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The international study of movement behaviours in the early years: A pilot study from Bosnia and Herzegovina

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Abstract

The World Health Organization (WHO) released guidelines for physical activity (PA), sedentary behavior, and sleep for children under 5 years of age in 2019, but there are no reports on the adherence to the guidelines in southeastern Europe. This study aimed to: (i) determine the proportion of preschool children (aged 3-5 years) who met the WHO guidelines and examine the feasibility of the proposed protocol for the SUNRISE study in Bosnia and Herzegovina (B&H), and (ii) define sex-, and urban/rural-living-specifics in movement-behaviors, anthropometrics, gross-motor-skills, fine-motor-skills, and cognitive-skills. The sample comprised 115 preschool children (63 girls and 52 boys), residing in urban (n = 66) and rural areas (n = 49) from B&H. Participants were tested on movement behaviors (PA, sleep time, screen time) by accelerometry and comprehensive questionnaires. Body height, weight, body mass index, executive function, fine-, and gross-motor skill, and cognitive function were also measured. The results showed that PA-, sleep duration-, and screen time guidelines were met by 64%, 74% and 53% of children, respectively, while only 23% of the children met all three guidelines on movement behaviors. Boys exhibited higher PA than girls, but no differences in gross- and fine motor skills and cognitive functioning were recorded between the sexes. Children living in urban and rural environments did not differ in any of the studied variables. Results evidenced preschool children from B&H being in line with other samples globally about study variables. Although PA was higher in boys than in girls it was not translated to differences in motor skills. Further studies on larger samples and other environments are warranted.

Keywords: *SUNRISE study; preschool children; screen time; sleep; sedentary behaviour*

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Introduction

The worldwide outbreak of childhood obesity continues to pose a significant challenge to public health. Over the course of four decades, the number of girls and boys affected by obesity has surged from 5 million to 50 million and from 6 million to 74 million, respectively (Abarca-Gómez et al., 2017; Montesano & Mazeo, 2019). In addition to impacting their immediate health and quality of life, children who suffer from obesity are also at an increased risk of developing various non-communicable diseases, including diabetes, cardiovascular diseases, hy-

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pertension, stroke, and cancer (Kim et al., 2022; Park, Falconer, Viner, & Kinra, 2012). Furthermore, obesity during childhood often persists into adolescence and adulthood, leading to chronic illness and premature death (Ward et al., 2017).

Physical inactivity is recognized as a significant contributor to the prevalence of overweight and obesity, and studies have established clear correlations between healthy levels of physical activity, screen time, sleep, and adiposity in middle and late childhood (de Fátima Guimarães, Mathieu, Reid, Henderson, & Barnett, 2021; Martinovic, Jaksic, Spahic, Lukic, and Nedovic-Vukovic, 2021). Since movement behaviors may persist from early- into middle- or later-childhood, researches have focused on the relationship between these factors even in pre-school and early-school-age (Janz, Burns, & Levy, 2005; Malina, 1996; Vukelja, Milanovic, & Salaj, 2022). For example, a study on 15651 children aged 6-9 years reported a negative association between high screen time and lower physical activity levels (Whiting et al., 2021). Also, optimal and high sleep time and high physical activity levels led to better cardiometabolic health and lower adiposity in children aged 5-17 years (Saunders et al., 2016). Also, more sedentary time was associated with higher odds of being classified as metabolically unhealthy individuals, while increased moderate-to-vigorous physical activity was beneficial for weight status and metabolic health in 5-18-year-old children (Kuzik et al., 2017).

Collectively, there is a general consensus that physical activity plays a significant role in attaining the health and well-being of children (Sheldrick, Tyler, Mackintosh, & Stratton, 2018). In their efforts to increase the level of physical activity in children and youth, the World Health Organization (WHO) issued global guidelines in 2019 for children under the age of five concerning movement behaviors. The guidelines were developed based on systematic reviews conducted in this age group, and suggest that children aged three and four should engage in 180 minutes of physical activity daily, out of which 60 minutes should be of moderate to vigorous intensity (Organization, 2019). Additionally, they should limit their sedentary screen time to no more than one hour and strive to get 10 to 13 hours of quality sleep per day. However, the global guidelines for physical activity, sedentary behavior, and sleep have been primarily informed by evidence from studies conducted in high-income countries.

Since their release, several studies have evaluated the prevalence of adherence to WHO guidelines and their correlation with adiposity and other health indicators (Berglind, Ljung, Tynelius, & Brooke, 2018; Chaput et al., 2017; Draper et al., 2020; Tanaka et al., 2020). Briefly, a study on 830 children aged 4-5 years from Sweden reported that 18% of the studied children met the combined recommendations of MVPA, screen time and sleep duration, while those factors were not associated with obesity at this age (Berglind et al., 2018). Similar, results were reported in a study on Canadian children aged 3-4 years (Chaput et al., 2017). However, there is a dearth of research in low- and middle-income countries, which is concerning given that approximately 90% of overweight or obese children worldwide reside in these regions (Kim & von dem Knesebeck, 2018).

The introduction of the global and national 24-hour movement guidelines for children up to 5 years (i.e., early years) emphasized the need for adequate surveillance methods. As a result, the International Study of Movement Behaviors in the Early Years (SUNRISE) was developed (Draper et al., 2020). The primary goal of The SUNRISE study is to assess the proportion of children adhering to the WHO Global guidelines from countries of different socioeconomic statuses. In addition to this, it aims to determine how 24-h movement behaviors are linked with overweight and obesity, gross and fine motor skills and executive function in the early years, and the variations among the countries (Carson et al., 2017). However, prior to conducting the study on a large scale, it was essential to assess the feasibility of the protocol in each participating country, including Bosnia and Herzegovina (B&H). Therefore, this study aimed to determine the proportion of preschoolers from B&H who adhere to the WHO global guidelines on movement behaviors and to explore the differences between genders (boys vs girls), and living environment (children living in urban- vs rural- communities) in guideline adherence, anthropometrics, indices of executive function, fine motor skills, and gross motor skills. Following the results of the previous SUNRISE studies, we hypothesized that: (i) low proportion of children would meet all WHO guidelines, (ii) boys will exhibit better movement behaviors and motor-skill status than girls, and (iii) rural children will exhibit better movement behaviors and motor-skill status than urban children.

Materials and Methods

Participants

Following the recommendations from the SUNRISE project, in this study, we observed preschool children from B&H, residing in urban and rural areas. All children were included in the regular preschool education in Tuzla Canton in B&H. In total, one hundred and fifteen children (boys: n = 52; girls: n = 63 girls) from five schools in the urban area (n = 66;) and three schools in the rural area (n = 49), participated in the study. The sample size was based on a previous study that suggested 50 participants each in urban and rural areas (Draper et al., 2020).

The sampling was done throughout several phases. In the first phase, we randomly selected preschools in both areas, and approval to conduct the study was sought from the principal of each preschool. Then, parents of eligible children were contacted through the preschool class teachers and were recruited for the study. After expression of interest, the researchers presented the idea, aims and protocol of the project, as well as benefits and risks of the participation to parents who expressed the interest for their child to be involved in the project. presentation of the aims of the study and protocol. A written informed consent was collected from the parents, before further participation. Each preschool supported to arrange in case the participating child became unsettled during the study. The protocol of this study was approved by the University of Wollongong Human Ethics Research Committee (ref. no. 2018/044) and by the Ethics Research Committee of the Faculty of Physical Education and Sports, University of Tuzla (ref. no. 03/2022).

Variables, measurement and protocol

Variables included anthropometric indices, physical activity levels, variables of executive function, fine motor skills, and gross motor skills.

Anthropometrics included body height, body mass, and calculated body mass index. Body height was measured using a portable anthropometer (Martin Type Anthropometer) and mass was measured barefoot using a digital scale (EGER www.eger.com). Measurements were taken twice and the average of a measure was used for analysis. Body mass index (BMI) was

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computed using the RedCap software (Vanderbilt University Australia). The BMI classification of the children were done according to the reference standards of the WHO (Di Cesare et al., 2019).

The 24-h movement behavior of the children was assessed using Actigraph GT3X + accelerometers (ActiGraph, LLC, USA) following the evidence-guided recommendation (Cliff, Reilly, & Okely, 2009). The devices were attached to an elastic belt and positioned on the right side of the child's body, just above the iliac crest. The sampling intervals, or epochs, were set at 15 s and the sampling rate at 30 Hz. Children were instructed to keep the accelerometers continuously on their waist for at least 72 h and only remove them for any water-based activities. The children were asked to wear the accelerometers for 5 days, as defined by SUNRISE study protocol. Children who had at least one full day of 'valid' data were included in the later analysis. A valid day (i.e., 24 h) of data was confirmed by visual inspection of the acceleration graph via the ActiLife 6 software, ensuring that acceleration peaks are present during the monitoring days. SUNRISE parental questionnaire, translated into local language, was utilized to gather demographic information (Okely et al., 2021). Also, the questionnaire was used to acquire the subjective screen time, sleep time, and physical activity (TPA and MVPA) duration. Sleep time and non-wear time were excluded from the analysis. Sleep time was predetermined based on the average parent-reported wake-up and bedtime of the children. Non-wear time was defined as > 20 min of consecutive zero counts during waking hours. This included the time when the monitor was taken off for water activities and daytime naps. The final time was used to calculate time spent in total physical activity (TPA), sedentary behavior (SB), light physical activity (LPA), and moderate to vigorous physical activity (MVPA). SB, LPA, MVPA were defined using the cutoffs of 0–199, 200–419, 420–841, and 842 and above counts per 15 s epochs, respectively.

To evaluate the executive function of the children, the visual-spatial working memory and inhibition of the children were assessed using the Go/No-Go and Mr. Ant tablet games (Ipad, Apple, USA) in the Early Years Toolbox (EYT) (Howard & Melhuish, 2017), respectively. In Mr. Ant, an ant character with sticker/s appears on the screen. After, children are asked to point the location of the sticker/s when an ant character with no sticker appears. The game starts with one sticker (Level 1) up to eight stickers (Level 8), and the game stops when 3 unsuccessful attempts are made. In the Go/No-Go the children are requested to tap the screen every time they see a fish and avoid touching the screen when a shark is present. The scoring for this game range from 0 (incorrect performance on all fish, shark) to 1 (perfect performance on both shark and fish trials), with 1 as the highest score (Hossain et al., 2021).

The Nine-hole Pegboard Test (NHPT) was used to assess dexterity and fine motor skills in children. In the NHPT, the children pick up nine pegs from the container one at a time, place them in a pegboard, remove the pegs in the holes, and place the pegs back in container. Only one hand is allowed for NHPT, but the other hand can be used to stabilize the board. The recording time for NHPT starts as soon as the children touch the first peg and ends when the last peg is placed in the container. After the task, NHPT is repeated on the other hand (Aneesha Acharya & Choudhary, 2023).

Gross motor skills were evaluated throughout standing long jump, supine timed up and go, single leg balance, and hand grip test. The standing long jump (ST-LJ) was used for assessment of lower body strength and mobility. In this test, the children jump as far as possible from a starting mark. A practice trial is administered, followed by two trials, and the average of two trials was used for analysis.

Supine-timed up and Go (S-TUG) was utilized to assess posture and mobility. From supine position with feet positioned at the starting line, the children stand up and sprint for 3 m and back. One trial was facilitated for familiarization the two trials were performed for the S-TUG, and the average of two S-TUG trials was included for analysis.

In the Single-Leg Balance test (SLB) the one-leg standing time is recorded, wherein recording starts after one leg leaves the ground. Arms were allowed to move freely. Timing stops when the standing leg is deemed unstable or the free leg is hooked to the standing leg to maintain balance. The test is also concluded if SLB reached 30 seconds. The recorded time in seconds was the result of this test. The test is repeated on the other leg.

Handgrip Test (HGT) with dynamometer (TKK5825, Grip-A, Takei, Tokyo) was utilized for assessment of upper body strength. In the HGT, children were asked to squeeze the dynamometer for 3 seconds as hard as possible without the equipment touching the body. Two practice trials were facilitated prior to recording three trials per limb. The average of the three trials was used for analysis.

All children were tested throughout two sessions, separated by 5 days, between December 2022 and March 2023. Testing was done at a designated area in each school.

Measurement of anthropometric indices, executive function, and fine and gross motor skills of the children were carried out in the first session. Parents/caregivers were also asked to complete a locally-translated questionnaire to obtain demographic information and subjective movement behaviors of their child. Additionally, children were asked to wear accelerometers for five days. After five days, the accelerometers were collected for processing and analysis. The testers in this study underwent extensive training prior to conducting field-level data collection.

Data analysis

TheREDcap application and REDcap web platform were used for data management All statistical analyses were performed using SPSS Statistics for Window version 26.0 (IBM Corp, Armonk, NY). Descriptive statistics (mean and standard deviation) were computed for all variables. T-test for independent samples was conducted to examine differences in anthropometrics, movement behaviors and motor skills between the sexes and residential settings. All hypothesis testing should be treated as preliminary and treated with caution due to the study being underpowered.

Results

Table 1 presents the age and anthropometric characteristics of the children, and no significant differences were observed between boys and girls for age or any anthropometric outcomes ($p>0.05$). Moreover, there were no significant differences in anthropometric characteristics between the urban and rural sub-samples. Using the World Health Organization's cut-offs, 79.1% of the sample were within the normal range for BMI, while 9.6% were identified as overweight, 5.2% as obese, and 4.3% were classified as underweight.

Table 1. Children's age and anthropometric characteristics, by sex and setting (community)

Variable	Total (n = 115)	Boys (n = 52)	Girls (n = 63)	p value ¥	Rural (n = 49)	Urban (n = 66)	p value ≠
Age (y)	4.6 ± .6	4.6 ± .1	4.6 ± .1	.658	4.7 ± .1	4.6 ± .1	.202
Height (cm)	111.2 ± 6.6	111.0 ± .7	111.4 ± .9	.781	111.1 ± .9	111.2 ± .7	.933
Weight (kg)	19.5 ± 3.4	19.4 ± .3	19.4 ± .4	.722	19.4 ± .3	19.7 ± .5	.591
BMI (kg.m-2)	15.7 ± 1.7	15.7 ± .1	15.7 ± .2	.898	15.8 ± .2	15.6 ± .1	.418

Note: Data are presented as mean ± SD for normally distributed data;; ¥p value for comparison by sex; ≠p value for comparison by setting.

The results of the accelerometry are presented in Table 2. According to the findings, boys exhibited a significantly higher level of physical activity than girls, and lower sedentary time (SED, p<0.009; MPA, p<0.007; VPA, p<0.007, and MVPA, p<0.004). However, there was no significant difference in physical activity levels between urban and rural children.

Table 3 displays the gross and fine motor skill scores of boys and girls, which were found to be comparable (both p>0.05), indicating no significant differences between the sexes. Furthermore, no statistically significant differences in motor skill scores were observed between urban and rural children.

Table 2. Acelerometry by sex and seting (community)

Variable	Total (n = 101)	Boys (n = 46)	Girls (n = 55)	p-value ≠	Rural (n = 42)	Urban (n = 59)	p-value ≠
SED (min/d)	622.0 ± 48.3	608.3 ± 48.5	633.4 ± 45.4	.009	623.6 ± 6.0	620.8 ± 7.04	.770
LPA (min/d)	97.4 ± 16.5	98.7 ± 18.1	96.3 ± 15.0	.476	17.3 ± 2.6	15.9 ± 2.0	.510
MPA (min/d)	70.5 ± 18.9	76.0 ± 20.7	65.9 ± 16.0	.007	15.7 ± 2.4	20.8 ± 2.7	.269
VPA (min/d)	24.1 ± 13.3	28.0 ± 15.3	20.8 ± 10.4	.007	10.4 ± 1.6	25.8 ± 1.9	.136
MVPA (min/d)	94.6 ± 30.5	104.0 ± 34.2	86.8 ± 24.7	.004	23.5 ± 3.6	34.4 ± 4.4	.181
TPA (min/d)	192.0 ± 41.2	202.7 ± 45.5	183.1 ± 35.2	.005	35.2 ± 5.4	44.7 ± 5.8	.210

Note: Data are presented as mean ± SD for normally distributed data; ¥p value for comparison by sex; ≠p value for comparison by setting. SED, sedentary behaviour; LPA, light-intensity physical activity; MPA, moderate-intensity physical activity; VPA, vigorous-intensity physical activity; MVPA, moderate - to vigorous-intensity physical activity; TPA, total physical activity

Table 3. Motor skills by sex and setting (community)

Variable	Total (n = 115)	Boys (n = 52)	Girls (n = 63)	p value ¥	Rural (n = 49)	Urban (n = 66)	p value ≠
STUG	5.1 ± 1.3	5.2 ± 1.6	5.1 ± .9	.570	5.0 ± 1.6	5.2 ± 1.03	.521
SLB-R	10.6 ± 9.2	9.1 ± 8.0	11.9 ± 10.0	.113	10.4 ± 9.8	10.9 ± 8.9	.770
SLB-L	10.8 ± 8.6	9.1 ± 7.4	12.1 ± 9.3	.066	11.3 ± 9.7	10.4 ± 7.7	.587
STLJ	72.7 ± 20.5	74.5 ± 22.6	71.2 ± 18.8	.390	71.2 ± 22.8	73.8 ± 18.8	.501
F-R	8.1 ± 3.0	8.5 ± 3.0	7.7 ± 2.9	.175	7.5 ± 3.1	8.5 ± 2.8	.099
F-L	8.2 ± 2.9	8.6 ± 2.7	7.8 ± 3.0	.196	7.9 ± 3.1	8.4 ± 2.7	.420
9H-R	34.6 ± 10.7	35.8 ± 13.2	33.5 ± 8.1	.252	32.9 ± 7.4	35.8 ± 12.5	.159
9H-L	38.2 ± 9.7	38.7 ± 10.2	37.8 ± 9.4	.608	36.3 ± 8.4	39.6 ± 10.4	.081

Note: Data are presented as mean ± SD for normally distributed data; ¥p value for comparison by sex; ≠p value for comparison by setting. STUG, Mobility and posture: Supine-Timed up and go; BA-R, Posture: One-leg standing balance test right leg; BA-L, Posture: One-leg standing balance test left leg;; ST-LJ, Lower body strength and mobility: Standing long jump; F-R, Upper body strength: hand grip dynamometer right hand; F-L, Upper body strength: hand grip dynamometer left hand; 9H-R - Manipulation: 9-hole peg-board test right hand; 9H-L - Manipulation: 9-hole peg-board test left hand.

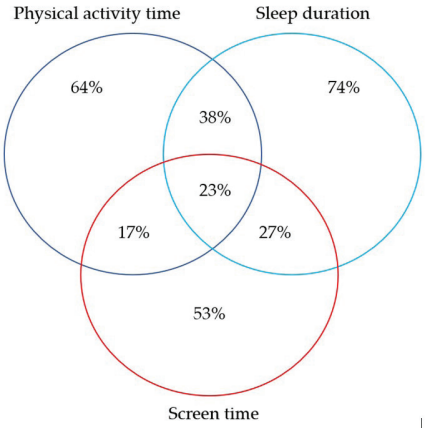

Figure 1. The Venn diagram displaying the proportion of children meeting the 24-hour movement guidelines

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The number of children meeting the different components of the 24-hour movement guidelines is presented in Figure 2. The proportion of children meeting the physical activity (MVPA + TPA) guidelines was 64%, while the screen time and sleep guidelines were met by 53% and 74% of the sample, respectively. When considering all three guidelines together, only 23% of the sample met the integrated guidelines (Figure 1).

Figure 3 displays the time spent in various movement

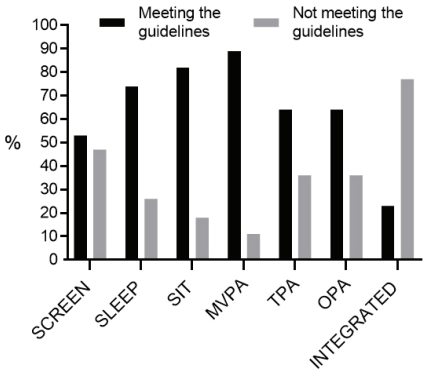

Figure 2. Proportion of children meeting the 24-hour movement guidelines (MVPA - moderate - to vigorous-intensity physical activity; TPA - total physical activity; OPA - overall physical activity; SCREEN – screen time; SLEEP – sleep time; SIT – restrained sitting time; INTEGRATED – integrated guidelines).

behaviors. Total physical activity (TPA) was found to be 3.2 hours per day, which is slightly above the World Health Organization's guidelines. However, sedentary time was much higher than the recommended guidelines, at 10.5 hours per day. It can be assumed that a significant portion of this sedentary time is spent in front of screens.

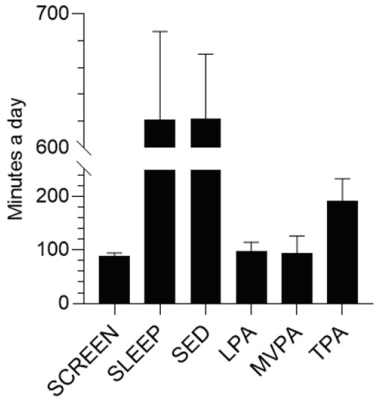

Figure 3. Time spent in different movement behaviors (SCREEN – screen time; SLEEP – sleep time; SED – sedentary behaviour; LPA - light physical activity; MVPA - moderate - to vigorous-intensity physical activity; TPA - total physical activity).

Discussion

This study investigated the compliance of B&H preschoolers with the World Health Organization (WHO) guidelines on movement behaviors. There are several most important findings with regard to study aims. First, results showed that only 23% of the children met all three guidelines (e.g., physical activity time, sleep duration, and screen time), with 64%, 74%, and 53% complying with the guidelines on physical activity time, sleep duration, and screen time, respectively. Second, girls demonstrated greater SED, and lower MPA, MVPA, VPA, and TPA compared to boys, with no significant differences in gross motor skills, fine motor skills, and cognitive skills between sexes. Third, urban and rural children did not differ in movement behaviors, gross- motor, fine-motor and cognitive skills.

Movement behaviors and body-weight status

Our results revealed that 23% of participants met all the three WHO guidelines. Since in this investigation we used standardized measurement protocols and tools, our results are easily comparable to previous SUNRISE reports, which in generally have reported similarly low compliance rates with the WHO guidelines on movement behaviors. In brief, previous reports from SUNRISE consortium reported 4.7% of children in Bangladesh 17.5% of children from Vietnam, 19.4% of children from Sweden and 26% of children from South Africa meeting all components of the WHO movement behavior guidelines (Delisle Nyström et al., 2020; Draper et al., 2020; Hossain et al., 2021; T. V. Kim et al., 2022).

In terms of specific facets of movement behaviors, our results are also in line with previous reports. Specifically, proportion of B&H preschoolers meeting the physical activity time was 64%, while previous reports showed higher prevalence in Sweden (90.3%) Australia (89%), South Africa (84%), Japan (75.4%), and China (64.5%), but lower prevalence in Canada (61.8%), and Vietnam (50.4%) (Delisle Nyström et al., 2020; T. V. Kim et al., 2022). Additionally, B&H preschoolers demon-

strated approximately 1.6 h in LPA, which is lower compared to the reported LPA among Chinese (3.7 h), Canadian (3.5 h), and South African (2.1 h). On the other hand, it is encouraging that 89% of our participants met the recommended 60 minutes of moderate-to-vigorous physical activity (MVPA), which is higher than children from Sweden (71%) and Bangladesh (41%)(Delisle Nyström et al., 2020; Hossain et al., 2021).

Sleep time plays a crucial role for maintaining normal physiological processes for growth and development. Therefore, it is encouraging that 75% of our participants met the WHO sleep guideline of 10-13 h/day. Once again, our results coincide with the findings posted in China (83.9%) and Australia (93%) (Chaput et al., 2017; Matarma et al., 2018). However, screen time of Bosnian children was better compared to other studied countries. While we found that 53% of our participants met the WHO guideline of ≤1 hour/day of screen time, this was considerably higher than the rates observed in Canada (24.4%), Australia (23%), and Japan (15.9%) (Chaput et al., 2017; Hinkley et al., 2020; Tanaka et al., 2020).

In this study, 22.3% of the Bosnian preschool children were classified as overweight/obese. Identical overweight/obesity prevalence was previously evidenced in children from Vietnam (22.3%) while higher prevalence of overweight/obesity was found in Sweden (31%) (Delisle Nyström et al., 2020; T. V. Kim et al., 2022). Meanwhile, with 11.2% overweight/obese children lower rates are evidenced in South Africa (Draper et al., 2020). The relatively low overweight/obesity in B&H preschoolers can be at least partially explained by the fact that nine of ten children achieve appropriate levels of daily MVPA (please see previous discussion for details)

Sex- and living-environment differences

Pre-school boys exhibited better movement behaviors than girls, which is particularly evident in MVPA. Surprisingly, these differences were not translated in motor-skills, where boys and girls achieved similar results in gross- and fine-motor-skills. Although at first glance may seem surprising, the lack of sex-differences in motor skills is in line with previous SUNRISE studies conducted in South Africa and Vietnam (Draper et al., 2020; T. V. Kim et al., 2022). While this can imply relative non-influence of increased physical activity on motor skills within this age, it is important to overview some possible reasons for the lack of sex-differences in motor skills, despite significant differences in movement behaviors between boys and girls.

First, it is possible that the type of PA our children were involved at doesn't have strong influence on tested capacities. Precisely, capacities we have tested here are more under the influence of power- and strength-based activities (i.e., jumping, climbing, throwing heavy objects). Meanwhile, we can witness that MVPA among boys in this age is mostly a consequence of playing some sports (particularly soccer), which directly influence cardiorespiratory fitness, the ability we didn't observe in this project. Second, it is possible that the higher PA among boys, and their PA templates are relatively „recent", and therefore were not yet translated to better motor-skills. Irrespective of the explanation, there is an evident necessity to further explore the connection of movement behaviors and performance variables during early childhood.

The lack of sex-differences in cognitive-skills was not surprising, and previous studies from other world regions consistently reported similar cognitive-function in boys and girls of pre-school age (Draper et al., 2020; Hossain et al., 2021). These results however, at least partially can explain the similar results in fine-motor skills among boys and girls in our study. Specifically, quality of the cognitive functioning in early childhood is known to be the most important determinant and predictor of fine motor control, which directly translates even to execution of precise motor tasks we applied as a way of evaluating fine motor skills (Bala & Katić, 2009).

Living environment (urban vs. rural living environment) didn't differentiate children in studied variables. Previous studies done within SUNRISE protocol reported similar results. Precisely, a SUNRISE study which included data from 19 countries reported no significant differences in movement behaviors between urban and rural residential settings (Kariippanon et al., 2022). The authors of that study explained such findings by a lack of a consistent classification criteria of a rural and urban setting. Similar explanation could be given for our results. Namely, territory where our study was done is densely populated, and there is no clear boundary between urban and rural areas. Therefore, life habits of children living in rural and urban communities are very similar. It is not rare that adults living in rural areas work in urban centers, which additionally contribute to similar way of life in both communities, resulting in similar anthropometrics, movement behaviors, and motor skills of urban and rural children.

Limitations and strengths

The main limitation of this study comes from the fact that we studied a limited number of children, from only one region in B&H. Therefore, results should be observed as preliminary and cannot be generalized for the whole country territory. Second, this is cross-sectional study, and causality cannot be interpreted. Therefore, for a more profound analysis of the relationships between studied variables, intervention studies should be performed.

This is one of the first studies in the region, and probably the first one in B&H which specifically observed movement behaviors in pre-school children. Also, this study is the first to provide a comprehensive overview of the movement behaviors of preschoolers from B&H using an objective assessment of physical activity. Also, we used standardized measurement protocols and standards, which allowed objective comparison with other reports worldwide, allowing relevant analysis of the status in studied variables.

Conclusions

Although we have found that only 23% of the pre-school children from B&H meet WHO guidelines on movement behaviors, it seems that when observed separately for each behavior screen-time deserves particular attention. Namely, 53% of preschoolers meet the WHO recommendation of being less than one-hour in front of the screen, it seems that this issue should be the main focus on future interventions aimed at reaching WHO-defined standards on movement behaviors.

Girls exhibit lower PA than boys, especially in terms of MVPA. While reaching appropriate levels of PA is one of the most important prerequisites of WHO health standards in early childhood, girls should be observed as a targeted population in that manner. Although more extensive investigations with larger samples are needed to confirm our results, we may suggest that interventions aimed at increasing PA should pay special attention on girls, and try to find a way to increase the MVPA among them.

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Based on our results, urban and rural children did not differ in movement behaviors, gross motor skills, fine motor skills, and cognitive skills. While we studied a specific region in the country, where urban and rural living environments are not strictly separated, our findings may be partially a consequence of such a geographical situation. Therefore, future studies in other parts of the country are needed to confirm these findings.

Informed Consent Statement

Written consent was obtained from parents of all subjects involved in the study.

Data Availability Statement

Data are available upon reasonable request.

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