ORIGINAL RESEARCH

CHRISTIAN JOURNAL for GLOBAL HEALTH

Step out and mix up daily outdoor play for institutional care boys' hand strength and motor dexterity: a comparative cross-sectional study

Silpa Voola[a], Kalpana Kosalram[b]

[a] SRM School of Public Health, SRM Institute of Science and Technology, Kattankulathur, Chengalpattu, Tamil Nadu, India, sv1104@srmist.edu.in (email)

[b] SRM School of Public Health, SRM Institute of Science and Technology, Kattankulathur, Chengalpattu, Tamil Nadu, India, kalpanab@srmist.edu.in (email)

Abstract

Background: Daily active outdoor play is important for every child's optimal healthy development. The purpose of this study was to compare and examine the differences in hand grip strength and hand dexterity of boys living at 3 different children's homes (home1, home2 & home3).

Method: Conducted a comparative cross-sectional study on 60 children, aged 10-12 years (mean age 11.20±0.66 years). Hand grip strength was assessed by CAMRY electronic dynamometer (Model EH101) and hand dexterity: box and block test and purdue peg board test.

Results: Differences in grip strength and dexterity by place of residential care setting were examined using one-way analysis of variance. Home boys significantly had stronger grip strength($p<0.05$) and faster dexterity skills($p<0.001$) than the boys of other two homes. Home1 boys scored the least grip strength and slower dexterity performance. Frequency & duration of outdoor play and outdoor activities the boys were engaged at the care settings explain the variations. All the home3 boys (100%) stepped out and engaged in mix up of unstructured play and structured team sports while, home1(25%) and home 2(15%) boys preferred to stay indoors and majority participated in only one activity type (unstructured free play).

Conclusion: Engaging in combined activities of free play and sport games best assists manual dexterity, and grip strength compared to only one activity type of play participation. The residential care environments must encourage regular mix up of physical activities to enhance motor competency skills.

Keywords: Institutional care children, manual dexterity, grip strength, outdoor play, free play, sports participation

Introduction

Children living outside of family care are a vulnerable group.[1] Institutional care is defined as "residential care provided in a safe and protected environment which has been mandated by a competent administrative body or judicial authority."[2] Play is a fundamental right, ensuring health for all children and leaving no one behind.[3] The Position Statement on Active Outdoor Play states, "Access to active play in nature and outdoors—with its risks—is essential for healthy child development," and recommends outdoor, self-directed, play opportunities for children in all contexts, including the neighbourhood, home, school, child care centres, and natural setting.[4] Quantity of time spent engaging in activities of outdoors is termed as outdoor play time.[5] Young people engage in both outdoor organized sports and self-organized play. Organized sports have some form of structure and is coordinated by adults. On the other hand, self-organized play or free play is less structured and usually is coordinated by young people themselves.[6] Playing develops key skills across wide developmental domains: physical (gross and fine motor skills), social, cognitive, and emotional.[7]

The literature suggests that using hands is fundamental to interact with the environment for an individual's healthy development.[8] Fine motor skills are the ability to make precise hand and finger movements for task execution of various everyday activities, ranging from writing and drawing to participating in sports and carrying out various household chores.[9,10] Fine motor skills heavily rely on hand dexterity and hand grip strength. During school age, deficiencies in these hand functional skills may impact daily activities, neurological development, physical activity performance, and academic achievement of children.[9,10] Based on this evidence, the importance of exploring hand grip strength and manual dexterity during school age is crucial.

Hand Grip Strength (HGS) refers to the maximal force generated by contracting the intrinsic and extrinsic hand muscles, which move hand joints to flexion.[11] HGS is considered a predominant factor to optimise performance and control, as it is necessary for sports participation.[12] Hand motor dexterity is the ability to manipulate objects through coordination of hands and fingers in a timely manner.[13] Dexterity is a key skill in motor development and indicates a well-developed, neuromuscular function.[14] Skills of dexterity can be assessed with tasks that require one hand/unimanual (e.g., pencil grasp) or the tasks that require coordinated activity of both hands/bimanual (e.g., knitting). These developmental skills are influenced by environmental stimuli, play experiences, and proximate settings in which the children live and grow. Hence, the main objective of this study was to compare hand grip strength and hand motor dexterity skills among children living in 3 different residential institutions. We use the term "children home," preferred term by the administrators of the institutions as an alternative to "orphanage" from here.

Materials and Methods

Study design

This research is a comparative cross-sectional study in which hand grip strength and manual dexterity was assessed. Residential care children 10-12 years of age from the three registered children homes in Chennai were sampled by enrolling the first 20 boys who arrived at the assessment room on the study day. Firstly, the procedure and purpose of the study were explained to the home administrators and home supervisors. Following the accession of the residential home, the study was presented to the children. Because of the participants' ages, consent was obtained from the supervisors and assent was obtained from the children themselves. The research was approved by ethics committee of SRMIST-School of Public Health.

Participants

A total of sixty boys (10-12 years) (N=60, mean age: 11.20±0.66 years; height: 139.87±5.97 cm; weight: 33.94±7.03kg; BMI:17.23±2.77 kg/m^2) from three children's homes were recruited: double orphan (a child who lost both the parents), single orphan (a

child who lost one parent), or social orphan (a child with one or both living parents but has been left in the institution as they cannot care for the child due to poverty, sickness, or drug or alcohol addiction). Orphan status was obtained from the home supervisor. All the subjects were physically normal and were not suffering from any chronic diseases at the time of collection of data. Subjects with less than 6 months residency in children's home, presence of any sickness, history of upper limb injuries within six months, physical disability, or cognitive impairments were excluded.

Study procedure

Data collection by convenience sampling took place in each children home premises and was carried out by the same investigator. A semi-structured questionnaire was designed to collect information related to sociodemographic data, relevant variables of the children containing outdoor play frequency, outdoor playing time, and participation in outdoor activities. Height, weight, and dominant upper limb was obtained. Thereafter, grip strength (right and left), box and block (right and left), and Purdue peg board test (right, left, and both) were administered, sequentially. All the subjects received standardized instructions and a trial before each test. Dominant hand followed by non-dominant hand was tested on the same day in the same room. All the data was collected using the same test equipment. A rest period of 5 minutes was ensured between each category of test administered.

Examination

Body weight and height Standing Height was recorded using stadiometer and Omron HBF 214 body composition monitor was used to measure body weight. Body Mass Index (BMI) was calculated as weight in kilograms divided by the square of the height in meters (kg/m^2).

Hand dominance Dominant hand was determined by asking the participants to write their name on paper.[15]

Hand grip strength HGS was measured in kilograms (kg) using CAMRY electronic dynamometer (Model EH101). The following measuring procedures were implemented: 1) participants stay seated; 2) flex their elbows to a 90-degree angle; 3) grasp the dynamometer first the right and then the left; 4) hold and squeeze the dynamometer for 3 to 5 s, thrice, as hard as they could with a one-minute break in between measures; 5) participants received verbal encouragement on each effort; 6) The force in kg of the maximal effort, the highest measurement on each side, was the measurement in this study.[16]

Hand dexterity

The Box & Block Test (BBT) measures gross hand manual dexterity. The participants were asked to transfer 1 inch cube blocks from one compartment of the box having 150 cubes to another compartment. The total number of blocks moved in 60 seconds was the outcome score of the test of each hand.[17]

The Purdue peg board test (PPT) measures fine manual dexterity and bimanual coordination that largely relies on coordination of eye -hand and motor speed. It consists of a long board with 2 vertically aligned 25 holes in series. The test has four subtests. First two subtests (subtest 1- right/preferred hand and subtest 2-left/less preferred hand) are unimanual tasks. The participants were asked to take one pin at a time and insert into the holes correctly as fast as possible within a time limit of 30s. Incorrectly placed pegs were excluded from scoring. The next two subtests are bimanual tasks (subtest 3- both hands, subtest 4-assembly). For subtest 3, the participants were asked to simultaneously insert pins with both hands within 30s. The assembly test included building small assemblies which involved pins, collars, and washers with both hands simultaneously over a 1-minute time period. The Purdue Pegboard has shown good reliability (correlations range from .60 to .91) and validity (coefficients for 14 studies range from .07 to .76).[18]

Semi structured questionnaire

Outdoor play frequency Children responded to the question "Think about the past 1 month. On average, how often did you play outside such as playing games or sports at your

children's home? On a 5-point scale:1= "never;" 2= "one day per week;" 3= "2-3 days per week;" 4= "4-6 days per week;" 5= "daily." Based on WHO recommendations that children must play outdoors on a daily/everyday basis, the responses were dichotomized into "daily outdoor play" and "less than daily outdoor play."[19]

Outdoor play time Children responded to the question "Think about last week. On average, in a day, how much time did you play outside such as games/sports at your children's home? The boys answered by selecting one time slot among three gradational options ranging from none to more than one hour with intervals of half an hour. On a 3-point scale:1= "less than ½ hour;" 2= ½ hour to 1 hour;" 3= "more than 1 hour." Based on WHO recommendations, children and adolescents aged under 18 years must spend playing outdoors for 60 minutes per day. Hence, the responses were dichotomized into outdoor play time at least 60 minutes per day "Yes" and "No."[20]

Activity participation during scheduled outdoor play time Children responded to the question: On average how did they spend the time outdoors? Generally, physical activities(PA) can be divided into two categories: unstructured PA or free play (informal child-initiated physically active play) and structured or organized PA (deliberate engagement in sports games under supervision). The boys answered by marking one slot among six options such as prefer to spend in free play of one's choice such as run and catch or tag; team sports with rules such as volley ball, basketball, cricket; mixed included both free play & sports; play with park equipment; hang out with friends and chit chat; prefer to stay indoors. Participation in free play and team sports exclusively indicates engagement in a single kind of activity. Hence, for analysis, the responses were grouped under participation in only one activity type. Outdoor play in this study was defined as any time that children were outside playing, including free play/unstructured activity and organised sport/structured activity.

Statistical Analysis

Data are expressed as means and standard deviations. Differences between groups was determined by One-way ANOVA. *Post-hoc* tests with Bonferroni correction were implemented when the differences between groups were significant after the one-way ANOVA. A difference was considered to be statistically significant if the *P*-value was <0.05. All the collected data was analysed with statistical package of social sciences (SPSS,16).

Results

Sixty boys from three institutions participated. Characteristics of children and children's homes are presented in Table 1. Summary of hand strength and hand dexterity skills of the participants is shown in Table 2. Of the 60 children participating, there were those in home1 (n=20, mean age=11.05± 0.70 years), home2 (n=20, mean age=11.75±0.57 years), and home3 (n=20, mean age=11.15± 0.58 years). Overall, 9 boys (15%) were 10 years old, 31(52%) were 11 years and 20 (33%) were 12 years of age. More than half of the participants, 38(63%), were staying in respective institutions for a period less than 5 years. Based on orphan status, majority 35(58%) were single orphans followed by social orphans,18(30%) and least were double orphans,7(12%) (Table 1).

Table 1 Characteristics of boys and children's homes (N=60)

	Home1	Home2	Home3	Total
Number of study participants	n=20	n=20	n=20	N=60
Average age of participants, years (SD) F(p-value)	11.05 ± 0.70	11.75 ± 0.57	11.15 ± 0.58	11.20± 0.66 1.021(0.366)
Height(cm) F(p-value)	140.77±5.5	138.8 ± 6.4	140.05±6.09	139.87±5.97 0.551(0.579)
Weight(kg) F(p-value)	34.52± 7.43	33.79 ± 7.38	33.51 ±6.57	33.94±7.03 0.105(0.900)
BMI (kg/m^2) F(p-value)	17.29 ± 2.91	17.43 ± 3.03	16.98 ±2.45	17.23±2.77 0.137(0.871)
Participants age category, years N(%)				
10	5 (25)	1 (5)	3 (15)	9 (15)
11	9 (45)	11 (55)	11(55)	31 (52)
12	6 (30)	8 (40)	6 (30)	20 (33)
Average duration of stay, years (SD)	4.35 ± 1.59	3.90 ± 1.51	4.55 ± 2.01	4.26 ± 1.71
Participants length of stay category, years N(%)				
< 5 years	13(65)	14(70)	11(55)	38(63)
> 5 years	7 (35)	6 (30)	9 (45)	22(37)
Participants orphan status N(%)				
Double orphan	2 (10)	3 (15)	2 (10)	7(12)
Single orphan	12(60)	10(50)	13(65)	35(58)
Social orphan	6 (30)	7 (35)	5 (25)	18(30)
Outdoor play area sufficient for all activities, including running (by warden report)? (Y/N)	Y	Y	Y	
Outdoor demarcated sport area? (volley ball, basketball) (Y/N)	N	N	Y	
Indoor board games	Y	Y	Y	
Fixed Park equipment	Y	Y	N	
Child discretion allowed in choosing outdoors or indoors? (Y/N)	Y	Y	N	
Outdoor play frequency N(%)				
Daily	0(0)	2(10)	20(100)	22(37)
Less than daily	20(100)	18(90)	0(0)	38(63)
Outdoor play time at least 60 min/day				
Yes	2(0)	4(20)	20(100)	26(43)
No	18(90)	16(80)	0(0)	34(57)
Time spent playing outdoors/day N(%)				
T≤ ½ hour	17(85)	13(65)	0(0)	30(50)
½ hour < T ≤ 1 hour	3(15)	7(35)	18(90)	28(47)
T > 1 hour	0(0)	0(0)	2(10)	2 (3)
Activity participation during scheduled outdoor play time N(%)				
Only one activity type (free play/ team sports)	9(45) 8(40)/1(5)	12(60) 9(45)/3(15)	9(45) 4(20)/5(25)	30(50) 21(35)/9(15)
Mixed	1(5)	4(20)	11(55)	16(27)
Play on fixed equipment	3(15)	1(5)	0(0)	4(7)
Sedentary (hang out with friends)	2(10)	0 (0)	0(0)	2(3)
Stay indoors	5(25)	3(15)	0(0)	8(13)

Note. Values are presented as mean standard deviation or number (%). BMI, body mass index

Differences in hand grip strength of children across the children homes Home1, home 2 & home 3 showed significant differences in grip strength scores in both right/dominant hand (F= 4.57, df=2,57, p<0.05) and left/non-dominant hand, (F= 12.23, df=2,57, p<0.001) respectively. The post hoc pair-wise comparison revealed that boys of home 3 had stronger grip in both the hands when compared to the boys of home1 and home2 (Table2).

Differences in gross and fine hand motor dexterity of children across the children homes Gross motor dexterity as measured by box & block test showed a significant difference in means of right hand (F= 7.68, df=2,57, p<0.05) and left hand (F= 12.23, df=2,57, p<0.001) between the three homes. Differences for groups revealed that boys in home 3 were much faster in performance by both right and left hands than boys of home1 and home 2. Moreover, boys of home 1 performed worse than boys of other 2 groups (Table 2).

Fine motor dexterity scores as measured by the four subtests of Purdue pegboard task, namely right hand (F= 7.01, df=2,57, p<0.05), left hand (F= 10.07, df=2,57, p<0.001), both hands (F= 27.46, df=2,57, p<0.001), and assembly (F= 29.08, df=2,57, p<0.001) revealed a significant difference in means between the three homes. Pair wise comparison showed that boys in home 3 had a quicker performance in all the unimanual and bimanual tasks of fine motor dexterity than boys of home 1 and home 2. Out of the three homes, home 1 had lower performance than other two groups in all the subtests (Table 2).

Table 2. Hand grip strength and hand dexterity (gross motor & fine motor) of boys across three children's homes

		Home1	Home2	Home3	F (P value)
Hand Grip Strength	DHGS	15.35 ± 1.86	15.70 ± 1.46	16.72 ± 1.10[ab]	4.572 (0.014) *
	NDHGS	13.89 ± 2.05	14.80 ± 1.67	15.95 ± 0.85[ab]	8.313 (<0.001) **
Gross hand manual dexterity	BBT-R	53.35 ± 7.37	58.20 ± 4.94	61.05 ± 6.27[ab]	7.683 (0.0011) *
	BBT-L	48.45 ± 7.47	53.60 ± 5.95	59.00 ± 6.71[ab]	12.232 (<0.001) **
Fine hand manual dexterity	PPT-R	12.50 ± 1.73	13.05 ± 2.35	14.75 ± 1.80[ab]	7.011 (0.0018) *
	PPT-L	11.50 ± 1.14	12.01 ± 0.91	13.25 ± 2.11[ab]	10.070 (<0.001) **
	PPT-B	15.00 ± 2.71	18.60 ± 3.11[a]	22.05 ± 3.17[ab]	27.469 (<0.001) **
	PPT-A	8.05 ± 2.60	9.95 ± 2.13[a]	11.40 ± 1.72[ab]	29.088 (<0.001) **

Notes. Values are presented as mean standard ± deviation.

DHGS, dominant hand grip strength: NDHGS, non-dominant hand grip strength; BBT, box and block test; PPT, Purdue peg board test; L, left hand; R, right hand; B, both hands; A, assembly task

[a]Different from home1; [b] different from home2.

[*]Significance at 0.05 level p<0.05, [**]Significance at the 0.001 level p<0.001.

Figure 1. Comparison of hand grip strength

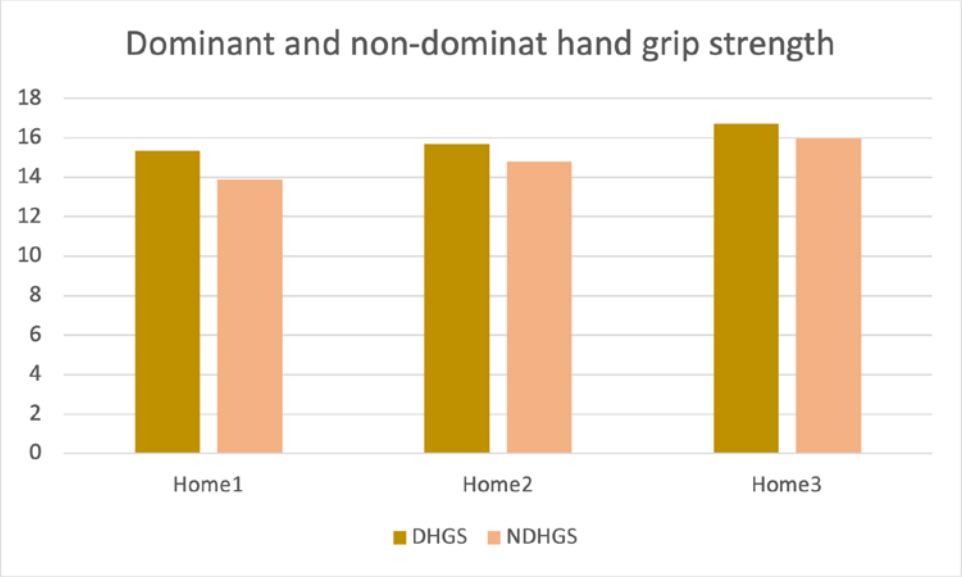
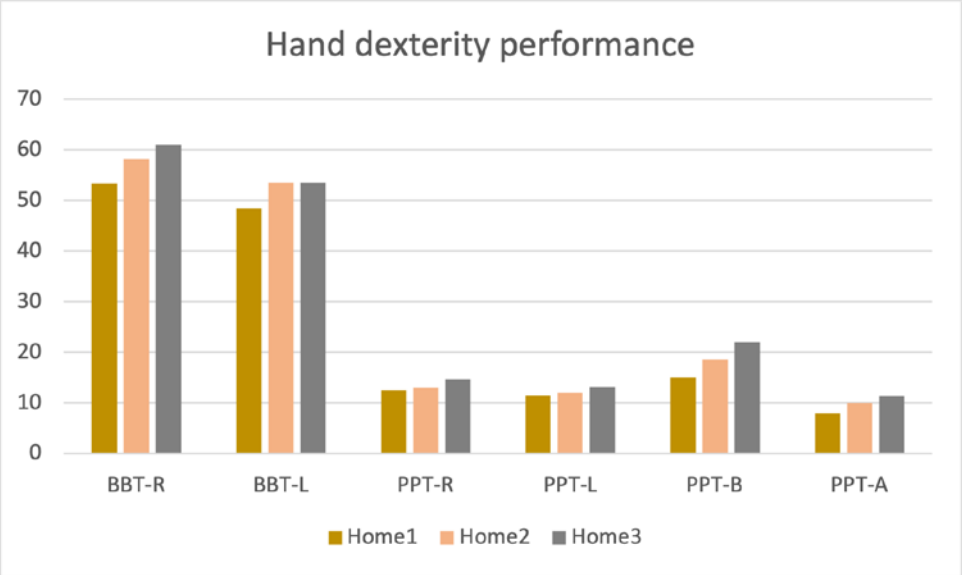


Figure 2. Comparison of hand dexterity test performance



Discussion

The purpose of this study was to analyse the differences in hand strength and hand dexterity skills in 10–12-year-old boys residing in 3 different children's homes. Based on one way ANOVA and pair wise comparison, it was found that there were significant differences between the groups of boys residing in 3 different residential care facilities. The main findings of this study suggest that boys of home 3 outperformed in dexterity skills, both gross (BBT) and fine (PBT), with strong grip bilaterally than their counterparts residing in home 1 and home 2. On the other hand, boys of home 1 had least skill performance in motor dexterity (both gross and fine) and weaker grip strength of all. The variations in the outcomes may be explained by the outdoor play experiences the boys had at their residential care setting, including frequency & duration of their outdoor play and type of outdoor activities they were engaged at their institutions.

Participation in sports positively influence all the bodily systems—motor, cardiovascular, respiratory, hormonal, immunological, and nervous. Thus, it stimulates brain's motor regions, enhancing child's motor skills and overall development.[20-26] Play needs to be age appropriate, keeping in mind that the peak age range for sports involvement is between 10 and 14 years of age.[27] Children 12 years and under who participate in sports for more than 3 hours per week outperform in motor performance than children who have less than 3-hour, sport participation.[28] Participation in a variety of unstructured and structured activities promote motor skills.[29]

Daily outdoor play for at least 60 minutes All the boys (100%) from home 3 have engaged in minimum daily, 60-minute, outdoor playtime within their children's home following school hours. WHO recommends that children and adolescents aged under 18 years spend 60 minutes playing outdoors.[30,31] Besides being outdoors daily, all the boys of home 3 participated in free play and structured sports such as volley ball and cricket. Being and doing in the outdoors adds extra motor skill efficiency. Children experience well known physical, social, emotional, and cognitive benefits with regular participation in recommended amounts of active play.[32-34]

Unlike the boys from the other two homes, home 3 did not allow child discretion; thus, all the boys stepped outdoors and eventually engaged in play activities. As a result, every boy from home 3 spent the designated outdoor playtime outside, daily engaging in sports and games involving moderate to intense physical activity. This may have contributed towards a stronger grip and quicker skills of dexterity in the boys from home 3. In contrast, boys from home 1 and home 2 were allowed discretion to stay indoors or play outdoors. One-fourth of the boys from 1st home and one-sixth from 2nd home preferred to remain indoors. Hence, all the boys of home 1 (100%) and 90% from home 2 lagged in recommended daily outdoor activity participation. Compared to children from home 3, who engaged in outdoor active games and sports for at least 60 minutes per day, children from homes1 and 2 exhibited weaker grip strength and slower dexterity skills. Evidence supports children who spend playing outdoors less often have fewer opportunities to reap the many benefits from outdoor play[4] and moderate-to vigorous physical activity[32] than those who choose to play outdoors frequently. It is a concern to note when the duration and frequency to spend at outdoor declines, then subsequent chance for participation in active games lessens. In general, children engage in more physical activity while they are outdoors as opposed to indoors.

Mixed physical activity is an optimal approach. Physical activity is highly crucial during childhood, especially in late childhood.[35] N.Wiium and R. Säfvenbom[36] reported that a combination of different activities seemed more developmentally beneficial than only one activity. Moreover, a combination of activities could be the optimal approach to achieve efficient motor skills.[37] Against this background, a majority (55%) of boys from home 3 participated in regular mixed physical activities, a combination of both structured sports and unstructured free play. These boys had stronger grips, faster manipulative skills in unimanual and bimanual tasks and better bimanual coordination and fine motor as was evident in PPT-bimanual-assembly task performance. The mix of activities possibly encouraged children of home 3 to stay more active throughout the whole 60-minute outdoor session. On the other hand, boys from homes 1 (45%) and 2 (60%) preferred single type activity over mixed activities. Free play was more favoured than team sports. Home 2 boys had better fine motor bimanual dexterity performance than home 1 boys as majority (80%) engaged in active play outdoors. Home 1 boys (5%) participated the least in combined free play with sports.

Despite these insights, results must be interpreted with caution as this study did not take into account other variables such as school environmental factors (e.g., frequency & duration of outdoor playtime and type of play activities) and social factors (e.g., having friends).

Conclusion

Children who spend time daily in outdoor play outperform those who do not. Furthermore, engaging in combined activities of free play and sport games better assists manual dexterity and grip strength than only one activity type. In particular, team sport participation best promotes the development of fine motor coordination, bilateral coordination, and manual dexterity. Children are more active and play more when they are outdoors. Therefore, the residential care environment should encourage regular physical activity. The best approach will be one that involves both sport participation and free play without child discretion, encouraging all children to step out and engage in mixed activities to enhance motor skill efficiency in late childhood.

References

1. Cluver L, Orkin M, Boyes ME, Sherr L, Makasi D, Nikelo J. Pathways from parental AIDS to child psychological, educational and sexual risk: developing an empirically-based interactive theoretical model. Soc Sci Med. 2013;87:185-93. https://doi.org/10.1016/j.socscimed.2013.03.028
2. United Nations Children's Fund Progress for children: a report card on child protection (Number 8). UNICEF. New York, NY; 2009. Available from: https://doi.org/10.1007/978-1-4419-1005-9_1424
3. United Nations Committee on the Rights of the Child (UNCRC). General comment No. 17 on the right of the child to rest, leisure, play, recreational activities, cultural life and the arts (art. 31). 2013. Available from: https://www.refworld.org/docid/51ef9bcc4.html
4. Tremblay MS, Gray C, Babcock S, Barnes J, Bradstreet CC, Carr D, Chabot G, et al. Position statement on active outdoor play. Int J Environ Res Public Health. 2015;12(6):6475-505. https://doi.org/10.3390/ijerph120606475
5. Lee EY, De Lannoy L, Li L, De Barros MIA, Bentsen P, Brussoni M, Crompton L, et al. Play, learn, and teach outdoors—Network (PLaTO-Net): terminology, taxonomy, and ontology. Int J Behav Nutr Phys Act. 2022;19(1):66. https://doi.org/10.1186/s12966-022-01294-0
6. Haugen T. One size does not fit all: physical activity and mental health in adolescents: exploring the role of self-perceptions, personal characteristics, and contextual specificities. Portal Books; 2015.
7. Sutapa P, Pratama KW, Rosly MM, Ali SK, Karakauki M. Improving motor skills in early childhood through goal-oriented play activity. Children. 2021;8(11):994. https://doi.org/10.3390/children8110994
8. Rostamzadeh S, Saremi M, Vosoughi S, Bradtmiller B, Janani L, Farshad AA, Taheri F. Analysis of hand-forearm anthropometric components in assessing handgrip and pinch strengths of school-aged children and adolescents: a partial least squares (PLS) approach. BMC Pediatr. 2021;21:1-12. https://doi.org/10.1186/s12887-020-02468-0
9. Patti A, Vicari DS, Giustino V, Figlioli F, Seidita GM, Monella AC, Oddo A, et al. The impact of sports experience on manual dexterity performances in school-age children. Heliyon. 2025;11(1):e41421. https://doi.org/10.1016/j.heliyon.2024.e41421
10. Alshahrani MS, Thomas RA, Samuel PS, Kakaraparthi VN, Reddy RS, Dixit S. Predictive analysis of dominant hand grip strength among young children aged 6–15 years using machine learning techniques: a decision tree and regression analysis. Front Pediatr. 2025;13:1569913. https://doi.org/10.3389/fped.2025.1569913
11. Mitsionis G, Pakos EE, Stafilas KS, Paschos N, Papakostas T, Beris AE. Normative data on hand grip strength in a Greek adult population. Int Orthop. 2009;33:713-7. https://doi.org/10.1007/s00264-008-0551-x
12. Hammed AI, Obaseki CO. Interdependence of body mass index with handgrip strength and endurance among apparently healthy teenagers. Turk J Kin. 2018;4(1):1-7. https://doi.org/10.31459/turkjkin.393476
13. Gonzalez V, Rowson J, Yoxall A. Development of the variable dexterity test: construction, reliability and validity. Int J Ther Rehabil. 2015;22(4):174-80. https://doi.org/10.12968/ijtr.2015.22.4.174

14. Tissue CM, Velleman PF, Stegink-Jansen CW, Aaron DH, Winthrop BG, Gogola GR. Validity and reliability of the Functional Dexterity Test in children. J Hand Ther. 2017;30(4):500-6. http://dx.doi.org/10.1016/j.jht.2016.08.002
15. Jongbloed-Pereboom M, Nijhuis-van der Sanden MW, Steenbergen B. Norm scores of the box and block test for children ages 3-10 years. Am J Occup Ther. 2013;67(3):312-8. https://doi.org/10.5014/ajot.2013.006643
16. Garg K. Hand Function in healthy school going children aged 6-12 years in India. NeuroQuantology. 2022;20(10):5644. https://doi.org/10.14704/NQ.2022.20.10.NQ55563
17. Mathiowetz V, Federman S, Wiemer D. Box and block test of manual dexterity: norms for 6-19 year olds. Can J Occup Ther.1985;52(5):241-5. https://doi.org/10.1177/000841748505200505
18. Tiffin J, Asher EJ. The Purdue Pegboard: norms and studies of reliability and validity. J Appl Psychol. 1948;32(3):234. https://doi.org/10.1037/h0061266
19. Bull FC, Al-Ansari SS, Biddle S, Borodulin K, Buman MP, Cardon G, Carty C, et al. World Health Organization 2020 guidelines on physical activity and sedentary behaviour. Br J Sports Med. 2020;54(24):1451-62. https://doi.org/10.1136/bjsports-2020-102955
20. Van der Fels IM, Te Wierike SC, Hartman E, Elferink-Gemser MT, Smith J, Visscher C. The relationship between motor skills and cognitive skills in 4-16-year-old typically developing children: a systematic review. J Sci Med Sport. 2017. 2015;18(6):697-703.https://doi.org/10.1016/j.jsams.2014.09.007
21. Alesi M, Bianco A, Luppina G, Palma A, Pepi A. Improving children's coordinative skills and executive functions: the effects of a football exercise program. Percept Mot Skills. 2016;122(1):27-46. https://doi.org/10.1177/0031512515627527
22. Makarowski R, Lipowski M, Marszałł M, Czarnowski W. Temperamental determinants of physical activity as preventive factor of heart diseases—in the search of the model. Pol J Sport Med. 2009;25:83-94.
23. Strzałkowska D, Szewieczek J, Janowska M. Czy sport to zawsze zdrowie? Zaburzenia rytmu serca u sportowców wyczynowych [Is sport always healthy? Cardiac arrhythmias in competitive athletes]. Ann Acad Med Sil. 2005;59:497-505.
24. Biddle SJ, Gorely T, Stensel DJ. Health-enhancing physical activity and sedentary behaviour in children and adolescents. J Sports Sci. 2004;22(8):679-701. https://doi.org/10.1080/02640410410001712412
25. Janssen I, LeBlanc AG. Systematic review of the health benefits of physical activity and fitness in school-aged children and youth. Int J Behav Nutr Phys Act. 2010;7:1-6. https://doi.org/10.1186/1479-5868-7-40
26. Sun S, Chen C. The effect of sports game intervention on children's fundamental motor skills: a systematic review and meta-analysis. Children. 2024;11(2):254. https://doi.org/10.3390/children11020254
27. Brenner JS. Sports specialization and intensive training in young athletes. Pediatrics. 2016;138(3). https://doi.org/10.1542/peds.2016-2148
28. Vallence AM, Hebert J, Jespersen E, Klakk H, Rexen C, Wedderkopp N. Childhood motor performance is increased by participation in organized sport: the CHAMPS Study-DK. Sci Rep. 2019;9(1):18920. https://doi.org/10.1038/s41598-019-54879-4
29. Bergeron MF, Mountjoy M, Armstrong N, Chia M, Côté J, Emery CA, Faigenbaum A, et al. International Olympic Committee consensus statement on youth athletic development. Br J Sports Med. 2015;49(13):843-51. https://doi.org/10.1136/bjsports-2015-094962
30. Eaton DK, Kann L, Kinchen S, Shanklin S, Flint KH, Hawkins J, Harris WA, et al. Youth risk behavior surveillance—United States, 2011. Morbidity and Mortality Weekly Report. Surveillance Summaries. Centers for Disease Control and Prevention. 2012;61(4).

31. Carson V, Lee EY, Hewitt L, Jennings C, Hunter S, Kuzik N, Stearns JA, et al. Systematic review of the relationships between physical activity and health indicators in the early years (0-4 years). BMC Public Health. 2017;17:33-63. https://doi.org/10.1186/s12889-017-4860-0

32. Poitras VJ, Gray CE, Borghese MM, Carson V, Chaput JP, Janssen I, Katzmarzyk PT, et al. Systematic review of the relationships between objectively measured physical activity and health indicators in school-aged children and youth. Appl Physiol Nutr Metab. 2016;41(6): S197-239. https://doi.org/10.1139/apnm-2015-0663

33. Carson V, Hunter S, Kuzik N, Gray CE, Poitras VJ, Chaput JP, Saunders TJ, et al. Systematic review of sedentary behaviour and health indicators in school-aged children and youth: an update. Appl Physiol Nutr Metab.2016;41(6): S240-65. https://doi.org/10.1139/apnm-2015-0630

34. Schmidt M, Jäger K, Egger F, Roebers CM, Conzelmann A. Cognitively engaging chronic physical activity, but not aerobic exercise, affects executive functions in primary school children: a group-randomized controlled trial. J Sport Exerc Psychol.2015;37(6):575-91. https://doi.org/10.1123/jsep.2015-0069

35. Myer GD, Faigenbaum AD, Edwards NM, Clark JF, Best TM, Sallis RE. Sixty minutes of what? A developing brain perspective for activating children with an integrative exercise approach. Br J Sports Med. 2015;49(23):1510-6. https://doi.org/10.1136/bjsports-2014-093661

36. Wiium N, Säfvenbom R. Participation in organized sports and self-organized physical activity: associations with developmental factors. Int J Environ Res Public Health. 2019;16(4):585. https://doi.org/10.3390/ijerph16040585

37. Dapp LC, Gashaj V, Roebers CM. Physical activity and motor skills in children: a differentiated approach. Psychol Sport Exerc. 2021;54:101916. https://doi.org/10.1016/j.psychsport.2021.101916

Submitted 29 Sept 2024, Revised 8 April 2025, Accepted 8 April 2025, Published August 2025

Acknowledgement: We appreciate and thank the children home administrators, staff, and children who supported and participated in this study.

Funding: The authors received no financial support for this article.

Conflicts of interest: No potential conflict of interest.

Correspondence: Silpa Voola, Tamil Nadu, India, Email: sv1104@srmist.edu.in

Cite this article as: Voola S, Kosalram K. Step out and mix up daily outdoor play for institutional care boys' hand strength and motor dexterity: a comparative cross-sectional study. Christ J Glob Health. 2025 Aug; 12(2). https://doi.org/10.15566/cjgh.v12i2.368