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Self-report Participation of Physical Activity Outside of School on Rate of Motor Skills Development in Elementary Students

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Self-report Participation of Physical Activity Outside of School on Rate of Motor Skills Development in Elementary Students

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By

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Abstract

In this research project, the question of why some younger children appear to have better motor skills than older children is investigated. The hypothesis proposed is that children involved in physical activities after school or in the evenings have better motor skills at younger ages than children who are not involved in physical activities outside of school. Young children have very varied levels of motor skills competency that have developed due to living in different environments and having varied opportunity to be physically active. These differences are a result of factors like socioeconomic status, parental influence, climate, culture, etc.[1] Sports and physical activities are usually executed in team settings, allowing children to develop important social skills like team work, leadership, sportsmanship, and responsibility among other ethical skills.[2] But what if in addition to these numerous benefits, physical activity throughout childhood also offered an improvement in the rate of development of motor skills? One hundred and thirty-five students in grades K-5 participated in a program looking at perception, cognition and motor skills. There were no exclusion criteria for the study and all children were invited to participate. A total of 95% of the kids participated in the study. This study focuses on a portion of a larger study that was completed prior to the start of the program. Children's motor skills were evaluated with a standardized measure Bruininks-Oseretsky Test of Motor Proficiency (BOT-2). Three sections of the (BOT-2) were implemented: running speed and agility, balance, and upper limb coordination. The scores were analyzed along with self-reported surveys on the levels of physical activity of the children. The results showed evidence to support an association between the amount of physical activity outside of school, either after or in the evenings, $r = .621$, $p = .001$. An association was also seen between the amount of time spent in physical activity after school/evenings and running speed and agility scores, $r = 0.295$ and 0.269 $p=.001$. This work will be useful in understanding the relationship between children's participation in physical activity after school and motor skill development rate. The information gathered from this research can be used to promote and support the increase of physical activity time that is available to students during school. Allowing children to have more experiences and opportunities of physical activity at school can help minimize any disadvantage in the rate of motor skills development that children who are not physically active at home may have.

Approval

This was approved by the ETSU IRB.

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Introduction

Motor development is defined as the process through which a child acquires movement patterns and skills.[2] The development of motor skills is an important topic to understand because movement is used for almost every task performed during the day. The process of motor skill development begins at an early age and continues well into adulthood. Newborns are not very mobile, but as they develop physically and intellectually, they start to gain motor skills. These basic skills form a foundation for more complex skills and tasks that can be learned as they keep growing. There are different types of motor skills. The two commonly used categories are gross and fine motor skills. Gross skills develop first, and involve skills that require coordination of the large muscles in the body and the ability to move around the environment.[2] Activities like running, sitting, and jumping are accomplished with gross motor skills. On the other hand, fine motor skills involve smaller muscles and require a lot more precision. A lot of activities requiring hand movements such as tying a shoe, sewing, and throwing a dart are examples of fine motor skills being used. There are varying factors that influence this development.

Motor skills are learned in steps and the acquisition of tasks is affected by physical growth.[3] For example, it takes time for an infant to fully develop and strengthen its' muscular skeletal system, and so the ability to walk must be reached in steps. Walking happens before the advent of sitting as the muscles must be strong enough to sustain the body weight with sufficient postural control to sustain the body in an upright posture.[4] A child starts by pulling to stand at the furniture, then standing up while supported and then once that is mastered, the ability to stand without any support then gets developed. Eventually, the child begins to take a few steps and with practice, walking becomes smooth and effortless. As motor skills are developed and mastered, responses become quicker and more accurate because the ability to control the

movements is developed.[5] With this developed control, movements become more coordinated and seem smooth, effortless, and controlled.

Development and age are related; however, development is not necessarily dependent on age.[6] Children of the same age greatly vary in levels of skills because of the different experiences and opportunities that they are exposed to.[7] There are many factors that can affect the rate of development such as the environment and experiences that someone has access to. The amount of after school physical activity varies from child to child because of the following factors: exposure to structured physical education, socioeconomic status, residence region, parental and sibling influences, genetics, and cultural differences.[1] The goal of this study is to investigate the relationship of after school physical activity to the rate of motor skills acquisition.

Literature Review

Based on CDC data, there has been a gradual decline among youth in the amount of volume and intensity of physical activity over the past 40 years.[8,9] The current recommended amount of physical activity is at least 60 minutes of vigorous to moderate activity every day. Even with awareness of rising obesity levels[10,11] and health benefits that physical activity offers, a study showed that less than half of the children in America obtain this recommended amount.[12] The study found that boys tend to be more active than girls. Previous research found a decline in the amount of physical activity of approximately 37-50 minutes per day for each year after age 9 until age 15.[13]

A possible reason for this decline is the popularity of social media and phone application/game usage in younger children.[14] It is recommended by the American Academy of Pediatrics that children under 2 years of age should not be allowed any screen time, and that all

children older than 2 should have limited screen time of 2 hours at most.[15] At the University of Washington, it was found that 66% of children in a study exceeded this recommendation with an average of over 4 hours of daily screen time.[16] Studies have found a link between screen time and increased obesity[17] and research has also shown a decrease in exercise.[18] Contextual factors in the home or varying childrearing philosophies, can affect the promotion of health recommendations. Examples include increased use of sedentary activities, such as television or video games in the home. Similar tendencies are seen in schools and day care centers where there may be low caregiver to child ratios.[19] School age children spend a large portion of the day sitting in the classroom, with activities that promote and maintain a calm and organized classroom. Therefore, being active after school is important.

In a UK study, the difference between amount of in school and out of school physical activity was investigated.[20] They found that average in-school activity levels were lower than out-of-school activity levels. This was seen in both genders, primary and secondary schools, normal weight, and obese children. This same study reinforced the previous idea that as children age, the amount of physical activity decreases. The secondary school children participated in the least amount of physical activity. The physical activity performed before and after school has a substantial contribution to the overall activity levels, emphasizing the importance of physical activity opportunities, especially in the older children.

In many cases, the time allotted for physical activity during school has decreased due to budget constraints and the priority of other academic areas being prioritized.[21] A study hypothesized that children have a biological drive to be physically active, and higher levels of after school activity would be seen if opportunity for physical activity at school was restricted. [22] It was found that the children did not compensate for the lack of activity opportunity at school. If

children are not given enough opportunities to be physically active throughout the school day, the amount of overall activity involvement throughout the day will be compromised. Lack of physical activity has been shown to affect rate of motor development, and promoting physical activity in early childhood may help develop motor skills. Williams et al. reported significant improvements in motor development after physical activity interventions describing the cause and effect relationship between physical activity levels and rate of motor skills development.[23]

Previous cross-sectional studies have found that there is a positive association between physical activity levels and motor proficiency seen with children and adolescents.[24,25,26] Research on how implementing short, intense after-school programs has shown that motor skills are significantly improved.[27,28] Fitness can variate throughout the different stages of life; however, motor skills training develops permanent skills. Once basic motor skills are acquired, it leads to the continual acquisition and improvement of more complex skills. Therefore, this study focuses on demonstrating what effects the amount of after-school physical activity has on the rates of motor development in elementary children.

Methods

This research was part of a larger study involving various faculty members in Physical Therapy, Psychology, and Exercise Science departments. The main purpose of the overall study was to implement The Run, Jump, and Throw program into the children's school day. The research team was specifically interested in the potential impact that the program would have on the children's attitudes towards physical activity, motor development, self-confidence, and cognitive development. This thesis focuses on a small part of the study involving motor development and after-school activity levels.

Program

The Run Jump Throw program is a commercially available program developed by Hershey and was implemented for 6 weeks. The children participated in the RJT program during school hours once a week. The duration of each session of the program was within 30-45 minutes long. In this time, the children learned a variety of movement skills, such as javelin throwing and other activities to promote gross motor development and overall fitness.

Participants

In this study, 135 students in grades K-5 at the East Tennessee State University School participated in a 6 week Run Jump Throw physical activity program. There were no exclusion criteria for the study and all children were invited to participate. The study had a 95% participation rate and the attrition rate was zero. However, not all children finished the post-testing due to absences.

Test Used

The Bruininks-Oseretsky Test of Motor Proficiency (BOT-2) was used to provide an overview of the fine and gross motor skills in the children.[29] This test measures motor skills of children relating to the coordination, balance, mobility, and strength by having them perform simple and fun activities, throwing a ball at a target, bouncing a ball, standing on a small balance beam, hopping on one foot, and doing jumping jacks. Content validity has been established revealing anticipatory improvements with development of age and sex characteristics and concurrent validity established comparing values to this tool to those of other similar validated tools such as the Peabody. Various evaluations produce inter-rater reliability range from 0.92-0.99 for each subscale.[30]

Survey

A self-report survey on physical activity intensity was used to assess the amount of physical activity the children reported. Two primary questions on this survey described the amount physical activity performed right after school or in the evenings over the last seven days. Physical activities were described with sports, dance, and play games. The amounts of physical activity reported were compared to the pre-BOT score to determine if there was a relationship between the two.

Procedure

The BOT-2 was administered before beginning the RJT program and after completion of the program. Pre-testing served as a control giving a baseline measurement of gross motor skills. There are 3 subsections of the BOT-2 that were chosen for the purposes of the study: balance, running speed and agility, and a portion of upper limb coordination. All the sub-tests were administered to the children after completion of the Run Jump Throw program and were scored based on the BOT-2 guidelines.

Administration and Reliability of Scorers

For this study, several research staff served as scorers and administrators of the BOT test, including faculty, graduate students, and undergraduate students in the psychology, exercise science, and physical therapy departments. The administrators oversaw the children through the different exercises as they gave and demonstrated instructions. The scorers had to assign scores for each exercise that the children completed based on the BOT-2 guidelines for scoring. Before any of the testing began, the scorers completed a trial run scoring videos of children performing the different tests. This helped identify how reliable the scoring of the volunteers were with the

different subsets. The individuals were assigned to score the different subsets based on the determined reliability in them. Reliability between testers of the overall study was established prior to the start of the program and reliability of .92 was the cut-off score for each tester to be reliable in each subtest.

Study

To fulfill the objective of this study, which was to investigate the significance that physical activity engagement had on younger children having higher rates of motor development skills than older children, the results from the pre-program BOT testing were used and compared to the survey answers on physical activity participation. It was predicted that children of all ages involved in sports and a lot of physical activity would have greater motor skills than those that were not as involved or active.

Statistics

Grade	Frequency	Percent
Kindergarten	18	13.3%
1st Grade	22	16.3%
2nd Grade	22	16.3%
3rd Grade	23	17.0%
4th Grade	25	18.5%
5th Grade	25	18.5%
Total	135	100%

Table 1 shows the distribution of the number of participants in each grade.

Gender	Frequency	Percent
Female	63	46.7%
Male	72	53.3%
Total	135	100%

Table 2 includes the gender distribution of participants.

Age	Frequency	Percent
5	12	9.2%
6	18	13.7%
7	24	18.3%
8	23	17.6%
9	24	18.3%
10	26	19.8%
11	4	3.1%

Table 3 categorizes the participants into the varying age groups.

Above are the descriptive statistics for the participants in the study.

Results

The descriptive statistics of the questions describing the children's physical activity in the evening is listed in table 3. This table demonstrates that out of the 123 children in grades K through 5th, who completed the survey, 23% of them reported they did not participate in any physical activity in the evening, 17% reported 1 time participation, 29% of the students reported 2-3 times, 13% reported 4 times, and 15% of students reported 5 times. The descriptive statistics of the questions describing the children physical activity right after school is listed in table 4. This table demonstrates that out of 125 children that completed the survey 24% reported no participation in physical activity after school, 16% reported participation 1 time, 32% reported 2 or 3 times, 8% reported 4 times, and 18% reported 5 times. One interesting finding is that the percentage of children who stated they participate 5 times in physical activity appear much higher right after school than later in the evening.

Response	Frequency	Percent
None	29	23.6
1 time	22	17.9
2 or 3 times	36	29.3
4 times	17	13.8
5 times	19	15.4
Total	123	100

Table 4 shows the responses to 1st survey question. Physical Activity amount and intensity: *In the last 7 days, how many days **in the evenings** did you do sports, dance or play games in which you were very active?*

Response	Frequency	Percent
None	31	24.8
1 time	20	16
2 or 3 times	40	32
4 times	11	8.8
5 times	23	18.4
Total	125	100

Table 5 has the responses for survey question: *Physical Activity amount and intensity: In the last 7 days, how many days right after school did you do sports, dance or play games in which you were very active?*

Correlations were run through SPSS to test the hypothesis that increased participation in physical activity outside of school was related to gross motor skills of school aged children. These correlations are seen in table 5. The data collected for physical activity in the evenings and right after school were analyzed to establish a relationship with the reported survey answers. There was a strong, significant correlation between the two categories with a $r= 0.621$, $p<0.01$. The next step was to compare the survey data to the scores collected during the pre-BOT testing. The three subsections used were balance, running speed and agility, and upper-limb coordination. The results showed that the amount of physical activity that the children are involved in after school and in the evening are positively correlated to running speed and agility with $r=.295$, $p<0.01$. Physical activity right-after school and running speed and agility had a $r=.269$, $p<0.01$. This shows a relationship between after school activities and that specific motor skill. It was also seen that upper limb coordination had a weaker significant correlation with physical activity right after school with a $r=.253$, $p<0.05$

When looking at correlation between categories of motor skills, it was found that all three were positivity correlated with each other running speed and agility was significantly correlated to balance with r=.516 and to upper limb coordination with a r=.568, p<0.01. Balance and upper-limb coordination were also correlated with a r=.255, p<0.05. A significant correlation was seen between running speed and agility with balance r=.516 and p<0.01, however balance on its own did not have a correlation with physical activity after school or in the evenings.

Table 6 has the cumulative correlation data between the survey questions and BOT subsection scores.

Correlations						
		Physical activity in the ***evenings***	Physical activity ***right after school***	Balance	Running Speed / Agility	Upper Limb Coordination
Physical activity in the ***evenings***	Correlation Coefficient	1.000	**.621****	0.045	**.295****	0.025
	Sig. (2-tailed)	.	0.000	0.677	0.002	0.823
	N	123	122	88	108	83
Physical activity ***right after school***	Correlation Coefficient	**.621****	1.000	0.059	**.269****	**.253***
	Sig. (2-tailed)	0.000	.	0.584	0.004	0.02
	N	122	125.000	89	111	84
Balance	Correlation Coefficient	0.045	0.059	1.000	**.516****	**.255***
	Sig. (2-tailed)	0.677	0.584	.	0.000	0.037
	N	88	89	95	92	67
Running Speed / Agility	Correlation Coefficient	**.295****	**.296****	**.516****	1.000	**.568****
	Sig. (2-tailed)	0.002	0.004	0	.	0.000
	N	108	111	92	120	76
Upper Limb Coordination	Correlation Coefficient	0.025	**.253***	**.255***	**.568****	1.000
	Sig. (2-tailed)	0.923	0.02	0.037	0.000	.
	N	83	84	67	76	87.000

** Correlation is significant at the 0.01 level (2-tailed). It indicates a **stronger** correlation.

* Correlation is significant at the 0.05 level (2-tailed). It indicates a **weaker** correlation.

Conclusion/Discussion

A possible reason for the amounts of physical activity after school or in the evenings not being directly correlating with all subsections could be the activities being performed. The activities that the children are involved in could include mainly movements associated with running speed and agility. However, the results did show that the three subsections affect each other. Exercises performed with running speed and agility allow certain muscles and movements to be practiced and controlled more efficiently. These movements are also used when performing balance and upper limb coordination exercises which improves them. A lot of the same muscle groups can be used in the different subsections, so it is understandable that getting more practice and improvement of skills on one subsection would also improve the others. Especially since motor skills development is cumulative. The learned skills and movements are used as a foundation to master more complex ones.

The study had a few limitations with the methods and data collection. The first limitation was that amounts of physical activity were self-reported by the children. This is not the most reliable method because it included children in K-5, and the younger grades may not have been as accurate. In future studies, self-report surveys can be accompanied by surveys reported by the parents to try to obtain more accurate data. Another limitation present was with the BOT testing. There were different scorers for the same activities which could have led to variations in interpretation. The scorers had different levels of strictness on the scoring of activities. In addition, stopwatches were used as the measure for most activities. Stopwatches are not the most accurate because there is variability with the users. To reduce these different limitations in future studies, it is suggested that multiple individuals score each of the children to get an average of all the interpretations of the activity performed.

This study was very broad with the topic. Physical activity in this study referred to any sports, dance, or play games in which the children were involved in, and only the amount of overall involvement was recorded and used. It would be interesting to be more exact with the types of physical activities, intensities, and times spent in each to be investigated. Knowing the types of movements and activities that the children are performing could help find relationships between the different activities and the different BOT subsections. It would also be interesting to investigate how much of a difference there is in importance when it comes to the previously mentioned home environmental conditions. Socioeconomic status, culture, family size, and residence region could all investigated and compared to BOT scores to determine which has the most influence on rate of motor development based on correlations.

Appendix

5. In the last 7 days, on how many days *right after school*, did you do sports, dance, or play games in which you were very active? (Check one only.)

None ..... ❍
1 time last week ..... ❍
2 or 3 times last week ..... ❍
4 times last week ..... ❍
5 times last week ..... ❍

6. In the last 7 days, on how many *evenings* did you do sports, dance, or play games in which you were very active? (Check one only.)

None ..... ❍
1 time last week ..... ❍
2 or 3 times last week ..... ❍
4 or 5 last week ..... ❍
6 or 7 times last week ..... ❍

These were the survey questions used and analyzed to determine an estimate of the amount of physical activity that the children are involved in after school and in the evenings.

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