

Incidence and determinants of chronic stress as a health risk factor in a group of Polish high school students

Występowanie i uwarunkowania stresu przewlekłego jako czynnika zagrożenia zdrowia w grupie polskich uczniów szkoły średniej

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Słowa kluczowe: czynnik ryzyka, młodzież, stres przewlekły, zdrowie, osobowość typu D.

Abstract

Introduction: Stress is an everyday experience for most individuals; chronic stress may lead to numerous disorders and diseases. In high school, last-grade students are at particularly high exposure to stress as they experience the pressure of the upcoming final exams. In addition, this stage of early adulthood is associated with important decisions regarding the choice of occupation and career as well as building one's own independence.

Aim of the research: To assess the incidence of chronic stress in a group of Polish high school students and to identify the potential impact of selected sociodemographic, health, and personality type-related factors on the intensity of stress.

Material and methods: The study was conducted in a group of 250 persons aged 18–19 years. Study material was collected using a proprietary questionnaire, the Perceived Stress Scale (PSS-10) questionnaire, and the DS-14 questionnaire for the measurement of type-D personality traits.

Results: High stress levels were identified in 58.6% of subjects; stress was more common in female students ($p = 0.0002$) and individuals with poor health self-evaluation ($p < 0.0001$). The variability in PSS-10 scores was best explained by the variability in negative affectivity ($R^2 = 55\%$) and type-D personality ($R^2 = 12\%$).

Conclusions: Serious chronic stress burden poses a threat to the subjects' health. A school prevention team should be prepared to control stress as a health risk factor in students, which capable of implementing efficient preventive measures.

Streszczenie

Wprowadzenie: Stres staje się codziennym doświadczeniem jednostki, a skutki przewlekłego jego oddziaływania mogą być przyczyną wielu zaburzeń i chorób. W szkole średniej na stres szczególnie narażeni mogą być uczniowie klasy maturalnej, którzy doświadczają presji zbliżającego się egzaminu dojrzałości. Ponadto ten okres wczesnej dorosłości wiąże się z koniecznością podejmowania ważnych decyzji związanych z wyborem zawodu i drogi życiowej, a także budowaniem swojej samodzielności.

Cel pracy: Ocena występowania stresu przewlekłego wśród dorosłych uczniów klas maturalnych i próba wskazania, jakie znaczenie dla nasilenia stresu mają wybrane czynniki społeczno-demograficzne, związane ze zdrowiem oraz cechami osobowości stresowej.

Materiał i metody: Badaniem objęto 250 uczniów szkoły średniej w wieku 18–19 lat. Do zgromadzenia materiału badań wykorzystano kwestionariusz własnego opracowania, Skalę Odczuwanego Stresu (PSS-10) oraz Skalę do Pomiaru Typu D (DS-14).

Wyniki: Wysoki poziom stresu zidentyfikowano u 56,8% badanych i częściej dotyczył on dziewcząt ($p = 0,0002$) oraz osób z niską samooceną zdrowia ($p < 0,0001$). Najwyższe wartości PSS-10 wiązały się ponadto z występowaniem problemów zdrowotnych ($p < 0,05$). Największą zdolność do wyjaśniania zmienności na skali PSS-10 miała negatywna emocjonalność ($R^2 = 55\%$) i typ D osobowości ($R^2 = 12\%$).

Wnioski: Zidentyfikowane poważne obciążenie stresem przewlekłym stanowi zagrożenie dla zdrowia badanych. Szkolny zespół profilaktyczny powinien być przygotowany do kontrolowania stresu jako czynnika ryzyka zdrowotnego wśród uczniów i podejmowania skutecznych działań profilaktycznych.

Introduction

Technological advances, acceleration of life, and changing environmental factors are strong stressors affecting the emotional and physical condition of humans. Stress has become an everyday experience for most individuals; chronic stress may lead to numerous disorders and diseases [1–4]. According to Selye – the pioneer of stress research – stress is the non-specific response of the body to all types of stressors, positive and negative alike [4]. Due to the differences in definitions, 3 complementary rather than mutually exclusive concepts are in use today, including stress being construed as a stimulus, a response, or a transaction. Construed as a stimulus, stress is defined as any event or situation leading to the experience of tension and strong, usually negative emotions. Construed as a response, stress consists of physiological and psychological consequences of exposure to stressors. The transactional understanding of stress was introduced in the concept proposed in 1984 by Richard Lazarus and Susan Folkman. Since that time, the concept has gained wide acceptance in the field of psychology. According to the transactional model, stress is a particular relationship (transaction) between an individual and their environment. Stress is defined as a situation assessed by the individual to be a burden exceeding their ability to cope and posing a threat to their well-being [2, 4–6]. Thus, stress is caused by the imbalance between the demands and burdens of the environment and resources owned and used by the individual as part of their coping efforts (stress transaction) [7]. The model focuses not only on the actual event being experienced, but also on how it is being perceived and interpreted by the individual, with physiological and psychological reactions developing when a person considers a particular situation to pose a threat, a loss, or a challenge [5].

In adult populations, the main sources of stress are from the work and home environments [3, 8–10]. In adolescence, the main source of stress is school, followed by the home and peer environment, the stressors including school violence or excessive expectations of parents [7, 11]. The importance of parenting stress is also highlighted as a factor disturbing family relationships and thus having a negative impact on the life and health of children [12]. In addition, high school students reaching their physical, psychosocial, and sexual maturity are at high risk of stress as they cope with various developmental tasks including those associated with their sexuality, decisions regarding further education (occupation), and gaining independence from their parents [13–16].

Physical and emotional stressors trigger a series of systemic processes that comprise the stress response. The stress response involves complex biochemical, physiological, behavioural, and emotional phenomena; many of these may lead to pathological consequences

[4, 17–20]. Diseases with stress response constituting a part of their aetiopathomechanism are referred to as stress-related disorders (SRDs). They include disorders both caused by stress and exacerbated by stress. These include both psychiatric disorders usually related to post-traumatic stress and physical disorders usually resulting from chronic stress exposure [2, 17–25]. Chronic stress is particularly adverse as it may lead to functional disorders of many types of tissues and organs [4, 6, 22, 26–28]. It is defined as “the physiological or psychological response to a prolonged internal or external stressful event (i.e. a stressor)” [26]. Studies suggest a significant role of chronic stress in the development of, e.g., cardiovascular disorders [3, 9, 27, 29, 30]. Chronic stress may also increase the risk of carcinogenesis [31], autoimmune diseases [32], inflammatory bowel disease [33], gastric or duodenal ulcers [4], food allergies [34], or mental illnesses and schizophrenia [20, 35]. Chronic stress may also increase individuals’ susceptibility to depression and drug abuse-related disorders [36]. Negative systemic responses secondary to stressor exposure depend on environmental factors or duration of exposure as well as on genetic predisposition, particularly on the individual’s susceptibility to stress [37]. Studies on distressed (type D) personality have been ongoing for more than a decade. Type D personality is reported to be a risk factor of somatic disorders, particularly cardiovascular disorders [5, 38–41], with the risk of coronary artery disease being increased as much as 4 fold [42]. In high school, last-grade students are at particularly high exposure to stress as they experience the pressure of the upcoming final high school exams. In addition, this stage of early adulthood is associated with important decisions regarding the choice of occupation and career as well as building one’s own independence.

Aim of the research

The objective of this study was to assess the incidence of chronic stress in a group of Polish high school students and to identify the potential impact of selected sociodemographic, health, and personality type-related factors on the intensity of stress.

Material and methods

Study design, procedure, and participants

The designed cross-sectional study was conducted in the 2017/18 school year. The research area was School Complex No. 3 in Kielce, and the participants were adult students of the above-mentioned educational institution, including the Secondary School named after Józef Piłsudski as well as Technical Secondary School No. 8 named after Maria Skłodowska-Curie. The above educational institution was selected as the research area by using a simple random sampling technique with the application of a closed list of 16 secondary

schools in the city of Kielce. Additionally, the management of a randomly selected school agreed to conduct the research. The criteria for including a candidate in the study were being over 18 years of age, being a high school student, and giving informed and voluntary consent to participate in the study.

A total of 268 students were included in the study. A school nurse, providing health care to students of the mentioned institution, was entrusted with the role of interviewer. Moreover, she was provided by the research organisers with the instructions including how to make the questionnaire available, the need to obtain informed and voluntary consent from students, assuring them of anonymity, and conducting a collective analysis of the collected data.

Furthermore, the instructions also specified the place to deposit completed questionnaires, how to store them, and how to make them available to the research team. The box for the completed questionnaires was located in the school nurse office, which was secured with a lock, and the key was solely in the possession of the researchers. Participants were given survey questionnaires containing 2 standardised tools prepared in the measurement strategy and a self-developed questionnaire. To ensure anonymity, the questionnaires were distributed in envelopes, and after completing and sealing them, they were placed by students in a closed box. Questionnaires were distributed to students in the classroom during scheduled teaching classes. Additionally, written consent to participate in the study was provided by the students on separate forms, which were then collected in one envelope, sealed, and thrown into the ballot box. To ensure optimal conditions when answering questions, students took the questionnaires home and deposited the completed ones in a box located in the school nurse's office. After completing the data collection phase, the ballot box was transported to the university to assess the usefulness of the completed questionnaires in terms of completeness and their codification.

Finally, the study material consisted of data collected from 250 high school students (72.8% female and 27.2% male, $M_{age} = 18.1$, age range: 18–19 years), who had submitted fully completed questionnaires (Table 1). The study was approved by the Bioethics Committee (Decision no. 5/2017 of 27.02.2017) and the high school authorities.

Study measures

Study data were collected using a proprietary questionnaire as well as 2 standardised tools. The stress levels were measured using the Polish version of the Perceived Stress Scale (PSS-10) used to assess the intensity of stress associated with the circumstances of one's life. The questionnaire is used to assess the subjective feelings related to problems and events in one's personal life, as well as behaviours and actions taken as part

of coping strategies. According to its assumptions, PSS-10 is focused on the subjective evaluation of the symptoms of distress caused by particular situations rather than on recording these situations themselves. The intensity of stress depends on the appraisal of stressors rather than on their number. As a result, the score is the measure of emotional comfort in relation to coping with stressors, and thus a measure of chronic stress. The questionnaire may be used in patients and healthy individuals alike. The original questionnaire was developed by Sheldon Cohen, Tom Kamarck, and Robin Mermelstein. The 10-question survey was adapted to Polish conditions by Zygfryd Juczyński and Nina Ogińska-Bulik. PSS-10 is an established psychometric tool. Its reliability was assessed by estimation of its intrinsic consistency and absolute stability. Cronbach's α for the Polish version of PSS-10 was 0.86, with satisfactory correlation between all questions and scale scores. PSS-10 is a self-assessment tool, with the responders providing answers to questions using a 5-point ordinal scale. Each response is assigned a value of 0 to 4 points. The overall score may range between 0 and 40 points; the higher the score, the greater the intensity of stress. The results may also be presented using categories of low (0–13 points), medium (14–19 points), and high (20–40 points) intensity of stress [2, 5].

Features of distressed (type D) personality were assessed using the Polish version of the DS-14 scale. The original scale, developed by Johan Denollet, was adapted to Polish conditions by Nina Ogińska-Bulik and Zygfryd Juczyński. The questionnaire consists of 14 statements. Seven of these statements are used to assess the individual's predisposition to negative affectivity (NA) while another 7 are used to assess the individual's predisposition to social inhibition (SI) of emotions and emotion-triggered behaviours. DS-14 is a self-assessment tool, with subjects providing their responses using a 5-point ordinal scale. Each response is assigned a value of 0 to 4 points. The results are calculated separately for both dimension; each dimension is summarised by the total score of 0–28 points. The higher the score, the greater the intensity of features comprising the particular dimension of type D personality. To be classified as type-D personality, a subject must attain a minimum score of 10 in each of the 2 dimensions. DS-14 is an established psychometric tool. The reliability of the Polish version was assessed in a group of 1154 patients and healthy volunteers, with Cronbach's α amounting to 0.86 for the NA scale and 0.84 for the SI scale [5].

Statistical analysis

The data were collected and stored using Microsoft Excel. The χ^2 test or Fisher's exact test were applied to compare proportions as part of statistical analyses. Student's *t*-test or one-way ANOVA were used to

Table 1. Characteristics of the study group of high school students and chronic stress intensity as measured by PSS-10

Variable	N (%)	PSS-10 scale	
		Mean (± SD)	P-value
Sex:			
Female	182 (72.8)	22.1 (±7.08)	t = 3.73; 0.0002
Male	68 (27.2)	18.4 (±7.19)	
Area of residence:			
Large urban	82 (32.8)	20.7 (±7.55)	F = 0.589; 0.56
Small urban	31 (12.4)	20.3 (±8.32)	
Rural	137 (54.8)	21.5 (±6.90)	
Economic status:			
Very good	48 (19.2)	20.7 (±7.54)	F = 0.087; 0.92
Good	144 (57.6)	21.2 (±7.10)	
Average or poor	58 (23.2)	21.1 (±7.65)	
Chronic diseases (personal):			
Present	35 (14.0)	21.3 (±8.82)	F = 3.179; 0.043
Absent	200 (80.0)	20.7 (±7.02)	
Disturbing symptoms present	15 (6.0)	25.6 (±5.65)	2 vs. 3: 0.15
Health self-evaluation:			
Very good	61 (24.4)	18.0 (±6.91)	F = 12.316; < 0.0001
Good	143 (57.2)	21.2 (±6.81)	
Average or poor	46 (18.4)	24.9 (±7.58)	
Chronic diseases (family):			
Absent	154 (61.6)	20.7 (±7.47)	t = −1.1 0.28
Present	96 (38.4)	21.7 (±6.99)	
Type-D personality (DS-14):			
Type D	103 (41.2)	24.1 (6.09)	t = 5.82 < 0.0001
Non-type D	147 (58.8)	19.0 (7.34)	

Note. N = 250. M – Mean; SD – standard deviation; *Post-hoc test (Tukey-test).

compare means of continuous distributions. Post-hoc analyses were performed by means of Tukey test. For the differences between means, the 95% confidence intervals were calculated. Associations between 2 continuous variables were assessed using Pearson's correlation coefficient. For the linear regression models, the coefficient of determination (R^2) was calculated. Categorical data were expressed as number and percentage distributions whereas numerical variables were summarised using means and standard deviations. A two-tailed p -value < 0.05 was considered as statistically significant. All statistical analyses were performed using R (version 3.1.2; The R Foundation for Statistical Computing, Vienna, Austria) and Statistica (StatSoft, Inc. 2014, version 12) software packages.

Results

The mean PSS-10 score in the study population was high ($M = 21.1$; $SD \pm 7.29$) with individual scores ranging from 1 to 36 points. In terms of low/medium/high stress categories, high stress (20–40 points) was diagnosed in a majority of students (56.8%; $n = 142$) (Figure 1).

As shown by the data in Table 1, statistically significant differences in PSS-10 scores were observed for different subgroups stratified by gender ($p = 0.0002$), health self-evaluation ($p < 0.0001$), and type D personality features ($p < 0.0001$). A difference was also observed in the preliminary analysis for subjects with different actual health status ($p = 0.043$), with the dis-

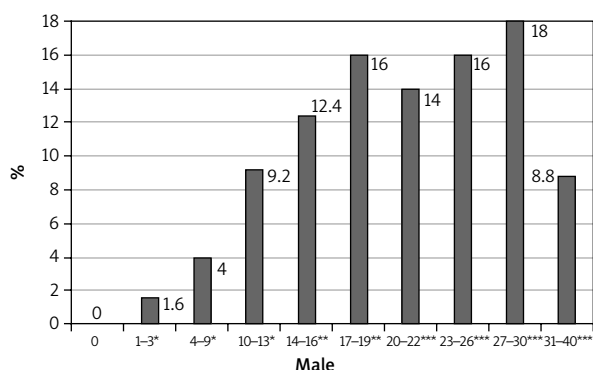


Figure 1. Chronic stress level as measured by PSS-10 in the study group of high school students. Note. $N = 250$. Stress level: *low (0–13 points), **medium (1–19 points), ***high (20–40 points)

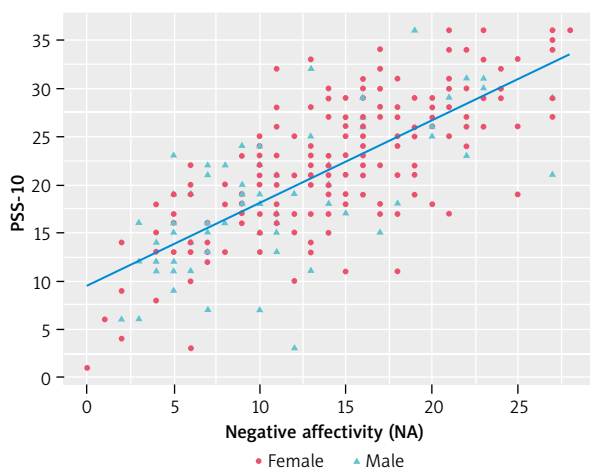


Figure 2. Correlation between PSS-10 and NA scores ($r = 0.74$; $p < 0.0001$)

tribution of means suggesting that the highest stress level was experienced by individuals presenting with disturbing symptoms. This, however, was not confirmed in a post-hoc Tukey test ($p > 0.05$).

Pearson's linear correlation analysis revealed a statistically significant, positive correlation between the stress intensity and DS-14 scores. The strong correlation was observed between PSS-10 and NA scores: $r = 0.74$, $p < 0.0001$ (Figure 2). The weaker correlation was observed between PSS-10 and SI scores: $r = 0.16$, $p = 0.011$.

Linear regression analysis (Table 2) revealed that the variability in PSS-10 scores was best accounted for using negative affectivity levels ($R^2 = 55\%$). Type-D personality accounted for 12% of PSS-10 score variability.

Negative affectivity was used as a variable together with sex and health self-evaluation in a multidimensional linear regression model (Table 3). The coefficient of determination was 56% (Table 3).

PSS-10 scores were also analysed for individual quartile groups (GQ1–GQ4), as shown in Table 4. As in the previous analyses, correlation can be observed between higher PSS-10 scores and female sex ($p = 0.003$), low health self-evaluation ($p = 0.0002$), higher DS-14 scores ($p < 0.0001$), higher NA scores ($p < 0.001$), and incidence of type D personality ($p < 0.0001$). No correlation was observed with regard to the SI scale ($p = 0.1$).

Table 4 presents also the results of an analysis of variables associated with the top quartile PSS-10 scores. Subpopulation of students presenting with the highest stress levels (> 27 points) was characterised by a high percentage of individuals with low health self-evaluation (39.3% vs. 13.1%), individuals presenting with disturbing symptoms (13.7% vs. 4.0%), as

Table 2. PSS-10 linear regression models – unidimensional analysis with one independent variable

Independent variable	b	95% CI	t	P-value	R ²
DS-14 (global scores)	0.44	0.36–0.52	11.17	< 0.0001	33%
Negative affectivity (NA)	0.85	0.76–0.95	17.37	< 0.0001	55%
Social inhibition (SI)	0.22	0.05–0.39	2.56	0.011	3%
Personality:					12%
Non-type D	ref. level				
Type D	5.12	3.38–6.85	5.82	< 0.0001	
Sex:					5%
Male	ref. level				
Female	3.77	1.78–5.76	3.73	0.0002	
Health self-evaluation:					9%
Very good	ref. level				
Good	3.18	1.08–5.29	2.98	0.003	
Average or poor	6.75	4.07–9.43	4.95	< 0.0001	

Note. b – the model parameter used to modify the independent variable; ref. level – reference level; R^2 – coefficient of determination.

Table 3. PSS-10 multiple linear regression model

Independent variable	<i>b</i> (adjusted)	95% CI	<i>t</i>	<i>P</i> -value	<i>R</i> ²
Negative affectivity (NA)	0.81	0.71–0.91	15.77	< 0.0001	56%
Sex:					
Male	ref. level				
Female	0.67	(–0.75)–2.10	0.93	0.35	
Health self-evaluation:					
Very good	ref. level				
Good	0.99	(–0.49)–2.48	1.32		
Average or poor	2.50	0.55–4.46	2.52	0.012	

Note. *b* (adjusted) – the model parameter used to modify the independent variable after adjustment for the remaining independent variables; ref. level – reference level.

well as type-D personalities (60.8% vs. 36.2%). One should also note that 39.2% of individuals presenting with stress scores of more than 27 points were non-type-D personalities, while all of them (100%) scored at least 10 points in the negative affectivity scale.

Discussion

Many researchers suggest that human adolescence may be burdened by multiple negative factors [7, 11–14]. The stress associated with this burden may exceed their ability to cope [7], thus putting them at risk of health problems, including deferred onset chronic diseases [16]. Particularly difficult burden may be experienced by last-grade high school students being under the pressure of the upcoming final high school exams. Stress may originate from school and demands imposed by school-related duties (school-related stress) as well as from the individuals facing important decisions and choices regarding their future lives. Therefore, this study attempted to assess the incidence of chronic stress in a group of last-grade high school students as well as to identify selected factors that determine the intensity of stress being experienced.

As shown by the obtained PSS-10 scores, high-level chronic stress was experienced by more than half of the students at the age of 18–19 years (56.8%), with the mean score amounting to $M = 21.1$. These data are higher compared to those obtained in adult population of Central Poland – both healthy subjects ($M = 16.62$) and patients with ischaemic heart disease ($M = 18.84$), diabetic patients ($M = 17.5$), and haemodialyzed patients ($M = 16.87$). On the other hand, they are close to data obtained in menopausal women ($M = 20.8$) and post-myocardial infarction patients ($M = 21.48$) [5]. Few reports are available in the scientific literature with regard to stress intensity being measured in subjects of age similar to that in our study group. According to the Health Behaviour in School-aged Children: a WHO Collaborative Cross-National Survey (HBSC) conducted in 2014 in younger students (11–15

years old) from 41 countries, school-related stress levels are quite high and tend to increase with age. Elevated stress was declared by 22% of girls and 24% of boys aged 11 years (in Poland: 29% and 24%; $p = 0.043$), 38% of girls and 33% of boys aged 13 years (in Poland: 33% and 30%; $p > 0.05$), and as much as 51% of girls and 39% of boys aged 15 years (in Poland: 44% and 32%; $p = 0.000$) [43]. In addition, comparative analysis of HBSC results obtained in Polish students suggests that the population of students with elevated stress levels has increased from 21.8% in 2010 to 32.1% in 2014 [44]. Few studies are available regarding the levels of chronic stress experienced by high school students as measured using standardised psychometric tools. Somewhat lower levels of stress compared to those obtained in our study were reported for a slightly younger population of high school students in Thailand (15–19 years). In that group, T-PSS-10 score ranged from 6 to 34 points ($M = 15.95$; $SD \pm 4.95$) [45]. Our percentage of high chronic stress scores was similar to that assessed using the PSS-10 scale in a group of somewhat older Polish students ($M_{age} = 22.3$ years), where high stress was reported by 50% of subjects [46]. High PSS-10 scores were also reported by Murphy, Denis, Ward, and Tartar [43] in a group of undergraduate students before ($M = 19.43$) and during final exam sessions ($M = 19.39$). To sum up, the comparison of the results of our study with the available literature data suggests that stress levels in last-grade high school students were higher than those in younger student groups and close to those in young adults exposed to academic stress and final exam burden.

As shown by the already cited HBSC study [43] as well as by the results obtained in a group of Polish adolescents [44], the percentage of significant school-related stress burden is higher in female students. Similar results were obtained in this study for last-grade high school students. Stress levels presented by last-grade female students were significantly higher than those in male students ($p < 0.0001$), the sex variable accounting for 5% of PSS-10 score variability. Higher levels of perceived stress were also observed in female

Table 4. PSS-10 in stress intensity quartiles vs. the study variables

Variables	PSS-10					P-value	P-value	
	GQ1 No. 68	GQ2 No. 64	GQ3 No. 67	GQ4 No. 51	GQ1-3 No. 199			GQ4 No. 51
	n (%)							n (%)
Sex:								
Female	38 (55.9)	48 (75.0)	53 (79.1)	43(84.3)	139 (69.8)	43 (84.3)	0.051	
Male	30 (44.1)	16 (25.0)	14 (20.9)	8 (15.7)	60 (30.2)	8 (15.7)		
Chronic disease (personal):								
Present	9 (13.2)	6 (9.4)	14 (20.9)	6 (11.8)	29 (14.6)	6 (11.8)	*	
Absent	58 (85.3)	54 (84.4)	50 (74.6)	38 (74.5)	162 (81.4)	38 (74.5)		
Disturbing symptoms present	1 (1.5)	4 (6.2)	3 (4.5)	7 (13.7)	8 (4.0)	7 (13.7)		
Health self-evaluation:								
Very good	25 (36.8)	19 (29.7)	12 (17.9)	5 (9.8)	56 (28.1)	5 (9.8)	****	
Good	38 (55.9)	37 (57.8)	42 (62.7)	26 (51.0)	117 (58.8)	26 (51.0)		
Average or poor	5 (7.4)	8 (12.5)	13 (19.4)	20 (39.3)	26 (13.1)	20 (39.3)		
M (±SD)								
DS-14 scale:								
Global scores	16.0 (±6.3)	22.1 (±8.1)	26.2 (±8.7)	30.7 (±8.8)	21.4 (±8.8)	30.7 (±8.8)	****	
NA scale	7.2 (±3.9)	12.5 (±4.7)	15.7 (±4.6)	19.9 (±4.5)	11.8 (±5.6)	19.9 (±4.5)	****	
SI scale	8.7 (±4.2)	9.6 (±5.3)	10.5 (±5.8)	10.9 (±5.7)	9.6 (±5.2)	10.9 (±5.7)	> 0.05	
n (%)								
Personality (DS-14):								
Type D	11 (16.2)	27 (42.2)	34 (50.7)	31 (60.8)	72 (36.2)	31 (60.8)	**	
Non-type D:	57 (83.8)	37 (57.8)	33 (49.3)	20 (39.2)	127(63.8)	20 (39.2)		
Non-D: NA < 10 and SI < 10	28 (41.2)	13 (20.3)	5 (7.5)	0 (0.0)	46 (23.1)	0 (0.0)	****	
Non-D: NA > 9 and SI < 10	9 (13.2)	20 (31.2)	27 (40.3)	20 (39.2)	56 (28.1)	20 (39.2)		
Non-D: NA < 10 and SI > 9	20 (29.4)	4 (6.2)	1 (1.5)	0 (0.0)	25 (12.6)	0 (0.0)		
Type D: NA > 9 and SI > 9	11 (16.2)	27 (42.2)	34 (50.7)	31 (60.8)	72 (36.2)	31 (60.8)		

Note. GQ – Stress intensity groups defined by quartiles (GQ1: score up to 16 points; GQ2: 17–21 points; GQ3: 22–27 points; GQ4: > 27 points); *p < 0.05; **p < 0.01; ***p < 0.001; ****p < 0.0001.

subpopulations in the aforementioned studies carried out in adult Poles; however, the differences were not significant in statistical terms [5]. No significant differences were observed for different sex subpopulations in the Thai student population [45]. The importance of sex in responding to stress in adolescence is indicated by Smith *et al.* [16]. According to the authors, this is due to the difference in the level of sex hormones between men and women, which affect stress and immune responses differently. The problem of the high incidence of stress-related disorders among women is also described by Helpman [17]. The author even talks about the stress of being a woman and being exposed to an individual set of gender-related stressors.

Chronic stress is reported to be a factor involved in the aetiopathogenesis of chronic non-infectious diseases [3, 4, 9, 27, 29–36]. On the other hand, diseases may also be the source of stress [2, 46–48]. In our own study, parental diseases had no impact on higher stress levels in the study subjects ($p > 0.05$). On the other hand, differences were observed with regard to the responders' own health status. Health self-evaluation was an important factor responsible for the variability of the study group students ($p < 0.0001$), accounting for 9% of PSS-10 variability. Ambiguous results were obtained with respect to the actual chronic morbidity rates in subjects. Higher stress levels were observed in subjects suspecting themselves of presenting with disturbing symptoms ($F = 3.179$; $p = 0.043$). However, this could not be confirmed in Tukey's test ($p > 0.05$). This variable was also observed to be one of the variables correlated with the top quartile PSS-10 scores (GQ4, PSS-10 > 27 points). Disturbing symptoms were reported by 13.7% of subjects presenting with the highest PSS-10 scores as compared to 4.0% of subjects presenting with lower stress levels ($p < 0.05$). Another study [49] also confirms the relationship between school-related stress and the incidence of health disorders in adolescents. According to the author, students experiencing stress may escape into disease; this behaviour may become a fixed coping mechanism leading to the development of SRDs.

Besides chronic stress, the importance of distressed (type D) personality is increasingly mentioned as a factor contributing to the aetiopathogenesis of certain diseases. Distressed personality is characterised by susceptibility to depression, low self-esteem, high sense of guilt, inability to share or speak about feelings, and tendency to experience negative emotions. Individuals with type-D personality are more prone to develop cardiovascular diseases, hypertension, psoriasis, and gastric ulcers [50]. One study [51] suggested that type-D personality is a predictor of poor prognosis in patients with coronary artery disease (RR = 2.2). Our own study showed that the level of stress experienced by high school students was predominantly determined by distressed per-

sonality traits. Type-D personality was responsible for 12% of PSS-10 score variability, with individuals with this type of personality presenting with significantly higher chronic stress levels compared to non-type-D personality types ($p < 0.0001$). Type-D personality was also correlated with the highest PSS-10 scores (60.8% of subjects). One of the dimensions of type-D personality, namely negative affectivity, was even more important as a determinant of high stress levels as it accounted for as much as 55% of PSS-10 score variability. In addition, all students (100%) who experienced the highest stress levels (GQ4, PSS-10 > 27 points) had scored at least 10 points in the NA subscale. Both our results and literature data [15, 43, 44, 46, 47] suggest that young individuals entering adulthood are significantly burdened by the adverse impact of stress. The high level of chronic stress identified in this study, being largely determined by type-D personality features including negative affectivity, poses a threat to the subjects' health since both chronic stress and type-D personality have been listed among psychosocial risk factors of chronic non-infectious diseases [9]. In addition, individuals with the highest stress levels were observed to present with high intensity of disturbing health symptoms and low health self-evaluation. The stress response caused by activation of the neuroendocrine and autonomous nervous system [52] triggers the neuroimmune axis, which ties the nervous system to the immune system [53]. Stress may reduce the efficacy of the immune system, making the chronically distressed individual more susceptible to various diseases [4]. Hypercortisolaemia, observed particularly in chronic stress, is responsible for an immunosuppressive effect. Stress may induce production of pro-inflammatory cytokines, increase the production of reactive oxygen species, activate pro-inflammatory factors, or release acute inflammatory phase mediators [54]. The importance of psychological factors analysed in this study is currently highlighted in cardiovascular disease prevention guidelines [9]. Chronic non-infectious diseases, particularly cardiovascular diseases and malignancies, are the causes of high morbidity and mortality rates both worldwide and in Poland. Considering the fact that these are deferred-onset diseases, which may develop over many years having been triggered by numerous concomitant risk factors, preventive interventions should be made as early as possible.

A limitation of this study was the relatively small sample of young adult participants and the narrow research area. Therefore, we are cautious in interpreting and generalising our results, considering them to be preliminary.

Implications for practice: The school environment, while being identified as a potential stress source, may also provide the basic environment for strengthening stress coping capabilities [7]. Every day, a lot of time

is spent by children and adolescents at school. Therefore, educators as well as school nurses, psychologists, and educationalists may be the first persons to notice potential problems and health hazards. Considering the burden being placed by stress on the current situation of a student as well as the deterred consequences of chronic stress, one may identify 2 categories of practice implications. Firstly, prevention teams should consider stress exposure and appropriate coping capabilities when monitoring the students' health. Particular attention should be paid to adolescents entering adulthood, particularly female students and individuals burdened with health problems. Cooperation in wider teams providing preventive care at school environments would be required. Teams should be prepared to control stress as a health risk factor and to provide individualised support to students. Secondly, efficient prevention of chronic stress-related diseases requires stress coping skills being developed from an early age. School environments provide excellent conditions for prevention programs involving the participation of school nurses. The possibility of taking advantage of screening programs based on standardised stress exposure assessment tools should be taken into consideration in both preventive dimensions. Such screening would facilitate identification of individuals particularly susceptible to stress and subsequent implementation of prophylactic measures to prevent potential health problems.

Conclusions

We have demonstrated a serious chronic stress burden to the study group of high school students. The stress burden was determined mainly by negative affectivity, type-D personality, health self-evaluation, and sex. Subpopulation of students presenting the highest stress levels was also characterised by a high level of disturbing disease symptoms.

Stress prevention teams should be prepared to control stress as a health risk factor, to provide individualised support to students, and to promote psychiatric health. An important role could be played by screening programs based on standardised stress exposure assessment tools that would facilitate identification of individuals particularly susceptible to stress and subsequent implementation of prophylactic measures to prevent potential health problems. It should also be considered to introduce classes on stress reduction methods at this level of education.

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Ethical approval

The study was approved by the Bioethics Committee (Decision no. 5/2017 of 27.02.2017) and the high school authorities.

Conflict of interest

The authors declare no conflict of interest.

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