

# The prevalence of risk factors for atherosclerosis among middle school students in Sopot, Poland: results of the SOPKARD 15 programme

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## Abstract

**Background:** SOPKARD 15 is a comprehensive programme to assess the health status of a population of teenagers. The aspects assessed in the study are: physical development, nutritional status, arterial blood pressure, lipid and carbohydrate metabolism, oral hygiene, and psychological parameters.

**Aim:** To assess the prevalence of cardiovascular risk factors in the study population.

**Methods:** We examined 372 children (185 girls) at the age of 14. The cut-off values for normal lipid blood levels were based on the NCEP-Peds guidelines. Body mass index was assessed on the basis of the Polish centile charts. Blood pressure values assessed against the centile charts were the mean values calculated on the basis of the second and third measurements.

**Results:** Systolic and diastolic blood pressure values were elevated in 15.81% and 10.90% of the subjects, respectively. Abnormal blood glucose was detected in fewer than 6% of the children. Total cholesterol was elevated in 8% and borderline in 24% of the subjects; 8.5% of children were overweight and 7.4% were obese; 5.0% of the subjects took very little physical exercise; 16.4% of boys and 23.4% of girls admitted smoking. Dental examination revealed inflamed gums in 77.6% of the subjects. The diagnosis of a depressive episode was confirmed in 4.2% of the teenagers.

**Conclusions:** 1. Due to the high prevalence of the risk factors there is a need to launch a comprehensive cardiovascular prevention programme among the teenagers. 2. A considerable proportion of children with lipid abnormalities indicate the need for more frequent lipid profile testing in children.

**Key words:** cardiovascular risk factors, atherosclerosis, adolescents, epidemiology

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## INTRODUCTION

Cardiovascular diseases (CVD) are the leading cause of death in developed countries. Although their symptoms do not generally manifest until adult life, atherosclerosis — the underlying pathology leading to CVD — begins to develop already in children and during adolescence [1]. For this reason undertaking preventive measures among children and adolescents has become one of the main goals of the Polish and European health programmes [2, 3].

The SOPKARD 15 programme, completed for the first time in 2007, is a study of all the students attending middle

schools in Sopot, Poland, in their eighth year. The main aim of the study is to assess the overall health of middle school students with particular emphasis on the risk factors of lifestyle diseases, i.e. ischaemic heart disease, metabolic syndrome and diabetes mellitus, chronic kidney disease and hypertension. Identification of children at a higher risk of developing the above conditions will make it possible to implement preventive measures early enough and detection of these conditions will make it possible to initiate effective therapy.

The aim of the study was to perform a comprehensive analysis of the prevalence of the so-called new risk factors for

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premature atherosclerosis, such as depressive symptoms, exposure to stressful situations and periodontal pathologies, as well as assessing the prevalence of the conventional risk factors: overweight and obesity, hypertension, lipid abnormalities, low physical activity and smoking — in the population of students attending middle schools in Sopot, Poland.

## METHODS

### Study group

The study group consisted of students attending middle schools in Sopot, Poland. All the eighth-year pupils were invited to participate and the only inclusion criterion was providing written informed assent by the child and written informed consent by the child's parent or legally acceptable representative. It was possible to assent/consent to some of the study procedures only. Before the launch of the study the investigators had organised briefings for parents and teachers. The study was conducted on the premises of the schools in collaboration with the school heads.

### Investigated risk factors

The laboratory parameters were determined at the University Clinical Centre at the Medical University of Gdansk, Poland. The cut-off values for blood lipid levels were based on the paediatric guidelines published by the National Cholesterol Education Program for Children and Adolescents (NCEP-Peds) [4].

Body mass, height and body mass index (BMI) were assessed with the use of centile charts developed for children inhabiting Warsaw, Poland [5].

Blood pressure (BP) was assessed on the dominant arm with three measurements taken at least 2 min apart. Blood pressure was measured with an electronic monitor (Omron M5-I) and a cuff matched to the arm circumference. Mean values of the second and third measurement were compared against the centile charts. Charts developed by the National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents were used [6].

Physical activity was assessed with a questionnaire that divided the study subjects into groups of low (practically lack of physical exertion, children irregularly attending physical education both for objective medical reasons and because of truancy, fake parents notes etc.), moderate (physical education only or physical education and irregular activity outside the school) and high physical activity (physical education and regular physical activity outside the school).

The frequency of smoking was rated as occasional (less frequently than once a week) or regular (regular smoking once a week or more frequently).

Dental examination with particular emphasis on periodontal status and the presence of inflammation was conducted by dental professionals from the Department of Periodontology and the Diseases of Oral Mucosa, Medical University of Gdansk, Poland.

Depressive symptoms were assessed with the use of the Beck Depression Inventory (BDI). The BDI is a tool commonly used worldwide to measure the severity of depressive symptoms in adolescents from 13 years of age and in adults [7, 8]. The depression questionnaires were, if necessary, verified by an examination by a psychiatrist. The stress level was assessed by examining the severity of stressful life events in the year preceding the study. The list of events had been compiled on the basis of "Life Events Checklist" by Johnson and McCutcheon, a tool that assesses the severity of stressful life events in adolescents [9]. All the questionnaire sheets were coded in order to ensure the highest possible level of objectivity.

### Statistical analysis

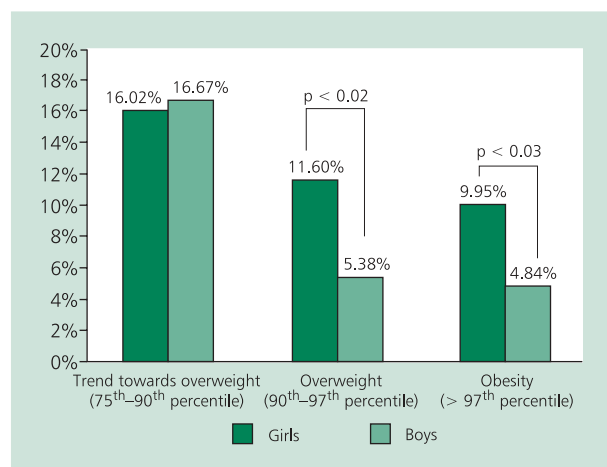
The results are presented as mean  $\pm$  SD or numbers and percentages. Continuous variables were compared using Student t-test and categorical variables using  $\chi^2$  test. A p value  $< 0.05$  was considered significant.

## RESULTS

A total of 372 children (78.8% of all eighth-grade students), including 187 boys and 185 girls were examined between 2006 and 2007. The mean age was  $14.06 \pm 0.34$ . Students in classes with an extended sports curriculum accounted for 22.3% of all the middle-school students.

Abnormal body mass was observed in nearly 16% of the subjects with 8.5% being overweight and 7.4% obese. Both overweight and obesity were statistically more prevalent among girls. A total of 16.4% of the subjects were at an increased risk of overweight (75<sup>th</sup> to 90<sup>th</sup> percentile) (Fig. 1).

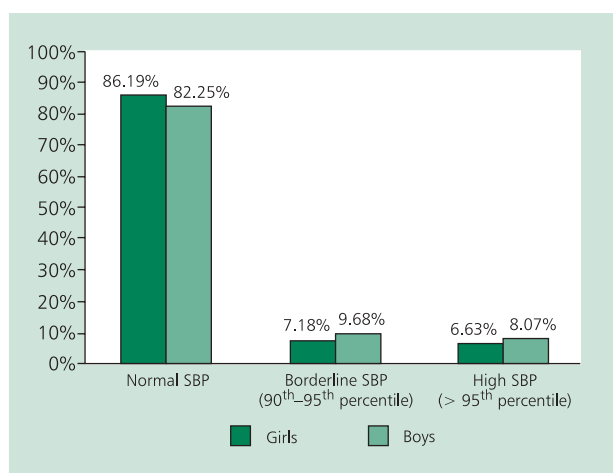
Normal values of total cholesterol were observed in 68% of the subjects. Borderline high and elevated total cholesterol values were observed in 24% and 8% of the children, respectively, and they were significantly more prevalent in girls. Low



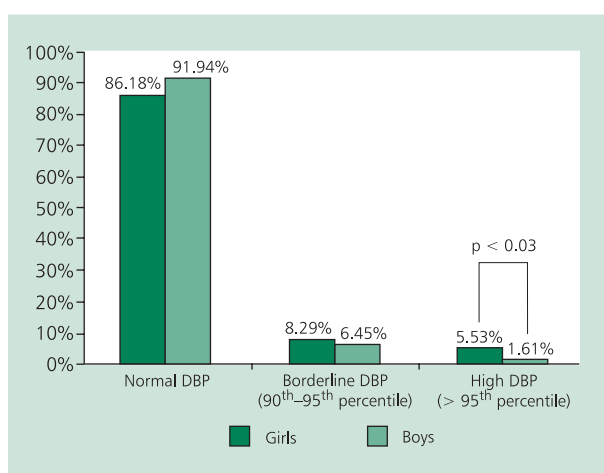
**Figure 1.** Body mass — interpretation according to percentile charts for body mass index

**Table 1.** Lipid and glucose profiles — rates of abnormal results

Parameter	Girls	Boys	P
Glucose: abnormal values ( $\geq 100$ mg/dL)	3.93%	7.56%	NS
Total cholesterol: borderline values (170–199 mg/dL)	29.94%	17.65%	< 0.01
Total cholesterol: abnormal values ( $\geq 200$ mg/dL)	10.74%	4.71%	< 0.02
LDL-cholesterol: borderline values (110–129 mg/dL)	19.38%	8.59%	< 0.01
LDL-cholesterol: abnormal values ( $\geq 130$ mg/dL)	7.75%	6.25%	NS
HDL-cholesterol: borderline values (35–45 mg/dL)	24.62%	30.83%	NS
HDL-cholesterol: abnormal values (< 35 mg/dL)	1.54%	4.17%	NS
Triglycerides: borderline values (90–129 mg/dL)	19.77%	21.77%	NS
Triglycerides: abnormal values ( $\geq 130$ mg/dL)	9.04%	7.06%	NS



**Figure 2.** Systolic blood pressure (SBP) — rates of abnormal values; differences non-significant



**Figure 3.** Diastolic blood pressure (DBP) — rates of abnormal values

and borderline low HDL-cholesterol levels were equally prevalent. Abnormal LDL-cholesterol values were observed in 21% of the subjects. Abnormal fasting glucose levels were observed in slightly fewer than 6% of the children. The rates of abnormalities of lipid and glucose metabolism according to gender are given in Table 1.

Borderline high values of systolic BP (90<sup>th</sup> to 95<sup>th</sup> percentile) were observed in 8.45% and the percentage of measurements exceeding the norm (> 95<sup>th</sup> percentile) was 7.36%. There were no significant differences between the boys and the girls. Borderline values of diastolic BP were observed in 7.36%. In 3.54% of the subjects diastolic BP exceeded normal values. Abnormal values of diastolic BP were significantly more commonly observed in girls ( $p = 0.0284$ ) (Figs. 2, 3).

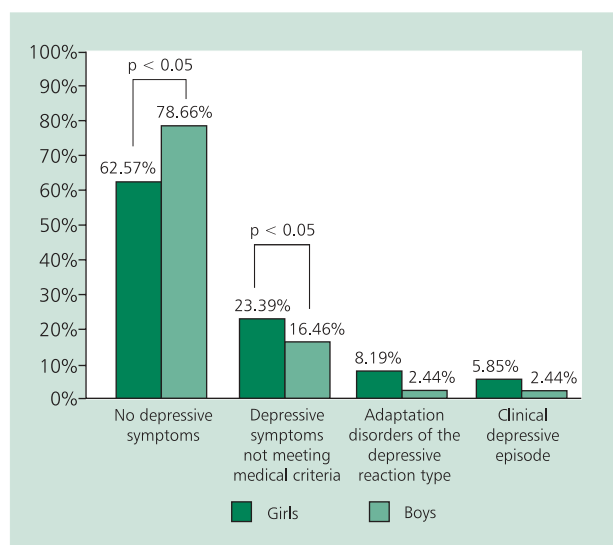
In 4.9% of the boys and 5.0% of the girls took very little physical activity. When we excluded sports class students, the rates rose to 6.2% and 6.5%, respectively. Regular physical activity outside the physical education lessons declared 33.9% of the non-sports class children.

**Table 2.** Smoking

Sex	Smokers		Non-smokers
	Regular	Occasional	
Female	7.60%	15.80%	76.60%
Male	8.50%	7.90%	83.60%

Differences non-significant

In the questionnaire, 16.4% of the boys and 23.4% of the girls admitted regular smoking and occasional smoking was declared by 1/3 and 2/3 of the smoking girls, respectively (Table 2). A common reason for smoking declared by both the boys and girls was the willingness to impress others and be attractive to peers. Additional reasons provided by the girls included the willingness to lose weight and coping with too much stress. The most common reason for smoking declared by the boys was the willingness to do something pleasant to oneself and “feel like an adult”. Passive smoking turned out to be quite a problem as well. More



**Figure 4.** Depression — results of a psychiatric examination

than a half of the subjects was exposed to cigarette smoke at home.

Questionnaires revealed depressive symptoms in 29.55% of the subjects (37.43% of the girls and 21.34% of the boys) ( $p < 0.05$ ). Subjects with depressive symptoms underwent a psychiatric examination, which confirmed a depressive episode in 4.2% of the teenagers and adaptation disorder in 5.4% (the diagnoses were established on the basis of ICD-10 criteria) (Fig. 4). A considerable percentage of the teenagers was exposed to stressful events in the year preceding the study (stressful situations at school [46%], death of someone close [41%], problems communicating with parents [28%], problems communicating with peers [24%], parents' divorce/separation [9%]).

Gingival inflammation was present in 77.6% of the subjects and involved isolated or several teeth. No cases of generalised gingival inflammation were observed. Early signs of periodontitis requiring further evaluation for aggressive periodontitis were present in a small percentage of the students (3.35%). In addition, the oral mucosa in 5% of the subjects showed signs suggestive of smoking.

In summary, only 19.6% of the subjects had no signs that would suggest the presence of risk factors for atherosclerosis. An increased risk of abnormalities was identified in 21.0% of the children and 59.4% had at least one parameter exceeding the normal range.

## DISCUSSION

The socioeconomic changes that have taken place in Poland in the past few years have contributed to dramatic lifestyle changes. They have led to the emergence of new positive health trends, such as prolonged life expectancy, but also trends that continue to cause concern among members of the medical community with the society-threatening obesity

epidemic being the most important one. Obesity is a problem that affects children in a particular manner. It is an independent CV risk factor and predisposes to the development of hypertension [10, 11], insulin resistance [12] and lipid abnormalities [13], leading in consequence to metabolic syndrome. In highly developed countries the prevalence of metabolic syndrome in children — depending on the adopted criteria — ranges from 4% [14] to 9.2% [15]. As there is no universally accepted definition of metabolic syndrome in children, further studies are required to develop a set of clinically useful diagnostic criteria.

Regular physical activity helps to prevent obesity [16] and contributes to BP normalisation. Systematic physical activity has also been proved to reduce CV risk even if it does not lead to weight loss [17]. In this context, the results of the questionnaire on physical activity we administered to middle school students in Sopot are alarming.

The rate of lipid abnormalities has turned out to be surprisingly high. Dyslipidaemia was the most common CV risk factor observed by us. Of note is the low awareness of the problem both among the patients and in the medical community. Our data should prompt a discussion on the need for widespread lipid profile testing as part of the periodic medical evaluation of 14 year-old. Including all the children from families at increased CV risk in a periodic screening programme seems to be the least that should be done. It is also necessary to disseminate knowledge on lipid abnormalities in adolescents among doctors, especially general practitioners.

The past few years have seen an increasing number of cases of type 2 diabetes mellitus in young people. We have also observed an increased percentage of children with impaired fasting glucose in our study. It should, however, be stressed that this number is most likely slightly overestimated and requires additional verification, as some of the children might have gone against the investigators' directions and not have had their glucose measured on an empty stomach.

Similarly, further evaluation is required in the group of children with high BP values, as the diagnosis of hypertension cannot be based on BP values observed on a single visit only, even if multiple measurements were made. Hence the teenagers in which abnormal BP values were identified were referred for ambulatory BP monitoring.

Smoking is an important CV risk factor. Despite the official complete ban on selling cigarettes to minors in Poland the problem of smoking affects a considerable percentage of adolescents. It should be emphasised that although we did assure the subjects that the questionnaires were anonymous, some of the teenagers might have withheld the fact that they smoked. A disturbing tendency towards a gradually increasing number of young smoking women is being observed worldwide [18]. In SOPKARD 15, the significant predominance of girls over boys was only present in the case of occasional smoking. This issue requires further observation, as we may be dealing with a changing tendency in the group of adult

smokers in which males predominate [19]. This change may very likely result from the rapid social changes happening over the past few years in Poland (for instance, changes in the image of women) and the greater susceptibility of girls to peer pressure. The need for acceptance by the group seems to be the decisive factor. Our study reveals the significance of the problem and suggests the need for intensified educational efforts among teenagers.

We have shown a considerable prevalence of depressive symptoms in our study subjects. These data take on a special meaning in the context of research results. While depression in adults is a proved CV risk factor [20], data are lacking on the association between depression in adolescence and future CV risk. Stressful life events in this period and social support received from parents during childhood and early youth exert a long-term effect on health [21]. The lack of close relations with their parents among Harvard University students was associated with an increased prevalence of coronary artery disease and hypertension 35 years later [22].

Periodontal inflammation is currently believed to play an important role in the pathogenesis of CVD, respiratory disease and stroke [23–25]. We found in our study that gingival pathologies in the form of inflammation resulted from poor oral hygiene. However, in a small group of subjects (3.35%) we observed signs of aggressive periodontitis requiring early specialist treatment. Also, the presence of signs of smoking in the oral mucosa is worth mentioning here. All the subjects in whom leukoplakia was discovered were smokers. Our results indicate the need for educational and prophylactic efforts in terms of oral hygiene and the harmfulness of smoking, and in the long run, the need for determining the correlation between periodontitis and systemic conditions, if any.

If any preventive activities are to be effective, relevant epidemiological data must be available. The investigations carried out as part of the SOPKARD 15 project will increase the currently scanty body of evidence related to the prevalence of risk factors for atherosclerosis in adolescents, and the future prospective studies will allow us to assess the efficacy and cost-effectiveness of prophylactic efforts.

## CONCLUSIONS

1. Implementing a comprehensive CV prevention programme in middle-school students is necessary due to the considerable prevalence of risk factors.
2. The significant percentage of children with lipid abnormalities should lead to a more frequent determination of lipid profile in this age group.

**Conflict of interest:** none declared

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# Rozpowszechnienie czynników ryzyka rozwoju miażdżycy wśród sopockich gimnazjalistów: wyniki programu SOPKARD 15

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## Streszczenie

**Wstęp:** Choroby układu sercowo-naczyniowego stanowią główną przyczynę zgonów w Polsce, dlatego też istnieje potrzeba prowadzenia skutecznej ich prewencji. Przykładem takiego działania jest SOPKARD 15 — badanie kompleksowo oceniające stan zdrowia młodzieży gimnazjalnej.

**Cel:** Celem pracy była ocena częstości występowania w badanej grupie czynników ryzyka chorób serca i naczyń.

**Metody:** Grupę badaną stanowili uczniowie klas drugich sopockich gimnazjów. Przebadano 372 dzieci (185 dziewcząt), a 22,3% spośród przebadanych stanowiła młodzież uczęszczająca do klas sportowych. Za prawidłowe stężenia lipidów we krwi przyjęto wartości oparte na wytycznych dla dzieci Zespołu Ekspertów Narodowego Programu Edukacji Cholesterolowej (NCEP-Peds). Oceny masy ciała, wskaźnika masy ciała i wzrostu dokonywano na podstawie siatek centylowych opracowanych dla dzieci warszawskich. Pomiar ciśnienia tętniczego wykonywano na ramieniu dominującym, 3-krotnie, w odstępiech minimum 2 min. Użyto aparatu elektronicznego Omron M5-I i mankietu odpowiedniego do obwodu ramienia. Do siatek centylowych odnoszono wartości średnie obliczone z drugiego i trzeciego pomiaru.

**Wyniki:** Nieprawidłowe wartości ciśnienia skurczowego (> 90 percentyla) stwierdzono u 15,81% dzieci, a ciśnienia rozkurczowego — u 10,9% dzieci. Nieprawidłowe (> 100 mg/dl) wartości glikemii na czczo rozpoznano u niespełna 6% dzieci. U 24% dzieci stężenie cholesterolu całkowitego było granicznie wysokie, a u 8% powyżej normy. Nieprawidłowe wartości cholesterolu frakcji LDL dotyczyły 21% badanych. Nadwaga występowała u 8,5%, a otyłość u 7,4% dzieci. Bardzo małą aktywnością fizyczną charakteryzowało się 5,0% dzieci. Spośród badanych 16,4% chłopców i 23,4% dziewcząt przyznaje się do sięgania po papierosy. Ponadto ponad połowa ankietowanych dzieci jest narażona na palenie bierne. W badaniach stomatologicznych wykazano, że u 77,6% badanych występowały stany zapalne dziąseł. U 3,35% uczniów rozpoznano wczesne cechy zapalenia przyzębia wymagające dalszej diagnostyki w kierunku agresywnego zapalenia przyzębia. W badaniach kwestionariuszowych objawy depresyjne wykazano u 29,55% badanych. W wyniku badania lekarskiego rozpoznano epizodu depresji potwierdzono u 4,2% młodzieży, a u 5,4% zdiagnozowano zaburzenia adaptacyjne (diagnozy stawiano zgodnie z kryteriami ICD-10).

**Wnioski:** 1. Prowadzenie kompleksowej profilaktyki chorób serca i naczyń wśród młodzieży gimnazjalnej jest konieczne ze względu na duże rozpowszechnienie czynników ryzyka. 2. Znaczny odsetek dzieci z zaburzeniami lipidowymi powinien skłaniać do częstszego oznaczania lipogramu w tej grupie wiekowej.

**Słowa kluczowe:** czynniki ryzyka sercowo-naczyniowego, miażdżyca, młodzież, epidemiologia

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