International Journal of Sport Culture and Science
March 2023 : 11(1)
ISSN : 2148-1148
Doi : 10.14486/IntJSCS.2023.670

Does hand grip strength correlate to buttoning speed in young women?

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Type: Research Article ***(Received: 22.06.2022 – Accepted: 18.03.2023)***

Abstract

Background: Hand grip strength is the measure of maximal force of the hand and is one of the primary indicators of the ability to live independently and perform activities of daily living, however does this correlate to shirt buttoning skills? **Material and method:** Female subjects (n = 28) volunteered for this study (age: 23.63 + 5.6 yrs; ht. 171.22 + 7.1 cm; mass: 73.21 + 23.1 kg). Participants were provided with a button shirt from the same manufacturer, with 5 buttons each. All subjects placed both hands on the collar with opposite fingers touching the first button before being given the start command. The research team digitally timed the participants in seconds on how fast the participant could button down the shirt. Of the three trials, the best time was recorded. Participants were then assessed 1 maximal grip strength test per hand via a Camry hand-grip dynamometer. **Results:** Pearson correlation from right-hand grip strength to best time (r = - 0.214; p = 0.274) and left-hand grip strength to best time (r = - 0.028; p = 0.888) was not significant. **Discussion:** No statistical significance was found between grip strength and the fastest trial of buttoning down a shirt.

Keywords: Activities of daily living, Buttoning, Grip strength, Women

Introduction

In the United States alone, there are over 1 million upper-extremity injuries each year (Le et al., 2021). The appropriate functioning of our hands in everyday life is often overlooked until a limitation arises. Additionally, effective hand function supports the independent execution of many Activities of Daily Living (ADLs), including picking up a toothbrush and dental hygiene, typing a paper, driving a car, drawing a picture, catching a ball, and buttoning a shirt. Owing to the high number of upper-extremity injuries per year, there are many individuals who are unable to complete tasks involving their hands (Novello et al., 2022). In conjunction with proper hand functioning, is the ability to produce and sustain appropriate amounts of hand grip strength. Grip strength can be a reliable and valid method to evaluate hand injuries and function (Sanders et al., 2022). Hand grip strength is considered a valid method to assessing and predicting health outcomes (Wang et al., 2018; Wong, 2016)). The ability to produce, maintain, and regulate grip strength is essential for the human hand to control objects and maintain functionality of daily tasks (Bobos et al., 2020).

Hand grip strength is the measure of maximal force of the hand and is one of the primary indicators of the ability to live independently and perform activities of daily living (ADLs) (Patrizio et al., 2021). ADLs consist of functional skills often needed to achieve a person's basic physical needs (Patrizio et al., 2021). Further examples of ADLs include bathing and showering, toilet hygiene, swallowing, feeding, functional mobility, and grooming (AOTA, 2020). In addition, ADLs are vital to daily function and independence due to an individuals' ability to complete daily tasks correlating with their ability to live and function freely (Patrizio et al., 2021). Individuals typically gain mastery of their fine motor skills in early life and display increased retention rates when compared to higher-level tasks (Mlinac & Feng, 2016).

Through the ability to independently complete basic ADLs and personal care, functional freedom is improved, thus leading to greater quality of life (Mlinac & Feng, 2016). Clinically, occupational therapists use ADL assessments to evaluate patients' function. Disadvantages to being dependent on external care in daily life skills include decreased quality of life, increased healthcare costs and mortality risk, and institutionalization (Mlinac & Feng, 2016). By way of suffering significant trauma to the hands, simple daily tasks and fine motor skills may be severely impacted.

Managing individual grip strength is crucial when performing various ADLs. Patients with a history of impaired tactile sensibility due to disease manifestations have all been observed to produce less than adequate grip strength while performing ADLs (Olczak, 2021). Buttoning is a skill that is considered as an ADL (Cheong et al., 2018). Buttoning a shirt or blouse involves a more skilled, complex motor task compared to unbuttoning skills based on muscle strength of the proximal limb (Cheong et al., 2018). Investigators studied how much time it took for stroke patients to complete 5 buttons sized 2.5 cm in diameter and compared this to the Jebsen-Taylor Hand Function Test (JTHFT). The JTHFT is a standardized measure of hand function using ADLs such as writing, simulated page-turning, lifting small objects, simulated feeding, stacking, and lifting objects (Berardi et al., 2022). The correlation among three groups based on their buttoning speeds and current level of health demonstrated strong correlations with both hands (r = .76-.91). However, there is an absence in the literature investigating the relationship between handgrip strength and buttoning skills among healthy or an impaired female population. Lindstrom-Hazel et al. (2016) compared the time it took males to button a shirt and complete a Nine Hole Peg Test with the intent of creating a normative reference value to assess fine motor skills (Sanders et al., 2022). However, women

were not included as subjects during this study and the size of the buttons were small (0.5 cm). There is currently an absence in the literature with assessing the grip strength of women and the speed of buttoning a shirt. The results of this study could provide valuable insight to healthcare providers regarding future treatment options and plan of care, should a strong relationship between the two variables be observed. Therefore, the purpose of this investigation was to determine if hand grip strength correlated to buttoning speed in young women.

Material and Method

Design of Research

To determine the correlation between hand grip strength and the speed of buttoning down a shirt, the investigators used a quantitative, one-shot case study (Creswell & Creswell, 2018). This design was implemented so the results could be acquired in one setting. An Institutional Review Board reviewed and approved the study prior to data collection.

Subject Demographics

The participants were recruited from a Midwestern institution of higher education. All participants were females between the ages of 19-40 years old (refer to Table 1). Participants were deemed to be healthy prior to testing with no previous injuries to the arms, wrists, spine, or brain. Before testing, each participant was provided with an informed consent which they were required to read and voluntarily sign to participate in this study.

Table 1. Subject demographic information (cm=centimeters; kg=kilograms).

N size	Age (years)	Height (cm)	Weight (kg)
28	23.63 $\pm$ 5.58	171.13 $\pm$ 7.06	73.21 $\pm$ 23.10

Table 2. Descriptive demographics of collected data (SD=Standard Deviation; N=Number of subjects).

Variable(s)	N	SD	Pearson Correlation (r-value)	P-value
Best Handgrip Right (lbs.)	28	69.81 $\pm$ 12.36	r = -0.214	p = 0.274
Best Handgrip Left (lbs.)	28	68.11 $\pm$ 17.10	r = -0.028	p = 0.888

Protocol

Data was collected on the campus of the Midwest institution of higher education. Due to the study being completed during COVID-19, researchers and participants were required to wear a face mask and social distance. Before each use, the equipment (shirts, buttons, and hand grip dynamometer) was sanitized. Each participant was provided with a button-down shirt that fit them best. All shirts used were the same style and from the same manufacturer with 5 buttons, 1 cm in diameter. During testing, the primary investigator digitally timed the participants on an Apple iPhone to 0.01 seconds on how fast they could completely button down the shirt. Every subject started with both hands holding on to the shirt collar. Upon command, they buttoned as quickly as possible until the 5th button completion signaled the stoppage from the timer. In between trials, everyone was provided one minute of rest. Three trials were completed, and the best time was recorded. After three buttoning trials were completed, the participant was provided a Camry hand-grip dynamometer. A hand grip dynamometer is considered a reliable and valid tool used for measuring force production of the hand (Sanders et al., 2022). The hand-grip dynamometer was set specifically to the participant's age and gender. The participants stood up with their arm at their side and the hand-grip dynamometer in their hand. They were instructed to squeeze the dynamometer with maximal effort. The investigators recorded both their left and right-hand grip strength in pounds.

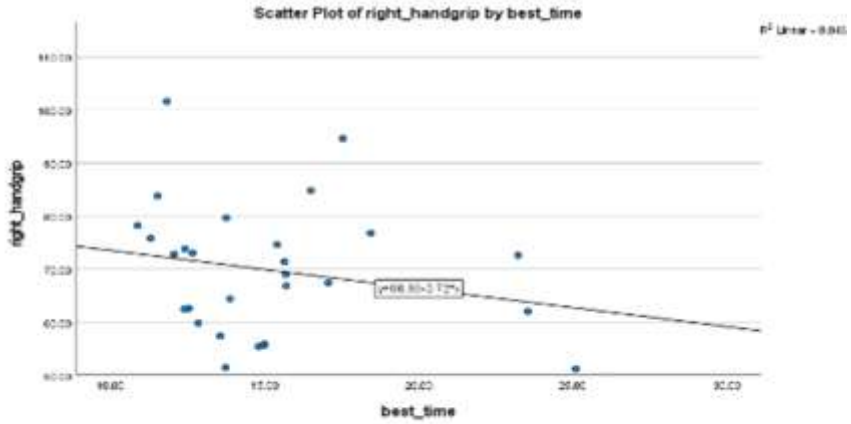
Statistical Analysis

The data analysis procedure was a Pearson correlation of two dependent variables. The two variables analyzed were the speed of buttoning (0.01 seconds) and hand-grip strength (in pounds). The data was analyzed using SPSS version 26 (New York, NY). Subject demographic data is listed in Table 1. Pearson correlation analyzed both right-hand and left-hand grip strength in comparison to the speed of buttoning down a shirt (refer to Table 2). The data was determined to be reliable based on the precise protocols followed for every participant and by allowing three trials to be used, only selecting the best time of all the attempts.

Findings

This novel pilot study determined if hand grip strength had a significant relationship to buttoning in females. By observing Table 2, Pearson correlation from right-hand grip strength to best time ($r=-0.214$; $p=0.274$) did not show a statistically significant relationship. Pearson correlation from left-hand grip strength to best time ($r=-0.028$; $p=0.888$) also did not show a statistically significant relationship. Figure 1 depicts the scatter plot for correlation of right and left-hand grip strength and best buttoning time, respectively. Even though a low to moderate relationship was seen, the p value demonstrated non-significance of the data.

Figure 1. Correlation of right-hand grip strength and best buttoning time.



Discussion and Conclusion

This novel study investigated the relationship between grip strength and the speed of buttoning a shirt. No statistical significance was identified between right-hand or left-hand grip strength and shirt buttoning speed. These results suggest that grip strengthening may not be the primary or sole therapeutic intervention when attempting to improve efficacy of fine motor function in ADLs, including buttoning skills. McGrath et al. investigated the association between a decrease in grip strength and impairments in ADL functioning (McGrath et al., 2018). Their findings indicated each five kilogram decrease in grip strength, yielding increased odds of ADL functional limitations. Specifically, the odds for functional limitations were increased by 9% in relation to dressing. While our observations of speed of buttoning a shirt did not correlate to grip strength, the task performance of dressing does hinge on grip strength to some degree, as presented in the study from McGrath et al.

Despite the fine motor skills necessary to button a shirt, the investigators of this study cannot completely rule out the role of grip strength in shirt buttoning. Rather, grip strength is not a single or sole contributor to the functional activity as indicated in the findings from Beqaj et al., (2018) which analyzed and concluded, a significant correlation between grip strength and time to completion of the 9 Hole Peg Test in adolescents. Upon analyzing our findings, perhaps the addition of a finger force assessment could have strengthened the data. When buttoning a shirt, pinch grips may be more appropriate than using hand grips due to primarily utilizing the fingers and associated fine motor skills instead of the entire hand or gripping when completing the task.

Numerous studies investigating the relationship between grip strength and fine motor tasks focus on the developing years in the pediatric population. Alaniz et al. (2015) observed a correlation between pencil control and grip strength in children with and without autism. Their observations suggested that grip strength and fine motor skills correlated with independence in performing functional motor activities. Further validation for this correlation was indicated in the investigation from Beqaj et al., (2018). These studies indicate that grip strength is a positive contributor to fine motor skills and function, and ultimately the ability to live independently with improved quality of life. The focus of our study on the relationship

between grip strength and shirt buttoning speed may speculate to a greater understanding of other upper-extremity strength and motor control factors with pinching vs grip. This could suggest a relationship between pinch strength and manual ability, which may demonstrate why we observed insignificant findings in our study between grip strength and shirt buttoning speed. Conversely, the performance of ADLs involves aspects of gross and fine motor performance that go beyond muscular strength, indicating a need to focus on improving fine motor skills concurrent with increasing hand grip strength.

Furthermore, performing one maximal grip strength test per hand after the 3 buttoning trials could have led to muscular fatigue in the hands and a temporary decrement of individual fine motor capabilities. Krause et al., (2022) indicated unilateral fatigue in one limb may cause fatigue in the other leading to decreased performance in fine motor tasks, especially with the onset of disease. Thus, even though the buttoning test time was short, the completion of 3 separate trials may have led to accumulating fatigue in both hands. Additionally, a maximal grip test on one hand, after 3 separate buttoning tests, may have led to poor test results on the opposite hand. Lastly, when investigating the quality of performance related to motor dexterity and strength in individuals who suffered a stroke compared to healthy subjects, Rinne et al., (2018) focused on the importance of the attention control system. Suppression of the attention control system, or distraction, leads to reduced performance in simple voluntary motor movements, such as gripping and buttoning a shirt. Therefore, distraction from the previously mentioned timing element could have led to insignificant results in our results. Future research should seek to investigate the role pinch grip strength and finger force have in determining ability to perform fine motor tasks and independently complete ADLs. Additionally, future research into therapeutic modalities to address and resolve weakness in pinch grip strength and finger force could lead to improved fine motor abilities, and ultimately, independence in completing ADLs.

Limitations of this study include a timing component in the methods, which could have served as a distraction in the participant's performance while buttoning the shirt. Schwartz et al., (2014) investigated comparing test anxiety and performance during timed and untimed tests. Their study found students' performance increased while their testing anxiety decreased during untimed tests. Data from this study suggests that the subjects may have had increased anxiety while buttoning which could have decreased their performance time. Practical implications from our study still suggest grip strength is a reliable and valid method towards assessing upper body functionality. However, it also would be noted to observe the ADL functional movement of women to suggest dexterity of the fingers could play a greater role towards buttoning performance than hand grip strength (Lindstrom-Hazel et al., 2016).

"Sports Medicine Australia 2021 Conference" *- Abstract Presentation*

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