ORIGINAL ARTICLE

Physical activity in adolescents who prefer and perform martial arts

Authors' Contribution:
A Study Design
B Data Collection
C Statistical Analysis
D Manuscript Preparation
E Funds Collection

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Abstract

Background and Study Aim: Role of physical activities (PA) characterised as martial arts (MA) has been gaining in importance regarding prevalence of physically active lifestyle among adolescents in the context of societal development. The study aim is a knowledge about the associations of MA types preferred and performed with composition of weekly PA in adolescents, taking into account gender differences.

Material and Methods: The sample concerned 1408 boys and 1831 girls aged 15-19 years from Katowice and Wrocław regions (Poland). To assess the rate of preferences and participation in PA, we used the International Physical Activity Questionnaire – Long Form (IPAQ-LF). The data was collected in 89 schools using the 'International database for research and educational support' (*Indares*) internet program.

Results: Out of MA, boys prefer boxing, kick-boxing (thai-boxing), and karate, while girls prefer boxing, judo and karate. Boys who prefer MA have significantly higher vigorous PA 2337 metabolic equivalent (MET-min) (girls 1665 MET-min) than other boys, who report only 1605 MET-min (girls 1289 MET-min). Boys who are involved in MA throughout the year have higher odds for meeting the weekly vigorous PA recommendation, compared with other boys (odds ratio OR = 1.696, confidence interval CI = 1.175-2.447), p = 0.005).

Conclusions: The present study confirms significant associations between preferring and performing MA and vigorous PA in boys. Adolescents' involvement in MA throughout the year contributes to achievement of weekly PA recommendation in a similar manner as other types of PA. Further research on the associations between involvement in MA, in comparison with other types of PA, and odds for meeting the PA recommendations is warranted.

Keywords: gender differences • Indares • IPAQ-LF • QPAQ

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INTRODUCTION

Martial arts – *plural noun* any of various systems of combat and self-defence, e.g. judo or karate, developed especially in Japan and Korea and now usually practised as a sport [41].

Musado – the term from Korean language, which means "the way of warrior". The modern martial art which is divided into two branches: a) the traditional musado and b) musado MCS (Military Combat System).

Metabolic equivalent (MET-min) – physiological measure expressing the energy cost of physical activities. It is defined as the ratio of metabolic rate during a specific physical activity to a reference metabolic rate [42].

Confidence interval (CI) – is used to estimate the precision of the odds ratio. A large CI indicates a low level of precision of the odds ratio, whereas a small CI indicates a higher precision of the odds ratio [43].

Odds ratio (OR) – is a measure of association between an exposure and an outcome. The OR represents the odds that an outcome will occur given a particular exposure, compared to the odds of the outcome occurring in the absence of that exposure [43].

Role of physical activities (PA) characterised as martial arts (MA) has been gaining in importance regarding prevalence of physically active lifestyle among adolescents in the context of societal development. However, there is a lack of scientific findings regarding prevalence rates and trend data on children's and youths' preferences of MA and their active participation in MA. Perennial statistics on prevalence rates and trends are available from the U.S. between 2006 and 2015. In 2014, the number of participants (aged six years and older) in MA amounted to approximately 3.69 million [1]. In England, on the other hand, number of people participating in MA decreased by 24% in the 2007-2016 period [1]. National traditions, ethnic, socioeconomic and other factors significantly affect rates of participation in MA [2]. Hishinuma et al. [3] reported that three in four Asian American and Pacific Islander adolescent males enjoyed watching mixed MA and two in five adolescent males practiced fight moves.

Most of the studies that focus on MA in Central and Eastern Europe have only a national character [4, 5] or assess the prevalence rates from the perspective of a single type of MA [6]. Only few studies use cross-national data [7]. Furthermore, longitudinal studies are grossly lacking, in particular, regarding adolescents, which could support new approaches to acquiring habits of regular PA. A 5-year prospective study of Frömel et al. [4] confirmed a high stability of PA preferences, despite pubescent age of respondents, which might have a substantial educational potential also from the perspective of MA.

From the educational point of view, studies that assess socio-psychological impact of MA participation on youth are important. Sanchéz-López et al. [8] observed that physical and mental training in the MA may increase the attention skills of boys and girls. Unfortunately, the studies yield inconsistent findings. For this reason, Vertonghen et al. [9] recommend focusing on measuring effects considering mediating factors, such as type of MA and combat sport, participants' characteristics, and social background, when conducting studies on the topic of MA. Moreover, intervention studies assessing effects of MA are needed. Intervention built upon traditional MA programs in children diagnosed with behavioural, emotional and social difficulties yielded psychotherapeutic benefits in education in this specific group of children [10]. Similarly, intervention program using karate in children suffering from epilepsy and their parents resulted in increase of quality of life in children and decrease of parental stress [11]. At all the competition levels of MA and across age categories, it is also necessary to pay attention to the issues of injuries. Jensen et al. [12] put emphasis on injuries as a consequence of MA participation not only during competitions, but also during training sessions and, in particular, among adolescents and women. It is also noteworthy that 8-week program focused on learning of basic MA falling techniques in lessons of physical education was shown as efficient in prevention of injuries related to falling in children who had low levels of physical activity [13]. Nevertheless, the issue of safe falling is well established topic [14, 15]

Popularity of MA is rising [16, 17]. This is further stressed by the importance of diagnostics of MA watching in media, interest in participation, as well as regular participation in MA. It is also important to utilize commercial, health and social benefits associated with active participation in MA. Knowledge of preferences for MA or interest in MA among adolescents is essential also for implementation of efficient education and treatment programs for violent adolescents and development of useful alternative for such dysfunctional adolescents [18]. In the Chinese environment, it has been also confirmed that the inheritance of MA culture is of great significant value for promoting youngsters' health and allround development [19]. The meta-analysis of Harwood et al. [20] demonstrates that martial arts reduce externalizing behavior (aggression) amongst the practicing youth.

We consider it particularly important to analyse participation in MA in the context of weekly PA, in terms of educational and health aspects. The study aim is a knowledge about the associations of MA types preferred and undertaken with composition of weekly PA in adolescents considering gender differences

MATERIAL AND METHODS

Participants

The sample concerned 1408 boys and 1831 girls from the Katowice and Wrocław regions (Poland) aged 15-19 years (Table 1). The survey was conducted at 89 schools and was carried out by

two trained research teams. All the participating schools, students and their parents gave consent to be involved in the survey. Only four schools disagreed with survey conditions due to organizational issues and refused to take part. Over 90% of respondents participated in the survey across the school classes.

Procedures

The survey at schools was conducted in ICT (Information and Communication Technology) classrooms during a single lesson in line with school program. Participants in the 'basic sample' completed the QPAQ questionnaire. Due to time constraints and organizational issues, only a part of the sample completed additionally the International Physical Activity Questionnaire – Long Form (IPAQ-LF) questionnaire. First, IPAQ-LF was filled in and then the QPAQ (see scheme in Figure 1) by this part of the sample.

Questionnaire on Physical Activity Preferences (QPAP)

Rate of involvement in MA and trend in preferences for MA were assessed using the QPAP. The questionnaire has been standardized for Polish population [5, 21]. PA preferences in the QPAP are split into eight categories: individual PA, team PA, fitness-related PA, water-based PA, outdoor PA, MA, rhythm and dance PA and overall PA. MA categories include aikido, boxing, judo, karate, kick-boxing (thai-boxing), kung-fu, musado, taekwondo,

Table 1. Sample characteristics (M mean; SD standard deviation).

Gender	Characteristics								
	n	age (years)		weight (kg)		height (cm)		BMI (kg·m^{-2})	
		M	SD	M	SD	M	SD	M	SD
Physical activity (PA) preferences									
Boys	1408	16.61	1.27	67.90	12.19	177.27	7.57	21.54	3.24
Girls	1831	16.74	1.35	56.93	8.64	166.10	6.02	20.62	2.82
PA preferences and IPAQ-LF									
Boys	681	16.35	0.86	67.55	12.73	177.15	7.36	21.46	3.45
Girls	842	16.33	0.74	57.04	8.83	166.24	5.96	20.61	2.81
Preferring martial arts (MA)									
Boys	388	16.64	1.28	68.89	12.10	177.72	7.03	21.75	3.20
Girls	188	16.58	1.19	56.52	8.63	165.92	5.67	20.51	2.74
Involved in MA									
Boys	178	16.54	1.31	68.76	12.08	177.31	7.43	21.82	3.35
Girls	60	16.46	1.12	55.93	9.22	165.60	5.25	20.38	3.09

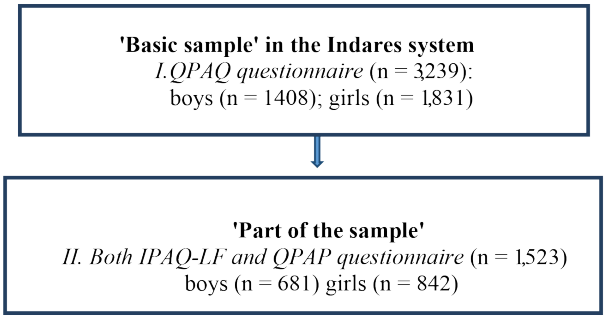

Figure 1. Research design.

wrestling (sumo), and other. Newly emerging or less known MA are assigned to the most similar activity or written in to the open-ended option 'other MA'. In the QPAP questionnaire, the respondents select the top five preferred PA. Each of the selected PA is scored for their ranking. The unselected PA receive score based on the average of the remaining rankings. The ranking of preferred PA is determined by the sum of points for ranking and subsequently the average number of points given for ranking. Respondents also indicate whether they are involved in organized PA throughout the year and report weekly hours spent in organized PA in the QPAP questionnaire. Furthermore, they specify the most frequently performed PA in summer and winter season. Rate of participation in MA and trend of preferences for MA are presented in two-year periods: 2009-2010, 2011-2012, 2013-2014, and 2015-2016.

International Physical Activity Questionnaire – Long Form (IPAQ-LF)

Polish version of the IPAQ-LF [22] was used to estimate weekly PA in the 'International database for research and educational support' (*Indares*), an internet-based system. The questionnaire was translated in compliance with requirements of the 'EORTC Quality of Life Group' [23]. The IPAQ-LF questionnaire covers various types of PA (job/school-related PA; transportation PA; housework, house maintenance, and caring for family; recreation, sport, and leisure-time PA), various intensities of PA (vigorous, moderate, and walking) and time spent sitting. To eliminate overestimation of the time spent in PA and underestimation of time spent sitting [24], we modified the official IPAQ-LF manual as follows: a) MET-min vigorous PA (VPA) were multiplied by six instead of eight, as recommended; b) all the estimates of weekly PA were transformed to average daily minutes of PA; c) the average daily sum of minutes of PA and transport was capped at 600 minutes; d) the maximum eligible amount of MET-min per week was capped at 20.000 MET-min. We excluded 230 participants for not meeting these conditions and due to missing data.

As a recommendation of weekly PA we decided for the minimum values, amended in line with healthy people 2010 [25], healthy people 2020 [26], 2008 Physical Activity Guidelines for Americans [27] and EU Physical Activity Guidelines [28]. According to the IPAQ-LF, meeting of the weekly PA recommendation is assessed separately for specific types of PA, which makes it harder to achieve the recommendation. Minimum recommendation were set as follows: for VPA it was at least 3 or more days per week for 20 or more minutes (hereinafter as 3×20 min VPA), recommendation for moderate PA was at least 5 or more days per week for 30 or more minutes (hereinafter as 5×30 min MPA), recommendation for any PA was at least 5 or more days per week for 60 minutes (hereinafter as 5×60 min PA) and then the most difficult concurrent meeting of two PA recommendations (5×60 min PA + 3×20 min VPA), which corresponds with the requirements stipulated in the healthy people 2020 to the furthest extent [26].

Data analysis

For statistical analyses, we used the descriptive statistics, crossing tables, Kruskal-Wallis test ANOVA, logistic regression and η^2 and w effect size coefficients [29, 30] in the Statistica version 13 (StatSoft, Prague, Czech Republic) and SPSS version 22 (IBM, Armonk, NY; USA).

RESULTS

Boys preferred boxing, kick-boxing and karate out of MA (Figure 2). Similarly, girls preferred karate, boxing, but at third rank they placed judo (Figure 3). Boys selected boxing (29 times), karate (25 times) and kick-boxing (25 times) as the most favourite out of all PA categories. In total, 8% of boys selected MA as their most favourite PA. Girls selected karate (10 times), kick-boxing (9 times) and boxing (7 times) as their most favourite PA. In total, 2% of girls selected MA as their most favourite PA.

Participation in organized MA and involvement in MA during summer and winter season corresponds with MA preferences (Table 2). Regarding the organized PA, the most participants were involved in karate, kick-boxing and boxing. Overall, 10% of boys (but only 2% of girls) were involved in organized MA in the sample of 1006 boys and 1211 girls.

The associations among preferences, participation in MA and meeting the recommendations for weekly physical activity

Boys who preferred MA over other types of PA showed significantly higher level of VPA (2337 MET-min) than boys who did not prefer MA ($H(3,1523) = 4365$, $p<0.001$; $\eta^2 = 0.029$). The

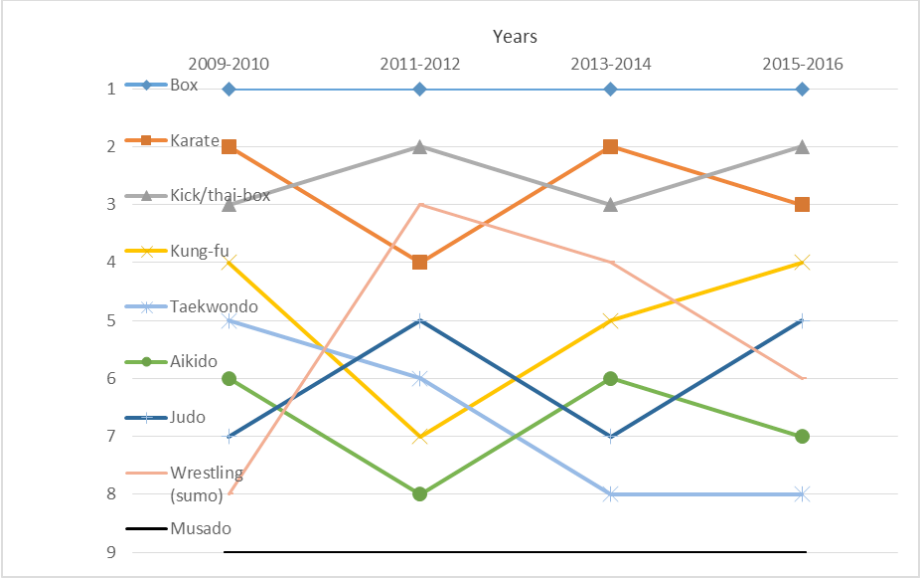

Figure 2. MA preferences in boys (n = 1408) between 2009 and 2016 (ranking position from 1 to 9).

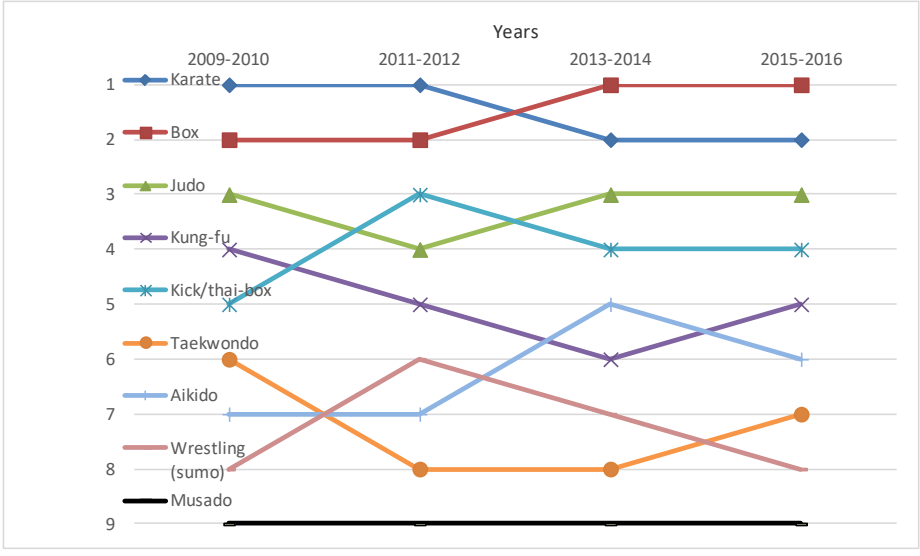

Figure 3. Martial arts preferences in girls (n = 1831) between 2009 and 2016 (ranking position from 1 to 9).

latter reported only 1605 MET-min of VPA. Girls who preferred MA had only 1665 MET-min of VPA, while those who did not prefer MA had 1289 MET-min of VPA (p = 0.200). These differences were observed also in overall weekly PA in boys ($H(3,1523) = 19.32$, $p<0.001$; $\eta^2 = 0.013$) (6500 MET-min vs. 5457 MET-min). In girls, the difference (6197 MET-min vs. 5183 MET-min) was non-significant. Boys who preferred MA were also significantly more likely to meet the recommendation of 3×20 min of VPA (56%) than boys who did not do so (41%) ($\chi^2 = 12.77$; $p<0.001$; $w = 0.137$). The recommendations of 5×60min of PA and 3×20min of VPA per week concurrently were met by 73% of boys preferring MA, compared with 64% of boys who did not prefer MA ($\chi^2 = 4.89$; $p = 0.027$; $w = 0.085$). Similarly, 67% of girls who preferred MA met this recommendation in comparison with 64% of girls who did not prefer MA; however, this difference was not statistically significant ($p = 0.521$) (Table 3).

Boys, who performed MA in throughout the year reported significantly more VPA 2413 MET-min than boys not involved in MA ($H(3,1523) = 33.19$, $p<0,001$; $\eta^2 = 0.022^*$), who showed only 1708 MET-min of VPA. Girls, who participated in MA

Table 2. The most frequently performed martial arts by boys and girls in in different circumstances.

Martial art	Circumstances performed of martial arts					
	organized		mostly performed in summer season		mostly performed in winter season	
	boys (n = 100)	girls (n = 26)	boys (n = 26)	girls (n = 10)	boys (n = 49)	girls (n = 16)
Karate	1	1	2	3-6	4	6-9
Kick-boxing (thai-boxing)	2	2	3	1	2	1
Boxing	3	7	1	2	1	2-4
Judo	4	4-6	4-7	3-6	6	5
Aikido	5	3	4-7	3-6	5	2-4
Wrestling (sumo)	6	8-9	4-7	7-9	3	6-9
Kung-fu	7	4-6	8-9	7-9	7	6-9
Taekwon-do	8	4-6	4-7	3-6	8-9	2-4
Musado	9	8-9	8-9	7-9	8-9	6-9

throughout the year reported 1503 MET-min, as compared with 1323 MET-min among other girls (p = 0.681). Concerning the overall weekly PA, the sex differences between those who participated in MA and those who did not were not significant. With regard to achieving the minimum recommendations for PA (3×20 min of VPA), we observed significant differences between those involved in MA and those not involved only in boys (χ^2 = 5.92; p = 0.015;w = 0.093) (Table 3).

Adolescents involved in MA throughout the year had higher odds for meeting the 3×20 min of VPA recommendation than those non-involved in MA (OR = 1.696, CI = 1.175-2.447, p = 0.005). Control variables, i.e. sex, participation in organized PA, size of settlement, having a dog in one's family, ownership of a car, did not change the significance of the associations between MA involvement and meeting the VPA recommendation (OR = 1.620, CI = 1.086-2.416), p = 0.018). Figure 4 displays influence of variables on the association of independent (involvement in MA) and dependent variable (meeting the VPA recommendation).

DISCUSSION

Long-term stability in preferences of boxing, kick-boxing and karate in boys and boxing, karate and judo in girls can be considered as key findings of the present study. These findings are in line with frequently reported rise in world-wide popularity of MA [3, 16, 17, 31]. The associations between preferences of various types of PA and involvement in such preferred PA or typical sport activities and associations with popularization or medialization of sport 'celebrities' are apparent in most of the sport disciplines.

Table 3. Rates of meeting the physical activity (PA) recommendations by participation in martial arts (MA) and preferences for MA.

Recommendation	Participating in MA (n/%)				Preferences MA (n/%)			
	boys		girls		Boys		girls	
	no	yes	no	yes	No	Yes	no	yes
3×20 min vigorous PA	263/43	52/57*	292/36	13/39	202/41	103/56*	264/35	41/45
5×30 min moderate PA	175/30	29/32	202/25	13/39	144/28	63/34	186/25	29/32
5×30 min walking	291/49	49/53	484/60	19/58	244/49	96/52	448/60	55/60
5×60 min PA	311/53	52/57	429/53	17/52	256/52	107/58	393/52	53/58
3×20 min vigorous PA + 5×60 min PA	388/66	67/73	520/64	22/67	320/64	135/73*	480/64	62/67

*p <0.05

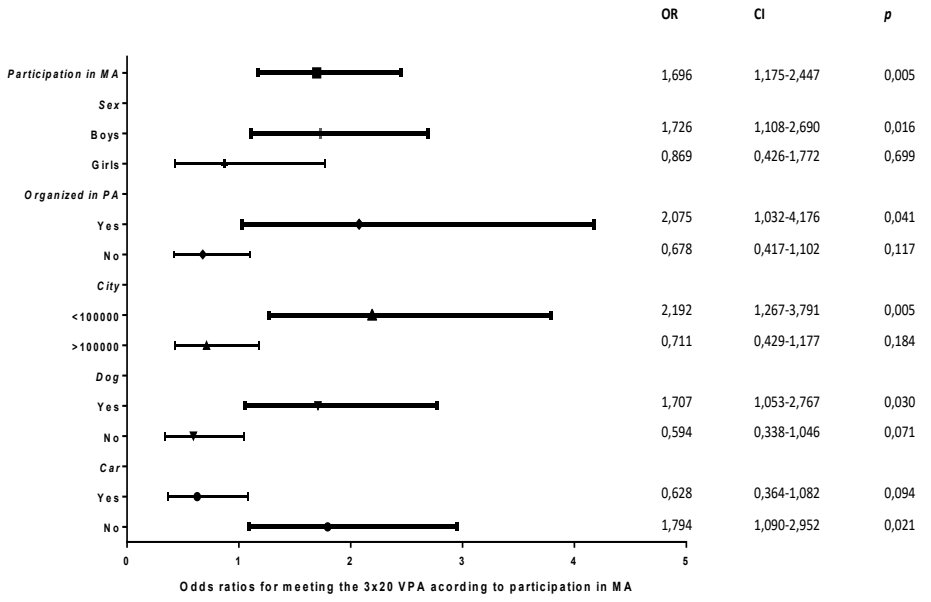

Figure 4. Odds for meeting the minimum VPA recommendation according to participation in MA, adjusted for sex, organization, size of settlement, dog and car in one's family.

Similar dependencies can be observed also in MA. Furthermore, these associations are also influenced, to further extent than in other sport disciplines, by global situation concerning rise in violence and decline in levels of personal, as well as overall safety.

The rate of participation in organized MA (10% boys, 2% girls), as observed in the present study, seems to be lower in comparison with other sport disciplines. For instance, in our research sample 56% of boys and 42% of girls participated in organized sport games. The rising popularity and ratings of MA [3], which was reported in other cultural and political contexts will likely manifest in Central European region in future.

The studies that point to negative consequences related to MA need to be considered [32]. However, it is also necessary to seek for ways to eliminate such risks. It is important to follow the recommendations of the Polish Society of Sports Medicine on age criteria for participation in combat sports [33]. Moreover, we lack information on injuries, which occur during both common activities and competitive matches despite rise of popularity in MA and mixed MA [31]. We believe that high-quality diagnostics of PA preferences can lead to appropriate approaches to combination of MA with aesthetic PA, mental training, fitness activities or social and gender benefits. Also, role of school physical education in exploiting benefits of MA and eliminating possible negative impacts is irreplaceable. Incorporating adequate forms of MA to lessons of physical education can be in complete compliance with the SAAFE principles (Supportive, Active, Autonomous, Fair and Enjoyable) [34].

The differences observed in rates of MA participation between boys and girls are not surprising. Indices of increased interest in MA among girls accent importance of monitoring of trends in girls' participation in MA in the context of increase in interest in typically male professions in police, army, emergency services, etc. [35-37], as well as 'deeper' perception of personal safety among girls [38]. We see the largest gaps in development of conditions for girls to get involved to MA in connection to popular martial dances, box-aerobics and fitness activities.

Rates of meeting recommendation of 3×20 min of VPA weekly, as well as 5×60 min of PA correspond with hitherto findings in the Central European region [39]. The biggest issue in assessment of rates of meeting the recommendations using the IPAQ-LF is that it is incomparable with other ways of self-rated assessment of weekly PA.

The *Indares* system can be an effective tool for promotion of MA at universities preparing physical education teachers. The usage of similar systems is supported also by Jagiello and

Dornowski [40], who found that 95% of students enrolled in academy of PE believe that elements of MA should be applied in the process of physical education of children and youth.

Strengths and weaknesses of the study

In our opinion, the key contribution of this study is the long-term assessment of adolescents' preferences in the field of MA. Thus far, the studies exploring the associations between involvement in MA and achievement of the weekly PA recommendations are scarce.

Selection of a part of the adolescent sample based on the level of cooperation between universities and secondary schools can be considered as a limitation. Further limitation is the possibility to include newly emerging or less known types of MA only in clearly defined MA in the QPAP questionnaire. Despite involvement of research team that always clarified less known types of MA, the level of awareness of MA types varied across schools.

CONCLUSIONS

The present study confirms significant associations between preferring and performing MA and vigorous PA in boys. Involvement in MA in boys and girls throughout the year contributes to meeting the weekly PA recommendations, similarly to other types of PA. Further research on associations between involvement in MA, in comparison with other types of PA and meeting the PA recommendations is desirable, in particular, using objective PA monitoring.

REFERENCES

1. The Statistics Portal (cited 2017 May 5). Available from: https://www.statista.com/statistics/191917/participants-in-martial-arts-in-the-us-since-2006
2. Bowman P. Making martial arts history matter. Int J Hist Sport 2016; 33(9): 915-933
3. Hishinuma ES, Umemoto KN, Nguyen TG et al. Epidemiology of mixed martial arts and youth violence in an ethnically diverse sample. Violence Vict 2012; 27(1): 439
4. Frömel K, Formánková S, Sallis JF. Physical activity and sport preference of 10-14-year-old children: a 5-year prospective study. **Acta Univ Palacki Olomuc Gymn** 2002; 32(1): 11-16
5. Kudláček M, Frömel K, Groffik D. Gender differences in preferences of martial arts in Polish adolescents. Arch Budo 2015; 11: 227-234
6. Ściślak M, Rokita A, Blach W. Interests in mobile activity forms of persons practicing judo. Arch Budo 2015; 11: 235-241
7. Kudláček M. Sport preferences survey – future of martial arts. Arch Budo 2008; 4: 101-105
8. Sánchez-López J, Fernández T, Silva-Pereyra J et al. Evaluación de la atención en deportistas de artes marciales. Expertos vs. novatos. Revista de Psicología del Deporte 2014; 23(1): 87-94
9. Vertonghhen J, Gheeboom M, Pieter W. Mediating factors in martial arts and combat sports: an analysis of the type of martial art, characteristics, and social background of young participants. Percept Mot Skills 2014; 118(1): 41-61
10. Vlachos E. The benefits of using traditional martial arts as an intervention programme for children with behavioural, emotional and social difficulties. J Pedagogic Dev 2015; 5(2): 37-45
11. Conant KD, Morgan AK, Muzykewicz D et al. A karate program for improving self-concept and quality of life in childhood epilepsy: Results of a pilot study. Epilepsy Behav 2008; 12(1): 61-65
12. Jensen AR, Maciel RC, Petrigliano FA et al. Injuries sustained by the mixed martial arts athlete. Sports Health: A Multidisciplinary Approach 2017; 9(1): 64-69
13. Nauta J, Knol DL, Adriaensens L et al. Prevention of fall-related injuries in 7-year-old to 12-year-old children: a cluster randomised controlled trial. Br J Sports Med 2013; 47(14): 1-6
14. Leavitt FJ. Can martial arts falling techniques prevent injuries? Injury Prev 2003; 9: 284-287
15. Walczak BG, Barczynski BJ, Kalina RM. Evidence-based monitoring of the stimuli and effects of prophylaxis and kinesiotherapy based on the exercises of safe falling and avoiding collisions as a condition for optimizing the prevention of body injuries in a universal sense-people with eye diseases as an example of an increased risk group. Arch Budo 2018; 14: 79-95
16. Ko Y, Kim Y. Martial arts participation: consumer motivation. Int J Sports Mark Spons 2010; 11(2): 2-20
17. Zeng HZ, Hipscher M, Leung RW. Attitude of high school students toward physical education and their sport aktivity preferences. J Soc Sci 2011; 7(4): 529-537
18. Twernlow SW, Sacco FC. The application of traditional martial arts practice and theory to the treatment of violent adolescents. Adolescence 1998;33(131): 505-518
19. Zheng T. On the value of martial arts culture in education of youngsters. Proceedings of 2013 International Symposium on Women's Survival and Development in Current Cultural Environment; 2013: 401-405
20. Harwood A, Lavidor M. Rassovsky Y. Reducing aggression with martial arts: A meta-analysis of child and youth studies. Aggress Violent Behav 2017; 34: 96-101
21. Křen F, Kudláček M, Wasowicz W et al. Gender differences in preferences of individual and team sports in Polish adolescents. Acta Gymn 2012; 42(1): 43-52
22. Craig CL, Marshall AL, Sjöström M et al. International physical activity questionnaire: 12-Country reliability and validity. Med Sci Sports Exerc 2003; 35(8): 1381-1395
23. Cull A, Sprangers M, Bjordal K et al. EORTC quality of life group translation procedure, (Second Edition). Brussels: EORTC Quality of Life Unit; 2002
24. Cerin E, Cain KL, Oyeyemi AL et al. Correlates of agreement between accelerometry and self-reported physical activity. Sci Sports Exerc 2016;48(6):1075-1084
25. U. S. Department of Health and Human Services. Healthy People 2010: Understanding and Improving Health (Second Edition). Washington, DC: U. S. Government Printing Office; 2000
26. U. S. Department of Health and Human Services. Healthy people 2020. Washington, DC: U.S. Department of Health and Human Services; 2010
27. U. S. Department of Health and Human Services. 2008 Physical activity guidelines for Americans. Be active, healthy, and happy! Washington, DC: U. S. Department of Health and Human Services; 2008
28. European; Commision. EU Physical activity guidelines recommended policy actions in support of health-enhancing physical activity. Brussels: Education and Culture DG; 2008

29. Cohen J. Statistical power analysis for the behavioral sciences (Second Edition). New York: Lawrence Erlbaum Associates; 1988

30. Sheskin DJ. Handbook of parametric and non-parametric statistical procedures (Forth Edition). Boca Raton, FL: Chapman & Hall/CRC; 2007

31. Walrod B. Current review of injuries sustained in mixed martial arts competition. Curr Sports Med Rep 2011; 10(5): 288-289

32. Sánchez Garcia R, Malcolm D. Decivilizing, civilizing or informalizing? The international development of mixed martial arts. Int Rev Sociol Sport 2011; 45(1): 39-58

33. Kostka T, Furgal W, Gawroński W et al. Recommendations of the Polish Society of Sports Medicine on age criteria while qualifying children and youth for participation in various sports. Br J Sports Med March 2012; 46(3): 159-162

34. Lubans DR, Lonsdale C, Cohen K et al. Framework for the design and delivery of organized physical activity sessions for children and adolescents: Rationale and description of the 'SAAFE' teaching principles. Int J Behav Nutr Phys Act 2017; 14: 24

35. Dojwa K. Kobiety w mundurze. Wybrane aspekty służby kobiet w wojsku, policji i straży granicznej. Polityka Społeczna 2009; 1: 19-24 [in Polish]

36. Bsoul M. Kobieta jako pracownik w grupach dyspozycyjnych (na przykładzie wojska). Zeszyty Naukowe Zarządzanie Politechniki Częstochowskie 2014; 15: 101-111 [in Polish]

37. Hoffman T. Feministyczne ujęcie bezpieczeństwa. Przegląd Naukowo-Metodyczny Edukacja dla bezpieczeństwa 2015; 3(28): 179-187 [in Polish]

38. Carver A, Timperio A, Crawford D. Perceptions of neighborhood safety and physical activity among youth: The CLAN study. J Phys Act Health 2008; 5(3): 430-444

39. Frömel K, Kudlacek M, Groffik D et al. Promoting healthy lifestyle and well-being in adolescents through outdoor physical activity Int J Environ Res Public Health 2017; 14(5): 533

40. Jagiello W, Dornowski M. Martial arts in the opinions of students at the Faculty of Physical Education. Arch Budo 2011; 7(2): 55-59

41. Dictionary of Sport and Exercise Science. Over 5,000 Terms Clearly Defined. London: A & B Black; 2006

42. Jetté M, Sidney K, Blümchen G. Metabolic equivalents (METS) in exercise testing, exercise prescription, and evaluation of functional capacity. Clin Cariol 1990; 13(8): 555-565.

43. Szumilas M. Explaining odds ratios. J Can Acad Child Adolesc Psychiatry 2010; 19(3): 227-229

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