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Article

Assessment of the Physical Activity of Children with Asthma Bronchiale

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Abstract: Physical activity is especially important of children's everyday life with chronic disease. The aim of the study was to show whether asthma is a barrier to physical activity in our society. The correlation between the severity of the disease, body mass index, and physical activity were analyzed, and, parents' opinion whether children should participate in active sports was assessed. Physical activity of children with asthma was analyzed by questionnaires and activity-measuring armbands. 93 parents and their children were involved in the survey, while 20 children were wearing the armband. The age of children was 12.6±3.5 years (mean±SD), 69.9% were boys, 30.1% were girls. 93.4% of the respondents participated in physical education program and 56.5% also attended sporting activities on a regular basis. 61.2% of the children had mild, 37.6% moderate, and 1.2% severe asthma. 6.5% of the respondents stated that their illness had been consistently or frequently limiting the performance concerning their school or home duties over the past 4 weeks. Twelve percent of parents felt that physical activity was not appropriate in the context of this disease. We conclude, that fear of the consequences of physical activity depends largely on education which should involve their parents, teachers and coaches.

Keywords: physical activity; childhood; asthma; parents' opinion; quality of life

1. Introduction

Physical activity and healthy lifestyle are important elements of children's everyday life. This is especially true for those with chronic disease, e.g., asthmatic children. In recent decades number of patients suffering from asthma and other respiratory disorders has continuously increased not only in Hungary but all over the world as well. In 2015, number of registered asthmatic patients in Hungary was more than 290.000, which indicates a 2.94% prevalence. Prevalence of asthma has increased as well, since it was 1.28% in 2000, 2.47% in 2010, while in 2015 it was 2.94% [1,2]. Endre and coworkers published several studies about the prevalence of childhood asthma in 2007, where Budapest showed a 1.5-times increase between 1995 and 2003 [3]. Comparing these numbers to the 5-6% of European prevalence data, the Hungarian values were significantly lower [4,5]. The reason for this could be the lack of reporting obligation in Hungary, since asthmatic children under the age of 18 and those patients who were not treated at pulmonology departments were not reported [6]. Interestingly, the prevalence of asthmatic patients who participated in follow-up examinations and got treated by pulmonologists because of their severe asthma, was very close to international data [7]. Subsequently, the real prevalence of asthmatic patients in Hungary was estimated between 4-10% by Kontz and coworkers in 2016 [6]. The prevalence of childhood asthma has been increasing continuously. In 2017, Mirzaei and coworkers conducted a meta-analysis based on 50 studies about the prevalence of asthmatic children in Middle East countries [8]. Based on the data of 289.717 children under the age of 18, the prevalence of childhood asthma was 7.53%. Prevalence of childhood asthma in the USA doubled between 1980 and 1995 followed by a slight increase between 2001 and

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2010 [9]. Several international studies proved the benefit of climate therapy on respiratory functions among asthmatic children [10–18]. The goal of different therapeutic approaches is not only to treat the disease but to improve patients' quality of life as well. Studies examining well-being and quality of life started in the 70s [19,20]. In Hungary a wide range of work investigated the quality of life on asthmatic patients [21–26]. Asthma-related surveys specialized to childhood asthma are more often used in clinical trials [27–34]. Long-term consequences on the quality of life was assessed by examining 105 adults who suffered from childhood asthma, their exercise habits were inhibited [35].

Therefore, we conducted our site initiated study among asthmatic children at the University of Debrecen, Department of Pediatrics. Exercise habits, favourite sports, and several obstacles that inhibit their physical activity were examined. The correlation between the severity of the disease, the body mass index of the children, and their physical activity were analyzed, and, furthermore their parents' opinion whether or not the children should participate in active sports was also examined.

The aim of the study is to show the extent to which the mindset that a chronic illness is a barrier to physical activity exists in our society. There are two aspects of this question in our study. The first is whether children with asthma are willing to engage in physical activity and whether this affects their social integration. The other is the extent to which parents inhibit or support their children to be active in sports. We were curious to see if any correlation could be detected between the severity of the disease and the child's physical activity and the closely related BMI.

We hypothesized that children with asthma practice less physical activity than their healthy peers, driven by fear of performance and parental concern about worsening symptoms. We further hypothesized that the more severe the disease, the less physical activity the child performs and that this is associated with an altered BMI. We also hypothesized that there are no gender differences in the above findings.

Our study fills a niche in that no such study has been conducted in this disadvantaged region of Eastern Hungary, where the level of education and per capita income is lower compared to other parts of the country, moreover unemployment and the prevalence of chronic diseases are higher than the national average.

2. Materials and Methods

Physical activity of children with asthma treated at the Department of Pediatrics of the University of Debrecen was analyzed by questionnaires and activity-measuring armbands. The Asthma Questionnaire was previously validated on an international level. Our special questionnaire for physical activity was validated and compared to the international IPAQ questionnaires in our previous studies [36,37]. The study adhered to the Declaration of Helsinki on Ethical Principles for Medical Research Involving Human Subjects and was approved by the Medical Research Council of Hungary (ETT-TUKEB: 24634-4/2018/EKU).

2.1. Study design

We asked 4 questions about sociodemographic data, followed by 8 questions related to sporting habits in the form of multiple-choice answers. The questionnaire was answered by the parents, i.e., how often, what, where and with whom the child likes to play sports and what is the motivation to be physically active. One more question was asked about the reasons for not playing sport, where several answers could be ticked. This was followed by 11 statements on the relationship between physical activity and asthma, and on the characteristics of the child's participation in physical education classes at school. In these cases, a 5-point scale was used to indicate the extent to which the parents agreed with the statements. The Asthma Control Test was the last part of the questionnaire, where we asked about the characteristic parameters of the last 4 weeks in relation to asthma included the data on respiratory function and physical status recorded by the pediatric pulmonologist. The whole survey was voluntary.

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2.2. Participants

93 parents and their children were involved in the survey, while 20 children were given a wrist-worn armband (Xiaomi Mi Band 2, Xiaomi Corporation, China; readout: steps in every minute) to monitor daily physical activity. Nine out of the twenty adhered to the two-week-long test without removing the armband or stopping the measurement. Extracurricular sport was defined as a continuous physical exercise that lasted at least 30 minutes. The average age of children was 12.6±3.5 years (mean±SD), 69.9% were boys, 30.1% were girls. After the Covid-19 pandemic, 16 children of the 93 who were still followed by the Pediatric Department, and those patients repeated the filling in the same questioner and medical assessment.

2.3. Data analysis

The completed questionnaires were processed using EvaSys software (VSL Inc., Hungary; http://www.vsl.hu). Responses were analyzed by gender and age group. SPSS (Statistical Package for the Social Sciences) 29.0 software (SPSS Inc., Chicago, IL, USA) was used for statistical analysis. The normal distribution of the data was checked using Kolmogorov-Smirnov test and Shapiro-Wilk test. In the case of multiple responses, frequency was analyzed using Multiple Response Frequencies and the correlation between groups was examined using Multiple Response Crosstabs. The Pearson's chi-square test or Fischer's Exact test was used for compare of proportions. The significance of differences between groups was assessed using Mann-Whitney-Wilcoxon test or the paired Student's t-test. A p value < 0.05 was considered statistically significant.

3. Results

3.1. Socio-economic factors influencing sports behavior

Close to one third of children studied in primary school, while the rest of them studied in different types of high schools (high school, technical college, technical school) (Figure 1A). Less than one third of the subjects lived in the county center Debrecen, almost half of them lived in different towns while the rest lived in villages (Figure 1B). Analysis by residence showed no significant difference between proportion of those engaged in physical activity (55%, 46.7% and 74.1%; villages, towns and Debrecen, respectively; p=0.075), participation in PE classes (100%, 91.1% and 92.3%; villages, towns and Debrecen, respectively; p=0.397) and physiotherapy (9.5%, 8.9% and 19.2%; villages, towns and Debrecen, respectively; p=0.401). We investigated the relationship between sport of choice and place of residence, but did not find a significant association. In terms of reasons for physical inactivity, we observed that inactivity due to lack of facilities is significantly more common among children living in villages (p=0.028; Chi-square test).

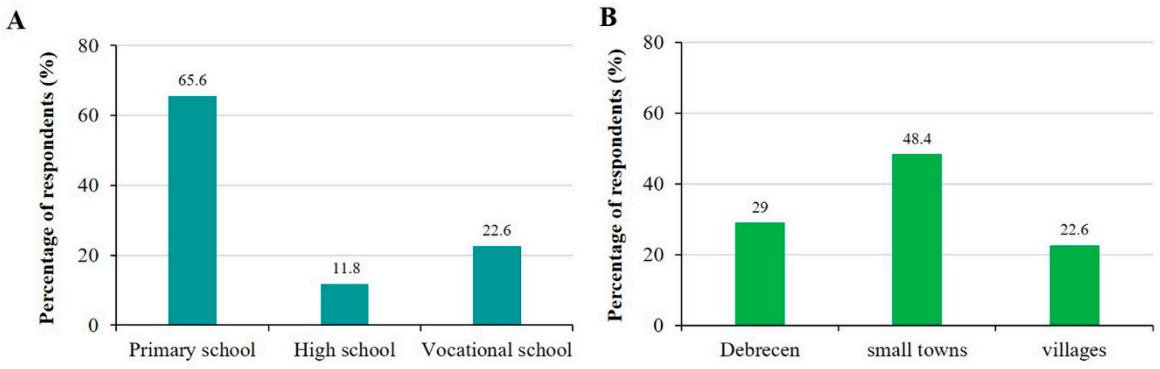

Figure 1. Demographic characteristics of children. (**A**) School attendance of the children. (**B**) Place of residence.

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48.4% of the families reported good standard of living including financial savings. 45.1% could cover all their expenditures without being able to save money. Only 2.2% of the subjects reported poor living circumstances and suffered from poverty in their everyday lives.

3.2. Physical and health status participation children

BMI of children varied within a wide range (12.33 & 37.37; minimum & maximum, respectively). Based on their BMI, 24 children were considered overweight, while 13 of them were underweight. However, mean value of BMI normalized to their ages was 54±34% which corresponded to the values of healthy children at the same age. We also examined the relationship between children's BMI status and their physical activity, but no significant difference was found between the groups (p=0.398, Chi-square test). The percentages of children doing and not doing physical activity were almost the same in all groups. Furthermore, the analysis of BMI status also revealed that no significant difference between their participation rates in physical education (91.2%, 95.7%, 85.7% and 100%; underweight, normal, overweight and obesity, respectively; p=0.698) and physiotherapy (17.1%, 10.9%, 0% and 0%; underweight, normal, overweight and obesity, respectively; p=0.548). When comparing the BMI status of different sports, we found significant differences for cycling (p=0.046) and gymnastic (p=0.016). For both, we observed that underweight children chose these sports more often than their overweight counterparts. Examining the association between reasons for physical inactivity and BMI status, we observed that significantly more children with normal BMI did not play sports due to lack of time (p=0.008). Moreover, the analysis shows that children with asthma who are overweight are more likely to be recommended by their doctor not to be physically active (p=0.007).

Conclusions were similar upon examining respiratory parameters (vital capacity, VC; forced expiratory volume in 1 second, FEV1; and forced expiratory flow at 25% to 75%, FEF25-75). Minimum and maximum values of VC, FEV1 and FEF25-75 normalized to the expected age-related values were 24 and 123%, 39.6 and 140%, 22.7 and 128%, respectively. As expected, strong correlation was detected between the values of FEV1, and FEF25-75 (r2 = 0.524). Also, mean value of FEF25-75 (74.4±21.6%) was significantly lower compared to the expected value at that age. However, there was no correlation neither between BMI and FEV1, (r2 = 0.0004) nor between BMI and FEF25-75 (r2 = 0.0002), respectively. Upon examining the data from the armbands, a typical recording is shown in Figure S1, it became clear that the number of steps per day varied greatly among the children, from 6029 to 13,981 on average over the two weeks. Overall, the average over the nine children participating in the study was 9235±2645 steps/day.

3.3. Sporting habits of children with asthma

56.5% of the children reported regular physical activity besides PE classes. 46.3% performed physical exercise once or twice a week, 38.9% three-four times a week, while 11.1% of them exercised at least five times a week.

Most common forms of physical activities (Figure 2) were soccer (18.4%), cycling (13.6%), swimming (11.7%) and dancing (8.7%). Children usually exercised in school (26.9%) as part of their afternoon activities or in different sport clubs (21.5%). Some exercised at home or chose outdoor activities.

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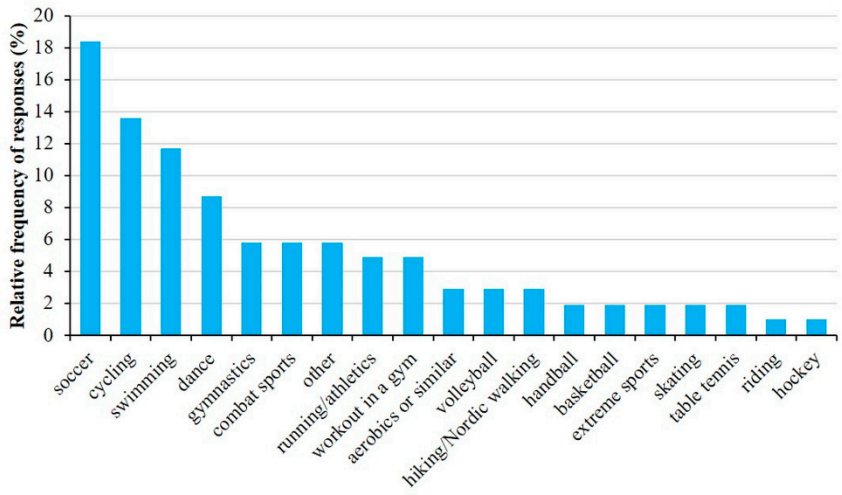

Figure 2. Relative frequency of types of sport among children with asthma. Data are presented for all respondents and they were allowed to select more than one response.

However, even those who did not exercise regularly performed frequent physical activity such as cycling or walking. More than likely, this was due to the fact that most of the subjects lived in small towns where cycling or walking were the most common forms of travel. It is important to note that except for 6.6%, almost all children participated in PE classes. In correlation to that, percentage of children going to physiotherapy was very low, only 12%. However, percentage of children who did not exercise due to their health status was very high (22.8%) among those who did not perform regular physical activity. Lackof time (28.10%), tiredness (15.8%) and lack of motivation (10.5%) were the other most common reasons for physical inactivity (Figure 3).

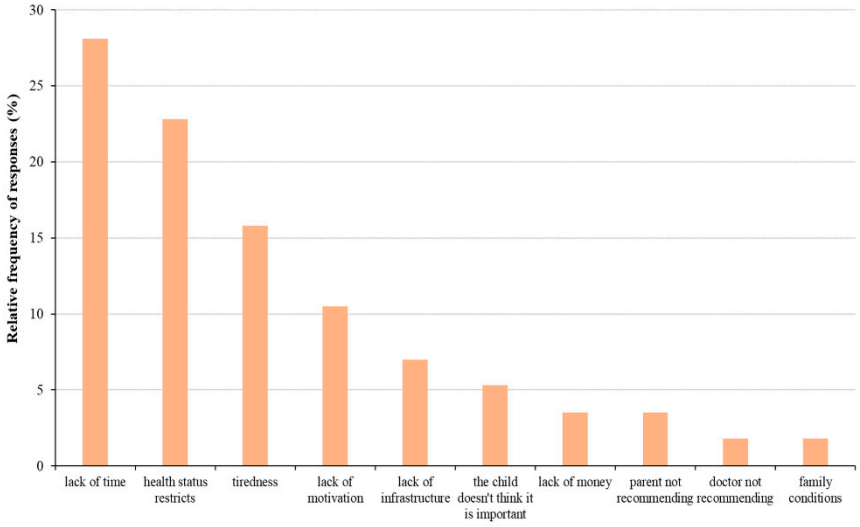

Figure 3. Relative frequency of reasons for not playing sports among asthmatic children. Respondents were allowed to choose more than one answer.

Figure 4 illustrates the relationship between asthma severity and physical activity, we found a significant association that the number of children doing physical activity decreases significantly with increasing asthma severity (p=0.035; Chi-square test).

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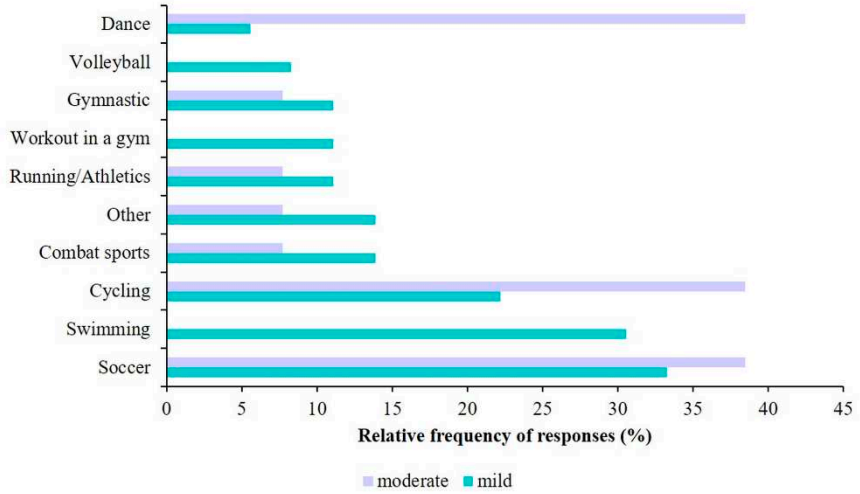

Figure 4. The association between asthma status and physical activity in children with asthma. PA: physical activity; No PA: no physical activity. A significantly lower number of children participating in physical activity as the severity of asthma increases (p=0.035; Chi-square test).

In terms of different types of sports, Figure 5 presents the most common activities performed by children with mild and moderate asthma. A significant difference between the two groups were only found for swimming (p=0.018; Chi-square test). Regarding participation in PE classes and asthma status, significantly more children with mild (62.3%) and moderate asthma (37.7%) participate in PE classes, while children with severe asthma (16.7%) are typically do not attend PE classes at school (p=0.002; Chi-square test). However, we did not find a significant difference between participation in physiotherapy and asthma status (p=0.140; Chi-square test). Analyzing the association between the reasons for physical inactivity and asthma status, we observed that the only significant difference among the different groups was in physical inactivity due to health status (p=0.023).

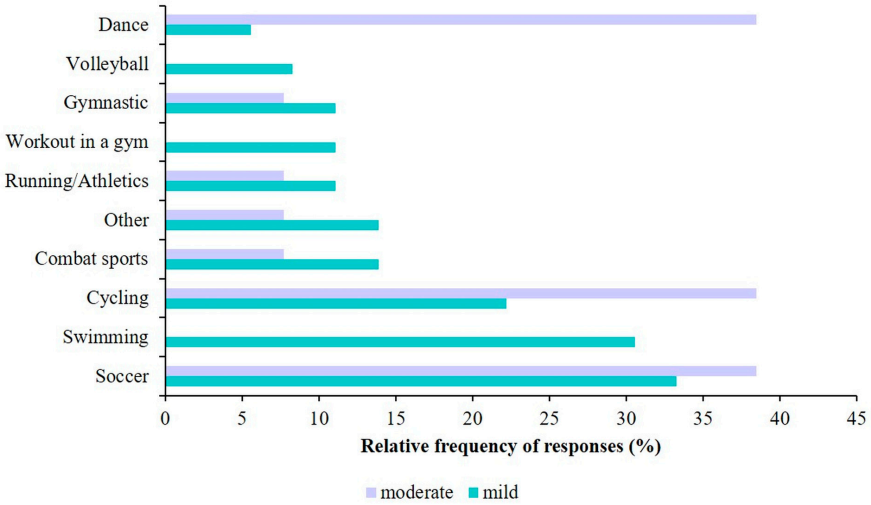

Figure 5. Top 10 chosen sports for children with asthma.

3.4. Parents' opinion on the physical activity of their children

77.2% of parents found the role of physical activity important for asthmatic children. However, only 56.5% said that physical activity could improve the disease.

56.1% of parents believed that their children could meet all the requirements of PE classes. Similarly, percentage of parents was about the same who believed that their children could participate in PE classes just like everyone else (Figure 6).

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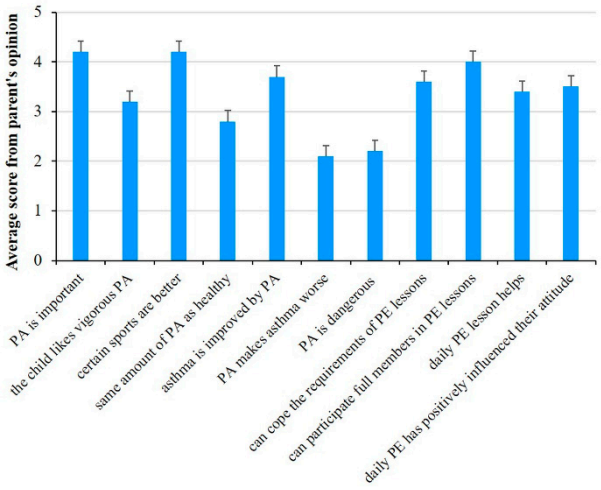

Figure 6. Parents' opinion – on a scale of 1 to 5 – on the relation of physical activity to asthma. Mean ± SD is shown.

Differences in parents' responses between those whose children exercised regularly versus those whose did not is worth consideration. Those parents and their children who exercised regularly believed that physical activity was important for asthmatic children, improved the asthma and could participate in PE classes with the group just like healthy children (Table 1). In contrast, the latter group's judgement on these points were not so positive (3.89, 3.33, and 3.49, respectively). Rating the significance of everyday exercise was also different among the two groups of parents. Parents of those children who exercised regularly said that daily PE classes had improved the health status of their children and positively affected their attitude toward physical activity. On the other hand, parents of those children who did not exercise regularly thought that effect of daily PE class was negligible (2.95 and 3.05, respectively). The statistically significant differences between groups of children whose regularly participate in physical activity and those whose did not are shown in Table 1. Significant p-values are indicated in bold and italic and p value <0.05 was considered statistically significant.

Table 1. Parents' opinions* on the relationship between physical activity and asthma.

Statement	Mean (SD)		p-value[a]
	Physical Activity	Physical Inactivity	
Physical activity is important for asthmatic children.	4.44 (0.80)	3.87 (1.08)	***0.006***
The child likes vigorous physical activity.	3.63 (1.28)	2.56 (1.05)	***< 0.001***
Certain sports are better for children with asthma.	4.33 (0.84)	4.00 (0.92)	0.062
Children with asthma can do the same amount of physical activity as their non-asthmatic peers.	2.98 (1.38)	2.44 (1.17)	0.071
Asthma is improved by physical activity.	3.87 (1.07)	3.33 (1.20)	***0.033***
Physical activity makes asthma worse.	1.98 (1.09)	2.35 (1.19)	0.139
Physical activity is dangerous for children with asthma.	2.06 (1.02)	2.46 (1.27)	0.160
My child feels can cope the requirements of PE lessons.	3.98 (1.53)	3.08 (1.42)	***0.002***
My child feels that he/she can participate fully in group sports activities in PE lessons.	4.45 (1.10)	3.49 (1.30)	***< 0.001***
My child's health has been improved by the introduction of daily physical education.	3.63 (1.25)	2.95 (1.26)	***0.010***
My child's attitude to physical activity has been positively influenced by the introduction of daily PE.	3.87 (1.30)	3.05 (1.30)	***0.002***

* 1 – Fully disagree, 5 – Fully agree; [a] Mann-Whitney-Wilcoxon test. Significant *p*-values are indicated in bold and italic (p<0.05).

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3.5. Impact of illness on children's quality of life

Close to half of the subjects reported that their child indicated no asthma-related dyspnoe during the last four weeks. Little over one third suffered from that once or twice a week, while only one child suffered more than once a day (Figure 7).

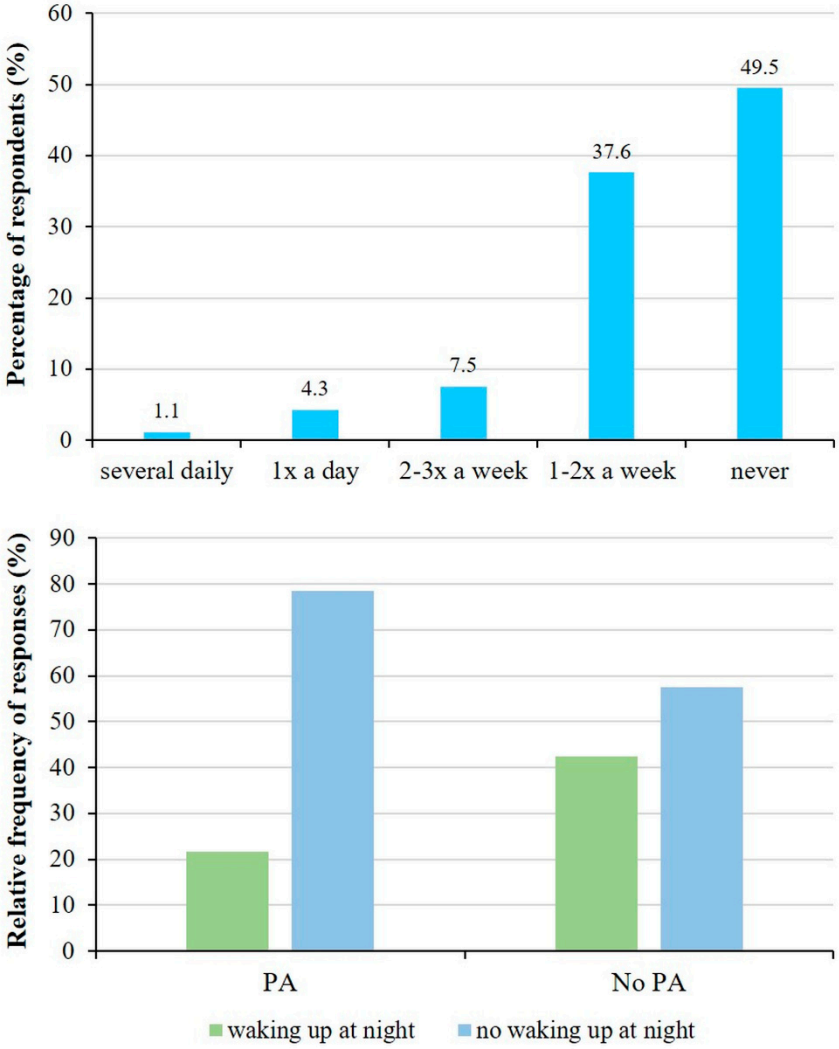

Figure 7. Rate of asthma-related dyspnoe in the past four weeks.

Studying the association between physical activity and sleep disturbances, we observed that 21.6% of children who participated in sports activities woke up at night or earlier than their usual wake-up time in the morning with asthma symptoms, while 78.4% did not wake up. In contrast, 42.5% of children who do not play sport have sleep-disrupting asthma symptoms. Reconsidering the options given in the questionnaire, we created 2 groups, children who wake up at night for asthma symptoms and children who do not wake up. Thus, when performing the analysis, we observed a significant difference between the physical activity group and the frequency of asthma symptoms that cause sleep disturbances ($p=0.041$; Fisher's exact test, Figure 8).

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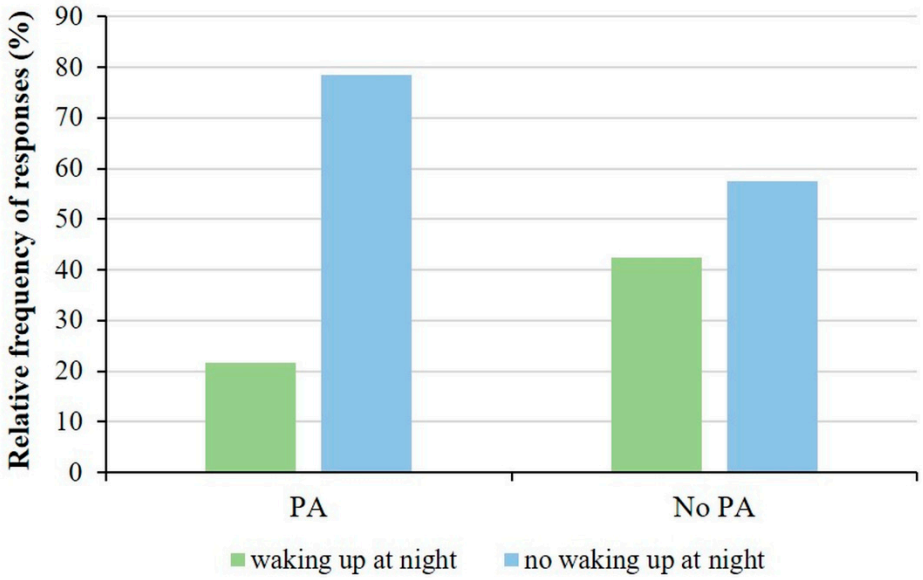

Figure 8. Association with the physical activity and sleep disturbances in children with asthma. Significantly higher number of children doing physical activity who did not experience sleep disturbance due to asthma symptoms (p=0.041; Fisher's exact test).

Analyzing the association between physical activity and asthma attacks, we did not find a significant correlation. 19.2% of children who were physically active used only the asthma medication, while 80.8% had not used it once in the 4 weeks before completing the questionnaire. On the other hand, 40% of children who did not play sport used their medicine and 60% did not use it at all.

3.6. Gender based analysis of physical activity of children with asthma

Separate analysis of the answers from boys and girls showed no significant difference between the rate of their physical exercise (50.0% and 59.4%; girls and boys, respectively), participation in PE classes (96.3% and 92.2%; girls and boys, respectively) and in physiotherapy (14.8% and 10.8%; girls and boys, respectively). However, similarly to healthy children at the same age [37–39], their choice of exercise type differed significantly. Girls mostly preferred dancing (25%) and gym (10.7%), while boys rather chose soccer (26.2%) and cycling (20%). The relative frequency for physical activity type by gender are summarized in Table 2 and significant differences are indicated in bold and italic. Parents of boys and girls agreed that physical activity was important for asthmatic children (4.22 and 4.19, weighted average of points on a 1-5-point-scale; for girls and boys, respectively), and that certain sports were better for them (4.11 and 4.21; for girls and boys, respectively). However, judgement of physical activity was very different among the parents. Parents having boys thought that physical activity could improve their sons' health status (3.8) and they could participate in PE classes just like healthy children (4.17). However, this was not obvious for parents having girls (3.32 and 3.74, respectively). Table 3 shows the summaries of the responses. Parents of girls are significantly less likely to agree (2.33) with the statement that children with asthma can do the same amount of physical activity as their healthy peers (p=0.023). Parents of boys disagree that physical activity is dangerous for children with asthma (2.05), while parents of girls are more neutral (2.68) and the difference is statistically significant (p=0.020). Furthermore, parents having boys believed that the introduction of daily physical education had improved their child's health (3.54 and p=0.042). We analyzed the relationship between the causes of physical inactivity and gender but we did not find a significant association.

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Table 2. Relative frequency for physical activity type by gender.

Type	Girls (%)	Boys (%)	p-value[a]
Dance	25	3.1	***0.001***
Gymnastic	10.7	4.6	0.272
Swimming	10.7	13.8	0.679
Aerobics or similar	7.1	1.5	0.161
Soccer	7.1	26.2	***0.037***
Handball	7.1	0	***0.029***
Volleyball	7.1	1.5	0.161
Running/Athletics	3.6	6.2	0.613
Cycling	3.6	20	***0.042***
Riding	3.6	0	0.126
Skating	3.6	1.5	0.535
Other	3.6	7.7	0.458
Workout in a gym	0	7.7	0.131
Basketball	0	3.1	0.348
Hiking/Nordic walking	0	4.6	0.248
Combat sports	0	9.2	0.096
Extreme sports	0	3.1	0.348
Hockey	0	1.5	0.509
Table tennis	0	3.1	0.348

Significant *p*-values are indicated in bold and italic. [a]Pearson's Chi squared test.

Table 3. Results of parents' opinions* for girls (n=28) and boys (n=65).

Statement	Mean (SD)		p-value[a]
	Girls	Boys	
Physical activity is important for asthmatic children.	4.22 (0.97)	4.18 (0.97)	0.864
The child likes vigorous physical activity.	2.81 (1.33)	3.34 (1.25)	0.091
Certain sports are better for children with asthma.	4.11 (0.89)	4.20 (0.89)	0.592
Children with asthma can do the same amount of physical activity as their non-asthmatic peers.	2.33 (1.39)	2.94 (1.25)	***0.023***
Asthma is improved by physical activity.	3.32 (1.16)	3.80 (1.13)	0.053
Physical activity makes asthma worse.	2.32 (1.09)	2.05 (1.17)	0.250
Physical activity is dangerous for children with asthma.	2.68 (1.25)	2.05 (1.05)	***0.020***
My child feels can cope the requirements of PE lessons.	3.36 (1.55)	3.70 (1.54)	0.225
My child feels that he/she can participate fully in group sports activities in PE lessons.	3.74 (1.46)	4.17 (1.18)	0.177
My child's health has been improved by the introduction of daily physical education.	2.93 (1.30)	3.54 (1.26)	***0.042***
My child's attitude to physical activity has been positively influenced by the introduction of daily PE.	3.29 (1.41)	3.63 (1.33)	0.257

* 1 – Fully disagree, 5 – Fully agree; [a] Mann-Whitney-Wilcoxon test. Significant *p*-values are indicated in bold and italic ($p<0.05$).

3.7. Cross correlations between dependent and independent variables

Overall, the results of our study show that regular physical activity and participation in PE classes are highly dependent on the severity of asthma in children (Section 3.3.). Choice of sport is influenced by gender (Table 2), BMI status (Section 3.2.), and asthma severity (Figure 5). In addition, the reasons for not doing sport are influenced by BMI status (Section 3.2.), asthma severity (Figure 4), and the place of residence (Section 3.1.).

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3.8. Results of follow up examinations

In the case of 16 children, it was possible to compare the values of asthma related parameters measured in 2019 with those identified in 2023. We examined BMI trends and observed significant changes. Comparing the values of vital capacity and FEV1, we observed higher values on average in 2023, but the change was not significant. However, when comparing the FEF25-75 parameters, we observed a reduced average value in 2023, although the difference was not significant. Table 4 reports results for the comparison of the asthma related variables in the study group.

Table 4. Comparison of asthma related parameters.

Variables	Mean (SD)		t-value	p-value[a]
	2019	2023		
BMI (kg/m²)	18.46 (3.95)	21.94 (4.14)	- 3.752	***0.002***
VC (%)	88.66 (16.43)	93.91 (20.29)	- 1.117	0.282
FEV_1 (%)	87.69 (13.20)	88.59 (19.84)	- 0.208	0.838
FEF_{25-75} (%)	76.82 (18.82)	74.56 (22.18)	0.549	0.591

[a] Student's t-test; BMI: body mass index, VC: vital capacity, FEV_1: forced expiratory volume at 1 second, FEF_{25-75}: forced expiratory flow at 25% to 75%. VC, FEV_1, and FEF_{25-75} values are normalized to the expected age-related values. Significant *p*-values are indicated in bold and italic ($p<0.05$).

4. Discussion

In the past 50 years, several studies analyzed the effect of physical activity on childhood asthma [40–47]. Many studies suggested regular physical activity to asthmatic children [48,49], since it could improve both their physical conditions, their social interactions and their development as well [50]. Several studies proved that obesity aggravated the severity of asthma and attenuated the quality of lives [42,51–53] strongly suggesting proper diet and regular physical activity [54]. Different studies examined the treatment of professional athletes' asthma [55], supplemented with the strategies suggested by coaches. Scientists stated that both competitive sport and physical activity were important to carry out proper lifestyle that is indispensable for both asthmatic children, adults and healthy people as well [56]. Although several studies examined the correlation between childhood asthma and physical activity, no research has been conducted on this subject in northeast Hungary yet. In this study, we examined the exercise habits of 93 asthmatic children as well as their parents' relation to sports. Based on our results we concluded that percentage of those who performed regular physical activity was smaller for asthmatic children compared to healthy children. While 90% of teenagers from northeast Hungary exercised regularly [39], it was only 60% for asthmatic children participated in this study. Compared to healthy individuals, rate of physical inactivity due to improper health conditions was much higher among those, who did not exercise regularly. Similarly, international studies [57] did not show any difference between boys and girls when examined the rate of regular physical activity. On the other hand, similar to prior observations on healthy children, the place of living greatly affected the significance of physical activity [38]. While children in small towns and villages (supposedly due to the lack of proper infrastructure [39]) exercised mostly in school or outdoor (38.1 and 19.0%, respectively), children in county centers exercised in sport clubs or sport facilities (33.3 and 22.2%, respectively).

One important aspect of our examination was the parents' attitude toward the physical activity of their asthmatic children. Similarly, to our observations, findings of international studies [58,59] stated that mothers showed more care and worry toward their children. Interestingly, those asthmatic children and their parents who exercised regularly had a more positive attitude toward sports and daily PE classes. It raised the question whether this was the consequence of their positive experiences or the fear of those who did not exercise. Another conclusion was that parents with boys supported exercise rather than parents with girls that can be due to the fact that parents with their daughters had a tendency to take less risk. It is important to emphasize that providing proper infrastructural conditions have significant impact on free time activities. Team sports are one of the easiest ways to

involve asthmatic children into physical activities [57]. Team sports, however, require proper infrastructural conditions.

There are certain limitations of the study. Although we tried to include all patients with asthma at the Pediatric Clinic, only 93 parents agreed to participate in the study. Moreover, only 9 of the children wore the armband continuously long enough for the data to be properly evaluated. As a consequence, it was not possible to include this data in correlation analyses, we thus relayed only on the reporting of the measurement results. Due to the regional nature of the patient care, all children are residents of the Northern Great Plain region of Hungary, the applicability of our results to the Hungarian population as a whole is limited.

5. Conclusions

In our study we conducted surveys, examined respiratory functions and used special bracelets that could measure physical activity in order to assess exercise habits of asthmatic children. We concluded that sport was beneficial to children's physical and mental well-being as well as to their development. Therefore, we have to strive that even asthmatic children could enjoy the benefits of regular physical activity. Besides providing proper infrastructural conditions, choice of appropriate sports and professional support is also necessary. Furthermore, since fear of the consequences of physical activity, and hence the choice of sport, depends largely on education, this should extend beyond the education of children and their parents and include their teachers and coaches as well.

Supplementary Materials: The following supporting information can be downloaded at the website of this paper posted on Preprints.org., Figure S1: Data from the armband to monitor daily activity. Each data point represents the number of steps taken in an hour long time period. Measurement started at 24 am on day 1 and covers 14 days (336 hours).

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