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Comparative evaluation of hand grip strength in weight trainers and manual laborers.

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Abstract

Background: Hand grip strength (HGS) is a key metric for assessing muscle function and overall physical capability, with particular relevance to aging populations. Previous research has indicated that even generally healthy individuals often exhibit weak HGS. The present study aims to evaluate and compare the HGS between weight trainers and laborers (loaders).

Methodology: This cross-sectional study was conducted in Karachi from August to September 2024 across the Malir and Central districts. A total of 200 male participants were enrolled and equally divided into two groups: Group 1 comprised weight trainers (n = 100), and Group 2 included loaders (n = 100). Hand grip strength was measured using a digital handheld dynamometer.

Results: Most participants in both groups demonstrated normal hand grip strength; 72 participants from group 1 and 84 from group 2 had normal HGS. Among weight trainers, 17 had strong grip strength and 11 had weak grip strength, whereas among loaders, 9 had strong grip strength and 7 were categorized as weak. There was no statistically significant difference in mean HGS between the two groups ($p = 0.429$). Similarly, age and weight were not significantly associated with HGS in either group ($p > 0.05$), although a non-significant trend toward higher grip strength with greater weight was observed, especially among weight trainers.

Conclusion: The findings indicate that although both weight trainers and laborers perform physically demanding tasks, weight trainers exhibit slightly higher HGS. Nevertheless, a notable proportion of participants in both groups had weak grip strength, suggesting that neither occupational labor nor weight training alone may be sufficient to maintain optimal muscle strength.

Keywords

Hand Grip Strength, Occupational Exposure, Muscle Strength, Weight Trainers, Labor, Loaders.

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Introduction

Hand grip strength (HGS) is widely regarded as a simple yet powerful indicator of muscular function and overall physical health, making it a valuable tool in clinical and fitness assessments across diverse populations[1]. It has long been used to gauge physical strength, endurance, and functional status, particularly in aging individuals, where diminished HGS is closely associated with increased risk of frailty, disability, and dependence[2–4].

Numerous studies have validated HGS as a predictive marker of critical health outcomes, including cardiovascular disease, all-cause mortality, and overall quality of life[5,6]. Importantly, low HGS has been linked to early mortality, regardless of other health conditions, underscoring its role as an independent prognostic indicator[6,7].

In addition to its utility in clinical aging research, HGS is known to be influenced by a variety of physiological and environmental factors such as nutritional status, levels of physical activity, psychological stress, and body composition[8–10]. For instance, both acute and chronic malnutrition have been associated with reduced grip strength, while nutritional repletion can lead to recovery in muscle function[11]. Similarly, elevated cortisol levels due to stress can promote catabolism, leading to muscle degradation and subsequently diminished HGS[10]. Obesity often characterized by systemic inflammation and increased cortisol can accelerate biological aging and further impair muscle strength[12].

In occupational and athletic contexts, HGS also serves as a relevant metric for evaluating the impact of different types of physical activity. Both manual laborers (e.g., loaders) and weight trainers depend heavily on hand and upper body strength. However, the nature and structure of their physical activities differ significantly. Weight training involves targeted, progressive muscle strengthening, whereas manual labor tends to be irregular and exhaustive, possibly contributing to different muscular adaptations and, in some cases, chronic overuse injuries[13–15]. Previous studies have produced mixed findings: while some suggest that physical occupations can help maintain muscle strength[13], others report that prolonged, unsupervised exertion under stressful conditions may actually compromise muscular health over time[16].

Given these observations, this study was designed to compare HGS in two distinct physically active populations weight trainers and laborers working as loaders whose work or training involves significant upper body exertion. A prior study conducted among otherwise healthy individuals in Karachi revealed widespread weak HGS, indicating possible systemic issues with muscle function that may warrant further investigation[12]. The current study aims to evaluate whether structured resistance training offers a measurable advantage over occupational physical exertion in terms of hand grip strength.

Methodology

Study Design

This research employed a comparative cross-sectional study design aimed at evaluating differences in HGS between two occupationally and physically distinct groups: weight trainers and manual laborers (loaders). The study was conducted over a two-month period from August to September 2024 to capture data within a uniform seasonal window, minimizing environmental variation that could influence physical performance.

Ethics

The study protocol was reviewed and approved by the Institutional Review Board of the affiliated academic institution. All participants were briefed about the objectives, procedures, and potential risks of the study. Written informed consent was obtained from each participant before data collection, ensuring ethical compliance in accordance with the Declaration of Helsinki.

Setting

The study was carried out in two socioeconomically and demographically diverse districts of Karachi, Pakistan i.e. Malir and Central Karachi. These districts were purposively selected to provide

representative samples of two contrasting populations: individuals regularly engaging in structured weight training (gym-goers) and those involved in strenuous occupational manual labor (loaders).

Participants

The target population comprised adult males aged 18 to 45 years, residing in the selected districts. Participants were recruited into one of two groups: (1) weight trainers with at least six months of consistent gym-based resistance training (minimum three sessions per week), and (2) loaders with at least six months of continuous employment in physically demanding loading work. Inclusion criteria also required participants to provide informed consent. Exclusion criteria included a history of upper limb injury, musculoskeletal disorders affecting grip strength, chronic illnesses such as diabetes or cardiovascular disease, and current use of medications like corticosteroids that could impact muscle function. Participants involved in both weight training and manual labor were also excluded to avoid confounding.

Variables

The primary outcome variable was hand grip strength (HGS) of the dominant hand. Additional variables included demographic data such as age, height, weight, and duration (in months or years) of engagement in their respective physical activities.

Data Sources/Measurement

Data collection was conducted in two phases. Phase I involved recruiting weight trainers directly from local gyms within the selected districts, while Phase II involved recruiting loaders from marketplaces, warehouses, and other loading zones. Demographic and background information was collected using a structured questionnaire. Hand grip strength was measured using a standardized digital hand-held dynamometer. All measurements were taken from the participant's dominant hand under resting conditions, with the participant seated and the arm positioned at 90 degrees at the elbow. Each subject was asked to exert maximum effort in three separate trials, and the highest value recorded in kilograms (kg) was used for analysis to ensure reliability and consistency.

Bias

To minimize selection bias, a purposive sampling technique was adopted targeting participants who strictly met the inclusion criteria. Measurement bias was minimized by using the same dynamometer device for all participants and standardizing measurement procedures across all data collection sites. All measurements were performed by the same trained investigator to ensure inter-rater reliability.

Study Size

A total of 200 participants were included in the study, with 100 individuals in each group. This sample size was determined based on available resources, time constraints, and expected effect size from previous literature on hand grip strength in physically active populations.

Quantitative Variables

The main quantitative variable was hand grip strength, measured in kilograms (kg) using a digital dynamometer. Other quantitative variables included age (years), weight (kg), height (cm), and duration of activity (months or years). These were analyzed to explore potential associations with hand grip strength and to assess group comparability.

Statistical Methods

Data were entered and analyzed using the Statistical Package for Social Sciences (SPSS) version 26.0. Descriptive statistics such as mean and standard deviation (SD) were used to summarize continuous variables. An independent sample t-test was applied to compare the mean hand grip strength between weight trainers and loaders. Additionally, a chi-square test was used to compare the proportions of participants categorized as having weak, normal, or strong HGS based on standardized cut-offs. A p-value of less than 0.05 was considered statistically significant.

Results

Participants

A total of 200 male participants were included in this study, equally divided into two groups: 100 weight trainers and 100 loaders. All participants provided informed consent prior to participation. The study aimed to assess and compare the hand grip strength (HGS) between these two occupational groups and examine the association of age and weight with grip strength categories (normal, strong, weak).

Descriptive Data

Table 1 provides a comparative summary of age, weight, and hand grip strength between the two groups. The mean age of weight trainers was 23.67 ± 8.31 years, which was significantly lower than that of the loaders (27.24 ± 10.03 years), with a p-value of 0.007. Similarly, weight trainers had a significantly higher average body weight (69.62 ± 13.80 kg) compared to the loaders (64.06 ± 11.86 kg), with a p-value of 0.003. However, there was no statistically significant difference in hand grip strength between the two groups, with weight trainers showing a mean of 45.12 ± 9.28 kg and loaders 44.15 ± 7.85 kg (p = 0.429).

Outcome Data

Figure 1 illustrates the distribution of hand grip strength categories among the two groups. The majority of participants in both groups fell within the "normal" hand grip strength range. Specifically, 72 weight trainers and 84 loaders had normal HGS. Among weight trainers, 17 had strong grip strength and 11 had weak grip strength. In contrast, 9 of loaders had strong grip strength, while 7 were categorized as weak.

Main Results

Table 2 explores the association of age and weight with hand grip strength categories within each group.

- Weight trainers: Age and weight were not significantly associated with grip strength categories among weight trainers. Most participants with normal (90.3%), strong (82.4%), and weak (90.9%) grip strength were below the age of 30 (p = 0.629). In terms of weight, the majority with strong grip strength were above 60 kg (94.1%), but this association did not reach statistical significance (p = 0.209).
- Loaders: Similar patterns were observed among loaders. A larger proportion of participants with normal (69.0%) and weak (71.4%) grip strength were under 30 years of age (p = 0.318). Participants weighing over 60 kg were more likely to exhibit strong grip strength (88.9%) compared to those under 60 kg (11.1%), but again, the relationship was not statistically significant (p = 0.151).

Overall, while weight trainers had significantly higher weight and were younger compared to loaders, these factors did not show a statistically significant association with grip strength in either group. Hand grip strength levels were comparable between the two occupational groups.

Table 1: Comparison of the descriptives of the weight trainers and the loaders (n=200).

Variables	Weight Trainers (n=100)	Labor as Loaders (n=100)	p-value
	Mean±SD		
Age (Years)	23.67 ± 8.31	27.24 ± 10.03	0.007*
Weight (kg)	69.62 ± 13.80	64.06 ± 11.86	0.003*
Hand Grip Strength	45.12 ± 9.28	44.15 ± 7.85	0.429

*p-value < 0.05 is considered statistically significant.

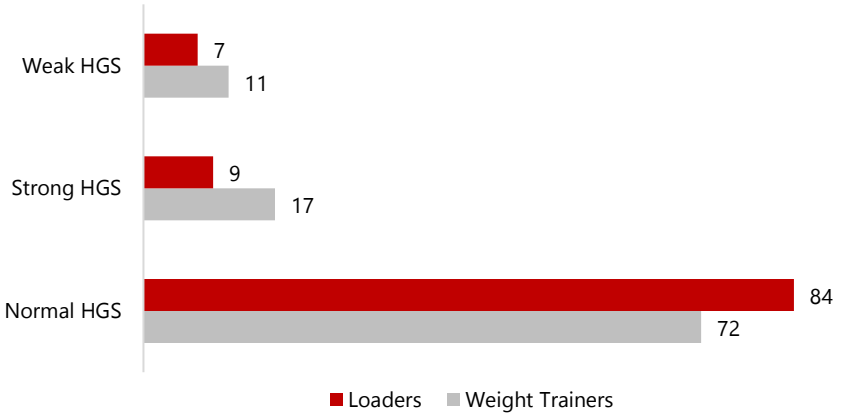

Figure 1: Comparison of hand grip strength among the weight trainers and loaders.

Table 2: Comparison of association of age and weight with the hand grip strength among both the groups.

Variables		Hand Grip Strength			p-value
		Normal	Strong	Weak	
		n (%)	n (%)	n (%)	
Weight Trainers					
Age	<30 years	65 (90.3%)	14 (82.4%)	10 (90.9%)	0.629
	>30 years	7 (9.7%)	3 (17.6%)	1 (9.1%)	
Weight	<60 Kgs	18 (25.0%)	1 (5.9%)	3 (27.3%)	0.209
	>60 Kgs	54 (75.0%)	16 (94.1%)	8 (72.7%)	
Loaders					
Age	<30 years	58 (69.0%)	4 (44.4%)	5 (71.4%)	0.318
	>30 years	26 (31.0%)	5 (55.6%)	2 (28.6%)	
Weight	<60 Kgs	30 (35.7%)	1 (11.1%)	4 (57.1%)	0.151
	>60 Kgs	54 (64.3%)	8 (88.9%)	3 (42.9%)	

*Significant at the level of <0.05

Discussion

This study aimed to compare hand grip strength (HGS) between weight trainers and manual laborers (loaders), and to explore the association of age and weight with grip strength within each group. Despite the physically strenuous nature of activities in both occupational settings, the findings revealed that the majority of participants in both groups had hand grip strength within the normal range, with no statistically significant difference in mean HGS between weight trainers and loaders.

The mean hand grip strength was slightly higher among weight trainers (45.12 ± 9.28 kg) compared to loaders (44.15 ± 7.85 kg), but this difference was not statistically significant (p = 0.429). This suggests that while gym-based exercise may be more structured and targeted toward muscle development, it does not necessarily confer a measurable advantage in grip strength over physically demanding manual labor[17,18]. Although structured resistance training typically emphasizes progressive overload and controlled repetitions aimed at optimizing muscle hypertrophy and strength[17], the repetitive lifting and carrying activities performed by laborers may also

contribute to functional adaptations through frequent real-world physical exertion[19].

Interestingly, a higher proportion of loaders had normal HGS compared to weight trainers, though the proportions of strong and weak grip strength were also similar between the groups. These findings challenge the assumption that structured physical activity automatically leads to superior muscular performance in all domains[17,19] and highlight the potential benefits of occupational physical activity for maintaining functional muscle strength[18].

There was no significant association between age and grip strength in either group, which aligns with previous research indicating that muscle strength decline typically becomes more prominent after the age of 40[20]. As the majority of our participants were young adults, this age-related effect is likely not yet pronounced.

Similarly, weight was not significantly associated with grip strength, although participants with higher body weight tended to have stronger grip strength. Among weight trainers, 94.1% of those with strong grip strength weighed over 60 kg, and a similar pattern was observed in loaders. While not statistically significant, these trends may suggest that greater muscle mass often reflected in higher body weight could contribute positively to grip strength[21,22]. This is consistent with studies that identify weight and lean mass as important determinants of grip strength and overall muscle performance[22].

Overall, the findings underscore that general physical activity, whether occupational or recreational, does not necessarily guarantee high grip strength. This points to the need for specific strength training interventions that target grip and forearm muscles, especially among individuals whose work involves upper-body exertion. Additionally, occupational factors such as nutrition, cumulative fatigue, and lack of recovery may blunt muscle adaptation in laborers despite high physical workloads[23]. These environmental stressors and lack of ergonomic optimization can reduce the efficiency of strength gains despite daily exertion[24]. Therefore, incorporating ergonomic education, proper nutrition, and structured recovery strategies could enhance functional strength and reduce the risk of musculoskeletal disorders in both populations[24].

Limitations

This study had several limitations. It included only 200 male participants, which restricts the generalizability of the findings to other populations, particularly females or older adults. The cross-sectional design limits causal interpretations between activity type and HGS outcomes. Although adjustments were made for age and weight, several other influential variables such as nutritional status, hydration, cortisol levels, sleep quality, and stress were not assessed. Additionally, only the dominant hand was evaluated, potentially underestimating overall muscular function especially among laborers who may frequently use both hands during work. Future studies should address these limitations and consider longitudinal designs to examine the effects of tailored strength training and lifestyle factors on HGS across diverse occupational and demographic groups.

Conclusion

The present study demonstrated that while both weight trainers and manual laborers engage in high levels of physical activity, weight trainers exhibited significantly stronger hand grip strength (HGS) than laborers. However, the finding that many individuals in both groups displayed weak HGS suggests that neither occupational labor nor general weight training alone may suffice for maintaining optimal muscular health. These results emphasize the importance of integrating targeted grip-strengthening exercises into the training routines of both laborers and gym users. Structured and progressive resistance training programs, when combined with adequate nutrition and rest, offer a more reliable pathway to improving and preserving muscle strength. Moreover, public health strategies should consider tailored interventions for physically active

populations to prevent musculoskeletal decline and promote long-term occupational and functional well-being.

Conflicts of Interest

The author(s) have no conflicts of interest.

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