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Ageing and prevalence changes of coronary heart disease risk factors among Vilnius men: the LiVicordia-V10 study

Robertas Petraitis[1],

Arvydas Kaminskas[1],

Algis Abaravičius[1],

Loreta Bagdonaitė[1],

Anders Olsson[2],

Zita Kučinskienė[1]

[1] *Department of Physiology, Biochemistry and Laboratory Medicine, Faculty of Medicine, Vilnius University, Lithuania*

[2] *Faculty of Health Sciences, Linköping University, Sweden*

Background. The aim of our study was to describe the development of risk factors of CHD in ten years among the LiVicordia study Vilnius men. 86 men from Vilnius cohort were reinvestigated at the age of 60 years. The new data were compared with the original data.

Methods. Sample of 86 Vilnius men were studied at age of 50 and 60 years. Investigation methods including laboratory analysis methods were followed as close as possible in both studies.

Results. Decreasing physical activity was noted among the men investigated. An increase in mean BMI and the proportion of obese individuals, an increase in mean serum total, LDL- and HDL cholesterol, triglycerides levels, increase of proportion of individuals with hypercholesterolemia were found. The ratio of apo B to apo A1 has decreased. The proportion of men with the optimal systolic blood pressure (less than 120 mmHg) and with optimal diastolic blood pressure (less than 80 mmHg) has increased during a 10 year period. The proportion of smoking men during ten years has decreased.

Conclusions. Levels of traditional CHD risk factors among the investigated Vilnius men remain high. Changes in lifestyle, namely, decrease in physical activity could partially explain the unfavourable changes of some CHD risk factors. The results of our study suggest that programs for control of CHD risk factors among middle aged men are necessary.

Key words: apolipoprotein, body mass index, blood pressure, cholesterol, lifestyle

INTRODUCTION

Cardiovascular diseases (CVD) are the most common cause of death in the developed countries and increasing rapidly in the developing world (1). CVD is the main cause of death over past decades in Lithuania as well (2). The most frequent causes of CVD mortality are coronary heart disease (CHD) and stroke

Longitudinal studies can provide useful insights into the effects of factors such as smoking, physical activity, nutrition etc. on the incidence of CHD. Because these conditions develop gradually over time, it is important to analyze their effects on intermediate risk factors such as blood pressure, low density lipoprotein (LDL) and high density lipoprotein (HDL) cholesterol. Adverse lipid and lipoprotein profile has been established as a risk factor form in many chronic conditions, including CHD. Often, age has been found to be associated with changes in lipid concentrations.

The LiVicordia study (Linköping – Vilnius coronary artery disease assessment study) was a cross-sectional investigation of CHD risk factors concomitantly comparing 150 randomly selected 50 year old men from Vilnius, Lithuania, and Linköping, Sweden (3). This study was performed in 1994. In our study LiVicordia-V10 (LiVicordia Vilnius men ten years follow-up study) we have reinvestigated the CHD risk factors in LiVicordia Vilnius men cohort ten years after the LiVicordia study. The aim of our study was to describe the changes of traditional CHD risk factors beyond the middle ages in the cohort of LiVicordia Vilnius men.

MATERIAL AND METHODS

In the LiVicordia study a random sample of 200 men, born between July 1 1943 and June 30 1944 was obtained from the Vilnius City Census Registry. Exclusion criteria were serious acute or chronic diseases, which could prevent participation or invalidate the results of investigations. A total of 159 men participated in the LiVicordia study.

The LiVicordia V-10 study was carried out at Vilnius University Hospital Santariškių Klinikos from March till April 2004, and 86 men from the original cohort were reinvestigated at the age of 60 years. The representativeness of the study cohort was tested by comparing its baseline investigated parameters (the LiVicordia study) to the dropouts. Comparing dropouts and participants of the LiVicordia study there were no significant differences among the investigated parameters.

Correspondence to: Robertas Petraitis, Faculty of Medicine, Vilnius University, M. K. Čiurlionio 21, LT-03101 Vilnius, Lithuania.
E-mail: robertas.petraitis@mf.vu.lt

Investigation methods including laboratory analysis methods were followed as close as possible to the methods of LiVicordia study in order to compare the results of both studies.

Body mass index (BMI) was used as a measure of relative body weight (kg/m^2). Blood pressure was measured twice by mercury manometer in a sitting position after 5 min of rest. Blood serum cholesterol and triglycerides were measured using enzymatic – colorimetric assays. Lipoproteins containing apolipoptotein B (apo B) were precipitated, and the cholesterol concentration in the solution was regarded as HDL cholesterol. LDL cholesterol was calculated by Friedewald equation. Apolipoprotein A1 (apo A1) and apo B were measured immunoturbidimetrically.

At the health examination site participants of the study had to fill in a self-administered questionnaire that included questions about medical history and health behaviour. Physical activity at work and leisure time was measured by a four category scale (score 1 – lowest physical activity, score 4 – highest physical activity). Score 1 of physical activity at work was described as "mainly sedentary work, e. g. sitting at the table"; score 2 – "necessary to walk during work without lifting of heavy items, e. g. work with the clients"; score 3 – "intensive walking during work, carrying heavy items, e. g. post-man's work"; score 4 – "heavy, intense physical work, lifting of heavy items, e. g. work of a nurse". Score 1 of physical activity at leisure time was described as "the time mainly spent for reading, watching TV or theatrical performances etc."; score 2 – "minimum 4 times per week going for a walk or wheeling, light work in the garden, fishing etc."; score 3 – "the time mainly spent for running, swimming, tennis or other similar sport"; score 4 – "mainly heavy training, running, swimming, skiing etc. regularly in matches". Participants of the study had to rate their physical activity by selecting one statement from four which would describe their physical activity the best. According to answers on smoking participants were divided into two groups: current smokers and non-smokers. The self-administered questionnaires were identical to both in our LiVicordia-V10 study and the LiVicordia study.

Table 1. **Mean values and prevalence rates of CHD biological risk factors**

Risk factor	50 years	60 years	
Body mass index (kg/m^2)	27.07 ± 3.55	28.35 ± 3.80	p < 0.001
<25	32.6	9.3	p < 0.001
25–29.9	45.3	53.5	p = NS
>30	22.1	37.2	p < 0.05
Sagittal diameter (cm)	21.34 ± 2.81	21.61 ± 2.87	p = NS
Ratio of waist circumference to hip circumference	0.92 ± 0.06	0.94 ± 0.05	p = NS
Total cholesterol (mmol/l)	5.13 ± 0.96	5.95 ± 1.17	p < 0.001
<5.0	52.3	22.1	p < 0.001
5–6.49	38.4	52.3	p < 0.05
6.5–7.99	9.3	22.1	p < 0.05
≥8	0	3.5	
HDL cholesterol (mmol/l)	1.16 ± 0.28	1.50 ± 0.28	p < 0.001
<0.9	12.8	0	
≥0.9	87.2	100	p < 0.001
LDL cholesterol (mmol/l)	3.35 ± 0.91	3.68 ± 0.98	p < 0.001
≤4.1	79.1	70.9	p = NS
>4.1	20.9	29.1	p = NS
Triglycerides (mmol/l)	1.36 ± 0.93	1.59 ± 0.90	p < 0.05
≤4.1	96.5	96.5	
>4.1	3.5	3.5	
Apo A1 (g/l)	1.30 ± 0.20	1.66 ± 0.31	p < 0.001
Apo B (g/l)	1.16 ± 0.29	1.13 ± 0.28	p = NS
Ratio of Apo B to Apo A1	0.92 ± 0.27	0.71 ± 0.23	p < 0.001
Systolic blood pressure (mm Hg)	140.41 ± 20.61	142.01 ± 24.15	p = NS
<120	4.7	15.1	p < 0.05
120–159	75.6	65.1	p = NS
≥160	19.8	19.8	p = NS
Diastolic blood pressure (mm Hg)	88.34 ± 11.90	85.53 ± 12.10	p < 0.05
<80	14.0	26.7	p < 0.05
80–99	60.5	60.5	
≥100	25.6	12.8	p < 0.05

NS – non significant; Apo – apolipoprotein.

Note. Values are means ± standard deviations or percentage.

The study protocol was approved by the Bioethical Committee of Lithuania.

Continuous variables are presented as mean values plus or minus 1 standard deviation; qualitative variables are presented as absolute frequencies. Only the men for whom the LiVicordia and the LiVicordia-V10 data were available were included for the investigation into the changes of CHD risk factors during a ten year period. Comparisons between continuous variables were made with paired t test. For investigation of differences between participants of the follow-up study and dropouts calculation Student's t test was used. Associations between categorical variables were tested with the calculation of χ^2 test. All reported p values are made on the basis of 2-sided tests and compared with a significance level of 5%.

RESULTS

The mean values and prevalence rates of CHD biological risk factors among the investigated men at the age 50 and 60 years are presented in Table 1. The changes in smoking, physical activity at leisure and work are presented in Table 2. There was not any significant change in proportion of men who received treatment for hypertension or dyslipidemia.

Figs. 1–3 show cumulative distributions of mean total cholesterol, LDL- and HDL cholesterol; the distributions are moved towards higher cholesterol levels at the age of 60 years. Fig. 4 shows cumulative distribution of the ratio of apo B to apo A1; the whole distribution is moved towards lower ratio values at the age of 60 years.

Table 2. **Prevalence changes in smoking and physical activity**

	50 years	60 years	
Current smoker	36.0	22.4	p < 0.05
Physical activity during working time	(86)	(70)	
low (scores 1 and 2)	74.1	94.3	p < 0.001
high (scores 3 and 4)	25.9	5.7	p < 0.001
Physical activity during leisure time	(85)	(81)	
low (scores 1 and 2)	73.3	92.6	p < 0.001
high (scores 3 and 4)	25.7	7.4	p < 0.001

NS – non significant.

Note. Values are means ± standard deviations or percentage (the number of men who rated their own physical activity in the study questionnaire).

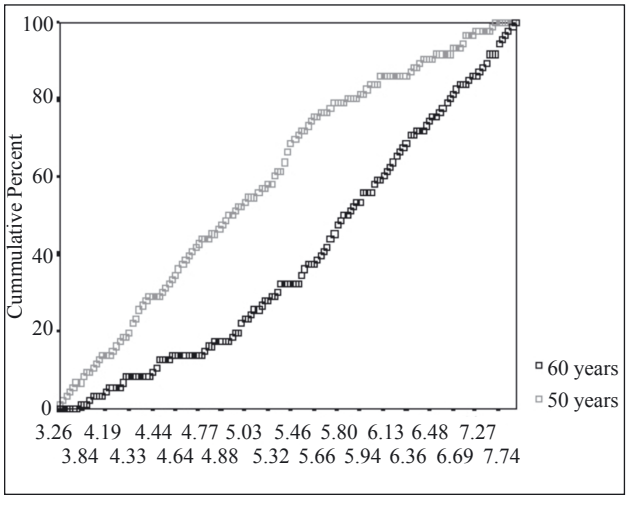

Fig. 1. Cumulative distribution of mean total cholesterol at the age of 50 and 60 years

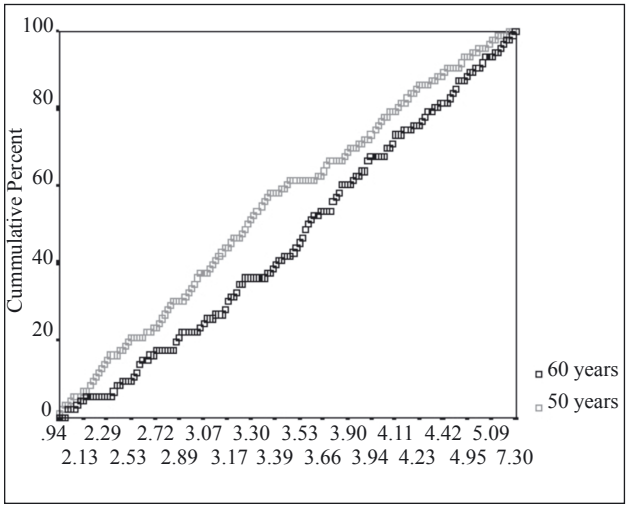

Fig. 2. Cumulative distribution of LDL cholesterol at the age of 50 and 60 years

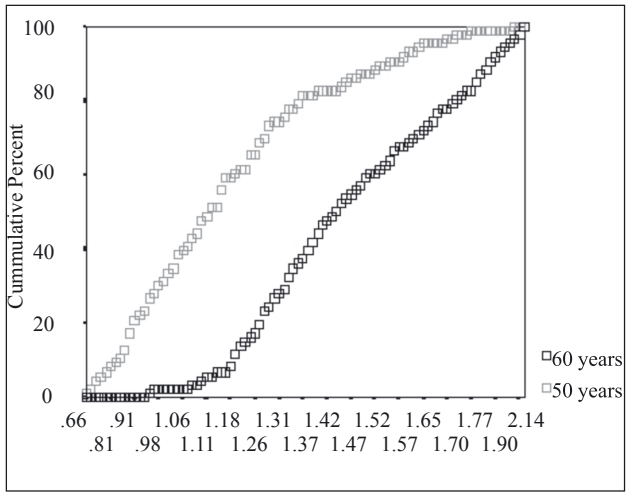

Fig. 3. Cumulative distribution of HDL cholesterol at the age of 50 and 60 years

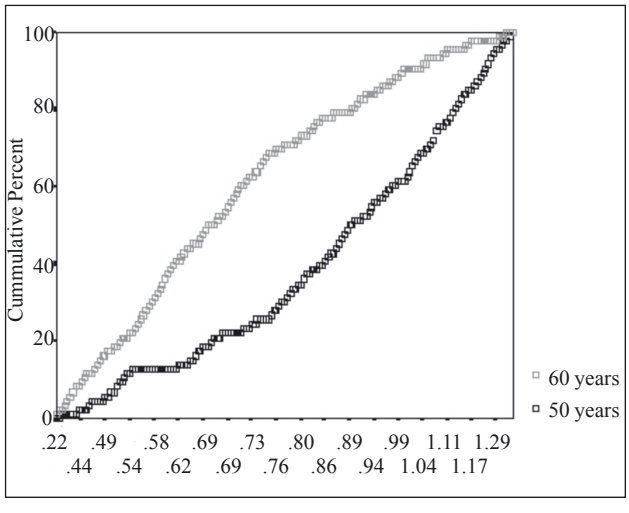

Fig. 4. Cumulative distribution of ratio of apo B to apo A1 at the age of 50 and 60 years

DISCUSSION

This paper provides information about the changes that were found in traditional CHD risk factors and other anthropometric, lipid and lifestyle variables in a cohort of Vilnius men of the same age group over a period of ten years from the time they were 50 until they reached the age of 60 years. In our study we found an increase in mean BMI and the proportion of obese individuals, increase in mean serum total and LDL cholesterol levels, increase of proportion of individuals with hypercholesterolemia and increase in mean triglycerides levels. The proportion of men with the optimal systolic blood pressure (less than 120 mmHg) and with optimal diastolic blood pressure (less than 80 mmHg) has increased. The proportion of smoking men during ten years has decreased as well.

Similar changes of CHD risk factors were found among middle aged Kaunas men. In the cross-sectional study performed in 1992–1993 and in 2001–2002, an increase in obesity prevalence, total cholesterol levels, improved blood pressure levels among middle-aged men were observed, and there were no changes in smoking prevalence among the investigated men (6). A recent cross-sectional study of CHD risk factors in rural population in Lithuania has shown that the increase in prevalence in hypercholesterolemia is also increasing with age (5).

The age dependent change of lipid levels were observed in many cross-sectional studies (6, 7), but reliable longitudinal increase of lipid levels with age is rare (8, 9). In Lithuania the longitudinal investigation of CHD risk factors was performed at 22 years follow-up from 1972–1973 to 1995–1996 among 45–59 year old 345 Kaunas men (10). In this study except mean systolic blood pressure any significant age-related changes of mean BMI, total cholesterol levels, and mean diastolic blood pressure were not observed comparing the results of the first health examination, when the mean age of the investigated men was 50.8 and the third examination, when the mean age of the investigated men was 66.0.

The Framingham study showed that the prevalence of the most of CHD risk factors increased with age, including BMI, total cholesterol, diabetes, and hypertension. In this study it was found that only cigarette smoking has decrease with age (11). It was also found that BMI of men increased until the age of 65 years and then has declined in men. Total cholesterol levels increases up to the age of 60–70 years in both, men and women, due to the increases in LDL cholesterol. The ratio of total cholesterol to HDL cholesterol declined steadily with age. HDL cholesterol levels increase with age.

Increase in mean BMI and proportion the of obese among middle-aged Vilnius men during ten years, which was found in our study, could also be explained by the changes in lifestyle among the investigated men and significant decrease in physical activity in both leisure and work time. High dependence of BMI on the reduced physical activity is the consisting finding in many studies of CHD risk factors. Some longitudinal studies have shown that changes in physical activity have an effect on obesity and lipid levels (12, 13).

The positive changes in nutritional parameters, namely, consumption of fat and decreasing proportion of energy intake from fats was found among the LiVicordia V-10 study men (16). Our study also suggests that we found an increase in BMI and lipid levels despite declining trends in dietary fat consumption and increasing trends in fruits and vegetables consumption seen in Lithuania during the past ten years (15, 16).

Obesity is not a well demonstrated hazard for the development of CHD with the increasing age, but weight gain and abnormal obesity continues to adversely influence all the major CHD risk factors by promoting insulin-resistant state (17). Excess accumulation of visceral fat is associated with insulin resistance, hyperinsulinemia, diabetes, hypertension, lipoprotein lipase abnormality and dyslipidemia and, as a result, accelerated atherogenesis.

In our study we have found a significant increase in waist circumference to hip circumference and an insignificant increase in sagittal diameter. Both these parameters are indexes of abdominal visceral adipose tissue accumulation and are related to cardiovascular risk. Obesity has been associated with the overproduction of Apo B, causing elevations of LDL cholesterol levels.

Mean total cholesterol level increased by 16% among the investigated men. This increase is attributable to the increase in both HDL- and LDL cholesterol; however, the ratio of total cholesterol to HDL cholesterol has decreased. This age-dependent increase in HDL cholesterol was reported in some studies and remains unclear.

Triglyceride levels among the investigated men also increased but there was no change in proportion of men with hypertriglyceridemia during ten years. The significance of triglycerides as a risk factor for CHD and its relationship with hyperinsulinemia and glucose intolerance is emphasized in recent studies (18, 19). Some studies concluded that the most important cause of hypertriglyceridemia is overweight (20). In our study increase in both triglyceride and HDL cholesterol levels was an unexpected finding because, in general, obesity and hypertriglyceridemia are associated with the decrease in HDL cholesterol. Similar finding was obtained also in other studies (21). As far as proportion of men with hypertriglyceridemia did not increase, indexes of central obesity are contradictory; we suggest that potentially "atherogenic" metabolic disturbances, that are age-dependant, did not increase among the investigated men. The ratio of Apo B to apo A1 that in recent studies was confirmed as a powerful lipid-related predictor of risk for CHD (22) has significantly decreased.

Smoking that is strongly associated with mortality from CHD, showing direct relationship with the amount of tobacco consumed and duration of the addiction (23) also has decreased among the investigated men during ten year. Other studies have also reported declining trends in smoking prevalence among men (24).

The LiVicordia V-10 study has shown improvements in proportion of men with normal systolic (less than 120) and diastolic (less than 80) blood pressure and a decreased mean diastolic blood pressure. Shift of blood pressure distribution can be explained by improved medication quality because proportion of men who received treatment for hypertension did not change. Similarly, trends of blood pressure decrease with the increase in obesity were found in other studies as well (25).

Levels of traditional CHD risk factors among Vilnius men aged 60 remain high. Similar finding of lower mortality rate

from CHD and higher total and LDL cholesterol levels among Linköping men comparing to Vilnius men in LiVicordia study ten years ago suggests that Vilnius men are approaching western pattern of CHD risk factor. Significant changes in the prevalence of CDH risk factors – increase in mean BMI, proportion of obese men, increase in mean total cholesterol and proportion of men with hypertriglyceridemia, increased mean triglyceride levels – could not be related only to ageing of the investigated group of Vilnius men. Nutritional and lifestyle factors that may influence the age-dependence of lipid levels and the known age-dependent rise of the level of atherogenic plasma lipoproteins are partly preventable (26). The results of our study suggest that programs for control of CHD risk factors among middle-aged men are necessary.

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Robertas Petraitis, Arvydas Kaminskas, Algis Abaravičius, Loreta Bagdonaitė, Anders Olsson, Zita Kučinskienė

VYRESNIO AMŽIAUS VILNIAUS M. VYRŲ KORONARINĖS ŠIRDIES LIGOS RIZIKOS VEIKSNIŲ POKYČIAI: LIVICORDIA V-10 STUDIJA

S a n t r a u k a

Mūsų studijos **tikslas** buvo išnagrinėti ir aprašyti koronarinės širdies ligos (KŠL) rizikos veiksnių pokyčius tarp vyresnių Vilniaus m. vyrų. LiVicordia studijoje dalyvavę 86 vyrai buvo pakartotinai ištirti, kai jiems sukako 60 metų. Studijos rezultatai buvo palyginti su LiVicordia studijos rezultatais.

Metodai. Tirti 86 vilniečiai vyrai 50 ir 60 metų amžiaus. Tyrimų metodai, įskaitant laboratorinius tyrimus, buvo kiek įmanoma analogiški.

Rezultatai. Per dešimtmetį tirtų vyrų fizinis aktyvumas sumažėjo. Daliai tiriamųjų nustatytas padidėjęs kūno masės indeksas, kraujo serumo bendras, MTL bei DTL cholesterolis, triacilglicerolių koncentracija serume, padaugėjo nutukusių asmenų, taip pat asmenų, kuriems nustatyta hipercholesterolemija. Tarp tirtų vyrų buvo pastebėtas sumažėjęs apo B / apo A santykis. Vyrų, turinčių optimalų kraujospūdį (mažiau nei 120 mmHg), bei vyrų su optimaliu diastoliniu kraujospūdžiu (mažiau nei 80 mmHg) dalis per dešimtmetį padidėjo. Rūkančių vyrų dalis per dešimtmetį sumažėjo.

Išvados. KŠL rizikos veiksniai tarp tirtų Vilniaus vyrų išlieka intensyvūs. Nepalankius rizikos veiksnių pokyčius galima paaiškinti pakitusia tirtų vyrų gyvensena, pvz., sumažėjusiu fiziniu aktyvumu. Studija patvirtina, jog KŠL rizikos veiksnių kontrolės priemonės yra būtinos tarp vyresnio amžiaus vyrų.