

TOPICS IN EXERCISE SCIENCE AND KINESIOLOGY

Comparison of Physical Fitness between Sport and Non-Sport Groups among Elementary School Children

Implementation Strategies

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Abstract

- We compared physical fitness factors between sport and non-sport groups of elementary school children in all grades. The subjects of this study were 1,079 1st- to 6th-grade male elementary school children. Their parents completed a questionnaire examining whether the child attended sports lessons as a regular after-school activity. Physical fitness was evaluated by a new physical fitness test recommended by the Japanese Ministry of Education, Culture, Sports, Science, and Technology (4). The test consists of the following items: 1) Grip strength (kg); 2) Sit-ups (number completed in 30 sec); 4) Sitting front stretches (cm); 5) Side steps (number completed in 20 sec); 6) 20-m shuttle run (number of repetitions); 7) 50-m run (sec); 8) Standing long jump (m); 9) Softball throw (m); 10) Height (m); and 11) weight (kg).
- **Point of application # 1:** In regards to the sit-ups, 20-m shuttle run, and softball throw, children who attend sports lessons after school showed a better performance compared to children who do not attend sport lessons, especially after the 3rd grade.
- **Point of application # 2:** Performance in physical fitness that requires complex movements, such as the side steps and 50-m run, were susceptible to sports lessons.
- **Point of application # 3:** Flexibility and performance in physical fitness that require simple movement, such as the grip strength and standing long jump, were not affected significantly by sport lessons during elementary school ages.
- Key Words: 20-m shuttle run, sit-ups, softball throw

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Introduction

Sports are very popular after-school activities for children, and it is likely that sports have a positive effect on child growth in many ways (1,2). The Ministry of Education, Culture, Sports, Science, and Technology (MEXT) has reported a polarizing trend in physical activity (3). In addition, they reported that indicators of physical fitness also tend to be polarized (3). One way to increase children's exercise time is to attend after-school sports lessons. Sports have a positive effect on physical fitness, however, it is not clear which grade of elementary school children show an effect of sports on physical fitness and physical fitness factors. Therefore, the purpose of this study was to investigate the influence of sports lessons on physical fitness factors in all grades of elementary school children.

Methods and Results

The subjects of this study were 1,079 1st- to 6th-grade male elementary school students. Their parents were asked to complete a questionnaire investigating whether their child attends sports lessons regularly as an after-school activity. We placed children who participated in sports lessons in the sport group and children that did not participate in sports lessons in the non-sport group. Physical fitness was evaluated by a new physical fitness test recommended by the Japanese Ministry of Education, Culture, Sports, Science, and Technology (4). The test consists of the following items: 1) Grip strength (kg); 2) Sit-ups (number completed in 30 sec); 4) Sitting front stretches (cm); 5) Side steps (child stands on the center line of three lines drawn at 1 m intervals, and crosses or steps on the line as quickly as possible, number completed in 20 sec); 6) 20-m shuttle run (number of repetitions); 7) 50-m run (sec); 8) Standing long jump (m); 9) Softball throw (m); 10) Height (m); and 11) weight (kg). A general linear model analysis was used to analyze the effects of sports lessons on physical fitness factors depending on the grade of elementary school children. The general linear model was constructed with the physical fitness factors as dependent variables and the sports lesson, grade, and interaction term (sports lesson* grade) as the independent variable. A P-value of <0.05 was considered statistically significant, and all P-values were two-sided. In regards to the sit-ups, the 20-m shuttle run, and the softball throw, there were significant differences at the 3rd grade and older between the sport and non-sports groups. In regards to the 50-m run, there were significant differences between the sport and non-sport groups for many grades. In regards to the side steps, there were significant differences between the groups in half of the grades. In regards to sitting front stretches, grip strength, and long jump, few grades showed a significant difference between the sport and non-sport groups.

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1. Regular sports lessons improve endurance and throwing ability after the 3rd grade

Regarding the sit-ups and the 20-m shuttle run, the difference between the sport and non-sport groups increased after the 3rd grade. The sit-ups and the 20-m shuttle run are measured as indicators of endurance ability. According to previous studies, endurance ability develops markedly near the PHV* (5,6). Third graders (pre-PHV) were ~8 years old. The results of this study showed that these abilities were improved by sport lessons at a younger age prior to PHV. According to a previous study, the development of throwing ability of boys, which requires complex movements, was reported to be significant at 7 to 8 years old (7). The results of our study are similar to those of previous studies.

*PHV (Peak Height Velocity) is the period of height growth per year during the secondary sex characteristics stage.

Table 1. Comparison of physical fitness between Sport and Non-sport groups (effect of interaction)

	grade	Sports lessons				Between-group difference (sport vs non-sport)		P-value	
		n	sport	n	non-sport	mean	95%CI	interaction	pair comparison
Sit-ups								0.033	
(number)	1st	93	15.2 ± 4.9	65	14.1 ± 5.0	1.04	-0.54 , 2.63		0.194
	2nd	103	17.2 ± 5.9	53	15.4 ± 6.8	1.78	-0.29 , 3.85		0.092
	3rd	114	20.3 ± 6.3	45	17.2 ± 6.7	3.07	0.83 , 5.32		0.008
	4th	121	21.9 ± 6.2	38	17.9 ± 6.5	4.02	1.71 , 6.33		0.001
	5th	139	24.2 ± 5.7	62	21.4 ± 6.1	2.82	1.06 , 4.57		0.002
	6th	130	25.7 ± 5.5	57	21.9 ± 6.0	3.78	2.00 , 5.56		0.000
20 m shuttle run								0.002	
(number)	1st	95	29.9 ± 13.3	63	25.6 ± 10.6	4.33	0.38 , 8.28		0.032
	2nd	105	36.5 ± 14.8	53	32.7 ± 13.7	3.83	-0.99 , 8.64		0.119
	3rd	116	47.6 ± 17.8	45	36.3 ± 15.7	11.35	5.37 , 17.32		0.000
	4th	126	56.8 ± 20.2	37	44.6 ± 15.1	12.23	5.13 , 19.32		0.001
	5th	140	65.2 ± 18.7	61	52.7 ± 21.3	12.46	6.55 , 18.37		0.000
	6th	132	74.9 ± 19.9	58	61.4 ± 22.6	13.47	7.03 , 19.92		0.000
Softball throw								0.003	
(m)	1st	93	10.3 ± 4.6	64	8.5 ± 2.5	1.83	0.58 , 3.08		0.004
	2nd	104	11.2 ± 4.1	53	10.3 ± 3.5	0.87	-0.43 , 2.17		0.187
	3rd	117	14.8 ± 6.2	46	11.6 ± 4.6	3.21	1.23 , 5.19		0.002
	4th	127	18.8 ± 7.1	36	14.3 ± 5.1	4.55	2.04 , 7.06		0.000
	5th	140	22.0 ± 8.3	60	17.6 ± 5.4	4.38	2.10 , 6.67		0.000
	6th	129	26.3 ± 8.9	57	21.9 ± 8.6	4.32	1.55 , 7.10		0.002

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2. Regular sports lessons improved agility and speed in many grades during elementary school grades

Regarding side steps and the 50-m run, no interaction was observed with the progress of grade. In regards to the 50-m run, there were significant differences between the sport and non-sport groups for many grades. In regards to the side steps, there were significant differences between the sport and non-sport groups in half of the grades. Although, the side steps and 50-m run were measured as indicators of agility and speed, physical fitness in complex movements were susceptible to sports lessons.

Table 2. Comparison of physical fitness between Sport and Non-sport groups (no effect of interaction)

grade	Sports lessons				Between-group difference (sport vs non-sport)		P-value		
	n	sport	n	non-sport	mean	95%CI	interaction	pair comparison	
Side steps								0.142	
(number)	1st	92	30.9 ± 6.5	64	29.6 ± 5.9	1.30	-0.72 , 3.31		0.206
	2nd	102	35.7 ± 7.5	52	34.5 ± 7.0	1.22	-1.26 , 3.69		0.333
	3rd	114	40.3 ± 7.4	45	37.5 ± 7.0	2.87	0.34 , 5.39		0.026
	4th	120	43.7 ± 7.6	38	38.4 ± 7.7	5.31	2.49 , 8.12		0.000
	5th	138	47.0 ± 7.3	61	45.2 ± 7.5	1.77	-0.46 , 3.99		0.119
	6th	129	50.0 ± 6.1	56	46.1 ± 7.3	3.93	1.88 , 5.97		0.000
50 m run								0.795	
(sec)	1st	95	11.0 ± 0.9	65	11.4 ± 1.2	-0.37	-0.71 , -0.04		0.028
	2nd	103	10.4 ± 1.0	53	10.6 ± 1.4	-0.13	-0.52 , 0.26		0.524
	3rd	116	9.8 ± 0.9	45	10.3 ± 1.0	-0.49	-0.82 , -0.16		0.004
	4th	127	9.4 ± 0.8	38	10.0 ± 1.1	-0.61	-0.94 , -0.28		0.000
	5th	139	9.0 ± 0.8	62	9.4 ± 0.9	-0.37	-0.63 , -0.10		0.007
	6th	129	8.7 ± 0.7	58	9.0 ± 1.1	-0.34	-0.61 , -0.08		0.010

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3. Regular sports lessons have little effect on flexibility, strength, and power during elementary school grades

Regarding sitting front stretches, grip strength, and long jump, no interaction was observed with the progress of grade. The sitting front stretches, grip strength, and long jump were measured as indicators of flexibility, strength, and power, respectively. Regarding these physical fitness factors, there were few grades in which there was significant difference due to implementation of sports lessons. There have been many reports that muscle strength and power develop after PHV (8,9). In the elementary school age (boys), PHV ages have not been reached, therefore, the training effect on strength and power may be low. In any case, flexibility and physical fitness that requires simple movements were not significantly affected by sport lessons during elementary school grades. These results suggest that training for endurance and ability to acquire complex movements is effective if the child was trained until the 3rd grade. However, it is unclear how the endurance acquired during this period develops thereafter. This study did not analyze each sports category, and this is necessary to investigate the influence on physical fitness factors for each sports category in the future.

Table 3. Comparison of physical fitness between Sport and Non-sport groups (no effect of interaction)

grade	Sports lessons				Between-group difference (sport vs non-sport)		P-value	
	n	sport	n	non-sport	mean	95%CI	interaction	pair comparison
Sitting front stretches (cm)								0.481
1st	92	28.6 ± 6.3	65	27.9 ± 6.0	0.69	-1.29 , 2.68		0.492
2nd	100	28.9 ± 6.0	51	28.4 ± 5.7	0.55	-1.45 , 2.55		0.589
3rd	111	32.1 ± 6.8	45	29.0 ± 7.1	3.14	0.73 , 5.55		0.011
4th	114	32.5 ± 7.9	38	31.0 ± 6.9	1.45	-1.38 , 4.27		0.314
5th	142	35.8 ± 6.7	62	34.5 ± 8.0	1.39	-0.76 , 3.53		0.204
6th	127	36.8 ± 8.0	57	38.0 ± 9.9	-1.14	-3.85 , 1.58		0.410
Grip strength (kg)								0.552
1st	94	10.1 ± 2.4	65	9.2 ± 2.1	0.96	0.23 , 1.69		0.010
2nd	105	11.2 ± 2.5	53	11.1 ± 2.9	0.06	-0.83 , 0.96		0.890
3rd	115	13.2 ± 2.8	45	11.8 ± 2.7	1.33	0.37 , 2.29		0.007
4th	128	14.8 ± 3.5	39	13.7 ± 2.5	1.14	-0.05 , 2.32		0.060
5th	143	16.9 ± 3.5	60	17.4 ± 3.9	-0.50	-1.60 , 0.60		0.374
6th	130	20.5 ± 4.9	58	19.9 ± 5.2	0.61	-0.95 , 2.17		0.440
Long jump (cm)								0.444
1st	93	123.3 ± 15.9	65	118.7 ± 20.8	4.66	-1.12 , 10.43		0.113
2nd	101	128.6 ± 19.1	50	125.3 ± 28.0	3.38	-4.28 , 11.05		0.385
3rd	113	137.7 ± 25.6	45	131.8 ± 24.0	5.89	-2.88 , 14.66		0.187
4th	118	151.6 ± 28.1	37	139.0 ± 19.4	12.60	2.80 , 22.41		0.012
5th	138	161.3 ± 18.7	60	154.5 ± 21.4	6.79	0.83 , 12.75		0.026
6th	126	169.6 ± 20.9	57	164.2 ± 31.5	5.45	-2.32 , 13.21		0.168

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