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Effects of 30-second active stretching on manual grip strength in young adults: A randomized cross-over study

Efectos del estiramiento activo de 30 segundos sobre la fuerza de prensión manual en adultos jóvenes: estudio cruzado aleatorio

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ABSTRACT

Introduction: grip strength is an indicator of health, as well as a predictor of functional disability, morbidity and mortality. Grip strength protocols do not take into account stretching prior to these. Stretching significantly decreases muscle force production capabilities. **Objective:** to determine the effect of 30-second stretching on grip strength in healthy young adults. **Methods:** randomized, parallel, two-arm, blinded clinical trial. 80 young adult volunteers, aged 20-37 years participated in the study. They were randomly assigned to two intervention sequences manual prehensile strength measurement and active wrist flexor stretching for 30 seconds followed by manual prehensile strength measurement with a 24-hour washout period between the two interventions. A generalized linear model was used to estimate the efficacy of the intervention. **Results:** a 30-second static stretching of the flexor muscles of the hand generated a significant decrease in strength of -1.66 (-2.66 to -0.67). **Conclusions:** stretching prior to the measurement of the manual prehensile strength generates a decrease in this, therefore, it should be taken into account in the protocols for the evaluation of the manual prehensile strength.

Keywords: Muscle strength dynamometer; Hand strength; Muscle stretching exercises; Young adult; Cross-over studies.

ABSTRACT

Introducción: la fuerza de agarre es un indicador de salud, así como predictor de discapacidad funcional, morbilidad y mortalidad. Los protocolos de fuerza de agarre no tienen en cuenta el estiramiento previo a estos. Los estiramientos disminuyen significativamente las capacidades de producción de fuerza muscular. **Objetivo:** determinar el efecto del estiramiento de 30 segundos en la fuerza de agarre en adultos jóvenes sanos. **Método:** ensayo clínico aleatorizado, paralelo de dos brazos y cegado. 80 voluntarios adultos jóvenes, con edades entre 20 y 37 años participaron del estudio. Fueron asignados aleatoriamente a dos secuencias de intervención medición de la fuerza prensil manual y estiramiento activo de flexores de muñeca por 30 segundos seguido de medición de fuerza prensil manual con un periodo de lavado de 24 horas entre las dos intervenciones. Para estimar la eficacia de la intervención se utilizó un modelo lineal generalizado. **Resultados:** un estiramiento estático de 30 segundos en musculatura flexora de la mano, genera disminución de fuerza de manera significativa -1,66 (-2,66 a -0,67). **Conclusiones:** los estiramientos previos a la medición de la fuerza prensil manual generan disminución de esta, por lo tanto, se deben tener en cuenta en los protocolos de evaluación de la fuerza manual prensil.

Palabras clave: dinamómetro de fuerza muscular; fuerza de la mano; ejercicio de estiramiento muscular; adulto joven; estudios cruzados.

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INTRODUCTION

Handgrip strength (HGS) is a functional and cost-effective test that assesses an individual's overall muscle strength.[1,2] It is an essential indicator of biological health, muscular endurance, dexterity, and overall strength.[3,4] Recent studies have illustrated a relationship between HGS and various functional, clinical, and psychological or psychosocial parameters in different populations.[5] They have observed that individuals with higher HGS values show a lower risk of developing high blood pressure,[6] diabetes,[7] cardiovascular pathologies,[7,8] depression,[9] and other conditions.[10] HGS testing has been described as particularly quick, requiring no complex logistics and low-cost measurement tool, among other advantages.[11]

HGS measurement requires a simple, objective, and responsive dynamometer to determine the isometric muscle strength of the hand flexor chain.[12] In the current study setting, a wide range of dynamometers is used to perform tests.[13–15] Therefore, establishing a standardized test protocol is required when using an appropriate measurement tool.[16] However, HGS measurement has different types of protocols that are considerably variable in terms of dynamometer choice, arm position, tries quantity, and warm-up. Those variations could explain the differences among studies focused on measuring and estimating HGS since uncertainty is triggered when comparing measurement results. Then, it would not be possible to determine which is the most effective one.[10,17]

Different protocols for measuring HGS differ considerably in the choice of dynamometer and measurement protocol.[18] In the latter case, only aspects such as subject, arm and elbow position, warm-up, number of repetitions, grip duration, etcetera. have been considered. Stretching impact before handgrip measurement has yet to be studied.[19,20] However, it has been learned that it can affect muscle strength results and may influence HGS tests' results.[21–23]

This study aimed to determine the effect of 30-second stretching on HGS in healthy young adults.

METHODS

Study design

The present study implemented a randomized cross-over trial with a double-anonymized design (evaluators and data analysts). Randomization was conducted using a random number generator (Random.org; Randomness and Integrity Services). Moreover, the party responsible for randomization was an external actor in the research process.

Participants

Eighty subjects were recruited from the community and randomly assigned to two experimental sequences for stretching and HGS evaluation. Inclusion criteria included young adults aged 18 to 37 willing to participate. Subjects who were routinely involved in physical activities and exhibited physical disabilities showed musculoskeletal injuries during the six months prior to the study or had a cardiovascular history were excluded. All subjects were volunteers and provided written informed consent to participate in this study.

Measurement procedures and results

Only a randomized, blinded evaluator performed all measurements. Participants attended the laboratory on two separate occasions. Before initiating the assessment, participants were instructed to refrain from strenuous physical activity for two days before the examination and the duration of the investigation. Data collection was performed in the kinematic sciences laboratory of the faculty of health of the University of Pamplona, Colombia.

Age and sex information on each participant was recorded, and anthropometric measurements were taken under minimal clothing and barefoot. Measurement instruments were previously calibrated. Weight was obtained using a Tanita segmental Body Composition FitScan BC-601F bioimpedance analyzer, with an easy-to-read LCD screen, 4-subjects memory span, reminder function, and a 150-kilogram capacity. Height was measured using a Health-o-Meter stadiometer at a heeled-together bipedal position and feet at a 45° angle. Heels, buttocks, back, and occipital region were placed against the vertical surface of the stadiometer.

HGS Evaluation: HGS was measured using a Camry digital hand grip dynamometer with a capacity of 198lb (89.81 kg). It included an adjustable handle to change the grip depth according to the individual's age. Participants were instructed to remain in a bipedal posture, avoiding any compensatory movements that could affect the test. The required posture included shoulder adduction, neutral rotation, extended elbow, and neutral-positioned forearm. Participants maintained maximal voluntary contraction for 3 seconds. Evaluations were performed individually. They were supervised and directed by a 15 year- experienced trained physiotherapist who provided instructions regarding upper limb position, stretching, and time accuracy. No warm-up was performed before the HGS measurement.

Static Stretching: The static stretching protocol consisted of a self-stretch with the subject in a standing position, upright, feet shoulder width apart, their dominant upper limb at 90° of shoulder flexion, in supination, with the wrist in maximum extension, and with the opposite hand performed the stretch by holding the dominant hand for 30 seconds

Intervention groups: After the initial assessment, subjects were randomly assigned to two intervention groups: the first intervention group corresponded to the following two time points: on the first day, only HGS was assessed; 24 hours later (wash-out period), performed active stretching of wrist flexors for 30 seconds followed by HGS measurement. On the first day, the second group performed active stretching of wrist flexors for 30 seconds, followed by HGS measurement; on the second day, with a 24-hour wash-out period, only performed HGS measurement. The scheme of the two interventions is presented (Figure 1).

Wash out: A 24-hour wash period was decided to guarantee the same basal condition.

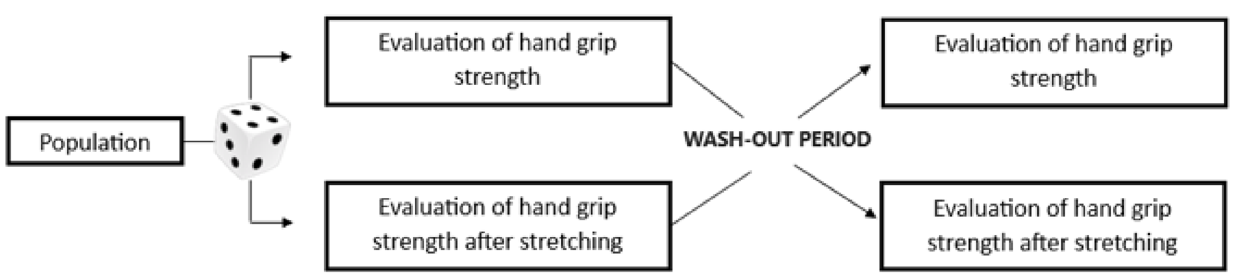

Figure 1. Random Distribution and Allocation to Intervention Group.

Statistical analysis

Firstly, an exploratory analysis was performed for quantitative variables, and their distribution (outliers, symmetries, kurtosis, types of distribution) was determined. Regarding qualitative variables, relative frequencies were analyzed (mode, erroneous, and missing data). After that, sociodemographic variables were described by sex. Regarding qualitative variables, absolute and percentage frequency were reported. In respect of quantitative variables, their mean and standard deviation were described.

In order to estimate the effect of these two "interventions," a two-level hierarchical model was used (family: normal, link: identity level 1: the two types of grip strength measurements; level 2 each individual). It was modeled as follows:

$$y_{ij} = \beta_{oj} + \beta_{1i}X_{1i_{Est}} + e_{ij}$$

Where y_{ij} scale score, β_o the intercept, β_{1i} coefficient of HGS including stretching. Subsequently, it was adjusted for sex, height, weight, and laterality.

$$y_{ij} = \beta_{oj} + \beta_{1i}X_{1i_{Est}} + \beta_{2j\ldots5j}X_{2j\ldots5j} + e_{ij}$$

Where $\beta_{2j\ldots5j}$ are change coefficients for individuals' variables such as sex (β_{2j}), height (β_{3j}), weight (β_{4j}), and laterality (β_{5j}). Finally, a sex-stratifying model was developed.

Ethical considerations

All participants were informed of research benefits and risks and provided written informed consent. This study considered the guidelines of Resolution 8430 of 1993, classified as research with minimal risk. Beneficence and non-maleficence were upheld throughout all research phases. This research work was approved and endorsed by the Ethics and Environmental Impact Committee of the University of Pamplona, according to minutes June 07th June 15th, 2022.

RESULTS

Population characteristics

A total of 115 young adults were recruited. Thirty did not meet the inclusion criteria, and five declined to participate in the research. Eighty subjects were included and randomized into two groups. Forty were assigned to the stretching group, while forty remaining were allocated to the non-stretching group. There were no losses in follow-up or analysis. Further details of the selection process are shown in Figure 2.

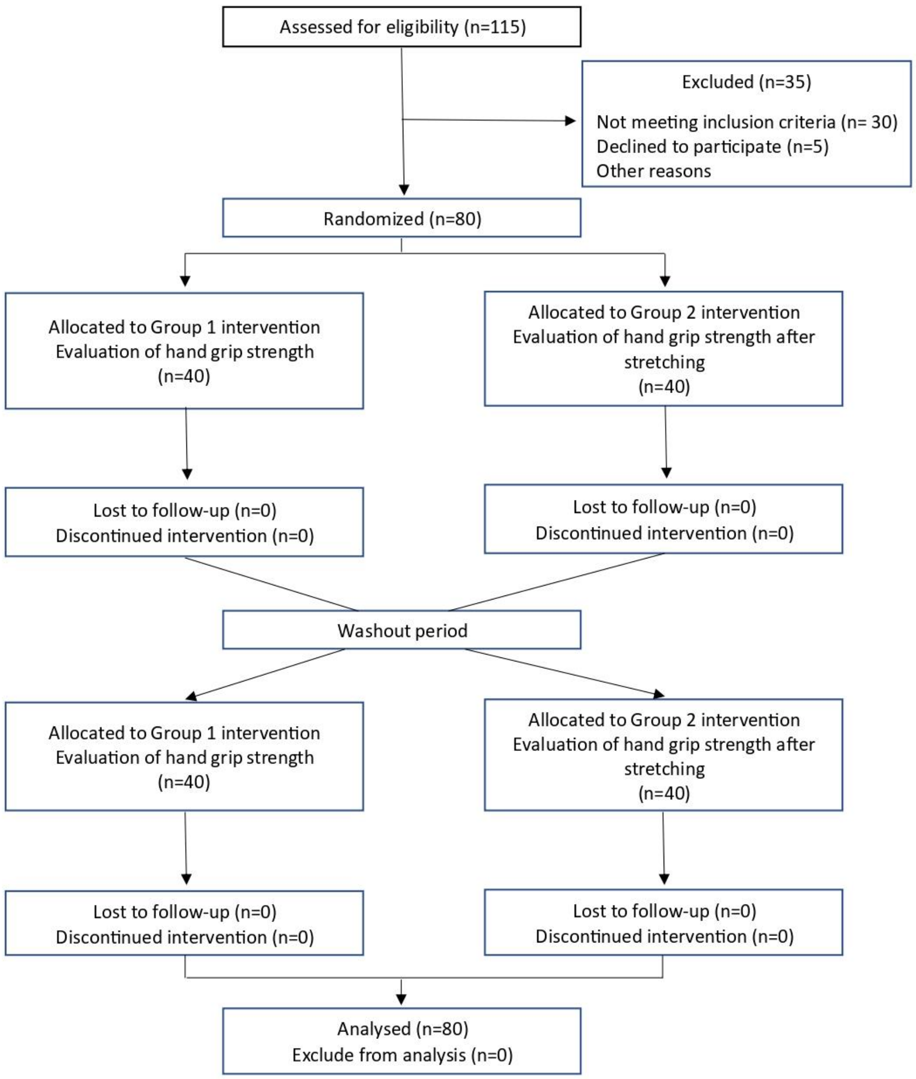

Figure 2. Flowchart of Subject Allocation, Follow-up, and Analysis.

Forty of the eighty selected subjects were women. Their mean age was 22.9 (2.6) years. 88.8% of the participants were right-handed. Details of the sample are presented in Table 1.

Table 1. Sample's anthropometric characteristics and laterality by sex.

	Female	**Male**	**Total**
Laterality	n (%)	n (%)	n (%)
Right	36 (90,0)	35 (87,5)	71 (88,8)
Left	4 (10,0)	5 (12,5)	9 (11,3)
	$\bar{x}$ *(de)*	$\bar{x}$ *(de)*	$\bar{x}$ *(de)*
Age	23,4 (2,1)	22,3 (2,9)	22,9 (2,6)
Weight (kg)	61,5 (10,4)	73,6 (20,6)	67,5 (17,3)
Size (cm)	159,3 (4,9)	171,0 (16,3)	165,1 (13,4)

Contrasting stretching protocol vs. no stretching one showed a mean difference (MD = -1.66, 95% CI -2.66 to -0.67) against the stretching protocol. However, when stratifying the analysis by sex, the difference in men was significant (MD = -3.04, 95% CI -4.75 to -1.32), while in women, it was not (MD = -0.29, 95% CI -1.21 to 0.63). Further details on comparisons are shown in Table 2.

Table 2. HGS measurement by sex, before and after stretching.

	No stretch	**Post Stretch**	**Post Stretch vs. No stretch Df (IC95%)**	**ICC**
	$\bar{x}$ (de)	*$\bar{x}$ (de)*	*Df (IC 95%)*	*ICC*
General sample	35,9 (10,9)	34,3(10,5)	-1,66 A (-2,66 a -0,67)	0,90
			-1,66 B (-2,66 a -0,67)	0,81
Female	27,5 (4,7)	27,2 (5,3)	-0,29 A (-1,21 a 0,63)	0,83
			-0,29 C (-1,21 a 0,63)	0,84
Male	44,4 (8,4)	41,3 (9,5)	-3,04 A (-4,75 a -1,32)	0,82
			-3,04 C (-4,75 a -1,32)	0,83

$\bar{x}$: Average, de: standard deviation; df: Average difference; IC95%: Confidence interval del 95%; ICC: Intraclass correlation coefficient.
A. Bivariate model.
B. Adjusted model by gender, laterality, weight, and size.
C. Adjusted model by laterality, weight, and size.
Significant values are shown in bold.

DISCUSSION

It has been identified that grip strength decreases statistically significantly after applying a hand muscle stretching protocol. To the best of the authors' knowledge, this is the first study to investigate the effect of hand flexor stretching on strength in young adults.

Present findings demonstrate that a 30-second static stretching applied to hand flexor muscles can decrease muscle strength and, thus, grip strength. Different authors have found that muscle strength tends to decrease after stretching.[24–26] It appears that stretching duration has a lot to do with muscle strength loss.[26] Matsuo et al. observed that increasing stretching duration was associated with muscle strength loss, particularly in stretches lasting longer than 60 seconds.[27] Nakamura et al. identified that a 60-second stretching with 30-second intervals decreases muscle strength for up to 20 minutes after stretching. Therefore, they recommend avoiding stretching interventions before events requiring strength.[28] Similarly, Siatras et al. observed strength loss after a 30-second-stretching application when performing stretches for 10, 20, 30, and 60 seconds. Therefore, they recommended avoiding static stretching for more than¬¬ 30 seconds before maximal strength activities.[29] Besides, some authors have learned that stretches with interventions shorter than 30 seconds do not cause strength loss in stretched muscles.[30,31]

To explain the strength deficit following stretching, different authors have described the possibility of two main factors. The first of these is the mechanical factor involving the decrease in the stiffness of the musculoskeletal unit, with the consequent activation of the lower motor unit,[26,30] as this may affect the amplitude and shape of the muscle contraction because more time is needed to recover the slack in the serially compatible elements.[32] The second aspect to consider is the increase in muscle length, which may alter the delicate balance of muscle properties and joint kinematics, which combine to produce force.[33] On the other hand, altered strength-length characteristics may influence neural activation patterns due to altered feedback and proprioceptive coordination.[34,35]

When analyzing the sample by sex, the current study identified that male participants had a statistically significant decrease in strength after stretching. However, this was not the case for the female ones. A probable explanation can be a possible increase in estrogen during the ovulatory phase. It decreases passive stiffness without a difference in muscle strength or a decrease without a correlation between changes in muscle strength and passive stiffness.[36] Nagahori et al.[37] found that skeletal muscle function in women can be affected by the menstrual cycle in terms of muscle strength and flexibility.

This is one of the first studies to estimate the differences between manual grip force protocols. Its development will allow the estimation of measurement bias during extension, which may affect the measurement of grip strength at a population level and in clinical follow-up in upper limb rehabilitation.

This study has limitations; one is that no assumptions about the sample sizes were made to calculate the differences correctly. On the other hand, the 24-hour wash-out period may not have eliminated the effects of stretch stimulation.

CONCLUSIONS

Stretching before measuring HGS decreases grip strength. Therefore, it should be considered in protocols for assessing grip strength. Further work on the following topics is recommended to confirm or refute our findings.

CONFLICT OF INTEREST STATEMENT

The authors of this study declare that the research was conducted without any commercial or financial relationships that could be construed as potential conflicts of interest.

AUTHORS' CONTRIBUTION

OEMA participated in conceptualization, investigation, method, and writing – original draft.
MER participated in conceptualization, investigation, method, and writing – original draft.
MELP participated in conceptualization, investigation, method, and writing – original draft.
EBM designed method, formal analysis, and writing – original draft

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