

Hand-grip strength in recreational downhill skiers: a comparison to normative reference values

Eur J Transl Myol 34 (4) 13021, 2024 doi: 10.4081/ejtm.2024.13021

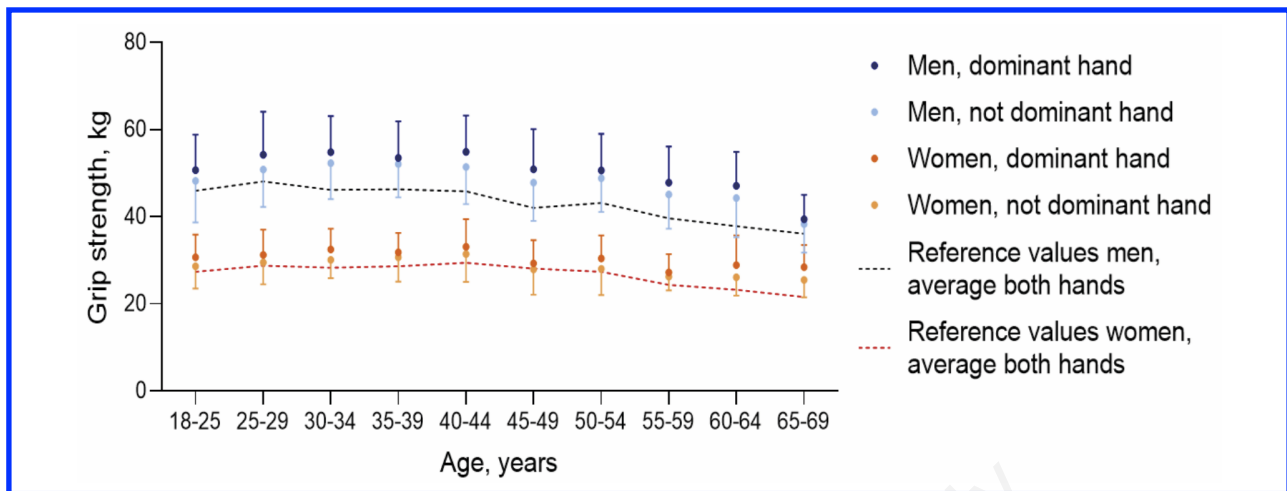


Figure 1. Visualization of age-dependent grip strength values in skiers compared to reference values of a normal population.

peaked at 41–50 and 31–40 years in men and women, respectively. Subsequently, a rate of decline of approximately 12% per decade was observed, regardless of sex. This is in agreement with data from World Records of Master athletes, demonstrating an absence of sex differences in the decline of performance with aging.²⁸

Low values of hand-grip strength may not only provide information on the fitness status of downhill skiers but are also closely related to morbidity and mortality of various causes,^{29–31} and this association tended to be stronger in women.³² Thus, the overall health effects in regular long-term downhill skiers are not surprising.² On the other hand, the injury risk during downhill skiing should not be underestimated,^{33,34} but higher muscular strength has been suggested as a preventive factor, particularly considering the relatively high risk of an anterior cruciate ligament (ACL) injury in female skiers.³⁵ This risk is about three times greater in women than men, which may, besides neuromuscular factors, be attributed to hormonal and anatomical, but also environmental and equipment-related factors.^{34,36}

Furthermore, increased hand-grip strength is associated with a reduced risk of falls in older age, but is partly mediated by balance problems.³⁷ Generally, the maintenance of appropriate musculoskeletal fitness with aging is a long-known measure for the prevention of injury in sports.³⁸ As demonstrated by the association between lower hand-grip strength with higher all-cause, cardiovascular, and cancer mortality risk,²⁹ as well as a higher risk of falls, grip strength measurements in skiers may provide possible clues about the ability to ski and the associated injury risk in older people. Hand-grip strength values are markers for the strength of knee extensor muscles,¹⁰ which are predominantly used in downhill skiing.³⁹ Both appropriate strength training and performing regular downhill skiing improve lower leg strength and consequently also hand-grip strength.³⁹ However, it must be noted that muscle strength is only one factor contributing to skiing performance and other parameters, e.g., aerobic and anaerobic endurance, agility, balance capability, and technical skills are also crucial.^{8,40}

Limitations

First, besides age and sex, multiple factors such as height, body mass, type, volume, and intensity of physical activity, pre-existing diseases, and dietary behavior may all influence hand-grip strength, all of them have not been sufficiently considered in the present study. Second, the sample size of some age groups is small likely provoking a type II error. Third, no detailed information was collected, e.g., on geographic, sociocultural and economic characteristics of participants. Hence, potential selection biases cannot be ruled out. Finally, refinements of hand-grip strength measurement protocols are needed⁴¹ for a deeper understanding of age-dependent trajectories of muscle strength in downhill skiers.

In conclusion, this study provides average values of hand-grip strength for 5-year age categories of male and female skiers from 18 to 69 years and draws comparisons to a normal population. On average, recreational alpine skiers have greater hand-grip strength than individuals of the normal population but may have lower strength values than competitive athletes of both sexes across all age groups considered. Differences may be a consequence of the volume and intensity of exercise regularly performed. These results can help to assess whether the individual hand-grip strength is above or below average with regard to the normal population and the skier population as well and will support advice for training and/or rehabilitation. Future studies should determine more precisely the potential impact of hand-grip strength on the age-related skiing ability and the associated risk of injury.

List of abbreviations

ACL, Anterior cruciate ligament
CI, Confidence Interval
ES, Effect size
SD, Standard deviation

Contributions

MB was responsible for the conception and design of the study; EP, VM, GR and MP were involved in data collection; MB, JB, and BS were involved in the processing and statistical analysis of data; MB, JB, BS, and MK were involved in the drafting of the manuscript; and all authors contributed to the interpretation of the data for the work and revising it critically for important intellectual content. All the authors finally approved the manuscript. MB was responsible for obtaining project funding and takes responsibility for the integrity of the work as a whole. All authors have read and agreed to the published version of the manuscript.

Conflict of interest

None of the authors report any conflict of interest related to this study.

Ethics approval and consent to participate

The study was performed according to the Declaration of Helsinki and was approved by the Institutional Review Board of the Department of Sport Science (University of Innsbruck); informed consent was received and the rights of the subjects were protected.

Availability of data and materials

All data generated or analyzed during this study are included in this published article.

Acknowledgements

We thank to the Austrian Ski Federation for the valuable support of this study.

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Submitted: 5 September 2024.

Accepted: 27 September 2024.

Early access: 17 October 2024.