Effect of Preschool Education on Hand Grip Strength and Functional Skills in Children

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Abstract

Aim: It is thought that whether play-based manual activities performed in preschool education institutions have an effect on children's manual skills, future school life and self-confidence has become an important issue. The aim of this research is to examine the contribution of children who received and did not receive preschool education to hand grip and functional skills and to contribute to the evaluation of personal motor skill characteristics to be determined during this period.

Method: The study included 118 individuals with no physical problems, divided into two groups as children who received preschool education and those who did not. Hand grip strength, finger grip strength and hand functional skills were assessed in both hands, dominant and non-dominant. Participants' hand functional skills were evaluated by measuring the Perdue Pegboard test, key grip strength with the Jamar® hydraulic pinch meter, and gross grip strength with the J-tech® digital hand dynamometer.

Results: As a result of the study, hand and finger grip strength and hand functional skills were found to be higher in children who received preschool education compared to those who did not ($p<0.05$). As a result of the analysis based on the gender of individuals who received preschool education, no statistically significant difference was found between girls and boys ($p>0.05$).

Conclusion: In conclusion, it has been shown that preschool education increases hand grip strength and functional skills in children.

Keywords: Preschool children, hand strength, pinch strength, motor skills.

Okul Öncesi Eğitimin Çocuklarda El Kavrama Gücü ve Fonksiyonel Beceriler Üzerine Etkisi

Öz

Amaç: Çocuklarda okul öncesi eğitim kurumlarında yapılan oyun temelli el aktivitelerinin çocukların el becerilerine, gelecekteki okul hayatına ve özgüvenlerine etkisi olup olmadığının önemli bir konu haline geldiği düşünülmektedir. Araştırılan bu çalışmayla, okul öncesi eğitim alan ve almayan çocukların el kavrama ve fonksiyonel becerilerine katkısını incelemek ve bu dönemde belirlenecek kişisel motor beceri özelliklerinin değerlendirilmesine katkı sağlamak amaçlanmıştır.

Yöntem: Çalışmaya fiziksel olarak herhangi bir problemi bulunmaya 118 birey, okul öncesi eğitim alan ve almayan çocuklar olacak şekilde iki gruba ayrılmıştır. Bireylerde dominant-nondominant her iki el olacak şekilde el kavrama kuvveti, parmak kavrama kuvveti ve el fonksiyonel beceri değerlendirmesi yapılmıştır. Bireylerin el fonksiyonel becerileri Perdue Pegboard testi, anahtar kavrama kuvveti Jamar® hidrolik pinçmetre, kaba kavrama kuvveti J-tech® dijital el dinamometresi ile ölçülerek değerlendirilmiştir.

Bulgular: Yapılan çalışma sonucunda, okul öncesi eğitim alan çocukların almayanlara göre el ve parmak kavrama kuvveti, el fonksiyonel becerileri yüksek bulunmuştur ($p>0.05$). Okul öncesi eğitim alan bireylerin cinsiyeti bakımından yapılan analiz sonucunda kız ve erkek bireyler arasında istatistiksel olarak anlamlı bir fark bulunmamıştır ($p<0.05$).

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Sonuç: Sonuç olarak, okul öncesi eğitimin, çocuklarda el kavrama kuvveti ve fonksiyonel becerileri artırdığı ortaya konmuştur.

Anahtar Sözcükler: Okul öncesi çocuklar, el gücü, parmak kavrama, motor beceriler.

Introduction

Preschool education, which is seen as the first step in people's educational life, is of great importance. Scientific data indicates that preschool education contributes to the child's future development and that the quality of education received during this period is very important. The first years of life are important in terms of cognitive, social and physical change, as many researchers have stated. It is stated that children's success up to the age of 6 accounts for 33% of their total academic success by the age of 18[1].

“Preschool education”, which is recognized as the first step of education, includes a period of time in which the physical, psychomotor, emotional, social, mental and language skills, which are important factors in the future lives of children, develop significantly, their sense of self is shaped and the child is in a constant state of change[2,3].

As is known, activities performed in preschool education institutions play a major role in the functional development of a child's hand. From the moment a child enters a preschool education center, they are continuously engaged in activities that involve the use of their hands. Activities performed both individually and in group activities increase the functional capacity of the hand. As children use crayons, scissors, various papers, glue, and tape for their intended purposes in preschool education institutions, and repeatedly engage in similar activities for extended periods, the development of hand muscle strength, finger grip, and fine motor skills becomes inevitable[4].

The functional adequacy of the hand should be considered as a whole encompassing gross grip muscle strength, finger grip strength, fine motor skills and hand-eye coordination. When evaluating the functional developmental capacity of a child's hand, it is necessary to evaluate each one separately and reach the most accurate conclusion about hand function with the inductive method. In addition, one of the first movement patterns that children develop in preschool education institutions is hand-eye coordination. Hand-eye coordination refers to the ability to produce goal-oriented hand activities guided by visual information from the eyes. Good coordination between the sensory-visual system and the musculoskeletal system is necessary for the individual's functionality during interaction with the environment[5].

This study aims to investigate the effects of preschool education on hand muscle strength, finger grip strength and fine motor skills in children and to reveal the benefits of preschool education provided by families during the period when their children are most receptive to development until they start primary school in order to enhance their children's future academic and social success.

Material and Methods

Ethical Considerations

This randomized controlled trial was ethically approved by the Bakırköy Dr. Sadi Konuk Research Hospital Clinical Research Ethics Committee (date: 20.11.2017; protocol no:

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2017/365). All procedures followed the Declaration of Helsinki and written informed consent was obtained from families of all participants.

Participants

First grade students from Istanbul Ahmet Cevdet Paşa Primary School were included in the study. The study initially started with 130 children but continued with 118 children. 12 students were excluded from the study due to exclusion criteria. Inclusion criteria were being between 5.5-7 years old, being in the first grade of primary school, exclusion criteria were having a history of fractures, having a rheumatic disease, and having a history of nerve injury.

Interventions

In our study, firstly, the classes in the school were visited and the students who received preschool education (n=58) and those who did not (n=60) were determined. The students were divided into two groups according to their preschool education status. In the study, hand function was evaluated using hand gross grip, finger grip, and Purdue pegboard fine motor skill tests for both the dominant and non-dominant hands in both groups, and the results were compared.

Outcome Measures

Demographic Information Form

The form consisted of questions regarding the child's age, height, weight, dominant hand, whether they had received preschool education, whether they had a current systemic or rheumatic disease, and whether there was a history of nerve injury or fracture.

Assessment of Hand Grip Strength

In the study, J-tech hand dynamometer was used to determine the hand grip strength, considering the students' ages and physical fitness capacities and the reliability of the study. After the measurement with the dynamometer, the average of the three values obtained was calculated, and these data were used for statistical analysis.

Assessment of Fine Grip Strength of the Hand

In the study, Jamar hydraulic pinchmeter was used to evaluate the finger grip strength of the participants. After the measurement with the pinchmeter, the average of the 3 values obtained was calculated, and these data were used for statistical analysis.

Perdue Pegboard Manual Dexterity Assessment Test

The Purdue Pegboard dexterity test includes washers, rings, and small pegs. The number of items placed in the test is recorded to assess the functional ability of the hand.

Statistical Analysis

SPSS 20.0 package program was used for statistical evaluation. Since the data did not have a normal distribution ($p>0.05$), non-parametric tests were used. Mann Whitney U test was used to compare the means of two independent groups and Spearman Correlation coefficient was used to test the relationship between two variables. In all analyses, the significance level was given as 0.05. In the power analysis performed using

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the G*Power package program, the effect size was taken as 0.5; the significance level was taken as 0.05, and it was concluded that the power was 0.85 with a sample size of 118.

Results

Of the 118 participants in the study, 49.2% were male and 50.8% were female. 49.2% of the children participating in the study received preschool education and 50.8% did not receive preschool education.

Table 1. The demographic and clinical characteristics of the participants.

	Total Participant (n=118)
Gender	
Female	60 (%50,8)
Male	58 (%49,2)
Weight (kg)	27,62±3,85
Height (cm)	137,16±4,39
Age (years)	6,48±0,49
Preschool Education	
Yes	58 (%49,2)
No	60 (%50,8)

Abbreviations: kg: kilograms; cm: centimeter.

The comparison of the hand grip strength (D.H+N.D.H), fine motor skills (D.H+N.D.H), perdue pegboard right+left+both (s) and combination difference values between the experimental and control groups is presented in Table 2. There is a statistically significant difference in the values between the groups ($p<0.05$). The values of individuals who received preschool education are higher than those who did not.

Table 2. Comparison of values in the assessment of hand grip strength, fine motor skill, between experimental and control groups.

	Experimental Group (n=58) mean±SD	**Control Group (n=60) mean±SD**	**p value**
Hand Grip Strength D.H(kg)	10,52± 1,56	7,89± 1,60	**0,00***
Hand Grip Strength N.D.H (kg)	9,48± 1,72	6,69± 1,65	**0,00***
Pinch Grip Strength D.H(kg)	5,63± 1,15	4,16± 0,99	**0,00***
Pinch Grip Strength N.D.H(kg)	4,36± 0,90	3,20± 1,00	**0,00***
Perdue pegboard right+left+ bilateral (s)	31,63± 3,44	23,55± 2,63	**0,00***
Perdue pegboard both hands together (s)	22,13± 3,32	14,75± 2,75	**0,00***

Data are presented as mean±SD: standart deviation. Abbreviations: kg: kilograms; D.H: dominant hand; N.D.H: non-dominant hand; s: second.

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The results of the comparison values of the measurements made on the participants who received preschool education according to gender are presented in Table 3. It has been revealed that there is no statistically significant difference in terms of gender difference in hand grip strength (D.H+N.D.H), fine motor skills (D.H+N.D.H), perdue pegboard right+left+both(s) and combination values of individuals who received preschool education ($p>0.05$). There is no significant difference between girls and boys in terms of hand grip, fine grip and functional skill test results.

Table 3. Comparison of values in the assessment of handgrip strength, fine motor skill by gender in children attending preschool education

	Male (n=35) mean±SD	**Female (n=23) mean±SD**	**p value**
Hand Grip Strength D.H(kg)	10,72 ± 1,62	10,22 ± 1,44	**0,230***
Hand Grip Strength N.D.H (kg)	9,69± 1,76	9,17 ± 1,65	**0,221***
Pinch Grip Strength D.H(kg)	5,56± 1,08	5,73 ± 1,27	**0,429***
Pinch Grip Strength N.D.H(kg)	4,34± 0,76	4,40 ± 1,10	**0,713***
Perdue pegboard right+left+bilateral(s)	31,74± 3,12	31,47 ± 3,94	**0,987***
Perdue pegboard both hands together(s)	22,54± 3,43	21,52 ± 3,13	**0,364***

Data are presented as mean±SD: standart deviation. Abbreviations: kg: kilograms; D.H: dominant hand; N.D.H: non-dominant hand; s: second.

Discussion

The purpose of this study was to examine the relationship between hand grip, finger grip strength, and functional hand skills of children who received and did not receive preschool education. As a result of our study, it was concluded that preschool education has a positive effect on the development of hand grip, finger grip strength and functional hand skills.

The German Child Safety Act has determined the preschool education rights for children. In this context, preschool education is categorized into two groups: under 3 years old and over 3 years old. While communication, attachment and security issues are emphasized for children under 3, language, physical health and physical skills are included for children over 3[6].

Weakness in hand coordination skills is an important individual difference that can affect a child's ability to have self-care skills, writing, academic success, and future career acquisition. Preschool education ensures the development of hand coordination skills and has a positive effect on the child's future achievements.

Ferrariera et al. preferred the Jamar hand dynamometer in their studies on hand grip strength assessment in children and adolescents[7].

There are difficulties in using Jamar hand dynamometer in children due to its weight and hardness. In some studies, dynamometers called Bulb Dynamometers were preferred[8].

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In their manual dexterity test study conducted on 1334 children, Gardner et al., described the Purdue Pegboard test as an excellent test that can be use in children[9].

In the light of this information, J-tech hand dynamometer and Purdue pegboard hand dexterity test were used for hand grip and skill tests in this study.

In a study conducted by Surrey et al. in 2001, the key, palmar and fingertip pinch strengths of 414 children (180 boys, 234 girls) between the ages of 5 and 12 were examined, and in another study, the data obtained from the measurement of key pinch strengths of 262 healthy children between the ages of 5 and 12 were found to support the results of the study conducted by Surrey et al. in 2001. When we compare the data in the mentioned studies with the values of the children aged 6-7 in our study, it is revealed that there are similar results with their peers[10,11].

When we look at the study conducted by Yim et al., the key grip values are lower than those in our study, and no significant difference was found between girls and boys in key grip measurement values. Our study also supports the mentioned study[12].

In the study conducted by Tremblay et al. in the Greater Montreal area using the functional manual dexterity test on 267 children (137 girls) aged 3-5, a statistically significant difference was found in the functional dexterity test scores, but no significant difference was found between the genders. Our study also supports the mentioned study[13].

Gardner & Broman published normative data using the Perdue Pegboard Manual Dexterity Test in children and adolescents (671 females and 663 males) aged 5–15 years to guide future studies and set standards for this age group[9].

Desai & Kene in their study stated that the Western population has sufficient purdue pegboard norms and therefore aimed to develop purdue pegboard norms in the Indian population between the ages of 5-65. When the values of individuals are examined, it is found that manual dexterity decreases as age increases and there is no significant difference between boys and girls in manual dexterity test results. Our results are consistent with this study, as the manual dexterity test outcomes for boys and girls in the same age groups were similar, thereby supporting our findings[14].

In a study by Wilson and colleagues, normative data on the Purdue Pegboard were presented based on the performance of 206 right-handed boys and girls aged 2–5 years. Evidence for a dissociation between hand preference and peg-placement efficiency in the younger groups is discussed in light of the results[15].

In a study conducted on primary school children in South Korea, the hand dexterity test measurements of boys and girls were examined, and no significant difference was found between them in terms of hand dexterity. This study also supports these findings[12].

In a study conducted by Case-Smith in 2000, which examined the effects of manual skill practices on hand functional performance and fine motor skills in preschool children, it was stated that after 8 months of regular manual skill practices, the results of children who received preschool education were higher in terms of fine motor and functional performance results. These results support the importance of the therapeutic use of play in intervention[16].

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In a study conducted by Chien et al. in 2014 examining the factors that play a role in manual skill performance in the self-care functions of disabled and non-disabled children aged 2-12, they emphasized that children's manual skill performance in real life is a factor that contributes to their self-care functions and that it is necessary to evaluate children's manual skill performance for real-life activities[17]. The results of this study are also parallel.

Conclusion

According to the results of our study, it is revealed that preschool education has a positive effect on the physical development of children. It is seen that making preschool education compulsory will not only positively affect the physical development of children but will also provide many other benefits. Children with good physical development, good manual skills and hand grip strength will be more successful in academic and social activities. To make studies on this subject to be more robust, larger-scale, high-numbered, and multi-center studies are needed. Especially in our country, there is a need for more studies and data that provide information on the average values of children's hand grip and skill test results.

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