Gender-differences in (un)healthy ageing: the crucial role of musculoskeletal conditions evidenced in the French CONSTANCES cohort.

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Abstract.

Background: In France as elsewhere, women can expect to live longer than men, but experience more years with disabilities. In this study, we analyze how much of the gender differences relates to very frequent disabling conditions, the Musculoskeletal Conditions (MC). First, we estimate their contribution to disability in men and women. Second, we estimate the transition probabilities in and out of disability status for each sex, conditional on the presence of MC. **Methods:** Based on data from the French CONSTANCES cohort we select 55,297 individuals (aged 50-69 at inclusion) who participated to the cohort, recruited between 2012 and 2019 and followed-up. We measure disability with the Global Activity Limitation Indicator, and identify MC based on the reporting of diagnosed osteo-articular diseases and/or frequent body pains. With a cross sectional analysis (attribution method), we assess gender differences in the association between disability and MC, accounting for comorbidity. With longitudinal data, we fit multi-state Markov models to estimate transition probabilities between disability status. **Results**: In the study population, the prevalence of disability and MC is higher in women; MC are the major contributors to disability, especially in women. Reporting MC increases the chance of disability onset and staying 'limited', and decreases the chance of disability recovery and staying 'unlimited', among all. On gender differences, results show that MC reduce the chance of disability recovery and increase the risk of staying limited more among women.

Context

In the French longevity context in 2021, women benefit a 5.3 year longer life expectancy relative to men, yet most of the extra years are lived with activity limitations. This pattern, that is not exclusive to France, is known as the male-female health survival paradox. It is largely explained by men being at higher risks of lethal diseases (ie. Cancers or cardiovascular diseases), which reduce their life expectancy compared to women; women being more likely to have disabling diseases with which they outlive men. Among these diseases, musculoskeletal conditions (MC) are known to be massively responsible for disability, and to be more prevalent in women. They are also socially marked, due to uneven exposure to their risk factors across population groups, and can possibly be addressed by life-long schemes to prevent diseases, disorders and injuries: improving individuals' work and living conditions; promoting physical activities and rehabilitation; improving collective physical environment… Therefore, MC are relevant targets for prevention to both favor healthy ageing and reduce differentials. In that context, providing enhanced insights on how MC foster disability and whether these dynamics vary across gender is crucial.

In this work, we leverage the population-based CONSTANCES cohort conducted in France over the 2010's, allowing to work on a very large sample, with a large collection of health and social variables. First, we estimate the prevalence of MC and their contribution to disability in men and women, and second, we estimate the transition probabilities in and out of disability statuses, across ages, conditional on the reporting of MC. We conclude on whether the observed dynamics suggest gender specific dynamics depending on age and relative to the presence of MC.

Methods.

Data source and sample

The French CONSTANCES cohort is a large population-based study, representative of the population and subgroups of individuals aged 18 to 69. Individuals (drawn from the health insurance of the French social security), are invited to participate to the cohort. Participants go to a medical center where they complete a questionnaire on health (current and past) helped by a physician, and a questionnaire on demographic and socioeconomic characteristics. Participants receive a follow-up questionnaire, on a yearly basis, repeating a

set of questions that allows longitudinal measurements. Data collection started in 2012 and included yearly participants until 2019, when the objective of 200,000 participants was reached. The sample is not directly representative of the population due to the low acceptance after the invitation (around 10%), but the very large sample and the great variety of social situation allows comparing populations groups. In our study, we select individuals aged 50 years and older at baseline who provide information on disability at inclusion and in at least one follow-up questionnaire, to measure transitions (n= 55,297. 46% males, 54% females). Those included in 2012 have already completed up to seven follow-up questionnaires and have reached up to age 75.

Variables

Disability. We used the Global Activity Limitation Indicator (GALI), here formulated as: "*For at least the past 6 months, have you been limited, meaning have you had difficulties because of a health problem, in performing daily activities (at home, at work, during leisure time) compared to a person of your same age ?*". Except for years 2016 and 2017, all follow-up questionnaires comprise a shorter version of the question: "*For at least the past 6 months, have you been limited because of a health problem, in activities people usually do?*". The questions have four response categories: "*Yes, severely limited*", "*Yes, limited*", "*Yes, slightly limited*", and "*No*". We consider the 'Limited' (all answers 'Yes'), otherwise 'Not limited' individuals. We estimate sets of probability: "Remaining Not limited" and "Onset of disability" among individuals with no limitation, as well as "Remaining Limited" or Recovering" among those initially limited.

Musculoskeletal conditions. MC are measured by gathering individuals who previously received a "diagnosis of osteo-articular diseases" based on a list (arthritis, carpal tunnel syndrome…) and/or those who report "frequent pain in at least one part of the body (back, neck…)". In this study, we use both measures to identify MC.

Other Health conditions. In order to account for comorbidity, we use self-reported medical diagnosis of several conditions that contribute to the disablement process: Cancer, Diabetes, Hypertension and other Cardiovascular diseases (myocardial angina/infraction, stroke…). We also account for mental disorders by using the Center of Epidemiologic Studies Depression scale (CES-D). We did not specifically account for neurodegenerative diseases which are scarce before age 70.

Socio-economic covariate. We account for socio-economic status by using the highest level of completed education grouped in three categories: No Diploma (< 5 years of education), Low diploma (5-13 years of education), and High diploma (> 13 years of education).

Statistical Analysis

We first conduct a cross-sectional analysis with baseline information. We apply the attribution method (additive regression model) to attribute disability to a selection of health conditions, accounting for comorbidity. We obtain the percentage of activity limitation that can be attributed to each of the considered diseases, controlling for the others (and beside the background, including age, education and the unspecified diseases and factors).

To estimate transition probabilities across disability states, we use continuous multi-state markov models conditional to having MC (R *msm* package), adapted to longitudinal data. Models deliver the four sets of probabilities summarizing individual transition between two consecutive waves depending on whether they have MC or not. We fit separate models for males and females, adjusted for age and education as factors related to disability. Age was used as a time varying covariate.

Overview of the main results

Disability and Musculoskeletal Diseases in cross sectional analysis

Among men and women, aged 50-69 years old at baseline, women are more likely to report activity limitation and MC than men (Table 1). Logistic regression (not shown) indicates that prevalence of MC increases with age and that the female excess prevalence remains when controlling for age and education.

The attribution model shows that, for both genders, MC are the major contributors to disability (Figure 1): MC contribute by 16.6% in men and 20.8% in women within the total prevalence. MC are not only more frequent in women but also more disabling (not shown here).

Transition in and out of disability, conditionally to MC

Figure 2 displays the 4 sets of transitions probabilities among those initially not limited (top panel) and limited (bottom panel), conditionally to MC. The probabilities of having no limitation at two consecutive waves or to recover from limitation decrease with age and are much lower among individuals with MC. Probabilities of remaining or becoming limited increase with age and are much higher for those with MC.

Besides that they more frequently report activity limitation than men, women tend to be less likely to become limited and, when they are limited, to be more likely to recover than men, when controlling for education. These gender differences increase with age. Interestingly, it is less significant for individuals with MC, and even inverted for those initially limited. However, MC decrease the chance of recovery and increase the chance of staying in limitation more among women.

Discussion.

Despite limitations of the study, our results confirm the major contribution of MC both on the dynamics of disability and on gender differences. Our results suggest that women largest prevalence of activity limitation is partly associated with their higher prevalence of MC with which the disability onset is much higher (although lower for women than for men) and the risk of recovering much lower (and not different than men's one). Preventing MC could both favor health ageing and reduce gender differences.

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Tables and Figures

Table 1. Average (and age specific) prevalence of activity limitation and musculoskeletal conditions (MC) at inclusion

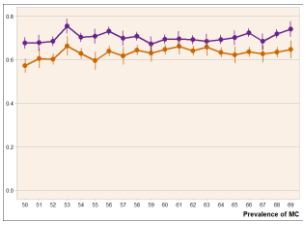
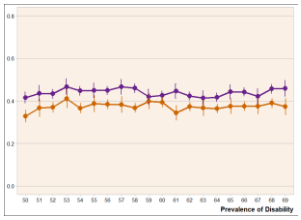
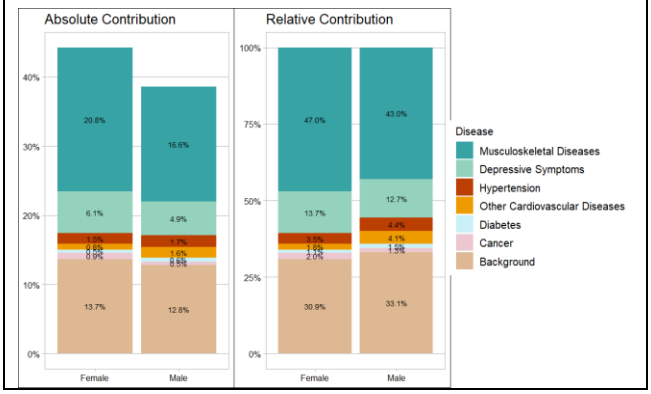
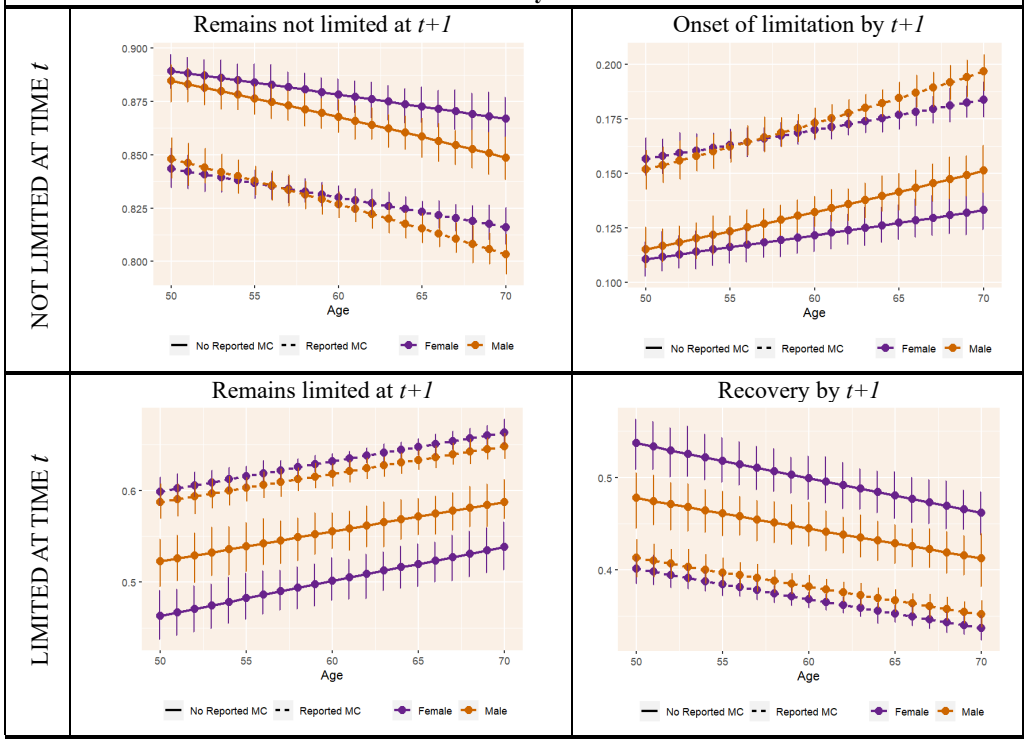
	Musculoskeletal conditions	Activity limitation
Ages 50-69:		
-Women	64.2%	43.4 %
- Men	56.2%	37.1 %
Age-specific:		

Figure 1. Absolute and Relative of diseases contribution to self-reported activity limitation at inclusion



Source: CONSTANCES participants at inclusion waves (2012-2019)

Figure 2. Estimated transition probabilities between disability status (not limited and Limited) conditionally to MC



Source: CONSTANCES Panel Data based on inclusion and follow-up responses (2012-2019)