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The Impact of Hand Grip and Sit-and-Reach Exercises in Children Aged 6 to 7 Years

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Abstract

It has been suggested that grip strength can predict physical fitness in children and adults. The overall plan of this study is to validate this conclusion. The study analyzed the correlation between hand grip strength and sit-and-reach in 70 children aged 6-7 years to gain insight into the correlation between grip strength and sit-and-reach. Descriptive statistics were used in the study to find out the mean scores and differences in these exercises. The correlation between hand grip strength and sit-and-reach flexibility was also explored using Pearson's correlation coefficient. The results showed the correlation coefficient between hand grip strength (mean±sd=5.46±3.75) and sit-and-reach flexibility (mean ±sd=8.25±5.28) was 0.078, indicating a weak positive correlation ($p > 0.05$). The study's results suggest that grip strength is not a valid predictor of physical dexterity in seated forward bends in the 6-7-year-old children age group. As suggested in previous studies, grip strength can predict physical fitness in children, such as a strong correlation between grip strength and physical flexibility, lung function, muscular endurance, and physical stability. However, from the results, grip strength is not a reliable predictor of physical flexibility. We need to validate further the predictive role of grip strength for other physical fitness indicators. This is a very important validation for us to develop children's physical fitness assessment programs more efficiently in the future.

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INTRODUCTION

Physical fitness is a crucial aspect of child development, contributing to overall health and well-being (Sciaraffa et al., 2018; Tulchin-Francis et al., 2021). Assessing and understanding the physical capabilities of children is essential for designing appropriate interventions and promoting healthy lifestyles (Cornish et al., 2020; Masini et al., 2020; Ortega et al., 2008) Hand grip strength and sit-and-reach flexibility are two commonly used measures to evaluate upper body strength and flexibility (Sugiyama et al., 2023), respectively, in children. This study aims to comprehensively analyze the hand grip and sit-and-reach exercises performed by a group of 70 children aged 6-7 years old. Descriptive statistics, including the mean and standard deviation, offer valuable insights into the central tendency and variability of the data. The mean represents the average performance of the children in each exercise, while the standard deviation indicates the spread or dispersion of the data points around the mean. By examining these statistics, we can better understand the typical hand grip strength and sit-and-reach flexibility levels among children in the 6-7 age group (Matsudo et al., 2014).

Furthermore, exploring the correlation between hand grip strength and sit-and-reach flexibility provides valuable information about the potential relationship between these two

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measures (Behan et al., 2022; Lindsay et al., 2021). The Pearson correlation coefficient is used to quantify the strength and direction of this relationship (Lindsay et al., 2021). A positive correlation suggests that higher hand grip strength is associated with greater sit-and-reach flexibility, while a negative correlation indicates an inverse relationship (Lee et al., 2022). Understanding the correlation between these exercises can provide insights into the interplay between upper body strength and flexibility in children.

Physical fitness components are crucial for optimal athletic performance and well-being, contributing to various aspects of fitness in different physical activities and sports (Kokko et al., 2019). Endurance, measured by cardiovascular fitness, reflects the body's ability to sustain prolonged exercise (Chu et al., 2019). Muscle strength, determined by maximal force against resistance, improves through strength training exercises. Speed involves moving quickly in a specific direction, enhanced by sprint and interval training (Suchomel et al., 2018). Agility, the ability to change direction quickly, requires balance, coordination, and speed, improved through drills like ladder or cone exercises (Noyes & Barber-Westin, 2019). Flexibility, the range of motion around joints, is vital for posture and injury prevention, improved through stretching, yoga, and Pilates. Explosive power, critical for rapid force generation, is developed through plyometrics, Olympic lifting, and resistance training (Hryvniak et al., 2021). Balance, essential for stability, is enhanced through yoga and balance training (İnal et al., 2023). Coordination and synchronizing body parts for smooth movements are developed through martial arts and dance practices. Accuracy and precision in movements are crucial in sports like archery, and they are improved through target practice and specific drills. Reaction, the speed and accuracy of responding to stimuli, is vital in quick decision-making sports and can be enhanced through training exercises like agility ladder drills (Malm et al., 2019).

This study is an important part of the research on exploring the correlation between grip strength and physical fitness (muscular endurance, flexibility, lung function, etc.) in children, with a focus on exploring the correlation between grip strength and physical dexterity (sit-and-reach) in 6–7-year-old children and investigating whether grip strength can be a prognostic indicator of seated physical dexterity. Most of the correlation analyses of various types of physical literacy, physical fitness, and motor skills in the children's field are overall generalized studies (Saunders et al., 2018; Sugiyama et al., 2023), mainly presenting the overall correlation of the three major segments of physical qualities, physical activity, and motor skills, for specific physical literacy (e.g., grip strength, core strength, speed, and agility, etc.), specific physical activities (conducive to walking, running, and being sedentary, etc.), and specific motor skills (e.g., grasping skills, visuomotor integration skills, object manipulation skills, etc.) Evidence does not support Correlations between these indicators (Sugiyama et al., 2023). There is a significant correlation between the following anthropometric dimensions (stature, sitting hip breadth, wrist circumference, hand circumference, and heel ankle circumference) and hand grip strength (Nurul Shahida et al., 2015). There was a significant sex-dependent difference in the maximum and mean strength, with men being stronger than women, and a hand-length-dependent difference in the force exerted by small versus large hands. Both at work and in leisure time, repetitive manual loads did not consistently improve strength (Wichelhaus et al., 2018).

This study will conduct a series of correlations for each indicator to provide valid support for assessment tools and intervention programs for children's physical and physical fitness. This research also contributes to understanding physical development in children aged 6-7 years by examining two specific exercises, namely hand grip and sit-and-reach. This information can be useful for parents, educators, and health professionals to assess and improve overall physical well-being in this age group. The results of this study will serve as an important guide for designing physical fitness assessment programs for children in this age group. The results for the correlation of hand grip and sit-and-reach have implications for physical education programs, physical fitness training, and overall health promotion strategies for children in this age group. In addition, understanding the performance and potential associations between grip strength and sit-to-stand stretching flexibility may guide educators, coaches, and healthcare professionals in customizing interventions to enhance children's physical fitness and health.

METHOD

Participants

Table 1. Anthropometry

	N	Minimum	Maximum	Mean	Std. Deviation
Weight (KG)	70	15.50	57.20	23.7443	7.32084
Height (CM)	70	104.10	159.30	121.4071	9.93358

All participants were recruited from the Children's Sports Ability Center, Chengdu, Sichuan Province, China. All children at the center underwent a standard physical examination and inquiries about disease history and injury history before starting training. Volunteers undergoing acute or chronic cardiovascular, pulmonary, or metabolic therapy were excluded. Those with any orthopedic condition that would limit their physical performance. Children with limited physical performance were excluded. Seventy children (Table 1) aged 6-7 years (35 boys and 35 girls) were randomly selected for inclusion in this study at the center. Written informed consent was obtained from the parents or legal guardians of the volunteers. The center's Research Ethics Committee approved the study.

Equipment

Participants' grip strength and sit-and-reach were tested for this study, and data was collected using the National Physical Fitness Monitoring All-in-One Machine from China. The machine has a central computer with all the items of physical fitness assessment, including height, weight, grip strength, sit-and-reach one-legged stand with eyes closed, choice reaction time, step experiment, sit-ups, and push-ups. The study analyzed the correlation between hand grip strength and sit-and-reach in 70 children aged 6-7 years to gain insight into the correlation between grip strength and sit-and-reach. Therefore, this equipment can be used to assess hand grip and sit-and-reach.

Data Analysis

In this study, the height and weight of 70 children were analyzed using descriptive statistics for basic anthropometrics. For the correlation between grip strength and sitting forward bending in 6–7-year-old children, Pearson correlation analysis ($p<0.001$) was used to analyze the correlation between grip strength and sitting forward bending in this age group.

RESULTS AND DISCUSSION

Result

Table 2. Descriptive Statistics

	Mean	Std. Deviation	N
Hand-Grip (kg)	5.4643	3.75044	70
Sit-and-Reach (cm)	8.2514	5.28333	70

The data represents the results of hand grip and sit-and-reach exercises performed by 70 children aged 6-7. Descriptive statistics have been calculated for both exercises, as shown in (**Table 2**).

Table 3. Correlations

		Hand-Grip	Sit-and-Reach
Hand-Grip	Pearson Correlation	1	.078
	Sig. (2-tailed)		.518
	The sum of Squares and Cross-products	970.541	107.280
	Covariance	14.066	1.555
	N	70	70

		Hand-Grip	Sit-and-Reach
Sit-and-Reach	Pearson Correlation	.078	1
	Sig. (2-tailed)	.518	
	The sum of Squares and Cross-products	107.289	1926.035
	Covariance	1.555	27.914
	N	69	69

For the hand grip exercise, the mean value is 5.4643, indicating that, on average, the children achieved a hand grip strength of approximately 5.4643 units. The standard deviation is 3.75044, which measures the variability or spread of the data. This suggests that the hand grip strengths of the children vary quite a bit from the mean. The sample size, denoted by N, is 70, meaning that data was collected from 70 children for this exercise (Table 3).

For the sit-and-reach exercise, the mean value is 8.2514, indicating that, on average, the children achieved a sit-and-reach distance of approximately 8.2514 units. The standard deviation is 5.28333, suggesting that the sit-and-reach distances of the children also vary quite a bit from the mean. The sample size, denoted by N, is again 70, indicating that data was also collected from 70 children for this exercise.

The correlation coefficient measures the strength and direction of the relationship between two variables. In this case, the Pearson correlation coefficient is used. For the hand grip and sit-and-reach exercises, the Pearson correlation coefficient is 0.078. This value indicates a very weak positive correlation between the two exercises. The correlation coefficient ranges from -1 to 1, where 1 represents a perfect positive correlation, 0 represents no correlation, and -1 represents a perfect negative correlation. Since the correlation coefficient is close to 0, it suggests that there is little to no relationship between the hand grip and sit-and-reach exercises for these children.

The significance value (Sig.) associated with the correlation coefficient is 0.518. This value indicates the probability of observing the correlation coefficient by chance. In this case, the significance value is greater than 0.05, a commonly used statistical significance threshold. Therefore, we fail to reject the null hypothesis, suggesting that the correlation between the hand grip and sit-and-reach exercises is not statistically significant.

The remaining information details the sum of squares and cross-products, covariance, and sample size (N) for both exercises. These values are used in calculating the correlation coefficient and provide additional statistical information about the relationship between the hand grip and sit-and-reach exercises for the 70 children aged 6-7.

Discussion

The present study aimed to analyze the hand grip and sit-and-reach exercises performed by 70 children aged 6-7. The descriptive statistics provided insights into these exercises' average performance and variability. At the same time, the correlation analysis explored the potential relationship between hand grip strength and sit-and-reach flexibility.

This study's mean hand grip strength was 5.4643 units, with a standard deviation of 3.75044. These findings suggest that, on average, the children in this age group possess moderate hand grip strength. However, the wide standard deviation indicates considerable variability in hand grip strength among the participants. This variability could be attributed to various factors, such as differences in 3 physical development, exercise habits, and individual variations in muscle strength (Zhang et al., 2017).

Regarding sit-and-reach flexibility, the mean score was 8.2514 units, with a standard deviation 5.28333. These results indicate a moderate level of flexibility among the children. The wide standard deviation suggests a considerable range of flexibility levels within the group, possibly influenced by genetics, physical activity levels, and individual differences in joint mobility (Lopes et al., 2012).

The correlation analysis revealed a weak positive correlation (r = 0.078) between hand grip strength and sit-and-reach flexibility. However, this correlation was not statistically significant (p >

0.05). These findings suggest little to no relationship between hand grip strength and sit-and-reach flexibility in children aged 6-7 (Kobayashi-Cuya et al., 2018).

The lack of a significant correlation between hand grip strength and sit-and-reach flexibility may be attributed to several factors. Firstly, it is important to consider that hand grip strength primarily reflects upper body strength, while sit-and-reach flexibility primarily assesses lower body flexibility. These two measures may not be strongly related due to the involvement of different muscle groups and physiological mechanisms (Kobayashi-Cuya et al., 2018).

Additionally, the studied age group may play a role in the weak correlation. Children in this age range are still in the early stages of physical development, and their strength and flexibility levels may not be fully developed or coordinated. As children age, the relationship between hand grip strength and sit-and-reach flexibility may become more pronounced (Castro-Piñero et al., 2010; Mahmoud et al., 2020).

Notably, the sample size of 70 children in this study provides a reasonable representation of the population. However, the findings may not be generalizable to all children aged 6-7, as geographical location, cultural background, and socioeconomic status could influence physical capabilities (Kobayashi-Cuya et al., 2018).

Future research should consider expanding the sample size and including a wider range of age groups to investigate the relationship between hand grip strength and sit-and-reach flexibility in children. Additionally, incorporating other measures of physical fitness, such as cardiovascular endurance and muscular endurance, could provide a more comprehensive understanding of overall physical capabilities in this population (Abe et al., 2023).

In conclusion, this study provides valuable insights into the hand grip and sit-and-reach exercises performed by children aged 6-7. The descriptive statistics highlight the average performance and variability in these exercises. At the same time, the correlation analysis reveals a weak and non-significant relationship between hand grip strength and sit-and-reach flexibility. These findings contribute to our understanding of children's physical capabilities in this age group and emphasize the need for further research to explore additional factors influencing physical fitness in children.

CONCLUSION

In summary, the data presented in this paper consisted of the mean and standard deviation of hand-grip strength (Hand-Grip) and sit-and-reach dexterity (sit-and-reach) in a sample of 70 individuals. The p-value of this correlation coefficient was 0.518, indicating that the correlation was not statistically significant. The covariances between hand-grip strength and sitting and stretching flexibility were 14.066 and 1.555, respectively. These values indicate a weak positive correlation between these two variables. Overall, the study results show that for children aged 6-7 years, grip strength is not a valid predictor of physical flexibility in seated forward bending. Suppose grip strength can predict children's physical fitness, as proposed in the previous study. In that case, it means that grip strength is directly correlated with physical flexibility, lung function, muscular endurance, and physical stability. However, as can be seen from the results of this study, grip strength is not a reliable predictor of physical flexibility. Then, we need to validate further the predictive effect of grip strength on other physical fitness indicators. This is a very important validation for us to develop children's physical fitness assessment programs more efficiently in the future. In the meantime, understanding the performance and potential associations between hand grip strength and sit-to-stand extension dexterity can guide educators, coaches, and healthcare professionals in customizing interventions to enhance children's physical fitness and health.

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AUTHOR CONTRIBUTION STATEMENT

JWM (Main author, Data collection), AAA (Author, Data collection), NFAM (Data collection), NIM (Proofreading), MHB (Editor, Data Analysis), NIMo (Supervisor, Corresponding author).

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