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Original Article

Handgrip strength is inversely and independently associated with multimorbidity among older women: Results from the KORA-Age study

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ABSTRACT

Background: Data on the association between handgrip strength and multimorbidity (MMB) are missing.
Aim: The purpose of this study was to examine if handgrip strength is related to MMB in a large population-based sample of older persons.
Methods: The cross-sectional analysis was based on 1079 older people (aged 65–94 years), who participated in the KORA-Age study in the Augsburg region, southern Germany. Participants underwent an interview and extensive examinations, including anthropometric measurements, registration of chronic diseases, determination of health-related behaviors (smoking, alcohol intake and physical activity), collection of blood samples, and muscle strength measurement using hand-grip dynamometry.
Results: In men, handgrip strength correlated strongly with the number of co-existing diseases ($r = -0.176$, $p < 0.001$), and the same pattern was observed for women ($r = -0.287$, $p < 0.001$). Among women, handgrip strength in the lower tertile compared to the upper tertile was significantly associated with an increased odds of having MMB (OR: 2.57, 95% CI: 1.30–5.07, $p = 0.007$) after controlling for age, BMI, education, alcohol intake, smoking habits, medications number, inflammatory markers, telomere length and levels of physical activity. Contrary, no significant association between handgrip strength and MMB was found among men (OR: 1.32, 95% CI: 0.73–2.40, $p = 0.362$) after multivariable adjustment.
Conclusion: Lower levels of handgrip strength are associated with a higher odd of MMB among older women even after adjusting for traditional and novel confounders. Increasing the levels of muscular strength in older women seems to be important in order to reduce the risk for the co-occurrence of multiple chronic diseases.

1. Introduction

Multimorbidity (MMB), defined as the co-occurrence of two or more chronic diseases in the same individual, causes a major problem for both the health care system as well as the patients and the society in general and has been linked with functional decline, poor quality of life and increased morbidity and mortality [1,2]. The prevalence of MMB in population-based studies ranged between 58% and 73% among older aged >65 years [3,4], a trend that will further increase with rising life expectancies [5].

It is well documented that regular physical activity and a high level of cardiorespiratory fitness have proven to be protective against several chronic diseases [6,7], and recently such a strong relationship between an active lifestyle and MMB has also been reported [8,9]. Muscular strength, another important component of physical fitness, has gained popularity in the last decade and is suggested to play a key role in the prevention of numerous chronic diseases. Several epidemiological studies have shown that muscular weakness in middle-aged and older individuals is strongly related to functional decline, disability, and mortality even after adjusting for traditional risk factors [10–14].

However, data from population-based studies addressing the relationship between handgrip strength and MMB among older men and women are missing. Given that the skeletal muscle is the largest organ in the human body, which confrontate with the catabolic effects of aging, it is of vital importance for older people to preserve a sufficient

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level of muscle mass and strength to counteract the adverse effects of MMB, especially the decline of physical functioning and mortality. Only one prior relevant cross-sectional study conducted by Cheung et al. [15] analyzed a sample including 1145 subjects (aged 50 years and older) living in Hong-Kong. They found that low grip strength was significantly associated with an increased odds of having five and three chronic diseases in men and women, respectively, after controlling for age, BMI, history of smoking, educational level, marital status, and comorbidities.

However, other factors, e.g., elevated inflammatory markers or the level of physical activity, may significantly influence the association between muscular strength and MMB. Furthermore, cellular aging, as measured by the leucocytes telomere length (LTL), may also have an impact on the association between muscle strength and MMB given the causal link that exists between telomere shortening and the incidence of many chronic diseases [16].

Thus, the aim of the present study was to examine if hand grip strength is associated with MMB in a large population-based sample of older men and women aged 65–94 years. We hypothesized that lower levels of handgrip strength are associated with MMB independent of other cofactors, including the status of inflammation, telomere length and the levels of physical activity.

2. Methods

2.1. Study population

Data were collected in 2009 during the KORA (Cooperative Health Research in the Region of Augsburg)-Age study, a follow-up study of the four MONICA/KORA Augsburg Surveys [17]. The KORA-Age study population consisted of a subgroup of 5991 individuals who were born in 1944 or earlier. In total, 4127 individuals participated in a standardized telephone interview (response 67%). Out of this group, a randomly drawn sample of 1079 participants additionally underwent extensive physical examinations, including the registration of medication, collection of blood samples, assessment of anthropometry, grip strength measurement, and an additional interview amongst others. After exclusion of 13 participants due to missing values, the final data set for the present analysis consisted of 1066 participants (534 women and 532 men) aged 65–94 years. The KORA-Age study was approved by the Ethics Committee of the Bavarian Medical Association. Written informed consent has been obtained from the participants, and all investigations have been conducted according to the principles expressed in the Declaration of Helsinki.

2.2. Data selection

The presence of chronic health conditions was self-reported by the participants in a self-administered questionnaire and a standardized telephone interview. In the questionnaire, the participants were asked whether they were ever diagnosed with a myocardial infarction, hypertension, stroke, diabetes mellitus, or a malignant disease. In addition, participants should indicate whether they had a coronary artery bypass graft surgery or received a coronary artery stent.

In the telephone interview, the assessment of chronic diseases was based on the Charlson Comorbidity Index [18]. The participants were requested to indicate whether they currently have asthma, emphysema, or chronic obstructive pulmonary disease, an inflammatory joint disease (e.g., arthritis) or a rheumatic disease, a gastrointestinal disease (e.g., gastric or duodenal ulcer, colitis, cholecystitis), heart complaints (e.g., angina pectoris, heart failure, coronary heart disease), a kidney disease, or a liver disease (e.g., cirrhosis).

In addition to the disorders covered by the Charlson Comorbidity Index, it was asked for the presence of neurologic diseases such as multiple sclerosis, Parkinson's disease, or epilepsy, whether the participant has or had a glaucoma or cataract, and finally the presence of any other disease, which has not been mentioned before was requested. Depression was assessed using the Geriatric Depression Scale (GDS-15) [19]. Scores above 10 points were considered framing depression. The presence of an anxiety disorder was assessed using the Generalized Anxiety Disorder Scale-7 (GAD) [20]. Scores >10 points indicated the presence of an anxiety disorder. An eye disease was deemed to be present if participants indicated to have glaucoma or cataract or other eye diseases such as macular degeneration, diabetic retinopathy, and retinitis pigmentosa. Each single response to the open question on other diseases was checked. If they contained information regarding the above mentioned conditions, the presence of the condition was modified accordingly. Considering all available information on diseases, 13 conditions were defined (Table 1). Due to prior studies, MMB was defined as the co-occurrence of two or more of these conditions within one person [4,21].

Table 1
Assessment of diseases in the KORA-Age study

Self-report generated Charlson Comorbidity Index	Kora-Age study	Method
Asthma, emphysema, or chronic bronchitis	√	Telephone interview
Arthritis or rheumatism	√	Telephone interview
Cancer, diagnosed in the past 3 years	√	Questionnaire
Diabetes	√	Questionnaire
Digestive problems (such as ulcer, colitis, or gallbladder disease)	√	Telephone interview
Heart diseases (such as angina, congestive heart failure, or coronary artery disease)	√	Questionnaire, telephone interview
Kidney disease	√	Telephone interview
Liver problems (such as cirrhosis)	√	Telephone interview
Stroke	√	Questionnaire
HIV illness or AIDS	–	not requested
	Neurologic diseases such as multiple sclerosis, Parkinson's disease, or epilepsy	Telephone interview
	Eye diseases such as glaucoma, cataract, macular degeneration, diabetic retinopathy or retinitis pigmentosa	Telephone interview
	Hypertension	Questionnaire
	Depression	Geriatric Depression Scale (GDS-15) administered via telephone interview
	Anxiety	Generalized Anxiety Disorder Scale-7 (GAD) administered via telephone interview