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Nutritional status and selected atherosclerotic risk factors in young adults in relation to their birth weight

Stan odżywienia i wybrane czynniki ryzyka miażdżycy u młodych osób dorosłych a ich masa urodzeniowa

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Abstract

Barker's thrifty phenotype hypothesis suggests a relationship between low birth weight and obesity, type 2 diabetes mellitus and atherosclerosis in later life. **Aim:** The aim of the study was to assess the nutritional status and the incidence of selected atherosclerotic risk factors among people in their third decade of life in relation to their birth weight and term of delivery. **Material and methods:** A total of 119 subjects aged between 19 and 29 years were classified into the following groups: born prematurely (group I – 38 subjects), born at term, but with low birth weight (group II – 39 subjects), and born at term with normal birth weight (group C – 42 subjects) as well as into groups with birth weight <10th percentile and ≥10th percentile for gestational age. We analysed sociodemographic data on health behaviours and the health status of both participants and their parents. Body weight and height, waist and hip circumferences as well as blood pressure were measured. Additionally, body composition was estimated by bioelectrical impedance analysis. Glucose, cholesterol and triglyceride levels were determined using strip tests. **Results:** Significantly higher mean levels of cholesterol, a significantly higher prevalence of increased cholesterol and a non-significant increase in the prevalence of obesity, including abdominal obesity, were found in group I compared to other groups. A non-significant increase in the prevalence of abdominal obesity and a higher proportion of adipose tissue compared to controls as well as significantly the lowest prevalence of hypercholesterolaemia were observed on group II. A positive correlation was observed between the body mass index in those born prematurely and the body mass index of their mothers. Among the independent variables affecting the number of atherosclerotic risk factors, the importance of premature birth, age and excessive parental nutritional status was confirmed. **Conclusions:** 1) Premature birth increases the risk of elevated serum cholesterol levels in the third decade of life. 2) Premature birth and intrauterine growth restriction do not increase the risk of obesity in the third decade of life. 3) Premature birth, increasing age and excessive parental nutritional status have an impact on the number of atherosclerotic risk factors in the third decade of life.

Keywords: birth weight, term of delivery, atherosclerotic risk factors, young adults

Streszczenie

Hipoteza Barkera, dotycząca „oszczędnego fenotypu", sugeruje istnienie związku między małą urodzeniową masą ciała a rozwojem otyłości, cukrzycy typu 2 i miażdżycy w przyszłości. **Cel pracy:** Ocena stanu odżywienia i częstości występowania wybranych czynników zagrożenia miażdżycą u osób w trzeciej dekadzie życia, w odniesieniu do ich masy urodzeniowej i terminu porodu. **Materiał i metody:** 119 osób w wieku 19–29 lat podzielono na grupy: urodzonych przedwcześnie (grupa I – 38 osób), urodzonych o czasie, z małą masą ciała (grupa II – 39 osób) i urodzonych o czasie, z prawidłową masą ciała (grupa K – 42 osoby) oraz na grupy urodzonych z masą ciała <10. i ≥10. centyla w stosunku do wieku ciążowego. Przeanalizowano dane demograficzno-społeczne dotyczące zachowań zdrowotnych, stanu zdrowia badanych oraz ich rodziców. Dokonano pomiarów masy i wysokości ciała, obwodów talii i bioder, wysokości ciśnienia tętniczego oraz – metodą impedancji bioelektrycznej – składu masy ciała. Oznaczono stężenia glukozy, cholesterolu i triglicerydów metodą testów paskowych. **Wyniki:** W grupie I, w porównaniu z pozostałymi grupami, stwierdzono istotnie wyższe średnie stężenie

cholesterolu i znamiennie częstsze występowanie podwyższonych stężeń cholesterolu oraz nieznamiennie częstsze występowanie otyłości, w tym brzusznej. W grupie II odnotowano nieznamiennie częstsze występowanie otyłości brzusznej i zwiększonego odsetka tkanki tłuszczowej w porównaniu z grupą kontrolną oraz znamiennie najrzadsze występowanie hipercholesterolemii. Zaobserwowano dodatnią korelację wartości wskaźnika masy ciała urodzonych przedwcześnie i wskaźnika masy ciała ich matek. Wśród zespołu zmiennych niezależnych wpływających na liczbę czynników ryzyka miażdżycy potwierdzono istotne znaczenie urodzenia się przedwcześnie, wieku oraz nadmiernego stanu odżywienia rodziców. **Wnioski:** 1) Urodzenie się przedwczesne zwiększa ryzyko wystąpienia podwyższonych stężeń cholesterolu we krwi w trzeciej dekadzie życia. 2) Urodzenie się przedwczesne lub z hipotrofią wewnątrzmaciczną nie zwiększa ryzyka wystąpienia otyłości w trzeciej dekadzie życia. 3) Na liczbę czynników ryzyka miażdżycy pojawiających się u osób w trzeciej dekadzie życia wpływają przedwczesne urodzenie się, wzrastający wiek oraz nadmierny stan odżywienia rodziców.

Słowa kluczowe: masa urodzeniowa, termin porodu, czynniki ryzyka miażdżycy, młodzi dorośli

INTRODUCTION

Recent studies point to the possible causal relationship between low birth weight and susceptibility to obesity, lipid and carbohydrate disorders as well as atherosclerotic cardiovascular disorders in later life[1,2]. There are multiple risk factors for low birth weight (maternal, foetal, placental). The term "small for gestational age" (SGA) describes children with birth weight and/or body length inadequate for gestational age and sex [less than 2 standard deviation (*SD*) or less than the 10th percentile for gestational age][3]. Some of these children are diagnosed with intrauterine growth restriction (IUGR), while other children with birth weight below the 10th percentile are constitutionally predisposed to this disorder (30–70%)[1]. Attempts to explain the relationship between low birth weight and atherosclerosis in later life were already made by Hales and Barker, who proposed the thrifty phenotype hypothesis, which states that limited nutrition during critical periods of intrauterine life may trigger adaptive changes in the child[2]. According to Barker's hypothesis, a change in the foetal metabolism and reduced vascularisation of multiple foetal tissues and organs occur, leading to increased postnatal accumulation of fat. This may consequently lead to obesity, metabolic syndrome and atherosclerotic disease in adult life[2]. Atherosclerotic lesions develop asymptomatically in young adults; therefore, it seems important to ensure early identification of atherogenic risk groups and their assessment for risk factors, such as obesity, dyslipidemia, carbohydrate metabolism disorders and hypertension. It is also important to assess family history of health conditions, eating habits, physical activity and living conditions of those at risk. Considering the above, it seems necessary for the family doctor to monitor young adults at a risk of early onset of atherosclerotic diseases.

The aim of the study was to assess the selected risk factors for atherosclerosis, including obesity, in young adults born prematurely and those born at term, but presenting with the signs of intrauterine growth restriction, compared to their peers born at term and with normal birth weight.

MATERIAL AND METHODS

The study was conducted between 2013 and 2016, after obtaining the consent of the Bioethical Commission at the Medical University of Silesia in Katowice (Resolution No. KNW/0022/KB1/62/13 dated June 25, 2013 and Resolution No. KNW/0022/KB1/62/I/13/16 dated April 5, 2016 – extension of the research duration), and involved 119 young adults aged between 19 and 29 years recruited during a visit to the primary health care centre or during breaks in lectures and classes at the School of Health Sciences of the Medical University of Silesia in Katowice. The inclusion criteria were: age between 19 and 29 years, birth at term or before 37 weeks gestation with low or normal birth weight (depending on the group), and a written consent to participate in the study. The lack of consent to participate in the study, chronic diseases (except for dyslipidemia, diabetes, hypertension, obesity), genetic conditions, disability, birth from a multiple pregnancy as well as manifestations of acute infection on the day of the study were exclusion criteria.

All participants were divided into three groups, depending on their birth weight and birth term:

- **group I** – 38 participants born before 37 weeks gestation;
- **group II** – 39 participants born at term, but with low birth weight (<2,500 g);
- **control group (group C)** – 42 participants born at term and with normal birth weight.

The research procedure involved a collection of detailed patient's history based on the author's questionnaire inquiring about sociodemographic data, the pregnancy/birth period, health behaviours (eating habits, physical activity), parental health status (only some of the questionnaire data were used in the study), and physical examination. The anthropometric assessment of nutritional status involved body weight (with an accuracy of up to 0.1 kg) and height (with an accuracy of up to 0.1 cm) as well as waist and hip circumference (with an accuracy of up to 0.5 cm) measurements. The obtained data were used to estimate body mass index (BMI), which was defined based on the World Health Organization standards (25–29.9 indicating overweight, 30 or more indicating obesity). The obtained waist measurements were compared with the 2005 criteria

set by the International Diabetes Federation (IDF), according to which waist circumferences of ≥94 cm in men and ≥80 cm in women indicate abdominal obesity[4]. Body composition was determined with the bioelectrical impedance analysis method using BioScan 920-II (the percentage of fat mass, FAT, in the total body mass was used for the purpose of the study). Cholesterol, triglycerides and glucose were measured in the capillary blood in fasting participants using strip tests (MultiCareIn and Accu-Chek Active) available in a family doctor's practice. Blood was collected following the principles of asepsis and antisepsis. The results were compared with the current standards[5].

Considering the reports pointing to the relationship between low birth weight for gestational age and an increased risk of obesity, lipid and carbohydrate disorders as well as atherosclerotic cardiovascular disorders in later life, the participants were divided into the following groups based on percentile values of birth weight: body weight <10th percentile (SGA) (groups I and II) and ≥10th percentile for gestational age (groups I and C).

Statistica ver. 12 (StatSoft) was used for statistical analysis. A Chi-square test was used to compare the prevalence of abnormal nutritional parameters and environmental risk factors for atherosclerosis between different groups. The number of atherosclerotic risk factors was assessed individually (a dependent variable), which was followed by a multiple stepwise backward regression analysis to assess the dependence of this number on the independent variables (classification to group I or II, age, breastfeeding duration, physical activity, excessive nutritional status and health conditions in the parents of participants). Spearman's rank correlation was used to determine the relationship between the BMI of participants and the BMI of their parents.

RESULTS

As for the health-related issues in the families of participants, we showed differences in the prevalence of excessive nutritional status. Maternal BMI in group C (69%) exceeded normal values significantly more often than in groups I (45%) and II (41%) (p = 0.035). There were no significant differences in this regard in paternal BMI. Furthermore, a positive correlation between the BMI of young adults in group I and the BMI of their mothers was shown (Tab. 1).

Correlated variables	Young adults – n = 119					
	Group I n = 38		Group II n = 39		Group C n = 42	
	r	p	r	p	r	p
Maternal BMI and the BMI of young adults	**0.38**	**0.017**	–0.28	0.095	0.21	0.195
Paternal BMI and the BMI of young adults	0.02	0.89	–0.25	0.122	0.07	0.64

Group I – prematurely born young adults; **group II** – young adults born at term, but with low birth weight; **group C** – young adults born at term and with normal birth weight.
BMI – body mass index.
r – Spearman's ranked correlation coefficient.
p – calculated probability/significance level.

Tab. 1. An analysis of correlation between the BMI of young adults included in the study and the BMI of their parents

Thyroid diseases (group I – 24%, group II – 11%, group C – 15%), hypertension (group I –18%, group II – 5%, group C – 10%), obesity (group I – 8%, group II – 8%, group C – 18%) and hypercholesterolemia (single cases) represented the most often reported maternal conditions in all study groups. Obesity (group I – 36%, group II – 24%, group C – 33%) and hypertension (significantly more often in group I – 36% compared to fathers in group II – 12%; p = 0.011), followed by (in some cases) coronary heart disease, diabetes, hypercholesterolemia and hypertriglyceridemia were the most common paternal conditions in all groups.

There were no significant differences related to living conditions between the groups.

The questionnaire data on the method of feeding during infancy revealed statistically significant differences between groups II and C and group I for breastfeeding. Participants in group I were significantly less frequently breastfed, but at the same time, the breastfeeding was most often maintained until 12 months of age in this group (Tab. 2).

The method of feeding of young adults during infancy (months)	Young adults – n = 119						p*	p* I/II	p* I/K	p* II/K
	Group I n = 38		Group II n = 39		Group C n = 42					
	n	%	n	%	n	%				
Breastfeeding	22	**58**	36	**92**	41	**98**	**<0.001**	**<0.001**	**<0.001**	0.555
Including:										
Until the first month	3	14	6	17	5	12	**<0.001**	**<0.001**	**<0.001**	0.238
From month 1 until month 3	2	9	5	14	5	12				
From month 4 until month 6	7	33	22	**61**	20	**49**				
From month 7 until month 12	10	**44**	3	8	11	27				
Artificial feeding from birth	16	**42**	3	**8**	1	**2**	**<0.001**	**<0.001**	**<0.001**	0.555

Group I – prematurely born young adults; **group II** – young adults born at term, but with low birth weight; **group C** – young adults born at term and with normal birth weight.
* Pearson's chi-squared test.

Tab. 2. Breastfeeding during infancy of young adults in the study groups and the control group

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The frequency and the types of meals	Young adults – *n* = 119						*p**	*p** I/II	*p** I/K	*p** II/K
	Group I *n* = 38		Group II *n* = 39		Group C *n* = 42					
	n	%	*n*	%	*n*	%				
The frequency of meals										
3 times daily	8	21	18	**46**	9	22	**0.018**	**0.007**	0.638	**0.027**
4 times daily	11	29	14	**36**	16	**38**				
5 times daily	19	**50**	7	18	17	**40**				
The types of meals										
Breakfast	35	92	38	97	39	93	0.555	–	–	–
Dinner	38	**100**	35	**90**	42	**100**	**0.014**	1.000	1.000	0.106
Afternoon snack	23	61	9	23	26	62	**<0.001**	**<0.001**	0.889	**<0.001**
Snacks,	34	**89**	32	**82**	36	**86**	0.648	–	–	–
including:										
Confectionery	28	**82**	24	**75**	30	**83**	0.468	–	–	–
Fruits	21	**62**	16	**50**	20	**56**	0.457	–	–	–

Group I – prematurely born young adults; **group II** – young adults born at term, but with low birth weight; **group C** – young adults born at term and with normal birth weight.
* Pearson's chi-squared test.

Tab. 3. The frequency and the types of meals consumed by young adults in the study groups and the control group

Physical activity among young adults included in the study		Young adults – *n* = 119						*p**	*p** I/II	*p** I/K	*p** II/K
		Group I *n* = 38		Group II *n* = 39		Group C *n* = 42					
		n	%	*n*	%	*n*	%				
Physically active individuals		25	**66**	19	**50**	19	**45**	0.272	–	–	–
Type of activity	Jogging	19	**50**	10	26	9	21	**0.013**	**0.027**	**0.007**	0.654
	Cycling	12	32	13	33	15	**36**	0.925	–	–	–
	Swimming	8	21	14	**36**	11	26	0.334	–	–	–

Group I – prematurely born young adults; **group II** – young adults born at term, but with low birth weight; **group C** – young adults born at term and with normal birth weight.
* Pearson's chi-squared test.

Tab. 4. Participation in physical activities and the types of physical activities among young adults in the study groups and the control group

Compared parameters		Young adults – *n* = 119						*p**
		Group I *n* = 38		Group II *n* = 39		Group C *n* = 42		
BMI [kg/m^2]		25–29.9	≥30	25–29.9	≥30	25–29.9	≥30	0.708
	n	6	4	3	3	7	1	
	%	**15.8**	**10.5**	**7.7**	**7.7**	**17**	**2**	
Waist circumference [cm]		≥80 ♀/ ≥94 ♂		≥80 ♀/ ≥94 ♂		≥80 ♀/ ≥94 ♂		0.248
	n	12		9		5		
	%	**32**		**23**		**12**		
SBP [mm Hg]		≥140		≥140		≥140		0.216
	n	5		3		2		
	%	**13**		**8**		**5**		
DBP [mm Hg]		≥90		≥90		≥90		0.344
	n	9		7		5		
	%	**24**		**18**		**12**		
FAT %		≥28		≥28		≥28		0.244
	n	13		15		10		
	%	**34**		**38**		**24**		

Group I – prematurely born young adults; **group II** – young adults born at term, but with low birth weight; **group C** – young adults born at term and with normal birth weight.
BMI – body mass index; **SBP** – systolic blood pressure; **DBP** – diastolic blood pressure; **FAT** – adipose tissue mass.
* Chi-squared test (the highest level of reliability).

Tab. 5. A comparison of the prevalence of high values of selected nutritional parameters and blood pressure among the groups of young adults included in the study

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Current eating habits are of key importance for the nutritional status of participants. These differed significantly between groups in terms of the frequency of meals during the day ($p = 0.018$). A total of five meals per day were usually consumed in group I (50% of participants), three (46%) or four (36%) meals per day in group II, and four (38%) or five (40%) meals per day in the control group. Most participants in all groups declared that they consumed breakfast (92% – I, 97% – II and 93% – C) and dinner (100%, 90% and 100%, respectively); an afternoon snack was significantly least common in group II (23% vs. 61% in group I and 62% in group C; $p < 0.001$). It should be noted that frequent snacking was reported in all groups (89% – I, 82% – II and 86% – C), with confectionery (82% – I, 75% – II, 83% – C) and fruits (62% – I, 50% – II, 56% – C) being most popular snacks (Tab. 3).

The questionnaire data on physical activity among participants indicated that they performed physical exercises in varying proportions. Statistically significant differences between the groups were related to the frequency of jogging (group I – 50%, group II – 26%, group C – 21%), ($p = 0.013$) (Tab. 4).

The prevalence of abnormal levels of tested biochemical parameters	**Young adults – *n* = 119**				
		Group I	**Group II**	**Group C**	***p****
Glucose	≥5.5 mmol/l				
	n	5	4	4	0.990
	%	**13**	**10**	**10**	
Cholesterol	≥4.9 mmol/l				
	n	28	15	20	**0.009**
	%	**74**	**38**	**48**	
Triglycerides	≥1.7 mmol/l				
	n	7	4	5	0.842
	%	**18**	**10**	**12**	

Group I – prematurely born young adults; **group II** – young adults born at term, but with low birth weight; **group C** – young adults born at term and with normal birth weight.
* Chi-squared test (the highest level of reliability).

Tab. 6. A comparison of the prevalence of abnormal biochemical findings among the groups of young adults included in the study

Tested biochemical parameters (mmol/L)	**Young adults *n* = 119**				***p****	**Post hoc analysis**		
		Group I	**Group II**	**Group C**		**I/II**	**I/K**	**II/K**
Glucose	$\bar{x}$	5.09	5.03	4.95	0.872	–	–	–
	SD	0.44	0.44	0.52				
Cholesterol	$\bar{x}$	5.40	4.58	4.85	**0.000**	**0.000**	**0.009**	0.526
	SD	0.69	0.97	0.83				
Triglycerides	$\bar{x}$	1.28	1.24	1.23	0.954	–	–	–
	SD	0.50	0.45	0.49				

Group I – prematurely born young adults; **group II** – young adults born at term, but with low birth weight; **group C** – young adults born at term and with normal birth weight.
$\bar{x}$ – mean value; ***SD*** – standard deviation.
* Analysis of variance.

Tab. 7. A comparison of the mean biochemical findings in the groups of young adults included in the study – a comparative analysis

Dependent variable	**Independent variables**	**BETA**	***p****
Atherosclerotic risk factors (abnormal fasting glycemia, hypercholesterolemia, hypertriglyceridemia, high BMI and waist circumference percentiles, abnormal systolic and diastolic blood pressure percentiles, percentage of adipose tissue)	Group I	0.262	**0.008**
	Group II	0.044	0.731
	Age	0.282	**0.009**
	Breastfeeding duration	0.112	0.334
	Physical activity	–0.053	0.638
	Maternal obesity	0.324	**0.018**
	Maternal overweight	0.091	0.404
	Maternal hypertension	–0.078	0.505
	Maternal cardiovascular disease	0.081	0.469
	Paternal obesity	–0.149	0.297
	Paternal overweight	0.253	**0.024**
	Paternal hypertension	–0.047	0.688
	Paternal cardiovascular disease	–0.011	0.917

Group I – prematurely born young adults; **group II** – young adults born at term, but with low birth weight.
* Multiple stepwise backward regression analysis.

Tab. 8. A summary of the analysis of the relationship between the number of atherosclerotic risk factors in young adults and a set of independent variables (multiple regression analysis)

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No statistically significant differences between study groups were found based on the analysis of the prevalence of abnormal (high) BMI and waist circumference, the percentage of adipose tissue and blood pressure measurements. Data comparison is presented in Tab. 5.

An analysis of abnormal biochemical findings showed statistically significant differences between study groups in terms of the prevalence of increased cholesterol levels. These were more common among prematurely born participants (group I – 74%), followed by group C (48%) and group II (38%) ($p = 0.009$) (Tab. 6). The levels ranged between 4.94 and 7.45 mmol/L in group I, between 4.99 and 6.72 mmol/L in group II and between 4.94 and 6.57 mmol/L in group C.

An analysis of variance showed statistically significant differences in mean cholesterol levels between the groups and confirmed significantly higher cholesterol levels in the group of prematurely born participants (group I – 5.40 mmol/L) compared to other study groups (group II – 4.58 mmol/L, group C – 4.85 mmol/L) ($p < 0.000$) (Tab. 7).

Statistical analysis based on a multiple stepwise backward regression analysis showed a significant positive correlation between the number of atherosclerotic risk factors (abnormal fasting glycaemia, hypercholesterolemia, hypertriglyceridemia, high BMI, high waist circumference, high percentage of fat tissue) and a set of independent variables, including classification to group I (premature birth), age as well as maternal obesity and paternal overweight (Tab. 8).

A chi-square test was used to analyse the prevalence of high BMI and waist circumference, the percentage of adipose tissue, blood pressure and abnormal glucose, cholesterol and triglyceride levels in groups I, II, participants born as SGA or with normal body weight for gestational age in groups I and C. No statistically significant differences were found between these groups.

DISCUSSION

Atherosclerotic cardiovascular diseases have an etiopathogenetic onset in the developmental period. The severity of atherosclerotic lesions increases with age, which is associated with different factors. The epidemiology of these factors is not fully understood in young adults[6]. According to Barker's hypothesis[2], individuals with low birth weight are at a higher risk of metabolic disorders, obesity and cardiovascular diseases in later life. This is associated with changes occurring during foetal life, accompanied by environmental factors, such as improper nutrition, limited physical activity and, consequently, increased weight gain during childhood.

Szostak-Węgierek, who included patients aged between 18 and 34 years in her study, showed high prevalence of overweight and obesity (49.3% and 19.2%, respectively) based on BMI[7]. This was not confirmed in our study, which showed that the percentage of individuals both, from the control group (17% and 2%) as well as those born prematurely (15.8% and 10.5%) or at term, but with low body weight (7.7% and 7.7%) with BMI corresponding to overweight or obesity was lower compared to that in the abovementioned study, as indicated by the data in brackets.

Just as in the case of Barker, Uthaya et al. found that prematurely born children are characterised by a significantly higher amount of subcutaneous intra-abdominal adipose tissue. The authors concluded that the disturbed fat distribution may increase the risk of cardiovascular diseases in later life[8]. The Bogalusa Heart Study, which included groups of young adults in their third decade of life, who had either low birth weight or normal birth parameters, showed no increase in the prevalence of BMI-based obesity in the group of participants with low birth weight[9]. Just as in the case of te Velde et al.[10] or Osler et al.[11], the authors concluded that abnormal health behaviours have a greater impact on the increased risk of cardiovascular diseases than low birth weight. Our study showed no significant increase in the prevalence of obesity or abdominal obesity in any of the compared groups. Obesity and abdominal obesity were usually observed in only some of prematurely born participants, with no statistical significance in relation to other groups.

Parental obesity is considered the most important risk factor for obesity in the offspring generation[12]. The collected data on the nutritional status of the parents of young adults included in the study indicated an increased prevalence of overweight and obesity among the mothers of controls compared to the mothers in other groups. Paternal nutritional status was comparable for all groups. As already mentioned, our study showed no significantly increased prevalence of abnormally high body mass index or waist circumference in any of the groups. However, there was a significant correlation between the BMI of prematurely born participants and the BMI of their mothers, which may indicate the impact of environmental factors, possibly including nutritional preferences among families. Such behaviours were not analysed, and the frequency of meals consumed by our participants did not allow to refer to their quality. The conducted multiple stepwise backward regression analysis demonstrated that maternal obesity and paternal overweight significantly promote an increase in the number of atherosclerotic risk factors, especially if combined with increasing age and premature birth.

Proper nutrition during childhood and adolescence is essential for normal growth and development of the human body[13]. Therefore, breastfeeding is important not only in the first period of child's life, but also in later years, as emphasised by the European Society for Paediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN), the American Academy of Pediatrics (AAP) and the Polish Society for Paediatric Gastroenterology, Hepatology and Nutrition. Breastfeeding is recommended until at least 6 months of age, with continued breastfeeding along with appropriate complementary foods[14,15]. Szajewska et al.[15]

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and the data of the Central Statistical Office published in 2016[16] indicate that most children are breastfed in their first days of life. However, this percentage is significantly reduced during subsequent months. Some publications emphasise the protective effect of breastfeeding only in the first years of the child's life[17,18]. Other studies suggest that the protective effect of breastfeeding lasts until school age[19], and even up to early adulthood[20]. Early exposure to artificial feeding is said to be associated with distant health consequences, such as cardiovascular diseases, hypertension, diabetes and obesity[21]. Our study showed that breastfeeding initiated immediately after birth was most common in children born at term and with normal body weight, and least common in preterm children. However, the latter group, which lacked the protective effect of breastfeeding, did not present with significantly higher proportion of individuals with excess body weight. Furthermore, a significant relationship between the BMI of adult participants and the BMI of their mothers was found.

Currently, the National Health Programme 2016–2020 is being implemented in Poland to improve lifestyle, also in the aspect of physical activity[22]. The Polish Forum for Prevention of Cardiovascular Diseases Guidelines recommends at least 30–45 minutes of physical exercise on a daily basis for adults[23]. According to the data collected by the Central Statistical Office in 2012, more than 45% of respondents participated in sports and recreation activities, which is by 8% more than in 2008[24]. On the other hand, Piekarzewska et al. showed that only 20–30% of people in the third decade of life spent time actively – as recommended by the World Health Organization[16]. In the presented material, 45% of controls, 50% of those born with IUGR and 66% of prematurely born participants declared participation in physical activities, which probably modulated the effects of dietary and prenatal factors on their current nutritional status.

As for the biochemical risk factors for cardiovascular diseases, we assessed the levels of basic lipid (total cholesterol and triglycerides) and carbohydrate (fasting glucose) metabolism parameters. We used capillary blood test strips, which are available in a family doctor's practice. The results were compared with the current standards. In 2016, hypercholesterolemia was detected in nearly 20 million people in Poland[as cited in 25], indicating that lipid disorders are the most common and the most poorly controlled cardiovascular risk factor. These disorders constitute an independent risk factor for cardiovascular events; therefore their effective treatment is as important as the treatment of hypertension or diabetes[26]. According to the preliminary results of the LIPIDOGRAM 2015 study, increased cholesterol levels, i.e. more than 190 mg/dL (4.9 mmol/L), are found in 58% of adult primary health care patients[25]. The guidelines recommend that total cholesterol levels in adults should be less than 190 mg/dL (4.9 mmol/L). Triglyceride level above which there is an increase in the cardiovascular risk is 150 mg/dL (1.7 mmol/L)[5].

An analysis of studies on the levels of biochemical risk factors for atherosclerosis confirmed the increasing tendency towards adverse changes in the lipid profile occurring with age among young adults. Słowikowska-Hilczer et al. found a positive correlation between patient's age and cholesterol/triglyceride levels[27]. According to NATPOL PLUS, increased total serum cholesterol levels are detected in 23% of women and 25% of men aged between 18 and 29 years, while serum triglyceride levels of more than 150 mg/dL (1.7 mmol/L) were reported in 17% of people included in the study[28]. The Bogalusa Heart Study, which included young adults born with IUGR or normal birth weight, showed an increased risk of abnormal lipid levels in those with low birth weight[9]. In our study, high cholesterol levels (exceeding the recommended level of 190 mg/dL; 4.9 mmol/L) were detected in a significantly higher proportion of prematurely born participants as opposed to IUGR patients, compared to other groups. Furthermore, multiple regression analysis demonstrated a significant positive impact of age and premature birth on the occurrence of a higher number of atherosclerotic risk factors. The highest incidence of hyperglycaemia was also observed in the group of prematurely born participants; however, with no statistical significance.

The small size of study groups is a limitation in the interpretation of our findings in a population context. However, the presented findings point to the necessity for general practitioners to provide young adults born prematurely or at term, but with low birth weight with medical management, which takes into account patient's family history, including atherosclerotic risk factors; an assessment of weight gain since infancy, along with eating habits and physical activity; anthropometric measurements of body weight, height and waist circumference (including BMI); as well as a periodic verification of these data. Biochemical evaluation, including glucose levels and lipid metabolism parameters, is also needed in these patients.

CONCLUSIONS

1. Premature birth increases the risk of elevated serum cholesterol in the third decade of life.
2. Premature birth and IUGR do not increase the risk of obesity in the third decade of life.
3. Premature birth, increasing age and excessive parental nutritional status have an impact on the number of atherosclerotic risk factors in the third decade of life.

Conflict of interest

Authors do not report any financial or personal connections with other persons or organisations, which might negatively affect the contents of this publication and/or claim authorship rights to this publication.

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