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Original Article

Formative action self-research: Promoting tertiary sport and physical education based on evidence and experience-based approaches

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Abstract
Purpose: Professional education in the field of sport and physical education (PE) is based primarily on evidence-based approaches. Using formative action self-research, the present study aims to present a verified method of evidence- and experience-based tertiary education of sport and PE by means of differences in the structure and volume of physical activity (PA). **Method:** In total, 472 Czech (203 Polish) male and 597 Czech (211 Polish) female students aged 20 to 29 years participated in the research. The subjective level of weekly PA was self-reported on the IPAQ-long and sport preferences were assessed by a questionnaire on sport preferences. Weekly PA was measured objectively using the pedometer. **Results:** Like in the general population, male students showed higher levels of PA than female students. Polish men and women in a single-subject sport program had significantly more vigorous school-based PA than Czech men and women studying sport and PE along with another field of study. The preference for fitness-related PA was a significant predictor of reaching 11,000 steps/day or at least 60 minutes of PA at least five times per week, and concurrently, 20 minutes of vigorous PA at least three times per week among male and female Polish and Czech students. **Conclusion:** Sport and PE students verified the evidence- and experience-based PA theory by means of self-research. The self-research of own PA using internet-based program is a suitable tool for improving the quality of tertiary education and for connecting education with research and real life.
Keywords: IPAQ-long, pedometer, sport preferences, recommendation.

Introduction

Any health- or lifestyle-related interventions or interventions related to social life and nature should be as evidence-based as possible. That said, it is also important to consider historically and developmentally verified experiences of preceding generations. Evidence-based approaches are the most prominent forms of research used in medicine and natural sciences, as noted by the historical development and the basic nature of these fields of science. However, the comprehensive issue of the relationship between evidence- and experience-based approaches is discussed in medicine (Honeybul & Ho, 2015; Kelly et al., 2010), as well as in the health, social and human sciences (Oakley, 2002). An emphasis on promoting an evidence-based approach is essential for the development of sport sciences. Several studies address the importance of physical activity (PA) with respect to health (Strong et al., 2005), fitness (Janssen & LeBlanc, 2010) and mental well-being (particularly that of students) (Fromel, Svozil, Chmelik, Jakubec, & Groffik, 2016). Long-term efforts to promote evidence-based approaches in sport sciences, however, do not undermine the importance of respecting experience-based approaches. The facts, evidence and theories in the sport sciences field are subject to time to a greater extent than those in natural or medical sciences, which is consistent with the philosophical thinking of Popper (2005).

The sport sciences form the background for sport education and the entire sport-related environment. An increase in physical literacy among all population groups, including schools of all types, should be as evidence-based as possible. Otherwise, physical literacy, which has recently become extremely popular, could be only a "passing fad", as stated by Corbin (2016). Within the tertiary professional education of teachers, coaches and other sport specialists, an evidence-based approach is proclaimed to be the best approach.

High-quality professional and tertiary education of sport specialists is typified by the interrelationship and connection between education and research, including student involvement in research, increased responsibility of students regarding research and their education, increased collaboration among students, and mutual methodological education. Furthermore, it is critical to promote the teacher as a researcher among sport specialists, as suggested by MacPhail (2011).

To improve the efficiency and quality of the tertiary and professional education of sport specialists, students should engage in research in which the student not only conducts the research but also is the subject of the research (student self-research). This approach, which has been advanced by Comenius (Keatinge, 1907), emphasizes that students simultaneously act as teachers and that they not blindly trust everything they are told. Accordingly, Comenius' recommendation "to transfer everything to practice" is supported by student

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engagement in self-research. The connection between self-research and actual practice with respect to sports is a good basis for increasing the quality of tertiary and professional education. Furthermore, it is an evident advantage of the sports environment that sport and PE students can verify evidence-based findings regarding their own PA and group PA. Self-research is understood to be a special type of formative (Joseph & Reigeluth, 2005) and action research (Bargal, 2008). In our approach, we regard formative research as the development of a project design that should promote the interconnection between education and practice and facilitate the selection of a strategy to improve the quality of tertiary and professional education. Furthermore, we consider action research to be students' active and coequal involvement in the process of improving the quality of evidence- and experience-based education. Formative action research is a type of research where the student plays the role of learner as well as educator, project manager, project opponent, verificator, falsificator, and implementer. Moreover, the student-researcher transfers the research findings into self-education and his or her subsequent professional career. This type of research contributes to a better understanding of the links between evidence- and experience-based approaches, the differences between methodological requirements and actual research options, and the nature of ecological validity and the research strategy of intervention programs. This research can also significantly promote the development and identification of research avenues by future sport specialists.

A high-quality, evidence- and experience-based tertiary education for sport and physical education (PE) supports the formation of critical thinking, as highlighted by Forawi (2016) with respect to education in general, the realization of the importance of self-study, as emphasized by Fletcher (2016) and the deeper understanding of specific conditions of sport and PE compared to other educational subject subjects or scientific fields of study.

The present study aims to present the developed verified evidence- and experience-based research approach that allows tertiary-level sport and PE students to engage in formative action self-research by examining the differences in the structure and volume of PA among Polish and Czech students.

Methods and design of professional education

Participants

The research project was conducted between 2010 and 2014 at the Academy of Physical Education Katowice in Poland and at six universities in the Czech Republic (Olomouc, Plzeň, Brno, Hradec Králové, České Budějovice, and Ústí nad Labem). In total, 472 Czech (203 Polish) self identified male students and 597 Czech (211 Polish) self identified female students aged 20 to 29 years (Table 1) participated in the study. The selected participants were enrolled in courses offered within physical education and sport programs or departments. Furthermore, the courses itself had to address PA and lifestyle issues. Despite the positive attitudes exhibited by the majority of students, 126 students were excluded from the final sample because they failed to meet the criteria necessary to complete the questionnaire and/or to engage in weekly PA monitoring and recording. The participants provided written informed consent after they were given information about the study. The Ethics Committee of the Faculty of Physical Culture, Palacký University, Olomouc approved the study design on January 2013 (no. 37/2013).

Table 1. Sample characteristics

Characteristics	*n*	Age (Years)		Weight (kg)		Height (cm)		BMI ($kg \cdot m^{-2}$)	
		M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Men PL	203	23.93	1.55	78.01	9.78	180.32	7.00	23.94	2.22
Men CZ	472	21.78	1.79	77.38	9.16	180.87	6.83	23.63	2.28
Women PL	211	23.09	1.86	59.58	7.51	167.82	6.27	21.12	2.10
Women CZ	597	21.55	1.48	60.96	7.85	167.69	6.49	21.67	2.45

Note. M = mean; *SD* = standard deviation; BMI = body mass index; PL = Poland; CZ=– Czech Republic

Procedures

During the initial lecture on the subject, the students were informed about procedures and the aims of the study and were invited to participate in the development of the self-research design. The instructions were given by the same research team in both Poland and the Czech Republic throughout the entire education and research period. The research was approved by Ethics Committee of all participating workplaces. All students received basic information on PA monitoring and were given a general introduction to the topic of a healthy lifestyle and informed consent was received form all students. They were then informed about the mission and the goals of the project, and they actively engaged in developing the aims of the project in cooperation with lecturers and other students. The overview of the educational project and the self-research strategy is presented in Figure 1.

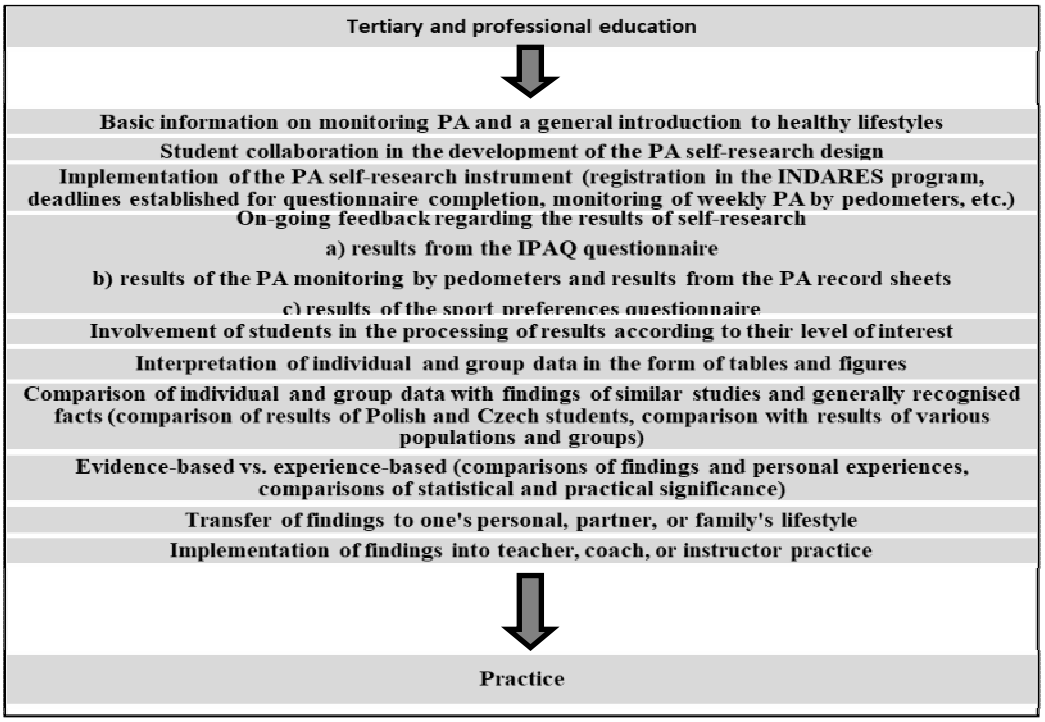

Figure 1. Schematic design of the student education and student self-research project.

Data analysis

For statistical processing and comparative analyses using the Statistica 12 and SPSS 22 programs, descriptive characteristics, contingency tables, Kruskal-Wallis ANOVA, repeated ANOVA and logistic regression analyses were used. To estimate practical (logical) significance and the role of sample sizes, we also computed effect size coefficients η^2 and ω^2. Both coefficients are interpreted as .01 □ small effect size ≤ .06; .06 □ medium effect size ≤ .14; and large effect size □ .14.

Results

PA self-research and analysis of results from the IPAQ-LF questionnaire

The questionnaire is the most frequently used research tool to obtain an overview of the current state and the trends in PA in respondent groups or larger populations. Therefore, following the initial lectures, the students became involved self-research using questionnaires. They registered in the International Database for Research and Educational Support (INDARES) (www.indares.com). There, to assess their PA, they completed the International Physical Activity Questionnaire-long (IPAQ-LF). To estimate their weekly PA, we used the Polish and Czech version of the IPAQ-LF (Craig et al., 2003). Both versions were subject to the translation procedures according to the EORTC Quality of Life Group (Cull et al., 2002), which had been applied previously (Vašíčková, Groffik, Frömel, Chmelík, & Wasowicz, 2013). The IPAQ-LF questionnaire covers various types of PA, such as job/school-related physical activity; transportation physical activity; housework, house maintenance, and family care; recreation, sport, and leisure-time physical activities, etc., various intensity levels of PA, such as vigorous, moderate and walking, as well as time spent sitting. The IPAQ-LF also asks for additional information, such as participation in organized sport (physical) activities, time spent working (time of regular employment) and car ownership. To eliminate the overestimation of PA and the underestimation of time spent sitting and to report the time engaged in PA as objectively as possible, the students were notified of the data procession procedures in order to make the outputs more accurate. Furthermore, the students were instructed on and applied the following procedures during the analyses: a) the MET-min of vigorous PA was multiplied by six, as opposed to being multiplied by eight, which was recommended in the manual for the IPAQ-LF questionnaire; b) the estimated weekly minutes engaged in different types of PA were converted to the average minutes engaged in PA per day; c) the permitted average daily sum of minutes of PA and transportation was set to 720 minutes. Moreover, when accounting for minutes spent sitting, the maximum sum was capped at 960 minutes/day. The maximum amount of MET-min per week was set to 20,000 MET-min.

As a recommendation for weekly PA, we used the modified minimum values consistent with Healthy People 2020 (U. S. Department of Health and Human Services, 2010). The minimum values were used because meeting the recommendations according to the IPAQ-LF questionnaire was based only on a single type of PA. The disadvantage of the IPAQ-LF questionnaire is that it investigates only the number of days in which the given PA took place. Therefore, it is impossible to determine on which days the given PA was performed. The minimum recommendations for vigorous PA (VPA) were set at three or more days per week for 20 minutes per day (3 × 20 minutes/week); moderate PA was set at 30 minutes for five or more days per week (5 × 30

minutes/week); walking was set at 30 minutes or more for five or more days per week (5 × 30 minutes/week) and any PA was set at a minimum of 60 minutes for five or more days per week with the simultaneous VPA of three or more days per week for 20 or more minutes (5 × 60 minutes of PA and 3 × 20 minutes of VPA). The extreme values of time spent sitting were corrected to a minimum value of 120 minutes per school day and 60 minutes per weekend day for a maximum value of 600 minutes/day on both school and weekend days.

On the IPAQ-LF questionnaire, male students reported significantly higher weekly vigorous PA [$H(3/1483) = 82.80$; p □ .001; $\eta^2 = .056$] than did female students (Figure 2) from both countries. In the moderate PA category, only Czech male students exhibited more PA engagement that Czech women ($p = .010$). With respect to walking, the highest values were observed among Polish female students (*Mdn* = 2574 MET-min/week).

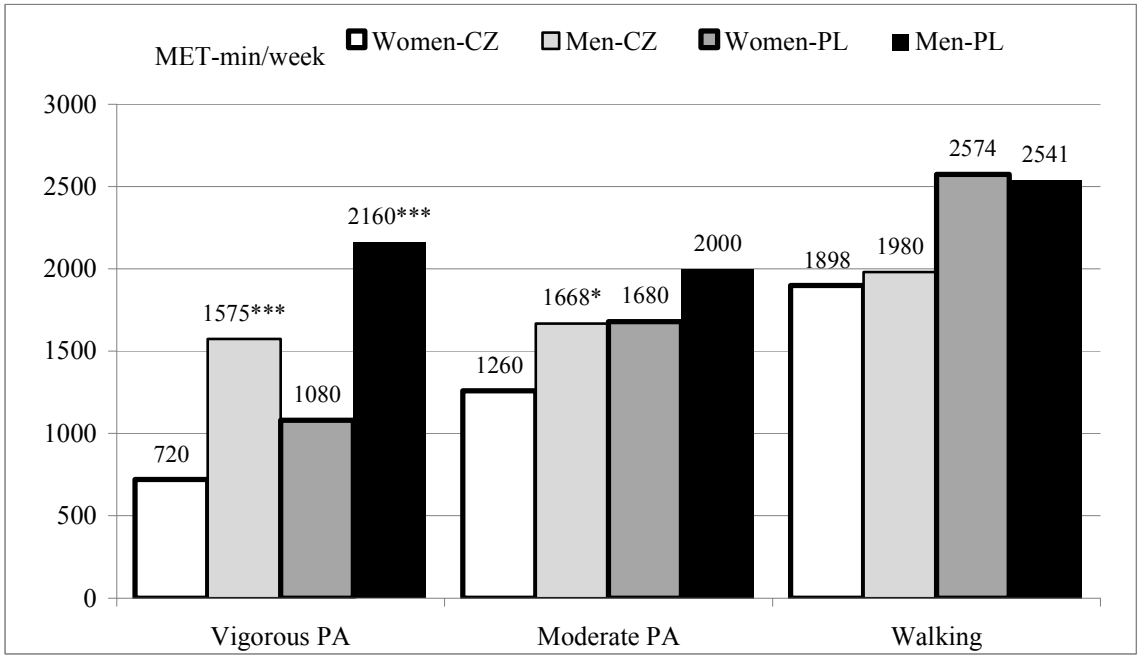

Figure 2. Structure of weekly physical activity (PA) among Polish (PL) and Czech (CZ) students based on by PA intensity (Mdn according to the IPAQ-LF).

The male students realized significantly more weekly vigorous PA than the female students, a finding that is similar to differences found between adolescent boys and girls (Frömel et al., 2016) and adult men and women in the Czech Republic (Mitáš et al., 2013). The weekly VPA among male students represents 32% (24% for women) of their overall weekly PA, which suggests that women do not compensate for their overall lower weekly PA by engaging in a higher volume of VPA. Similar findings were observed for adolescent girls' daily PA, regardless of their participation or non-participation in PE courses (Frömel et al., 2016). The students confronted the results of their own self-research with previous studies of respondents in the same age category and assessed their results based on the findings revealed for the general adult and adolescent populations. This process allowed them to compare their own research findings with evidence-based findings from previous studies.

Self-research of sport preferences and analyses of their structure

To develop suitable PA programs for PE and other educational activities, it is essential to know individuals' and groups' sport preferences because the content of lessons (i.e., select particular physical activities or exercises) can be aligned accordingly or to the fullest extent possible; this possibility is often neglected by PE teachers, coaches, and other sport specialists.

We explored the structure of sport preferences using the "Sport preferences" questionnaire within the INDARES platform. The questionnaire includes seven groups of sport activities: individual sports, team sports, fitness-related activities, water-based activities, outdoor sport activities, martial arts, and rhythmical and dancing activities. The standardized questionnaire is most often used to investigate sport preferences among adolescents (Kudláček, Frömel, & Groffik, 2015). The male students surveyed prefer team sports, individual sports and fitness-related physical activities (Table 2). Polish female students prioritize individual sports, then team sports, dancing activities and water-based activities. Czech women prefer the individual sports as well, then outdoor sport activities and team sports. The students also compared these preferences for particular types of sports with the preferences of adolescent boys and girls (Kudláček et al., 2015).

Table 2. Sport preferences among Polish and Czech students.

Preferences for various types of sports	Men - PL		Men - CZ		Women - PL		Women - CZ	
	Ranking	Average points (based on ranking)	Ranking	Average points (based on ranking)	Ranking	Average points (based on ranking)	Ranking	Average points (based on ranking)
Individual sports	**2**	**2.75**	**2**	**2.62**	**1**	**3.1**	**1**	**3.17**
Team sports	**1**	**2.29**	**1**	**2.43**	**2**	**3.4**	**3**	**3.53**
Fitness-related activities	**3**	**4.12**	**3**	**3.87**	6	4.34	4	3.87
Outdoor sport activities	4	4.35	4	3.88	5	4.05	**2**	**3.52**
Martial arts	6	4.82	5	4.87	7	5.66	7	5.69
Water-based activities	5	4.66	6	4.96	**3-4**	**3.88**	6	4.57
Rhythmic and dancing activities	7	5.62	7	5.73	**3-4**	**3.88**	5	4.03

Note. PL=– Poland; CZ = Czech Republic

Self-research of weekly PA using pedometers

To become more familiar with the objective monitoring of PA and with a simple way to assess lifestyle, the use of pedometers or smart fitness wristbands has recently become widely popular. Therefore, in the next stage of the project, we introduced pedometers to monitor PA and record sheets to record data on step counts and types of PA in the INDARES database. The first day wearing the pedometer was considered a trial day. We perceive this to be a sufficient retroactive requirement for sport and PE students. Accordingly, actual PA monitoring was launched on the following day. Students wore the pedometers on their hips throughout the day, except when sleeping, bathing or participating in water-based activities. The students recorded the time they put on the pedometer, the time they removed the pedometer and their daily step counts, all of which were subsequently entered into the INDARES system. The Yamax Digiwalker SW-700 (Yamax Corporation, Tokyo, Japan) was used to objectively monitor the weekly PA of each student. The extreme values of pedometer-derived data were adjusted, consistent with Tudor-Locke, Giles-Corti, Knuiman and McCormack (2008). Data for any single day indicating < 1,000 steps were removed, and values of > 30,000 steps on any single day were truncated to 30,000 steps. The recommendation of 11,000 steps/day was consistent with Tudor-Locke et al. (2011) and was the same for men and women. Overall, we found significant differences with respect to particular days of week ($F(6, 1483) = 53.20$; p □ .001; $\omega^2 = .096$), which applied especially to differences between school days and weekend days, respectively (Figure 3). These differences were not significant for Polish women on Monday ($p = .286$), Thursday ($p = .991$) or Friday ($p = .184$). Moreover, although male students demonstrated higher levels of PA than female students ($F(1, 1483) = 12.08$; p □ .001; $\omega^2 = .022$), country differences were found to be insignificant ($F = .90$; p □ .343).

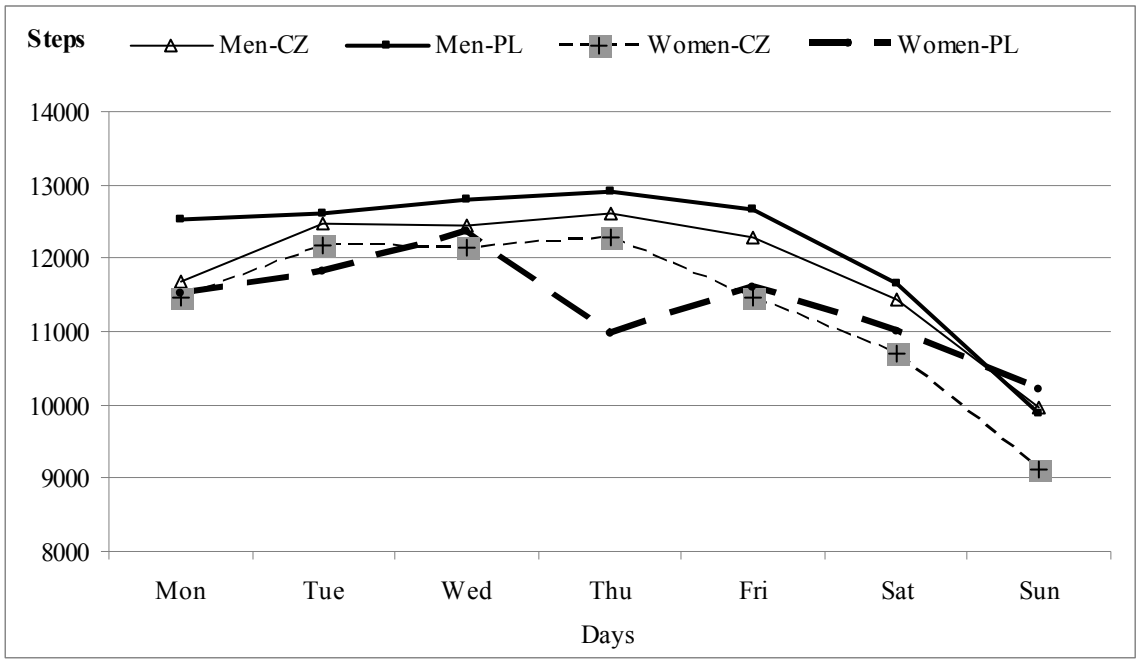

Figure 3**.** Mean step count/day for each day of the week for Polish (PL) and Czech (CZ) students.

The students participated in the evaluation and definition of the pros and cons of objective PA assessments using pedometers and subjective PA assessments using questionnaire methods. During the deeper analyses conducted in the next stages of the project, the statistical processing of data and results presentation were introduced to the students.

The students could also note the importance of the stimulus effect as a result of immediate individual feedback in addition to the data from the research. With respect to the INDARES system, the students learned to manage their personal accounts and their options regarding the handling and retrieval of data related to their personal PA. The students could also compare their results with the results of their group peers, and in this way, they gained more detailed insight into the assessment of PA and lifestyle from the perspective of both the subject (PA self-research) and the object (checking and working with survey results) of the research.

Analysis of the associations between physical activity and sport preferences

To understand the numerous variables that can affect PA and the rate of meeting PA recommendations, we performed an analysis of associations using the already-known facts regarding PA. The students participated in analyses of the associations between the objective and subjective assessments of the volume and structure of PA from the perspective of meeting PA recommendations in the context of sport preferences. Significant differences in achieving the 11,000 steps/day recommendation were found between genders with respect to involvement in organized physical activities and preferences related to team sports, fitness-related activities and rhythmic and dance activities (Table 3).

Table 3**.** Descriptive characteristics (N = 1483).

Variables	Total	Steps at recommended level of 11,000 steps/day		
		Yes	No	p value
	n (%)	n (%)	n (%)	
Gender				
Men	675 (45.5)	418 (61.9)	257 (38.1)	< .001***
Women	808 (54.5)	421 (52.1)	387 (47.9)	
Countries				
Czech Republic	1069 (72.1)	600 (56.1)	469 (43.9)	.577
Poland	414 (27.9)	239 (57.7)	175 (42.3)	
Job				
No	958 (64.6)	535 (55.9)	423 (44.2)	.444
Yes	525 (35.4)	304 (57.9)	221 (42.1)	
Ownership of a car				
No	407 (27.4)	244 (60.0)	163 (40.0)	.107
Yes	1076 (72.6)	595 (55.3)	481 (44.7)	
Sport preferences				
Individual sports				
lower	454 (30.6)	258 (56.8)	196 (43.2)	.896
higher	1029 (69.4)	581 (56.5)	448 (43.5)	
Team sports				
lower	516 (34.8)	272 (52.7)	244 (47.3)	.028*
higher	967 (65.2)	567 (58.6)	400 (41.4)	
Fitness-related activities				
lower	886 (59.7)	481 (54.3)	405 (45.7)	.031*
higher	597 (40.3)	358 (60.0)	239 (40.0)	
Water-based activities				
lower	1086 (73.2)	629 (57.9)	457 (42.1)	.084
higher	397 (26.8)	210 (52.9)	187 (47.1)	
Outdoor sport activities				
lower	851 (57.4)	475 (55.8)	376 (44.2)	.495
higher	632 (42.6)	364 (57.6)	268 (42.4)	
Martial art activities				
lower	1293 (87.2)	729 (56.4)	564 (43.6)	.694
higher	190 (12.8)	110 (57.9)	80 (42.1)	
Rhythmic and dancing activities				
lower	1120 (75.5)	655 (58.5)	465 (41.5)	.009**
higher	363 (24.5)	184 (50.7)	179 (49.3)	

Note. * statistical significance of $p < .05$, ** statistical significance of $p < .01$; *** statistical significance of $p < .001$; lower and higher dividing the median

The association between preferences for various types of sport activities and meeting PA recommendations were observed in fitness-related activities. The preference for fitness-related activities is associated with increased odds of meeting the PA recommendation of 11,000 steps/day (Table 4).

Table 4. Odds ratios for meeting the 11,000 steps/day recommendation according to sport preferences.

Variables	Model 1		Model 2		Model 3	
	OR (95% *CI*)	*p*	*OR* (95% *CI*)	*p*	*OR* (95% *CI*)	*p*
Sport preferences (reference: lower)						
Individual sports	.955 (.739-1.234)	.722	.952 (.736-1.231)	.709	.948 (.732-1.227)	.683
Team sports	1.284 (.999-1.650)	.051	1.214 (.941-1-565)	.135	1.184 (.916-1.531)	.197
Fitness-related activities	1.297 (1.009-1.669)	**.043***	1.325 (1.029-1.707)	**.029***	1.307 (1.013-1.686)	**.039***
Water-based activities	.926 (.706-1.213)	.575	.954 (.725-1.254)	.735	.947 (.719-1.247)	.696
Outdoor sport activities	1.179 (.920-1.512)	.194	1.230 (.956-1.583)	.107	1.242 (.963-1.601)	.095
Martial arts activities	1.118 (.794-1.574)	.522	1.045 (.739-1.478)	.805	1.030 (.727-1.460)	.867
Rhythmical and dancing activities	.814 (.616-1.076)	.148	.950 (.704-1.280)	.734	.964 (.714-1.303)	.813
Gender (reference category-women)			1.405 (1.106-1.786)	**.005****	1.379 (1.081-1.759)	**.010***
Country (reference category - Czech Republic)			.924 (.730-1.170)	.513	1.058 (.831-1.345)	.648
Job (reference category - Yes)					.934 (.748-1.166)	.544
Ownership of car (reference category - yes)					1.317 (1.037-1.671)	**.024***
Organised sport (reference category - lower)					1.363 (1.092-1.701)	**.006****

Note. *OR* = odds ratio; *CI* = confidence interval; */ statistical significance of $p < .05$, **/ statistical significance of $p < .01$; Model 1 = Sport preferences; Model 2 = Adjusted for gender and country; Model 3 = Adjusted further for organised sport, ownership of a car and job

We found similar results regarding the associations between fitness-related PA and meeting PA recommendations according to the IPAQ-LF (at least 60 min of PA five times per week and, simultaneously, at least 20 min of vigorous PA three or more times per week) (Table 5). The significant observed differences in meeting PA recommendations between gender, country and involvement in organized PA did not affect the strength of the association between the preference for fitness-related activities and meeting the recommendation of at least 5 × 60 minutes of PA/week and simultaneously 3 × at least 20 min of VPA/ week. Furthermore, with regard to the previously cited subjective assessment of PA and meeting PA recommendations, we observed that the preference for fitness-related activities was associated with higher odds of meeting the PA recommendations among sport and PE students. By means of logistic regressions analyses, the students were guided towards a multi-factorial assessment of the research results.

Table 5**.** Odds ratios of meeting the PA recommendations (at least 5 × 60 min/week PA and 3 × 20 min/week of vigorous PA) by sport preference.

Variables	Model 1 *OR* (95% *CI*)	*p*	Model 2 *OR* (95% *CI*)	*p*	Model 3 *OR* (95% *CI*)	*p*
Sport preferences (reference: low)						
Individual sports	1.120 (.855-1.468)	.411	1.126 (.855-1.482)	.398	1.148 (.867-1.520)	.336
Team sports	.964 (.740-1.255)	.784	.855 (.652-1.123)	.260	.769 (.582-1.018)	.066
Fitness-related activities	1.263 (.974-1.639)	.078	1.340 (1.029-1.747)	**.030***	1.324 (1.010-1.735)	**.042***
Water-based activities	.857 (.642-1.145)	.296	.858 (.638-1.153)	.309	.837 (.619-1.132)	.247
Outdoor sport activities	.874 (.673-1.135)	.312	.974 (.746-1.273)	.848	1.034 (.786-1.360)	.812
Martial arts activities	1.085 (.763-1.542)	.649	1.000 (.698-1.433)	.999	.963 (.667-1.390)	.839
Rhythmic and dancing activities	.537 (.393-0.732)	**.000*****	.694 (.496-0.970)	**.032***	.738 (.524-1.038)	.081
Adjusted						
Gender (reference category - women)			1.673 (1.301-2.152)	**.000*****	1.502 (1.161-1.944)	**.002****
Country (reference category -			1.696 (1.330-	**.000*****	1.707 (1.325-	**.000*****

Czech Republic)	2.163)	2.200)	
Job (reference category - yes)		.859 (.678-1.088)	.208
Ownership of car (reference category -yes)		1.020 (.789-1.320)	.880
Organised sport (reference category - lower)		2.559 (1.986-3.297)	**.000****

Note. *OR* = Odds ratio; *CI* = Confidence interval; */ statistical significance of $p < .05$, **/ statistical significance of $p < .01$; ***/ statistical significance of $p < .001$; Model 1=– Sport preferences; Model 2 = Adjusted for gender and country; Model 3 = Adjusted further for organised sport, ownership of a car and job

Discussion

An analysis of the results of the weekly PA assessment based on the IPAQ-LF questionnaire and the monitoring of students' weekly PA using pedometers revealed, in most cases, consistency with generally recognized evidence-based findings regarding PA in the general population. On the basis of self-research, theoretical analyses and acquired practical experience, rationales for observed variances regarding gender, country, study programs, etc. were identified. It is important to note that students were provided the opportunity to verify the benefits and the detriments of objective and subjective PA monitoring and that they observed the most efficient recommended combination of these approaches (Skender et al., 2016). This approach to tertiary and professional education, which links theoretical knowledge with research and personal experience, could promote an efficient integrated system of education for teachers, which, for instance, Backman and Larsson (2016) miss in the Swedish curricula. Their analyses, however, have an international, or at least a European, impact.

We also found that sport and PE students engaged in less PA on weekend days than on school days, which is consistent with similar observations for university students (Clemente, Nikolaidis, Martins, & Mendes, 2016) and adolescents (Nováková Lokvencová, Frömel, Chmelík, Groffik, & Bebčáková, 2011). In this context, the finding of Kudláček, Frömel, Jakubec and Groffik (2016) that adolescents who experience increased mental loads during school hours do not compensate for this load during the weekends any more than those experiencing lesser mental loads appears more serious. Furthermore, weekend days do not play a compensatory role in different socially political or educational environments in either Poland or the Czech Republic. Sunday, again, was found to be the most critical day with respect to PA. When considering higher VPA among students on school days, we did not expect higher VPA on weekends, as observed by Devís-Devís, Peiró-Velert, Beltrán-Carrillo and Tomás (2012) among boys and young adolescents. This finding indicates that for students of sport and PE who do not engage in sufficient PA throughout the week, there is a substantial opportunity to compensate for educational mental load and to lead up to positive lifestyle changes on the weekend, especially on Sundays.

Pedometer monitoring did not eliminate differences in PA between men and women based on observations of Czech, Polish, and Slovak adolescents (Nováková-Lokvencová et al., 2011). Pedometer use did not have a more significant motivating effect on female sport and PE students than on adolescent girls (Ho et al., 2013; Vašíčková et al., 2013). When comparing these findings with those of other studies, men, regardless of age, were found to be more physically active and to spend less time sitting than women (Collings et al., 2014).

The fact that Polish students (both men and women) record higher school-based levels of PA than Czech students is primarily the result of different study programs. Polish single-subject studies provide markedly more opportunity for practical physical activity subjects than do Czech studies. Similar differences between Polish and Czech adolescents, which could also be affected by a higher number of PE courses, have not been confirmed to date (Nováková Lokvencová et al., 2011).

The agreement observed among Polish and Czech male students for sport preferences and, conversely, the differences found between female students are remarkable. Due to the effect of several other influences, however, it is difficult to determine the extent to which the differences in sport preferences between Polish and Czech women are affected by distinct study programs. Nonetheless, we believe that the Polish study program, which covers a broader array of aesthetic, rhythmic, dance and music-related physical activities, is more attractive to Polish female students than the content of the Czech study program for Czech female students.

The continuous diagnostics of sport preferences in primary and secondary school girls should form an integral part of the new PE program for girls, as emphasized by Oliver and Kirk (2016) in their call to action for researchers, teachers, policy-makers and other relevant stakeholders. The gender differences in sport preferences among future sport specialists, as well as among adolescents, also draw attention to the issue of coeducational vs. single-sex PE. Research on this issue in the Central European environment is necessary because coeducational PE at the secondary school level in the Czech Republic, Poland, and Slovakia is the exception rather than the norm. In other words, single-sex PE courses continue to dominate in these countries. At the general level, Pahlke, Hyde and Allison (2014) did not observe significant differences between these two approaches. In the Central European environment, it is crucial, as noted by McKenzie, Prochaska, Sallis and Lamaster (2004), that strategy in secondary schools should be based on the need for PA, the need to develop PA-related skills, and on the emotional needs of boys and girls. Although the extension of coeducational PE in schools within the Central

European environment is desirable, currently, the combination of both approaches in parallel classes is more likely.

The association between sport preferences and the level of PA or meeting PA recommendations is not presented globally in literature. Sport and PE students must be aware of these associations to understand the importance of sport preferences diagnostics and adequately respect these preferences when creating the conditions for PA and for their own PA performance. Accordingly, we consider it important that, despite the different methodological approaches, i.e., objective and subjective monitoring, the preference for fitness-related PA was unambiguously found to be a predictor of both men and women meeting the PA recommendation.

A comparison of the results regarding meeting PA recommendations between the objective PA monitoring using pedometers and the subjective PA assessment using the questionnaire with the analysis of moderators (e.g., gender, country, job, etc.), mediators (wearing of pedometers) and confounders (e.g., differences in study requirements) promoted students' better understanding of the links between objective and subjective methods, the implementation of triangulation approaches, and the need to employ additional qualitative methods. The analyses also provided students with deeper insight into a theoretically difficult investigation of the roles of determinants, correlates, causal variables, mediators, moderators, and confounders, as described by Bauman, Sallis, Dzewaltowski and Owen (2002).

The connection between education and self-research was facilitated by the INDARES database (www.indares.com). The use of this tool allows students to gain experience and further apply it in their studies or in their professional careers. At the same time, students can exploit options regarding the use of the INDARES for inter-subject integration in schools based on their own experiences, i.e., options to link PE with biology, computer science, mathematics, and foreign language learning. Nonetheless, the inter-subject integration that includes PE in the educational systems in Europe remains insufficient (European Commission/EACEA/Eurydice, 2013).

As a part of the formative action research, associations among motivation for PA, engagement in PA, and well-being/quality of life were analyzed, as was knowledge regarding the relationship between a physically active lifestyle and actual engagement in PA (not presented in this study). For future research it is necessary to verify the effects of the tertiary and professional education of sport specialists with respect to these issues. Thus far, we can infer the effects of formative action self-research based on the student consent with repeating the measures (over 90%), the quality of meeting the research tasks (91.5% met the requirements without technical deficiencies), the experimentation with other research techniques available in the INDARES system (approximately 20% of students) and the increasing interest in researching these issues, as evidenced by master theses and doctoral studies focused on this topic.

Conclusions

Student formative action self-research on PA verified individual and group results of self-research using evidence- and experience-based approaches in the study of PA and lifestyle among sport and PE students. Involvement in the design, organization, realization and evaluation of a comprehensive and organizationally demanding self-research of one's personal PA was found to be not only feasible but also beneficial to the improvement of the quality of tertiary and professional education of sport specialists in the Polish and Czech universities. Polish students with single-subject study programs engaged in significantly more school-based PA than did Czech students enrolled in double-field studies. The INDARES database was determined to be a solid foundation for the group assessment of the results of students' PA self-research and for the implementation of projects focused on improving the quality of sport specialists' tertiary and professional education.

Regarding future research, we recommend further exploration of the benefits of formative action self-research among students with respect to lifestyle changes and the effects of formative action self-research in other fields of tertiary and professional education. Moreover, further studies should verify similarly structured, albeit more methodologically oriented, formative action self-research regarding PA among PhD students and focus on the application of the most recent variables.

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