon was observed. Never married men had on average higher SBP and DBP than married men. Never married had also a higher risk of hypertension when compared to married men, even when adjusted for different demographic, socio-economic, life-style variables, and even that never married men had lower BMI than married subjects. Marital differences in psychological status (prolonged stress and low social support), dietary intake (mainly sodium and potassium intake) and economic aspects of living alone are suggested as factors, which might explain at least partly the marital diversity in blood pressure and the risk of hypertension in men.

Key words: Blood pressure, Body mass index, Hypertension, Marital status, Men

Introduction

Hypertension is commonly known to have unfavourable effects on health status. First of all, the elevated blood pressure significantly accelerates the progression of atherosclerosis within various body regions (heart, brain, kidneys, etc.), promoting the development of such diseases as heart failure, renal failure or stroke [1, 2]. It is estimated that arterial hypertension constitutes a significant etiological factor of more than 50% of all-caused deaths [3].

In most cases (more than 90%) the aetiology of hypertension is unknown (i.e. essential or primary arterial hypertension). In cases of secondary hypertension, elevated blood pressure can result from kidney dysfunction, endocrine disturbances, pregnancy, aorta coarctation, to name but a few [4].

Furthermore, there is substantial evidence on the relationships between blood pressure and several social and psychological factors, including lifestyle elements. First of all, a strong linear relationship between body mass and blood pressure has been demonstrated in Westernized populations [5, 6]. Simultaneously, taking into consideration an unquestionable relationship between body mass and lifestyle behaviours [7], an evident influence of lifestyle behaviours on blood pressure also has been observed [8].

From social and psychological factors linked to the increased risk of cardiovascular diseases, there is substantial evidence on unemployment, low occupational status, social alienation, personal vulnerabilities, depression and anxiety, acute and chronic stress [9, 10].

The aim of the present study was to investigate the relationship between marital status and blood pressure, and to assess the risk of hypertension in Polish men aged 25–60, after adjustment for BMI.

Material and methods

In this analysis a part of the very large data set collected by the Silesian Centre for Preventive Medicine (DOLMED) in the course of screening health surveys of adult commissioned by employers was used. The surveys have been conducted routinely since the early 1980s. From the paper archives of DOLMED persons examined between 1983 and 1993 were selected. The sample consisted of 2,271 men, 25–60 years of

age, who were free from overt disease and who were occupationally active inhabitants of Wroclaw, in south-western Poland.

Systolic and diastolic blood pressure (SBP, DBP) was measured twice in the sitting position using an MPC-350 apparatus; the subsequent two readings were averaged for the data analyses. Following the recommendations of the Sixth Joint National Committee on the Detection, Evaluation, and Treatment of High Blood Pressure [11], arterial hypertension was diagnosed when SBP ≥40 mm Hg and/or DBP ≥90 mm Hg. Because 'trends in hypertension prevalence are difficult to assess because of a massive increase in the prevalence of antihypertensive treatment' [12], men taking anti-hypertensive medications were excluded from the analyses. Height and weight were measured, and the body mass index (BMI, weight/height^2) was calculated. Three categories were applied: (1) normal men – BMI <25; (2) overweight men – BMI ≥25 and <30; (3) obese men – BMI ≥30 [13].

Only two categories of marital status were analysed: never married (n = 1220) and currently married men (n = 1051). To avoid the confusion associated with marital history, previously married men (separated, divorced and widowed) were excluded from the analysis. Lack of information on their loneliness period did not allow assessing the real importance of having a spouse for the health status. These data do not present a real proportion of never married and married men in subsequent age groups. As a result of i.a. late marriages and higher rates of mortality among those living alone, the number of single men decreases in a general population during a life-span [14]. For example, in 1988, 74.8% of men aged 20–24 were single, whereas among 45–59-year-old men only 5.8% were never married [15]. Additionally, higher rates of disabilities among older singles [16] excluding them from the labour market could bear responsibility for their minority in this material. Because of significant surplus of married men in the population only part of them got into the collection. Therefore, the material was gathered as a case–control study in order to reach the more or less equal number in marital-age groups.

In the analyses two categories of educational level were applied: (1) men well educated (12 or more years at school) and (2) men poorly educated (less than 12 years at school). These two educational groups approximated two broad occupational categories, i.e. (1) professionals and non-manual workers, and (2) skilled and unskilled manual workers, respectively. Examined subjects were divided into four age groups, namely men aged 25–30, 31–40, 41–50 and 51–60.

For the description of alcohol consumption the following categories were used: (1) 'non-drinkers' (including former drinkers), (2) 'moderate drinkers' (at least once a month) and 'heavy drinker' (at least once a week). Taking the cigarette smoking into consideration, men were divided into the following groups: (1) 'never smokers', (2) 'former smokers' and (3) 'current smokers'. Following the level of physical activity in the leisure time, men were classified as those of: (1) 'no physical activity', (2) 'irregular physical activity' (1–3 h/week) and (3) 'regular physical activity' (more than 3 h/week).

Multifactorial analyses of covariance (ANCOVA) were used to compare SBP and DBP in married vs. never married men in subsequent age categories, with BMI as a covariate. Two analyses were computed, for SBP and DBP, respectively. The significance of marital differences in SBP and DBP with regard to educational level in particular age groups was assessed with *t*-tests for independent samples. Probability levels $p < 0.05$ were considered significant.

The logistic regression model was used to determine the associations between marital status, life-style variables and BMI, and the risk of hypertension in examined men. Categories: married, well-educated, age-group 25–30 years, never smokers, non-drinkers, regular physical activity were chosen as reference categories. The regression coefficients of variables and their standard errors were used to calculate the odds ratios (OR) with 95% confidence intervals (CI). Maximum likelihood ratio test was used to assess the fitness of the constructed models to the empirical data. The analyses were based on the case–control methodology, so the intercept coefficients were not interpreted in this paper.

The STATISTICA 6.0 package was used for all analyses.

Results

Table 1 shows the distribution of background characteristics and life-style behaviours for each marital category. In this study, married men were somewhat better educated than never married men. Different pattern in life-style elements between never married vs. married men was observed. Married men more often quitted smoking, in contrast, single men more often never smoked. The prevalence of alcohol drinking was comparable among single and married men, but single men more often drank heavily. Married men took less exercise in their leisure time than never married. Married men were more likely to be overweight or obese than never married individuals.

The numbers of individuals, BMI-adjusted means and standard errors of SBP and DBP are presented in Tables 2 and 3. The marital differences in SBP and DBP among 25–30-year-old men were small and not significant. However, the differences in SBP and DBP between single and married men increased with age and became significant (in particular for SBP) in men

Table 1. The distribution of background characteristics for never married and married men from Poland

	Never married	Married	*p*
N	1220	1051	
Level of education (%):			
Well-educated	47.58	50.24	
Poorly educated	52.42	49.76	
Cigarette smoking (%):			
Never smokers	28.35	21.22	***
Former smokers	12.90	18.84	**
Current smokers	58.75	59.94	
Alcohol consumption (%):			
Non-drinkers	18.10	17.42	
Moderate drinkers	47.20	54.61	***
Heavy drinkers	34.70	27.97	***
Physical activity (%):			
No physical activity	44.89	56.14	***
Irregular physical activity	25.54	13.04	***
Regular physical activity	29.57	30.82	
BMI (%)			
–24.99	63.81	44.62	***
25.00–29.99	28.32	43.87	***
30.00–	7.87	11.51	***

$^{**}p < 0.01$; $^{***}p < 0.001$; level of significance of differences between two groups of men.

aged 51–60. Regardless of the educational level, never married men aged respectively 31–40, 41–50 and 51–60 had higher values of SBP and DBP than married men in analogous age groups.

The results of covariance analyses are summarised in Table 4. There were significant relationships between marital status, and both SBP and DBP. Beside BMI, marital status was the most important predictor of SBP. Additionally, education and age were significantly related to SBP. Aside from BMI and age, marital status significantly affected DBP, whereas educational level was not related to DBP. Only age and marital status showed a significant interaction for both SEP and DBP.

Table 5 presents the estimated coefficients β, odds ratios (OR) and 95% confidence intervals (95% CI) of the multiple logistic regression. The model included demographic variables, life-style variables and BMI, in order to investigate whether there is any relationship between marital status and the risk of hypertension in men. Single men had a significantly higher risk of hypertension than married men. Also age and educational level affected the incidence of hypertension in examined men. Each decade of life increased the risk of hypertension by 38%. Poorly educated men had higher risk of hypertension than well educated men. Current smoking, alcohol drinking and the lack of leisure physical activity were not significantly associated with the risk of hypertension. However, each 1-point increase in BMI was related to a 12% greater risk of hypertension.

Table 2. Sample sizes (N), BMI-adjusted means and standard errors (SE) of systolic blood pressure in adult Polish men

		Age groups, years											
		25–30			31–40			41–50			51–60		
		Never married	Married	*p*	Never married	Married	*p*	Never married	Married	*p*	Never married	Married	*p*
Well-educated	Mean ± SE	132.4 ± 1.01	130.7 ± 1.69	NS	136.2 ± 1.31	132.0 ± 1.24	NS	135.4 ± 2.10	129.2 ± 1.59	*	146.6 ± 2.6	137.7 ± 1.55	***
	N	297	103		170	188		66	115		43	122	
Poorly educated	Mean ± SE	135.5 ± 1.05	135.3 ± 1.72	NS	139.0 ± 1.09	134.0 ± 1.26	**	144.2 ± 1.84	136.3 ± 1.53	**	150.6 ± 2.93	139.7 ± 1.59	***
	N	268	99		249	182		86	124		34	117	
Total	Mean ± SE	133.9 ± 0.74	132.9 ± 1.21	NS	137.9 ± 0.84	133.0 ± 0.89	**	140.4 ± 1.39	132.9 ± 1.11	***	148.4 ± 1.96	138.6 ± 1.12	***
	N	565	202		420	370		152	239		77	239	

NS – not significant; $^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$; (Fisher test).

Table 3. Sample sizes (N), BMI-adjusted means and standard errors (SE) of diastolic blood pressure in adult Polish men

		Age groups, years											
		25–30			31–40			41–50			51–60		
		Never married	Married	*p*	Never married	Married	*p*	Never married	Married	*p*	Never married	Married	*P*
Well-educated	Mean ± SE	79.9 ± 0.58	79.9 ± 0.96	NS	82.9 ± 0.75	82.1 ± 0.71	NS	85.3 ± 1.20	82.1 ± 0.91	NS	90.1 ± 1.49	86.6 ± 0.89	*
	N	297	103		170	188		66	115		43	122	
Poorly educated	Mean ± SE	81.1 ± 0.60	81.3 ± 0.98	NS	84.9 ± 0.62	82.6 ± 0.72	NS	88.1 ± 1.05	83.4 ± 0.88	**	88.0 ± 1.67	84.8 ± 0.91	NS
	N	268	99		249	182		86	124		34	117	
Total	Mean ± SE	80.4 ± 0.42	80.6 ± 0.69	NS	84.0 ± 0.48	82.4 ± 0.51	NS	86.9 ± 0.79	82.8 ± 0.63	***	89.2 ± 1.11	85.7 ± 0.64	**
	N	565	202		420	370		152	239		77	239	

NS – not significant; ***$p < 0.001$; **$p < 0.01$; *$p < 0.05$; (Fisher test).

Table 4. Results of the analyses of covariance (ANCOVA) of the systolic and diastolic blood pressure in Polish men aged 25–60

	Df	*F*	*p*
Systolic blood pressure			
Main effects:			
BM1	1	104.36	< 0.001
Age	3	19.23	< 0.001
Marital status	2	42.94	< 0.001
Education	1	25.54	< 0.001
Interactions:			
Age × marital status	3	4.75	0.003
Age × education	3	2.14	0.093
Marital status × education	1	0.21	0.644
Age × marital status × education	3	0.27	0.847
Diastolic blood pressure			
Main effects:			
BMI	1	149.03	< 0.001
Age	3	32.18	< 0.001
Marital status	1	19.49	< 0.001
Education	1	1.87	0.172
Interactions:			
Age × marital status	3	4.49	0.004
Age × education	3	2.21	0.085
Marital status × education	1	0.31	0.579
Age × marital status × *education*	3	0.42	0.735

Table 5. The estimated coefficients β, odds ratios (OR) and 95 % confidence intervals (95% CI) in the multiple logistic regression model estimating the probability of hypertension in Polish men aged 25–60

	β	OR	95% CI
Demographic variables:			
Marital status	0.458	1.58***	1.31–1.91
Age	0.322	1.38***	1.26–1.52
Education	0.357	1.43***	1.19–1.71
Life-style variables:			
Cigarette smoking	−0.046	0.95	0.79–1.15
Alcohol drinking	0.016	1.01	0.81–1.28
Physical activity	−0.028	0.97	0.81–1.16
BMI	0.116	1.12***	1.09–1.15

***$p < 0.001$.

Discussion

The aim of the present study was to determine the relations between marital status and blood pressure in adult men. Our findings indicate that never married men had higher systolic and diastolic blood pressure than married men and that this difference increased with age. Among older individuals the marital differences in blood pressure were considerably higher as compared with individuals from younger age groups, where never married men had blood pressure comparable to married men. Our findings agreed with those of Rosengren et al. [17], Mendes de Leon et al. [18] and Gliksman et al. [19].

In our analysis an interesting epidemiological phenomenon has been observed. A lot of studies have reported a strong linear relationship between BMI and blood pressure in Westernized populations [6]. However, the analysed here never married men had lower BMI than their married counterparts [20] and at the same time they had significantly higher blood pressure than married men. Independently on age, educational level and BMI, the factor of living alone significantly elevated both systolic and diastolic blood pressures.

Several possible explanations of this phenomenon can be proposed. First, according to 'the marriage selection' theory, the selective processes can reduce the probability of getting married for disabled and/or less healthy subjects [21]. In that case, regardless of body mass, single men did not get married in the past, because they probably suffer from diseases linked to higher blood pressure and were more likely to suffer from hypertension and/or other cardiovascular pathologies in their later life. But this concept cannot explain why slimmer never married men have higher values of both SBP and DBP. From the other hand, it is assumed that marriage yields the health benefits through the emotional and social support, being a buffer against the effects of everyday stress [22]. Never married men are partly deprived of the social ties and the social support resulted from marriage, and therefore they are exposed to the higher levels of stress. Stressful situations, anxiety, a feeling of instability and/or social isolation are linker to a worse functioning of cardiovascular system by some authors [23]. It is commonly known that stressful events stimulate the adrenergic part of autonomic system to the increased production of stress hormones (adrenaline, noradrenaline). These hormones being crucial for the functioning of cardiovascular system, result in the increase in both heart rate and blood pressure. Prolonged periods of increased blood pressure can finally lead to the development of hypertension and other cardiovascular diseases [24]. Siegrist et al. [25] found that 31% of patients experiencing myocardial infarction had been previously exposed to at least three 'critical negative life events' as compared to 14% of control subjects having been exposed to an analogous level of stress. A number of investigators have concluded that marriage decreases the level of stress. Only 14.7% of 47–55-year-old married Swedish men reported a permanent stress during the previous five years, whereas 17.9% of never married men stated to be severely stressed ($p < 0.05$) [17]. Generally, married people are more likely to be happy than never married men and women. Among 25–39-year-old male Americans, 46.8% married men reported being very happy as compared with only 21.0 % of never married peers [26]. Marital happiness has a considerably greater contribution to global happiness than the satisfaction from health and physical condition, work and finances, family life, friendships and nonworking activities [27].

Furthermore, it is suggested that differences in dietary intake may at least partly explain the marital diversity in blood pressure and the increased risk of hypertension in never married men. Generally, married men have better eating habits [28]. Single men prefer food that are the right portion size and easy to open, prepare and cook [29]. Men living alone are more likely to consume food of poor quality with a lower content of fruit and vegetables as compared with men living with a spouse [30]. A diet based mainly on ready-made food is related to the increased sodium intake, as sodium content in ready-made food and fast food exceeds several times the required amount (a recommended daily sodium intake is less than 2000 mg from all dietary sources) [31]. Dietary sodium intake is one of several dietary factors known to influence on blood pressure. The excessive dietary sodium content can result in fluid retention, and in consequence may lead to hypertension [32].

Sodium and potassium, cooperating in water homeostasis, reveal the opposite effects on blood pressure. Potassium tends to decrease values of blood pressure. A 30–45 mmol increase in daily potassium intake was accompanied by an average 2–3 mm Hg reduction of systolic blood pressure in an examined population [33]. As potassium is found primarily in fresh fruit and vegetables, the increased consumption of processed food usually leads to a decrease in potassium intake. Therefore, an average diet of living-alone men (being poor in fresh fruit and vegetables and containing mainly ready-made food) is likely to increase sodium intake and reduce potassium intake. The effects of such food behaviours can be responsible at least partly for increased blood pressure and the higher risk of hypertension in single men [24, 34].

Many papers have reported that various lifestyle behaviours influence blood pressure [35–37]. Unexpectedly, in our analysis none of evaluated lifestyle elements increased the risk of hypertension. Although never married men were significantly less physically active than married men, this factor did not affect their risk of hypertension.

From an economic perspective, couples living together can perhaps live more economically than individuals living alone. Single persons do not share household goods, the major part of their income is allocated in rent and other payments, hence, the individual cost of living is higher for them [38]. Thus, being at the same income level, married individuals have potentially greater financial resources available for health care, promoting more healthy lifestyle.

One limitation of the present study is the fact that our conclusions have to be restricted only to men. Unfortunately, the absence of female data in this material does not allow us to analyse sex differences in blood pressure and the risk of hypertension with

regard to marital status. However, some studies suggest that the benefits from marriage are generally much stronger for men than for women [19, 39].

In conclusion, the main finding of our study is the observation that married men have lower blood pressure than their never married counterparts, although they are more likely to be fatter and even obese. There are some possible explanations of this epidemiological phenomenon. The observed marital differences in blood pressure seem to be insufficiently explained by 'the selection theory'. According to 'the social causation' theory it may be concluded that obesity is the important risk factor for hypertension, but at the same time the fact of being married is related to much stronger beneficial effects on health, outweighing the detrimental impact of obesity. It can be also hypothesised that obesity is not as a strong risk factor for morbidity as it is assumed, and rather the fact of living alone related to augmented stress and unbalanced diet might have more detrimental and stronger effects on male health than obesity *per se*.

References

1. Lea JP, Nicholas SB. Diabetes mellitus and hypertension: Key risk factors for kidney disease. J Natl Med Assoc 2002; 94(8): 7S–15S.
2. Slama M, Susic D, Frohlich ED. Prevention of hypertension. Curr Opin Cardiol 2002; 17: 531–536.
3. Boutitie F, Gueyffier F, Pocock S, Fagard R, Boissel JP. J-shaped relationship between blood pressure and mortality in hypertensive patients: New insights from a meta-analysis of individual-patient data. Ann Intern Med 2002; 136: 438–448.
4. O'Sullivan JJ, Derrick G, Darnell R. Prevalence of hypertension in children after early repair of coarctation of the aorta: A cohort study using casual and 24 hour blood pressure measurement. Heart 2002; 88: 163–166.
5. Stamler J. Blood pressure and high blood pressure. Aspects of risk. Hypertension 1991; 18(3): 195–107.
6. Bender R, Jockel KH, Richter B, Spraul M, Berger M. Body weight, blood pressure, and mortality in a cohort of obese patients. Am J Epidemiol 2002; 156: 239–245.
7. Lahti-Koski M, Pietinen P, Heliovaara M, Vartiainen E. Associations of body mass index and obesity with physical activity, food choices, alcohol intake, and smoking in the 1982–1997 FINRISK Studies. Am J Clin Nutr 2002; 75: 809–817.
8. Kannel WB. New perspectives on cardiovascular risk factors. Am Heart J 1987; 114: 213–219.
9. Hemingway H, Marmot M. Psychosocial factors in the aetiology and prognosis of coronary heart disease: Systematic review of prospective cohort studies. Br Med J 1999; 318: 1460–1467.
10. Carroll D, Smith GD, Shipley MJ, Steptoe A, Brunner EJ, Marmot MG. Blood pressure reactions to acute psychological stress and future blood pressure status: A 10-year follow-up of men in the Whitehall II Study. Psychosom Med 2001; 63: 737–743.
11. Joint National Committee. The sixth report of the Joint National Committee on the Detection, Evaluation, and Treatment of High Blood Pressure (JNC-VI). Arch Intern Med 1997, pp 2413–2446.
12. Kannel WB, Garrison RJ, Dannenberg AL. Secular blood pressure trends in normotensive persons: The Framingham Study. Am Heart J 1993; 125: 1154–1158.
13. Report of a WHO Expert Committee. Physical Status: the Use and Interpretation of Anthropometry. Geneva, 1995 (WHO Technical Report Series 854).
14. Welon Z, Bielicki T, Rogucka E, Malina RM. Effect of education and marital status on premature mortality among urban Adults in Poland, 1988–1989. Am J Hum Biol 1999; 11: 397–403.
15. Statistical Yearbook of the Republic of Poland. eds. Polish Official Statistics, 1990.
16. Verbrugge LM. Marital status and health. J Marr Family 1979; 41: 267–285.
17. Rosengren A, Wedel H, Wilhelmsen L. Marital status and mortality in middle-aged Swedish men. Am J Epidemiol 1989; 129: 54–64.
18. de Mendes Leon CF, Appels AWPM, Otten FWJ, Schouten EGW. Risk of mortality and coronary heart disease by marital status in middle-aged men in the Netherlands. Int J Epidemiol 1992; 21: 460–466.
19. Gliksman MD, Lazarus R, Wilson A, Leeder SR. Social support, marital status and living arrangement correlates of cardiovascular disease risk factors in the elderly. Soc Sci Med 1995; 40: 811–814.
20. Lipowicz A, Gronkiewicz S, Malina RM. Body mass index, overweight and obesity in married and never married men and women in Poland. Am J Hum Biol 2002; 14: 468–475.
21. Kisker EE, Goldman N. Perils of single life and benefits of marriage. Soc Biol 1987; 34: 135–152.
22. Wyke S, Ford G. Competing explanations for associations between marital status and health. Soc Sci Med 1992; 34: 523–532.
23. Venters M, Jacobs DR Jr, Pirie P, Luepker RV, Folsom AR, Gillum RF. Marital status and cardiovascular risk: the Minnesota Heart Survey and the Minnesota Heart Health Program. Prey Med 1986; 15: 591–605.
24. Kaplan RM, Sallis JF Jr., Patterson Thl. Health and human behaviour: McGraw-Hill Inc., 1993.
25. Siegrist J, Dittmann K, Rittner K, Weber I. The social context of active distress in patients with early myocardial infarction. Soc Sci Med 1982; 16: 443–453.
26. Lee GR, Seccombe K, Shehan CL. Marital status and personal happiness: An analysis of trend data. J Marr Family 1991; 53: 839–844.
27. Glenn ND, Weaver ChN. The contribution of marital happiness to global happiness. J Marr Family 1981; 43: 161–168.
28. Roos E, Lahelma E, Virtanen M, Prattala R, Pietinen P. Gender, socioeconomic status and family status as determinants of food behaviour. Soc Sci Med 1998; 46: 1519–1529.
29. Donkin AJ, Johnson AE, Morgan K, Neale RJ, Page RM, Silburn RL. Gender and living alone as determinants of fruit and vegetable consumption among the elderly living at home in urban Nottingham. Appetite 1998; 30: 39–51.
30. Billson H, Pryer JA, Nichols R. Variation in fruit and vegetable consumption among adults in Britain. An

analysis from the dietary and nutritional survey of British adults. Eur J Clin Nutr 1999; 53: 946–952.
31. Diet, Nutrition and the Prevention of Chronic Diseases. Geneva: WHO, 2003 (WHO Technical Report Series 916).
32. Geleijnse JM, Witteman JCM, Bak AAA, den Breijen JH, Grobbee DE. Reduction in blood pressure with a low sodium, high potassium, high magnesium salt in older subjects with mild to moderate hypertension. Br Med J 1994; 309: 436–440.
33. Dyer AR, Elliott P, Shipley M. for the INTERSALT Cooperative Research Group. Urinary electrolyte excretion in 24 hours and blood pressure in the INTERSALT study. 2. Estimates of electrolyte-blood pressure associations corrected for regression dilution bias. Am J Epidemiol 1994; 139: 940–951.
34. Hooper L, Bartlett C, Davey Smith G, Ebrahim S. Systematic review of long term effects of advice to reduce dietary salt in adults. Br Med J 2002; 325: 628–636.
35. Hagberg JM, Brown MD. Does exercise training play a role in the treatment of essential hypertension?. J Cardiovasc Risk 1995; 2: 296–302.
36. Sesso HD, Paffenbarger RS, Lee MI. Physical activity and coronary heart disease in men. The Harvard Alumni Health Study. Circulation 2000; 102: 975–980.
37. Lip GY, Beevers DG. Alcohol and hypertension – Does it matter? J Cardiovasc Risk 2003; 10: 11–14.
38. Waite LJ. Does marriage matter?. Demography 1995; 32: 483–507.
39. Rogers RG. Marriage, sex, and mortality. J Marr Family 1995; 57: 515–526.

Address for correspondence: Anna Lipowicz, PhD., Institute of Anthropology, Polish Academy of Sciences, ul. Kuznicza 35, 50-951 Wrocław, Poland.
Phone: 0048-71-3438675; Fax: 0048-71-3438150
E-mail: Anna.Lipowicz@antro.pan.wroc.pl