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전완 원주와 악력과의 상관관계

한서대학교 물리치료학과

신헌석

Correlation of Forearm Circumferences With Hand Grip Strength

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- 국문요약 -

이 연구의 목적은 전완 원주와 악력과의 상관관계를 알아보는 것이다. 오른손잡이 여성 30명이 이 연구에 참여하였으며, 연구의 대상자의 평균 연령은 31.8세였다. 전완 원주는 척골의 주두와 경상돌기의 1/2 지점과 근위 3/4 지점에서 줄자를 이용하여 측정하였다. 악력은 미국 수부 치료사 협회의 기준에 의하여 Jarmar dynamometer를 사용하여 측정하였다. 통계학적 분석은 피어슨 상관 관계 계수를 이용하여 상관관계를 조사하였다. 전완 두 지점에서 측정된 원주와 악력 간에는 낮은 상관관계를 나타내었다(r=.02, p=.921; r=.02, p=.928). 연구 대상자 30명 중 정기적으로 상체 운동을 하는 18명의 연구 대상자들의 전완 두 지점에서도 낮은 상관 관계를 나타내었다(r=.16, p=.521; r=.18, p=.468). 본 연구의 결과는선행된 다른 연구 결과와는 상이하게 높은 상관관계를 나타내지 않았다. 그 이유로는 본 연구에서 악력에 영향을 주는 여러 가지 요소들(신체 유형, 운동 습관, 직업, 피하 지방성분, 유전적 요소 등)의 측정이 고려되지 않았고, 연구 대상자의 수(n=30)가 적었다는 점을 들 수 있다.

key words : 전완 원주; 악력; Jarmar dynamometer

I. INTRODUCTION

Hand grip strength measurements are widely used by physical and occupational therapists in patients with various types of injuries or dysfunctions. Hand grip strength measurements establish a baseline from which to assess improvement, compare effectiveness of various surgical or treatment procedures, set realistic treatment goals, and assess a patient's ability to return to previous functional level and employment(Trombly, 1983). Hand grip strength has been measured using numerous instruments in previous studies. The Jamar dynamometer utilizes a sealed hydraulic system and has been found to give the most accurate measurement of grip strength(Schmidt and Toews, 1970). Mathiowetz et al used the Jamar dynamometer for the reliability study and reported strong inter-rater reliability(r=.996), and test-retest reliability (r=.822), (1984). For reliable and valid strength measurement, standardized procedures(test position and instruction) are used. The American Society of Hand Therapist has recommended a standardized position for grip strength measurements(Fess and Moran, 1981).

Previous studies were designed to examine validity and reliability of the strength measurement instrument and to establish normative data for comparison. Only a few studies exist that evaluate the relationship between had grip strength and anthropometric factors. The capacity of muscle to produce force is highly correlated with the cross-sectional area of muscle that are made perpendicular to the orientation of the muscle fibers(Enoka, 1994). This cross-sectional area measurement can be obtained from cadavers or from imaging procedures requiring three dimensional measurements. Kallman et al(1990) suggested that forearm circumference, as an anthropometric factor and a one-dimensional index, provides the most practical indicator for grip strength-related forearm muscle mass. Previous studies have used the midway point between the styloid process and the olecranon of the ulna(Chong et al, 1994), while others just stated using the forearm at its widest point(Kallman et al, 1990). Kallman et al also reported a high correlation between forearm circumference and grip strength, with 16% of the variation in grip strength independently explained by forearm circumference. In another study, a positive correlation coefficient of 0.516 was demonstrated($P<.001$), between mid-forearm circumference and grip strength(Chong et al 1994). The purpose of the present study was to evaluate the correlation between forearm circumference and hand grip strength using a Jamar dynamometer. The Pearson Correlation Coefficient was computed as a statistical analysis.

II. METHODS

1. Subjects

A sample of 30 female subjects, aged 22 to 53, participated in this study. Right had dominant, adult females were included in this study. Any individual with a history of trauma to the dominant upper extremity or hand, musculoskeletal or neurological dysfunction in the upper extremity, or recent acute illness or disease was excluded from the study. Males were not included because of the significant differences in strength between men and women. Left hand dominant and ambidextrous subjects were also excluded. Left-handed individuals tend to demonstrate less strength in their dominant hand than right-handed people. They also have an increased variability between their left and right hands as compared to right-handed people(Crosby and Webhe, 1994). Therefore, to minimize variability, only right hand dominant individuals were recruited.

2. Determination of Forearm Circumference

Forearm circumference was measured at two locations, 1) the midway point between the styloid process and the olecranon of the ulna and 2) the point three-fourths of the way proximally between the styloid process and the

olecranon of ulna. The circumference was measured in centimeters. The same tape measure was used for each measurement by the same experimenter. The measurements were taken with the subjects seated in a chair. The right elbow was positioned at 90 degrees of flexion and rested on a tabletop with the forearm in a supinated position. This method of assessment does not take into account the percentage of lean body mass versus fat.

3. Hand Grip Dynamometer

The grip strength measurements were taken with a new Jamar Hand Grip Dynamometer(J.A. Preston Co.). The standardized test position was used as recommended by the American Society of Hand Therapist(ASHT): Shoulder adducted and neutrally rotated, elbow flexed to 90 degrees, and the forearm and wrist in a neutral position(Crosby et al, 1994; Chong et al, 1994; mathiowetz et al, 1985). The level two grip position has been shown to yield maximum grip strength results in a majority of subjects. Therefore, all subjects were tested at level two. The same instructions were given t the patient. The subjects was positioned properly and when subject began to squeeze, verbal encouragement was given for the maximal effort. A rest period of 10 seconds was given and a total of three trials were taken. A separate experimenter recorded the readings. The mean of the three maximal efforts was used for statistical analysis.

4. Data Analysis

Standard Pearson Product Correlation Coefficients were calculated for analysis of the data.

III. RESULTS

Table 1 presents characteristics of subjects. The mean mid-forearm circumference was 22.4±1.7 centimeters. The mean upper forearm circumference was 24.8±1.8 centimeters. The mean grip strength measurement was 70 ±11.3 pounds. The data was analyzed for all 30 subjects and a weak correlations were found between both of the two circumferential measurements of the forearm and grip strength(r=.02, p=.921; r=.02, p=.928), (Table 2). The data was reanalyzed, attempting to find a correlation between either of the two circumferential measurements of the forearm and grip strength in the subjects who reported that they exercised regularly. However, analysis for the data for these 18 subjects also did not yield any strong correlations(r=.16, p=.521; r=.18, p=.468), (Table 3).

Table 1. Subject Characteristics

	Age (yr)		Height (cm)		Weight (kg)	
	Mean±SD	Range	Mean±SD	Range	Mean±SD	Range
Female (n=30)	31.8±7.5	22-53	164.1±6.6	152.9-176.5	137.4±20.7	110.2-200.8

Table 2. Correlation matrix for all 30 subjects

	Mid-circumference	Upper circumference	Mean strength
Mid-circumference	1.00		
Upper circumference	.94	1.00	
Mean strength	.02	.02	1.00

*p<.05

Table 3. Correlation matrix for actively exercising 18 subjects

	Mid-circumference	Upper circumference	Mean strength
Mid-circumference	1.00		
Upper circumference	.91	1.00	
Mean strength	.16	.18	1.00

*p<.05

IV. DISCUSSION

The correlation between forearm circumference and grip strength has been studied and reported positive correlation(Kallman et al, 1990; Chong et al, 1994). The capacity of muscles to produce force has been stated to be related to the cross-sectional area of the muscles being assessed(Enoka, 1994). The purpose of this study was to

assess this correlation in the female sample group. The experimenter expected to find significant correlations between forearm circumferences and hand grip strength, especially at the upper circumferential measurement because it was located more directly over the muscle mass of the forearm than the mid-forearm circumferences used by Chong et al(1994). However, in contrast to the studies previously reported, this study did not find any significant correlations between the two variables. There may be several explanations for the failure to fine the positive correlations that other investigators have reported. One reason the experimenter failed to find strong correlations may have been that the lean muscle mass versus adipose tissue in the forearms of subject was not considered, which can greatly affect forearm circumference. By using only female subjects, subjects group tend to have a higher percentage of body fat than male subjects. Therefore, an increased forearm circumference does not necessarily imply an increased muscle mass. The skin fold assessments should have been performed to exclude subjects with a high percentage of body fat. Another reason the result were not significant may have been that subject group was non-random sample group. This group of subject was very homogeneous in that they have similar types of occupations, lifestyles, and environmental conditions.

Therefore, these findings cannot be generalized to the population at large. Although a group of 30 subjects have been accepted to be adequate sample size for correlations research(Currier, 1990), this may has been an insufficient number for a study of this type. In the studies by Kallman et al(1990) and Chong et al(1994), where significant correlations were detected, the sample sizes were 864 and 437, respectively. Large number of subjects may be necessary to decrease the likelihood of the results being skewed by the presence of a few extreme scores.

V. CONCLUSION

This study did not confirm previous findings relating forearm circumference and grip strength. Many factors are involved in determining grip strength such as body type, exercise habits, occupation and hobbies, and fat versus lean tissue. The limitation of this study was that these factors influencing forearm circumference were not taken into account. These factors are likely to influence negatively in the results of correlation of forearm circumferences with grip strength.

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