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Depressive symptoms and muscle weakness: A two-way relation?

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ABSTRACT

The potential association between depressive symptoms and dynapenia – i.e. muscle weakness – is limited to few, mainly cross-sectional, studies. We use SHARE (Survey on Health, Ageing and Retirement in Europe) panel data to investigate whether the onset of dynapenia at 4-year follow-up can be explained by pre-existing (either at baseline, or at 2-year follow-up) depressive symptoms, or vice versa. Depressive symptoms were identified as a score of 4 or more on the 12-item EURO-D scale. Individuals were classified as affected by dynapenia if they had handgrip strength of < 20 kg for women and 30 kg for men. We estimate whether being affected by symptoms of depression at baseline or becoming symptomatic between baseline and a 2-year follow-up increases the odds-ratio (OR) for dynapenia at a 4-year follow-up among individuals with no muscle strength impairment at baseline. We also carry out the reverse analysis, and study whether dynapenia at baseline or incident dynapenia between baseline and first follow-up increase the probability that individuals develop depressive symptoms by the second follow-up. The analysis was carried out using multivariate logistic regression. After adjusting for a full set of potential confounders, being symptomatic for depression at baseline did not increase the risk of dynapenia at the 4-year follow-up. Instead, individuals developing depressive symptoms between baseline and the 2-year follow-up had a 34% increased risk of developing dynapenia at the 4-year follow-up (OR 1.34, 95% CI 1.02 1.66). No significant association was detected between dynapenia at baseline or the onset of dynapenia between baseline and the 2-year follow-up and the incidence of depressive symptoms at the 4-year follow-up. In conclusion, our results support the effect of the onset of depressive symptoms on the onset of dynapenia, even after considering the role of confounding factors.

1. Introduction

Depression is a common condition among the elderly, particularly among young-older persons (Lohman et al., 2016; Vaughan et al., 2015). It affects up to one over ten community-dwelling senior individuals, and is even more common in other settings (e.g. hospitals and nursing homes) (Lohman et al., 2016; Vaughan et al., 2015). Depression is a significant and independent risk factor for several diseases and negative health outcomes, including disability, reduced quality of life, increased mortality and higher cardiovascular disease risk (Lohman et al., 2016; Vaughan et al., 2015). Numerous risk factors for depression in older age have been identified and, among them, low physical performance has recently attracted attention. For example, in about 1000 senior participants in an Italian study, low physical performance predicted the onset of depression over 4 years of follow-up (Veronese et al., 2017).

Sarcopenia is another common condition of older individuals, and its prevalence rate varies between 10%–33%, according to the settings and the target population and usually increases with age (Cruz-Jentoft et al., 2010). The presence of low muscle strength – or dynapenia – is used in conjunction with low muscle mass to diagnose sarcopenia (Cruz-Jentoft et al., 2010). Similar to depression, sarcopenia and dynapenia are associated with physical inactivity, disability, metabolic and cardiovascular diseases, and ultimately mortality (Cruz-Jentoft et al., 2010; Booth et al., 2012; Cederholm et al., 2013; Cruz-Jentoft & Michel, 2013; Gielen et al., 2012; Landi et al., 2013; Landi et al., 2012; Lang et al., 2010).

Since depression and dynapenia have similar consequences and similar risk factors (such as inflammation (Bano et al., 2017; Miller & Raison, 2016)), some authors report epidemiological evidence of an association between sarcopenia and depression. Also, some studies reported that decline in muscle mass is reduced in people with depression, and vice versa (Kahl et al., 2017; Walther, 2015; Walther et al., 2017; Yu et al., 2014). In a cross-sectional study involving Korean men and women aged 60 years or older, subjects with self-reported depression or those taking antidepressants had a significantly lower

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appendicular skeletal muscle mass than those not affected by depression or not using antidepressants. However, after adjusting for potential confounders, this association remained significant only in men (Kim et al., 2011). In another study, involving only hospitalized patients, sarcopenic individuals were more likely to suffer from depressive symptoms (Gariballa & Alessa, 2013). These findings (i.e. people with sarcopenia suffered more frequently of depressive symptoms and vice versa) were substantially confirmed by other cross-sectional studies in Asiatic subjects (Ishii et al., 2016; Hsu et al., 2014), with the exception of one large study of older Korean individuals that did not find any significant association between sarcopenia and depression (Byeon et al., 2016). In a recent systematic review and meta-analysis of the cross-sectional studies, it was reported that dynapenia was significantly associated with a higher presence of depression and depressive symptoms, even after adjusting for potential confounders (Chang et al., 2017).

Even if all these studies advance our knowledge regarding the possible association between dynapenia and depressive symptoms, they all suffer from some limitations. First, they consider mainly Asian subjects, and there may be significant differences in depressive symptoms and dynapenia prevalence between Asians and Europeans or Americans. Second, the cross-sectional nature of these studies did not let them explore a possible causal association.

In this paper, we have used harmonized panel data from the Survey of Health Ageing and Retirement in Europe – SHARE – on handgrip strength and depressive symptoms, where individuals are observed at a given time ("baseline"), at a first follow-up two years later and at a second follow-up two more years later. With these data, we explore whether depressive symptoms at baseline or its incidence between baseline and the first follow-up increase the likelihood of developing dynapenia by the time of the second follow-up. We also investigate the reverse question, concerning whether dynapenia at baseline or the incidence of dynapenia between baseline and the first follow-up increase the probability that individuals develop depressive symptoms symptoms by the second follow-up.

2. Methods

We used data covering twelve European countries participating in the SHARE (Survey of Health, Ageing and Retirement in Europe) study. SHARE is a multidisciplinary and cross-country survey providing longitudinal information about the health and socio-economic status of the European population aged 50+ that is collected in a harmonized way across countries and over time (Boersch-Supan et al., 2013). Ethical approval for SHARE has been provided by the institutional review board at University of Mannheim, Germany (until 2011) and by the Ethics Council of the Max-Planck-Society for the Advancement of Science (MPG) (from 2011 onward).

2.1. Depressive symptoms

Depressive symptoms were assessed in SHARE using the EURO-D scale, which was validated in a cross-European prevalence study (Castro-Costa et al., 2007). The scale contains 12 items: sadness, pessimism, wishing death, guilt, sleep, interest, irritability, appetite, fatigue, concentration, enjoyment, and tearfulness. Each item is given a score of 1 for the negative case. Then, items are summed and the presence of depressive symptoms was defined as a EURO-D score equal to 4 or more.

2.2. Dynapenia

Dynapenia was assessed in SHARE through a handgrip dynamometer (Bertoni et al., 2017). This test was carried out using a harmonized protocol across all countries and waves. After the dynamometer was set up to fit the respondent's hand, interviewees were instructed to possibly stand up, to keep their arms tight to the body with their elbows forming a 90° angle, and to push on the dynamometer as hard as they could. Four measurements were taken for each respondent, two for each hand. After each measurement, interviewers reported the value displayed by the dynamometer on their answer sheet first, and typed them on the interview software at the end of the GS test. The GS scale ranges between 0 and 100 kg. We considered individuals as affected by dynapenia if their highest recorded GS measurement was below 20 kg for females and 30 kg for males (Cruz-Jentoft et al., 2010).

2.3. Covariates

In our analysis we used other variables concerning respondents' demographics, socio-economic status, health conditions and health behaviors. We considered their values at the baseline interview at wave 4 and – for the ones indicated with an asterisk in the list here below – also their evolution between wave 4 and the 2-year follow-up, at wave 5. The covariates we include are the following (for details, see Appendix Table A1):

- Demographics: age, gender and country of residence.
- Socio Economic Status (SES): education, homeownership, income, marital status, number of children and grandchildren.
- Health conditions*: having ever had a heart attack, stroke, cancer, hip fracture, diabetes, arthritis, and short-term recall ability.
- Mobility limitations*: reporting limitations in walking 100 m; getting up from a chair after sitting for long periods; climbing several flights of stairs without resting; climbing one flight of stairs without resting; stooping, kneeling, or crouching.
- Healthy behaviors: having ever smoked, smoking currently, being physically inactive*, overweight*, obese*, carrying out at least a social activity once a week*.
- Nutrition*: indicators for frequency of consumption of fruits and vegetable, dairy products, legumes and eggs, fish and meat.

2.4. Statistical analysis

We first present a descriptive analysis of the characteristics of our sample in terms of the means and standard deviations of the key variables we use. Then, we run multivariate logistic regression with standard errors robust to the presence of heteroscedasticity to assess whether – among the participants without dynapenia (without depressive symptoms) at baseline – individuals affected by depressive symptoms (dynapenia) at baseline, or who become symptomatic between the baseline and the 2-year follow-up, have an increased odds-ratio for dynapenia (depressive symptoms) at the 4-year follow-up.

We started by considering a model that includes as regressors only the presence of depressive symptoms (dynapenia) at baseline or their insurgence between the baseline and the 2-year follow-up. Then, we report how our estimated effects for baseline and incident depressive symptoms (dynapenia) change as we sequentially include in the model the covariates, in the following order: baseline demographics (age-by-gender dummies and country dummies Andersen-Ranberg et al., 2009) and socio-economic status (SES); baseline health conditions; baseline health behaviors; baseline nutrition; baseline mobility limitations; changes in health conditions; changes in health behaviors; changes in nutrition; changes in mobility limitations.

All analyses were conducted using STATA version 14. Two-sided $p < 0.05$ was considered statistically significant.

3. Results

3.1. Sample selection

As our longitudinal research design requires three consecutive observations per individual, we first select countries that took part in

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