Mental Load of Secondary School Students in Educational Process in the Context of School Physical Activity

Radim Žatka, Karel Frömel, Petr Valach, Dorota Groffik, Zbyněk Svozil

Abstract

Demands for current school education are increasing, which is a challenge to fundamental changes in school life style in the context of the rise of civilisation diseases in children and youth. The aim of this paper is to point out that the school in the educational process, within the school subjects, also acts on the students as a stressor. Furthermore, the paper aims to highlight the danger of negative impact of mental load on adolescents' physical activity, in particular, among girls of adolescent age. Therefore, it is the responsibility of educators to look for ways to effectively compensate for this psychological burden. The research was conducted at 21 secondary schools in the Czech Republic and 11 in Poland, and a total of 4,784 participants were included in the study. The results have shown that students are most exposed to stress in natural science subjects. This psychological burden is not compensated for in the context of daily physical activity, especially among girls. The management of school and educators should be more concerned with compensating for the psychological burden of students in the educational process, and a certain benefit could be expected from the development of school physical activity programs and their effective implementation.

Keywords: Sedentary behaviour, psychological burden, stress, well-being, compensation, school subjects.

Emoční stav středoškolských studentů v edukačním procesu v kontextu se školní pohybovou aktivitou

Abstrakt

Na současné školní vzdělávání jsou kladeny stále větší nároky, což je v kontextu s nárůstem civilizačních chorob u dětí a mládeže výzvou k zásadním změnám ve školním životním stylu. Cílem příspěvku je poukázat na fakt, že škola v edukačním procesu, v rámci školních vyučovacích předmětů, působí na edukanty i stresově a že je proto povinností pedagogů hledat možnosti účinné kompenzace tohoto psychického zatížení. Výzkum byl realizován na 21 středních školách v České republice a 11 v Polsku a celkem bylo do studie zařazeno 4 784 participantů. Výsledky ukázaly, že edukanti jsou nejvíce vystaveni stresu v přírodovědných vyučovacích předmětech. Toto psychické zatížení není kompenzováno v rámci denní PA zejména u děvčat. Vedení škol a všichni pedagogové by se měli více zabývat kompenzací psychického zatížení edukantů v edukačním procesu a jistý přínos by se mohl očekávat od tvorby školních pohybových programů a jejich efektivní realizací.

Klíčová slova: Sedavé chování, psychické zatížení, stress, well-being, kompenzace, vyučovací předměty.

Introduction

Increasing psychological burden, inadequacy of the requirements of education systems, or stressful situations of the educational reality significantly disrupt the effectiveness of educational process. Particularly in the time of technological developments and acceleration of social change, including an accelerated pace of life, higher demands are being placed on adolescent school education, which makes school education one of the many stressors among the 'stress' factors (Kudláček, Frömel, Jakubec, & Groffik, 2016; Salmela-Aro, & Tynkkynen, 2012; Tavares, & Eva, 2013). The decisive role in development of inadequate educational environment is played by inappropriate educator-student interaction, forms of testing and other types of evaluation (mainly demanding oral and written tests), the teaching style and the personality characteristics of educators, as well as the personality characteristics of students, educational programs or the educational environment.

Compensating for these negative effects in the educational process is a very important task for all those involved in school education, and this task cannot be transferred only to parents, after-school leisure-time facilities, sports clubs, or community activities. The use of various forms of physical activity (PA) seems to be a necessity. According to Frömel et al. (2011), the habit of compensating for the school load, recognizing the necessity of compensating for the psychological burden, and getting satisfaction from compensating for the psychological burden by physical activity is fundamental to the adoption of a healthy lifestyle. Svozil et al. (2015) emphasise that the school has a primary role in immediate compensation for the educational burden, not only in physical education lessons, but also during breaks. The study by Crone, Smith and Gough (2006) presents the results of the analysis of qualitative studies aimed at identifying associations between PA and mental health. These analyses clearly show that there is a positive relationship between mental health and PA; the mechanisms influencing this relationship are of a complex nature and require an explanation of the intersubject nature, mostly using psychological, biochemical or physiological knowledge. Similarly, Pate, Flynn and Dowda (2016, 47) describe positive associations between PA and mental health. According to them, physical activity promotes good mental health and improves cognitive and school performance. Therefore, it is important to create opportunities for the preferred type of PA, which has a positive impact on meeting the globally recognized recommendations for weekly PA – 60 minutes of PA daily for adolescents (European Commission, 2008; US Department of Health and Human Services, 2008) – and providing a positive influence on adolescents' well-being (Frömel, Kudláček, Groffik, Svozil, Šimůnek, & Garbaciak, 2017).

The school curriculum is still characterised by sedentary behaviour of students, including physical inactivity during school breaks (Kwon, Burns, Levy, & Janz, 2012; Ridgers, Salmon, Parrish, Stanley, & Okely, 2012). Sedentary behaviour prevails over active energy expenditure, and considering the severity of mental stress (mainly negative stress), we can expect health complications in the future in the form of atherosclerosis, high blood pressure, obesity, depressive states and other 'civilization diseases', which are now registered globally (Carrera-Bastos, Fontes-Villalba, O'Keefe, Lindeberg, & Cordain, 2011). These warnings persist even though the child and adolescent health (The Global Burden of Disease Child and Adolescent Health Collaboration, 2017) have improved worldwide over recent years. Therefore, Frömel, Svozil, Chmelík, Jakubec and Groffik (2016) highlight the importance of the school PA, which, in the form of moderate-to-vigorous physical activity (MVPA), should contribute as much as possible to day-to-day PA, thus supporting mental health of adolescents.

Among the main tasks of secondary schools is undoubtedly the preparation of students for future professional careers, not only in terms of knowledge but also in terms of their physical health. This means, among other things, to increase the physical and psychological fitness in order to build the ability to eliminate or resist the assumed

psychological burden in future professions. Schools should be involved in creating the foundation of a healthy lifestyle and in cooperation with the family, they should offer guidelines for sharing psychological burden that the educational system brings, and will, to some extent, always bring in spite of the positive changes in school lifestyle that will be put in place. These approaches are consistent with preferred priorities and strategies to promote health of general population (Fulton et al., 2016).

The aim of the paper is to point out that the school – in the educational process within school teaching subjects – acts also as a stressor, and that it is therefore the duty for all participants in the educational process to look for ways to effectively compensate for this psychological burden.

The paper aims to draw attention to possible negative impact of educational process on adolescents' mental well-being in specific school subjects in a daily school routine and to describe influence of mental load on adolescents' volume of PA. We consider the search for options of efficient compensation for the negative impact of educational process on students as a crucial duty of all concerned educators as well as the parents.

1 Methodology

1.1 Participants

The research was carried out at 21 secondary schools in the Czech Republic and 11 in Poland. The participants, involved in the study, agreed to be included in the research on the basis of signed informed consent, including their parents. The management of schools and participants were acquainted with the course of the research and the way of evaluation. A total of 4,784 participants (Table 1), who recorded the all-day course of the school day and a more detailed record of the school program in accordance with the timetable, were included in the study.

Table 1
Characteristics of the sample

Gender	n	Age (Years)		Height (cm)		Weight (kg)		BMI (kg·m^{-2})	
		M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Girls	3129	16,32	1,12	167,7	6,55	59,44	9,45	21,13	3,08
Boys	1655	16,25	1,10	177,9	8,15	69,99	12,62	22,05	3,39

Note. *M* = mean; *SD* = standard deviation; *BMI* = body mass index

A smaller sub-sample (n = 141) was selected from the total sample according to evaluation of Mathematics lessons and all-day heart-beat record (Table 2). The Mathematics subject was chosen because it induced the most pronounced response in students' mental state.

Table 2:
Participants (n = 141) evaluating mathematics lessons

Gender	n	Age (Years)		Height (cm)		Weight (kg)		BMI (kg·m^{-2})	
		M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Girls	70	16.71	1.39	169.7	7.79	59.83	8.77	20.81	3.00
Boys	71	16.27	1.31	176.7	8.87	70.41	12.33	22.51	3.36

Note. *M* = mean; *SD* = standard deviation; *BMI* = body mass index

1.2 Research instruments

We used the ActiTrainer (Pensacola, FL, USA) monitoring devices that measured the volume of PA (counts), the number of steps (n), the distance travelled (km), caloric expenditure (kcal, METs), and the Polar Wearlink T31 chest belts, which enable all-day heart rate recording (HR/min). The validity of the ActiTrainer device and its reliability were verified in the survey of Neuls (2008). The intensity level of daily PA was evaluated in low PA intensities (<3 MET/min) and MVPA intensities (≥3 MET/min).

We also used the Indares Internet program (www.indares.com), a Czech and Polish version, which was used to record and evaluate habitual PA of participants. The methodology of the PA record is described in more detail in the research studies published previously (Frömel et al., 2016). Mental load or level of mental well-being were written down in recording sheets next to the specific lessons of a daily school schedule: W (well-being) – the lesson was OK, no signs of stress; S (stress) – the lesson was stressful with additional reasoning written down or the main cause of stress identified.

The participants recorded 0th–10th lessons in the full-time school program. In this article, we analyse school lessons (n = 23,672) from the viewpoint of perceived well-being (n = 19,079) or perceived stress (n = 4,593). Czech and Polish lessons are taught according to the content of subjects in the category of the native language. Czech-Polish cooperation further identified similar problems concerning adolescents' educational load in both countries. In future research, we will focus our attention on a more in-depth comparison of mental load and its potential influence on PA among adolescent population; although, it requires demanding measurement of a comprehensive nature requiring strict adherence to natural conditions, etc.

Due to the number of the records, when conducting the analysis of associations between the subjective assessment of emotional state (stress) and daily PA adolescents, we focus only on the lessons of Mathematics that showed the least favourable ratio between perceived well-being and stress.

1.3 Procedures

We introduced the initial information concerning the research at the schools in a computer classroom during a single lesson, and in order to maintain the standard school conditions, always in line with the school curriculum. The participants first registered with the Indares system, and subsequently we acquainted them with the PA monitoring method, the PA record, and the record for the evaluation of individual subjects according to the school timetable. The initial information was always given by the same research team at both Czech and Polish schools. Monitoring of daily PA and records during the educational process took place on two consecutive days so that there was a chance of recording full-day heart rate at least in one school day.

Within a week after the end of the research, the participants received individual results on weekly PA, teachers and school management received summary results for individual groups of participants.

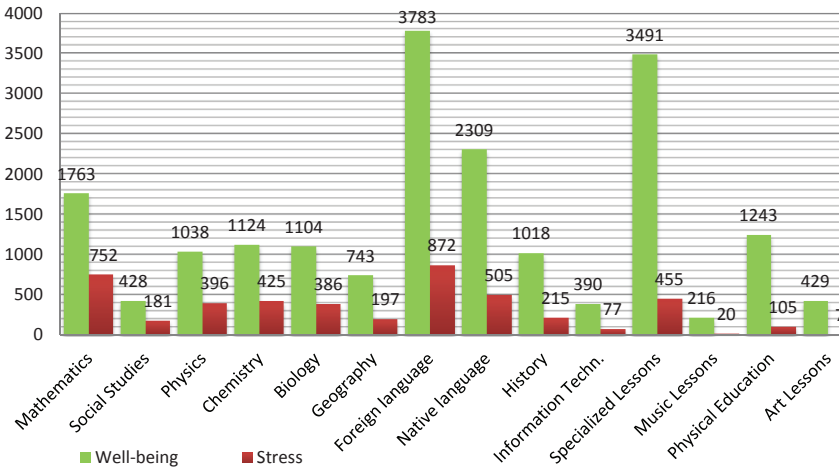
1.4 Data Analysis

We used basic statistical characteristics, analysis of variance (ANOVA) with Scheffé Post-hoc test and ω^2 'effect size' coefficient (Cohen 1988). The analyses were performed in the Statistics 13 (StatSoft, Prague, Czech Republic) and Microsoft Excel programs.

2 Results

The school subjects that were indicated to be the most stressing ones include Mathematics, Social Sciences, Physics and other science subjects (Figure 1). As the least stressful subjects, participants selected the Physical Education, Art Lessons and Music Lessons.

Figure 1
Total number of records of 'well-being' and 'stress' in individual school subjects



The presented well-being / stress ratio (Table 3) demonstrates the order of the subjects in terms of psychological burden.

Table 3
Subjective evaluation of lessons according to feelings of stress or well-being (well-being – stress ratio)

School subject	Total number of records n = 23 672	Stress (%) n = 4 593	Well-being (%) n = 19 079	Ratio (Well-being/Stress)
Mathematics	2515	29.90	70.10	2.34
Social Sciences	609	29.72	70.28	2.36
Physics	1434	27.62	72.38	2.62
Chemistry	1549	27.44	72.56	2.64
Biology	1490	25.91	74.09	2.86
Geography	940	20.96	79.04	3.77
Foreign Language	4655	18.73	81.27	4.34
Native Language	2814	17.95	82.05	4.57
History	1233	17.44	82.56	4.73
Information Technology	467	16.49	83.51	5.06
Specialised Lessons	3946	11.53	88.47	7.67

School subject	Total number of records n = 23 672	Stress (%) n = 4 593	Well-being (%) n = 19 079	Ratio (Well-being/Stress)
Music Lessons	236	8.47	91.53	10.80
Physical Education	1348	7.79	92.21	11.84
Art Lessons	436	1.61	98.39	61.29

Associations between stress in Mathematics lessons and daily PA are significant in the indicators of steps/day in girls (p = 0.038) (Table 4). The average difference of 3099 steps/day between the two groups of girls is also practically significant. These results also confirm the differences between girls in kcal/kg (p = 0.011)

Table 4
All-day characteristics of students' PA according to their psychological burden in lessons of Mathematics (only the second lesson in the daily timetable (n = 141)

PA Characteristics	n	Well-being (n = 87)		Stress (n = 54)		*F*	*p*	ω^2
		M	*SD*	*M*	*SD*			
Steps/days	Boys	10365	5416	10429	4519	4.52[b]	0.035	0.027
	Girls	10667	3726	7568	2408			
Kcal/kg/hour	Boys	7,57	3,96	7,84	3,92	4.14[b]	0.044	0.010
	Girls	7,77	3,77	5,49	2,13			
MVPA >3 MET/min	Boys	5,12	3,22	4,83	3,04	0.17	0.682	0.003
	Girls	4,05	1,69	3,39	2,23			

Note. *M* = mean; *SD* = standard deviation; *MVPA* = moderate-to-vigorous physical activity; *F* = F-test; p = significance level; ω^2 = coefficient 'effect size'; [a] significant difference between boys (wellbeing – stress); [b] significant difference between girls (well-being – stress).

Discussion

The assessment of the natural science lessons from the point of view of the psychological burden is not surprising except for the subject of Social Sciences. The results in the subjective assessment of psychological burden in Mathematics (Chvál, 2013), Chemistry (Rusek, 2013), Physics (Chalupníková, 2015) and other subjects correspond to the attitudes of pupils to these subjects. Accordingly, the research report of the project 'Quality Management in Education', which was aimed at providing information on the quality of education of secondary school students, clearly shows high emotional demands of Mathematics compared to the Czech and English Languages (Navrátilová & Výsmek, 2012). The evaluations of Social Sciences are most likely attributed to fewer

lessons that do not meet the requirements of teachers or the interdisciplinary content, but there will certainly be other, not less important, factors.

The mental load in lessons is difficult to be diagnosed. The combination of quantitative and qualitative methodological approaches appears to be necessary in these types of research. In our research, therefore, the participants had the opportunity to describe verbally the cause of stress or well-being in a class, among which the most frequent answers included: testing and the fear associated with it, and the difficulty of the subject (or the difficulty of a given topic). Frequent mention was also made of the teachers themselves, especially the style of their teaching and their personality characteristics.

Higher levels of stress in lessons require compensation for this psychological burden in order to maintain educational health. PA (Svozil et al., 2015) is considered to be a suitable way of compensating for the psychological burden in the educational process. An essential role in immediate compensation for the psychological burden of adolescents in lessons is played by school breaks and physical education lessons (Council on School Health, 2013; Gidlow, Cochrane, Davey, & Smith., 2008; Groffik, Sigmund, Frömel, Chmelík, & Nováková-Lokvencová, 2012; Ramstetter, Murray, & Garner, 2010) and leisure-time PA after school and at weekends (Kudláček, 2016; Lokvencová, Frömel, Chmelík, Groffik, & Bebčáková, 2011). Focusing on immediate compensation for mentally demanding lessons and days is indispensable in school and after-school programs.

In our monitored associations of psychological burden in Maths classes and full-day PA, we found significant differences only among girls feeling stressed (7568 steps/day) and girls feeling well-being (10667 steps/day). In addition, these results highlight the fact that the psychologically burdened girls do not meet the minimum requirement of 11,000 steps/day in order to maintain their health (Tudor-Locke et al., 2011). Differences in daily MVPA were not significant in boys or girls, but they confirm that the psychological burden in the educational process is not compensated for by higher intensity PA and, in addition, in a shorter time. Thanks to the cooperation with the Polish schools, we found that there are similar issues concerning adolescents' mental load. A comparison and analysis of the differences in results between the Czech and Polish schools will not be possible before the follow-up analyses are conducted, because of 'topic sensitivity and educational ethics'.

The main strength of the study is a combination of objective and subjective monitoring of physical and mental stress in the educational process, while preserving natural school conditions. The focus on PA monitoring has also made it possible to maintain as 'natural' school atmosphere and the habitual educational process as possible. The biggest limitation was the involvement of continuous all-day heart rate monitoring and recording of all changes in the daily school timetable that a regular school program brings.

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The high demands on an effective educational process are reflected in a higher psychological burden, manifested by an increase in the stress of students. The study has confirmed that the greatest psychological burden is experienced by students in natural science subjects. Students, who are most psychologically burdened in Mathematics lessons, do not compensate for this with PA, especially girls. School programs should allow for the most effective compensation of mental stress by immediate PA and address the issue of developing school physical programs systemically. Further research should focus on associations between the school subjects and the content of school breaks, between the school educational programs and the school extra-curricular programs, as well as the school days and the weekend days.

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