

# Awareness of the role of cardiovascular risk factors and their prevention from the perspective of Tricity adolescents

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## Abstract

**Introduction.** Arterial hypertension (HT) affects 10.4 million adult Poles, and the blood pressure (BP) control rate is only 26%. Beyond any doubt, high blood pressure results in cardiovascular (CV) target organ damage, which markedly influences national healthcare programs. Childhood introduced cardiovascular prophylaxis offers opportunities to decrease incident HT and delay or even eliminate its consequences. Therefore we have decided to study the level of knowledge on HT and CV disease (CVD) among random 1st and 2nd grade high school students in Tricity, Poland.

**Material and methods.** Questionnaire-based study was conducted voluntarily in two selected high schools of the Tricity agglomeration, Poland, in 2000 and repeated in 2016. All participants were presented with a 38-item questionnaire on cardiovascular risk factors knowledge as well as students' health habits.

**Results.** Studied group consisted of 615 students (57.6% females) at the age of 16, mean BMI  $20.89 \pm 2.95$  kg/m<sup>2</sup> (78% BMI norm). The evaluation of the several habits in two time-points was as follows: additional salt intake was reported by 38.3% vs. 35.1% adolescents in 2000 and 2016, respectively;  $p = 0.43$ , dining in fast food restaurants at least once a week: 13.9% vs. 44.8%; 2000/2016;  $p < 0.01$ ; hours per week spent on physical activity:  $5.6 \pm 4.4$  vs.  $5.5 \pm 4.5$ ;  $p = 0.85$ ; students who never drank alcohol: 19.7% vs. 31.1%;  $p < 0.01$ ; cigarettes ever smoking: 39.6% vs. 21.2%;  $p < 0.01$ ; regular smokers: 10.2% vs. 4.1%;  $p < 0.05$ . The awareness of CV-preventive measures such as body weight reduction was presented by 88.1% vs. 93.9% students in 2000 vs. 2016;  $p = 0.01$ ; regular physical activity 92.6% vs. 97.1%;  $P = 0.01$ , limiting smoking and alcohol consumption 84.2% vs. 91.2%;  $p = 0.01$ ; salt reduction: 62.6% vs. 82.3%;  $p < 0.001$ . Interestingly, in 2016 the majority of students identified myocardial infarction as a consequence of AH 92.4%, which was markedly less evident in case of stroke and kidney disease (46.2%, and 28%, respectively).

**Conclusion.** Although the awareness of negative consequences of HT and other CV-risk factors has grown over the past 15 years, the implementation of this knowledge is insufficient among high-school adolescents.

**key words:** health literacy, adolescents, CVD risk factors, salt, diet, smoking, physical activity

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## Introduction

Arterial hypertension affects approximately one third of Polish adult population [1]. The prevalence of systemic arterial hypertension (AH) continues to rise, especially in young adults [2]: in the United States it has reached 19% in 2008 in the 24–32 age group, according to the Add Health study [3]. The problem of the increased blood pressure becomes also considerable among adolescents. According to the Polish survey OLA/OLAF, which provided blood pressure percentiles charts for Polish adolescent population, 6.2% of children between 10–20 years of age presented with hypertension [4]. Arterial hypertension in young adults is mainly caused by habits instilled in childhood such as increased salt and fat consumption, and using recreational substances such as alcohol and cigarettes [5]. The role of these risk factors is well established, being modifiable at the same time.

The prevalence of overweight in Polish children population ranges between 2 and 12% depending on age and sex. These numbers place us into the medium to high prevalence level compared with other European countries [6]. Childhood ponderosity is well established risk factor for high adult blood pressure [7]. Although, there are many actions towards promotion of physical activity and weight reduction, the problem of increasing obesity prevalence among children is still unsolved.

Excessive salt intake poses as a risk factor for development and progression of hypertension. Numerous studies have shown that the global salt consumption is very high, exceeding the physiological need up to ten times [8]. This tendency described for the adult population is similar among adolescents. It has also been proved that the salt consumption increases with aging [9].

Another factor which may affect the level of blood pressure in adolescence is recreational substances usage. There is a lack of recent studies on the prevalence of smoking among children. In 2002, 9–18% of Polish 14–15 years olds admitted to regular smoking, what outnumbers the prevalence from earlier studies [10]. In the questionnaire-based study SOPKARD 15 Programme conducted ten years ago, 7.6% girls and 8.5% boys declared every-day cigarettes smoking [11]. There is also an increase in e-cigarette use among Polish students [12]. Tobacco consumption usually begins in adolescence and early smoking initiation is related to stronger nicotine dependence and problems with smoking cessation in adulthood [13]. The problem with increasing alcohol consumption among teenagers has also been observed. In Warsaw adolescents' population, the alcohol intake was significantly higher in 2004 compared to 1988, and the increasing tendency was noted among both boys and

girls [14]. Analogously to smoking, alcohol intake by adolescents may determine early development of alcohol dependence [15].

Instilling healthy habits in adolescents appears to be a crucial factor in overall cardiovascular disease (CVD) prevention. Therefore, we evaluated changes in healthy lifestyle habits and assessed the knowledge on HT and CVD risk factors, as well as the awareness of CV-preventive measures within the population of Tricity adolescents.

## Material and methods

Questionnaire-based study was conducted voluntarily in selected high schools of the Tricity agglomeration, Poland. Responsible relatives of the participants as well as the subjects themselves gave an informed consent. The study conformed to the standards set by the Declaration of Helsinki. The Ethical Committee of the Medical University of Gdansk approved the study (NKEBN/114/2016).

All participants were presented with a 38-item questionnaire developed by A. Sz. (Fig. 1) which was completed individually in Polish, during a class.

Students were evaluated two times. In 2000 we surveyed anonymously school adolescents at the age of 16 ( $n = 201$ , 54.2% females; 1 student did not specify sex) attending the first, and the second high school grade. The procedure was replicated in 2016 and their coevals participated ( $n = 410$ ; 59.3% females; 3 students did not specify their sex).

The questionnaire was composed of two main domains related to (1) the awareness of cardiovascular risk factors, and (2) self-reported lifestyle habits such as physical activity, dietary approach, and substances use. Students were also asked about basic anthropometrical data i.e. weight (actual/declared and desired), and height, as well as their parents' CVD history. Later anthropometrics were compared to Polish adolescents-specific percentile charts [16].

All data were tabulated in MS Excel and processed in statistical package (Statistica 10, Statsoft, Poland licensed to GUMed). The questionnaire answers between the year of 2000 and 2016 were compared with the Chi-squared test. Continuous variables were compared with unpaired t-test, p-value less than 0.05 was considered statistically significant for all comparisons.

## Results

In total, six hundred fifteen students (72.8% of the eligible subjects) agreed to participate in the survey.

**Ankieta jest anonimowa, a głównym jej założeniem jest poznanie postaw prozdrowotnych i wiedzy o nadciśnieniu tętniczym wśród uczniów 1. klasy Liceum Ogólnokształcącego.**  
 Dane w niej zawarte zostaną wykorzystane przez Studenckie Koło Naukowe Kliniki Nadiśnienia Tętniczego i Diabetologii Gdańskiego Uniwersytetu Medycznego w celach statystycznych.

**Ankieta dotycząca postaw prozdrowotnych i wiedzy o nadciśnieniu tętniczym  
 GODŁO 2016**

WIEK: \_\_\_\_\_ KLASA: \_\_\_\_\_  
 PŁEĆ:  K  M PRÓBIL: \_\_\_\_\_

1. Czy uprawiasz jakiś sport lub korzystasz z jakichś zajęć ruchowych poza szkołą, przynajmniej raz w tygodniu? Jakich?  
 tak  nie

2. Jak dużo trenujesz w tygodniu?  
 godz. / dzień 

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 / tydzień  
 za dużo  za mało  w sam raz

3. Czy uważasz że ilość zajęć „WF” w szkole jest wystarczająca? Oczywiście  
 za dużo  za mało  w sam raz

4. Ile czasu spędzasz dziennie przed telewizorem, lub komputernym?  
 0-2 godz.  2-4 godz.  >4 godz.

5. Ile czasu Twoim zdaniem powinno poświęcać się na aktywność fizyczną tygodniowo?  
 w ogóle  1-2 godz.  2-4 godz.  4-6 godz.  >6 godz.

6. Czy kiedykolwiek w życiu paliłeś papierosa?  tak  nie  
 Jeżeli tak, to w jakim wieku wypaliłeś pierwszego papierosa? \_\_\_\_\_

7. Czy obecnie palisz papierosa?  tak  nie  
 Jeżeli tak, to od ilu lat? \_\_\_\_\_

8. Jeżeli palisz, to ile papierosów dziennie wypalasz?  
 / dziennie

9. Jeżeli palisz, to w jaki sposób określiłbyś swój stosunek do palenia papierosów? (Wybierz jedną odpowiedź.)  
 Jestem uzależniony i nie chcę rzucić palenia  
 Jestem uzależniony i chciałbym rzucić palenie  
 Nie czuję się uzależniony i nie chcę rzucić palenia  
 Nie czuję się uzależniony, ale chciałbym rzucić palenie

10. Czy Twój rodzic pali papierosa?  
 tak  nie  jedno z rodziców  obydwój rodzice

11. Czy kiedykolwiek lekarz mówił Ci o szkodliwych skutkach palenia papierosów?  
 tak  nie  nie wiem

12. Jak palenie szkodzi zdrowiu?  
 a) może powodować nowotwory  tak  nie  nie wiem  
 b) może powodować choroby serca  tak  nie  nie wiem  
 c) może powodować udar mózgu  tak  nie  nie wiem  
 d) może powodować choroby płuc  tak  nie  nie wiem  
 e) palenie jest bardzo szkodliwe  tak  nie  nie wiem

13. Czy kiedykolwiek próbowałeś narkotyków pod jakąkolwiek postacią (joint, trawa itp.)?  
 tak  nie

14. Czy byłeś świadkiem zażywania narkotyków przez kogoś z Twojego otoczenia?  
 tak  nie

15. Czy jesteś abstynentem? (Tzn. nigdy nie piłeś alkoholu.)  
 tak  nie

16. Czy często jadasz owoce i warzywa?  
 tak  nie  
 Ile porcji dziennie (porcja = objętość dłoni)?  
 1-2  3-4  >5

17. Czy często jadasz w barach typu „fast food” (np. McDonalds, Pizza Hut, KFC itp.)?  
 tak  nie  
 Jak często?  
 >1 raz w tygodniu  1 raz w tygodniu  1-2 razy w miesiącu

18. Czy dostajesz potrawy na talerzu?  
 tak  nie

19. Który z poniższych sposobów może Twoim zdaniem zmniejszyć ryzyko chorób układu krążenia?  
 a) zmniejszenie masy ciała u osób z nadwagą  tak  nie  nie wiem  
 b) regularna aktywność fizyczna  tak  nie  nie wiem  
 c) ograniczenie palenia tytoniu i picia alkoholu  tak  nie  nie wiem  
 d) ograniczenie soli w posiłkach  tak  nie  nie wiem  
 e) regularne jedzenie warzyw i owoców  tak  nie  nie wiem  
 f) ograniczanie spożycia tłuszczów w posiłkach  tak  nie  nie wiem

20. Jaki sposób stosujesz, aby zachować zdrowie?  
 a) utrzymuję optymalną masę ciała  tak  nie  
 b) regularnie ćwiczę  tak  nie  
 c) nie używam/ograniczam palenia tytoniu i picia alkoholu  tak  nie  
 d) ograniczam sól w posiłkach  tak  nie  
 e) regularnie jem warzywa i owoce  tak  nie  
 f) ograniczam spożycie tłuszczów w posiłkach  tak  nie

21. Jaki choroby Twoim zdaniem są związane z nadciśnieniem tętniczym?  
 a) udar mózgu  tak  nie  nie wiem

b) zawał serca  tak  nie  nie wiem  
 c) choroby nerek  tak  nie  nie wiem  
 d) miażdżyca tętnic  tak  nie  nie wiem

22. Co Twoim zdaniem może być przyczyną nadciśnienia i innych chorób serca?  
 a) predyspozycja genetyczna (występowanie nadciśnienia u rodziców)  tak  nie  nie wiem  
 b) nadmierne jedzenie, nadwaga, otyłość  tak  nie  nie wiem  
 c) siedzący tryb życia  tak  nie  nie wiem  
 d) nadmiar soli w diecie  tak  nie  nie wiem  
 e) palenie tytoniu  tak  nie  nie wiem  
 f) nadmierne picie alkoholu  tak  nie  nie wiem  
 g) stres  tak  nie  nie wiem

23. Gdzie poszukujesz informacji o zdrowiu? Uzupełnij niżej wymienione sposoby w skali od 1 do 5 (1 – najczęstszy sposób, 5 – najrzadszy sposób).  
 gazety, czasopisma i książki  
 radio i telewizja  
 rozmowa z rówieśnikami  
 rozmowa z rodzicami  
 internet

24. Czy uważasz, że w szkole powinno się więcej mówić o sprawach zdrowia?  
 tak  nie

25. Jeżeli tak, to która z metod uważasz za najlepszą? Uzupełnij niżej wymienione sposoby w skali od 1 do 5, gdzie 1 to Twoim zdaniem najlepsza metoda.  
 oglądanie filmów i programów o zdrowiu w trakcie zajęć w szkole  
 wykorzystanie komputerów (Internet, programy multimedialne)  
 rozmowa z nauczycielami  
 spotkania z zaproszonymi osobami spoza szkoły  
 ulotki, czasopisma i książki do czytania w domu

26. Czy korzystasz z komputera?  tak  nie

27. Czy masz dostęp do Internetu?  tak  nie

28. Jeżeli korzystasz z Internetu, to gdzie to robisz?  
 a) w domu  tak  nie  
 b) w szkole  tak  nie

c) w kawiarniach internetowych  tak  nie  
 d) na urządzeniach przenośnych (telefon komórkowy, tablet)  tak  nie  
 e) u znajomych  tak  nie  
 f) w innym miejscu (hotele, sklepy, restauracje, dworce)  tak  nie

29. Czy uważasz, że Internet może być dla Ciebie źródłem informacji dotyczących zdrowia?  
 tak  nie  nie wiem

30. Ile masz wzrostu? \_\_\_\_\_ cm

31. Ile ważysz? \_\_\_\_\_ kg

32. Czy uważasz, że masz nadwagę?  tak  nie  nie wiem

33. Ile powinienś ważyć? \_\_\_\_\_ kg

34. Jakie masz ciśnienie tętnicze?  
 Nie znam swojego ciśnienia  
 moje ciśnienie to \_\_\_\_\_ / \_\_\_\_\_ mmHg

35. Jaka jest Twoim zdaniem norma ciśnienia tętniczego?  
 norma ciśnienia \_\_\_\_\_ / \_\_\_\_\_ mmHg

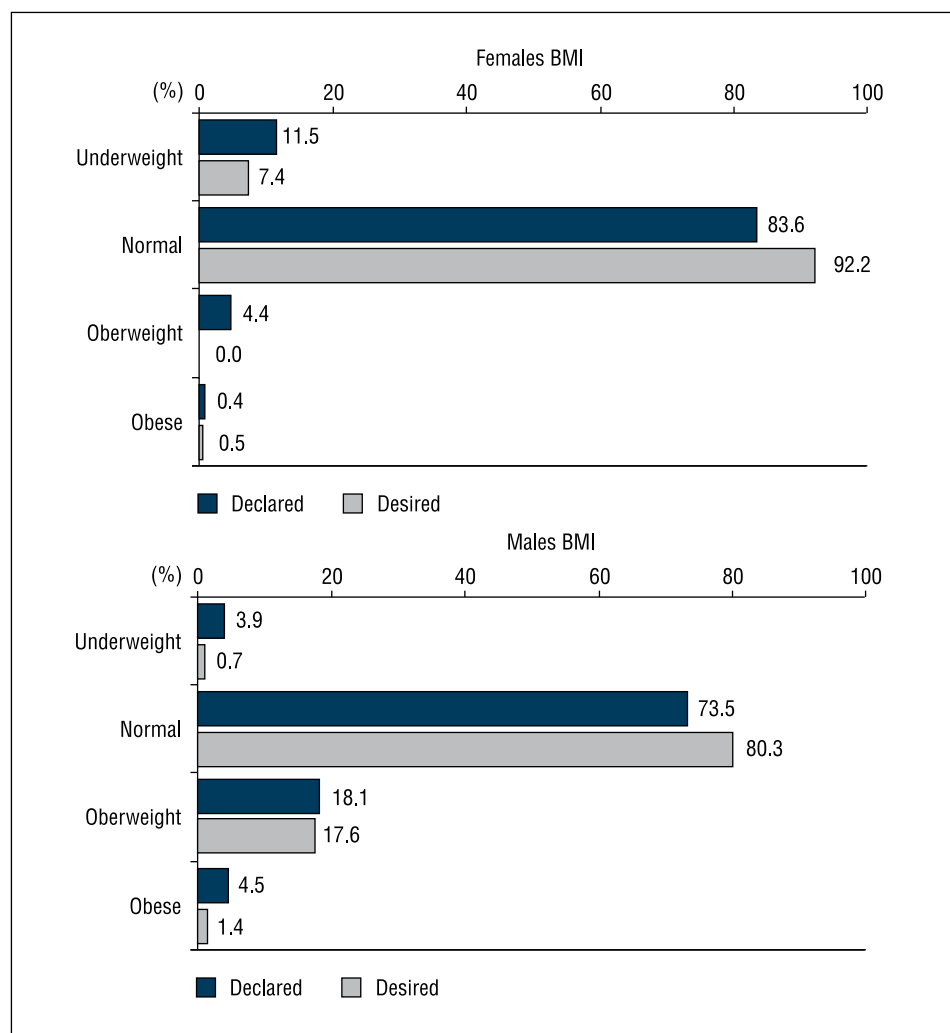
36. Czy chorujesz na jakąś chorobę przewlekłą? Jaka to choroba?  
 tak  nie  
 Jaki: \_\_\_\_\_

37. Czy któryś z Twoich rodziców:  
 a) choruje na nadciśnienie tętnicze?  nie  jedno z rodziców  oboje z rodziców  nie wiem  
 b) przeżył zawał serca?  nie  jedno z rodziców  oboje z rodziców  nie wiem  
 c) przeżył udar mózgu?  nie  jedno z rodziców  oboje z rodziców  nie wiem  
 d) choruje na cukrzycę?  nie  jedno z rodziców  oboje z rodziców  nie wiem  
 e) ma nadwagę?  nie  jedno z rodziców  oboje z rodziców  nie wiem

38. Czy ktoś w Twojej rodzinie zmarł „na serce” w młodym wieku (przed 55 r.ż.)?  
 tak  nie  nie wiem

Dziękujemy za wypełnienie ankiety.

Figure 1. The original questionnaire presented to students (in Polish)



**Figure 2.** The comparison of declared vs. desired body mass. BMI category according to percentiles (Kulaga *et al.*)

The response rate varied between 93% and 100% depending on the presented question. Out of 38 requested answers, twelve questions were related to social aspects which were not a primary goal of this analysis.

The distribution of body mass index based on declared weight is depicted in Figure 2. Seventy eight percent of surveyed children were characterized by normal BMI as referred to percentile charts. Interestingly, females vs. males were more likely to declare desired body weight within underweight range (12% vs. 0.7%;  $p < 0.05$ ). Concurrently, boys would have expected to have their body weight exceeding normal values (19% vs. 0.5% as preferred by their female counterparts;  $p < 0.05$ ).

### Dietary habits

Additional salt intake (meals seasoning) was declared by a similar proportion of teenagers at two time-

points (38.3% vs. 35.1% in the year of 2000 and 2016, respectively;  $p = 0.43$ ). The subanalysis limited to those adolescents who add salt to their meals showed that 76.8% of children in 2016 knew that salt reduction may be protective against hypertension. Twenty percent of them had at least one of their parents diagnosed with hypertension.

Along with increasing awareness on detrimental impact of salt on CV system (75.8% vs. 52.9% associated excessive salt intake with CVD in 2000 and 2016, respectively;  $p < 0.01$ ), there was a growing recognition of potential CV benefits resulting from salt reduction (Tab. I).

Although there was a moderate increase in vegetables/fruits consumption observed between the two time-points ( $p = 0.02$ ), concurrently, there was a three-fold increase in declared regular fast-food dining ( $p < 0.01$ ). Interestingly, this unfavorable trend accompanied growing recognition of the fact

**Table I.** Lifestyle, diet and substances use

	2000	2016	P-value
<b>Lifestyle and activity:</b>			
Percentage of students who do sports out of school	51.0%	73.4%	< 0.01
Number of hours per week of physical activity	5.6 ± 4.4	5.5 ± 4.5	0.85
Students who practice 3 or more types of sport disciplines	3.9%	10%	0.05
Students who recognize physical activity as a mean to reduce risk CVD	92.6%	97.1%	0.01
Students who use computer or TV set for 2 or more hours per day	46.3%	47.2%	0.82
Students who use computer or TV set for 4 or more hours per day	9.3%	14%	0.09
Students who consider sedentary lifestyle to cause hypertension	65.4%	85.3%	< 0.01
<b>Dietary approach:</b>			
Students who consider salt excess in meals as a risk factor of HT and CVD	52.9%	75.8%	< 0.01
Students who consider reduction of salt in meals to decrease risk of CVD	62.6%	82.3%	< 0.01
Percentage of students who add salt to their meals	38.3%	35.1%	0.43
Salt-users with hypertensive parent	–	20.0%	N.A.
Salt-users who consider salt in diet as a risk factor of HT and CVD	–	71.1%	N.A.
Salt-users who consider salt reduction to decrease risk of CVD	–	76.8%	N.A.
Students who consider regular consumption of fruits/vegetables to decrease risk of CVD	79.3%	83.1%	0.25
Students who declare regular eating of fruit and vegetables	80.1%	87.3%	0.02
Students dining in fast food restaurants at least once a week	13.9%	44.8%	< 0.01
Students who consider reduction of fats in meals to decrease risk of CVD	84.7%	86.2%	0.61
Students who declare to reduce amount of fats in their diet	57.4%	55.5%	0.65
Students who consider excessive eating, overweight and obesity to cause hypertension	86.3%	93.9%	< 0.01
<b>Substances:</b>			
Students who never drank alcohol	19.7%	31.1%	< 0.01
Students who consider alcohol to cause hypertension	57.8%	67.7%	0.02
Students who tried smoking in the past	39.6%	21.2%	< 0.01
Average age of smoking initiation	12.9 ± 1.9	14.6 ± 1.4	0.02
Current smokers	10.2%	4.2%	< 0.01
Current smokers with at least one smoking parent vs. non-smokers with at least one parent smoking		47.1% 22.6%	0.02*
Students informed by health professionals about negative effects of smoking	36.0%	43.3%	0.08
<b>Students who consider tobacco smoking to cause:</b>			
Hypertension	64.9%	64.8%	0.98
Cancer	94.6%	98.0%	0.01
Heart diseases	95.6%	82.4%	< 0.01
Stroke	15.6%	39.9%	< 0.01
Lung diseases	98.0%	98.5%	0.65
Students who consider reduction of smoking and alcohol to decrease risk of CVD	84.2%	91.2%	< 0.01

p-value corresponds to  $\chi^2$  test performed to delineate the differences between 2000 and 2016

\*p-value refers to the difference between non-smokers and current smokers with at least one parent smoking

that excessive fat consumption contributes to the development of hypertension ( $p < 0.01$ ; Tab. I).

No significant change in the attitude towards fat limitation in the diet was evident between 2000 and 2016 ( $p = 0.65$ ; Tab. I).

### Physical activity

As compared to the year of 2000 there was a marked increase in the interest in various sport-activities. 73.1% of students in 2016 declared out-of-school activity at least once a week compared with 48% in



**Table II.** The Awareness of CVD risk factors and corresponding real-life implementation

	Students who consider the following factors to reduce CVD risk			Students who regularly practice the following activity		
	2000	2016	p-value	2000	2016	p-value
Body weight reduction	88.1%	93.9%	0.01	65.2%	81.1%	< 0.001
Regular physical activity	92.6%	97.1%	0.01	62.7%	68.6%	0.15
Limiting smoking and alcohol consumption	84.2%	91.2%	0.01	82.9%	91.1%	< 0.01
Reducing salt in meals	62.6%	82.3%	< 0.001	49.0%	61.7%	< 0.01
Regular fruit and vegetable consumption	79.3%	83.1%	0.25	80.1%	87.3%	0.02
Fat reduction in meals	84.7%	86.2%	0.61	57.4%	55.5%	0.65

p-value corresponds to  $\chi^2$  test performed to delineate the differences between 2000 and 2016

**Table III.** Students correctly identifying smoking-related diseases

Condition	2000	2016	P-value
Cancer	94.6%	98.0%	0.01
Heart diseases	95.6%	82.4%	< 0.01
Stroke	15.6%	39.9%	< 0.01
Lung diseases	98.0%	98.5%	0.65

p-value corresponds to  $\chi^2$  test performed to delineate the differences between 2000 and 2016

2000 ( $p < 0.01$ ; Tab. I). Moreover, a higher proportion of teenagers identified regular exercises as an effective CV-prevention measure (92.3% vs. 97.0% in 2000 vs. 2016, respectively;  $p < 0.01$ ; Tab. II). Surprisingly, the interest in sports was not followed by the greater amount of time spent on physical activity per week (approx. 5.5 hrs/week;  $p = 0.85$ , Tab. I). The detailed distribution of sport intensity is presented in Table I.

### Recreational substances

There was an increase of proportion of students who declared that they refrain from first-ever alcohol use. In 2016 the alcohol abstinence was declared by approximately 1/3 of students which contrasts with 1/5 observed 15 years earlier ( $p < 0.05$ ; Tab. I). This favorable trend aligned with 10% net increase of students who recognize alcohol as a CV-risk factor ( $p < 0.05$ ; Tab. I).

There was also a 6% points drop of cigarettes smokers observed in time. Only 17 students (4.2%) in 2016 declared to be a current smoker. Apparently, the recognition of detrimental effects of smoking habit resulted in older age of first contact with cigarettes, which equaled  $14.6 \pm 1.35$  years of age in 2016 (approx. 1.6 years later as compared to the year of 2000;  $p = 0.02$ , Tab. I). Additionally, less students reported to ever smoke a cigarette (21.2% vs. 39.6%, in 2016 vs. 2000, respectively;  $p < 0.01$ ). Although there was a common understanding of a causative

**Table IV.** Students correctly identifying target organ damage in hypertension

	2000	2016	P-value
Stroke	14.4%	46.2%	< 0.001
Myocardial infarction	83.9%	92.4%	0.001
Kidney diseases	8.9%	28.0%	< 0.001
Lower limb atherosclerosis	49.5%	73.7%	< 0.001

p-value corresponds to  $\chi^2$  test performed to delineate the differences between 2000 and 2016

role of cigarettes smoking in the development of lung cancer (Tab. III), at the same time there was an unacceptably low recognition of this habit as a stroke risk factor (Tab. III). There was a remarkable coincidence related to generation-driven smoking pattern. Among 17 students who were current smokers almost half has at least one parent smoking (Tab. I) compared to 22.6% of non-smokers with at least one parent smoking ( $p = 0.02$ ).

### CVD risk factors and health-promoting behavior

Responses to several questions related to the awareness of selected CV-risk factors and its role in the development of CVD are summarized in Tables II, III, and IV.

## Discussion

In a year 2000 and 2016, a questionnaire-based study was conducted among first and second grade pupils in randomly-selected high schools of the Tricity agglomeration, Poland. Students were asked to complete a 38-item questionnaire aiming at assessing their knowledge on cardiovascular risk factors as well as to evaluate the prevalence of healthy everyday behaviors (physical activity, substance use, diet). Our findings indicate that although the awareness of neg-

ative consequences of HT and other CV-risk factors has grown over the past 15 years, the implementation of this knowledge is insufficient among high-school adolescents.

### Body weight

In our population we noted higher prevalence of declared overweight and obesity in boys compared to girls (22.6% vs. 4.8%, respectively), whereas the underweight was more common among girls (11.5%, vs. 3.9% observed in men). Those results are consistent with the results of two other Polish surveys, which reported the higher risk of excessive body weight in boys as compared with girls (12.9% vs. 8.7% for boys and girls, respectively;  $p < 0.001$ ), especially in urban areas as well as higher frequency of underweight in girls in comparison with boys [17, 18]. Interestingly, the prevalence of overweight/obesity in Tricity high-school pupils is at similar level as the abnormal weight prevalence described by Dereziński *et al.* in younger urban-rural high schools pupils (22% in 2014) [19].

However, it is worth to mention that the prevalence of normal/abnormal body weight and BMI were calculated from declared data, not from actual measured ones, therefore are not free from self-reported bias. The German research showed that boys and girls tend to under-report their weight. Based on self-reports, the prevalence was 9.7% for underweight and 15.1% for overweight, according to measured data the corresponding rates were 7.5% and 17.7%, respectively [20].

The analysis of body size perception showed that almost all girls with higher than normal declared BMI, indicated normal body weight as desired, whereas boys tended to point to higher values of body weight than normal. This confirms the fact noted by Scandinavian researches that men tend to underestimate their body weight more often than women, allowing them for higher level of satisfaction from their body size.

### Salt

Salt intake results in an increased blood pressure, which has been further supported by epidemiological data showing that excessive salt-use is associated with higher HT rates. The WHO recommendations for salt intake are established at the level of 5 g per day [21]. However, there is a common tendency to exceed this limits which is also observed in adolescents [9]. The main sources of sodium in adolescents' diet are cereal and cereal products (41%), followed by meat and milky products, whereas the fast food constitutes 9% of salt source [22]. What might be disturbing is

that proportions of students who put extra salt into their meals has not changed significantly over the course of the past 15 years. This now accounts for 1/3 of this young population (Tab. I). This is particularly important in relation to the level of knowledge about risk factors and prevention of HT and CVD. Our study shows that recently students more frequently identify salt as a CV-risk factor as compared to the year of 2000, but still, the same proportion of them uses additional salt in meals. In a recent survey only 22% of adolescent girls and 9.8% of boys met WHO recommendation on sodium intake (based on the sodium urine excretion) [22].

### Physical activity

According to the World Health Organization recommendation, young people aged 5–17 should spend at least 60 minutes daily on physical activity [23]. Regular and time-efficient approach to physical activity has been associated with benefits in young people by improving glucose and fats metabolism, reduction of risk of chronic disease and enhancement of immune system [24]. Nowadays, access to places to engage in physical activity is increasing. We now demonstrate in our study that 73.4% of students report the engagement in out-of-school sport activities which is a substantially higher proportion as compared to the year of 2000 (Tab. I).

We observed a tendency to take up more types of sport by present-day youth. The awareness about the beneficial role of exercise among adolescents from Tricity high schools seems to be well widespread in 2016, comparing to the year 2000. On the contrary, the amount of time spent on physical activity does not change over the course of the past 15 years (5.6 vs. 5.5 hours per week in 2000 and 2016, respectively). Favorably, greater number of adolescents in 2016 claim to be active out of school but only one-third of them spend recommended time training (> 5 hours). According to Eurostat data only 57.3% of young people between the age of 15–24 engage in regular physical activity in 2008, this number has slightly improved in 2012 (68.2%) [25]. In Poland in 2014 only 16.2% of 15–19 years olds declared time spend on physical activity to be longer than 300 minutes (5 hours) a week, whereas almost 35% did not participate in any form of sports [26]. It is important to mention that almost 25% of children who do not participate in sufficient amount of weekly sports activities share at least one more risk factor of the development of hypertension (overweight, family history) [27, 28]. Interestingly, the majority of them is well educated about the preventive role of physical activity.

### Dietary habits

A balanced diet is well-known as a component of a healthy lifestyle and plays an important role in the prevention of cardiovascular diseases [29]. Therefore in the study, we examined closer eating habits among Tricity adolescents, concentrating on the two aspects: fruits and vegetable intake and fast food consumption.

The World Health Organization and Food and Agriculture Organization of the United Nation reports recommend adults and adolescents to consume at least five portions of fruits and vegetable a day [30]. Furthermore, it is proved that the diet rich in fruits and vegetables reduces blood pressure [31]. Our results show that the majority of adolescents in both groups is aware of diet rich in fruits and veggies' preventive role in cardiovascular diseases, and claims to eat them frequently (Tab. I). Despite this fact, less than one in ten participants eats recommended number or more of fruits and vegetable servings per day.

Frequent fast food consumption is associated with a higher BMI in adolescents [32], therefore it might lead to higher cardiovascular risk [33]. In our study we observed the increase in awareness of excessive fat intake being a risk factor for obesity and hypertension between the year 2000 and 2016, reaching as much as 93.9% in 2016 (Tab. I). Unfortunately, this data has no reflection in lifestyle of both groups. Our data shows a significant grow in the percentage of adolescents who reported eating fast foods once a week or more, rising from 13.9% in the year 2000 to 44.8% in 2016. Unlike in the survey conducted in Lithuania were the consumption of fast foods among adolescents decreased from 13.1% and 16.4% in 2006 to 6.7% and 10.5% (girls and boys, respectively) in 2010 [34].

Our results might lead to the conclusion that in contradiction to a notable improvement in knowledge about healthy eating habits among Tricity adolescents, their habits in this area deteriorated significantly.

### Alcohol and smoking

Analogously to studies in adulthood, it has been shown that adolescents' regular alcohol consumption increases blood pressure [35]. Of more, such behavior may contribute to the development of hypertension in adulthood [36]. In our study, the number of teenagers who were aware that excessive alcohol consumption might lead to hypertensive effect was greater in 2016 than fifteen years earlier. This may reflect the improvement in education in this particular area which is further supported by increased number of declared abstinence.

We noticed similar trends towards smoking reduction. Smaller proportion of children tried smoking at least once in their life in 2016 than in 2000. Moreover,

the age at which students tried smoking for the first time has increased significantly in 2016 (Tab. I). It is worth mentioning that in our group the declared smoking status was present in 4% of students, what puts the reported smoking prevalence among the lowest in Europe [37]. This finding is in agreement with published data on smoking prevalence changes, between year 2009 and 2014 the prevalence of smoking decreased by nearly 2% in Poland [38]. The education about cigarettes smoking harmful effects has been improved but, most importantly, stroke and hypertension remain uncorrelated with this habit accurately in the perception of studied adolescents. Additionally, only half of students from 2016 reports having been informed by their doctor about the negative effects of smoking on their health.

### Hypertension and concomitant diseases

Clearly, hypertension leads to target organ damage [4]. Uncontrolled high blood pressure increases risk of stroke, myocardial infarction and chronic kidney disease [39].

Over fifteen years the awareness of long-term consequences connected with HT increased in a studied population. However, the percentage of correct answers is satisfactory only in terms of MI and lower limbs atherosclerosis. Kidney diseases and stroke are still being ignored in terms of complications of HT.

### Strengths and weakness

Strength of our study is the possibility to compare the pupils', on the verge of adulthood, perception of healthy behaviors between year 2000 and 2016. This period of time is connected with the greatest development of internet-based technologies, changes in information distribution as well as a great shift in prevalence of cardiovascular risk factors among young people.

A possible bias of our results may be linked to declared rather than true anthropometrical data (results based on declared body weight and height).

### Conclusion

To conclude, our study indicates that present-day adolescents from Tricity's high schools are better educated about the role of CV-risk factors, and the prevention measures than in the year 2000. Interestingly, the awareness of the link between CV-risk factors such as hypertension and smoking with myocardial infarction was satisfactory, but it was insufficient for stroke and renal diseases. The number of declared smokers and first-time alcohol users among high-school adolescents



is decreasing. Finally, the awareness of health-promoting behaviours such as regular physical activity, limited salt and fats intake, vegetables and fruits-based diet is common in this population but its implementation is insufficient (Tab. II).

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