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Review Article

Muscular strength as a strong predictor of mortality: A narrative review

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ABSTRACT

Muscular strength, an important component of physical fitness, has an independent role in the prevention of chronic diseases whereas muscular weakness is strongly related to functional limitations and physical disability. Our purpose was to investigate the role of muscular strength as a predictor of mortality in health and disease. We conducted a systematic search in EMBASE and MEDLINE (1980–2014) looking for the association between muscular strength and mortality risk (all-cause and cause-specific mortality). Selected publications included 23 papers (15 epidemiological and 8 clinical studies). Muscular strength was inversely and independently associated with all-cause mortality even after adjusting for several confounders including the levels of physical activity or even cardiorespiratory fitness. The same pattern was observed for cardiovascular mortality; however more research is needed due to the few available data. The existed studies failed to show that low muscular strength is predictive of cancer mortality. Furthermore, a strong and inverse association of muscular strength with all-cause mortality has also been confirmed in several clinical populations such as cardiovascular disease, peripheral artery disease, cancer, renal failure, chronic obstructive pulmonary disease, rheumatoid arthritis and patients with critical illness. However, future studies are needed to further establish the current evidence and to explore the exact independent mechanisms of muscular strength in relation to mortality. Muscular strength as a modifiable risk factor would be of great interest from a public health perspective.

1. Introduction

It is well known that both males and females of all ages benefit from regular physical activity, which reduces the risk of premature mortality in general, and of coronary heart disease (CHD), hypertension, certain kinds of cancer, and diabetes in particular. Physical activity also improves mental health and is important for the health of muscles, bones and joints [1,2]. On the contrary, physical inactivity causes 6–10% of all deaths from the major diseases (CHD, type 2 diabetes, and breast and colon cancers) which occurred worldwide each year as estimated by Lee and colleagues [3]. For this reason, the WHO recently recognizes physical inactivity as one of the leading global risk factors for morbidity and premature mortality [4].

Prior studies found that the dose–response relationship between cardiorespiratory (aerobic) fitness and health is stronger than that between physical activity and health [5,6]. Furthermore, in the last decade, a low level of cardiorespiratory fitness has been confirmed as a powerful predictor of mortality in healthy and diseased individuals [7–10].

Another important component of physical fitness is muscular strength, which independent role in the prevention of chronic diseases has now increasingly been recognized. Several epidemiological studies have shown that muscular weakness in middle-aged and older individuals is strongly related to functional limitations and physical disability [11–13]. Impressive are the findings of Cheung et al. [14] who newly reported that handgrip strength appeared to be a more useful marker of multimorbidity (co-occurrence of two or more diseases) than chronological age in men.

Recently, a growing body of evidence suggested that muscular strength is inversely and independently associated with death from all causes and cancer even after adjusting for cardiorespiratory fitness and other cofactors such as age, body fat, smoking, alcohol, and hypertension [15–20]. This review will discuss the strong, inverse association of muscular strength with mortality, as reported in epidemiological studies as well as in clinical populations with chronic disease, in order to provide recent scientific evidence.

2. Methods

We conducted a systematic search in EMBASE and MEDLINE (1980–2014) looking for the association between muscular strength and mortality risk in healthy as well as diseased individuals. Key words used for

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the electronic searches were muscular strength, mortality (all-cause, cardiovascular- and cause-specific), risk factor, disease, and health. In addition, a manual search was conducted based on the reference list of the selected publications. The studies were checked independently by 2 researchers (K.V., C.M.) and when disagreement existed another researcher (M.H.) was encouraged to achieve consensus. As inclusion criteria were used: i) usage of a validated muscular test (hand-grip dynamometry or other tests of muscular voluntary contraction either dynamic or isometric), ii) mortality as a primary outcome measure and iii) English as a publication language. Review papers and cross-sectional studies were excluded.

3. Results

A total of 420 studies were found after the electronic search (Fig. 1). After title screening 315 were excluded and 105 were selected. After abstract reading 84 studies were excluded and 21 full-papers were comprehensively examined. In addition 8 studies were selected during the manual search. After reading this 29 studies, 6 were excluded for not meeting the inclusion criteria; therefore 23 studies were finally included in this review (Tables 1 and 2).

Fifteen of them were epidemiological studies and eight studies focused on hospitalized subjects or patients with chronic disease such as heart failure, hypertension, peripheral artery disease, chronic obstructive pulmonary disease, cancer and patients with critical illness (clinical studies). The majority of the epidemiological studies focused on middle-aged or older persons with some of them also included younger individuals while in the clinical studies all the participants were older than 50 years.

The follow-up time between the baseline assessment of muscular strength and mortality/survival ranged from several weeks or months in the case of clinical studies to 40 or more years in the epidemiological

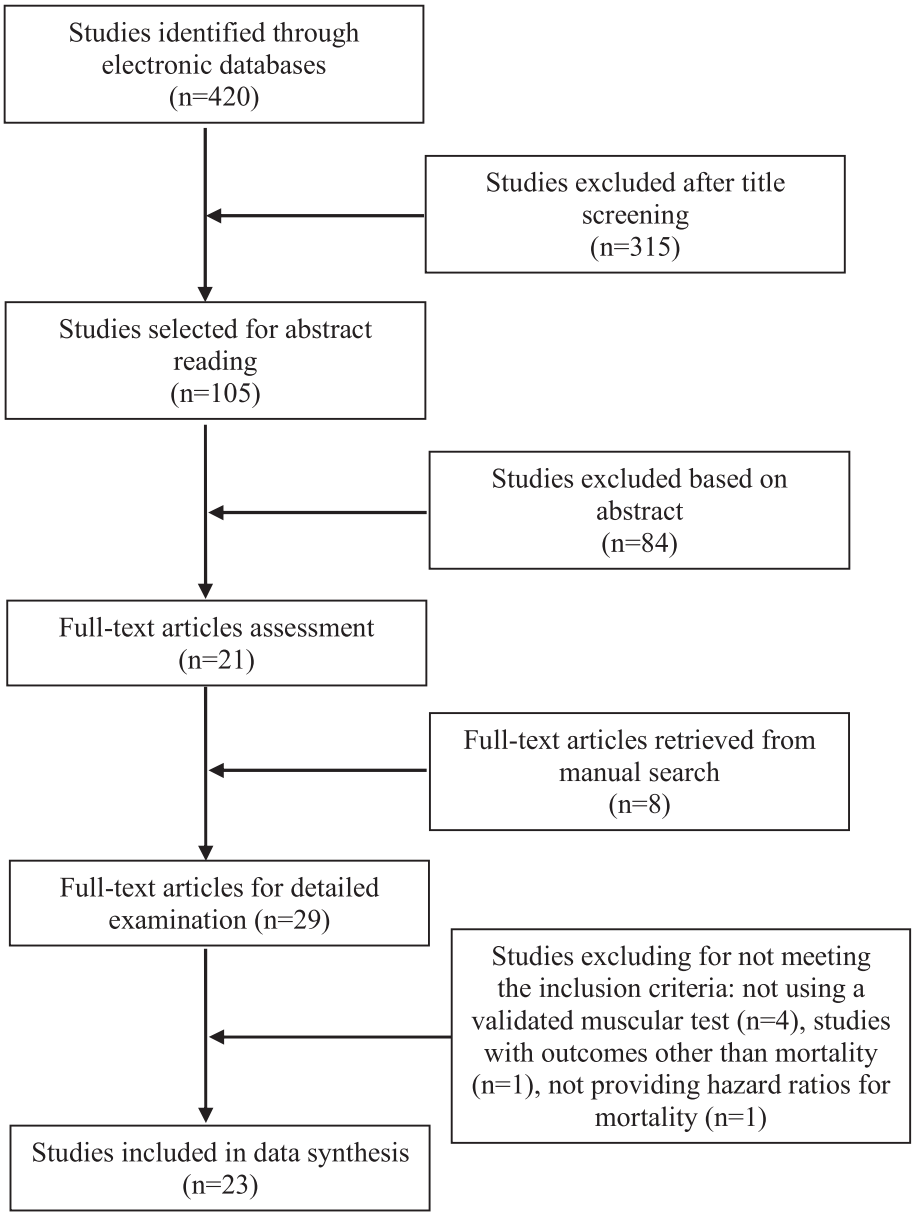

Fig. 1. Flow-chart indicating the selection strategy of the studies.