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Research Article

The Relationship between Athletic Ability and Frequency of Practice among Talented Children with Advanced Athletic Ability: A Study of a Talent Identification and Development Program for Fourth Graders

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Abstract

This study explored the relationship between the weekly frequency of sports practice and athletic ability among children in the fourth grade of elementary school with advanced athletic ability selected through a Talent Identification and Development (TID) program. The participants were 104 boys and 115 girls selected through a TID program over the past 7 years. The participants' parents were administered questionnaires to ascertain whether their children train in sports and how frequently they train each week. In addition to height and weight, athletic ability measures included a standing long jump, medicine ball throw, side step test, and 20 m shuttle run. No significant differences were observed in the height, weight, or Body Mass Index (BMI), nor in the standing long jump, medicine ball throw, or side step test results, with regard to frequency of practice per week by boys or girls. While no significant difference was observed in the frequency of practice in 20 m shuttle run per week among the boys, a significant difference was observed among the girls ($p<0.05$). This study revealed that among fourth graders with talented athletic ability, girls who train more frequently each week had higher endurance. This suggests that endurance in girls of this age is acquired, a point that must be considered when selecting children for athletic ability in a TID program, or achievement or performance in competitive sports.

Keywords: Endurance; Girls; Strength; Power; Agility

Introduction

Efforts to identify and train children into sporting stars of the future (Talent Identification and Development: TID) are a long-standing practice in major countries involved in international sports [1,2]. In the past years, such TID initiatives have become common across the globe. Japan, a country bestowed the honor of hosting the Olympics, is no exception, and many prefectures and sports organizations have been working actively on TID programs [3].

While TID includes diverse techniques, one method is to measure the athletic ability and evaluate the physical fitness profiles of young athletes [4,5]. However, the growth and developmental stages of children are not the same, and their maturity levels vary [6]. In fact, it is even unclear whether physiological property in a person is the same during childhood and adulthood.

Children's athletic ability is impacted not only by genetic factors but also through habitual exercise and lifestyle. Therefore, individual aspects of physical fitness such as power and endurance are also influenced by the type, intensity, and frequency of habitual exercise [6]. Yet, it is not fully understood how these factors influence athletic ability in children. There are very few studies on athletic ability in children that focus on superior physical skills and its influencing factors.

There are several potential methods for measuring the duration and intensity of exercise, including heart rate monitors, accelerometers, and activity trackers [7-9]; however, utilizing these tools with children comes with different challenges, hence making it difficult to use a large sample size. Among the primary factors influencing athletic performance (intensity, time, frequency), the weekly frequency of sports practice can be measured with relative ease.

Therefore, this study explored the relationship between the weekly frequency of sports practice and athletic ability in children with advanced athletic ability who were selected through a TID program.

Methods

Participants

Participants were 104 boys and 115 girls in the fourth grade of elementary school selected by the Saitama Prefecture Junior Athlete Identification and Development Program (Platinum Kids Program) between 2011 and 2017. The Platinum Kids Program selects 15 boys and 15 girls in the fourth grade based on different athletic ability tests and determines their aptitude through a training program. The study survey of the present study was administered after the research was approved by the ethics committee of the Saitama Sports Association Sports Science Commission. Parents and children consented to

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participate in the study after receiving a thorough written explanation of the purpose of the research and risks associated with the tests.

As the Platinum Kids Program revise their method for measuring athletic ability each year, the present study utilized only the items that were not revised (standing long jump, medicine ball throw, side step test, and 20 m shuttle run). Athletic ability tests were carried out by an experienced member of the Saitama Sports Association Sports Science Commission.

Survey items

Survey of exercise habits: When the participants were finally selected through the talent identification program, they were asked *via* questionnaire whether they practice sports-related activities and if yes, how frequent do they practice each week.

Tests of athletic ability

Standing long jump: Participants were positioned to stand with both feet on a thin mat and jumped forward using the momentum of their whole body. The distance was measured in a straight line from the tips of the toes before they jumped to the heel after landing. After sufficient practice, two trials were completed and the best distance was used for the analysis.

Medicine ball throw

Standing on both feet, the participants held a 1kg medicine ball with both hands and threw it forward from between the thighs using momentum. The landing site of the ball was visually confirmed and the distance from the tips of the toes in the original standing position to that point was measured. After sufficient practice, two trials were completed and the best distance was used for the analysis.

Side step test

Three lines were drawn on the ground at 1 m intervals. Participants were positioned standing over the central line and were instructed to step on or over the right line, central line, and left line, in that order, as quickly as possible. The number of times a line was crossed was counted over a 20 second period. After sufficient practice, two trials were completed and the best score was used for the analysis.

20 m shuttle run

Participants ran a 20 m distance back and forth at the sound of a beep that increased in tempo each minute. Participants were disqualified when they were unable to return to the 20 m line before the next beep two times in a row. Whether a participant made it to the line before the beep was determined by two experienced judges standing on either side of the 20 m line. The number of times the participants were able to make it to the 20 m line was counted. This test was completed only once.

Statistical analysis

The general linear model was used to analyze the impact of sports practice frequency on indicators of physical fitness. All tests of athletic ability were used as dependent variables while practice frequency was used as the independent variable. Practice frequency was treated as an ordinal/nominal variable with four levels (0 times, 1-2 times, 3-4 times, or 5+ times per week). A two-tailed P value of <0.05 was considered statistically significant. All statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS), version 23.0 (IBM Japan, Ltd., Tokyo, Japan).

Table 1-a: Physical fitness profile and weekly practice frequency in talented children (boys).

Practice	Number	Height	Body Mass	BMI
Frequency	n	m	kg	Index
0 times	13	1.36	31.4	16.9
		0.03	3.6	1.5
1-2 times	25	1.4	32.7	16.7
		0.05	4.1	1.4
3-4 times	35	1.4	31.5	16.2
		0.05	2.9	1
5+ times	31	1.38	31.6	16.5
		0.04	3.6	1.5

Table 1-b: Physical fitness profile and weekly practice frequency in talented children (girls).

Practice	Number	Height	Body Mass	BMI
Frequency	n	m	kg	Index
0 times	16	1.4	32.7	16.6
		0.06	5.1	1.4
1-2 times	43	1.42	33.8	16.7
		0.06	4.5	1.3
3-4 times	40	1.4	32.4	16.4
		0.07	4.8	1
5+ times	17	1.4	32.2	16.3
		0.06	5.1	1.6

BMI: Body Mass Index (Body mass / Height^2).
Standard deviation (SD).

Results

Boys most commonly had sports practice 3 to 4 times per week (n=35, 33.7%; Table 1-a), while 1 to 2 times per week was most common in girls (n=43, 37.4%; Table 1-b). There were 13 boys and 16 girls who did not attend any sports lessons (Table 1-a, -b), while 31 boys and 17 girls had sports lessons 5 or more times per week (Table 1-a, -b).

Significant differences were not observed in height, weight, or BMI for boys or girls based on their frequency of practice per week (Table 1-a, -b). The frequency of practice per week also did not result in a significant difference in results for the standing long jump, medicine ball throw, or side step test in boys or girls (Table 2-a, -b). A significant difference in 20 m shuttle run results was not observed in practice frequency for boys (Figure 1-a). However, there were significant differences in the 20 m shuttle run results between girls who trained 0 times and 5+ times per week, 1-2 times and 3-4 times per week, and 1-2 times and 5+ times per week (Figure 1-b).

Discussion

This study explored the relationship between the weekly frequency of sports practice and various athletic abilities in fourth-grade children with advanced athletic ability who had been identified as talented. Exploring factors involved in the acquisition of advanced athletic ability in the fourth-grade children of elementary school is

Table 2-a: Athletic ability and weekly practice frequency in talented children (boys).

Practice	Standing long jump	Medicine ball throw(1 kg)	Side step test
Frequency	m	m	kg
0 times	1.84	7.35	50.7
	0.10	0.68	5.7
1-2 times	1.84	7.44	49.1
	0.10	0.75	4.0
3-4 times	1.84	7.56	50.7
	0.10	0.86	3.9
5+ times	1.82	7.18	50.8
	0.10	0.90	3.5

Table 2-b: Athletic ability and weekly practice frequency in talented children (girls).

Practice	Standing long jump	Medicine ball throw(1 kg)	Side step test
Frequency	m	m	kg
0 times	1.78	6.6	48.4
	0.09	0.68	7.1
1-2 times	1.83	6.78	48.7
	0.08	0.99	3.6
3-4 times	1.84	7.19	50.8
	0.11	0.83	3.5
5+ times	1.80	6.91	47.6
	0.13	0.76	4.7

Standard deviation (SD).

considered extremely important for both the study of growth and development and TID.

Participants of this study were children selected each year based on their advanced athletic ability. Specifically, several athletic abilities were tested with slight modifications each year to select 15 boys and 15 girls with high athletic ability. Although children with high athletic ability are selected in this way each year, their frequency of practice in sports each week ranges from 0 (not practicing sports) to 5 or more times per week for both boys and girls (Table 1). Although the participants had relatively the same athletic ability, having been chosen by relative estimate, their practice frequency each week differed and this could be why few relationships between practice frequency and athletic ability were found. Exercise intensity, time, and frequency are primary factors impacting athletic performance. As elementary school children are unlikely to be assigned high intensity or long hours of practice, frequent weekly practice was considered most likely to influence their athletic ability; however, this was not the case among children with advanced athletic ability in this study.

However, a significant relationship with practice frequency was observed for endurance in girls (Figure 1-b). The 20 m shuttle run, used as an indicator of endurance, was developed as a method of estimating maximal oxygen uptake [10]. A few longitudinal studies reported that maximum oxygen uptake, a physiological index of endurance ability, improves markedly during a child' Peak Height Velocity (PHV) period [11,12]. Furthermore, studies in which participants underwent endurance training before, during, and after

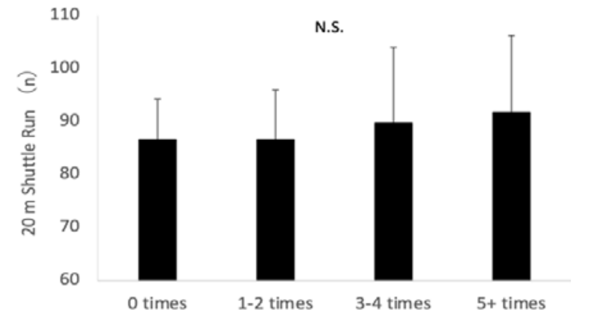

Figure 1-a: Relationship between practice frequency and 20 m shuttle run (boys).

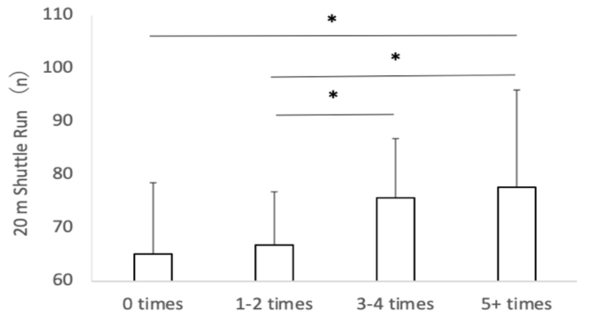

Figure 1-b: Relationship between practice frequency and 20 m shuttle run (girls). * $p < 0.05$

PHV found that performance before PHV was lower than during and after PHV [12]. While PHV has conventionally been reported at age 13 for boys and age 11 for girls [13], recent studies of Japanese children have observed PHV at age 11 in boys and age 9 in girls [14]. As fourth graders are between the ages of 9 and 10, more girls than boys had reached PHV age and this may explain why girls were more susceptible to effects from practice frequency.

Standing long jump, side step test, and medicine ball throw results were not found to be associated with weekly practice frequency in boys or girls (Table 2-a,-b). Standing long jump and medicine ball throw are used as indicators of power, while the side step test is an indicator of agility, but has been found to correlate strongly with strength and power. As strength and power are known to appear markedly after PHV age [15], it is likely that our results did not find a relationship between practice frequency because our participants were most likely pre- or mid-PHV judging by age, and therefore, their practice had a limited effect on the development of strength and power.

Participants of the present study had extremely high athletic ability compared to their peers. According to the new physical fitness test from the Ministry of Education, Culture, Sports, Science and Technology, average results for children in the same age group were 1.46±0.18 m for boys/1.41±0.17 m for girls on the standing long jump, 39.95±7.23 points for boys/38.68±6.88 points for girls on the side step test, and 47.03±20.02 points for boys/38.64±15.36 points for girls on the 20 m shuttle run [16]. Scores for study subjects greatly surpassed these scores for all tests and often exceeded the maximum for all age groups (Table 2, Figure 1-a,-b). Research, such as the present study, which focuses on children with advanced athletic ability, is extremely rare and valuable.

Many studies have found that children identified at a young age by TID have a low probability of becoming international athletes during their adulthood [17,18]. Clarifying how characteristics of childhood athletic ability impact athletic ability in adulthood could lead to increased accuracy in TID programs that focused on young children. The results of this study revealed that endurance is an acquired skill in girls of this age. How endurance is developed during this period will be an essential topic for future research. There are numerous potential factors that may influence athletic ability in children including not only the sport they are participating in, its intensity, and how long they exercise, but differences in individual maturity level [6] and birth month [19]. Exploring these factors is also a task for future research.

Conclusion

This study found that among the fourth-grade children with advanced athletic ability, girls who trained more frequently each week had higher endurance. This suggests that endurance in girls of this age is acquired, a point that must be considered when selecting children for athletic ability in a TID program, or achievement or performance in competitive sports.

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References

1. Zeng Fanhui, Japanese editor, Sekioka Y. Scientific selection for sport talent. Douwashoin. 1998.
2. Malina RM. Early sport specialization: roots, effectiveness, risks. Curr Sports Med Rep. 2010; 9, 6: 364-371.
3. Kinugasa T, Fujiwara A, Waku T, Gulbin J. Historical development of talent identification and development initiatives in Japan. Sports Science in Elite Athlete Support. 2018; 3: 15-26.
4. Johnston K, Wattie N, Schorer J, Baker J. Talent Identification in Sport: A Systematic Review. Sports Med. 2018; 48, 1: 97-109.
5. Zhao K, Hohmann A, Chang Y, Zhang B, Pion J, Gao B. Physiological, Anthropometric, and Motor Characteristics of Elite Chinese Youth Athletes From Six Different Sports. Front Physiol. 2019; 10: 405.
6. Robert M. Malina, Claude Bouchard, Oded Bar-Or. Growth, Maturation, and Physical Activity. Human Kinetics.
7. Veijalainen A, Haapala EA, Väistö J, Leppänen HM, Lintu N, Tompuri T, et al. Associations of physical activity, sedentary time, and cardiorespiratory fitness with heart rate variability in 6- to 9-year-old children: the PANIC study. Eur J Appl Physiol. 2019; 119, 11-12: 2487-2498.
8. Murakami H, Kawakami R, Nakae S, Nakata Y, Ishikawa-tK, Tanaka S, et al. Accuracy of Wearable Devices for Estimating Total Energy Expenditure: Comparison With Metabolic Chamber and Doubly Labeled Water Method. JAMA Intern Med. 2016; 176, 5: 702-703.
9. Böhm B, Karwiese SD, Böhm H, Oberhoffer R. Effects of Mobile Health Including Wearable Activity Trackers to Increase Physical Activity Outcomes Among Healthy Children and Adolescents: Systematic Review. JMIR Mhealth Uhealth. 2019; 7, 4: e8298.
10. Léger LA, Lambert J. A maximal multistage 20-m shuttle run test to predict VO2 max. Eur J Appl Physiol Occup Physiol. 1982; 49, 1: 1-12.
11. Kobayashi K, Kitamura K, Miura M, Sodeyama H, Murase Y, Miyashita M, et al. Aerobic power as related to body growth and training in Japanese boys: a longitudinal study. J Appl Physiol Respir Environ Exerc Physiol. 1978; 44, 5: 666-672.
12. Geithner CA, Thomis MA, Vanden Eynde B, et al. Growth in peak aerobic power during adolescence. Med Sci Sports Exerc. 2004; 36, 9: 1616-1624.
13. Tanaka T, Suwa S, Yokoya S, Hibi I. Analysis of linear growth during puberty. Acta Paediatr Scand Suppl. 1988; 347: 25-29.
14. Ohsawa, S. Determining the optimal age to begin physical fitness training: derived from an analysis of data from the MEXT new physical fitness test. Japan J Human Growth and Development Research. 2015; 69: 25-35.
15. Radnor JM, Lloyd RS, Oliver JL. Individual Response to Different Forms of Resistance Training in School-Aged Boys. J Strength Cond Res. 2017; 31:787-797.
16. The Portal Site of Official Statistics of Japan by the National Statistics Center.
17. Vaeyens R, Lenoir M, Williams AM, Philippaerts RM. Talent identification and development programmes in sport: current models and future directions. Sports Med. 2008; 38, 9: 703-714.
18. Engebretsen L, Steffen K, Bahr R, Broderick C, Dvorak J, Mats P, et al. The International Olympic Committee Consensus statement on age determination in high-level young athletes. Br J Sports Med. 2010; 44, 7: 476-484.
19. Mujika I, Vaeyens R, Matthys SP, Santisteban J, Goiriena J, Philippaerts R. The relative age effect in a professional football club setting. J Sports Sci. 2009; 27, 11: 1153-1158.