THESIS FOR DEGREE OF DOCTOR OF PHYLOSOPHY

THE EPIDEMIOLOGY OF HYPERTENSION AND ITS ASSOCIATED RISK FACTORS IN THE CITY OF DEBRECEN, HUNGARY

ZOLTÁN JENEI MD

Supervisor: Peter Polgar PhD

PROGRAM DIRECTOR: Prof. György Balázs

University of Debrecen
Medical and Health Science Center
1st Department of Medicine, Debrecen, 2002

THESIS FOR DEGREE OF DOCTOR OF PHYLOSOPHY

THE EPIDEMIOLOGY OF HYPERTENSION AND ITS ASSOCIATED RISK FACTORS IN THE CITY OF DEBRECEN, HUNGARY

ZOLTÁN JENEI MD

Supervisor: Peter Polgar PhD

PROGRAM DIRECTOR: Prof. György Balázs

University of Debrecen
Medical and Health Science Center
1st Department of Medicine, Debrecen, 2002

INDEX

1. INTRODUCTION

Cardiovascular diseases (CVD) are expected to become one of the major public health problems in many developing countries, including Hungary. During the past 30 years the geographical distribution of CVD in Europe has changed. The highest rate of CVD mortality, which was previously reported in Finland in 1970, was found, in 1995, to be in Central and Eastern Europe. The exact reasons for this unfavourable trend have not been fully explained yet. However, it seems to be that the changes in the CVD epidemiology in Central Europe may only partially be associated with the high prevalence of smoking, overweight, physical inactivity and hypertension. Presumably, other risk factors such as nutritional problems, stress, behavioural factors, and unhealthy life-styles also influence the prevalence of CVD. Over the past few years, studies have suggested that CVD is an important cause of death in Central and East European countries, such as Hungary.

While in Western-Europe a striking decreasing tendency in cardiovascular mortality and morbidity can be observed, in Hungary the prevalence of CVD has not changed significantly during the past 15 years and is still the leading cause of mortality and morbidity. According to data of WHO, in Hungary the cardiovascular mortality increased with 1-2% per year between 1970 and 1992, and in 1996 0.72% (73 980 persons) of the total population died due to cardiovascular diseases. The age-standardised cardiovascular mortality in Hungary 768.2/100000, while only 461.2/100000 in Austria. This remarkable difference can be explained with the effective preventive strategy to eliminate the cardiovascular risk factors and to change the unhealthy life-style. High blood pressure, smoking, high fat and salt consumption, physical inactivity and increased body weight are all lifestyle-related risk factors that have been shown to act synergistically to increase

cardiovascular morbidity. To achieve a reduction in premature death from CVD, it seems most appropriate to combine an intervention programme directed toward the total population with a targeted strategy aimed at risk factor reduction in high risk individuals with many CVD risk factors. Hypertension is considered to be a major risk factor in the development of CVD. The prevalence of hypertension, and the percentage of untreated and poorly controlled hypertensive patients is of major importance in cardiovascular morbidity and mortality. Guidelines published in the past years have suggested that the main goal of treatment of hypertension is to strictly normalise the blood pressure, to prevent target organ damages and to reduce the other risk factors associated with hypertension as well. Many studies have been reported that determined the prevalence of hypertension and associated modifiable risk factors, such as obesity, smoking, low physical activity, high alcohol consumption, high fat and salt intake, hyperlipidaemia, hyperglycaemia, and non-or hardly modifiable risk factors, such as, age, gender, family history of CVD and hypertension, together with the evaluation of the role of social background, educational level, demographic factors and employment status in its occurrence.

Despite the potential public health problems of hypertension and the associated CVD risk factors, only little information exists on their prevalence, relationships and mechanisms of their accumulation in Hungary. To the best of our knowledge only very few similar large scale studies on the epidemiology of hypertension and its associated CVD risk factors have been conducted in East and Central Europe. Our cross-sectional study was designed to find out the main reasons for the high CVD mortality in our region, such as the prevalence of high blood pressure, and associated CVD risk factors.

We evaluated the association and accumulation of these factors, and investigated the social, demographic, biological, and behavioural correlates of

hypertension and associated CVD risk factors in the city of Debrecen, which is the second largest city in Hungary. According to official statistics the prevalence of hypertension in Hungary is 20-24% which closely matches data from other West European countries, however, the hypertension related age-adjusted mortality was significantly higher than it was in these countries. This contradiction may originate from the underestimation of the prevalence, and the presence of high numbers of latent morbidity or poorly controlled high blood pressure.

Information on the real prevalence of hypertension and the CVD risk factors, as well as on the factors affecting their distribution and accumulation is crucial towards designing effective preventive strategies to significantly decrease CVD in Hungary.

2. AIMS OF THE STUDY

1. To determine the prevalence of hypertension and its associated cardiovascular risk factors amongst 20000 random selected inhabitants of Debrecen aged between 30-65 yrs.

2. To obtain epidemiological data about the cardiovascular risk factors which can, or may not be influenced by life-style.

3. To determine the frequency of cardiovascular risk factors associated with hypertension.

4. To study the frequency of the accumulations of cardiovascular risk factors.

5. To study the role of sociodemographic factors in the epidemiology of risk factors.

6. To identify the special social groups with the highest levels of cardiovascular risk factors.

7. To target the high risk groups for further examinations and prevention programmes.

3. METHODS

A cross sectional, population-based study was conducted in the city of Debrecen (eastern Hungary), in 1996. Closely 10% (21 800) of the total population (total population:208 449) inhabitants of Debrecen, aged 30-65 years were selected by the random sampling method for data collection in the "Cardiovascular Risk Screening Debrecen'96" study. The selection criteria also included that participants be permanent residents of the city. Before the study we conducted a wide media campaign to achieve a high level of participation in our study. Risk screening for cardiovascular disease was estimated by a questionnaire, via personal interview. Informed consent was obtained from each person who agreed to enter into the study. The study was carried out according to the Declaration of Helsinki.

The survey was based on standardised interviews performed by trained health professionals, and included collection and loading of data using a personal computer, within 24h after interview. The questionnaire included self-reported information about age, gender, education, working hours, physical activity, smoking habit, saturated fat intake, family history of heart attack, hypertension and stroke, alcohol consumption, awareness of hypertension, drug intake, and two recent self-reported results of systolic and diastolic blood pressure (BP). The BP was measured before the interview. Persons were classified as hypertensive, according to the World Health Organisation (WHO) criteria, if their two results of systolic blood pressures were at or above 140 mmHg or diastolic blood pressures at or above 90 mmHg, or if they were currently taking antihypertensive medications. The questionnaire used for the survey had been validated previously, and later modified to improve the comprehensibility of the text. The interview was repeated in some cases to evaluate the reproducibility.

Variables were defined and coded according to the frequency and number of risk factors. Current cigarette smoking status was classified into 5 categories according to the number of cigarettes smoked per day: non smokers, ex-smokers (stopped smoking for more than 1 year), light smokers (1-10 cigarettes/day), moderate smokers (11-20 cigarettes/day) and heavy smokers (>20 cigarettes/day). We calculated the body mass indices (BMI= weight/Kg//height/m/^{2}). Persons were classified as overweight if their BMI was higher than 25 Kg/m^2. With regard to alcohol consumption persons were classified into 4 groups according to their estimated reported weekly intake: none, occasional (less than 1 unit per week), light (1-15 units per week), moderate (16-42 units per week) and heavy(regular) (more than 6 units per day). One unit of alcohol (1 drink) is defined as half a pint of beer, a single measure of spirits, or a glass of wine (approximately 8-10 g alcohol). We distinguished three categories according to frequency of saturated fat intake: never (vegetarian or eats just fish and/or chicken), rarely (eats pork products1-3 times/week), and heavy (eats pork products 4-7 times/week). For statistical analysis the PC-STATA system, version 5.0 (STATA 702 University Drive East College Station 77840 Texas, USA) was used.

Descriptive statistics were calculated for all numerical parameters: age, weight, body mass index, BP, and for non-numerical parameters: physical activity, alcohol consumption, fat intake, cigarette smoking, family history of heart attack, hypertension and stroke, educational level, and type of work. For the identification of differences between the above mentioned risk factors prevalence as categorical variables in the hypertensive and normotensive group, Pearson χ^2 -test was used, and t-test in the cases of continuos variables when the variables were normally distributed. Relationships between cardiovascular risk factors within our sample were investigated by estimating the odds ratio (OR) using the multivariate logistic regression model. The odds ratio of having

hypertension, and its association with another 1 or 2 major CVD risk factors were estimated for the categories of sociodemographic, educational, and family history of CVD variables. Only probability values $p<0.05$ were considered to indicate statistical significance.

4. RESULTS

- The overall response rate was 91.56% (83.72% for males and 99.40% for females). 19 961 out of the total surveyed sample were considered appropriate for further evaluation, and comprised of 7618 (38.16%) males and 12 343 (61.84%) females aged 30-65 years. The median age was 47.36±9.68 years for males and 46.79±9.29 years for females.

- 37.02% of the studied population (41.35% of males and 34.34% of females) were categorised as hypertensive by the standard definition. This result is higher than was known from other previous studies and statistical data. 37.11% of the hypertensive individuals were treated with antihypertensive drugs, though, 17.03% of the treated hypertensives were normotensive. Blood pressure measurements were never done in 7.67% of the total population. In 35.92% of hypertensives BP measurements were rarely done. 15.64% of the hypertensive population were aware of their high blood pressure but did not take any antihypertensive drugs.

- 53.73% of the investigated sample (61.68% of males and 48.83% of females) were categorised as overweight (BMI>25 Kg/m^2). 17% of males and 19% of females were categorised as obese (BMI>30 Kg/m^2).

- 32.18% (39.35% of the males, and 27.77% of the females) of the studied population were current smokers. 15% of males and 5% of females smoke more than 20 cigarettes per day.

● In 59.11% (54.61% of the males and 61.46% of the females) of the studied population there were no reports of participation in leisure-time physical activity or sport.

● In 6.50% (15.47% of the males and 1.0% of the females) of the studied population a moderate or heavy drinking habit was found.

● 31.78% (31.78% of the males and 31.78% of the females) regularly consumed fatty food.

● 23.71% (29.94% of males and 19.86% of females) of the studied population had university education, while 47.07% (47.83% of the males and 46.60% of the females) had only high school education. 3.42% (2.91% of the males and 3.71% of the females) worked less than 6 hours per day. 44.32% of those studied (48.84% of the males and 41.54 of the females) were manual workers, while 42.23% (34.04% of the males and 47.25% of the females) did sedentary jobs.

● In 25% of the studied population hypertension was associated with overweight, in 32% it was associated with physical inactivity and in 22% a combination of hypertension, overweight and physical inactivity was found.

● Amongst hypertensives a higher male: female ratio, and a greater percentage of overweight, ex-smokers, moderate and heavy drinkers, manual workers, high fatty food consumers, physical inactivity, positive family history of hypertension, cardiac infarction and stroke were found compared to normotensives. Light and moderate current smoking occurred less in hypertensives, but significantly more frequently in normotensives.

● Adjusting for age, gender and other concurrent risk factors, being overweight, physically inactive ex-smoker, heavy drinker and eating unhealthy diet was associated with higher risk for hypertension. The male gender, older age, positive family history for cardiovascular diseases, menopause, low level education and labour work was associated also with higher risk for hypertension. Current smoking habit was not associated with hypertension, and the type of drink did not influence the risk for hypertension.

● Amongst the cardiovascular risk factors, overweight and physical inactivity were the most common combinations (in 50.76% of males and in 44.14% of females) when 2 risk factors were found, but other combinations such as hypertension and overweight (30.02% in males and 22.47% in females), hypertension and current smoking (14.82% in males and 7.89% in females), hypertension and physical inactivity (35.17% in males and 30.78% in females) also occurred frequently. Having 2 risk factors, overweight and physical inactivity, together with hypertension also occurred frequently, in 22.53%.

● The prevalence of hypertension, and the frequency of its combination with smoking, overweight, and physical inactivity increased generally with increasing age, inferior education, and the male gender. A family history of hypertension, cardiac infarction and stroke, and poor educational background was positively associated with hypertension.

● Prevalence of hypertension, overweight and physical inactivity was higher in postmenopausal females than in males of the same age group.

● According to risk stratification males or postmenopausal females who did manual jobs, had a family history of cardiac infarction, hypertension and

stroke, and who had no high school education, were not only more likely to be hypertensive but also more likely to have a combination of other risk factors, such as, smoking, overweight, and physical inactivity at the same time.

5. DISCUSSION

To our knowledge, very few population-based studies have examined the prevalence of hypertension and its associated CVD risk factors in Hungary, and only a few surveys with small samples have analysed the occurrence of concurrent CVD risk factors of a hypertensive population. In order to achieve a remarkable reduction in the prevalence of CVD, like in West-European countries, and to use effective preventive strategies, a knowledge of the epidemiology of hypertension and the effects of sociodemographic, economic, and behavioural factors on the prevalence of hypertension and CVD risk factors is significantly important.

A high response rate was obtained in this study (91.56%), though, a high percentage of males refused to participate in it (16.28%). The present cross sectional representative study shows a very high prevalence of hypertension (37.02%). This result is higher than was previously known from to official Hungarian statistical data (20-24%), and after standardisation for age, also higher than results of similar studies in Greece (28.4%), Canada (21%), and Germany (20%). However, studies conducted in Russian (36%), and in Spain (41.1%) showed higher prevalence of hypertension than in our cases. Our results may be explained by the high proportion of latent, unrecognised morbidity.

The very high prevalence of hypertension may be due not only to the poorer economic conditions in Hungary compared with Western-Europe, but probably also because of the special eating, drinking and behavioural habits, and the low level of health awareness in Hungary. These factors may probably have contributed to the unenviable leading position of Hungary in CVD mortality.

A few studies have demonstrated the proportion of poorly treated, and well (BP<140/90 Hgmm) controlled hypertensives. Just 37.11% of hypertensive individuals were treated with drugs and amongst them only 17.03% were normotensives. Also only a very low percentage of hypertensives measured their blood pressure regularly. Amongst hypertensives, only a very low percentage of them were aware of their disease. These depressing data highlight the importance of more effective prevention and health education programmes, early recognition, and the better control of hypertension.

54% of the studied population were overweight, which is higher than data presented previously in Hungary (30%), however, lower number of males were smokers than was originally known (44%). In respect of alcohol consumption, physical activity and unhealthy diet habit significant differences were not found between our and previously presented data.

Being overweight, low physical activity, highly saturated fatty food, and heavy alcohol intake was positively associated with hypertension. To determine the social class with the most likelihood of becoming hypertensive is crucial, because in economically less prosperous countries, like Hungary, the public health system is unable to conduct general nation-wide screening projects. The screening programmes for high risk persons should be cost-effective and lead to similar good results.

In our study, low educational level, the male gender, elderly age, labour work, a positive family history of hypertension, myocardial infarction and stroke were independent risk factors for hypertension, and the concurrent occurrence of hypertension with overweight, low physical activity and smoking. These findings are consistent with previous reports showing an inverse relationship between socio-economic status and cardiovascular risk factors.

Hypertension is associated with an atherogenic cardiovascular risk profile, as reflected by overweight. This result is not unexpected in light of previous studies, indeed the association that we found probably can be considered a manifestation of the multiple metabolic syndrome. Comparing the smoking frequency obtained from this study, 32.18%, with results of other studies, we found similar results. Regarding alcohol consumption, 6.50% of the studied population drank regularly. However, in spite of promised confidentiality in handling of information, we assume that the studied subjects did not answer probably our questions accurately. According to the National Statistics Office about 12% of the total population take alcohol regularly.

It is interesting that current smoking habit occurred less frequently amongst hypertensive individuals, and that age-, gender- and other characteristics-adjusted odds ratio did not show positive risks for hypertension. These unexpected findings may be due to education and anti-smoking prevention programs. Probably these hypertensive patients are more responsive to these programmes and give up smoking easily. This trend is reflected by the high percentage of ex-smokers amongst hypertensives. However, a large number of epidemiological studies have reported that smokers have a lower blood pressure during abstinence from smoking than non-smokers. Therefore, blood pressure during smoking and during abstinence should be considered separately in smokers. It is important to point out that our data, similar to other studies, have elucidated the interesting phenomenon that smokers during abstinence have lower blood pressure than non smokers, and also did not refute the fact that smoking is one of the main cardiovascular risk factors.

Our survey provided the unique opportunity of examining the distribution of CVD risk factors and the epidemiological features of hypertension amongst the population of Debrecen, in Hungary. From similar studies, it appears that on a population level, self reports of overweight, and

smoking provide a feasible selection instrument by which a subpopulation with high risk factor frequency can be identified.

6. CONCLUSION

Our results have shown a very depressing picture about the prevalence of CVD risk factors and indicate the higher prevalence of hypertension in Hungary than was known previously. This difference can be explained by the high number of latent morbidity of hypertension, which call for attention to the importance of better blood pressure control, screening, prevention, and health education, especially, amongst high risk groups.

In summary, the present study was aimed at determining the prevalence and risk factors of high blood pressure in the adult population of Debrecen. The characterisation of these factors will contribute to defining more effective and specific strategies to screen and to control hypertension and CVD.

7. BIBLIOGRAPHY

The above work is based on the following references:

1. **Zoltán Jenei**, Dénes Páll, Éva Katona, Péter Polgár, Zsolt Karányi, Miklós Bodor, György Kakuk: Cardiovascular risk factors of smokers and non-smokers in the city of Debrecen, Hungary Publich Health 2000; 114: 295-299 **IF: 0.6**

2. **Zoltán Jenei**, Dénes Páll, Péter Polgár, Éva Katona György Kakuk: Prevalence of hypertension and its associated cardiovascular risk factors in the city of Debrecen, Hungary. Public Health 2002; 116: 1-7. **IF: 0.6**

3. **Jenei Zoltán**, Páll Dénes, Katona Éva, Polgár Péter, Zsolt Karányi, Miklós Bodor, Kakuk György: Cardiovascularis rizikótényezők alakulása Debrecen város dohányos és nem dohányos lakossága körében. Magyar Belorvosi Archivum: 2000; 53:29.34

4. Polgár Péter, Páll Dénes **Jenei Zoltán** Karányi Zsolt, Katona Éva Bodor Miklós, Kakuk György: CARD'96- Cardiovascularis rizikószűrés, Debrecen. A vizsgálat I. fázisának főbb eredményei . Magyar Belorvosi Archivum: 1999; 52: 261-265.

5. Katona Éva, Páll Dénes, **Jenei Zoltán**, Polgár Péter, Karányi Zsolt, Kakuk György: Debrecen túlsúlyos felnőtt lakosainak epidemiológiai adatia, különös tekintettel a cardiovascularis rizikótényezőkre. Magyar Belorvosi Archivum: 200;53: 239-243

Other publication:

1**. Jenei Zoltán**: Vesebetegségek rizikótényezői: Obesitas, életmód, étrend: Nephrologiai ismeretek 1998, 148-150

2. **Jenei Zoltán:** Szalicilát-mérgezés. Nephrologia 1999, 235-243

3. **Jenei Zoltán:** Gyógyszeres kezelés-Nil nocere. Nephrologia 2000,175-183

4. Pall D, Katona E, Fülesdi B, **Jenei Z,** Paragh G, Polgar P, Kakuk G: Epidemiology of hypertension in aldolescence and factors influencing blood pressure. Orv Hetil 2001;142: 1891-1896

The above work is based on the following citable abstracts:

1. **Zoltán Jenei**, Dénes Páll, Péter Polgár, Zsolt Karányi, György Kakuk: The non-influental cardiovascular risk factors among the inhabitants between the ages 30-65 in Debrecen. Can J. Cardiol Vol 13 Suppl B June 1997, 247B **IF:1.23**

2. Péter Polgár, Dénes Páll, **Zoltán Jenei**, Zsolt Karányi, György Kakuk: CARD'96-Cardiovascular risk screening in the city of Debrecen, Hungary. Can J.Cardiol Vol 13 Suppl B June 1997, 247B **IF:1.23**

3. **Jenei Zoltán**, Páll Dénes, Polgár Péter, Karányi Zsolt, Bodor Miklós, Katona Éva, Kakuk György: A dohányosok cardiovascularis rizikótényezőinek főbb jellegzetességei Debrecenben- CARD'96. Cardiologia Hungarica, 1998, Suppl. 1.,25

4. Dénes Páll, **Zoltán Jenei**, Péter Polgár, Zsolt Karányi, György Kakuk: The cardiovascular risk factors which can be influenced with life-style changes among the inhabitants between the ages of 30-65 in Debrecen. Can J Cardiol Vol 13 Suppl B, 248B **IF:1.23**

5. **Jenei Zoltán**, Páll Dénes, Polgár Péter, Katona Éva, Bodor Miklós, Karányi Zsolt, Kakuk György: Hypertonia gyakorisága Debrecen város magas cardiovascularis rizikójú lakossága körében. Cardiologia Hungarica, 1999, Suppl. 2., 17.

Other citable abstracts

1. **Zoltán Jenei,** Dénes Páll, István Kárpáti, János Mátyus, László Újhelyi, Zsolt Zilahi, Attila Juhász, György Kakuk: Blood pressure changes during hemodialysis using dialysis solution 35 C °, 36 C° and 37 C°. J. Hypert., June 1996 Suppl.1., S41 **IF: 3.64**

2. Páll Dénes, Homoródi Nóra, **Jenei Zoltán**, Polgár Péter, Katona Éva, Bodor Miklós, Kakuk György: Emelkedett eseti vérnyomású fiatalok ambuláns vérnyomás monitorozása. Cardiologia Hungarica, 1998, Suppl. 1., 25

3. **Zoltán Jenei**, Dénes Páll, István Kárpáti, János Mátyus, László Újhelyi , Zsolt Zilahi, Attila Juhász, György Kakuk: Effect of cool temperature (35 C°) dialysis solution for intradialytic blood pressure changes. Eur. Heart J., August 1996, 339. **IF: 1.41**

4. Dénes Páll, **Zoltán Jenei,** Tibor Bojti, Éva Katona, Béla Hunyadi, Zsolt Zilahi, Péter Polgár, György Kakuk: Epidemiological data of 5053 secondary school students' blood pressure in Debrecen, Hungary. Eur. Heart J., August 1996, 344. **IF:1.41**

5. Dénes Páll, **Zoltán Jenei,** Tibor Bojti, Éva Katona, Béla Hunyadi, Zsolt Zilahi, Péter Polgár, György Kakuk : First experience with blood pressure screening of secondary school students J. Hypert., June 1996 Suppl.1., S361
IF:3.64

6. **Jenei Zoltán**, Páll Dénes, Bojti Tibor, Katona Éva, Hunyadi Béla, Zilahi Zsolt, Polgár Péter, Kakuk György: Eseti hipertenziós középiskolások további vizsgálata során szerzett kezdeti tapasztalataink. Cardiologia Hungarica, 1996, Suppl.1.,78

7.Páll Dénes, **Jenei Zoltán,** Bojti Tibor, Katona Éva, Hunyadi Béla, Zilahi Zsolt, Polgár Péter, Kakuk György: 5053 középiskolás vérnyomás-szűrésével szerzett kezdeti tapasztalataink. Cardiologia Hungarica, 1996, Suppl.1.,79

8. **Jenei Zoltán,** Páll Dénes, Bojti Tibor, Katona Éva, Hunyadi Béla, Zilahi Zsolt, Polgár Péter, Kakuk György: Eseti hipertenziós középiskolások további vizsgálata során szerzett kezdeti tapasztalataink. Cardiologia Hungarica, 1996, Suppl. 1.,78

9. Páll Dénes, Katona Éva, Takács Erzsébet, Zrínyi Miklós, **Jenei Zoltán**, Polgár Péter, Kakuk György: Vérnyomás szűrés eredményei egy nagy esetszámú serdülő populációban – Debrecen Hipertonia Study. Cardiologia Hungarica, 2000, Suppl. 3., 27.

10. **Jenei Zoltán**, Domokos Zsuzsa, Kárpáti István, Balla József, Varga Zsuzsa, Paragh György, Kakuk György: Krónikus hemodialízis programban kezelt beteget cardiovascularis rizikótényezőinek és célszervkárosodásainak vizsgálata. Cardiologiai Hungarica, 2002, Suppl. 4., 64.