Cardiovascular health among the Czech population at the beggining of 21st century

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Abstract:

Background: In late 1980s, the Czech Republic was among countries with the highest cardiovascular (CVD) mortality in the world. In spite of enormous improvements since that time, there are still large opportunities to further improve cardiovascular health of the population.

Methods: Based on the Czech HAPIEE sample (n=8857 at baseline, 10 years of follow-up, 326 CVD deaths up to 2012) the impact of selected covariates such as *education, smoking, high blood pressure, high blood cholesterol level, diabetes, obesity, physical activity and binge drinking* (model controlled for *age, gender, partner and prevalence of CVD*) was evaluated by Cox regression. Further population attributable fractions (PAF%) were used to quantify the impact of these factors in the population.

Results: The prevalence of modifiable risk factors was high; the presence of three or more CVD risk factors were found in 35 % of participants, and 55% of participants fulfilled the criteria of metabolic syndrome. Education was found to be the strongest determinant of population's CVD mortality (HR=2.92 (basic vs. university), p-value<0.001; PAF%=47.7). The risk was also twice higher for persons with diabetes compared to those without (HR=2.12, p-value<0.001), even the impact on population CVD health was not so high (PAF%=8). From other major risk factors similar impacts was found for smoking (HR=1.72 (smoker vs. non-smoker), p-value<0.001; PAF%=20.6), high blood pressure (HR=1.71, p-value<0.001; PAF%=27.9) and physical inactivity (FR=1.72, (none vs. sufficient) p-value<0.001; PAF%=19.4). Results moreover confirmed that quitting smoking reduces the cardiovascular risk very quickly and that even insufficient physical activity is beneficial to cardiovascular health. Conversely, the effects of obesity, binge drinking and high total cholesterol were not significant.

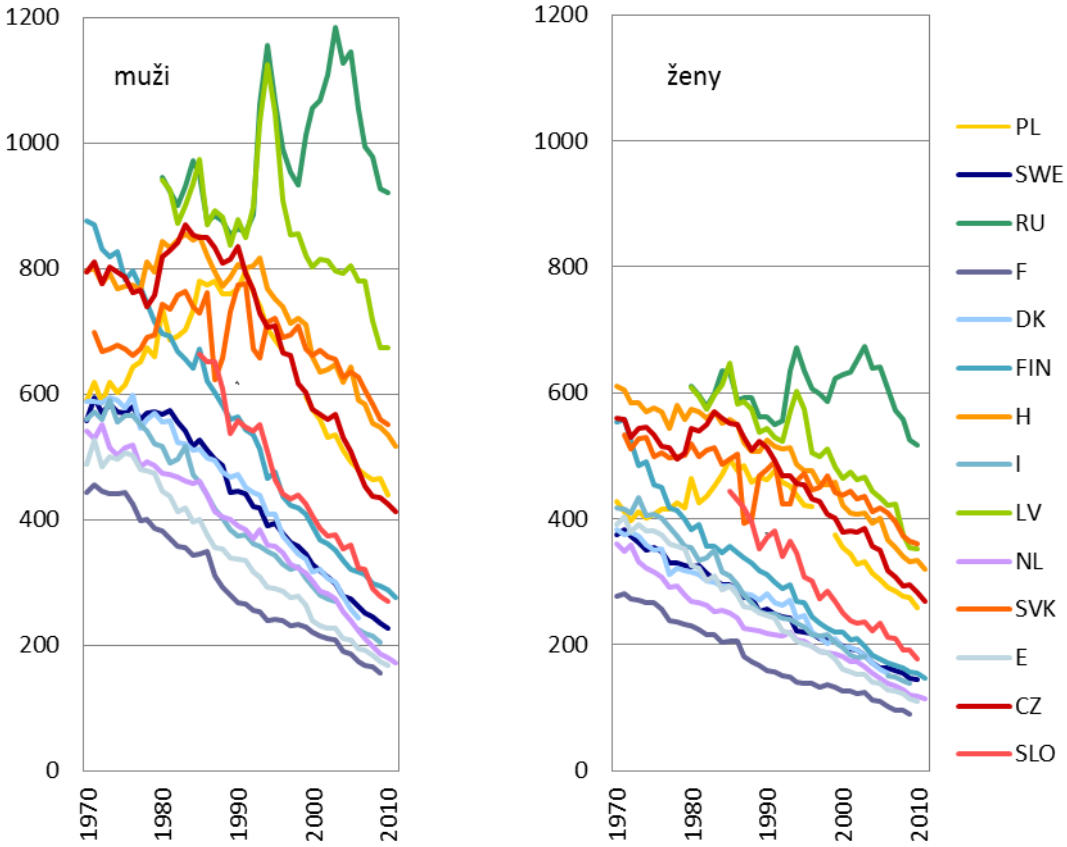
Conclusions: Education had the largest impact on cardiovascular mortality in the Czech population. Almost 50% of CVD death could be prevented if the whole population had the same risk as the highest educated population.

Keywords: cardiovascular diseases, mortality, health transition, cardiovascular health, risk factors, survival analysis, health promotion

1. Introduction

In late 80s of the last century, the Czechia belonged among countries with the highest mortality rate due to cardiovascular diseases (CVD) in the world. Since that time, there have been many changes and significant improvements of cardiovascular health due to changes in the life-style, subsequent decrease in prevalence of risk factors and due to changes in the healthcare area. In spite of significant improvements, there are still significant opportunities to further improve the health of population. Mortality rate due to CVD in Czechia is approximately three times higher compared to France, where the mortality rate is among the lowest ones. Together with malignant neoplasms, the circulation system diseases constitute the main cause of over-mortality in the Czech population as compared to 15 EU countries.

Figure 1 Epidemiological situation, Europe
Cardiovascular mortality (SDR per 100 000 inhabitants), period 1970-2011



Notes:
Central Europe Region: CZ – Czechia, H – Hungary, PL – Poland, SLO – Slovenia, SVK – Slovakia
East Europe Region: RU – Russia, LV – Latvia
West Europe Region: DK – Denmark, E – Spain, F – France, FIN – Finland, I – Italy, NL – the Netherlands, SWE – Sweden

Data source: WHO HFA-DB, January 2013

Causes of development of cardiovascular diseases are well known – more than 300 risk factors were found during the last 60 years. As far as view on health of the whole population is concerned (cardiovascular epidemiology, public health), the most attention is devoted to factors with high prevalence in the population and to factors that are possible to modify (*Mackay, 2004, p. 24*).

Main/traditionally perceived risk factors are generally considered the following ones (next to the age and gender): *tobacco products consumption, unhealthy diet and alcohol consumption, insufficient physical activity* (life-style related factors) and next *high blood pressure, high blood cholesterol level, obesity and diabetes mellitus* (metabolic risk factors) which are, however, significantly influenced by the life-style of an individual.

The goal of this paper is to estimate the amount of cardiovascular risk among the Czech population, and to evaluate the impact of traditionally perceived risk factors of cardiovascular diseases on mortality in the Czech population.

Testing the impact of main risk factors on the development of cardiovascular diseases among the Czech population was based on longitudinal data of the HAPIEE study, and the evaluation of risks was based on the method of survival analysis, and the impact of a factor in the population was then estimated on basis of population attributable fraction. Monitored risk factors were selected on basis of the INTERHEART study (*Yusuf et al., 2004*) with the results showing that nine risk factors (blood fats, hypertension, diabetes, obesity, insufficient consumption of fruits and vegetables, insufficient physical activity, the protective effect of alcohol consumption and psychosocial factors/stress) are related to up to 90 % of coronary events.

2. Data and methods

Testing of determinants on cardiovascular health was performed by the survival analysis using data of the HAPIEE study organized and coordinated by University College London and by the National Institute of Public Health in the Czech Republic. International **prospective cohort study HAPIEE** *(Health, Alcohol and Psychosocial factors in Eastern Europe)* monitors the impact of life-style and psychosocial factors on the health condition of populations in 4 selected countries in the Central and Eastern Europe, including the Czechia. Czech cohort was founded during 2002–2005, and since that time has been regularly monitored for changes on health condition, including mortality. At start of the study, the Czech cohort included 8,857 persons at the age of 45–69 years. There were 869 deaths in this cohort within the monitored period, i.e. during 2002–2012. Exactly 326 out of 869 deaths were due to cardiovascular diseases.

Estimate of strength of the impact of independent variables on mortality due to cardiovascular diseases was performed by the survival analysis method, specifically by Cox regression (regression model of proportional risks). Testing of the assumption of risk proportionality was performed by the graphic method based on transformation of estimates of survival function using the log(-log $S(t)$) function. Curves were controlled both for the age and gender. The risk of prevalence of the monitored event against time, here the risk of death due to cardiovascular disease, is described by the set of explanatory variables. The monitored event is death due to circulation system disease (n=326), and all other deaths (n=543) representing a so-called competing risk, were censored at the day of death. Survival time was monitored in terms of months, and was defined as follows: process time started at the moment of entry into the study, and the end of process time was the moment of death or the respondents were censored (in 31/12/2012). The resulting proportional risk/effect expresses how many times the risk of development of the fatal cardiovascular event for a given category is higher or lower compared to the

reference category with the risk value of 1. Other categories of the given variable express only the relation to this reference category. Combined effects of variables are multiplicative then.

Risk population was represented by a cohort of 8,855 persons. Monitoring time of individuals in the cohort ranged from 1 to 131 months with the average time of 107.6 months and the total of 952,984 person-months. Explanatory socio-demographic variables and variables representing risk factors for cardiovascular health were considered to be time-constant.

The impact of *smoking, high blood pressure prevalence, high blood cholesterol level, diabetes, obesity, physical activity and binge drinking* was evaluated. Then, basic socio-demographic characteristics were included into the model – *age, gender, education* as markers of socio-economic position and *partner* as a significant demographic characteristic with influence on the health condition of an individual. The model was also evaluated for the impact of prevalence of *pre-existing cardiovascular disease* of an individual. Blood pressure, total cholesterol and obesity were determined based on medical examination. Remaining variables were determined based on subjective responses of respondents in questionnaires.

Individual variables were added to the final model sequentially so that their impact on the model could be evaluated. Model selection was made using iteration – model was compared to the closest preceding model (the one that included by a single iteration factor less) using the Likelihood ratio test.

Population attribution function (%) was finally estimated for individual variables as the marker of the impact of the risk factor in population. The population attribution function helps to estimate which factor has a stronger impact on cardiovascular health in the population. In the final model the variables with significant effect on cardiovascular mortality as well as variables with significant effect on model were left.

Statistical software STATA (version 12) was used to process and evaluate the data.

3. Results and discussion

There are still significant opportunities for cardiovascular health of the Czech population mainly in the life-style. Prevalence of modifiable health risk factors is enormous within the middle aged Czech population in the start of the 21st century. There were 65 % of males with high blood pressure in the male population in the age of 45–69 years. 55 % of males did not have sufficient physical activity, almost 30 % of males were obese and smoked and 27 % of males had high blood cholesterol level. The proportion of most risk factors in females was lower than in males, with the exception of insufficient physical activity (56 %), high cholesterol level (34 %) and obesity (32 %). Another part of the population was in a higher cardiovascular risk, and optimum values of monitored factors (ideal cardiovascular health) were found only in a small portion of the population. Three or more risk factors of development of cardiovascular disease were found in 40 % males and 30 % females of the HAPIEE population. These persons were at the high risk of development of cardiovascular event at start of the study. Also the proportion of participants with metabolic syndrome was striking as well (55 %).

The high prevalence of risk factors within the population reflects the persisting small responsibility for their own health in a significant part of population and underestimation of behaviour benefiting to good health at a young age.

Table 1: Prevalence of CVD risk factors, HAPIEE, 2002–2005 (age group 45–69 years)

Risk factor	Males (%)	Females (%)
High blood pressure (> 140/90 mmHg)	64,8	45,8
High cholesterol level (>6,2 mmol/l)	27,0	33,9
Obesity (BMI > 30 kg/m2)	29,7	31,7
Smoking	29,5	23,8
Diabetes	13,6	10,2
Insufficient physical activity (<3,5 hours a week)	55,2	55,9

Data source: HAPIEE Study, National Institute of Public Health

At the present, socio-economic factors (*Marmot, Wilkinson, 2003*) are considered to be the most important determinants of health. *Achieved **education**, as a variable presenting the socio-economic status, did show that the education is a significant factor with the impact on cardiovascular health in the Czech population.* Persons with the primary education had 2.9 times higher risk of death due to cardiovascular diseases compared to persons with tertiary education. The risk was statistically much higher in persons with secondary education (approx. 2 times). Population attributable risk (%), which can be understood as the portion of deaths that could be prevented, if the whole monitored population had the same risk of death as the reference group (tertiary education), was estimated for the case of education to be almost 50 % of deaths.

Socio-economic factors influence the life-style through material security, psycho-social markers, as well as in a direct way. Material deprivation may result in psychic stress and subsequently in risky behaviour of an individual, and also results in reduced availability of products, services and activities supporting good health. Persons of lower socio-economic groups are more frequently exposed to stress resulting from negative life situations, daily conflicts with their surroundings, stress at work (mainly the imbalance between their effort and remuneration, high expectations without the option of decision). Stress factors may result in worsening of health condition in a direct way (biological way) or in the behavioural way, which again may result in the risky behaviour. Health deteriorating life-style exists, due to the reasons listed, more frequently among groups with socio-economic disadvantage (*Mackenbach, 2006*). Persons with a higher education are in general more sensitive to health-related information, and they also have a healthier life-style more often than persons with a lower education. Persons living in poverty are often forced to adopt a life-style that has a negative impact on their health (*Mackenbach, 2006*).

The HAPIEE cohort also confirmed **a protective effect of partnership** on cardiovascular health. In the monitored age group (45–69 years) this can be explained mainly by "protective hypothesis", which assumes that presence of a partner provides certain psychological and social support, help during illness, help to cope better with stress situations, better and more stable economic situation, healthier and more responsible life-style and easier access to information about health and healthcare (*Goldman, 2001, p. 10 069*). Fusing categories to persons with a partner and persons without a partner did not allow us to evaluate the negative widowhood effect.

Negative effect of smoking was unambiguously confirmed also by results of the HAPIEE study, where the risk was found to be by 72 % higher for smokers compared to life-time non-smokers. Several studies confirmed that mortality of smokers due to circulation system diseases is at minimum by 50 % higher compared to non-smokers (e.g. *Šimon et al., 2001*). Report *U. S. HHS, The Health Consequences of Smoking – 50 Years of Progress (2014)* shows a risk of development of ischemic heart disease for smoking males to be in the range of 1.78–2.50 compared to non-smokers and 2.00–2.86 for smoking females. The risk of development of cerebrovascular event is higher by 92 % for smoking males and 2.1 times higher for smoking females.

A higher risk of development of cardiovascular disease was not found for ex-smokers in the HAPIEE study data analysis, and this was also confirmed by several studies monitoring the effect of quitting smoking on cardiovascular risk. At the present, it is estimated that quitting smoking reduces the cardiovascular risk very quickly (*CDC, 2010*). The risk of development of acute myocardial attack decreases very rapidly at the first year after quitting. Quitting after a cardiac event lowers the risk of relapse by one third, and then the risk of development of a cerebrovascular event decreases to the level of life-time non-smokers after 2 to 5 years after quitting (*CDC, 2010*). Among ex-smokers in the HAPIEE cohort there were only 12 % of those who had quit smoking at a time shorter than 5 years before entry into the study.

Blood pressure effect was analysed in the HAPIEE cohort as follows – population was divided only to individuals with high blood pressure (above 140/90 mmHg) and individuals with lower values. High blood pressure was confirmed as the significant risk factor contributing to death due to circulation system diseases, and increased this risk by more than 70 % in the final model controlled for the influence of other risk factors. It was, however, confirmed by meta-analysis (data of 61 prospective cohort studies) where the blood pressure represented a continuous variable that the pressure value, at which the risk of death due to circulation system diseases starts to increase, is 115/75 mmHg for all age categories *(Lewington et al., 2002*). Starting at this value this risk increases about twofold with each 20 mmHg of systolic blood pressure or with 10 mmHg of diastolic blood pressure, and it relates to cerebrovascular disease, ischemic heart disease and other vascular diseases. Limitation of our data, however, did not allow similar analysis.

The **effect of obesity** on cardiovascular health was monitored using the body mass index (BMI), which still remains to be a significant predictor of both general and specific mortality. For an example: *Whitloc et al. (2009)* based on analysis of data of 57 prospective studies (more than 900,000 respondents) confirmed the relation between BMI and mortality according to causes of death. The lowest mortality was found based on this analysis in persons with BMI in the range of 22.5–25.0 kg/m^2. The total mortality rate increased by 30 % with each 5 kg/m^2, mortality due to IHD increased by 40 % and by 50 % for other vascular diseases (the model was controlled for age, gender and smoking habits). Our model monitored only the effect of obesity (i.e. persons with BMI of 30 kg/m^2 and higher were compared to persons with BMI below 30 kg/m^2) on CVD mortality. As a separately monitored factor, obesity increased the risk of fatal cardiovascular disease by 60 %. The variable obesity in the model controlled for socio-demographic factors and smoking similarly as in the study of *Whitlock et al.* (*2009*) increased the monitored risk by 47 %. In the final model, the effect of this factor disappeared mainly after addition of the variable prevalence of diabetes.

Quite surprisingly, the **effect of total cholesterol level** on cardiovascular health of Czech population was not found in this model. This fact may be due to several facts. A high portion of persons without a detected value of this marker was present in the total population as well as in the population of deaths due to CVD. Also, more exact results would be achieved, if the variable were included in the model as a continuous variable (or divided into categories with the same number of respondents, e.g. quartiles, quintiles), however, this was abandoned because of missing values for the part of population.

Another fact that might result in not confirming cholesterol as the CVD risk factor in the Czech population is the high prevalence of this factor in the population. Confirmation of the effect of a factor, when a large part of the population is affected, is usually very difficult (*Rose, 1981*). 76 % of persons in the HAPIEE population were detected with a higher cholesterol level (above 5 mmol/l). Meta-analysis made using data from 61 prospective studies (*Lewington et al., 2007*) and monitoring the effect of cholesterol level on mortality due to circulation system diseases confirmed the effect of the total cholesterol level on ischemic heart disease. With each decrease by 1 mmol/l, the risk for both genders dropped by one half, one third and one fifth depending on the age of 40–49 years, 50–69 years and 70–89 years respectively. Results of the relation between the cholesterol level and death due to cerebrovascular disease were quite surprising, since no relation was found. Authors of the study believe that statins (drugs lowering the cholesterol level) reduce the risk of development of cerebrovascular event beyond lowering the cholesterol level and the associated coronary risk. This conclusion, however, needs more evidence. Monitoring the effect of cholesterol level on mortality due to all circulation system diseases may have been influenced in our study by the fact that some cardiovascular diseases are not significantly influenced by a high total blood cholesterol level.

In recent years, studies have appeared that note also the issue of a low total blood cholesterol level (hypocholesterolemia). Therefore, cholesterol is another determinant of health condition, where the risk of development of health difficulties is probably distributed as a U-curve, i.e. a negative effect on human health is exhibited also by a low cholesterol level. The low cholesterol level is most frequently associated with depressions, cancer, respiratory diseases, mainly chronic obstructive pulmonary disease and also with haemorrhagic cerebrovascular event (*Jacobs et al., 1992*). However, this issue is neglected in comparison to the effect of high blood cholesterol level, and the research in this area is only marginal. Studies performed so far have their limitations, and are not accepted in general. Neglecting this issue and inclusion of persons with low cholesterol level into the group with the optimum cholesterol level in our analysis may be also one of reasons for not confirming the risk of the increased cholesterol level on cardiovascular health in the HAPIEE population.

Relation of **diabetes** and CVD has been known for a long time. For an example, the Framingham study estimated the risk of clinical development of atherosclerotic disease to be twice to three times higher in diabetic patients compared to persons without diabetes (*Kannel, McGee, 1979*). The negative effect of diabetes on mortality due to circulation system diseases was confirmed also by data from the HAPIEE study. The risk was twice higher for persons with diabetes even after control for the monitored socio-demographic factors and other life-style related factors.

With the variable of **physical activity**, it is necessary to consider not only its protective effect, but also the negative effect of physical inactivity on human health. Report of the US Department of Health of 1996 (*U.S.HHS, 1996*) notes that the protective effect of regular physical activity on prevention of

development of coronary event is not only comparable to other life-style related factors, e.g. to life-time non-smoking, but mainly that physical inactivity is comparable to cardiovascular risk resulting from smoking. The risk resulting from smoking and the risk from none physical activity for cardiovascular health were comparable in the final model. Health benefits of regular physical activity increase with the progressing age. Older persons have a higher risk of development of many health difficulties or chronic diseases, and physical activity helps to control already existing health difficulties (e.g. diabetes, high blood pressure or increased cholesterol level). Beyond the control of optimum body weight, physical activity improves the function of vascular internal wall and therefore it prevents from formation of atherosclerotic plates.

Another variable without a detected effect on cardiovascular health or on mortality in the monitored cohort was excessive **alcohol consumption** during short time. This variable is probably mostly influenced by subjective responses made by respondents or by underestimation of their own consumption. On the other hand, similar results were presented by *Malyutina et al. (2002)* by data from MONICA study in Russian population. Risk of death due to circulation system diseases increases in persons falling into the category of heavy alcohol consumers, i.e. "drinkers", but occasional binge drinking (160 g or more of pure alcohol) may not necessarily increase the cardiovascular risk. *Malyutina et al. (2002)* chose 160 g or more of pure alcohol to be the criteria for binge drinking. The analysis of HAPIEE study used even more moderate criteria of 100 g.

Among significant determinants of cardiovascular health, the effect of nutrition was not tested. Nutrition as a decisive factor for development of cardiovascular diseases must have a significant effect on health also in Czech population. Nutrition in Czech population can be described as rich on animal fats, low on fiber, low on fruits and vegetables and with high energy uptake, which reflects also the prevalence of obesity and diabetes to be among the highest in Europe.

With regard to the **population viewpoint**, a significant risk factor in Czech population was mainly the high blood pressure. Its elimination could prevent from 28 % of deaths due to circulation system diseases. Approximately 20 % of deaths in the population were due to smoking and the insufficient physical activity. A total of 18 % of deaths could be hypothetically prevented, if persons living without a partner had the same risk of development of fatal circulation system diseases as persons living with a partner. The lowest portion of deaths in the population relates to obesity (7 %; small and insignificant difference in the risk between obese and normal persons) and diabetes (8 %; low prevalence of persons with diabetes in the population compared to other risk factors).

The main results are presented in table 2 and 3.

Table 2: Hazard ratios for selected covariates and CVD mortality, basic and final model (Cox regression)

Covariates		Basic model Hazard ratio	sign.	Final model Hazard ratio/	sign.
Socio-demographic factors					
Age (completed)		1,111	***	1,109	***
Prevalence of diseases of circulatory system	No	*1*		*1*	
	Yes	2,651	***	2,288	***
Gender	Female	*1*		*1*	
	Male	2,771	***	2,312	***
Education	Tertiary	*1*		*1*	
	Primary	3,937	***	2,915	***
	Vocational	2,248	***	1,891	**
	Secondary	2,107	**	2,091	**
Partner	Yes	*1*		*1*	
	No	1,652	***	1,595	***
Metabolic factors and lifestyle factors					
Smoking habits	Non-smoker			*1*	
	Smoker			1,723	***
	Ex-smoker			1,240	
Obesity	No			*1*	
	Yes			1,248	
High blood pressure	No			*1*	
	Yes			1,709	***
2DM	No			*1*	
	Yes			2,050	***
Physical activity	Sufficient			*1*	
	None			1,723	***
	Insufficient			1,060	

Log Likelihood		-2719	-2665
Likelihood ratio test, p-value			***
Significance:	*=5%	p-value<0,05	
	**=1%	p-value<0,01	
	***=0,1%	p-value<0,001	

Data source: HAPIEE Study, National Institute of Public Health

Table 3 Population attributable fraction of selected covariates in the final model and CVD mortality (PAF, %)

Risk factor	PAF (%)
Education (tertiary vs. others)	47,7
Partner (no vs. yes)	17,8
Smoker and ex-smoker vs. non-smoker	20,6
Obesity (yes vs. no)	7,1
High blood pressure (yes vs. no)	27,9
2DM (yes vs. no)	7,7
Physical activity (none and insufficient vs. sufficient)	19,4

Data source: HAPIEE Study, National Institute of Public Health

4. Conclusions

Diseases of circulation system constitute the main cause of death not only in developed European countries. Complications of atherosclerosis present a rapid increase of prevalence and mortality rate in developing countries as well. Prevention and treatment of CVD are the most important worldwide epidemiology challenges, and **cardiovascular health is the key component of improvement of health condition of populations.**

After more than 60 years of the intense epidemiology research devoted to cardiovascular diseases, it can be noted that the **main role in the cardiovascular health condition has the external environment**. WHO in its report on chronic diseases 2010 (*WHO 2011*) attributes 80 % of all heart diseases and cerebrovascular diseases to factors resulting from behaviour/life-style of an individual/population. These diseases can be prevented in a large part mainly by effective and preventive interventions focused on risk factors as improper nutrition, excessive (harmful to health) alcohol consumption, smoking of tobacco products and insufficient physical activity. These life-style risk factors are also responsible for more than 80 % of premature deaths due to circulation system diseases (*Carlos et al., 2014*).

Cardiovascular epidemiology places more and more emphasis on achieving the so-called **ideal cardiovascular health**, which includes not only elimination of risk factors at the level of an individual and of a population, but mainly active strengthening the health through life-time and achieving optimum values of factors benefiting to health (*Donald et al., 2010*).

High risk of development of fatal and non-fatal cardiovascular event has about 20–30 % of the middle age population, but almost all population is at risk. Only individuals with minimum/**optimum values of all risk factors** of these diseases, i.e. with protective effect of the small risk are "protected" against development of cardiovascular diseases. About 3 % of individuals of middle age American population have optimum values (stipulated as non-smoker, systolic blood pressure below 120 mmHg and total cholesterol below 4.6 mmol/l) of risk factors (*Stamler et al., 2005b)*. Within the Czech population of middle and older age (according to data of the HAPIEE study, 45–69 years, 2002–2005) only a mere fraction of population, about 0.5 %, can be designated to be without a risk.

Ideal cardiovascular health in the middle age drops not only the mortality rate due to cardiovascular diseases, but also mortality rate due to other chronic diseases (e.g. diabetes, malignant tumours, chronic obstructive pulmonary disease, kidney disease), improves the quality of life during the older age and prolongs the length of life without illness. Patients with diagnosed cardiovascular disease represent only a "tip of the iceberg" of the epidemic of this disease in the population. The remaining and highly numerous part of the "iceberg" is represented by the population with increased of high values of risk factors resulting in development of these diseases.

In early 1990s, the **Czechia** entered into the stage of health transition characterized by reducing cardiovascular diseases, the so-called "cardiovascular revolution". During more the last twenty years, there has been a permanent drop in mortality rate due to circulatory system diseases. In spite of this significant drop, mortality rate due to these diseases remains to be twice higher than in countries of the former EU15. Some **problematic zones** can be detected behind the overall decrease.

Drop in mortality rate can be seen in acute forms of diseases as the result of healthcare improvements and new treatment approaches during the acute manifestation of a disease. However, there is still no success in reducing the prevalence and the subsequent mortality due to **chronic form of cardiovascular diseases** as chronic ischemic heart disease. Many **deaths** can be considered as **premature** or preventable. Mortality before the age of 75 years has a large share in the overall mortality due to circulation system diseases (44 % in males and 18 % in females). Current development of mortality due to CVD reflects changes in the life-style of individuals, historical development in mortality and in illness rate and the impact of risk factors in population during the entire second half of last century or during the life-time of individuals.

There are significant opportunities in cardiovascular health within the Czech population mainly in the life-style of people. Countries of the so-called "Western Europe" passed through the "cardiovascular crisis" not only due to developments in medicine, but also in more than a half due to changes in life-style of their population. Our population remains to be still far from the "healthy life-style", mainly from the viewpoint of nutrition habits, physical activity and the related overweight, obesity and prevalence of diabetes. Changes in life-style of the Czech population are very slow compared to the extraordinary improvements in healthcare during the 1990s. We are not successful in reducing the portion of smokers in the population. Number and portion of people suffering from diabetes and of obese people in the population have been increasing. The portion of hypertonic patients in the population is increasing as well, but average population blood pressure values have been standing still during the last 10 years. On the other hand, a positive trend is the significant drop in the average level of total cholesterol in the population and a higher portion of persons having their hypertension under control.

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Current approach of cardiovascular epidemiology undergoes a transition from the approach reducing only the prevalence of risk factors in risk exposed individuals to the approach of active strengthening the cardiovascular health of the whole population during the life-time. Many studies confirmed that without support of public health of the whole population, it is not possible to expect a drop in prevalence of circulation system diseases (e.g. *Capewell, 2008*). Structural changes in cardiovascular

health of the population can be expected mainly with changes at the level of physical activity and nutrition habits of the whole population (*Willet, 2013; Stamler, 2005a*). For the Czech population, it is necessary to supplement the healthcare focused on the individual with an increased cardiovascular risk by population health strategy focused on the whole population.

There are no such findings or miracle drugs/methods in the fight with diseases as antibiotics or vaccines that almost eradicate a given problem as in case of infectious diseases. There are only various types of treatment of already existing diseases or health difficulties, e.g. postponement of clinical manifestations of hypertension or hypercholesterolemia, improvement of quality of life after a cardiovascular event and subsequent prolongation of life. Success in treatment of chronic diseases is limited by the chronic characteristics of these conditions, by their consequences and their impact on quality of life mainly during late stages of the disease. Prevention of cardiovascular and cerebrovascular diseases is much more difficult and complex process than the prevention of infection diseases, and it is necessary to include individuals into the process of changing the life-style. Healthcare policy and individual strengthening the health are therefore mutually dependent. The driving force of the second stage of health transition is the perception of risk factors as of the decisive element in the fight with cardiovascular diseases and with man-made diseases.

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