Original Article

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Comparison of physical activity of children in a state kindergarten and a forest kindergarten in the Czech Republic

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Abstract

Introduction: This study compares physical activity of children in a state kindergarten and a forest kindergarten, particularly the number of steps taken, which can indicate the quantity of physical activity. The objective is to monitor the number of steps taken by children in selected institutions and to conduct an analysis in relation to the structure of the daily programme and movement regimen of these institutions contributing thus to the discussion concerning physical literacy formation among preschool children. *Methods:* The study is of a descriptive non-intervention character using mechanical pedometers. The sample consists of 73 children (36 in the state kindergarten, 37 in the forest kindergarten). The data are processed using a nonparametric Mann-Whitney test and Cohen's d. *Results:* At the significance level of 0.05 it was discovered that children from the forest kindergarten take significantly more steps in the observed period than children from the state kindergarten. The Z-score is -4.357 and $p < 0.001$. Substantive significance for the level of physical activity measured by the number of steps is high. Cohen's d = (532057–354714)/133355.005729 = 1.33. *Conclusion*: Physical literacy is influenced by both the quality of physical activity and the quantity, which was larger in the forest kindergarten. This may be related to the amount of spontaneous physical activity and the frequency and length of trips. However, controlled physical activities in the state kindergarten, especially morning exercise, can improve the quality and increase physical literacy as well. There is a need for a competent approach of teachers, sensitive inclusion of physical activities in the daily programme with emphasis on internal motivation, and awareness of benefits and drawback of both spontaneous physical activity and controlled activities represented by regular morning exercise.

Keywords: preschool education, pedometer, movement regimen, spontaneous physical activity,

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INTRODUCTION

Physical activity is an inseparable and everyday part of human life. It helps to maintain the organism in the state of physical, mental and psychosocial well-being [1]. It is a necessary and natural prerequisite for optimal maintenance and improvement of physiological functions of the organism. It increases physical fitness, contributes to mental freshness, enhances the feeling of mental well-being and resistance to stress, helps to improve blood circulation and oxygenation of the brain, strengthens the bones reducing the risk of fractures, improves blood circulation in the skin resulting in better physical appearance, helps to prevent chronic non-infectious diseases (so-called diseases of civilisation) [2]. Kalman, Hamřík and Pavelka [3] also mention good mood, better pain tolerance, feeling relaxed and happy, the ability to think better and longer, improvement of memory, resistance to all kinds of stress, and increased self-confidence. Tröndle [4] remarks that physical activity improves the overall perception of our body.

Physical activity is an inseparable part of healthy lifestyle. Furthermore, it is a main manifestation of physical literacy understood in accordance with its definition by Vašíčková as a concept describing whole-life qualitative level of man; an ability and effort based motivation to apply physical abilities, skills and knowledge in practice via individual's fitness leading towards physical well—being contributing to healthy lifestyle and its everyday routine application [5]. In relation to preschool age, the formation of physical literacy among children is interpreted via Mužík, Šeráková and Janošková [6]. The formation of physical literacy presupposes that children are taught physical abilities corresponding with their age and individual preconditions. With the help of physical abilities as a part of physical routine, children's health-oriented fitness is maintained or developed; such fitness is considered to be a vital component of human physical well—being. Children are able to master particular experience of compensation exercises, the need for warming up, various abilities and rules regarding safety and personal hygiene. These all contributes to their attitude towards physical activities and is reflected in their physical activity routine and individual programme, constituting a part of their lifestyle.

Lifestyle, whose component includes the current level of physical literacy, is formed during childhood and besides the influence of family and parents, the decisive factor is the amount and quality of physical activity in preschool institutions and elementary schools, where pupils spend a significant part of their lives. Today, there is a wide range of various preschool institutions with different priorities and educational approaches, such as public or private kindergartens, private children's clubs or children's groups. Institutions discussed in this study are a public kindergarten and forest kindergarten practising outdoor education. A forest kindergarten can be considered to be a special type of “eco-kindergarten,” whose fundamental feature is that most of the programme takes place “outdoors in any weather.” Typical features of forest kindergartens include holistic learning, development of fine and gross motor skills through movement out of doors, support of sensory perception through direct experience, development of creativity and imagination using various natural elements, learning about one's own physical boundaries as well as the values of both forest environment and human society [7]. These institutions also support a certain level of risk that helps children develop while playing [8]. The stay of preschool children out of doors brings many benefits, which include increased self-confidence, motivation, concentration, development of social, physical and language skills, deeper conceptual understanding of and respect for nature. Children who spend more time outdoors and go to a forest more frequently show better motor skills and a larger number of social and imaginative games [9].

Physical activity in preschool institutions focused on outdoor education is most often spontaneous physical activity connected with being outside, trips and strolls. Controlled physical activities are included less frequently [10]. Education in ordinary kindergartens is governed by the Framework Educational Program for Preschool Education. The teacher's goal in the area of Child and Body is to “stimulate and support child's growth and neuro-muscular development, its physical comfort, to improve its physical fitness as well as its motive and health culture, to support its motor and manipulative abilities, to teach children self-servicing skills and lead them to healthy life habits and attitudes” [11].

Unlike in forest kindergartens and clubs, controlled physical activities in state kindergartens usually tend to be more structured and can often be divided into:

- Morning exercise, which introduces children to the plan of exercise in the introductory part, then warms up the organism by means of playing simple games; the preparatory includes warming up, exercising the whole body and prevention of faulty posture; in the main part, which is sometimes completely omitted, includes development, training and improvement of motor skills; the final past is supposed to induce relaxation [12].
- Thematically oriented movement games, which are part of the educational block.
- Music-movement sessions, which primarily use the rhythm of words, songs, music and dancing games [13].

In state kindergartens, spontaneous or controlled stay outside usually lasts for two hours in the morning. The afternoon stay outside varies depending on several factors, such as the length of the children's stay in the institution on the given day, or the season of the year. This is established by the regulation 410/2005 of the collection of laws. In forest kindergartens and clubs, spontaneous or controlled outdoor stays prevail in the daily routine [10]. Whether it is controlled or spontaneous physical activity, the important factors are motivation, influence of the environment, and stimuli. Encouraging children to spend more time outdoors may be an effective strategy for increasing physical activity, reducing sedentary behaviour and preventing excess weight gain (particularly boys' play) [14]. Staying out of doors can contribute to children's stress relief, improved concentration as well as to create the formation of supportive social groups. [15]. It It is vital to reconnect children with nature in their daily environment since nature experiences benefits children's holistic development [16]. Children can be physically active for a long time because it brings them joy and fatigue is caused more by a lack of interest in a monotonous activity [17]. It is important to ensure that children feel pleasant after physical activity, which activates internal motivation and results in a lifelong positive relationship with physical activity [18]. A study in Hong Kong found that children in kindergartens with large enough indoor and outdoor areas were significantly more physically active than children in kindergartens having only indoor institutions [19]. It was also discovered that children who have more movement-stimulating toys at home, such as climbing frames, slides, swings, riding toys or balls, are considerably more physically active both at home and in the kindergarten than children who do not have such options [20]. Michek [21] argues that forest kindergartens help the development of movement abilities and creativity comparable or better than common kindergartens, and also that forest kindergartens have positive compensation influence on civilizational deprivation of children.

A preschool child has a high need for movement, approximately 6 hours a day. Of the total duration of 6 hours, spontaneous physical activity accounts for approximately 4.5 hours a day [22]. Preschool children feel an urgent need to test the possibilities of their own bodies. By means of spontaneous movement games, children test their motor skills which they further improve [23]. The achieved level of children's motor skills influences their physical fitness, as well as their selection of physical activities, group engagement, perception, speech, drawing and later also writing. Children with impaired motor skills and abilities show different speed and accuracy of movement. These children very often intentionally avoid more demanding physical activities. The impairment of motor abilities and skills influences the development of other functions considerably [24].

Physical activity should be part of the programme in kindergartens on a daily basis. "Physical exercise at a heart rate of 170 – 180 beats per minute should be included in a child's everyday routine in a kindergarten" [25]. It is not necessary to conduct a warm-up exercise every single day, but is vital to encourage children to move while creating as many opportunities for physical activity as possible. Through motivated exercise and movement games children are lead to the correct posture, better endurance, physical fitness, or locomotion skills, depending on the teacher's intentions [25]. From the perspective of quantity, the recommended daily number of steps taken by preschool children is 13 000, as advocated by Sigmund and Sigmundová [1]. The correlation between the number of steps and the amount of strain (measured by a triaxial and a uniaxial accelerometer) is presented by Tanaka and Tanaka [26] who also recommend that a preschool child should take approximately 13 000 steps a day, where so-called moderate-to-vigorous physical activity done for 60 minutes, 100 minutes, or 120 minutes a day corresponds to 9 934, 12 893, or 14 373 steps per day respectively. Vale, Trost, Dunca and Mota [27] make a different recommendation, having found that 3 hours of physical activity

translate roughly to about 9,099 steps per day, and concluded that children who take fewer steps may be considered insufficiently active. An even less explicit recommendation is made by Creamer, Decker, Bourdeaudhuij, Verloigne, Manios and Cardon [28], who claim that 180 minutes of physical activity per day could translate to anywhere from 4 653 steps per day to 13 326 steps per day, depending on how the output from the accelerometer was measured. The researchers noted that children are more likely than adults to lose, remove or just not wear their fitness trackers.

Whether speaking about spontaneous or controlled physical activity, quality or quantity, 13 000 or 9 099 steps, physical activity should be voluntary, enjoyable and positively motivated. It is advisable to increase the amount of movement by ordinary everyday activities. It is also important to maintain an optimal level of flexibility in children and young people by means of stretching exercise [29]. When monitoring children's physical activity as an important variable of physical literacy, it is possible to observe, among other variables, the quantity of physical activity, which is the subject of this study.

The objective of this study is to monitor and compare the number of steps children take during their stay in observed preschool institutions; the monitored findings will be reflected in relation to the structure of the daily programme of the said institutions, while taking into consideration their environment, conditions and preferred pedagogical approaches/concepts applied. Secondly, the aim is to arrive at conclusions discussing corelations between the amount of physical activity and realized daily programmes or preschool institutions in the context of physical literacy formation. The research question is: What is the difference in physical activity between the number of steps taken in the morning by children in a regular state kindergarten and a forest kindergarten and what are the causes and connections of the findings in relation to physical literacy formation among preschool children?

METHODS

The presented study is of a descriptive character and it monitors physical activity of children in preschool institutions. It uses mechanical pedometers in order to monitor the number of steps taken by children during their stay in the institutions.

Methods of data acquisition and processing

Pedometers Yamax SW 700 were used to monitor physical activity. Pedometers “are small devices which detect change of direction of movement in the vertical axis (the swing when a step is being taken), usually working on the principle of a spring” [30]. It is advisable to use pedometers in activities where the centre of gravity moves vertically and the energy expenditure depends on the number of steps. Pedometers are fastened to the garment on the side near the hip joint. Due to the tremors caused by walking, the number of steps is recorded.

After the data were acquired, they were processed in Microsoft Excel, where basic descriptive characteristics were found. Subsequently, the nonparametric Mann-Whitney test and the substantive significance were performed in IBM SPSS Statistics program (Version 23 for Windows; IBM, Armonk, NY, USA).

Research organization and research sample

The state kindergarten in which the research into children's physical activity was conducted is a facility operating from 6:30 a.m. to 4:30 p.m. This kindergarten works according to the school educational programme (SEP), created on the basis of the Framework Educational Programme for Preschool Education. In the SEP, the facility mentions opportunities for physical activity, such as a large garden with play elements, or a playroom with a range of equipment for physical exercise. The surrounding institutions suitable for physical activity are also mentioned.

In the kindergarten there are two heterogeneous classes, in which children of different ages are educated together. The aim of the kindergarten is to create a friendly, even family atmosphere. In the educational process the children are encouraged to become independent, to desire to actively seek solutions to problems with a friend's help and not to rely on an adult. Other preferred areas of education include the development of a positive attitude to nature, the development of motor skills and gaining knowledge of the world through experiential learning.

The number of monitored children in the discussed kindergarten was 36. The morning programme of the observed group was the following:

06:30 – 08:30 arrival of children (exceptionally later, after agreement with the class teacher);

06:30 – 09:00 block of play activities focused on both intentional and spontaneous learning, movement and health oriented activities, art and manual activities.

09:00 – 09:15 hygiene, morning snack;

09:15 – 11:45 didactic activities alternating with spontaneous activities;

11:45 – 12:15 hygiene, lunch.

In the forest kindergarten, 37 children were involved in the research, who were also divided into two heterogeneous groups. Educational inspirations of this facility are the concept of free play, the concept of "Respect and Be Respected," educational systems – Montessori pedagogy, Waldorf pedagogy, environmental education, experiential and situational learning, ecology and sustainable development, community functioning and cooperation with parents. The morning programme of the facility is the following:

7:30 – 8:30 free play in the garden, children are gathering, a selection of prepared activities depending on the season of the year, fire;

8:45 – 9:30 morning circle – outside or in a tee-pee, opening of the day, motivation for the day and the theme of the week; poems, songs and games related to the theme;

9:30 – 10:00 snack – outside, by the fire in the garden gazebo, in the tee-pee, or in the forest;

10:00 – 11:45 trip to the forest with a programme, free play alternating with controlled activities, games, music, creation of art, all depending on the season of the year and weather;

11:45 – 12:45 hygiene, lunch, cleaning, preparation for relax.

The communication with the institutions and the children's parents took place in person, by e-mail, and by phone. One week before the monitoring, there was an information meeting with parents regarding the details of the measurement. Pedometers, informed consent and record sheets were handed over. Upon the child's arrival at the facility, a pedometer was attached. Before lunch, the obtained values were always recorded in the record sheet. The measurement process lasted for 4 weeks, i.e. 20 weekdays, in March and April 2018.

RESULTS

The average number of steps taken in the morning in the forest kindergarten was 5 321, in the state kindergarten the average number was 3 547. Obtained values by type of institution, by gender and by age are shown in the Table 1 and Figures 1,2. Comparative statistics utilising Mann-Whitney are reflected in the Table 2.

Table 1. Basic descriptive characteristics for the number of steps taken by children during the morning in the state kindergarten (SK) and the forest kindergarten (FK).

Group	E	Total	Girls	Boys	Girls aged 3-4	Boys aged 3-4	Girls aged 5-7	Boys aged 5-7
SK	A	3547	3466	3648	2431	2699	3811	3868
	M	3630	3520	3946	2245	1535	4205	4005
	SD	1244	999	1489	517	2252	874	1141
	n	36	20	16	5	3	15	13
FK	A	5321	5085	5521	4333	5217	5753	5824
	M	5281	5281	5236	3778	5469	5585	5236
	SD	1417	1406	1496	1135	1132	1280	1560
	n	37	17	20	8	10	9	10

E – estimator; A - average; M - median; SD - standard deviation; n - number of monitored children

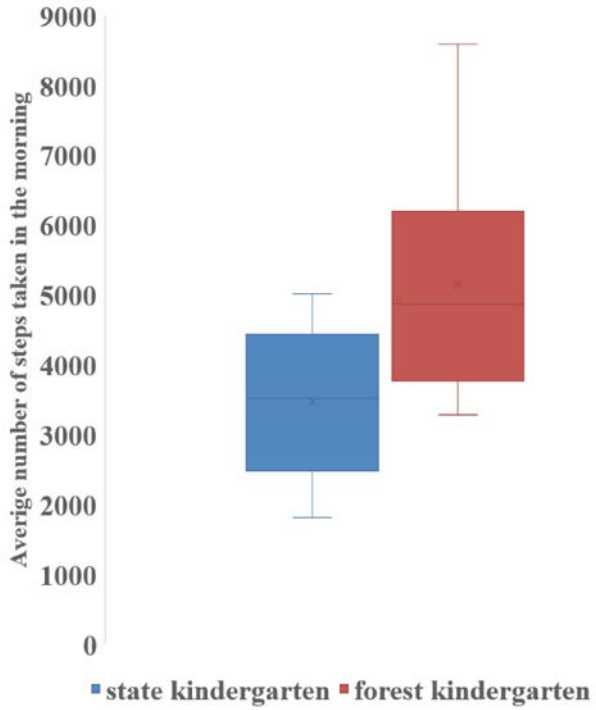

Figure 1. Statistically significant difference of numbers of steps taken by children during the morning programme in the state kindergarten and forest kindergarten ($p < 0.00001$).

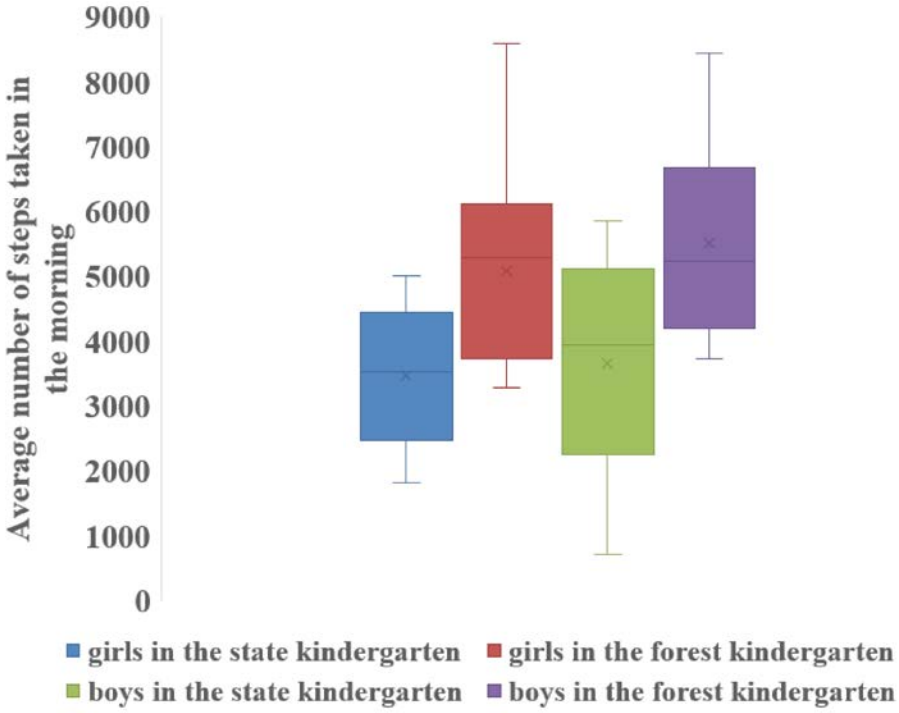

Figure 2. Statistically significant difference of numbers of steps taken by children during the morning programme in the state kindergarten and the forest kindergarten with respect to the gender ($p= 0.002$ for differences between girls, $p= 0.003$ for differences between boys).

Table 2. Nonparametric Mann-Whitney test statistics of differences between the monitored preschool institutions in the number of steps taken by children during the morning.

Test statistics	SK vs FK	girls in SK vs in FK	boys in SK vs in FK	girls vs boys in SK	girls vs boys in FK	girls 3-4 in SK vs in FK	girls 5-7 in SK vs in FK	boys 5-7 in SK vs in FK
Z-score	-4.357	-3.154	2.945	-0.557	0.960	2.855	-3.160	-2.450
p-value	**0.000**	**0.002**	**0.003**	0.575	0.337	**0.004**	**0.002**	**0.014**
U-value	-	66	67	147	238	0	14	25
cv	-	105	98	98	105	6	34	33

cv - critical value of U at $p < 0.05$; SK - the state kindergarten, FK - the forest kindergarten, bold - statistically significant

Using a nonparametric Mann-Whitney test, it was discovered that children from the forest kindergarten take significantly more steps in the morning than children from the kindergarten at the significance level of 0.05. The Z-score is -4.357 and $p < 0.001$. Statistically significant differences were found between girls from the state school versus the kindergarten school, both in the case of 3-4 year-old girl groups, but also for girls aged 5-7. Analogously, statistically significant differences were found between the boys at monitored institutions, namely boys aged 5-7. Due to the low "n" for boys aged 3-4, it was not possible to carry out the statistics. Substantive significance for the level of physical activity measured by the number of steps is high. Cohen's d = (532057 – 354714) / 133355.005729 = 1.33

DISCUSSION

The present study draws attention to the difference in the number of steps taken by children in a state kindergarten and a forest kindergarten, where we monitored a larger number of steps taken by children than in the first stated institution. The statistically significant difference was identified in all monitored aged categories. The average number of steps measured in the morning at the forest kindergarten equalled 5321, while at the state school 3547. The recommended daily number of steps at preschool age is between 13 000 [1,26] and 9 099 [27], meaning that pupils at the forest school fulfil between 41 to59 % in the morning, while at the state school the average step number equals 27 to 39 %. Although no conclusions can be drawn in relation to daily recommended norms, it can be argued that fulfilling the norm from 50 % in the morning can be a solid basis for the completion of the recommended daily norm.

The question is how influential can higher or lower amount of physical activity (measured by pedometers) mean in the formation of physical literacy. It is possible to consider the findings of Culková and Francová [10] who, in the context of forest kindergartens and children forest clubs contrasted with state kindergartens, discuss regular inclusion of longer outings and trips and extensive spontaneous physical activity (SPA), whereas in the state kindergarten contrarywise to forest kindergartens and forest clubs they notice a regular inclusion of controlled physical activity (CPA) – morning exercise. Whether it is CPA or SPA, the important factors are motivation, influence of the environment, and stimuli [12]. In the case of children with fewer taken steps but more frequent CPA, motivation is the teacher's responsibility, as well as the appropriate environment, selection of tools and places. The same can be said about stimuli. In the case of children with higher steps taken and more frequent SPA, the motivation can come from the environment itself and the group of children. The environment, with the teacher's support, can be a source of sufficient stimuli. In the case of SPA, both preparation of the programme and the pedagogical "performance" itself are less demanding for the teacher.

As Sigmund [13] mentions, it is important to ensure that children feel pleasant after physical activity. This activates internal motivation, which is one of the seminally important elements of physical literacy, and results in a lifelong positive relationship with physical activity. This leads to a fundamental question: In which case is the likelihood of the pleasant feeling higher? As a result of CPA or SPA? Taking into consideration that in the case of CPA, motivation, environment and stimuli are primarily influenced by the teacher, it is apparent that only the teacher's quality performance can

result in a successful educational process, transforming the external motivation into the internal one, which further leads to the child's activation. On the contrary, SPA is inherently dependent on the existence of internal motivation, which is not purposefully controlled by external factors. The question is what happens if the internal motivation for SPA is insufficient. However, preschool children have a high need for movement, approximately 6 hours a day [22] and also feel an urgent need to test the possibilities of their bodies and their motor skills and to further improve them [23]. If the environment is sufficiently stimulating, there is a high likelihood that the internal motivation will be activated and the child will engage in SPA. Should we follow Svobodová's recommendation [25] that we do not necessarily have to conduct warm-up exercise every day, but we should encourage children to move, SPA seems to be more appropriate than CPA. This is supported by the fact that in the monitored forest kindergarten, which is an institution preferring SPA and long trips [10] children take a significantly larger number of steps than children in the state kindergarten. It can be inferred that more opportunities for SPA and more frequent trips out of doors also mean more steps and therefore a larger quantity of physical activity.

However, Svobodová, Vaculíková, Hlavoňová, Skotáková, Čihounková and Bugala [29] also recommend leading children to the correct posture, endurance, physical fitness and locomotive skills through motivated exercise and movement games. Can this be ensured by SPA and a larger daily number of steps? It can be assumed that endurance, physical fitness and locomotive skills can be improved this way within the group of children, provided that the environment is sufficiently stimulating. In SPA, all the main large groups of muscles are usually involved and there is an appropriate and even load and therefore strengthening of muscles. However, stretching positions and exercises preventing faulty posture are very rare in SPA. It is important to maintain an optimal degree of flexibility in children and adolescents by adequate stretching exercises [29] or an appropriate amount of strength training [31]. Regular inclusion of such exercises can eventually lead to the creation of a habit and the child's awareness of the necessity of adequate stretching exercises and strength training, despite the fact that the initial physiological effect might be minimal.

This probe into the movement regimen in the state kindergarten and a forest kindergarten provides an interesting insight into the issue of children's physical activity in these institutions. In further research of this area, it would be appropriate to test both groups of children with the focus on selected motor skills and abilities, motivation to move and perception of movement as important factors of physical literacy and as a prerequisite of a healthy life.

CONCLUSION

The answer to the research question is that a nonparametric Mann-Whitney test revealed a significant difference in the measured number of steps and the substantive significance was found to be high. Children in the monitored forest kindergarten took more steps than children in the state kindergarten. The obtained average values for one child were 5 321 in the forest kindergarten, and 3 547 in the state kindergarten, both measured between the children's arrival and lunch. These numbers represent 41 % and 27 % of the recommended daily number [26] respectively 59% and 39% respectively [27]. Because not only quantity, but also quality plays an important role in the development of children's physical literacy, two different approaches to physical activity in preschool institutions were discussed, both of which have their benefits and drawbacks. More extensive SPA and regular inclusion of outings and trips can be connected with the larger number of steps taken by children in the forest kindergarten. On the other hand, more frequent CPA in the state kindergarten – primarily in the form of morning exercise – can be an important tool for improving posture and creating movement habits, also increasing physical literacy.

To conclude, it is important to emphasise that there is a need for a competent approach of teachers in preschool institutions, resulting in reasonable and balanced inclusion of various physical activities in the daily routine. Physical activity should be included in the everyday programme of kindergartens including both CPA and SPA, accentuation outdoor stay. It is not necessary to conduct a warming up session every day, but it is important to encourage children to move while making use of motivation coming from the environment itself, from the group of children, and from the innate need to move. Via motivated exercise and movement games children are taught the correct posture,

physical abilities and knowledge regarding the importance of healthy lifestyle.. Whether we speak about spontaneous or controlled physical activity, or about quality versus quantity, physical activity at preschool age should be voluntary, pleasant and positively motivated.

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