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Differences in Hand Strength and Key Pinch Grip Between Sitting and Standing Positions in a Sample of Healthy Mexican Young Adults

Gabriel Ibarra-Mejia[1, 4], Jeffrey E. Fernandez[2], Robert J. Marley[3], Brandy F. Ware[2], Ana G. Vazquez-Salinas[4], and Ivette Navarro-Hernández[4]

[1] Department of Public Health Sciences
University of Texas at El Paso
500 West University Ave
El Paso, Texas 79968

[2] JFAssociates, Inc.
Vienna, Virginia 22031

[3] Mechanical and Industrial Engineering Department
Montana State University
212 Roberts Hall, P.O. Box 173820
Bozeman, Montana 59717

[4] Department of Industrial and Manufacturing Engineering
Universidad Autonoma de Ciudad Juárez
Avenida del Charro 450 Norte
Ciudad Juárez Chihuahua, México

Corresponding author's email: gabmejia@utep.edu; gabriel.ibarra@uacj.mx

Abstract: To assess differences between sitting and standing positions, measures of hand grip and key-pinch strengths were taken from a sample of forty-four, able-body males and females from the Northern Mexico region using Caldwell´s protocol. Mean comparisons between both positions revealed statistically significant higher hand grip strength in the standing position, while no differences were detected for key-pinch grip. Strength data suggest that there is a significantly lower capacity between the study population and the strength reported for several other countries; however more research is required to verify these differences.

Keywords: strength, hand grip, key-pinch, MVC, Mexican population.

Following up on our own previous studies documenting anthropometric and physiological capabilities of Northern Mexican populations, the objective of this study was to determine differences in the MVC for hand grip and key-pinch in neutral sitting and standing postures.

2. Methods and Procedures

Forty-four able-bodied, male and female subjects were recruited from the student population at Northern-Mexico University. The participants ranged in age from 18 to 35 years. Potential subjects were screened to eliminate individuals who had a history of cumulative trauma of the upper extremities. Phalen's test was also administered to confirm absence of current neurological disease at wrist and hand level.

2.1 Instruments

A self–administered questionnaire was designed and used to collect participant's personal and demographic information. Height and weight anthropometric data were collected using a Detecto® weight balance beam with height rod. Grip measurements were collected using a Jamar® hydraulic grip dynamometer; key pinch strength measurements were collected with a Chattanooga® hydraulic pinch gauge.

2.2 Procedures

After passing the initial screening, participants were informed of the study objectives and procedures. Participants then read and signed an informed consent. Height and weight were collected with the subjects in minimal clothing. Grip measures in a sitting position were collected while subjects were in a neutral sitting posture. This posture was obtained using an adjustable chair which allowed participants to maintain feet supported and parallel to the floor, knees flexed at 90^o, trunk flexed at 90^o, shoulders adducted, elbows flexed at 90^o, forearms parallel to the floor, and wrist in neutral position. Grip measures in a standing position were collected while subjects were in a neutral standing posture. Neutral standing position was obtained while subjects were standing upright, shoulders adducted, elbows flexed at 90^o, forearms parallel to the floor, and wrists in neutral position. To prevent shoulder abduction while measuring, Velcro straps were attached around the subject's waist and tested arm. The Caldwell protocol (Caldwell et al., 1974) was used to determine both peak grip and pinch MVC measures. The subject was asked to squeeze the hand dynamometer or pinch gage slowly, build to his/her maximum, and then hold for three seconds. This measure was repeated twice with a 5-minute rest between measures, the maximum value was recorded for each hand.

2.3 Data analysis

Descriptive statistics were obtained for all measured data; comparison of grip and pinch MVC measures were conducted between sitting and standing postures applying a t-test at a significance level of 0.05. All statistical analyses were performed using SPSS® v18 software.

3. Results

The population's mean for several anthropometric and strength variables were compared to previous results in the sitting (Ibarra-Mejia et al., 2009) and standing positions (Ibarra-Mejía, et al., 2010). Simple comparisons showed that although strength measures for this subject population were slightly higher for hand grip strength, and slightly lower for key pinch, there are no noticeable differences in these strengths between studied populations.

Descriptive statistics of demographic data for the study participants were evaluated and are shown in Table 1. Demographic parameters such as age, height, weight, and body mass index (BMI) were significantly different between genders.

Table 1. Pooled and by Gender Characteristics of Participants: Gender, Age, Height, Weight and BMI

Characteristic	N= 44	Gender		*p* value
		Males n=30	Females n=14	
	Mean ± SD	Mean ± SD	Mean ± SD	
Age (years)	23 ± 3.2	22.33 ± 2.25	24.71 ± 4.29	0.03
Height (cm)	168.98 ± 20.26	174.23 ± 7.83	157.73 ± 7.96	< 0.001
Weight (Kg)	72.19 ± 23.09	77.48 ± 21.39	60.86 ± 12.18	< 0.001
BMI (Kg/m2)	25.13 ± 5.86	25.47 ± 6.54	24.40 ± 4.14	< 0.001

3.1 Grip Strength Results

Pooled MVC grip strength data from both gender participants are shown in Table 2. Analysis of these data showed significant differences between MVC grip strength in sitting and standing positions (Table 2). Participants were able to exert an average of 1.18 kg (3.0%) more force with the right hand while in an upright posture as compared to a sitting posture. Participants were able to exert an average of 1.41 kg (3.9%) more force with the left hand while in an upright posture as compared to a sitting posture. For both positions, right hand strength was higher that left hand strength due to majority´s hand dominance.

Table 2. Differences in Pooled Hand (Power) Grip Strengths Participants in Sitting and Standing Positions

Hand	Body position						*p* value
	Sitting			Standing			
	Mean (Kg)	95% CI		Mean (Kg)	95% CI		
		Lower	Upper		Lower	Upper	
Right hand	38.00 ± 10.52	34.89	41.11	39.18 ± 10.24	36.16	42.21	**0.026***
Left hand	34.48 ± 10.44	31.39	37.56	35.89 ± 10.08	32.91	38.86	**0.026***

*Bold characters indicate a statistically significant difference at a value of p=0.05

3.2 Key Pinch Strength Results

For key pinch strength, pooled data from both genders are shown in Table 3. Evaluation of these data showed no statistically significant differences between sitting or standing posture or right or left hand. The key pinch strength was slightly higher for the right hand in both the sitting and standing posture (Table 3).

Table 3. Differences in Pooled Key Pinch Strengths Participants in Sitting and Standing Positions

Hand	Body position						*p* value
	Sitting			Standing			
	Mean (Kg))	95% CI		Mean (Kg)	95% CI		
		Lower	Upper		Lower	Upper	
Right hand	2.16 ± 1.00	1.87	2.46	2.15 ± 1.11	1.82	2.48	0.86
Left hand	1.87 ± 0.91	1.60	2.14	1.93 ± 0.88	1.67	2.19	0.33

*Bold characters indicate a statistically significant difference at a value of p=0.05

4. Concluding Remarks

Grip and key pinch strength were measured in a sample of a Northern Mexican population to assess differences between MVC in neutral sitting and standing postures. For both genders, hand grip strength comparison between sitting and standing positions revealed higher level of voluntary exertion in the standing position that was statistically significant ($p<0.05$); however, no statistically significant differences were detected for key pinch strength between sitting and standing postures. Several authors have reported lower pinch and grip strength in the sitting position. Palanisami, Narasimhan, and Fernandez (1994) reported a lower pinch strength capability in a sitting posture; lower grip strength results were also previously reported by Catovic, Kosovel, Catovic, and Muftic (1989) when comparing sitting and standing positions in a sample population of dentists.

Few studies have looked into the cause of grip and pinch differences between sitting and standing, thus it remains unclear. Explanation for these differences in strength between sitting and standing have been given by Åstrand and Rodahl (1977), Berger (1982), Lamb (1984) and Boadella, et al. (2005), stating that a sitting position produces a physiological relaxation effect with a lower feedback and muscle recruitment from the lower limbs resulting in an elevated grip strength measured in the standing position as compared with the sitting position; in standing position, overall more muscles of the body are recruited, so the Central Nervous System received greater feedback and can more effectively recruit additional motor units from the muscle fibers of the hand and forearm.

Another explanation was given by Clarke et al., (1991), hypothesizing that the differences were due to mechanical and systemic factors. Citing Breig (1978), Clarke reported that decreases in grip strength may be due to tension in the cervical cord and dura while the body is in a state of thoraco-lumbar flexion, such as the sitting posture.

Both pinch and grip strength measurements in the current study were similar to those from two previous studies conducted by the researchers in different populations from the same region; hence there is the possibility to combine data. When compared to other populations, these strength data suggest there is a significantly lower capacity between the study population and several others reported for the United States (Mathiowetz et al., 1985; Richards, 1997), England (University of Nottingham, 2000), Brazil (Schlussel et al., 2008), Bohannon's metanalysis (Bohannon et al., 2006), and Taiwan females (Wu et al., 2009). Since the number of participants in this study is relatively small, future research should be conducted to verify these population differences.

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