J Korean Soc Phys Med, 2024; 19(3): 21-27
https://doi.org/10.13066/kspm.2024.19.3.21

Online ISSN: 2287-7215
Print ISSN: 1975-311X

Research Article

Open Access

Comparative Analysis of Grip Strength between Military Personnel and Civilian Adults

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Received: April 25 2024 / Revised: May 13 2024 / Accepted: July 11 2024

| Abstract |

PURPOSE: This study compared the grip strength of young adult male soldiers who had undergone military training with civilian adult males by indirectly examining the impact of military training on the grip strength and overall muscle mass. Grip strength, an essential biomarker for overall health and crucial combat abilities, was explored within the demanding conditions of military service.

METHODS: The research measured the grip strength of soldiers actively serving in the military and compared it with data from healthy civilian males in their twenties to determine if a structured training regime significantly enhances grip strength more than a typical civilian lifestyle. The data were analyzed using descriptive statistics with the means and group differences assessed using a t-test ($p < .05$). An online survey was conducted among the military group to self-assess the changes in grip strength before and after enlistment to gauge the awareness of such changes.

RESULTS: Significant differences were observed between the groups, with an observable increase in grip strength with age within the military group, suggesting that military training can positively impact muscle maintenance and enhance daily life.

CONCLUSION: Further research will be needed to elucidate the effects of military physical training programs and their broader implications for military readiness and overall health.

Key Words: Bio Data, Digital Healthcare, Grip Strength, Military Training

Ⅰ. Introduction

The advances in medical and technological sciences have improved the life expectancy and quality of life in modern society. Although the development of medical and scientific technologies is a positive phenomenon, negative outcomes, such as an increased incidence of chronic diseases and lifestyle-related illnesses due to a lack of exercise and physical activity, have been encountered [1,2]. These issues are prevalent among the elderly, who are more vulnerable to various diseases, but they are increasingly being reported among young adults. Reports indicate a steady increase in obesity and abnormalities in body composition among young adults [3], and muscle function and muscle mass

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in adults deteriorate proportionally with age.

Generally, the decline in muscle function and muscle mass begins after the age of 30, making it increasingly challenging to enhance muscle mass as one ages [4]. Therefore, efforts to increase muscle mass and improve the muscle function in young adults are highly effective means of maintaining good muscle function and high muscle mass as age progresses. In this context, grip strength is a predictor of functional ability and a strong indicator of potential health risks [5,6]. Poor grip strength has been associated with higher mortality rates, particularly regarding cardiovascular events and falls in the elderly. For example, research has shown that a weak grip strength in older adults is closely related to increased mortality from cardiovascular and non-cardiovascular causes [7].

Grip strength has been proven to be a valid and reliable assessment in healthy individuals and those with illnesses, offering a relatively easy and low-cost test. Grip strength varies significantly across different demographics, underscoring its importance as a diagnostic tool in health assessments. Research suggests that grip strength varies with age, occupational activities, and overall health status, providing a nuanced perspective on the physical capabilities of a population. For example, a study comparing grip strength across various occupations revealed notable differences, suggesting that job-related physical demands significantly influence muscular strength [8].

Grip strength significantly predicts critical clinical outcomes across various health conditions. Large-scale and multinational studies have reported a strong association between grip strength and all-cause, cardiovascular, and non-cardiovascular (such as respiratory or cancer-related) mortality. In elderly patients, grip strength can predict the risk of falls and limitations in daily living activities. The hand is a complex anatomical system composed of 27 bones and 15 joints, designed to perform finely tuned compound movements with approximately 30 degrees of rotation and mobility to grasp and exert force on objects of all shapes and sizes. In many sports, gripping and applying force are crucial, such as baseball, climbing, golf, hockey, paddling, swimming, tennis, weight lifting, and wrestling. Hence, sufficient or high grip strength is necessary for optimized performance and injury prevention.

Thus, grip strength is an essential indicator of muscle condition and overall health, playing a critical role in the physical readiness and operational effectiveness of military personnel. This study compared the grip strength of young male soldiers and civilians to assess the impact of military training on grip strength. Previous studies have suggested that military training provides a foundation that can enhance the day-to-day activities and task performance capabilities of soldiers, highlighting the contribution of such training to enhance grip strength [9, 10]. Grip strength is emphasized in multiple studies as a crucial measure of muscle function and can serve as a predictor of healthy physical capabilities [11,12]. This study examined the grip strength of soldiers versus civilians who engaged in regular physical activities, illuminating the unique impact of military training on physical health [13]. This analysis provides insights into the effects of military training and applicable physical activities for civilians, exploring ways to promote physical health in the military and civilian sectors.

Ⅱ. Methods

The Institutional Review Board (IRB) at Sehan University approved this study (SH-IRBB 2024-007. This study incorporated a detailed methodological approach involving 63 young adult males, consisting of 33 soldiers and 30 civilians, and utilized standardized dynamometers to conduct grip strength assessments (Table 1). The civilians consisted mainly of university students who had not completed military service, while the professional soldiers were selected from 33 individuals currently serving in Special Forces units, all of whom had a minimum of three to 10 years of service.

Table 1. General characteristics of the experimental participants (Gender: Male)

	N (%)	Age	Military service experience (Yrs)
Total	63 (100%)	25.76 ± 2.99	3.17 ± 3.33
Soldiers	33 (52.4%)	26.97 ± 3.13	5.84 ± 2.91
Civilians	30 (47.6%)	24.43 ± 2.19	.79 ± .99

The appropriate sample size was determined using the G*Power program to calculate the required sample size for an independent samples t-test. With an effect size, alpha level, and power of 0.7, 0.05, and 0.80, respectively, the minimum required sample size per group was 26 individuals, resulting in 52 participants. Therefore, the current sample size of 63 participants (33 military personnel and 30 civilians) is sufficient.

The participants were recruited according to the inclusion and exclusion criteria, adhering to research ethics. Descriptive statistics were conducted to identify variables, such as age and length of service, to evaluate the effects on grip strength.

Initially, the participants provided basic demographic information, such as age, gender, training experience, and health status. The data were collected for comparative analysis of the grip strength and appropriate screen participants for the study objectives (restricted to those who had served in the military for a minimum of one year and up to ten years). The grip strength was measured using a Jamar® hydraulic hand dynamometer following standardized procedures. The participants were seated with their arms on a table, ensuring that the wrist and elbow were positioned at 90 degrees, which ensured consistency and accuracy in the measurements, enhancing the reliability of the study results.

Each participant performed two measurements, with adequate rest in between, to minimize the effects of fatigue on the outcomes. The impact of the handle width on the results was minimized by providing all subjects with sufficient instructions and practice to comfortably grip based on their hand size and strength level before the experiment commenced.

The measured data were analyzed using descriptive statistics with means, and the differences between the groups were examined using a t-test ($p < .05$). An online survey form was also used to explore self-perceived changes in grip strength among the military group before and after enlistment. This survey included five questions rated on a five-point scale to assess the participants' awareness of any changes in their grip strength.

Ⅲ. Results

The military group exhibited a significantly higher grip strength than the civilian adult group, suggesting the impact of systematic military training. Previous studies have proposed that different exercise directions can significantly affect muscle activation, which aligns with the current findings, potentially offering specific training protocols to optimize grip strength enhancement in the future. The average measured grip strength of the military and civilian groups was 51.68 kg and 47.55 kg, respectively (Table 2).

This data demonstrates a significant difference of approximately 4.13 kg (L: 4.34kg, R: 4.92kg) in grip strength between the two groups, suggesting that the higher grip strength observed in soldiers is linked directly to their routine training regimens. In addition, the standard deviation for grip strength was 6.23 kg and 7.69 kg in the military and civilian groups, respectively, suggesting that the civilian group showed a much wider range of grip strength and that the military group underwent more consistent physical training. Furthermore, a comparison of the minimum and maximum grip strengths revealed a

Table 2. Comparative analysis of grip strength between military personnel and civilian adults

N	63				
Age	25.76 ± 2.99				
Group	Solider(33)	Civilians (30)	t	df	p
Left	50.63	46.29	2.303	29	.290
SD	± 6.23	± 7.69			
Right	53.73	48.81	2.584	29	.150
SD	± 5.52	± 9.61			
Bilateral	51.68	47.55	3.022	59	.040*
SD	± 5.90	± 8.72			

*p < .05

Table 3. Comparison of grip strength among soldiers based on duration of military service

		Term of military service			df	f	p
		1–3’	4–6’	7–9’			
Age (yrs)	Mean	23.78 ± 2.17	25.67 ± 2.36	29.67 ± 1.07			
Grip strength (M ± SD, kg)	Left	47.78± 5.87	50.44 ± 5.46	51.78 ± 6.70	2	1.166	.326
	Right	51.11 ± 2.67	53.67 ± 4.42	55.14 ± 6.77	2	1.598	.220
	Both	49.44 ± 4.74	52.06 ± 50.09	53.46 ± 6.83	2	2.598	.083

minimum and maximum grip strength of 40 kg and 66 kg in the military group. In contrast, the minimum and maximum grip strengths in the civilian group were 27 kg and 67 kg, respectively. These results show that the military group, on average, can exert higher maximum grip strength than the civilian group.

In a detailed examination of the variations in grip strength among soldiers, the results correlated with the demographic (age) and training-related factors (length of service) (Table 3). They indicated an apparent increase in grip strength as the number of years of military service increased. An examination of the bilateral grip strength showed that the group with less than three years, up to six years, and up to nine years of military service had an average grip strength of 49.44 kg, 52.06 kg, and 53.46 kg, respectively. The analysis confirmed that regular physical training within the military context effectively prevents significant age-related declines in grip strength. The statistical significance of these findings, confirmed through rigorous tests during the data analysis phase, suggests that the specific benefits of diverse military training regimens can be attributed to these observed effects.

Furthermore, a survey assessing self-perceived changes in grip strength was conducted among 33 military personnel before and after their service periods, as shown in Table 4. The survey comprised five questions. Initially, 91% of the respondents had prior experience measuring their grip strength, with 52% rating their grip strength as average and 27% as strong. The most common duration of military service was 7–9 years (45%), followed by 1–3 years (30%)

Table 4. Subjective assessment of changes in grip strength before and after military service (N: 33)

Survey Questions	Survey Result Scale				
1. Pre-Service Grip Strength Assessment: Have you ever measured your grip strength before entering military service?	Yes 30 (91%)			No 3 (9%)	
2. Initial Grip Strength: If yes, how would you rate your initial grip strength?	Very Weak 0 (0%)	Weak 5 (15%)	Average 17 (52%)	Strong 9 (27)	Very Strong 2 (6%)
3. Duration of Military Service: How long was your military service?	~ 1 year 0 (0%)	1–3 years 10 (30%)	4–6 years 80 (24%)	7–9 years 15 (45%)	10 years ~ 0 (0%)
4. Change in Grip Strength After Military Service: Do you think your grip strength increased after your military service?	Significantly decreased 0 (0%)	Slightly decreased 0 (0%)	Stayed the same 5 (15%)	Slightly increased 17 (52%)	Significantly increased 11 (33%)
5. Influence of Military Training on Grip Strength: Do you think the training during military service helped improve your grip strength?	Not at all 0 (0%)	Slightly helpful 2 (6%)	Moderately helpful 5 (15%)	Very helpful 14 (42%)	Extremely helpful 12 (36%)

and 4–6 years (24%). When asked if their grip strength had increased through military service, 52% and 33% reported a slight and significant increase, respectively. Furthermore, the impact of military service on grip strength was very helpful (42%) or extremely helpful (36%), indicating that military training had a highly positive influence on enhancing grip strength.

Ⅳ. Discussion

These results suggest that the differences in grip strength are not merely between groups but are also connected to physical health and military training. For example, improved grip strength can be seen as a potential benefit for soldiers, including enhanced combat readiness and injury prevention. As discussed in the introduction, where grip strength was used to indicate overall physical resilience and a potential health marker, these findings confirmed that soldiers have significantly higher grip strength than civilians, reflecting the positive effects of systematic physical training. Previous studies suggested that grip strength can serve as a comprehensive health indicator, and the physical training programs for soldiers could contribute to overall health management beyond physical fitness [13].

Therefore, the significance of the results is that the high grip strength in soldiers is crucial for daily and repetitive physical activities and essential for maintaining superior physical performance in extreme situations. High grip strength in soldiers can contribute significantly to their overall health status and improved life skills, extending beyond mere muscle strength enhancement.

Many studies reported that grip strength training contributes to performance improvement and injury prevention among athletes [14,15]. In particular, for soldiers, grip strength training is linked directly to combat efficiency, and high grip strength is a crucial element in enhancing equipment handling capabilities and overall combat readiness. Systematic grip strength training programs can play a vital role in improving the overall combat capabilities of soldiers.

The present results align with previous research on the current state and future prospects of U.S. military fitness training programs, showing that military training programs can continuously improve the physical performance of soldiers [10]. Military training programs are designed to enhance various physical capacities, including strength, endurance, and agility. The superior grip strength observed in military personnel can be attributed to the comprehensive

nature of their physical training, which consistently emphasizes the development of muscle strength and endurance. This study reinforces the importance of regular and structured physical activity, which is particularly evident in the systematic training approach of the military. Although no prior measurements were taken for the soldiers, training may impact grip strength. The military context, in particular, offers a unique perspective on the utility of grip strength. According to Keeley et al. [17], systematic grip strength training is vital for improving overall combat efficiency and readiness.

This study supports how such training impacts grip strength enhancement. Through comparative analysis of these studies, this research underscores that physical training for soldiers plays a vital role in enhancing grip strength and improving the overall physical and functional capabilities, providing evidence for the importance of fitness training programs within military organizations. Furthermore, this study suggests that grip strength measurements can be a reliable method to assess combat readiness in soldiers and provide essential information for planning and implementing training to enhance grip strength.

Ⅴ. Conclusion

This study showed that the military group, comprising adults of similar age, displayed significantly higher grip strength, indicating that systematic military training can help enhance grip strength among young adult males. This suggests similar training regimes could be integrated into civilian fitness programs to improve general health and physical capabilities.

Future research directions will include longitudinal studies to observe changes before and after service and as military service time progresses, as well as studies to comprehensively assess the impact of various training intensities and types on physical health outcomes. This research aims to enable military organizations to develop and implement more systematic fitness training programs and provide detailed measures to enhance soldiers' physical readiness and overall welfare, making substantial contributions to fitness management and health promotion strategies in the military and civilian sectors.

Acknowledgments

This study was supported by research funding from Sehan University in 2024.

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