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THE RELATION BETWEEN ELEVATED BLOOD PRESSURE IN YOUNG MEN AND CRITICAL GROWTH PERIODS

Summary of doctoral dissertation

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JAUNUOLYSTĖS AMŽIAUS VYRŲ PADIDĖJUSIO KRAUJOSPŪDŽIO SĄSAJOS SU KRITINIAIS AUGIMO PERIODAIS

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ABBREVIATIONS

ABP	arterial blood pressure
AH	arterial hypertension
BD	body density
BF	breast feeding
BMI	body mass index
CHD	coronary heart disease
CI	confidence interval
CNID	chronic non-infectious diseases
CVD	cardiovascular diseases
DBP	diastolic blood pressure
HCF	heart contraction frequency
HDLC	high-density lipoprotein cholesterol
hs-CRP	high sensitivity C – reactive protein
LDLC	low-density lipoprotein cholesterol
MAP	mean arterial pressure
max	maximum value
min	minimum value
OR	odds ratio
PAH	primary arterial hypertension
PGS	pubertal growth spurt
PI	ponderal index
PP	pulse pressure
SBP	systolic blood pressure
SD	standard deviation
SUA	standard unit of alcohol
TC	total cholesterol
TG	triglycerides
WHR	waist-to-hip ratio

1. INTRODUCTION

Primary arterial hypertension (PAH) is a progressing syndrome of cardiovascular changes which shows as high arterial blood pressure (ABP) caused a number of interrelated reasons when a single obvious reason is not known. PAH is one of the major cardiovascular risk factors and the main cause of morbidity and mortality in most countries including Lithuania. The disease is diagnosed in 15–37% of adult inhabitants in developed countries and twice as often in Eastern European countries. The *FinBalt Health Monitor* project carried out in the Baltic States and Finland has shown a decline, within 14 years, in the number of overweight people in Lithuania as well as in the number of cases of hypercholesterolemia and occurrences of PAH in women. However, the risk for Lithuanian citizens, particularly male, to suffer from cardiovascular diseases (CVD) remains high. It must be stated that the positive changes towards reducing the risk factors for chronic non-infectious diseases (CNID) are too slow in Lithuania. According to the data of the CINDI (*Countrywide Integrated Noncommunicable Diseases Intervention*) survey of 2007, Lithuania is still to be placed among the countries of higher PAH prevalence. The findings of the epidemiological researches carried out in Lithuania show that the total PAH morbidity has remained similar in both genders for the last 20 years, but the number of cases increases with years. Younger men are prone to have this disease: within the period from 1987 to 2007, the prevalence of PAH in young males of 25 to 34 years old did not decrease and the rates remain sufficiently high at 39.4%. Meanwhile the problem is less relevant to young women as within 20 years the number of PAH cases in young females has decreased almost four-fold to 12.7%.

More attention is encouraged to be paid to high blood pressure in young people. Younger people are developing PAH not only in Lithuania. Children, especially teenage boys, are more and more often diagnosed with it. Taking into consideration the findings of surveys carried out in other countries and due to the fact that younger and younger individuals, especially males, are diagnosed with PAH, its causes should be searched for in the childhood. The possible relation of birth parameters and growth peculiarities to this disease is given insufficient attention. According to research results, PAH morbidity, especially among young people, can only be partially explained by the general cardiovascular risk factors. More and more research is carried out into the critical growth periods in an individual's development, i.e. the periods which are particularly sensitive to the impact of the environment, which prove that saltatory, disharmonious, and rapid growth of weight and/or height occurring in the aforementioned periods may influence the development of CNID in the future. Research studies of this nature in various populations are heterogeneous and contradictory and longitudinal studies are insufficient. Lithuanian children differ from their peers in other countries in terms of constitution, therefore there are likely to exist differences in their growth as well as certain correlation peculiarities in predicting higher blood pressure. However, it is not clear which of the general risk factors for hypertension and which of the peculiarities of the critical growth periods have major influence on blood pressure developments in young people in our country. The topicality of this question gave encouragement to research and identify the arterial hypertension (AH) risk factors that have a major influence on young Lithuanian men with elevated blood pressure. The pursuance of better understanding of the reasons why some young people are liable to have elevated blood pressure led to the search of the relation between growth peculiarities and high blood pressure disease.

1.1. The aim of the research

The aim of the research was to evaluate the relation between elevated blood pressure in young males and the peculiarities of different critical growth periods, cardiovascular risk factors, heredity, and the social and economic conditions of the young man's family.

1.2. The objectives of the research

The following research objectives were set:

1. To evaluate the importance of neonatal parameters (birth weight, birth length, body mass index, head circumference, chest circumference, gestational age) to blood pressure and body mass index at young age.
2. To establish the differences in the velocity of growth of the anthropometric parameters in the periods of infancy and adiposity rebound and the influence thereof on blood pressure.

3. To analyse the relation of the peculiarities of the body mass changes in adolescence and at the beginning of adolescence and puberty indicators (pubertal growth spurt start time and spermarche time) to the risk of elevated blood pressure at young age.
4. To compare the characteristics of constitution, composition, proportion and somatotype of young men with elevated blood pressure to the ones of healthy peers.
5. To evaluate the relation between elevated blood pressure at young adult age and the traditional hypertension and biochemical atherogenesis risk factors (high sensitivity C – reactive protein, dyslipidemia and glycaemia).
6. To establish the importance of the cardiovascular risk in the parents of the research participant, the family's socioeconomic factors and the peculiarities of early infancy feeding to the risk of elevated blood pressure.

1.3. The novelty of the research

The novelty of this research study lies in the choice to research unusually young Lithuanian citizens, only males, whose age fits the interval of young adult age (between 18 and 21), who have not been researched in the area of AH as extensively as older individuals. The data of the research were evaluated using the longitudinal method: growth parameters from birth until young adult age (a period of 18 years) were analysed, which help to reveal child growth and puberty characteristics that can be linked to the development of elevated blood pressure specific to our population. At the same time, apart from the characteristics of the changes in anthropometric growth parameters, traditional AH risk factors were evaluated in terms of their occurrence not only in the participating young men but also in their parents, thus integrating traditional risk factors and growth peculiarities. Furthermore, the novelty of the study is in the examination of lipid quantities in the young participants and the attempt to analyse high sensitivity C – reactive protein (hs-CRB) marker not only as a risk factor for obesity or coronary heart disease (CHD) but also as a possible risk factor for elevated blood pressure in individuals of that age.

2. RESEARCH PARTICIPANTS AND RESEARCH METHODS

The research was commenced on 15 July 2009 and completed on 31 October 2010. The research was carried out under permit No.158200-6-058-056LP3 obtained from the Vilnius Regional Biomedical Research Ethics Committee.

2.1. The selection of research participants and the formation of groups

The participants of the research were patients of four family clinics in Vilnius, only males at young adult age (18 to 21 years old). 231 individuals (n=231) were researched: 48 in the case group and 183 in the control group (1:3.8). The research participants were informed young men who had agreed to participate and signed the participant information form and the informed consent form. Following the preset exclusion criteria, the following individuals were excluded: those who refused to undergo any of the procedures necessary for the proper evaluation of the condition according to the research methodology; patients with mental disorders, those unable to understand speech; patients with chronic diseases which affect weight and height or with diseases that may be a secondary cause of high ABP; those who, during the research period, were being treated for burns; those who were taking medicines or food supplements affecting ABP, hs-CRP quantities, glucose and lipid quantities; individuals with chronic diseases (systemic connective tissue diseases, liver diseases, chronic urinary or kidney diseases, chronic gastritis); those who, at the time of research, had common cold symptoms; individuals who had higher than 10 mg/l hs-CRP quantities in their blood tests. According to their blood pressure, all the research participants were divided into two groups: those with ABP<130/85 mmHg (optimal and normal ABP) were attributed to the *control* group, and those with ABP≥130/85 mmHg (pre-hypertension and AH parameters; hereafter referred to as elevated blood pressure) were included into the *case* group.

2.2. The research process

The young men were researched during one visit, in the morning, after at least 10 hours of fast. All the participants' data were recorded using the specially-tailored seven-part research participant data form. Each individual's anthropometric development data from birth until 18 years old was recorded in the form and fulfilment of the inclusion criteria was noted. Before the survey and measuring of the participant, a sample of venous blood was taken in order to perform biochemical analysis. After the venipuncture, the young men were surveyed using the specially-tailored questionnaire to record their age, nationality, and risk factors related to PAH development. Later, ABP and heart contraction frequency (HCF) were tested. Finally, various anthropometric parameters of the participants were taken in order to assess their constitutional and proportional characteristics. The parents of the participants were contacted and if they agreed to take part in the research (the participant information form and the informed consent form signed), the parents were also surveyed.

2.3. The research methods

2.3.1. The evaluation of the young men's birth and further development anthropometric parameters

From each participant's child health and development records (f.025-112/a) and/or medical records (f.025/a) to the research participant's data form at classified age periods, the following anthropometric parameters about the peculiarities of the participant's birth and further development until the age of 18 were transferred: birth weight, birth length, head circumference and chest circumference at birth, gestational age, and changes in weight, height and ABP within the period. The body mass index (BMI) was calculated by dividing the participant's body weight at each age period in kilograms by the square of his height in metres. Also, the ponderal index (PI) at birth was calculated by dividing the individual's birth weight in kilograms by the cube of his birth length in metres. The transferred anthropometric data of the young men from both the groups were to be inter-compared and used for comparison with the Lithuanian child weight, height, BMI population-based normative data. Having the participant's height development data, the pubertal growth spurt (PGS) was identified and the data were compared between the two groups. PGS is the period of rapid increase in height, weight and other body measurements, which is a sign of coming puberty. In the longitudinal data analysis, each young man's total height increase in centimetres for each year between 11 and 16 years old was calculated.

2.3.2. The participants' questionnaire survey into hypertension risk factors

The participants were asked to provide their demographic information (date of birth, age, nationality) and answer the questionnaire questions related to the research inclusion criteria (medicines taken at the moment, their continued use period; present health condition and complaints; presence of cold symptoms; chronic diseases anamnesis). During the survey, the young men were asked to choose the most appropriate answer to the survey questions and the following traditional risk factors related to the development of PAH were evaluated: changes in smoking, alcohol consumption, nutrition and physical activity. In order to avoid possible participants' memory errors the harmful habits account period was 30 days. All the questions and answer options were given to the participants by the researcher.

Smoking was considered taking into account whether the young man was a smoker at the time of the survey and if he had been a smoker in the past. For the smokers, pack-years, a number which describes the amount a person has smoked over time, were calculated by multiplying the number of cigarette packs smoked per day by the number of years the person has smoked. In the case of those who had smoked in the past, the age when they started to smoke and the number of years they smoked were recorded. Alcohol consumption was defined by the amount of alcoholic drinks the participant usually drinks per day in standard units of alcohol (SUA) according to the kind of alcoholic drink (or the kinds of most frequently consumed drinks), its alcoholic strength and amount indicated by the participant. It was assessed how often the research participant is liable to consume risky amounts of alcoholic beverages during one drink (≥6 SUA) as well as how frequently he is prone to consume alcohol in general, regardless of the quantity or strength of the beverage consumed. In terms of nutritional habits, the most relevant aspects were the following: how often the young man eats crisps, sweets and fast food (McDonald's type) and how frequently he consumes vegetables (fresh, boiled or stewed) and fresh fruit. Physical activity was determined by the participants' free-time sport or exercise habits. It was assessed whether the young man did exercise or sport at the time of survey or if he had done it before. Those who were doing sport were asked about the frequency and duration (in minutes) of each session as well as how long they had had the habit. The kind of sport was not taken into consideration. In the case of the participants who had done sport earlier, the age when they started doing sport and the period when they were involved in the activity were recorded. In order to determine the beginning of the young man's puberty the time occurrence of spermarche was indicated. The participants were also asked to indicate their age at which pollutions started.

2.3.3. The measurement of blood pressure and anthropometric parameters at young adult age

ABP was measured in all the participants following the recommendations provided in the European Society of Hypertension guidelines for correct ABP measurement of 2007. Following the second ABP measurement, HCF in the sitting position was evaluated by palpating the pulse on the radial artery site and counting the number of pulsations for 30 seconds. Mean ABP was calculated from three measurements on the left hand with a 2-minute break using the non-invasive method of auscultation (F.Bosch set, Germany). On the basis of systolic (SBP) and diastolic (DBP) blood pressure rates, pulse pressure (PP) and mean arterial pressure (MAP) values were calculated.

In order to evaluate the peculiarities of the young men's body constitution, composition and proportion, in accordance with the rules of correct measurement, the following anthropometric parameters were taken: height in the standing and sitting positions, weight, various body parts girths (chest, waist, hip, thigh, calf, humerus, and forearm). Also, skinfold thickness in different body areas (13 in total), breadths of different body segments (shoulder and chest breadth, chest depth, pelvis breadth) and limb bone breadths (the breadths of the distal humeral, forearm-bone, femoral, and tibia epiphyses) were measured. The height was measured using the metal Martin anthropometer (GMP Siber Hegner, Switzerlalnd; error +/- 5 mm), the participants were weighed wearing underwear only on medical electronic scales with 100 g precision (Kern MFB, version 1.0 08/2008; Kern&Sohn GmbH, Germany; calibrated at the time of the research following the manufacturer's recommendations). Body girths measurements were taken on the right side of the body using a measuring tape (error +/- 0.1 mm), without applying any pressure. Body segments' breadth values were measured with spreading callipers (error +/- 2 mm), limb bone breadths were taken with sliding callipers (error +/- 2 mm), on the right side of the body, skinfold thickness was measured using the Holtain callipers (Siber Hegner GMP, Switzerland; 40 mm scale, 0.2 mm step, skinfold pressure 10 g/mm², error 0.1 cm), performing three measurements on the right side of the body and calculating the arithmetic mean value.

Body girths closely correlate with weight and body size and reflect not only the subcutaneous adipose tissue but also the muscle and bone sizes. Body girths measurement methodology applied: the *humerus* was measured in the middle of its middle third; the *chest* was measured underneath the lower angles of the scapulas and over the areolas, during the breathing pause; the *waist* – at its thinnest site or at the navel (on obese participants), during the breathing pause; the *hips* – over the pubis, the greater trochanter of the femur and the nates (on the widest site); the *thigh* – in the widest site of the upper third; the *calf*– in the widest site of the upper third; and the *forearm* was measured in the widest site of the upper third.

The segment breadths are closely related to the size of the skeleton, bone mass and have influence on the constitutional type. The measurement methodology applied: the *shoulder breadth* measurement was taken between the acromions; the *chest breadth* is the largest diameter of the thorax at the level of mesosternale on the horizontal plane, during the breathing pause; the *chest depth* is the measurement taken between the mesosternale and the precess spinous of the thoracic vertebra on the horizontal plane (on the sagital axis, during the breathing pause); the *pelvis breadth* is the distance between the most lateral points on the superior border of the iliac crest.

The limb bone breadths were used for bone mass assessment. The measurement methodology applied: the *humerus breadth* was measured between medial and lateral epicondyles of the humerus; the *wrist breadth* – between the forearm-bone processus styloideus; the *femur breadth* –between medial and lateral epicondyles of the femur; the largest ankle diameter was recorded as the *ankle breadth*.

The skinfold thicknesses measuring describes the amount of the subcutaneous adipose tissue and the type of its topographic distribution in the body. The following special skinfold measuring methodology was applied: the *chin* measurements were taken sagitally in the middle of the lower part of the chin; the *chest I* – diagonally at the axillary crest of the pectoralis major; the *chest II* - diagonally at the costal arch in the middle of the line linking the nipple and the navel; the *axilla* – across the middle axillary line at the sternum midpoint level; the *abdominal* - longitudinally 2–3 cm sideways from the navel; the *hip* – vertical fold immediately superior to the iliac crest at the mid-axillary line; the *subscapular*– 2 cm underneath the lower scapula margin in the skinfold formation direction; the *back-part of the humerus* – longitudinally in the middle of the humerus over the triceps; the *front-part of the humerus* – longitudinally in the middle of the humerus over the biceps; the *forearm* – longitudinally at the largest size on the front part of the forearm; the *thigh I* – longitudinally in the middle of the thigh at the rectus muscle of the thigh, with the leg relaxed and the weight shifted on the left leg; the *knee* - crosswise over the patella; the *medial calf* – longitudinally at the largest size site on the medial part of the calf (the measurements were taken in the sitting position, with the thigh and the shin bent). The two research participant groups were compared not only in terms of the thickness of individual skinfolds, but in terms of the total thickness of skinfolds, the total of the thickness of individual skinfolds in specific areas of the body which reflect the distribution of this tissue in individual body areas. Therefore, on the basis of the skinfold measurements taken, the following additional calculations were performed: the total of the skinfolds in the *upper part of the body* and in the *lower part of the body*; the total of the *waist* (central body skinfolds) skinfolds (distinguishing the total of the upper part of the waist and he total of the lower part of the waist); the total of *three waist skinfolds;* the total of the *limbs'* skinfolds (separately assessing the totals of the upper and lower limbs skinfolds); the total of the body *peripheral* skinfolds.

Applying formulas, certain participants' anthropometric body composition and constitution characteristics were calculated and compared between the groups: BMI, PI, waist-to-hip ratio (WHR). According to their BMI, the young men were distributed into four groups: insufficient weight, with BMI <18.5 kg/m^2; normal weight, with BMI 18.5–24.9 kg/m^2; overweight, with BMI 25–29.9 kg/m^2; obesity, with BMI ≥30 kg/m^2. In order to determine the fact of presence of the metabolic syndrome, the recommended criteria for the diagnostics of the metabolic syndrome set by the 2009 common agreement of international organisations (IDF – *The International Diabetes Federation*; AHA/NHLBI – *American Heart Association / National Heart, Lung and Blood Institute*;

WHF – *World Heart Federation*; IAS – *International Atherosclerosis Society* and IASO – *International Association for the Study of Obesity*) were observed. Body density (BD) was calculated using the J.V.G.A. Durnin and M.M. Rahaman formula adapted for men:

Body density (BD) = 1. 610–0.0632 ($\log_{10}$ S)

(S – the sum of the front-part of the humerus, back-part of the humerus, subscapular and hip skinfolds (mm))

The body is made of the active (lean) and the passive mass: the active mass is bones, muscles, internal organs, and the passive mass is the fat tissue. The percentage of the passive body mass (fat) was calculated using the W. E. Siri formula:

Passive body mass (%) = [(4.95 / BD) – 4.50] x 100)

Having this rate, the total amount of the active and the passive body mass in kilograms was calculated, the percentage of the active body mass was assessed as well as the passive body mass-to-height ratio in metres squared *(fat mass ratio*) was defined. In order to analyse the young men's body size and proportion peculiarities, the following rates and indexes were calculated: leg length, waist length, waist-to-height percentage, and acromiocristal index. The conicity index was related to the amount of the fat tissue on internal organs and abdomen. For the evaluation of the skeleton size, the frame index was used. The young men's somatotype was defined by the metric index value: -1.3 and less – very slim; -1.2 to -0.7 – slim (leptomorphic); -0.6 to ±0,0 – medium (metromorphic); +0.1 to +0.6 – pyknomorphic; +0.7 and more – very pyknomorphic.

2.3.4. The methodology of the evaluation of the metabolic characteristics *(lipids, glucose, hs-CRP)*

Each venous blood sample for biochemical tests was extracted into two test-tubes following the main procedure rules. The procedure was performed by a trained nurse maintaining the same conditions for every participant. Each individual was placed in the sitting position, and blood from his right arm was first extracted into a test-tube with a grey plug (with sodium fluoride as glucose inhibitor) for the amount of glucose, then – into a test-tube with a yellow plug (with test-tube walls coated with silica particles and separator gel) for hs-CRP and lipids amounts. The biochemical tests were performed at the Laboratory Diagnostic Centre of Vilnius University Hospital Santariškių Clinics (VUH SC). The amount of lipids (total cholesterol (TC), low-density lipoprotein cholesterol (LDLC), high-density lipoprotein cholesterol (HDLC), and triglycerides (TG)) was evaluated according to the standard norms recommended by the European Society of Hypertension in 2007: dyslipidemia was defined when TC >5 mmol/l or LDLC >3 mmol/l, or HDLC <1 mmol/l, or TG >1,7 mmo/l. The normal values of glucose amount are 4.1–6.4 mmol/l. The hs-CRP as an inflammation marker test was performed by the standardised turbidimetric method. The concentration of <1.0 mg/l was defined as low-risk, 1.0–3.0 mg/l – medium-risk, ≥3 mg/l – high-risk. When hs-CRP amount was ≥10 mg/l, the result was not included into the research and the test was repeated after 2 weeks.

2.3.5. The questionnaire survey of the participants' parents

The questionnaire tailored for the participant's parents aimed at evaluating both parents' current age, their age at the time of the son's (research participant's) birth, the parents' weight and height, according to which their BMI was calculated. For data analysis, the parents were divided into four groups: insufficient weight, normal weight, overweight, and obesity. The questionnaire also included questions about the fact of PAH (if the participant's ABP≥140/90 mmHg or he continuously takes medicine for elevated blood pressure) and CVD (diabetes, hypercholesterolemia, vascular atherosclerosis, stroke, infarction) in the participant's parents and/or in their parents (the young man's grandparents). The parents were also asked about their smoking habits and pack-years were calculated for the smokers. The parents' education (according to the Education Classification approved by the Ministry of Education and Science, Decree No. ISAK-522 of 31 March 2005) and occupation (according to the standardised Lithuanian Classification of Occupations prepared in accordance with ISCO-88 International Standard Classification of Occupations) were recorded. The participant's family's social and economic conditions were also analysed: the respondents were asked about the number of family members (the number of children in the family, which child in the family the research participant is), income (for one family member in Litas per month), they were asked to class their income as one of the three given types in terms of the amount (lower than average, average, higher than average) and to describe the changes in their social and economic conditions in 18 years (remained stable, improved, worsened). The research participant's infancy nutritional peculiarities were considered as a possible AH risk factor; therefore, the mothers were asked about the length of the breastfeeding (BF) period and the dominant type feeding until the age of six months taking into account the proportion between BF and/or formula feeding. Feeding with cow milk, goat milk or C formula was defined as the formula feeding type. All the questions were independently answered by the participant's parents.

2.4. The methods of statistical analysis

The statistical analysis was performed using SPSS 13.0 for Windows, Exel 2007 and WinPepi programmes. The following quantitative parameters were provided: mean (M), standard deviation (SD), minimum value (min) and maximum value (max); and the following qualitative parameters: total number (n) and percentage (%) were given. For the comparison, in two groups, of mean characteristics, when the data is distributed equally, the Student's t-test was applied. For the comparison of two independent samples, the assumption of normality not being satisfied, the non-parametric Mann – Whitney U test was used. For the comparison of three independent samples in terms of the interval variable distribution, the non-parametric Kruskal – Wallis criterion was applied. For the verification of the independence of two variables or homogeneity of a single variable in both groups, on a nominal or rank scale, the χ^2 (chi-square criterion) was applied. Three group means and their dispersions were compared using the method of disperse analysis (ANOVA). For the assessment of linear correlation between characteristics, correlation analysis was performed by calculating the Spearman ir Pearson correlation coefficients (r). Correlation was defined as significant when r=0,3 or more. In order to identify correlation and predict the impact of individual independent interval variables on the possibility to have elevated blood pressure (using it as a dichotomous dependent variable), logistic regression was applied to assess the odds ratios and 95% confidence interval (CI). For the analysis of the quantitative variables' dependence on other factors, the models of multi-factor linear regression were applied.

For the verification of hypotheses and statistical confidence, $p<0,05$ significance level was chosen. In the analysis of the anthropometric growth parameters, the relative standard deviation method was used, calculating z-scores. Comparing the z-score at one certain age with the z-score (through the difference between the scores), the pace and direction of a certain individual could be defined. If a shift occurred within ≥0,67 SD, it was considered as catch-up growth. Growth models were made for the longitudinal analysis (panel data) of the repeated measurements (from birth until 18 years old) of the anthropometric variables. The models were created analysing the relation between the chosen independent variables and ABP response depending on time. For that purpose, the R statistical software was used.

In order to ensure the reliability of the questionnaires designed for the survey of the research participants and their parents, the test-retest method was used following 30 days after the first survey. 50 young men and the same number of fathers and mothers were retested. Comparing the interval values from both questionnaires, the ICC (*intraclass correlation coefficient*) was calculated and its confidence interval as well as p value was defined. For the nominal scale values, the simple kappa coefficient was calculated, and for the rank scale values, the weighted kappa coefficient was calculated; also standard errors (SE) and p values were defined for these rates, using Stata, version 10.

3. RESULTS

3.1. Critical growth periods' anthropometric parameters and their relation to blood pressure

The characteristics of different development periods were assessed and compared between the case and the control group participants. Later, taking into account all the significant differences and evaluating their possible correlation, their relation to elevated ABP was researched. Table 1 below shows the ABP and age characteristics defining the two groups of young men.

Table 1. Blood pressure and age characteristics in the two groups.

Characteristic	**Case group** (n=48)		**Control group** (n=183)		**p value**
	M (±SD)	Min–Max	M (±SD)	Min–Max	
Age (y.o.)	20 (1.4)	18.0–21.9	19.7 (1.3)	18–21.9	0.09
SBP (mean; mmHg)	134.5 (4.3)	130.0–144.7	115.7 (8.3)	88.7–129.3	**0.0005**
I	137.8 (6.5)	130.0–150.0	117.8 (9.3)	80.0–134.0	**0.0005**
II	134.4 (5.5)	122.0–146.0	116.2 (9.0)	94.0–134.0	**0.0005**
III	131.5 (4.0)	124.0–140.0	113.1 (8.9)	90.0–132.0	**0.0005**
DBP (mean; mmHg)	81.4 (4.7)	70.7–94.7	71.2 (6.9)	52.0–90.0	**0.0005**
I	82.2 (5.1)	70.0–94.0	72.1 (8.0)	50.0–90.0	**0.0005**
II	82.7 (5.9)	70.0–100.0	71.7 (7.5)	50.0–92.0	**0.0005**
III	79.4 (5.6)	60.0–90.0	69.7 (7.5)	50.0–90.0	**0.0005**
PP (mmHg)	53.1 (5.2)	41.3–63.3	44.5 (5.9)	26.0–58.7	**0.0005**
MAP (mmHg)	99.1 (3.8)	90.4–109.3	86.0 (6.9)	66.0–101.1	**0.0005**
HCF (b/min)	77.2 (10.1)	60.0–99.3	70.3 (10.5)	48.0–108.0	**0.0005**

I, II, III – the values of the first, second and third ABP measurement; PP – pulse pressure; MAP – mean arterial pressure; HCF – hear contraction frequency; M – mean, SD – standard deviation.

The young men from the two groups were compared by their birth characteristics (Table 2). It is noticeable that the young men from the case group have statistically significant differences in smaller head (p=0.001) and chest (p=0.04) circumference, taking into account possible gestational age influence. Head circumference at birth parameter compared to population norms, the case group mean value matched 25^{th} ‰, and the control group mean value matched 50^{th} ‰.

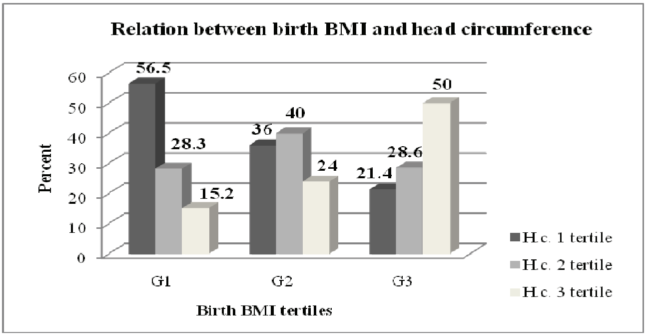
Table 2. Comparison of birth parameters between the groups.

Characteristic	**Case group** (n=48)		**Control group** (n=183)		**p value**
	M (±SD)	Min–Max	M (±SD)	Min–Max	
Birth weight (g)	3501 (500)	2300–4700	3564 (442)	2400–4720	0.43
Birth length (cm)	52.7 (2.5)	46.0–58.0	52.9 (2.4)	44.0–60.0	0.66
Birth BMI (kg/m^2)	12.5 (1.0)	10.0–15.6	12.7 (1.0)	10.0–15.6	0.30
Birth PI (kg/m^3)	0.24 (0.02)	0.20–0.29	0.24(0.02)	0.19–0.31	0.37
Gestational age (w)	39.7 (1.1)	36.0–42.0	39.7 (1.1)	34.5–42.0	0.74
Weight at discharge from hospital (g)	3450 (427)	2690–4600	3504 (419)	2080–4500	0.48
Head circumference at birth (cm)	35.0 (1.4)	32.0–37.0	36.0 (1.4)	32.0–40.0	**0.001**
Chest circumference at birth (cm)	34.1 (1.7)	31.0–38.0	34.9 (1.6)	31.0–38.0	**0.04**

PI – ponderal index; M – mean, SD – standard deviation

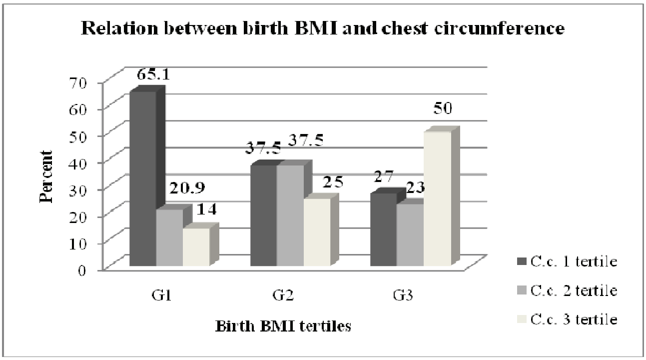
In order to carry out a more detailed study of homogeneity by the BMI value in both groups, apart from the mean values comparison, the research participants were distributed into three groups: from the lowest to the highest BMI value by forming tertiles. The same method was applied in the cases with the head and chest circumferences. In the elevated ABP group, individuals with the lowest and medium tertiles were relatively dominant, and in the control group, those who had the highest BMI at birth were dominant; however, the difference was statistically insignificant ($p=0.2$, $\chi^2=3.21$). The relatively lower birth BMI value was caused by the individuals' smaller weight at birth as compared to the whole sample and their insignificantly smaller length at birth. This was proved by the weight and height z-scores. Taking into account the fact that the case group was dominated by the infants with lower birth BMI, and the birth characteristics being compared, the statistically significant difference occurred only due to the head and chest circumferences, an assumption was made that the aforementioned indicators correlate with each other and that they reflect the generally smaller nature of the individuals in the case group. The hypotheses that all the three birth BMI tertiles differ by the individuals' head and chest circumferences at birth. In terms of he distribution of the head circumference tertiles in respect of the other two groups (the first and the second birth BMI group), the research participants from the third group had statistically significant difference as they had the largest head circumference, and those who had the smallest weight at birth (in terms of BMI) most frequently had the smallest head circumference (Fig. 1). The same consistent pattern was observed when analysing the chest circumference; however, in this case the statistically significant difference was found among all the three birth BMI groups (Fig. 2). Thus, both the aforementioned indicators reflect smaller cross measurements of the bone skeleton, and in terms of the longitudinal (height) measurements, validate the fact of the smaller somatotype at birth of the neonates in the case group.

Figure 1. Distribution of head circumference tertiles by birth BMI.



G1/G2 – p=0.13, χ^2=4.10; G2/G3 – p = **0.02**, χ^2=7.73; G1/G3 – p = **0.0002**, χ^2=17.25.

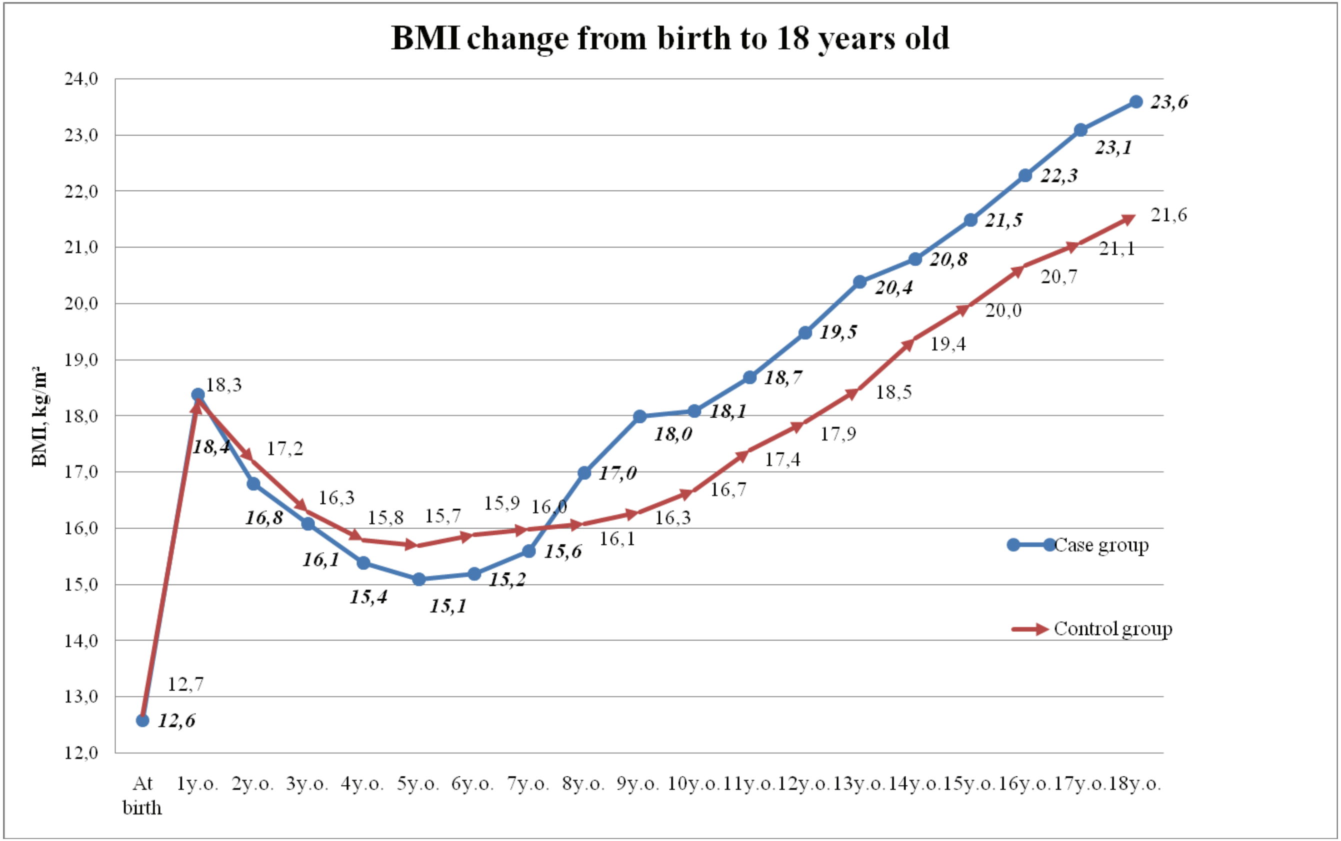
Figure 2. Distribution of chest circumference tertiles by birth BMI.



G1/G2 – p=**0.03**, χ^2=6.92; G2/G3 – p=**0.03**, χ^2=6.71; G1/G3 – p= **0.0002**, χ^2=16.89.

The graph in Figure 3 shows the development of the young men's BMI in both the groups from birth to the age of 18.

Figure 3. BMI change in two groups from birth to 18 years old.

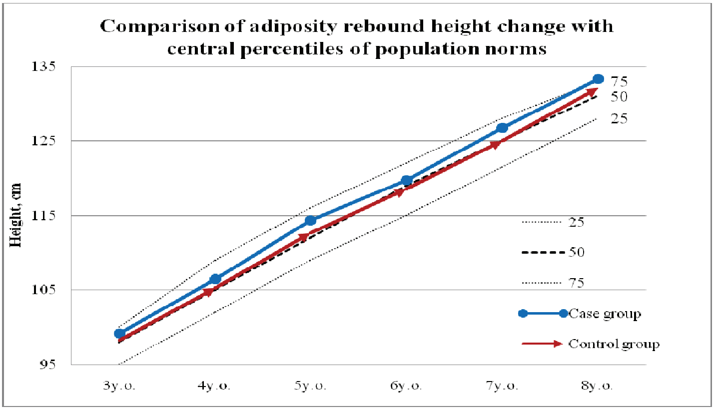


Through the analysis of the infancy development (from birth to 1 years old) and the comparison of the weight, height and BMI means of the individuals from both the groups at three-month interval, no statistically significant differences were found ($p>0.05$). At the age of 6 months, BMI values of the individuals from the two groups are almost identical. However, at the beginning of the second year, the case group has insignificant difference by the smaller BMI value, which might be caused by the bigger height. At the end of the first year, the individuals from the case group had a statistically insignificantly bigger weight (by 300 g on average) and height (1 cm higher on average). At the beginning of the first year, the height of the individual in the case group was at 50th ‰, at 9 months, the mean height value fell into the interval between 50th and 75th ‰ population norm, and at 1 year old, it was equal to 75th ‰ (shifted by 1 percentile interval). Meanwhile, the values in the control group were defined by 50th ‰. The weight growth in the case group was not so intensive and changed insignificantly on the percentile diagram. The infancy BMI values in both the groups matched 50th ‰ of the population norm. Therefore, statistically significant differences between the two groups compared were not found in the infancy period. However, the trends for intensive height growth that started at that period and continued in the childhood had an important influence on the prognosis of elevated ABP.

In order to define the growth peculiarities at the age between 1 and 7 years old, the childhood development characteristics, which cover the critical period of adiposity rebound (3-7 years old) as well, were compared. The most significant difference between the groups was in the BMI values (Fig. 3). The trends were similar in both the groups, but the children in the case group were prone to a have lower BMI value throughout the analysed period. The lowest values (maximum leanness moment) were reached by the children in both groups in their fifth year of life. The statistical significance by the before-mentioned indicator between the groups at this age is marginal ($p=0.10$). The comparison of the values shows that the research participants in the case group were more prone to gain height during the adiposity rebound (3-7 years old) period (the height value significance at 7 years old is marginal, $p=0.09$), which could explain the lower BMI values at this age period. The values of all the childhood indicators were compared with the population norm percentiles. The weight and BMI means were almost equal to

50th ‰ throughout the analysed period. Figure 4 shows the comparison of the noticed height differences with the central percentiles (25, 50, 75 ‰) of the population norms. It should be noted that in the period of childhood the height of the children in the case group reached 70th ‰ several times (at 1, 3 and 7-8 years old).

Figure 4. Comparative analysis of children's height in both groups.



Some quite specific observations were made when it was found that, in the childhood period, the individuals with elevated ABP continue to gain height more rapidly thus continuing the trend which started in the infancy. The total height difference from birth to 7 years old and the z-score change in the period provided statistically significant differences between the groups ($p<0.05$). The young men in both the groups experienced the adiposity rebound in a similar period from 5 to 6 years old. It was not early and matched the physiological development norm.

Taking into account the information provided in the overviewed literature that adolescence is one of the critical periods in the human development, it tried to analyse the peculiarities of the development taking place during puberty, at the beginning and the end of the period (7-18 years old). The comparative BMI diagram (Fig. 3) shows that the young men from the elevated ABP group, from the age of 9 and throughout this period, had statistically significant differences by this characteristic from their peers ($p<0.05$). The higher value of this indicator is determined by significantly bigger weight. The tendency for bigger height remains in the case group; however, it has statistically significant value only at a certain age (12 years old, p=0.02), and the difference significance is usually marginal. In order to perform a more detailed practical assessment, the adolescence weight and BMI indicators were compared with the current Lithuanian population norms (Fig. 5, 6). The weight values in the case group matched 75th –90th ‰ interval and reached 90th ‰ at the time of pubertal peak height velocity; meanwhile the values in the control group were almost equal to 50th ‰ and at some years analysed fell into the interval 50th – 75th ‰. Higher height growth trends were also observed in the case group, but this indicator was less significant. Year by year, a higher risk for BMI retention at adult age occurs (tracking phenomenon). This possibility was confirmed by the correlation analysis: the correlation between a certain age and the BMI of a young adult gradually increases from 7 to 18 years old (r increased from 0.5 to 0.8, in all cases p=0.0005). Meanwhile, the infancy and childhood BMI statistically significantly correlate with the young adult age BMI, but the correlation is weak or medium (r=0.3–0.4; p=0.0005).

Figure 5. Comparative analysis of the research participants' weight changes from 7 to 18 years old.

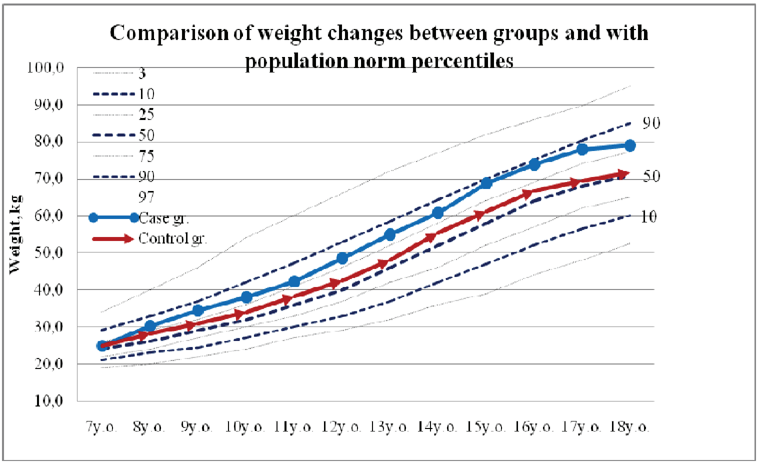
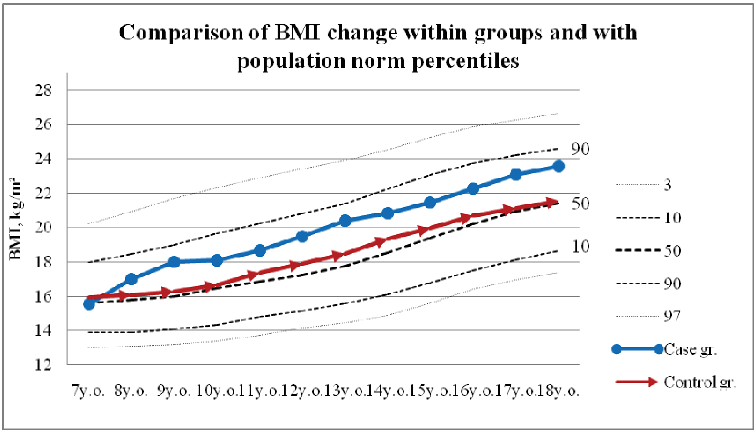


Figure 6. Comparative analysis of the research participants' BMI changes from 7 to 18 years old.



The information about the young men's ABP from 10 years old was available for analysis from medical records. At nearly every age, the SBP and DBP values of the young men in the case group were statistically significantly higher ($p<0.05$). Later, this information about ABP was analysed using the panel data analysis method by creating a growth model which facilitated the explanation of the changes in ABP occurring with time depending on the factors influencing it.

3.1.1. The comparison of the changes of the z-scores in all growth periods

The year-by-year changes in the weigh, height and BMI of the participants from both the groups, as well as the differences in the mean values were observed; also, the pace and trends of growth of these anthropometric parameters in certain age intervals (from birth to 1 year old, 1-7 years old, 7-18 years old) were compared. For this purpose, z-scores were calculated for the points marking the ends of the age intervals mentioned before (at birth, 1 year old, 7 years old, 18 years old). The assessment of the differences of each individual's z-score values at the end-points of certain age periods using longitudinal method, allowed the calculation and comparison of the amplitude of change (this variable may be defined as the change of z-score). The point charts of the weight, height and BMI z-scores are provided below.

Figure 7. Comparison of weight z-scores in chosen age periods.

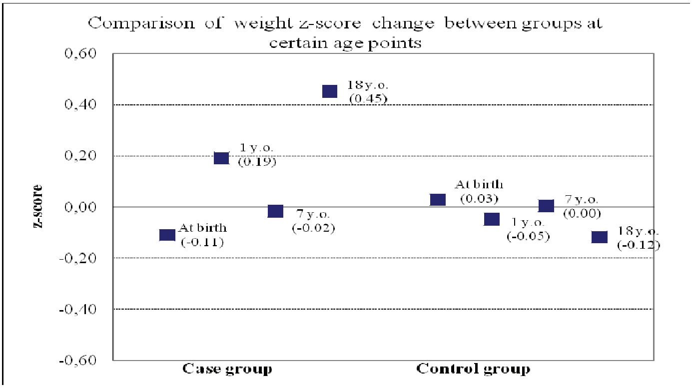


Figure 8. Comparison of height z-scores in chosen age periods.

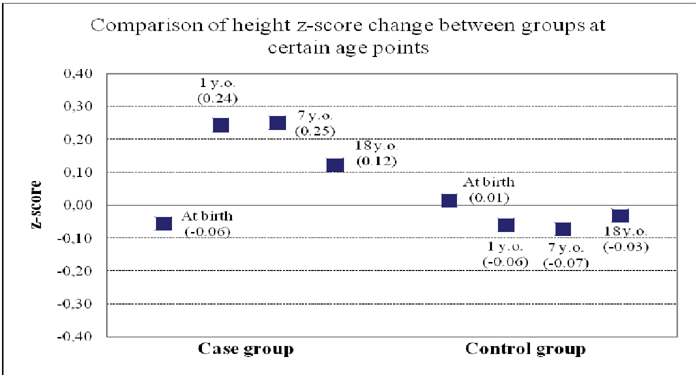
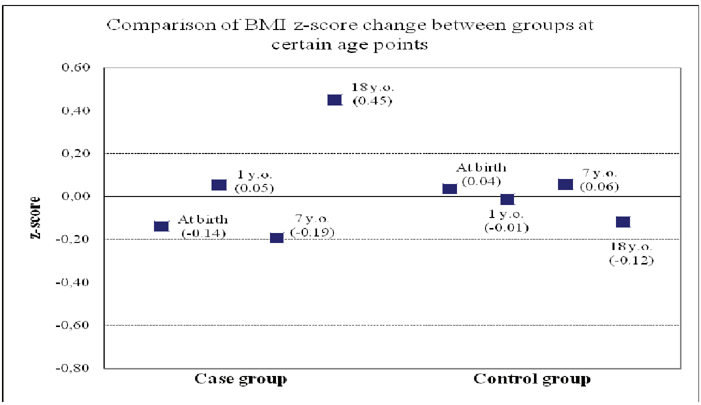


Figure 9. Comparison of BMI z-scores in chosen age periods.

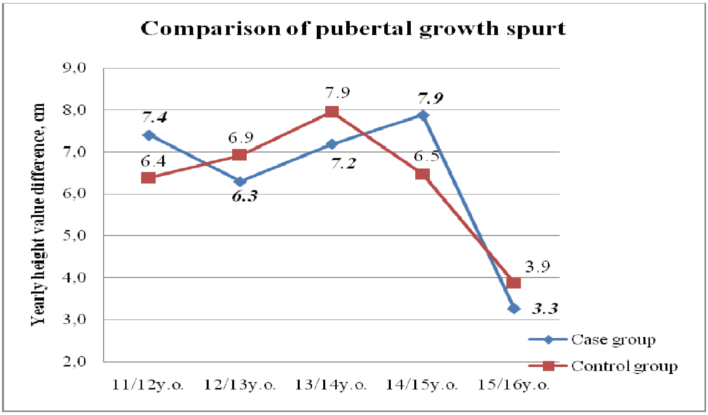


All the four weight z-scores in the control group were positioned close to the mean and no intensive growth spurs were observed; whereas the weight of the young men in the case group increased more intensively during the first year (the individuals were of smaller weight at birth) and especially in the period from 7 to 18 years old (the significance of the weight z-score change between the groups is marginal, p=0.07). There is a statistically significant difference between the groups by the weight z-score at the age of 18 (p=0.01). More rapid statistically significant height growth within the first 7 years is specific to elevated ABP group participants (statistically significant height z-score change, p=0.01). The same method having been applied in the analysis of the peculiarities of the BMI z-scores, a statistically significant BMI z-score difference between the groups at the age of 18 (p=0.01) and a statistically significant more rapid BMI growth between 7 and 18 years old (significant BMI z-score change, p=0.01) were found.

3.1.2. The relation between the puberty peculiarities and elevated blood pressure

The beginning of the young men's puberty was defined by the time of the spermarche (pollution age) given by the young men themselves and by the PGS which was calculated by the yearly height value difference using the longitudinal method. No statistically significant difference between the research participants from the two groups was found in terms of the first criterion as the given time of the spermarche was similar (13.9±1.3 y.o. (11.0–17.0) in the elevated ABP group vs 13.8±1.1 y.o. (12.6–16.0) in the control group, p=0.86).

Figure 10. Analysis of pubertal growth spurt in both groups.



The chart in Figure 10 shows that the young men with elevated ABP experienced the most intensive growth in the fourteenth and fifteenth years, when their PGS is, whereas the biggest difference in height in the control group occurred in the thirteenth and fourteenth years (one year earlier than that of the case group). There is no statistically significant difference between the groups by the yearly height difference, except the thirteenth and fourteenth years when the young men in the case group experience their PGS, but the height growth of those in the control group gradually slows down.

3.1.3. The creation of the growth model for the assessment of the relation of the significant differences of growth parameters to elevated blood pressure and a young man's body mass index

As the longitudinal measurements of the research participants' weight, height, BMI and ABP (from 10 years old) taken at different points in time from birth to adulthood may be defined as panel data reflecting the course of change of variables, the growth model was created for the longitudinal analysis of the data. The statistically significant differences of certain variables between the two groups having been considered, the following three variables were chosen for the attempt to explain the changes of SBP and DBP (from 10 years old to young adult age): the head circumference at birth, the BMI values at certain age from 10 to 18 years old and the BMI value from the last measurement in the research, and the change of height z-scores from birth to 7 years old (the difference between the height z-score at 7 years old and the length z-score at birth). The scores of the model showed that the BMI, the change of height z-scores within the first 7 years and the time variables were significant, whereas the head circumference at birth was not significant for the explanation of the relation to the change of SBP. The model scores allowed for the following conclusions: the increase of BMI by one unit raises SBP by 1.15 mmHg; the respondents who experienced relatively more rapid height growth within the first 7 years are prone to have higher SBP (when the difference between the height z-score at 7 years old and the length z-score at birth increases by one unit, SBP rises by 1.8 mmHg); the average SBP level gradually increases in children from 10 to 18 years old (at the age of 18-19 years old, the respondents had about 10 mmHg higher SBP than the 10-year-old respondents). The R^2 statistic of the model equalled 0.62. The same method was applied in the analysis of the models of the relation between the growth of identical variables and DBP. The R^2 statistic of the created model equalled 0.53. The scores of the BMI, the change of height z-scores within the first 7 years and the time variables in this model were also statistically significant ($p<0.05$); whereas, as in the case of SBP, the head circumference at birth was not significant ($p>0,05$) for the explanation of the relation to the change of DBP. Thus, the following conclusions were made: the increase of BMI by one unit raises DBP by 0.7 mmHg; the respondents who experienced relatively more rapid height growth within the first 7 years are prone to have higher DBP (when the difference between the height z-score at 7 years old and the length z-score at birth increases by one unit, DBP rises by 0.9 mmHg); the average DBP level gradually increases with time in children from 10 to 18 years old (at the age of 18-19 years old, the respondents had about 11 mmHg higher SBP than the 10-year-old respondents). Attempts to include more variables into the models were made, but as their regression coefficients were statistically insignificant, they were not incorporated into the final model.

For the conclusion about the significance of the change of height in childhood to be more practical and easier-interpretable, in the growth models, the change of height z-scores within the first 7 years was replaced with the total height change (in centimetres) within the same period. In all cases the R^2 statistics remained the same. The conclusions related to the impact of BMI and time on both blood pressures remained almost unchanged. The head circumference at birth remained insignificant. The conclusion that more intensive height growth within the first 7 years increases SBP and DBP (10 cm increase in height raises SBP by 4 mmHg and DBP by 3 mmHg) was successfully formulated. The first version of the conclusion about the pace of height growth in childhood (z-score change) should to be considered of more importance; however, the analysis of the total change of height (in centimetres) may be easier-interpretable. Also, the total height difference (in centimetres) from birth to 7 years old was statistically significant between the two groups of young men (74.8±4.2 cm (68.0–83.0) in the case group vs 72.4±5.3 cm (58.0–90.0) in the control group, p = 0.01). The general mean of the whole sample by this characteristic matched 72.9±5.1 cm scores and fluctuated between 58 and 90 cm.

As there were differences between the participants of the two research groups by some birth anthropometric parameters, an assumption was made that there may be a possible relation between those parameters sand BMI at young adult age and hence an impact on elevated ABP. The multifactor linear analysis was carried out and all the data obtained at the respondent's birth were modelled. Also, the variable defining the change of height z-scores within the first 7 years was added. After the assessment of the results of the model, not all the coefficients had statistically significant differences (p>0.05); therefore they were removed from the model on-by-one. The head circumference and weight at birth have statistically significant (p<0.0005) influence on the BMI at young adult age, coefficient of determination – 0.154, and there is no multicolinearity. For the assessment of beta (β) coefficients, the influence of both variables on the BMI value is equally important (β = - 0.43 for the head circumference and β=0.47 for the birth weight). According to the B-coefficient scores of the model, 1 cm larger head circumference at birth predetermines 1.07 lower BMI when the young man reaches adulthood; while 100 g bigger weight at birth increases BMI at young adult age by 0.4 units. The head circumference and birth weight explain the 15.4% BMI variation in the young adult age group The correlation analysis showed that the birth weight has statistically significant correlation with the active body mass (r=0.4, p=0.0005) and there is no correlation with the amount of fat. The head circumference at birth has weak negative but statistically significant correlation with the body fat mass ($r = -0.2$, $p=0.04$) and no linear dependence with the active body mass.

In search of links between the BMI values at young adult age and elevated ABP and for the assessment of their prognoses (using BMI as a dichotomous dependent variable), the logistic regression model was created and the odds ratio was assessed. First, only the BMI at young adult age was included, then, taking into account the relation between the young adult age BMI and the head circumference at birth, the latter variable was added to the model. This improved the overall classification percentage and R^2 statistic and changed the odds ratio (OR) value. The analysis of the influence of both the parameters on the prognosis for elevated ABP showed that they both were statistically significant ($p=0.005$ for the head circumference, $p=0.008$ for the BMI at young adult age). The overall classification percentage was 80.4%, the feasibility of the model is proved by χ^2 – 18.76, $p<0.0005$, Nagelkerke coefficient of determination – 0.186. The result of odds ratio (OR) for the head circumference was 0.64 (95% PI: 0.48–0.87) and for the BMI at young adult age indicator – 1.16 (95% PI: 1.04–1.29). The birth weight added to the model was statistically insignificant and impaired the overall classification percentage; therefore, it was excluded from further analysis.

3.2. The comparative analysis of the young men's anthropometric parameters of body composition, constitution and proportion and the influence on blood pressure

As the capability of the BMI value among young people, especially men, to identify the individuals who have weight increase due to a bigger amount of fat is insufficient (50-60% sensitivity), the research aimed at a more detailed assessment of body composition and the influence of both the key body components (active body mass and passive body mass) on ABP. Table 3 presents the comparative analysis of the main anthropometric parameters and body composition components.

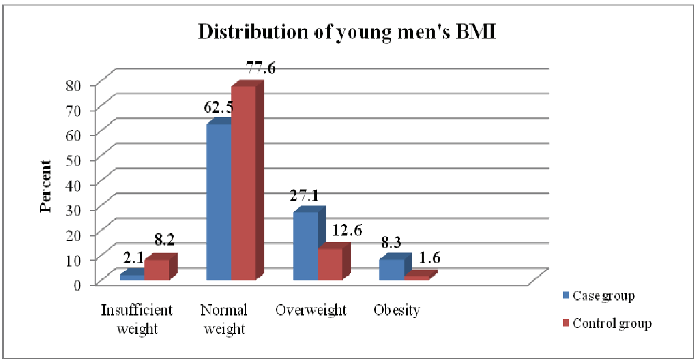
Table 3. Anthropometric parameters of the two research groups.

Parameter	**Case group** (n=48)		**Control group** (n=183)		p value
	M (±SD)	Min–Max	M (±SD)	Min–Max	
Weight (kg)	81.5 (15.6)	58.6–136.3	73.3 (11.8)	52.1–153.0	**0.001**
Height (cm)	183.2 (7.7)	167.0–203.0	181.7 (6.8)	164.3–200.0	0.22
BMI (kg/m^2)	24.3 (4.6)	18.0–40.7	22.2 (3.1)	16.7–42.7	**0.003**
Body density	1.061 (0.013)	1.035–1.089	1.069 (0.009)	1.043–1.085	**0.0005**
Fat mass (%)	16.5 (5.8)	4.6–28.1	13.3 (4.0)	6.4–24.4	**0.0005**
Active mass (%)	83.5 (5.8)	71.9–95.4	86.7 (4.0)	75.6–93.6	**0.0005**
Fat mass (kg)	14.2 (7.5)	2.7–37.0	9.9 (4.2)	3.6–23.1	**0.0004**
Active mass (kg)	67.4 (9.2)	52.8–99.3	62.9 (7.1)	47.4–84.0	**0.003**
Passive mass index (kg/m^2)	4.2 (2.3)	0.83–11.03	3.0 (1.3)	0.0–7.09	**0.0005**

M – mean, SD – standard deviation.

The research participants from the case group has statistically significant difference of bigger weight ($p<0.005$) and higher BMI value ($p<0.005$), but had no height difference ($p>0.05$). These young men had a statistically significant characteristic of relatively higher fat percentage (by nearly 3%) and bigger total lean mass as well as bigger total fat mass ($p=0.003$ and $p=0.0004$ respectively). It was found that the case group included a statistically significantly larger number of overweight or obese participants, while in the control group there were more young men with normal or insufficient weight ($p=0.003$, $\chi^2=13.98$) (see fig. 11).

Figure 11. Young men's distribution within groups by BMI value.



$p=0.003$, $\chi^2=13.98$

The number of individuals with the metabolic syndrome in both the groups was assessed: there were no participants with this syndrome in the control group, while the case group contained three young men (6.25%) matching the criteria for the syndrome. The odds analysis by three weight intervals was carried out for the young men with elevated ABP. There is a statistically significant risk increase along with the BMI category increase: prehypertension-level or higher ABP is 2.7 times more frequent in the overweight individuals and 6.3 times in the obese young men ($\chi^2=9.95$, $p=0.007$). The calculated correlation with the mother's BMI value is statistically significant but weak ($r=0.2$, $p=0.01$); whereas the influence of the father's BMI is stronger ($r=0.3$, $p=0.0005$).

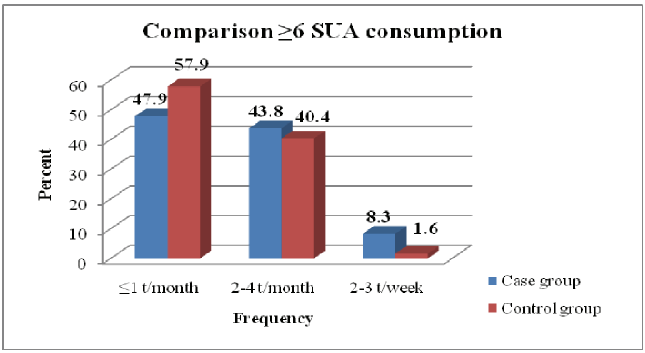
In terms of the various body parts girths, the young men with higher ABP were statistically significantly bigger by all girths, and the WHR was of marginal significance ($p=0.05$). The results of the body segment breadths and limb bone breadths measurements on the frontal plane showed that the young men in the case group have statistically significantly bigger parts of proximal limb skeletons and axial skeletons. The values of skinfold thickness measured in different parts of the body show that the young men from the case group have statistically significantly larger subcutaneous adipose tissue ($p<0.05$) in all body areas, except forearm. It may be asserted that these young men are prone to have centralised adipose tissue distribution and relatively smaller fat concentration in the upper limbs as compared to all skinfolds ($p=0.01$). It may be presumed that these young men also have thicker adipose tissue in their internal organs and in the abdomen as their conicity index was statistically significantly higher ($p=0.04$). In terms of body part proportions, there were no differences between the two groups by the shoulder-to-pelvis ratio and the waist and leg length ($p>0.05$). The values of acromiocristal index and the metric index were similar and the difference between the groups was statistically insignificant ($p>0.05$). The research participants from both the groups were similar by their somatotype: most frequently they were of slim and very slim body built (79.2% in the case group and 85.5% in the control group, $p>0.05$). The correlation analysis showed that SBP had statistically significant correlation with the axial skeleton (chest, waist, hip) and limb area (humerus, thigh, calf) breadths, all waist area skinfolds, both humerus and thigh area skinfols, knee area diameter (in all cases $r=0.3$, $p>0.0005$); DBP had statistically significant correlation only with the thickness of three waist area skinfolds: chest II, axilla and subscapular ($r=0.3$, $p<0.0005$).

In order to evaluate the connection of the body active mass and fat mass with ABP, a linear regression model with the aforementioned variables was created. It also included the head circumference at birth, which distinctly improved the value of the R^2 statistic. The active body mass and head circumference have statistically significant influence on SBP at young adult age ($p<0.005$). The body fat mass p value equalled 0.05, the coefficient of determination (R^2) was 0.24, multicolinearity was not found. For the assessment of beta (β) coefficients, the influence of all three variables on the SBP value is equally important (β = - 0.25 for the head circumference, β=0.20 for the total body fat mass and β=0.23 for the total active body mass). According to the B-coefficient scores of the model, 1 cm larger head circumference at birth, predetermines 1.7 mmHg lower SBP when the young man reaches adulthood. Also, bigger lean body mass amount predetermines 4 mmHg higher SBP with every 10 kg; while bigger fat body mass amount predetermines 3 mmHg higher SBP with every 10 kg. The model provides 24% explanation of the SBP variation at young adult age; however, it failed to explain the DBP variation. By including and excluding different variables into the analysis, the influence of certain variables on the DBP values was also successfully determined. The following scores were obtained: the chest circumference at birth, active body mass at young adult age, chest II skinfold, knee skinfold and calf breadth have statistically significant influence on DBP at young adult age ($p<0.05$), with the coefficient of determination (R^2) being 0.24 and no multicolinearity found (VIF<4). The beta (β) coefficients having been assessed, it was found that the most considerable significant influence on DBP was that of the chest II skinfold which is related to the risk of the metabolic syndrome (β=0.45, $p<0.0005$). The β scores for the other variables were as follows: β= -0.20 for the chest circumference at birth, β=0.42 for the total active body mass at young age, β= -0.32 for the calf breadth and β = -0.31 for the knee skinfold. According to the B-coefficient scores of the model, 1 cm larger chest circumference at birth, predetermines 0.9 mmHg lower DBP when the young man reaches adulthood. Also, bigger lean body mass amount predetermines 4 mmHg higher DBP with every 10 kg. The individuals whose calf breadth is 1 cm bigger will have 0.8 mmHg lower DBP, the ones whose knee skinfold is 1 cm thicker will have 1.2 mmHg lower DBP, and those with 1 cm bigger chest II skinfold will have 0.6 mmHg higher DBP. The model provides 24% explanation for the DBP variation at young adult age.

3.3. The comparison of the known hypertension risk factors occurrence in the young men from the two research groups

The research aimed at defining the known AH risk factors (smoking, alcohol consumption, nutrition, and free-time physical activity) which have the strongest relation to the risk of elevated ABP. There were no statistically significant differences found ($p>0.05$) in terms of the smoking habit (the fact of smoking, the age at which the individual started smoking, the length of smoking, the number of cigarettes smoked). Overall, 40% of the young men between 18 and 21 years old were smokers. However, it was observed that the participants from the elevated ABP group are statistically significantly more prone to consume risky amounts of alcohol during one drink ($p=0.04$, $\chi^2=6.41$) (see Fig. 12.).

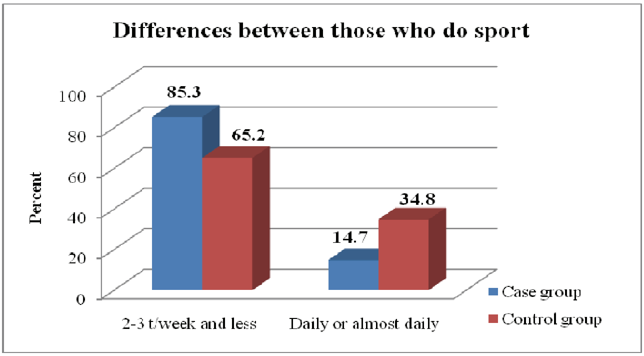
Figure 12. Comparison of the habit to consume risky amounts of alcohol between the groups.



$p=0.04$, $\chi^2 = 6.41$

No statistically significant differences were found between the groups ($p>0.05$) in terms of the amount of alcohol consumed per one drink and the frequency of alcohol consumption. About two thirds of the young men usually drink alcohol about 2-4 times per month (68.8% in the case group and 60.7% in the control group) and the amount consumed is usually equal about 9 SUA on average. The young men in our country are prone to consume weak or medium-strength (up to 20%) alcoholic beverages (68.8% in the case group and 66.1% in the control group, p>0.05). The peculiarities of the habitual consumption of health-adverse foods containing more salt, sweet foods (unitemised) and fruit and vegetables were studied. No differences were found between the two groups (p>0.05) in terms of all the above-mentioned aspects. Thus, it may be stated that there is no direct connection between young men's nutritional habits and elevated ABP. Only 50% of young men in our country eat fruit and vegetables every day or nearly every day, and only 10% eat them several times per day. The influence of physical activity on PAH was also assessed. Although there was no difference (p>0.05), between the young men from both the groups in terms of the number of individuals who do sport in their free time (about two thirds) and the length of one training session (about 90 minutes on average), it was found that the research participants with normal ABP do sport every day or nearly every day (≥4 times/week.), while those with elevated ABP - 2–3 times/week or less frequently (see Fig. 13). In comparison with doing sport every day or nearly every day, this lower-frequency physical activity increases the young men's risk for elevated ABP nearly three-fold (OR=3.1; 95% PI: 1.1–8.7, p=0.025).

Figure 13. Comparative analysis of individuals who do sport in both groups.

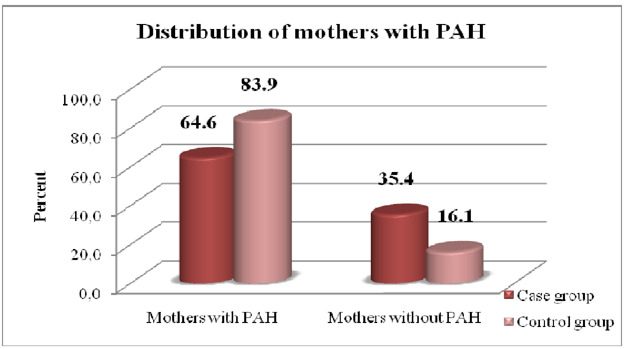


p=0.03, $\chi 2$=5.01

3.4. The analysis of the importance of the family and socioeconomic cardiovascular risk factors

Various family and social factors were analysed in order to better explain the young men's risk for the PAH development and to get a better understanding of the environment in which the research participants grew up. There were no statistically significant differences between the parents from the two groups in terms of their current age, key anthropometric parameters (weight, height, BMI), and the age at which their child (the research participant) was born ($p>0.05$). It was found that, among all the surveyed parents, 50 % of the mothers were of normal weight, while only one in three fathers were of normal weight. About 13% of the mothers and 27% of the fathers were obese. No differences were found ($p>0.05$) between the mothers and fathers of the participants from both the research groups in terms of the number of parents who smoke, their smoking intensity and the number of pack-years. Overall, about 12% of the mothers were smokers, while among the fathers the number was nearly 50%. There were some important observations made in the research related to the analysis of heredity. No differences were observed between the groups in terms of CVD occurrences among the father's and mother's family members ($p>0.05$). However, it was found that every third mother in the case group (35.4%), at the age of 47 on average, had already developed PAH; whereas the number of mothers with PAH in the control group was about two times smaller (16.1%). The difference was statistically significant ($p=0.003$, $\chi^2=8.69$) (see Fig. 14). The early development of PAH in the mother nearly three times increases the risk for her son to have elevated ABP at young adult age (OR=2.86, 95% PI: 1.4–5.9, $p=0.003$). The occurrence of PAH among the fathers and grandparents of the research participants (from the father's side) was similar, no statistically significant difference was found ($p>0.05$).

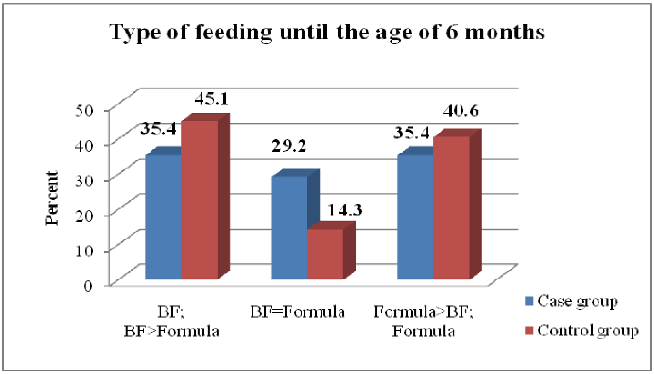
Figure 14. Comparison of mothers with PAH.



$p=0.003$, $\chi^2=8.69$

More mothers of the young men from the normal ABP group had a higher education (62.1%), while the mothers of the elevated ABP group participants more often were of a lower education (55.3%) ($p=0.03$, $\chi^2=4.60$). It was observed that the sons of the mothers with a higher education have a nearly 50% lower risk of elevated ABP (OR=0.49, 95% PI: 0.3–0.9, $p=0.03$). The significance of the fathers' education in both the groups was not stated, as 50% of the fathers had a higher education ($p>0.05$). The occupations of the parents were not important either in the attempt to explain the young men's elevated ABP by this factor ($p>0.05$). Both the research groups were compared in terms of the number of family members and the order number of the birth of the research participant. However, it was found that the same number of families in both groups had two (63%), three and more children (every fifth family) or one child (one in six families). Most of the young men from both the research groups were first children in their families (47.9% in the case group and 55.9% in the control group, $p>0.05$). The changes of their social and economic conditions within the period of 18 years were evaluated differently by the parents from the two groups: more parents in the control group described them as improving, while those in the case group were more often prone to describe the conditions as unchanging. The difference was statistically significant ($p=0.02$, $\chi^2=7.57$). It was assessed that an improvement of the socioeconomic conditions of the family would reduce the risk for the young men to have elevated ABP by 47% (OR=0.53, 95% PI: 0.3–0.98, $p=0.048$). The families from both the groups had no statistically significant difference by the income (in Litas) for one family member (971±620 litas (200–3000) in the case group vs 1040±557 litas (250–3000) in the control group, $p=0.6$). The comparison of the early feeding peculiarities of both the research groups does not allow drawing firm conclusions stating that the methods of feeding were different. The statistical significance was marginal ($p=0.05$, $\chi^2=5.85$); however, the mothers from the case group were slightly less prone to use BF and more often combined BF and formula feeding until the age of 6 months, while the mothers from the control group considerably more often used BF or used more BF than formula feeding (see Fig. 15).

Figure 15. Type of feeding until the age of 6 months.



p=0.05, χ^2=5.85

3.5. The comparison of the biochemical atherogenesis risk factors between the research groups

The research groups showed to have no statistically significant differences in terms of the mean values of the biochemical atherogenesis risk factors (hs-CRP, dyslipidemia and glycaemia) at young adult age (p>0.05). Therefore, each research participant's amount of lipids was assessed according to the norms recommended by the European Society of Hypertension in 2007, and both the groups were compared by the number of cases of change of every parameter (Table 4).

Table 4. Comparison of dyslipidemias between research groups.

Parameter	**Case group** (n=48, 100 %)	**Control group** (n=183, 100 %)	**p value**
	Number of cases (%)	Number of cases (%)	
TC (>5 mmol/l)	5 (10.4)	16 (8.7)	0.72
LDLC (>3 mmol/l)	8 (16.7)	26 (14.2)	0.67
HDLC (<1 mmol/l)	4 (8.3)	21 (11.5)	0.53
TG (>1.7 mmol/l)	7 (14.6)	11 (6)	**0.048**

In both the groups, varied amounts of LDLC were most frequent along with varied TC and less frequently – varied TG amounts. There was a statistically significant difference found between the groups in the number of individuals with varied amounts of TG (p=0.048). Isolated hypertriglyceridemia was characteristic for 54.5% of the young men in the control group and 28.6% of those in the case group. The latter more often also had varied amounts of LDLC and TC, and less frequently – varied amounts of HDLC. Smaller amounts of HDLC was the only change in the lipidogram in 75% of the cases in the elevated ABP group and 81% of the cases in the control group. In general, the lipids analysis showed that 31.3% of the young men from the case group and 26.2% of those from the control group had at least one varied parameter in their lipidogram, and there was no statistically significant difference between the groups in this aspect (p=0.49). According to the recommendations of the American Centre for Disease Control and Prevention and the American Heart Association, the research participants were divided into three risk groups by the hs-CRP amount; however no statistically significant difference was found between the case group and the control group individuals (p=0.12 χ^2=4.18). The amount of hs-CRP in the majority the research participants (nearly two thirds) was <1 mg/l. There was no statistically significant correlation observed between the SBP and DBP and high sensitivity C – reactive protein (p>0.05); however, this parameter correlated with the BMI at young adult age (r=0.3, p<0.0005) and the amount of TG (r=0.3, p<0.0005).

CONCLUSIONS

1. Smaller mean head and chest circumferences at birth are specific to the young men in the elevated blood pressure group. These characteristics along with the body mass index at young adult age are significant prognostic factors for elevated blood pressure. The head circumference is significant for diastolic blood pressure and the chest circumference is important for systolic blood pressure.
2. A higher velocity of height growth and the total height growth within the first seven years of life influence elevated blood pressure at young adult age; whereas the time of adiposity rebound did not explain the differences in blood pressure.
3. From 9 years old, the body mass index as well as its more intensive growth along with a higher velocity of weight growth have significant relation to elevated blood pressure at young adult age. Every following year of development increases the risk of the body mass index persistence in adulthood. The relation between the

adolescence pubertal parameters and elevated blood pressure at young adult age was not proved.

4. The young men in the elevated blood pressure group have bigger skeletons and every third of them is overweight or obese, while the metabolic syndrome is specific to 6.25 percent of these young men. The analysis of these parameters along with the birth parameters showed that the young man's lean body mass and fat body mass have different influence on systolic and diastolic blood pressure. There is a significant direct relation between the young man's body mass index and his father's body mass index.
5. Risky amounts of alcohol consumed have significant influence on elevated blood pressure. The risk of this disease is increased nearly three times by lower physical activity. More cases of varied triglyceride amounts in blood were found in the individuals with elevated blood pressure. The increase of hs-CRP has a significant direct relation to the body mass index and the amount of triglycerides at young adult age.
6. The early development of primary arterial hypertension in the mother nearly three times increases the risk for her son to have elevated blood pressure at young adult age. His blood pressure is also influenced by his mother's lower education and worse family socioeconomic conditions as well as a weaker trend of breastfeeding in infancy.

SUMMARY IN LITHUANIAN

ĮVADAS

Pirminė arterinė hipertenzija (PAH) – tai progresuojantis širdies ir kraujagyslių kitimų sindromas, pasireiškiantis padidėjusiu arteriniu kraujospūdžiu (AKS), kurį lemia daugybė tarpusavyje susijusių priežasčių, kai viena aiški priežastis nėra žinoma. Išsivysčiusiose šalyse ši liga diagnozuojama 15–37% suaugusių gyventojų, o Rytų Europos šalyse ji yra du kartus dažnesnė. Daugėja jaunų žmonių, kuriems pasireiškia kardiovaskulinė rizikos veiksniai. PAH jaunėja tarp vyrų. Lietuvoje 25 – 34 metų amžiuje PAH konstatuota net 39,4% vyrų ir 12,7% moterų (CINDI tyrimas, 2007*)*. Sergamumą šia liga, kaip rodo tyrimų duomenys, tik iš dalies galima paaiškinti bendraisiais kardiovaskulinės rizikos veiksniais, ypač kalbant apie jaunus žmones. Mažai kas kreipia dėmesį į PAH galimą ryšį su gimimo parametrais ir augimo ypatumais. Tyrimai rodo, kad harmoningas augimas padeda išvengti ligų suaugus, o svorio ir/ar ūgio augimo tempo ir amplitudės netolygumai lemia padidėjusią riziką susirgti ŠKL, ypač tarp berniukų. Tam tikri periodai yra itin jautrūs aplinkos poveikiui ir vadinami kritiniais (intrautererininis laikotarpis, kūdikystė, “tuklumo grąžos” laikotarpis ir paauglystė). Tyrimų duomenys apie augimo ypatumų vaidmenį kardiovaskulinės sveikatos rodikliams užaugus yra nevienareikšmiai, stinga linijinių tyrimų. Kadangi Lietuvos vaikai savo sudėjimo ypatumais skiriasi nuo kitų šalių, tuomet tikėtini ir jų augimo skirtumai, ir tam tikri ryšio savitumai programuojant būsimą padidėjusį kraujospūdį. Deja, nėra aišku, kurie iš bendrųjų hipertenzijos rizikos veiksnių ir kokie kritinių augimo tarpsnių ypatumai daro didžiausią įtaką mūsų šalies jaunimo kraujospūdžio raidai.

Tyrimo tikslas

Įvertinti jaunuolystės amžiaus vyrų padidėjusio kraujospūdžio ryšį su skirtingų kritinių augimo periodų ypatumais, kardiovaskulinės rizikos veiksniais, paveldimumu ir jaunuolio šeimos socioekonominėmis sąlygomis.

Tyrimo uždaviniai

1. Įvertinti naujagimystės rodiklių (gimimo svorio, ūgio, kūno masės indekso, galvos apimties, krūtinės apimties, gestacinio amžiaus) reikšmę jaunuolystės amžiaus kraujospūdžiui ir kūno masės indeksui.
2. Nustatyti kūdikystės ir „tuklumo grąžos“ periodų antropometrinių rodiklių augimo greičio skirtumus ir jų įtaką kraujospūdžiui.
3. Išanalizuoti paauglystės ir jos pradžios kūno masės kitimo ypatumų ir brendimo požymių (pubertetinio ūgio augimo šuolio pradžios bei spermarchės laiko) sąsajas su padidėjusio kraujospūdžio rizika jaunuolystėje.
4. Palyginti padidėjusį kraujospūdį turinčių ir sveikų jaunuolių kūno sudėjimo, sudėties, proporcijų ir somatotipo ypatumus.
5. Įvertinti padidėjusio kraujospūdžio jaunuolystėje ryšį su tradiciniais hipertenzijos ir biocheminiais aterogenezės rizikos veiksniais (didelio jautrumo C reaktyviu baltymu, dislipidemija, glikemija).
6. Nustatyti tiriamųjų tėvų kardiovaskulinės rizikos, šeimos socioekonominių veiksnių bei kūdikystės ankstyvo maitinimo ypatumų reikšmę padidėjusio kraujospūdžio rizikai.

Mokslinis naujumas

Tirti jauno amžiaus asmenys (18-21 metų jaunuoliai), tik vyrai. Su šia amžiaus grupe tyrimų AH srityje nėra atlikta tiek daug kaip su vyresniais asmenimis. Tyrimo duomenys buvo vertinami linijiniu būdu. Tuo pačiu metu buvo analizuoti ne tik antropometrinių rodiklių kaitos ypatumai, bet vertinti ir tradiciniai hipertenzijos rizikos veiksniai. Vertintas jų pasireiškimas ne tik tarp pačių jaunuolių, bet ir tarp jų tėvų. Didelio jautrumo hs-CRB žymenį bandyta analizuoti kaip galimą tokio amžiaus asmenų padidėjusio kraujospūdžio, o ne tik nutukimo ar koronarinės širdies ligos rizikos rodiklį.

TIRIAMIEJI IR TYRIMO METODIKA

Tyrimas pradėtas vykdyta gavus Vilniaus regioninio biomedicininių tyrimų etikos komiteto leidimą Nr.158200-6-058-056LP3. Tyrimo tipas - atvejo – kontrolės. Tyrimas vykdytas nuo 2009 07 15 dienos iki 2010 10 31 dienos keturiuose Vilniaus miesto šeimos medicinos centruose. Jame dalyvauti buvo kviečiami išskirtinai vyrai, sulaukę jaunuolystės amžiaus (18-21 m.). Ištirtas 231 asmuo (n=231), atvejo grupėje – 48, kontrolinėje – 183 (santykiu 1: 3,8). Į tyrimą buvo įtraukti informuoti apie tyrimą jaunuoliai, kurie sutiko dalyvauti ir pasirašė asmens informavimo formą bei informuoto asmens sutikimo formą. Visi tiriamieji pagal išmatuotą kraujospūdį buvo skirstomi į dvi grupes: *kontrolinę*, kurių kraujospūdis <130/85 mmHg (atitinka optimalų ir normalų kraujospūdžio lygmenis) ir *atvejo*, kurių kraujospūdis ≥130/85 mmHg (atitinka prehipertenzijos ir hipertenzijos lygmenis). Laikytasi iš anksto numatytų atmetimo kriterijų. Jaunuoliai buvo tiriami vieno apsilankymo klinikoje metu, iš ryto, tyrimo dieną nevalgę ir negėrę bent 10 valandų. Visi duomenys apie tiriamuosius buvo fiksuojami naudojant specialią šiam tyrimui sudarytą septynių dalių tiramojo duomenų anketą. Į ją buvo surašomi antropometriniai asmens raidos duomenys nuo gimimo iki 18 metų (panaudojant f.025-112/a ir/ar f.025/a). Prieš pradedant tiriamojo apklausą ir matavimus, buvo imamas kraujo mėginys iš venos biocheminiams rodikliams (gliukozei, lipidams, hs-CRB) nustatyti. Vėliau jaunuoliai buvo apklausiami, vertinant amžių, tautybę, su hipertenzijos išsivystymu susijusius rizikos veiksnius, spermarchės amžių. Buvo vertinamas kraujospūdžis ir širdies susitraukimų dažnis. Galiausiai buvo matuojami įvairūs tiriamojo asmens antropometriniai parametrai, siekiant įvertinti kūno sudėjimo ir proporcijų ypatumus, tam naudojant reikiamus antropometrinius instrumentus ir laikantis taisyklingo matavimo taisyklių. Susisiekus su tyrime dalyvavusių vyrų tėvais ir šiems taip pat sutikus dalyvauti tyrime (pasirašius asmens informavimo formą ir informuoto asmens sutikimo formą), buvo apklausti ir tiriamojo tėvai. Tam naudota speciali jiems skirta anketa, vertintas abiejų tėvų dabartinis amžius, svoris, ūgis, KMI. Teirautasi apie PAH (jei AKS ≥140/90 mmHg arba nuolat vartoja vaistus nuo padidėjusio kraujospūdžio) ir ŠKL (cukrinio diabeto, hipercholesterolemijos, kraujagyslių aterosklerozės, insulto, infarkto) buvimo faktą tarp pačių tėvų ir/ar jų tėvų (jaunuolio senelių). Taip pat domėtasi tėvų rūkymo įpročiu, išsilavinimu, profesija, socioekonominiais šeimos veiksniais. Kaip galimas AH rizikos veiksnys domino ir tiriamojo jaunuolio kūdikystės maitinimo ypatumai, todėl mamos buvo teiraujamasi apie maitinimo krūties pienu (MP) trukmę ir dominavusį maitinimo būdą iki 6 mėnesių amžiaus, atsižvelgiant į MP ir/ar maitinimo mišiniu santykį.

REZULTATAI

Palyginus abiejų grupių jaunuolius pagal gimimo charakteristikas nustatyta, kad atvejo grupės jaunuoliai statistiškai reikšmingai skiriasi mažesne galvos (p=0,001) ir krūtinės (p=0,04) apimtimi, įvertinus galimą gestacijos amžiaus įtaką. Abu rodikliai atspindi mažesnius skersinius kaulinio skeleto matmenis, o vertinant pagal išilginius (ūgio) matavimus pagrindžia atvejo grupės naujagimių mažesnio somatotipo gimus faktą. Nagrinėjant kūdikystės laikotarpio raidą ir lyginant dviejų grupių svorio, ūgio ir kūno masės indekso (KMI) vidurkių reikšmes, statistiškai reikšmingų skirtumų nerasta (p>0,05). Tačiau šiuo periodu prasidėjusios intensyvesnio ūgio augimo tendencijos atvejo grupėje, kurios tęsėsi ir vaikystėje, turėjo reikšmingą įtaką padidėjusio kraujospūdžio prognozei. Rasta, kad abiejų grupių jaunuoliai patiria „tuklumo grąžą“ panašiu laikotarpiu – 5 - 6 metų amžiuje. Lyginant reikšmes „tuklumo grąžos” periodu (3–7 metų) matyti, kad atvejo grupės tiriamieji labiau linkę priaugti ūgio ir tai paaiškintų mažesnes jų KMI reikšmes šiuo amžiaus tarpsniu. Radome išties savitų pastebėjimų nustatydami, kad vaikystės tarpsnyje tarp padidėjusio AKS jaunuolių toliau tęsiasi spartesnis ūgio augimas, kuris buvo prasidėjęs dar kūdikystėje. Absoliutus ūgio skirtumas nuo gimimo iki 7 metų bei šio periodo ūgio z-reikšmių skirtumas statistiškai patikimai atspindėjo skirtumus tarp grupių (p<0,05). Nuo 9 iki 18 metų padidėjusio kraujospūdžio grupės vaikinai statistiškai patikimai pagal KMI rodiklį skiriasi nuo savo bendraamžių (p<0,05). Remiantis z-reikšmių analize nustatytas statistiškai reikšmingai greitesnis KMI pokytis 7–18 metais (p=0,01). Didesnę šio rodiklio reikšmę nulemia reikšmingai didesnis svoris tarp atvejo grupės vaikinų (p<0,05). Koreliacinė analizė parodė, kad kiekvieni raidos metai lemia vis didesnę KMI išliekamumo riziką suaugus (r kito nuo 0,5 iki 0,8, visais atvejais p=0,0005). Nuo 12 metų praktiškai visais amžiaus metais atvejo grupės jaunuolių tiek sistolinio, tiek diastolinio kraujospūdžio reikšmės buvo statistiškai patikimai didesnės (p<0,05). Šių panelinių duomenų analizė sudarant augimo modelį parodė, kad KMI kitimas nuo 10 iki 18 metų, normalizuotų ūgio reikšmių pokytis per pirmuosius 7 gyvenimo metus ir laiko kintamieji yra reikšmingi (p<0,05), o galvos apimtis gimus nebuvo reikšminga (p>0,05), siekiant paaiškinti ryšį su sistolinio ir diastolinio kraujospūdžių kitimu. Galvos apimtis ir gimimo svoris statistiškai reikšmingai (p<0,0005) veikia jaunuolystės KMI, bet paaiškina tik 15,4% KMI variaciją jaunuolystės amžiaus grupėje. Analizuojant jaunuolystės KMI ir galvos apimties gimus įtaką padidėjusio kraujospūdžio prognozei, jie abu buvo statistiškai reikšmingi (galvos apimčiai p=0,005, jaunuolystės KMI p=0,008). Įvertinus pubertetinį augimo šuolį nustatyta, kad atvejo grupės vaikinai labiausiai paauga 14 – 15 metais, tuo tarpu kontrolinės grupės jaunuoliai – 13 – 14 metais (abi grupės vidutiniškai po 7,9 cm), tai yra vieneriais metais anksčiau nei atvejo grupė. Tokį vėlesnį šios grupės vaikinų augimo šuolį būtų galima paaiškinti tuo, kad jų KMI prieš brendimą ir brendimo metu yra didesnis, o tai galėtų įtakoti kiek vėlesnį vaikinų brendimą.

Iš atliktos duomenų analizės matyti, kad atvejo grupėje statistiškai patikimai dažniau buvo turinčių antsvorio arba nutukusių (p=0,003, χ^2=13,98), o metabolinio sindromo kriterijus atitiko 6,25% jaunuolių. Antsvorį turintiems beveik 2,7 karto, o nutukusiems 6,3 karto dažniau būdingas prehipertenzijos lygmens ar didesnis kraujospūdis. Padidėjusį kraujospūdį turintiems jauniems vyrams būdingas santykinai didesnis beveik trimis nuošimčiais riebalų procentas, šie jaunuoliai turi didesnę absoliučią tiek liesąją kūno masę, tiek riebalų masę (atitinkamai, p=0,003 ir p=0,0004). Jų visos kūno apimtys buvo statistiškai reikšmingai didesnės (p<0,05), šie vaikinai turėjo reikšmingai stambesnį proksimalinių galūnių dalių skeletą ir ašinį skeletą, matavimus atliekant frontalinėje plokštumoje (p<0,05). Atvejo grupės jaunuolių visose kūno srityse, išskyrus dilbio, odos klostės buvo statistiškai patikimai storesnės (p<0,05). Galima teigti, kad šiems jaunuoliams būdingas polinkis ir į „centralizuotą“ riebalinio audinio išsidėstymą bei santykinai mažesnis riebalų kaupimasis viršutinėse galūnėse, palyginti su visomis odos klostėmis (p=0,01). Sistolinio kraujospūdžio dydį įtakoja įvairių sričių riebalinis audinys bei liesa kūno masė, o diastolinį kraujospūdį labiausiai lemia liemens srities riebalinis audinys.

Išanalizavus anketų duomenis, abiejų grupių jaunuoliai nesiskyrė pagal rūkymo ir mitybos įpročius, tačiau galime konstatuoti alkoholio vartojimo bei fizinio aktyvumo įpročių skirtumus: padidėjusį kraujospūdį turintys asmenys statistiškai patikimai dažniau linkę vartoti sveikatai rikingą alkoholio kiekį (≥6 standartiniai alkoholio vienetai vieno išgėrimo metu) (p=0,04, χ^2=6,41). Kontrolinės grupės vaikinai laisvalaikiu linkę dažniau sportuoti kasdien ar beveik kasdien, tuo tarpu atvejo grupė statistiškai patikimai sportavo rečiau. Toks retesnis fizinis aktyvumas, palyginti su sportavimu kasdien ar beveik kasdien, kone tris kartus didina jaunuolių padidėjusio kraujospūdžio riziką (OR=3,1; 95% PI: 1,1–8,7, p=0,025). Pavyko nustatyti genetinių ir socialinių aspektų skirtumus: padidėjusio kraujospūdžio grupės jaunuolių mamos statistiškai reikšmingai dažniau serga pirmine arterine hipertenzija (amžiaus vidurkis 47 metai) ir yra žemesnio išsilavinimo. Mamos ankstyvas sergamumas hipertenzija beveik tris kartus didina jos sūnaus riziką turėti padidėjusį kraujospūdį jaunuolystėje (OR=2,86, 95% PI: 1,4–5,9, p=0,003). Nustatėme, kad mamos aukštasis išsilavinimas mažina jaunuolio padidėjusio kraujospūdžio riziką beveik 50% (OR=0,49, 95% PI: 0,3–0,9, p=0,03). Gautas ribinis statistinis patikimumas, jog ayvejo grupės mamos kiek mažiau buvo linkusios maitinti savo kūdikį krūties pienu ir dažniau buvo linkusios į pagalbą pasitelkti mišinį (p=0,05). Biocheminių rodiklių (gliukozės, lipidų, hsCRB kiekio) vidurkio reikšmių skirtumų tarp abiejų grupių jaunuolių neradome (p>0,05). Statistiškai reikšmingas skirtumas tarp tiriamųjų grupių rastas pagal asmenų, turinčių pakitusį trigliceridų kiekį, skaičių (p=0,048). Suskirsčius tiriamuosius į tris rizikos grupes pagal hs-CRB kiekį, statistiškai reikšmingo skirtumo tarp atvejo ir kontrolinės grupės asmenų nerasta (p=0,12 χ^2=4,18). Nenustatėme ir statistiškai reikšmingo koreliacinio ryšio tarp sistolinio bei diastolinio kraujospūdžių ir uždegimo baltymo hs-CRB (p>0,05), bet su šiuo rodikliu koreliavo jaunuolystės amžiaus KMI (r=0,3, p<0,0005) ir trigliceridų kiekis (r=0,3, p<0,0005).

IŠVADOS

1. Padidėjusio kraujospūdžio grupės jaunuoliams būdinga mažesnė vidutinė galvos ir krūtinės apimtis gimus. Šie požymiai kartu su jaunuolystės kūno masės indeksu yra reikšmingi padidėjusio kraujospūdžio prognostiniai veiksniai. Krūtinės apimtis reikšminga diastoliniam, o galvos apimtis – sistoliniam kraujospūdžiui.
2. Greitesnis ūgio augimas ir absoliutus ūgio priaugis per pirmus septynerius gyvenimo metus turi įtakos padidėjusiam kraujospūdžiui jaunuolystėje. Tuo tarpu „tuklumo grąžos“ pasireiškimo laikas kraujospūdžio skirtumų nepaaiškino.
3. Nuo 9 metų amžiaus kūno masės indeksas ir intensyvesnis šio rodiklio bei svorio augimo greitis turi reikšmingų sąsajų su jaunuolystės padidėjusiu kraujospūdžiu. Kiekvieni vėlesni raidos metai didina kūno masės indekso išliekamumo riziką

suaugus. Neįrodytos paauglystės laikotarpio brendimo rodiklių sąsajos su padidėjusiu kraujospūdžiu jaunuolystėje.

4. Padidėjusio kraujospūdžio grupėje jaunuoliai yra stambesnio skeleto, kas trečias turi antsvorio arba yra nutukęs, o 6,25 proc. būdingas metabolinis sindromas. Vertinant kartu su gimimo rodikliais nustatyta skirtinga jaunuolio liesos kūno masės ir riebalų masės įtaka sistoliniam ir diastoliniam kraujospūdžiui. Egzistuoja reikšmingas tiesioginis ryšys tarp jaunuolio ir jo tėvo kūno masės indekso.
5. Reikšmingą įtaką padidėjusiam kraujospūdžiui turi rizikingais kiekiais vartojamas alkoholis, o mažesnis fizinis aktyvumas ligos riziką didina beveik tris kartus. Tarp padidėjusio kraujospūdžio asmenų dažniau nustatytas pakitęs trigliceridų kiekis kraujyje. Uždegimo baltymo hs-CRB padidėjimas reikšmingai tiesiogiai susijęs su jaunuolystės amžiaus kūno masės indeksu ir trigliceridų kiekiu.
6. Mamos ankstyvas sergamumas pirmine arterine hipertenzija beveik tris kartus didina jos sūnaus padidėjusio kraujospūdžio riziką jaunuolystėje. Jo kraujospūdį taip pat lemia ne tik mamos žemesnis išsilavinimas ir blogesnė šeimos socioekonominė padėtis, bet ir retesnė maitinimo krūtimi kūdikystėje tendencija.

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Publications: Scientific research publications during fellowship:

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