

Editorial

Strength as a Predictor of Longevity: Compelling Evidence

Charles P. Lambert^{1,*}¹University of California San Diego, La Jolla, CA 92093, USA*Correspondence: CLCPL368@gmail.com (Charles P. Lambert)

Submitted: 14 February 2022 Revised: 13 March 2022 Accepted: 17 March 2022 Published: 16 May 2022

1. Introduction

There has been much to-do about the Obesity epidemic [1–3]. The so-called metabolic health detriments associated with Obesity have been promoted for years. Much effort and scientific inquiry has been dedicated to human longevity related to alterations in body weight. From epidemiological data, this appears to be of minor importance in the study of longevity. In this review, I provide compelling evidence that muscle strength is predictive of longevity regardless of other potential negative health altering “metabolic” factors. This is in both in middle age and older individuals. This is important for public health and may point us in the direction in the remainder of the 21st century. Succinctly, high muscle strength regardless of many other factors will prolong a person’s life.

2. Effect of Muscle Mass and Strength on All-Cause Mortality

With regard to the muscle mass on mortality rate, Abramowitz *et al.* [4] reported that at any body mass index at or above 22 participants with low muscle mass had increased propensity for diabetes and higher all mortality rate (adjusted). The higher the appendicular muscle mass the lower the level of mortality. These findings were similar in smokers and non-smokers. These results were the same after unintentional weight loss, early mortality, chronic illness, participants performing muscle-strengthening exercises or other chronic physical activity were excluded.

Metter *et al.* [5], when he was with the National Institutes of Aging, performed a number of investigations on the relationship between muscle mass, muscle strength, and all-cause mortality. In 2002, they evaluated grip strength, 24 hours urinary creatinine for muscle mass, and physical activity levels in individuals greater than 60 years of age, those alive vs. dead had a greater length of follow up, greater physical activity, and greater grip strength. The decline in strength was related to increased death rate. For those individuals 60 and older, the absolute level of muscle strength (as measured by grip strength) was predictive of mortality. The authors concluded that the muscle mass and physical activity are important predictors of mortality but they are over-shadowed by strength and the rate of loss of strength regarding the mortality rate. In a subsequent study in 2004, Metter *et al.* [6] reported that 10–15 second arm cranking power led to a significant positive relationship

with longevity. Arm cranking power requires both strength (force) and higher velocity movements. This was a stronger predictor of longevity than isometric (static) strength generating capacity. Dynamic power requires more of a neurologic component than static (isometric) strength and thus this may explain the greater longevity of those with higher 10–15 second power output.

Rantanen *et al.* [7] followed individuals who were 45–68 years of age for 30 years. Flying in the face of the theory of the effects of elevated weight on longevity, these authors found that death was the lowest in highest BMI category of the study (25 kg/m²). Interestingly, an additional finding was those in highest grip strength category had the lowest mortality. A BMI of 25 is about in the middle of the normal range of BMI’s with 30 being obese and 18.5 being about the low end of normal.

Ran *et al.* [8] reported that the level of low muscle mass in their population was 33% when defined by appendicular lean muscle mass. For people with low muscle strength all-cause mortality was higher regardless of muscle mass. These investigators found that the association of low muscle strength on all-cause mortality was independent of level of metabolic syndrome, leisure time physical activity or sedentary time.

In a very large epidemiological study (502,293 patients; 54% women), Celis-Morales *et al.* [9] reported that, in individuals originally 40–69 years of age who were followed for approximately 7 years, for every 5 kg decrease in grip strength for men there was a 16% greater chance of all-cause mortality.

In Korean co-hort, Eun-J Bae *et al.* [10] reported that the weakest group had a 2.6 (260% greater) mortality rate than the strongest group.

For elderly individuals (61–74 years of age), Laukkanen *et al.* [11] reported that strongest individuals regarding grip strength had 34% lower risk of death than the weakest individuals.

In an excellent meta-analysis of 38 studies (nearly 2 million data points/people), Antonio Garcia-Hermoso *et al.* [12] reported all-cause mortality was inversely related to grip strength and also that higher knee extension strength was also related to a substantial (14%) decreased risk of death.



3. Conclusions

It is clear from the above discussion that muscle strength, regardless of other factors such as metabolic syndrome, physical activity, and smoking is predictive of longevity. This is a call to action for individuals to engage in resistance exercise training and other strengthening activities and to ingest appropriate nutrition to support such activities.

4. Potential Mechanisms for the Relationship of Muscle Strength and Low Mortality

Clearly, proper strength training, sufficient sleep, proper nutrition (i.e., weight-maintenance and even a positive energy balance—since strength is predictive of longevity in the face of metabolic syndrome) including proper macronutrient percentages for training and supporting sufficient male hormone levels, and including nutritional supplementation, and if necessary and only under the care of a Physician, Testosterone Replacement Therapy. Furthermore, good hygiene and avoiding communicable infections (e.g., COVID-19) and other possible immunosuppressive activities (e.g., overtraining syndrome) would be also important for a high level of strength.

Ethics Approval and Consent to Participate

Not applicable.

Acknowledgment

Not applicable.

Funding

This research received no external funding.

Conflict of Interest

The author declares no conflict of interest. CPL is serving as one of the Guest editors of this journal. We declare that CPL had no involvement in the peer review of this article and has no access to information regarding its peer review. Full responsibility for the editorial process for this article was delegated to DP.

References

- [1] Caballero B. Humans against Obesity: Who Will Win? *Advances in Nutrition*. 2019; 10: S4–S9.
- [2] Conway B, Rene A. Obesity as a disease: no lightweight matter. *Obesity Reviews*. 2004; 5: 145–151.
- [3] Dan AG. Obesity—the Epidemic Crisis of our Time. *Surgical Clinics of North America*. 2016; 96: xv–xvi.
- [4] Abramowitz MK, Hall CB, Amodu A, Sharma D, Androga L, Hawkins M. Muscle mass, BMI, and mortality among adults in the United States: a population-based cohort study. *PLoS ONE*. 2018; 13: e0194697.
- [5] Metter EJ, Talbot LA, Schrager M, Conwit R. Skeletal muscle strength as a predictor of all-cause mortality in healthy men. *Journals of Gerontology—Series A Biological Sciences and Medical Sciences*. 2002; 57: B359–B365.
- [6] Metter EJ, Talbot LA, Schrager M, Conwit RA. Arm-cranking muscle power and arm isometric muscle strength are independent predictors of all-cause mortality in men. *Journal of Applied Physiology*. 2004; 96: 814–821.
- [7] Rantanen T, Masaki K, He Q, Ross GW, Willcox BJ, White L. Midlife muscle strength and human longevity up to age 100 years: a 44-year prospective study among a decedent cohort. *Age*. 2012; 34: 563–570.
- [8] Li R, Xia J, Zhang XI, Gathirua-Mwangi WG, Guo J, Li Y, *et al*. Associations of Muscle Mass and Strength with all-Cause Mortality among US Older Adults. *Medicine and Science in Sports and Exercise*. 2018; 50: 458–467.
- [9] Celis-Morales CA, Welsh P, Lyall DM, Steell L, Petermann F, Anderson J, *et al*. Associations of grip strength with cardiovascular, respiratory, and cancer outcomes and all cause mortality: prospective cohort study of half a million UK Biobank participants. *British Medical Journal*. 2018; 361: k1651.
- [10] Bae EJ, Park NJ, Sohn HS, Kim YH. Handgrip Strength and All-Cause Mortality in Middle-Aged and Older Koreans. *International Journal of Environmental Research and Public Health*. 2019; 16: 740.
- [11] Laukkanen JA, Voutilainen A, Kurl S, Araujo CGS, Jae SY, Kunutsor SK. Handgrip strength is inversely associated with fatal cardiovascular and all-cause mortality events. *Annals of Medicine*. 2020; 52: 109–119.
- [12] García-Hermoso A, Ramírez-Vélez R, Peterson MD, Lobelo F, Cavero-Redondo I, Correa-Bautista JE, *et al*. Handgrip and knee extension strength as predictors of cancer mortality: a systematic review and meta-analysis. *Scandinavian Journal of Medicine and Science in Sports*. 2018; 28: 1852–1858.