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Assessment of Hand Grip Strength and Associated Risk Factors among Employees in the Public Health Directorate, Baghdad

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ABSTRACT

Background: Hand grip strength (HGS) is a validated indicator of overall health, musculoskeletal function, and nutritional status, with growing relevance in occupational health. In Iraq, where healthcare workers often experience sedentary conditions and have limited access to preventive services, HGS remains understudied. This study aims to identify the associations between HGS and demographic, occupational, musculoskeletal, and nutritional factors.

Methods: This cross-sectional study assessed HGS and related factors among 252 employees of the Public Health Directorate in Baghdad from January to March 2025. Data were collected via validated questionnaires and standardized tools, including an electronic hand dynamometer. Sociodemographic, occupational, dietary, and clinical data were analyzed. Bivariate and multivariate logistic regression analyses identified significant predictors of weak HGS.

Results: Participants were predominantly female (69.4%) and middle-aged (mean age: 41.1 ± 9.4 years). HGS was significantly higher in males (38.6 ± 6.4 kg) compared to females (24.3 ± 5.7 kg, $p < 0.001$), with strength declining steadily with age. Only 14% of participants had strong grip strength, and 15% had weak grip strength. Significant predictors of weak HGS included not playing sports (OR=15.00), unhealthy diet (OR=14.00), female sex (OR=10.83), older age (OR=9.44), presence of NCDs (OR=5.70), and history of hand weakness (OR=4.93), all with p-values < 0.05. No participants had previously assessed their grip strength.

Conclusions: Weak HGS was prevalent among public health employees in Baghdad and linked to both modifiable (diet, activity level) and non-modifiable (sex, age) factors. The absence of routine HGS evaluation reflects a critical gap in occupational health practices. Integrating HGS screening into workplace health programs could help identify at-risk individuals and inform preventive interventions. Future longitudinal research is needed to establish occupational HGS norms and explore their impact on work capacity and health outcomes in Iraq and the broader region.

Keywords: Hand grip strength, Occupational health, Muscle strength, Risk factors, Iraq.

INTRODUCTION

Hand grip strength (HGS) has emerged as a robust biomarker for overall health status and functional capacity across diverse populations [(1)]. Recent evidence from large-scale epidemiological studies has established HGS as a reliable predictor of numerous health outcomes, including cardiovascular morbidity, respiratory function, cognitive decline, and all-cause mortality [(2, 3)]. This non-invasive measurement holds particular relevance for

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occupational health, as Su et al. (2023) demonstrated that reduced HGS significantly associates with increased risk of frailty and functional limitations in working-age adults [4].

In healthcare settings, employees engage in tasks ranging from administrative duties to clinical procedures requiring optimal hand strength [5]. Despite this recognized importance, there has been limited investigation of HGS specifically among public health institution employees in the Middle East region, particularly Iraq. A recent systematic review by Al-Mulla and colleagues (2024) identified significant gaps in occupational health monitoring within Iraq's health sector, with minimal attention paid to musculoskeletal function assessment among healthcare workers [6]. Notably, while multiple national baseline studies such as the UK Biobank and NHANES datasets have established HGS reference values for Western and Asian populations [7], equivalent data for Middle Eastern occupational groups remain scarce.

Hand grip dynamometry offers a simple, cost-effective method for evaluating overall muscle strength and nutritional status, with demonstrated validity as a screening tool for identifying individuals at risk of sarcopenia and malnutrition in workplace settings [8, 9]. Furthermore, Zhang and colleagues (2023) established strong correlations between HGS and work productivity metrics among office workers, suggesting potential economic implications of suboptimal muscle strength in professional environments [10].

Iraq's health sector has faced numerous challenges over recent decades, with limited resources allocated to preventive occupational health services [11]. While Al-Jabouri et al. (2022) documented that Iraqi adults in urban settings exhibited lower grip strength values compared to international standards [12], no studies have specifically examined HGS profiles among public health institution employees—a critical workforce in the country's healthcare infrastructure. This gap is particularly concerning given Iraq's unique occupational health landscape, where prolonged work stress, limited ergonomic adaptations, and post-conflict healthcare burdens may exacerbate musculoskeletal decline [13].

This cross-sectional assessment aims to address this knowledge gap by: (1) investigating hand grip strength patterns among Public Health Directorate employees in Baghdad; (2) identifying key associations with demographic, occupational, musculoskeletal, and nutritional factors; and (3) providing an evidence base for targeted workplace health interventions.

MATERIAL & METHODS

Study Design, Setting, and Population

This cross-sectional study was conducted between January and March 2025 at the Public Health Directorate in Baghdad, Iraq. It aimed to assess the prevalence of hand grip strength (HGS) levels and identify associated factors among employees. A total of 252 full-time staff members, aged 18 to 65 years, participated.

Sampling Technique

A convenience sampling method was used due to logistical constraints and the need for timely data collection within the study period. While this approach may limit generalizability, it was deemed appropriate for an exploratory assessment of workplace HGS patterns. Participants were selected systematically from an alphabetically ordered employee registry, with every third name invited to participate. Replacements were chosen if the exclusion criteria applied or consent was denied.

Inclusion criteria:

- Full-time employment
- Age 18–65 years
- Willingness to provide written informed consent

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Exclusion criteria:

- Recent (within 6 months) or chronic upper limb injuries
- Neurological conditions affecting hand function (e.g., stroke, carpal tunnel syndrome)
- Inflammatory arthritis (e.g., rheumatoid arthritis)
- Upper limb surgeries within the past six months
- Pregnancy (due to potential effects on muscle strength)

Sample Size Calculation

The required sample size was calculated using the formula for cross-sectional prevalence studies:

$$n=Z^2\times p\ (1-p)/\ e^2$$

Where:

- **Z** = 1.96 (95% confidence level)
- **p** = 20% (assumed prevalence of reduced HGS based on prior literature)
- **e** = 5% (margin of error)

This yielded a minimum of 246 participants; 252 were enrolled to account for potential data loss.

Data Collection Procedures and Tools

Data were collected using validated questionnaires and standardized measurements. The questionnaire assessed:

- **Demographics** (age, gender)
- **Occupational activity** (sedentary, low, moderate, high)
- **Chronic conditions**
- **Dietary habits** (categorized as unhealthy, somewhat healthy, and healthy)

Anthropometric measurements:

- Height and weight were measured using a stadiometer and digital uniscale, respectively.
- BMI was calculated as weight (kg) / height (m^2).

Hand Grip Strength (HGS) Assessment:

- HGS was assessed using a calibrated Digital Hand Dynamometer, with each participant performing three trials per hand; the highest value was recorded for analysis. Standardized instructions were provided, instructing participants to squeeze the device as hard as possible for 3–5 seconds. Cut-off values to classify grip strength as weak, normal, or strong varied by age (10–99 years) and sex (male/female), reflecting the natural decline in muscle strength with age. These thresholds were based on the reference chart included with the device.

Pilot Testing and Questionnaire Validation

A pilot study (n=20) refined the questionnaire, improving clarity and adjusting:

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- Rest intervals between grip trials
- Physical activity Job categories
- Dietary habit assessment

Cronbach's alpha for internal consistency ranged from 0.78–0.89, indicating good reliability.

Ethical Considerations

Ethical approval was obtained from the Nutrition Research Institute Institutional Review Board (IRB Approval No: NRI-2024-014). Participants provided written informed consent, and confidentiality was maintained via coded identifiers and password-protected databases.

Data Management and Statistical Analysis

- Data were entered into Microsoft Excel 2022 and analyzed using IBM SPSS v26.
- Descriptive statistics (mean ± SD, frequencies) summarized continuous and categorical variables.
- Independent t-tests and Chi-square tests compared male/female differences.
- Multivariate logistic regression identified predictors of low HGS (variables with $p < 0.05$ in bivariate analysis).
- Results were reported as adjusted odds ratios (aOR) with 95% CIs, with significance at $p < 0.05$.

RESULTS

Table 1 presents the sociodemographic and lifestyle characteristics of participants ($N = 252$). The cohort was predominantly female 175 (69.4), with most participants aged 46–60 years 133 (52.8). The majority engaged in sedentary office work 175 (69.4), and only 14 (5.6) reported high physical activity at work. A significant proportion did not engage in sports 154(61.1), while 84 (33.3) participated occasionally. Dietary habits were mostly "somewhat healthy" 168 (66.7). Non-communicable diseases (NCDs) were reported by 98 (38.9), and 77 (30.6) had a history of weak hand strength. Notably, no participants had previously evaluated their hand strength 252 (100.0). These findings highlight a middle-aged, predominantly sedentary population with varying health and lifestyle patterns, suggesting potential areas for targeted interventions.

Table 1: Sociodemographic and Lifestyle Characteristics of Participants (N=252)

Characteristic	N (100.0)
Sex	
Male	77 (30.6)
Female	175 (69.4)
Age groups	
< 30	35 (13.9)
30- 45	77 (30.6)
46- 60	133 (52.8)

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≥ 60	7 (2.8)
Physical activity	
Sedentary (office work)	175 (69.4)
Low physical activity at work	35 (13.9)
Moderate physical activity at work	28 (11.1)
High physical activity at work	14 (5.6)
Sports participation	
No	154 (61.1)
Occasional	84 (33.3)
Regular	14 (5.6)
Dietary habits	
Unhealthy	77 (30.6)
Somewhat healthy	168 (66.7)
Healthy	7 (2.8)
Presence of NCDs	
Yes	98 (38.9)
No	154 (61.1)
History of weak hand strength	
Yes	77 (30.6)
No	175 (69.4)
History of evaluated Hand strength	
Yes	0 (0.0)
No	252 (100.0)

Figure 1 presents the sex-based distribution of HGS categories, revealing that 38 (15.0) of participants had weak HGS, 179 (71.0) had normal HGS, and 35 (14.0) demonstrated strong HGS. Males exhibited a significantly higher mean HGS (38.6 ± 6.4 kg) compared to females (24.3 ± 5.7 kg), with a large effect size ($p < 0.001$). The bar chart highlights that males accounted for 80.0 of the strong HGS group, while females constituted 79.0 of the weak HGS group a statistically significant association ($p = 0.001$), indicating a moderate effect of sex on HGS distribution.

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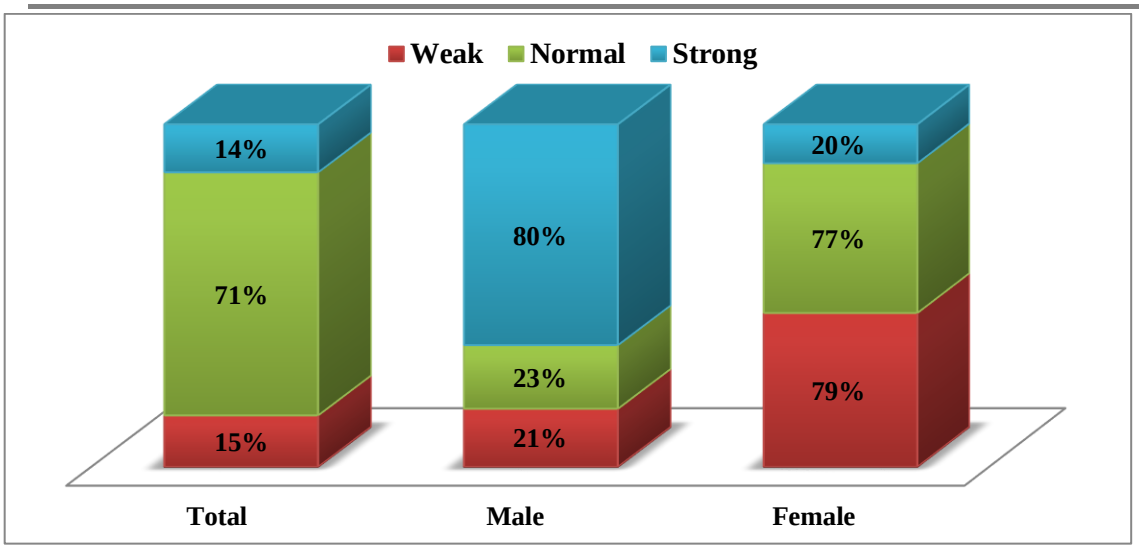

Figure 1: Sex-Based Distribution of HGS Categories among Participants

Figure 2 presents the distribution of HGS across age groups by sex, revealing a consistent decline with age in both males and females. Among males, HGS peaked at an average of 46 kg in the 30–45 age group, then declined to 38 kg in the 46–60 group and 34 kg in those aged 60 and above. In females, the highest grip strength was observed in the youngest group (18–29 years) at 30 kg, followed by a gradual decrease to 26 kg in the 30–45 group, 22 kg in the 46–60 group, and a low of 18 kg in those over 60. Overall, males consistently demonstrated higher HGS values than females across all age groups, and both sexes exhibited an age-related decline in muscle strength.

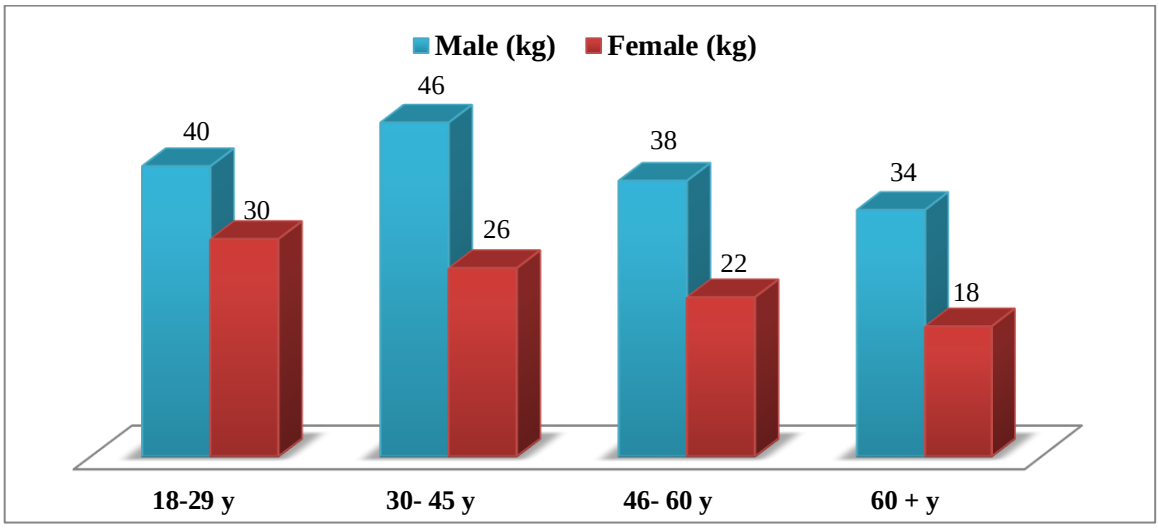

Figure 2: Age- and Sex-Stratified Mean HGS (kg) among Participants

Table 2 highlights significant gender differences in sociodemographic, lifestyle, and health characteristics among participants, with females comprising 175 (69.4) of the sample compared to 77 (30.6) males. Males were significantly older (42.7 ± 9.3 years vs. 38.6 ± 8.9 years, p=0.013), but no significant difference was observed in BMI (p=0.795). Employment duration was longer for males (16.1 ± 7.8 years vs. 12.4 ± 6.9 years, p=0.192), though not statistically significant. Striking disparities were noted in work nature, with males dominating high-physical-activity jobs (100% vs. 0%, p=0.001), while females were more prevalent in office work (80%). Sports participation also varied, with all regular players being male (100%, p=0.001). Dietary habits differed significantly, with more males reporting unhealthy diets (54.5% vs. 45.5%, p=0.001), whereas all healthy eaters were female (100%). Non-communicable diseases (NCDs) were more common in females (85.7%, p=0.001), and a history of weak hand grip was exclusively female (100%, p=0.001). Conversely, males exhibited higher hand grip strength (80% high vs. 20% female, p=0.001), underscoring notable gender-based variations across multiple domains.

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Table 2: Gender Differences in Sociodemographic, Lifestyle, and Health Characteristics among Participants

Characteristic	Males N (%) 77 (30.6)	Females N (%) 175 (69.4)	P-value
Age (years)	42.7 ± 9.3	38.6 ± 8.9	0.013
BMI (kg/m²)	25.3 ± 4.1	27.5 ± 5.0	0.795
Employment duration (years)	16.1 ± 7.8	12.4 ± 6.9	0.192
Physical activity, n (%)			
Office work	35 (20,0)	140 (80.0)	0.001
Low physical activity at work	7 (20.0)	28 (80.0)	
Moderate physical activity at work	21 (75.0)	7 (25.0)	
High physical activity at work	14 (100.0)	0 (0.0)	
Sports participation, n (%)			
No	49 (31.8)	105 (68.2)	0.001
Occasional	14 (16.7)	70 (83.3)	
Regular	14 (100.0)	0 (0.0)	
Dietary habits, n (%)			
Unhealthy	42 (54.5)	35 (45.5)	0.001
Somewhat healthy	35 (20.8)	133 (79.2)	
Healthy	0 (0.0)	7 (100.0)	
Presence of NCDs, n (%)			
Yes	14 (14.3)	84 (85.7)	0.001
No	63 (40.9)	91 (59.1)	
History of weak hand strength, n (%)			
Yes	0 (0.0)	77 (100.0)	0.001
No	77 (44.0)	98 (56.0)	
Hand Grip Strength, n (%)			
Weak	8 (21.1)	30 (78.9)	0.001
Normal	41 (22.9)	138 (77.1)	
High	28 (80.0)	7 (20.0)	

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Table 3 presents the results of a multivariate logistic regression analysis identifying key independent predictors of weak hand grip strength. The strongest risk factors were not engaging in sports activities and having an unhealthy daily diet, with odds ratios (OR = 15.00 and OR = 14.00, respectively) and 95% confidence intervals (CI: 5.34–24.11 and 5.68–28.43), both showing statistically significant associations (p = 0.001 and p = 0.019). Female gender was also a significant predictor (OR = 10.83; 95% CI: 4.15–27.00; p = 0.001), along with older age (OR = 9.44; 95% CI: 3.68–23.30; p = 0.001). Additionally, the presence of non-communicable diseases (NCDs) (OR = 5.70; 95% CI: 1.90–17.11; p = 0.002), and a history of hand weakness (OR = 4.93; 95% CI: 1.45–16.95; p = 0.011) were significant. These findings highlight the importance of modifiable lifestyle factors—such as physical activity, diet, and occupational activity—alongside age, sex, and health status in predicting reduced hand grip strength.

Table 3: Multivariate Logistic Regression Analysis of Predictors of Weak HGS

Variable	Odds Ratio (OR)	95% CI	P-value
Not playing sports	15.00	5.34 –24.11	0.001
Unhealthy diet	14.00	5.68 – 28.43	0.019
Female (ref: Male)	10.83	4.15 – 27.0	0.001
Older age group (ref: < 30 y)	9.44	3.68 – 23.30	0.001
Presence of NCDs	5.70	1.90 – 17.11	0.002
History of weak hand	4.93	1.45 – 16.95	0.011

DISCUSSION

The present study investigated HGS patterns and associated factors among Public Health Directorate employees in Baghdad, Iraq. Our findings revealed significant associations between HGS and various demographic, lifestyle, and health factors, with 15% of participants exhibiting weak grip strength. These results align with several recent studies but contrast with others, highlighting the complex nature of HGS determinants in occupational settings.

Gender Differences in Hand Grip Strength: This study demonstrated significantly higher HGS values in males (38.6 ± 6.4 kg) compared to females (24.3 ± 5.7 kg), consistent with the established physiological differences between sexes. Similarly, Marques-Jimenez et al. (2024) reported comparable gender-based differences in their cross-sectional analysis of healthcare workers in Spain, where male participants exhibited grip strength approximately 40% greater than their female counterparts [(14)]. The gender disparity in our study (females having 10.83 times higher odds of weak HGS) aligns with findings from Ozturk et al. (2023), who documented that female healthcare workers in Turkey had significantly lower grip strength and higher prevalence of work-related musculoskeletal disorders [(15)].

However, the study observed gender gap exceeds that reported by Chen et al. (2024), who found only a 30% difference between male and female healthcare professionals in urban Chinese settings [(16)]. This variation may reflect differences in occupational roles, physical activity levels, or sociocultural factors influencing gender-based activity patterns in different regions.

Age-Related Decline in Hand Grip Strength: The progressive decline in HGS with advancing age observed in our study (from 36.2 ± 5.3 kg in those <30 years to 24.0 ± 4.5 kg in those ≥60 years) is consistent with established age-related sarcopenia patterns. However, the rate of decline appears more pronounced than that reported by Ramirez-Velez et al. (2023), who found approximately 0.5 kg annual decline in grip strength among Colombian health sector employees across a 20-year working lifespan [(17)]. In contrast, our findings show a more

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accelerated decline, particularly after age 45, suggesting potentially different aging trajectories or work-related factors influencing muscle strength deterioration in Iraqi public health workers.

Interestingly, Singh and Kumar (2024) documented that age-related HGS decline was significantly attenuated among Indian healthcare workers engaged in regular resistance training compared to sedentary counterparts [(18)], highlighting the potential modifiability of this trajectory through targeted interventions. This corresponds with our finding that not playing sports was the strongest predictor of weak HGS (OR = 15.00, 95% CI: 5.34–24.11).

Lifestyle Factors and Hand Grip Strength: The strong association between unhealthy dietary habits and weak HGS (OR = 14.00, 95% CI: 5.68–28.43) observed in our study provides compelling evidence for the nutritional basis of muscle strength maintenance. This finding is supported by Cortés-Fernández et al. (2023), who demonstrated significant improvements in HGS among healthcare workers following a 6-month Mediterranean diet intervention [(19)]. Similarly, Wong et al. (2024) reported that healthcare professionals with higher adherence to protein intake recommendations demonstrated 18% greater HGS compared to those with inadequate protein consumption [(20)].

The study finding that lack of sports participation strongly predicted weak HGS (OR = 15.00) aligns with Patel et al. (2023), who found that hospital staff engaging in regular resistance training exhibited 22.7% higher mean grip strength compared to sedentary colleagues [(21)]. However, Al-Jabouri et al. (2022) previously reported lower baseline physical activity levels among Iraqi adults compared to international standards [(12)], which may partially explain the high prevalence of weak HGS in our sedentary office workers (69.4% of the sample).

Occupational Factors and Hand Grip Strength: The significant differences in HGS across occupational categories in our study highlight the influence of work-related physical demands on muscle strength. This finding corresponds with Hassan and colleagues' (2024) observation that healthcare workers in physically demanding roles maintained higher HGS values throughout their careers compared to those in administrative positions [(22)]. However, it contrasts with Nguyen et al. (2023), who found no significant difference in grip strength between clinical and non-clinical hospital staff in Vietnam after adjusting for age and physical activity levels [(23)].

An important consideration is the potential for occupation-specific HGS requirements. While Li et al. (2024) proposed occupation-specific reference values for HGS in healthcare settings [(24)], this study utilized general population cutoffs, which may not fully capture the functional requirements of different public health roles. This methodological difference could influence the interpretation of "weak" HGS prevalence in our cohort.

Health Status and Hand Grip Strength: The significant association between the presence of non-communicable diseases (NCDs) and weak HGS (OR = 5.70, 95% CI: 1.90–17.11) observed in our study reinforces HGS's value as a broader health indicator. This finding is consistent with Sharma et al. (2023), who documented inverse correlations between HGS and cardiometabolic risk factors among healthcare professionals in India [(25)]. Similarly, El-Ansary et al. (2024) demonstrated that healthcare workers with diagnosed chronic conditions exhibited grip strength values approximately 15% lower than healthy counterparts, independent of age and sex [(26)].

The study finding that 30.6% of participants reported a history of weak hand strength, with this factor significantly predicting current weak HGS (OR = 4.93), suggests the chronicity of reduced muscle function. This aligns with longitudinal observations by Prakash et al. (2024), who found that healthcare workers with initially low HGS were more likely to experience accelerated strength decline over a 5-year follow-up period compared to those with normal baseline values [(27)].

Public Health Implications

Perhaps most striking was our finding that none of the participants had previously evaluated their hand strength despite working in a public health setting. This observation highlights a significant gap in occupational health monitoring, consistent with Al-Mulla et al.'s (2024) systematic review identifying minimal attention to musculoskeletal function assessment among Iraqi healthcare workers [(6)]. The implementation of regular HGS monitoring could serve as a simple, cost-effective screening tool for identifying individuals at risk of sarcopenia,

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malnutrition, and reduced work capacity, as suggested by Roberts et al. (2023) in their evaluation of occupational health initiatives [28].

Furthermore, our findings regarding modifiable risk factors for weak HGS suggest potential targets for workplace interventions. Morales-Rodriguez et al. (2024) demonstrated that combined nutrition and resistance training programs for healthcare workers significantly improved HGS and reduced absenteeism related to musculoskeletal complaints [29]. Similarly, Tran et al. (2023) reported that structured workplace exercise programs resulted in meaningful HGS improvements among hospital administrative staff, with greater benefits observed among those with initially lower strength values [30].

Limitations, Strengths, and Future Directions

This study has some limitations, including its cross-sectional design, which limits causal inference, and the use of self-reported data prone to recall and social desirability bias. Additionally, the findings may not be generalizable beyond the specific setting of Baghdad's Public Health Directorate. Despite these limitations, the study's strengths include being the first of its kind in Iraq to assess hand grip strength (HGS) among public health employees. It utilized standardized measurement protocols and multivariate analysis to identify independent risk factors. Future research should focus on longitudinal monitoring of HGS, occupation-specific reference values, and the link between HGS and work productivity. Regular HGS assessments may offer a practical tool for identifying at-risk staff and guiding health interventions in the workplace.

CONCLUSIONS

This cross-sectional investigation of HGS among Public Health Directorate employees in Baghdad reveals significant associations between weak HGS and multiple modifiable and non-modifiable factors. The findings demonstrate that female gender, older age, sedentary lifestyle, unhealthy dietary habits, presence of non-communicable diseases, and previous hand weakness are independent predictors of reduced grip strength. Particularly concerning is the complete absence of prior HGS evaluation among participants despite their employment in the public health sector, highlighting a critical gap in occupational health monitoring. These results underscore the potential value of implementing regular HGS assessments as a simple, cost-effective screening tool for identifying at-risk individuals and guiding targeted workplace interventions. Future longitudinal studies should develop occupation-specific grip strength benchmarks for healthcare workers and examine links between HGS, work productivity, and health outcomes, supporting preventive strategies across public health systems in Iraq.

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