Hand grip strength in relation to low back pain and arthralgia in Kurdish men: a cross-sectional study using data from RaNCD cohort study

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Abstract

Background

Musculoskeletal disorders can reduce quality of life and work capacity. We found better muscle strength can prevent musculoskeletal pain including arthralgia, back, and joint stiffness. This current study was assessed hand grip strength in relation to low back pain and arthralgia in Kurdish men.

Methods

This cross-sectional study was conducted using data from Ravansar non-communicable diseases (RaNCD) cohort study on 2164 men aged 35–65 years. Hand grip strength (HGS) was measured using a hand-held hydraulic hand grip dynamometer. Low back pain, arthralgia, back and joint stiffness were evaluated by the RaNCD cohort study physician using a standard questionnaire.

Results

In current study, 21.39 and 24.58% of studied participants had low back pain and arthralgia. Among the participants with low back pain 14.5% had back stiffness and among the participants with arthralgia 12.8% had joint stiffness. The mean of HGS in participants with arthralgia, back and joint stiffness was significantly less than in participants without these disorders (P < 0.001; P = 0.05; and P = 0.005, respectively). We observed that increasing HGS was associated with lower risk of arthralgia, back and joint stiffness.

Conclusions

Our results highlighted that higher HGS was associated with lower risk of arthralgia, back, and joint stiffness. However, there was not any association between HGS and low back pain. To enhance muscle strength, do exercise and adhere to proper nutrition are suggested to reduce musculoskeletal pain.

Background

Pain is the most common complaint that can affect daily activities, even a person's sleep and ultimately reduce a person's work capacity [1]. One of the most common musculoskeletal problems is related to low back pain, which affects people's quality of life [2]. Low back pain is usually caused by disc herniation, lumbar stenosis, trauma, muscle strain, lumbar spondylosis, spine and kidney infections, certain cancers, endometriosis, arthritis, and ankylosing spondylitis [3, 4]. Arthralgia also known joint pain is the pain in the area of joints which usually is a subjective symptom of arthritis [5]. In general, low back pain is the major reason of immobility, decreased physical function, and work capacity, which is important, especially in men as the main workforce [3].
Results from a systematic review and meta-analysis in 2020 showed that the most common musculoskeletal disorders was related to low back pain among operating room personnel with 61.48% prevalence (CI 95%: 44.33–78.64) [6]. Since many musculoskeletal disorders are not reported, it should be noted that the number of people with these disorders is much higher in the community [7]. Many studies have reported that the prevalence of musculoskeletal disorders is higher in older men and women than in young people [8, 7].

Hand grip strength (HGS) is a convenient, practical method in clinical and epidemiological studies that can reflect musculoskeletal function, physical, and nutritional status [9, 10]. Optimal muscle strength is associated with lower risk of non-communicable diseases (NCDs) such as cardiovascular disease, diabetes, and overall mortality [9, 11]. Furthermore, poor muscle strength can predict adverse outcomes including frailty, sarcopenia, fall, and immobility [10, 12]. According to the high prevalence of musculoskeletal pain, it is important to recognize muscle strength as a preventative factor in different population races. Therefore, the present study aimed to evaluate the relationship between muscle strength and risk of low back pain and arthralgia in Kurdish men in Ravansar non-communicable diseases (RaNCD) cohort study.

**Material And Methods**

Study design and participants

Current cross-sectional study was conducted on baseline data of men who were enrolled in RaNCD cohort study. The RaNCD cohort study is a first Kurdish population-based study on 10059 Kurdish participants (4770 men and 5289 women) aged 35–65 years living in Ravansar city, Kermanshah province, Western-Iran since 2014. This study is one of 18 studies developed by the PERSIAN (Prospective Epidemiological Research Studies in Iran) mega cohort study that was approved by the ethics committees at in the Ministry of Health and Medical Education, the Digestive Diseases Research Institute, Tehran University of Medical Sciences, Iran. The details of this study are described in previous studies [13, 14]. This cohort study was approval by the Ethics Committee of Kermanshah University of Medical Sciences (ethics approval number: KUMS.REC.1394.318).

We only included in this study men whose muscle strength was measured in the first phase of RaNCD cohort study. Since muscle mass decreases in CVD, cancer, and thyroid diseases [15–18], we did not included these patients into the present study. (Fig. 1)

Anthropometric indices

In the study site in Ravansar, InBody 770 device (Inbody Co, Seoul, Korea) was applied to measuring weight of participants with at least clothing and without shoes. To measuring height the automatic stadiometer BSM 370 (Biospace Co., Seoul, Korea) was used in a standing position without shoes, and with the precision of 0.1 cm. Body mass index (BMI) was calculated using this formula: weight (kg)/
(height)$^2$ (meter)$^2$. Waist circumference was measured by using non-stretched and flexible tape in standing position at the level of the iliac crest for the three times and was reported its average.

Hand grip strength

A hand-held hydraulic hand grip dynamometer (Model SH5003; SAEHAN Corporation, Masan, Korea,) was applied to measuring HGS using the dominant hand when the participant was sitting and the elbow was at 90° of flexion. The participants were asked to squeeze the handle with maximal effort for 10 seconds and then dynamometry was repeated after 30 seconds, and was reported their average as HGS. Calibration of this dynamometer was done according to the manufacturers’ manual.

Outcome measurement

Participants were asked four questions about low back pain and arthralgia by the RaNCD cohort study physician as follows: 1) Have you ever a low back pain that lasted more than a week and lead to serious disruption into your daily activity? (Yes/ No); 2) Do you have a history of back stiffness more than an hour in the morning? (Yes/ No); 3) Do you have a history of arthralgia? (Yes/ No); and 4) Do you have a history of joints stiffness more than an hour in the morning? (Yes/ No). This questionnaire was administered by PERSIAN mega cohort study to evaluate chronic diseases in all Iranian adults ages ≥ 35 years.

Statistical analysis

Stata, version 14 (Stata Corp, College Station, TX) was applied for all statistical analysis. We compared baseline characteristics of studied participants by Chi square and independent samples T test. Quantitative variables were presented as mean ± standard deviation. Qualitative variables were reported using frequency (%). To assess relationship between muscle strength and back and arthralgia, logistic regression was performed to produce odds ratios (OR) for binary outcomes, in crude and adjusted models. We considered the variables of age and physical activity in adjusted Model 1. Furthermore, in adjusted Model 2, in addition to the variables of Model 1, we controlled the variables of drinking, and diabetes. In addition, to better illustrate this association, we considered liner regression OR a across increasing muscle strength with adjustment for mentioned variables in logistic regression. P-values were considered significant at the level of < 0.05.

Results

In current study, 21.39 and 24.58% of studied participants were reported low back pain and arthralgia. Among the participants with low back pain 14.5% had back stiffness and among the participants with arthralgia 12.8% had joint stiffness. Baseline characteristics of studied participants are presented in Table 1.
## Table 1
Baseline characteristics of studied participants

| Variables               | Total (n = 2164) | Without low back pain (n = 1701) | With low back pain (n = 463) | P** | Without arthralgia (n = 1632) | With arthralgia (n = 532) | P** |
|-------------------------|------------------|---------------------------------|-----------------------------|-----|-------------------------------|----------------------------|-----|
| Age (year)              | 46.77 ± 7.89*    | 46.53 ± 7.86                    | 47.63 ± 7.91                | 0.006 | 46.21 ± 7.71                  | 48.48 ± 8.17                | < 0.001 |
| Weight (kg)             | 75.44 ± 13.31    | 75.31 ± 13.23                   | 75.92 ± 13.61               | 0.326 | 75.38 ± 13.10                 | 75.63 ± 13.95               | 0.87 |
| BMI (kg/m²)             | 25.94 ± 4.07     | 25.96 ± 4.02                    | 25.91 ± 4.25                | 0.05 | 25.87 ± 4.04                  | 26.15 ± 4.16                | 0.432 |
| WC (cm)                 | 96.32 ± 9.73     | 96.35 ± 9.2                     | 96.22 ± 11.46               | 0.505 | 96.06 ± 9.81                  | 97.12 ± 9.43                | 0.03 |
| Muscle strength (kg)    | 41.15 ± 9.27     | 41.23 ± 9.24                    | 40.83 ± 9.42                | 0.326 | 41.69 ± 9.17                  | 39.47 ± 9.4                 | < 0.001 |
| PA (MET hour/day)       | 43.21 ± 9.65     | 43.27 ± 9.77                    | 43.01 ± 9.18                | 0.893 | 43.17 ± 9.63                  | 43.34 ± 9.71                | 0.472 |
| Drinking, %             | 13.7             | 13.6                            | 14                           | 0.436 | 13                            | 16                          | 0.05 |
| Diabetes, %             | 6.3              | 6.6                             | 5.4                          | 0.218 | 5.8                           | 7.9                         | 0.054 |
| Back stiffness, %       | 5.1              | 2.5                             | 14.5                         | < 0.001 | 2.6                         | 12.8                        | < 0.001 |
| Joint stiffness, %      | 3                | 2.1                             | 6                            | < 0.001 | 0.4                         | 10.9                        | < 0.001 |

BMI: Body mass index; WC: Waist circumference; PA: Physical activity.

*Mean ± SD

**P-values were obtained independent samples T test and Chi square.

Figure 2 showed that mean of HGS in participants with arthralgia, back and joint stiffness was significantly less than in participants without these disorders (P < 0.001; P = 0.05; and P = 0.005, respectively).

Multiple-adjusted OR and 95% confidence intervals (CI) for arthralgia, back, and joint stiffness across muscle strength were showed that increasing HGS was associated with lower risk of arthralgia, back and
joint stiffness. (Table 2) These associations were remained after adjusting for potential confounders including age, physical activity, drinking, and diabetes.

Table 2

|                | Low back pain | P      | Arthralgia      | P      |
|----------------|---------------|--------|-----------------|--------|
| Crude          | 0.99 (0.98-1) | 0.371  | 0.97 (0.96–0.98)| < 0.001|
| Model 1*       | 1 (0.99–1.01) | 0.744  | 0.98 (0.97–0.99)| 0.012  |
| Model 2**      | 1 (0.98–1.01) | 0.796  | 0.98 (0.97–0.99)| 0.008  |

|                | Back stiffness| P  | Joint stiffness| P    |
|----------------|---------------|----|----------------|------|
| Crude          |               |    |                |      |
| Model 1*       | 0.97 (0.95–0.99) | 0.013 | 0.95 (0.93–0.98)| 0.002 |
| Model 2**      | 0.98 (0.96-1) | 0.098 | 0.97 (0.94-1) | 0.077 |

*Model 1 adjusted for age and physical activity

**Model 2 adjusted for variables in model 1, drinking, and diabetes.

Furthermore, results from linear regression were showed that risk of back and arthralgia, back and joint stiffness were decreased with increasing HGS after adjusting for mentioned potential confounders in Table 2. (Fig. 3)

**Discussion**

Our findings were reflected that higher HGS can decrease risk of arthralgia, back, and joint stiffness. In fact, HGS is a general result of the strength of the body used in epidemiological studies [19, 9]. Although the prevalence of musculoskeletal pain in men is lower than in women, men are also affected by comorbidities associated with these chronic pains and may even resort to risky behaviors to suppress pain, such as the use of narcotic drugs [20]. Low muscle strength can predict frailty, sarcopenia, falls, fractures, and overall reduced quality of life [12, 10]. Since musculoskeletal pain is associated with disability and inactivity, recognizing the link between muscle strength and these chronic pains can be an appropriate strategy in reducing this mentioned condition. Furthermore, daily and occupational activity may be restricted by musculoskeletal pain.

In current study we did not observe any association between low back pain and HGS. However, higher HGS was associated with lower risk of stiffness. A study on elderly women without physical activity was showed that low HGS was related to higher risk of low back pain (P = 0.004) [21]. Hershkovitz et al. [19] in their study indicated that higher HGS was associated with better rehabilitation in patients with hip fracture. Results from a meta-analysis by de Sousa on fourteen studies showed that strength of hip
abductors, hip extensors, and Knee extensor muscles in patients with low back pain were significantly lower than healthy participants, however, there was no any difference knee flexor muscle strength in patients with low back pain and healthy participants [22]. The results of this study were showed that HGS of participants with arthralgia and joint stiffness were significantly low compared to healthy participants. Terauchi et al. [23] in a study on middle aged women showed that a greater HGS was associated with lower muscle and joint pains (OR: 0.92; CI 95%: 0.87–0.97). Forechi et al. [12] observed that patients with post-chikungunya chronic arthralgia had significantly HGS lower than adults without this disorder (P < 0.001).

With ageing, the balance between antioxidant capacity and the production of radical oxygen species is disturbed [24, 25]. In addition, systemic inflammation, like what occurs in arthritis and other chronic musculoskeletal pain, causes to produce inflammatory cytokines such as plasma interleukin 6 (IL-6) and tumour necrosis factor alpha (TNF-α) [25]. Poor muscle strength may be induced by oxidative stress and inflammatory cytokines production [24]. Excess radical oxygen species and inflammatory cytokines contribute to activate muscle proteases in which can lead to protein breakdown [24]. Overall, poor muscle strength is increased poor outcomes related age, including falls, disability and mortality [26].

This study suffered from several limitations. First, the degree and severity of pain in the cohort study were not measured. Also, this was a cross-sectional study, it is not possible to infer increased HGS causes arthralgia, back, and joint stiffness or contrariwise. Further studies are necessary without these limitations.

In conclusion, our findings highlighted that higher HGS was related with lower risk of arthralgia, back, and joint stiffness. However, these findings did not supported role of muscle strength on low back pain. Nevertheless, after controlling for potential confounders, we did not observed any association between muscle strength and low back pain. Therefore, proper physical activity and a healthy diet are recommended to improve muscle strength to reduce musculoskeletal pain.

Declarations

Ethics approval and consent to participate:

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This study was approved by the Ethics Committee of Kermanshah University of Medical Sciences (ethics approval number: KUMS.REC.1394.318).

Informed consent:
Written informed consent was obtained from each studied subjects after explaining the purpose of the study. The right of subjects to withdraw from the study at any time and subjects information is reserved and will not be published.

**Consent for publication:**

All authors are in agreement with the manuscript and declare that the content has not been published elsewhere.

**Availability of data and materials:**

Data will be available upon request from the corresponding author.

**Competing interests:**

All authors have no conflict of interest.

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**Authors' contributions:**

SM and YP equally contributed to the conception and design of the research; FN, BH, ES contributed to data collection; SM, YP and MM contributed to the acquisition and analysis of the data; SM, YP and MS contributed to the interpretation of the data; and SM, MS and YP contributed to draft the manuscript. All authors are in agreement with the manuscript and declare that the content has not been published elsewhere.

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**Figures**
Figure 1

Flowchart of the samples selection

4770 men participated in the RaNCD cohort study

2419 men with an available dynamometry status at baseline

2351 participants with undetermined dynamometry status at baseline

Diseases did not include to the study because of:
- Cardiovascular disease (n=193)
- Cancer (n=13)
- Thyroid diseases (n=49)

Participants included to this study (n=2164)
Figure 2

Differences of muscle strength in participants with low back pain, back stiffness, arthralgia, and joint stiffness and without all of them (*P= 0.326; P=0.05; P<0.001; and P= 0.005, respectively)
Figure 3

Linear regression between muscle strength and low back pain and arthralgia.