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Hand Grip and Pinch Strength in a Healthy Children Norms for 6 to 18 Years in Al-Kharj City, Kingdom of Saudi Arabia

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Abstract: Background: Measuring and comparing grip and pinch strengths with their normative data is a valid method to detect intensity of the numerous damages of hand. The aim of the study was to establish the normative data of grip strength and three types of pinch strengths (Key, Tip and Palmar) in healthy Saudi's children.

Method: In this cross-sectional study, of grip strength and three types of pinch strengths (Tip, Key and Palmar) were recorded for 82 healthy children (41 boys and 41 girls) heathy children aged 7-18 years. The Camry Electronic Hand Dynamometer and Hydraulic Pinch Gauge were used to measure grip strength and pinch strength, respectively.

Result: Normative data of grip and pinch strengths were provided. Grip and pinch strengths of both genders were close to each other's and increasing consistently with increasing age. The maximum grip strength and pinch strength was obtained in the group of 14-18 years among both genders. In addition: Study results showed that there was a significant association between weight and all the hand grip strength and pinch strength ($p < 0.05$) in boys whereas BMI considered as an effective parameter on grip strength and tip pinch strength in girls.

Conclusions: Findings from the present study provide reference values for hand grip strength and pinch strength for healthy children from 6- which will be useful to guide rehabilitation outcomes in routine clinical practice.18 years of age which will be useful to guide rehabilitation outcomes in routine clinical practice.

Keywords: Hand Strength, Grip Strength, Saudi, Children, Pinch Strength, Normative Data.

قبضة اليد وقوة القرص لدى الأطفال الأصحاء في عمر 6 إلى 18 سنة في مدينة الخرج بالمملكة العربية السعودية

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المستخلص: الخلفية: يعد قياس ومقارنة قوة القبضة والقرصة مع بياناتها المعيارية طريقة صالحة للكشف عن شدة الأضرار العديدة لليد. كان الهدف من الدراسة هو إنشاء البيانات المعيارية لقوة القبضة وثلاثة أنواع من قوة الضغط (المفتاح، الطرف، والبالمار) لدى الأطفال السعوديين الأصحاء.

الطريقة: في هذه الدراسة المقطعية، تم تسجيل قوة القبضة وثلاثة أنواع من قوة القرص (الطرف والمفتاح والراح) لـ 82 طفلاً سليمًا (41 ولدًا و41 فتاة) أطفال أصحاء تتراوح أعمارهم بين 7-18 عامًا. تم استخدام مقياس قوة اليد الإلكتروني Camry ومقياس القرص الهيدروليكي لقياس قوة القبضة وقوة القرص على التوالي.

النتيجة: تم توفير البيانات المعيارية لقوة القبضة والقرصة. كانت قوة القبضة والقرص لدى كلا الجنسين قريبة من بعضها البعض وتتزايد باستمرار مع تقدم العمر. تم الحصول على أقصى قوة للقبضة وقوة القرص في المجموعة من 14 إلى 18 سنة بين كلا الجنسين. بالإضافة إلى ذلك: أظهرت نتائج الدراسة أن هناك علاقة معنوية بين الوزن وكل قوة قبضة اليد وقوة القرص ($P < 0.05$) عند الأولاد في حين يعتبر مؤشر كتلة الجسم عاملاً فعالاً على قوة القبضة وقوة قرصة الطرف عند الفتيات.

الاستنتاجات: توفر نتائج هذه الدراسة قيمًا مرجعية لقوة قبضة اليد وقوة القرص للأطفال الأصحاء من سن 6 سنوات والتي ستكون مفيدة لتوجيه نتائج إعادة التأهيل في الممارسة السريرية الروتينية. 18 عامًا والتي ستكون مفيدة لتوجيه نتائج إعادة التأهيل في الممارسة السريرية الروتينية.

الكلمات المفتاحية: قوة اليد، قوة القبضة، سعودي، أطفال، قوة القرصة، البيانات المعيارية.

Introduction

Hands have an important role for everyday activities that require well- coordinated hand and arm movements (1,2). Hand strength is often a determinate of overall physical strength(3), healthiness(4), and the state of nutrition(5). Therefore, Measurement of hand grip strength and pinch hand assist to evaluate the level of motor development, degree of disability, and effectiveness of therapy(6). Normative data of grip strength applied across the global in many populations data of grip and pinch different age groups.

Hand function is an essential element in the rehabilitation process, in order to facilitate medical diagnosis and determine developmental stages of the functional levels, and the treatment interventions(7). Hand strength is related to the disabilities such as osteoarthritis of the hand, and rheumatoid arthritis(8). In addition, some studies have reported that grip strength was a remarkable measurement to acknowledge the association between sarcopenia and osteoporosis, falls and fractures. Assessment of grip strength is benefited to evaluate the status of people indiverse conditions(6,8–15).

Several studies have reported the relationship between the handgrip and pinch strength with age, gender, body mass index (BMI), and dominant hands(2,7,16). Few countries including, US, Korea, Australia, and Brazil had references values for grip and pinch strength(2,6,17,18). However, the way for acquiring these references values had many variables factors which lead to limit the clinical applications. People in different parts of the world have different body dimensions, which have influence on grip and pinch strength. In Saudi Arabia, it is difficult to apply because of the social culture and lifestyle. Few studies from Saudi Arabia have published the references values for the hand grip strength (19). The study was reported for old population and not contain the pediatric. Another study is a typical hand grip strength in the age 6–12 years was only conducted on children from the central area of Riyadh (20). Although these two studies have reported hand function in Saudis Arabia, a standardized method was not applicable. The relationship of hand anthropometric variables with grip and pinch strength has not been reported adequately for children.

Studying the grip and pinch strength in children from Saudi Arabia is crucial. It is estimated that at certain milestones during growth, the grip and pinch strength may vary and may not help the therapist to evaluate rehabilitation outcome. Therefore, the present study is designed to generate reference values of grip and pinch strength in specific age groups. The influence of age, gender, and anthropometric variables on grip and pinch strength.

Materials and Methods

Study design and subjects

A cross-sectional study enrolled healthy children subjects who were recruited from different cities at kingdom of Saudi Arabia. Children were selected convenience at shopping centers, public gardens, malls, child sports groups. The study obtained the previous study ethical approval from department of ethical committee (DEC), Prince Sattam Bin Abdulaziz University, Al-Kharj, Saudi Arabia with the reference number of RHPT/0020/0013. Parents of the participants signed a consent form before the assessment.

Inclusion criteria were: (a) age between 6-18-year-olds. (b) feeling no pain or impairments in upper extremities, (c) having no case of hand surgery, fracture or any other conditions that could affect upper extremities, and (c) having no recent hospitalization history. Exclusion criteria were any history of (a) inflammatory disease or (b) neurologic disease or (c) traumatic event to the upper extremity requiring medical management or leading to restrictions of daily activity.

Examiners collected the demographic data including age and sex for each child. Body weight and height were measured using a standard digital weight scale and a standard height scale with accuracy of 0.05 kg and 0.1 cm, respectively. Hand dominances was indicated by the subjects based on the hand used for writing(21).

Procedures and GRIPX

The Camry Electronic Hand Dynamometer and Hydraulic Pinch Gauge (Fabrican Enterprises Inc, Elmsford, NY USA) were used to measure grip strength and pinch strength, respectively, in kilogram(22).

For each of the strength assessments, subjects were asked to sit comfortably, spread and stretch out their hands, with their shoulder adducted, the elbow was flexed at 90°, the forearm and wrist were set in neutral positions(23,24). Three grip strength measurements (for both hands) were taken in this position with a 1-minute rest between each task to avoid muscle fatigue. The subject

was made to hold the dynamometer with the dominant hand first. The subject was asked to squeeze the dynamometer as much as they could and to sustain the effort for 5 seconds(25).

Pinch gauge was used for testing the palmer, tip, and key pinch strength with three successive times for each hand and one-minute to rest with alternating hands between trials(8). For measurement of, palmar, the pinch was placed between the pad of the thumb and pad of the index and middle fingers, tip pinch (with the index finger on top and the thumb below, with the other fingers flexed) and key pinch (pinch is placed between the pad of the thumb and the lateral surface of the index finger), with holding five seconds for each test(14). The instruments for measuring strength were calibrated by the manufacturers was recorded as the result of each type of pinch.

Statistical analysis

Data analyses were performed using statistical software Stata version 15.1 (Stata Corp, College Station, TX). P<.05 was considered significant. The sociodemographic data were presented as mean (standard deviation) or indicated otherwise. All data were checked for normality using Shapiro Wilk test. The baseline differences among both genders were calculated using an independent t-test for continuous data or Fisher's exact test for categorical data. The relationship between socio- demographic and anthropometric data and HGS and PS was analyzed using Spearman's rank correlation. The association and amount of changes in HGS and PS on account of changes in the sociodemographic and anthropometric variables were calculated using multiple linear regression analysis.

Results:

The study population was formed of 82 healthy children (41 boys and 41 girls) from 6 to 18 years of age who participated in the study. Most of the participants were right- handed in both gender and only 7.7 percent of the whole (6 subjects) were left-handed.

There were no significant differences between boys and girls with regard to sociodemographic and anthropometric characteristics. Table 1 presents sociodemographic and anthropometric characteristics of the study participants.

Table 1: Sociodemographic and anthropometric characteristics of the study participants

VARIABLE	BOYS (n = 41)	GIRLS (n = 41)	P- VALUE
Age, years	10.69 ± 3.05	10.97 ± 3.52	0.69
Weight, kg	38.31 ± 16.55	40.01 ± 15.19	0.63
Hight, cm	139 ± 16.15	139.49 ± 15.92	0.89
BMI, kg/m^2	19.05 ± 4.93	19.86 ± 4.56	0.44
Dominant side (RT/LT), n (%)	38 (92.7) / 3 (7.3)	38 (92.7) / 3 (7.3)	0.99
Education, n (%)			
Primary	31 (75.6)	26 (63.4)	0.48
Preparatory	6 (14.6)	10 (24.4)	
Secondary	4 (9.8)	5 (12.2)	
Hours spent on electronic devices, n	9.51 ± 3.74	10.17 ± 3.87	0.43

Hand grip strength and pinch strength stratified by age-group for boys, girls, and pooled gender sub-samples are presented in Table 2. The hand grip strength and Key, Tip, and Palmar pinch strength for both genders increased consistently by increasing age. It was the lowest in the children in the first age group from 6- 10 years and the highest in the age group from 14-18 years. Moreover, both genders showed that the dominant hand was stronger than non- dominant hand in the regards to hand grip strength. The values of hand grip strength and pinch strength in bothgenders were very close to each other except the hand grip strength for the non- dominant side was quite different (19.5-23.93).

Table 2: hand grip strength and pinch strength (*Kg*) stratified by age-group for boys,girls, and pooled gender sub-samples.

VARIABLE	BOYS	GIRLS	POOLED SAMPLE
HGS_D 6 to < 10 y	11.09 ± 2.49	10.68 ± 3.07	10.89 ± 2.75
10 to < 14 y	17.31 ± 3.37	16.81 ± 3.96	17.05 ± 3.63

VARIABLE	BOYS	GIRLS	POOLED SAMPLE
14 to 18 y	23.63 ± 6.94	23.11 ± 3.31	23.38 ± 5.23
HGS_ND 6 to < 10 y	10.67 ± 2.41	10.22 ± 3.19	10.45 ± 2.79
10 to < 14 y	16.18 ± 3.36	16.02 ± 2.89	16.10 ± 3.07
14 to 18 y	23.93 ± 7.87	19.50 ± 3.61	21.72 ± 6.32
KPS_D 6 to < 10 y	5.52 ± 0.83	5.56 ± 0.91	5.49 ± 0.86
10 to < 14 y	7.26 ± 1.58	6.88 ± 1.23	7.06 ± 1.40
14 to 18 y	9.14 ± 1.99	8.45 ± 1.09	8.79 ± 1.58
KPS_ND 6 to < 10 y	5.95 ± 0.67	5.46 ± 0.97	5.53 ± 0.82
10 to < 14 y	6.96 ± 1.53	6.34 ± 0.94	6.64 ± 1.27
14 to 18 y	8.81 ± 2.27	8.14 ± 1.89	8.48 ± 2.04
TPS_D 6 to < 10 y	3.65 ± 0.57	3.62 ± 0.80	3.63 ± 0.69
10 to < 14 y	4.40 ± 0.69	4.09 ± 0.92	4.24 ± 0.82
14 to 18 y	4.71 ± 1.29	5.07 ±0.70	4.89 ± 1.02
TPS_ND 6 to < 10 y	3.66 ± 0.63	3.65 ± 0.91	3.61 ± 0.77
10 to < 14 y	4.12 ± 0.77	3.88 ± 0.84	3.99 ± 0.80
14 to 18 y	4.88 ± 1.42	4.57 ± 0.89	4.73 ± 1.50
PPS_D 6 to < 10 y	4.21 ± 0.57	4.01 ± 0.83	4.11 ± 0.71
10 to < 14 y	4.89 ± 0.85	4.74 ± 1.33	4.82 ± 1.11
14 to 18 y	5.43 ± 1.64	5.83 ± 0.71	5.63 ± 1.23
PPS_ND 6 to < 10 y	4.08 ± 0.57	3.97 ± 0.95	4.03 ± 0.77
10 to < 14 y	4.76 ± 0.84	4.61 ± 1.01	4.68 ± 0.92
14 to 18 y	5.21 ± 1.48	5.02 ± 0.60	5.12 ± 1.09

HGS: hand grip strength, KPS: key pinch strength, TPS: tip pinch strength, PPS: palmar pinch strength, D: dominant side, ND: non dominant side

Table 3 shows the spearman's rank correlation coefficients between the hand grip and pinch strength and sociodemographic and anthropometric variables in boys. There was

a significant correlation between the hand grip strength and pinch strength with children's age, weight, height, and BMI except the BMI for PPS. However, there were no significant differences between the hand grip strength and pinch strength with the number of hours children spent on the electronic devices except the hand grip of the dominance side which was significantly related to the number of hours (r= 0.33, p =.034).

Table 3: Spearman's rank correlation coefficients between handgrip and pinch strength and other variables in boys.

	AGE	WEIGHT	HEIGHT	BMI	HRS. ON DEVICES
HGS_D *r*	0.78	0.79	0.71	0.43	0.33
P-value	<.001	<.001	<.001	.005	.034
HGS_ND *r*	0.80	0.79	0.71	0.39	0.25
P-value	<.001	<.001	<.001	.01	.18
KPS_D *r*	0.65	0.73	0.75	0.56	0.17
P-value	<.001	<.001	<.001	<.001	.27
KPS_ND *r*	0.61	0.65	0.70	0.55	0.15
P-value	<.001	<.001	<.001	<.001	.35
TPS_D *r*	0.42	0.49	0.52	0.41	0.024
P-value	.007	.001	<.001	.008	.88
TPS_ND *r*	0.37	0.39	0.46	0.37	0.12

	AGE	WEIGHT	HEIGHT	BMI	HRS. ON DEVICES
P-value	.02	.012	.003	.02	.45
PPS_D *r*	0.35	0.37	0.36	0.27	0.22
P-value	.025	.019	.021	.08	.17
PPS_ND *r*	0.35	0.39	0.38	0.24	0.09
P-value	.027	.013	.015	.12	.59

HRS: hours, HGS: hand grip strength, KPS: key pinch strength, TPS: tip pinch strength, PPS: palmar pinch strength, D: dominant side, ND: non dominant side, *r*: Spearman correlation coefficient

The correlation between the hand grip and pinch strength and some other variables in girls are outlined in (Table 4). For the girls, there was a significant relationship between age, weight, height, and BMI with hand grip and pinch strength. (Relationship ranged from the weak relationship) $r < 0.25$ too strong relationship meaning that the $r > 0.8$. Also, there was a significant relationship between the number of hours children spent on the electronic devices with the hand grip and pinch strength except for the TPS and PPS of the non-dominance side.

Table 4: Spearman's rank correlation coefficients between handgrip and pinch strength and other variables in girls

	AGE	WEIGHT	HEIGHT	BMI	HRS. ON DEVICES
HGS_D *r*	0.89	0.88	0.79	0.50	0.52
P-value	<.001	<.001	<.001	.001	<.001
HGS_ND *r*	0.86	0.89	0.83	0.54	0.49
P-value	<.001	<.001	<.001	<.001	<.001
KPS_D *r*	0.81	0.83	0.76	0.51	0.49
P-value	<.001	<.001	<.001	.001	.001
KPS_ND *r*	0.74	0.75	0.74	0.54	0.37
P-value	<.001	<.001	<.001	<.001	.015
TPS_D *r*	0.64	0.61	054	0.32	0.33
P-value	<.001	<.001	<.001	.045	.035
TPS_ND *r*	0.48	0.47	0.47	0.35	0.17
P-value	.002	.002	.002	.026	.28
PPS_D *r*	0.62	0.65	0.64	0.44	0.36
P-value	<.001	<.001	<.001	.004	.021
PPS_ND *r*	0.57	0.58	0.57	0.39	0.22
P-value	<.001	<.001	<.001	.011	.17

HRS: hours, HGS: hand grip strength, KPS: key pinch strength, TPS: tip pinch strength, PPS: palmar pinch strength, D: dominant side, ND: non dominant side, *r*: Spearman correlation coefficient

Table 5 shows the Spearman's rank correlation coefficients association between hand grip and pinch strength and other variables in the body. There is a non-significant association-between the age and all Hand grip strength and pinch strength variable (p-value more than 0.05). In addition, there is a significant association-between the weight and all Hand grip strength and pinch strength variable (p-value less than 0.05). Also, there is a significant association-between the height and HGS-D, HGS-ND, TPS-D,

TPS-ND. There is a tendency significant association between height and PPS-ND. There is a significant association between the BMI and HGS-D, TPS-D, TPS-ND. Finally, there is a non-significant association-between the HRS on devices and all Hand grip strength and pinch strength variables (p-value more than 0.05).

Table 5: Association between handgrip and pinch strength and other variables in boys.

		AGE	WEIGHT	HEIGHT	BMI	HRS. ON DEVICES
HGS_D	β (*P*)	0.30 (.22)	0.54 (.003)	-0.61 (.02)	0.97 (.04)	-0.05 (.62)
HGS_ND	β (*P*)	0.84 (.11)	0.49 (.008)	-0.55 (.046)	0.98 (.10)	0.16 (.38)

HGS_D	β (*P*)	0.30 (.22)	0.54 (.003)	-0.61 (.02)	0.97 (.04)	-0.05 (.62)
KPS_D	β (*P*)	-0.03 (.87)	0.18 (.006)	-0.16 (.09)	0.33 (.12)	-0.04 (.49)
KPS_ND	β (*P*)	0.10 (.61)	0.16 (.02)	-0.17 (.07)	0.37 (.11)	-0.03 (.54)
TPS_D	β (*P*)	-0.008 (.93)	0.11 (.004)	-0.13 (.015)	0.27 (.026)	-0.05 (.18)
TPS_ND	β (*P*)	0.04 (.76)	0.09 (.026)	-0.13 (.039)	0.28 (.047)	-0.03 (.48)
PPS_D	β (*P*)	-0.004 (.97)	0.08 (.07)	-0.09 (.19)	0.16 (.27)	-0.005 (.91)
PPS_ND	β (*P*)	-0.001 (.99)	0.1 (.018)	-0.12 (.054)	0.22 (.11)	-0.025 (.55)

HRS: hours, HGS: hand grip strength, KPS: key pinch strength, TPS: tip pinch strength, PPS: palmar pinch strength, D: dominant side, ND: non dominant side, β: regression coefficient

Table 6 shows the Spearman's rank correlation coefficients association between the hand grip and pinch strength and other variables in girls. There is a significant association-between the AGE and HGS-D, HGS-ND, KPS-D, KPS-ND. There is a non- significant association-between the WEIGHT and all Hand grip strength and pinch strength variable (p-value more than 0.05). In addition, there is a non-significant association-between the HEIGHT and all Hand grip strength and pinch strength variable (p-value more than 0.05). Also, there is a non-significant association-between the BMI and all Hand grip strength and pinch strength variable (p-value more than 0.05). Finally, there is a non-significant association-between the HGS on devices and all Hand grip strength and pinch strength variables (p-value more than 0.05).

Table 6: Association between handgrip and pinch strength and other variables in girls.

		AGE	WEIGHT	HEIGHT	BMI	HRS. ON DEVICES
HGS_D	β (*P*)	0.49 (.001)	0.26 (.06)	-0.51 (.38)	0.39 (.27)	-0.02 (.81)
HGS_ND	β (*P*)	0.52 (.026)	0.24 (.07)	-0.17 (.43)	0.49 (.25)	-0.7 (.59)
KPS_D	β (*P*)	0.21 (0.01)	0.01 (.81)	0.04 (.63)	-0.03 (.83)	.007 (.88)
KPS_ND	β (*P*)	0.26 (.014)	0.05 (.41)	-0.07 (.47)	0.18 (.36)	-0.02 (.77)
TPS_D	β (*P*)	0.13 (.08)	-0.002 (.96)	0.02 (.75)	-0.04 (.81)	-0.006 (.88)
TPS_ND	β (*P*)	0.11 (.16)	0.007 (.87)	0.002 (.97)	0.03 (.86)	-0.03 (.47)
PPS_D	β (*P*)	0.09 (.33)	-0.02 (.73)	0.08 (.31)	-0.12 (.45)	-0.004 (.95)
PPS_ND	β (*P*)	0.04 (.61)	0.03 (.54)	0.004 (.96)	0.025 (.87)	-0.027(.53)

HRS: hours, HGS: hand grip strength, KPS: key pinch strength, TPS: tip pinch strength, PPS: palmar pinch strength, D: dominant side, ND: non dominant side, β: regression coefficient

Discussion

In this study, the normative data of grip strength and three types of pinch strengths known as Tip, Key and Palmar were detected for the norms children aged 6-18 years old in Saudi Arabia which is none of the other studies reported in the literature identified a similar trend. The results of our study represented that there were increases in hand grip strength and hand pinch strength in both genders with advancing age. These findings were supported by studies previously published from Saudi Arabia and other countries(8,19,26,27) ,that established a positive relationship between hand grip strength and pinch strength with age. In addition, we observed that a significant increase in grip strength occurred around 14-18 years of age, which was consistent with the results of previous study(26) .This probably due to physical growth associated with the onset of puberty. All the participants showed that the strength of the dominant hand was stronger than of the non-dominant hand. A study conducted by Souza presented the norms values of hand grip and pinch strength, they found that dominant hands was significantly greater of non- dominant hands(17). These differences might refer to the hand that a person use in daily life to perform skilled activities. Our results showed that a s significant association between hand grip strength and pinch strength with weight and BMI for boys whereas girls did not have this relationship. Both genders had no significant association between the number of hours spent on the electronic devises with grip and pinch strength.

Comparing handgrip and pinch strength of healthy children in different studies have been published. Dominant and non-dominant hands had significant differences in grip strength which was consistent with the findings from a few studies(20,23,28). They had evaluated healthy children of both genders aged and found that grip strength of the dominant hand was stronger than that of the

non-dominant. However, according to the studies in Korea and Australia, children showed no significant difference according to hand dominance(2,29). Children in different countries might have different body dimensions, which have influenced their hand strength. Body weight should be taken into consideration to make a correct comparison between the performance values regards to the genders. The result of our study indicated that the body weight correlated with grip strength in boys. A study by Jasic S, stated the weight of the body has important effects on hand grip strength(30). In girls, the weight and height indicated correlated with grip strength. A cross sectional study of 2241 children by Joris JW Ploegmakers et al, was designed to investigate the association of grip strength with gender, weight, and height in norms children. Their results confirmed the present study with a remarkable association between weight and height with the hand grip in children for both genders(31).

Furthermore, the present study showed that there is a significant association between height, weight and BMI with tip pinch strength for boys. These findings are consistent same results studies which for the TPS of boys in similar age group(27).

The current study demonstrates no significant association between the number of hours spent on the electronic devises with grip and pinch strength. A consistent previous study compared hand grip strength and pinch grip strength between high-frequency electronic device users and low frequency among children. They divided 55 participants into two groups. Group A spent electronic device < 4 hours/day vs. group B who spent electronic device > 4 hours/day).The study reported no difference in grip and pinch strength between high and low frequency according to the time which spent among children(32).

A few advantages had including our study. First, it was carried out a large sample of school-aged children. Second, it recruited from different cities at kingdom of Saudi Arabia. They can also be used the need for further physiotherapy during hand rehabilitation. Some limitations should be noted on the present study. The first limitation is that most of the children were right- handed, and often this is also the strongest hand. We recommend measuring grip and pinch strength with the same numbers for right and left hand to validate the results. Second, the body dimensions especially those of upper extremities like hand and palm length, palm width, and forearm length did not consider to the study. Further studies would be recommended to determine if there is a relationship between hand dimensions and with handgrip and pinch strength among healthy children.

Conclusion

This study presents reference values for grip strength in children in both genders. While both genders had increasing in hand grip strength and hand pinch strength by increasing age, boys were recorded to have more a significant association with anthropometric measurements. Moreover, this study shows that grip strength for dominant hand was higher than non-dominant hand which may be the result of using dominant hand frequently. The information obtained from normative data of grip and pinch strength can be applied to treatment needs in the rehabilitation of physiotherapy.

References

- Exner CE. The zone of proximal development in in-hand manipulation skills of nondysfunctional 3- and 4-year-old children. The American journal of occupational therapy : official publication of the American Occupational Therapy Association. 1990;44(10).
- Yim SY, Cho JR, Lee IY. Normative Data and Developmental Characteristics of Hand Function for Elementary School Children in Suwon Area of Korea: Grip, Pinch and Dexterity Study. Journal of Korean Medical Science. 2003;18(4).
- Massy-Westropp N, Rankin W, Ahern M, Krishnan J, Hearn TC. Measuring grip strength in normal adults: Reference ranges and a comparison of electronic and hydraulic instruments. Journal of Hand Surgery. 2004;29(3).
- Jürimäe T, Hurbo T, Jürimäe J. Relationship of handgrip strength with anthropometric and body composition variables in prepubertal children. HOMO- Journal of Comparative Human Biology. 2009;60(3).
- Kenjle K, Limaye S, Ghugre PS, Udipi SA. Grip strength as an index for assessment of nutritional status of children aged 6-10 years. Journal of Nutritional Science and Vitaminology. 2005;51(2).
- Mullerpatan RP, Karnik G, John R. Grip and pinch strength: Normative data for healthy Indian adults. Hand Therapy. 2013;18(1).
- Kimmerle M, Mainwaring L, Borenstein M. The functional repertoire of the hand and its application to assessment. Vol. 57, American Journal of Occupational Therapy. 2003.
- Sil Asstt P. AGE-ASSOCIATED CHANGES OF HAND GRIP STRENGTH AND ABDOMINAL STRENGTH ENDURANCE IN 10 TO 14 YEARS OLD RURAL BOYS [Internet]. Vol. 02, INTERNATIONAL JOURNAL OF BEHAVIORAL SOCIAL AND MOVEMENT SCIENCES. 2013. Available from: www.ijobsms.in

- Osailan A. The relationship between smartphone usage duration (using smartphone's ability to monitor screen time) with hand-grip and pinch-grip strength among young people: an observational study. BMC Musculoskeletal Disorders. 2021 Dec 1;22(1).
- Link L, Lukens S, Bush MA. Spherical grip strength in children 3 to 6 years of age. The American journal of occupational therapy : official publication of the American Occupational Therapy Association. 1995;49(4).
- Karavelioglu MB, Harmanci H, Caliskan G. Gender differences in hand grip strength of the child athletes by using absolute, ratio and allometric scaling methods. Biomedical Research (India). 2017;28(4).
- Molenaar HM, Selles RW, Zuidam JM, Willemsen SP, Stam HJ, Hovius SER. Growth Diagrams for Grip Strength in Children. Clinical Orthopaedics and Related Research. 2010;468(1).
- Fredriksen PM, Mamen A, Hjelle OP, Lindberg M. Handgrip strength in 6–12-year-old children: The Health Oriented Pedagogical Project (HOPP). Scandinavian Journal of Public Health. 2018;46(21_suppl).
- Bhuanantanondh P, Nanta P, Mekhora K. Determining Sincerity of Effort Based on Grip Strength Test in Three Wrist Positions. Safety and Health at Work. 2018;9(1).
- El-gohary TM, Abd Elkader SM, Al-shenqiti AM, Ibrahim MI. Assessment of hand-grip and key-pinch strength at three arm positions among healthy college students: Dominant versus non-dominant hand. Journal of Taibah University Medical Sciences. 2019;14(6).
- Rostamzadeh S, Saremi M, Vosoughi S, Bradtmiller B, Janani L, Farshad AA, et al. 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 Pediatrics. 2021;21(1).
- de Souza MA, de Jesus Alves de Baptista CR, Baranauskas Benedicto MM, Pizzato TM, Mattiello-Sverzut AC. Normative data for hand grip strength in healthy children measured with a bulb dynamometer: A cross-sectional study. Physiotherapy (United Kingdom). 2014;100(4).
- Backman C, Daniels LE. A description of grip and pinch strength in children aged 6 to 11 years using the Martin Vigorimeter. Canadian Journal of Occupational Therapy. 1996;63(4).
- Alqahtani B, Alenazi A, Alshehri M, Alqahtani M, Elnaggar R. Reference values and associated factors of hand grip strength in elderly Saudi population: A cross-sectional study. BMC Geriatrics. 2019;19(1).
- Omar MTA, Alghadir A, al Baker S. Norms for hand grip strength in children aged 6-12 years in Saudi Arabia. Developmental Neurorehabilitation. 2015 Feb 1;18(1):59–64.
- American Society of Hand Therapists Clinical Assessment Recommendations [Internet]. Available from: https://www.researchgate.net/publication/303400806
- Hogrel JY. Grip strength measured by high precision dynamometry in healthy subjects from 5 to 80 years. BMC Musculoskeletal Disorders. 2015;16(1).
- Koley S, Melton S. Age-related Changes in Handgrip Strength among Healthy Indian Males and Females Aged 6-25 years. Journal of Life Sciences. 2010;2(2).
- España-Romero V, Ortega FB, Vicente-Rodríguez G, Artero EG, Rey JP, Ruiz JR. Elbow position affects handgrip strength in adolescents: Validity and reliability of jamar, dynex, and TKK dynamometers. Journal of Strength and Conditioning Research. 2010;24(1).
- Shiratori AP, Iop R da R, Júnior NGB, Domenech SC, Gevaerd M da S. Evaluation protocols of hand grip strength in individuals with rheumatoid arthritis: A systematic review. Vol. 54, Revista Brasileira de Reumatologia. 2014.
- Gómez-Campos R, Andruske CL, de Arruda M, Sulla-Torres J, Pacheco-Carrillo J, Urra- Albornoz C, et al. Normative data for handgrip strength in children and adolescents in the Maule Region, Chile: Evaluation based on chronological and biological age. PLoS ONE. 2018;13(8).
- Wen J, Wang J, Xu Q, Wei Y, Zhang L, Ou J, et al. Hand anthropometry and its relation to grip/pinch strength in children aged 5 to 13 years. Journal of International Medical Research. 2020;48(12).
- Omar MTA, Alghadir A, al Baker S. Norms for hand grip strength in children aged 6-12 years in Saudi Arabia. Developmental Neurorehabilitation. 2015 Feb 1;18(1):59–64.
- Newman DG, Pearn J, Barnes A, Young CM, Kehoe M, Newman J. Norms for hand grip strength. Archives of Disease in Childhood. 1984;59(5):453–9.
- Jaric S. Muscle strength testing: Use of normalisation for body size. Vol. 32, Sports Medicine. 2002.
- Ploegmakers JJW, Hepping AM, Geertzen JHB, Bulstra SK, Stevens M. Grip strength is strongly associated with height, weight and gender in childhood: A cross sectional study of 2241 children and adolescents providing reference values. Journal of Physiotherapy. 2013;59(4).
- Shruti Tidke MB, Rajesh Shah M, Hardik Kothari P. Effects of Smartphone Addiction on Pinch Grip Strength. International Journal of Health Sciences & Research (www.ijhsr.org). 2019;9(10).