The decline in physical activity in aging people is not modified by gender or the presence of cardiovascular disease

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Background: A physically active lifestyle decreases the progression of atherosclerosis and consequently reduces cardiovascular mortality. However, activity levels are hampered by aging. The association between aging and physical inactivity might be gender-specific or be modified by the presence of cardiovascular disease (CVD). In this study, we investigated if the association between aging and physical inactivity was different between men and women and between primary and secondary prevention patients.

Methods: We performed a cross-sectional analysis of three primary care samples including primary and/or secondary prevention patients (total n = 4726). Baseline data for sample 1 were collected in the years 2013–14, for sample 2 in 2009–10 and for sample 3 in 2009. Activity levels were measured by the patient reported Rapid Assessment of Physical Activity questionnaire. A multilevel regression analysis was used to explore the association between aging and physical inactivity, adjusted for confounders. We examined potential effect modification by gender and the presence of CVD on the association between aging and physical inactivity.

Results: Multilevel regression revealed that aging was consistently associated with physical inactivity in three out of three samples. This association was, however, not modified by gender or the presence of CVD.

Conclusions: Cardiovascular risk management interventions should aim at increasing or maintaining physical activity levels in aging primary care population. This study does not support the notion that extra emphasis should be put in targeting men or women, or people with or without the presence of CVD.

Introduction

A physically active lifestyle decreases the progression of atherosclerosis and consequently reduces cardiovascular mortality.1 Tailor cardiovascular risk management (CVRM) interventions to individual patients’ needs it is critical to identify patient characteristics that are associated with physical inactivity.

A physically active lifestyle may attenuate the impact of age on mortality.2 Adherence to a physically active lifestyle, however, becomes more difficult in the aging population, due to a progressive lowering of physical functions and capabilities, especially in frail older people.3,4 It is reported that the decline in physical activity along with age is higher in women compared to men.5–7 This could be caused by the fact that women have lower self-efficacy and self-management to maintain physical activity levels than men.8,9 In addition, women suffer more frequently from depression symptoms and increased prevalence of comorbidity compared to men, and may, therefore, be less physically active than men.10–13 To our knowledge, there is no research conducted into gender differences with respect to physical inactivity in an aging primary care CVRM population.

The presence of cardiovascular disease (CVD) may also have a negative impact on activity levels in the aging patients because comorbidity and depressive symptoms are more prevalent resulting in lower activity levels compared to patients at high cardiovascular risk without the presence of CVD (primary prevention patients).14–17 Besides, frailty is, independent of age, also more common in patients with the presence of CVD (secondary prevention patients) compared to primary prevention patients.4,18,19 On the other hand, it has been reported that aging was inconsistently associated with physical inactivity in a secondary prevention population participating in cardiac rehabilitation.7

To further explore the association between aging and physical inactivity, we used baseline data from three large cross-sectional primary care samples20–22 including primary and secondary prevention patients. The present study aimed to explore if the association between aging and physical inactivity was different between men and women and between primary and secondary prevention patients. The study investigates whether patient-specific lifestyle interventions to increase physical activity levels should be tailored to either men or women and/or to either primary or secondary prevention patients.

Methods

Study design

A secondary analysis of data from three primary care studies was conducted.20–22 Ethical approval was given for the studies from which we used the data. The declaration of Helsinki was followed. In our study, we followed the STrengthening the Reporting of
Observational studies in Epidemiology statement for the cross-sectional cohort design.23

Setting
Baseline data of three cross-sectional primary care samples, used in our study, were collected by the general practitioner or a nurse practitioner. Data for sample 1 were collected in the years 2013–14, for sample 2 in 2009–10 and for sample 3 in 2009. Data were used from Dutch primary care general practitioner facilities that offered CVRM.

Participants
Sample 1
Dutch baseline data, of European Tailored Implementation of Cardiovascular risk management (TICD) project were used, consisting of primary \( (n=1250) \) and secondary prevention patients \( (n=934) \).20 All patients were 18 years or older and were able to provide informed consent. Exclusion criteria were diabetes, pregnancy and lactation, terminal illness, cognitive impairment and poor language skills. Patient data from general practitioner practices that had a nurse practitioner employed with CVRM in the portfolio were included in the TICD project. Primary prevention patients had an estimated 10-year combined cardiovascular risk score of 20% or higher for morbidity and mortality due to CVD, based on the SCORE risk-stratification model used in the Dutch College of General Practitioners Practice Guideline for CVRM.24 Patient selection was based on the following International Classification of Primary Care (ICPC) codes: K74-K76, K85-K92, K99.1 and T93. Secondary prevention patients had a cardiovascular event, predominantly coronary artery disease or less frequently a stroke, in history or suffered from chronic heart disease or peripheral arterial disease.

Sample 2
This sample consisted of solely secondary prevention patients with angina pectoris, or with a history of acute myocardial infarction, other chronic ischemic heart diseases, transient ischemic attack, ischemic stroke, peripheral arterial disease, or aortic aneurysm. Selection of electronic medical records with these conditions was based on corresponding diagnostic ICPC codes K74, K75, K76, K89, K90.3, K92.1 and K99.1. Patients had to be in treatment for an estimated CVD for a minimum period of 12 months. Baseline data were derived, based on a sample of secondary prevention patients \( (n=1866) \), who participated in a Cluster Randomized Trial on the effectiveness of improvement plans for primary care practice accreditation.21

Sample 3
This sample consists of solely primary prevention patients \( (n=676) \) with an estimated cardiovascular mortality risk of 10% or higher in 10 years, based on the SCORE risk-stratification model.25 If this was not available, a proxy measure was used: the presence of three out of the following four risk factors: hypertension, hypercholesterolemia, smoking and men over 60 years. Exclusion criteria were established diabetes, terminal illness, cognitive impairment, psychiatric illness and poor language skills. The Dutch sample, from the European Practice Assessment of CVRM (EPA-cardio) project, was included in our study.22

Measurements and study size
Data were collected using structured questionnaires. The questionnaires, paper-based versions, were sent by mail to all eligible patients and returned by mail as well. Data collection was performed equally in primary and secondary prevention patients. The total study size consisted of 4726 patients.

Variables
The outcome measure in all samples was the degree of physical activity measured by the patient reported Rapid Assessment of Physical Activity Questionnaire (RAPA).26 The predictor measure is patient-reported age. Because sample 1 consisted of primary and secondary prevention patients, we were able to include the presence of CVD (i.e. being a secondary prevention patient) as a potential effect modifier of the association between aging and physical inactivity. Gender was considered as a potential effect modifier in all samples.

All included patients filled out the RAPA questionnaire. The RAPA is a valid measure of physical activity for use in clinical practice.26 Each question has a ‘Yes’ or ‘No’ option. The score ranges from 1 to 7; a score of 6–7 points is considered ‘active’, 4–5 points as ‘suboptimal active’, and ≤3 points is defined as ‘sedentary’ to ‘under-active regular-light activities’. We used the RAPA as a dichotomized and continuous variable. Age was used as a categorical and continuous measure.

Statistical methods
Data analysis was performed using SPSS (version 25, IBM Corp.). Data were described using means, standard deviations, numbers and percentages. Patient characteristics and the outcome of completed questionnaires were presented for the samples separately.

First, independent sample T-tests were used to compare the score for the RAPA and age between men and women, and between primary and secondary prevention patients. Second, the relationship between age and RAPA was checked. We worked with the model that gave the highest explained variance. Thereafter, the assumptions for multilevel regression (i.e. the linear relationship between the independent and dependent variables, multivariate normality, no multicollinearity, and homoscedasticity) were checked.27 Third, we performed a multilevel regression analysis with random slopes to explore the association between age and physical inactivity per sample, adjusted for confounders. Finally, we explored if this association was modified [95% confidence intervals (CIs)] by gender or the presence of CVD by adding the interaction terms gender*age and primary vs. secondary prevention*age to separate models. Correction for confounding was only applied if the regression coefficient for age, changed relatively by more than 10% when the potential confounding variable was added to the model.28 We considered the score on the Patient Health Questionnaire-9,29 Patient Activation measure30 and smoking status, as potential confounders in sample 1. In sample 2, this was subsequently the EuroCol 5D (EQ-5D)31 score, education level, marital status, employment status and if hospitalized in the last 3 months and in sample 3, the body mass index, using medication, employment status, smoking and suffering pain. The data were analyzed per sample because the inclusion and exclusion criteria and the measured confounders differed from each other per sample. A P-values <0.05 was considered as statistically significant.

Results
Participants and descriptive data
Figure 1 presents a flowchart of the enrolment of the study population. Table 1 presents descriptive statistics. Figure 2 presents the activity levels (RAPA) for the age-categories; younger than 65, 65–75 years and older than 75 years, for primary and secondary prevention men and women. Of all patients that were included in this study, 56% of the population scored ‘active’ on the RAPA (6–7) in the age-category 65–75 and 44% of the older population (>75 years).

Sample 1 consisted of 2184 patients (1250 primary and 934 secondary prevention patients), of which 761 were female patients.
and 1423 were male patients. In total were 2074 patients eligible for analysis. The primary prevention population consisted of 33% (mean age 75.7 ± 7.0) women and the secondary prevention group of 38% women (mean age 68.8 ± 13.1). Primary prevention patients were significantly older than secondary prevention patients (73.99 ± 6.99 vs. 68.50 ± 11.73, \( P < 0.05 \)). Female primary prevention patients scored significantly (\( P < 0.01 \)) lower (4.40 ± 1.62) on the RAPA than female secondary prevention patients (4.61 ± 1.55). Men in both groups were physically more active compared to women (primary prevention group 5.01 ± 1.54 vs. 4.4 ± 1.62, \( P < 0.01 \) and secondary prevention group 5.02 ± 1.58 vs. 4.61 ± 1.55, \( P < 0.01 \)).

Sample 2 consisted of 1866 secondary prevention patients, 629 (33.6%) women aged 67.19 ± 11.69 and 1227 (64.4%) men aged 72.11 ± 10.36. In total 1734 patients were eligible for analysis. Men were significantly older than women (\( P < 0.05 \)). Female secondary prevention patients were significantly (\( P < 0.01 \)) less active than men in this group (4.86 ± 1.55 vs. 5.21 ± 1.52).

Sample 3 consisted of 676 primary prevention patients, from which 636 patients were eligible for analysis. There were 83 (12.3%) women aged 70.20 ± 9.10 and 575 (87.7%) men aged 71.29 ± 6.64. No significant age difference was found between men and women.

**Outcome data**

The assumptions for multilevel analyses were not violated. The quadratic model was significantly (\( P < 0.001 \)) the best fitting model for the relationship between age and RAPA in sample 1 (\( R^2 = 0.040 \)) and sample 2 (\( R^2 = 0.017 \)). The \( R^2 \) was subsequently 0.027 in sample 1 and 0.011 in sample 2 in the linear model. There was no other model with a significantly better fit in sample 3 than the linear model (\( R^2 = 0.006 \)). Multilevel regression analyses revealed a significant (\( P < 0.05 \)) association between aging and physical inactivity (table 2, model 1). This association was not modified by gender (table 2, model 2), nor by being a primary or secondary prevention patient (table 2, model 3).

**Discussion**

**Key results**

The purpose of this study was to explore if the association between aging and physical inactivity was different between men and women and between primary and secondary prevention patients, using data from three cross-sectional primary care samples. We found that aging was consistently associated with physical inactivity in three out of three samples. This association was, however, not modified by gender or the presence of CVD.

**Interpretation**

Gender and the presence of CVD are not useful predictors for declining physical activity with increasing age in a primary care CVRM population. To our knowledge, this is the first study that investigated the possible differences between the association of aging and physical inactivity in women and men and primary and secondary prevention patients.

In our population only 56% of the patients aged 65–75 years and 44% of the patients aged 75 years and older met recommended activity levels (RAPA 6-7). This is still higher than the earlier reported 33% of the general population between 65 and 75 years and 25% of the patients aged over 75 years that met recommended physical activity levels of at least 150 min/week of moderate intensity activity.

Although our population, consisting of primary and secondary prevention patients, was physically more active than people from the general population, it is still of critical importance to stimulate the adoption of an active lifestyle. Women and men aged over 75 who exercised had, for example,
### Table 1: Descriptive statistics per baseline sample

| Samples | Men | Woman | N | N % of study population. RAPA mean (SD) | RAPA (% of population) | Active mean (SD) | Active (% of population) |
|---------|-----|-------|---|------------------------------------------|------------------------|-------------------|--------------------------|
| 1, N = 2184 | 843 | 23.15 (8.79) | 226 (59.9%) | 15.1 (40.1%) | 377 (46.7%) | 4.40 (1.62) | 289 (46.1%) | 340 (54.6%) |
| 2, SP, N = 934 | 407 | 5.02 (1.58) | 259 (46.1%) | 137 (40.3%) | 259 (46.1%) | 377 (46.7%) | 4.40 (1.62) | 340 (54.6%) |
| 3, PP, N = 1866 | 354 | 68.86 (13.10) | 253 (44.3%) | 44 (14.54%) | 79 (14.54%) | 4.86 (1.55) | 35 (43.3%) | 340 (54.6%) |
| Notes: RAPA, Rapid Assessment of Physical Activity Questionnaire, 1–7 points. Under-active, RAPA 1–5 points. Active, RAPA 6–7 points. PP, Primary prevention patients; SP, Secondary prevention patients. |
willing to participate and were included in that study. In sample 31 190 practices were invited, while 36 eventually participated.22

The selection criteria for patients being included were standardized in all samples, using ICPC diagnoses codes and internationally used cardiovascular risk tables. This is a strength of our study as is the use of the validated RAPA questionnaire.26 The statistical power was high in our study due to the inclusion of a high number of patients in the samples, showing consistent study results. Finally, the cross-sectional design used in our study lacks the ability to draw causal relationships. For instance, mortality rates are higher in secondary prevention patients than in primary prevention patients and the patients alive may represent a population that have always been physically more active compared with ones who have died.

**Generalizability**

Nearly all Dutch citizens are registered in a general practice. The general practitioner has a medical record of (almost) all patients,
and therefore every patient who is eligible for CVRM within the participating practices is in the original selection from which the samples have been taken. Also, the distribution of one-third female and two-third male patients in sample 1 and 2, is representative of the CVRM population in western primary healthcare facilities. In sample 3, this was 1:8. This is less representative of the Dutch population. Only 4% of the patients did not have the Dutch nationality, and therefore the generalizability to people originating from non-western countries might be limited.

Finally, it must be acknowledged that predominantly general practices from outside the urban area participated, therefore with respect to the urban population, this might hamper the generalization.

Conclusions

CVRM interventions should aim at increasing or maintaining physical activity levels in aging primary care patients. This study does not support the notion that extra emphasis should be put in targeting men or women, or people with or without a history of CVD. Longitudinal research should be performed to re-confirm the present findings. Also, future research should focus on the effect of lifestyle interventions aiming at the increase of physical activity in the aging CVRM population, despite gender difference and the presence of CVD.

Funding

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Conflicts of interest: None declared.

Key points

- Aging was associated with physical inactivity in three out of three samples consisting of primary and/or secondary prevention patients that participated in primary care cardiovascular risk management.
- The association between aging and physical inactivity was neither different for men and women, nor for patients at high cardiovascular risk with or without the presence of cardiovascular disease.
- This study does not support the notion that gender and the presence of cardiovascular disease are useful predictors for declining physical activity with increasing age in a primary care cardiovascular risk management population.

References

1 Ekelund U, Ward HA, Norat T, et al. Physical activity and all-cause mortality across levels of overall and abdominal adiposity in European men and women: the
Impact of physical activity, protein intake and social network and their combination on the development of frailty

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Background: Frailty is a geriatric condition associated with adverse health outcomes. As physical inactivity, low protein intake and poor social network are known risk factors, we aimed to assess the influence of these parameters and their interaction in an 11-year follow-up study on a Europe-wide level. Methods: Data from the Study on Health, Ageing and Retirement in Europe were used, including 22 226 community-dwelling robust and prefrail persons aged ≥50 years, from 11 countries. Frailty was assessed with the ‘Frailty Instrument for Primary care of the Survey of Health, Ageing and Retirement in Europe’. Additionally, self-reported physical activity (PA), protein intake and satisfaction with social network were assessed. The impact of these parameters on the development of frailty was calculated using multivariate cox regressions. Results: Performing no regular PA, was associated with higher hazards ratio (HRs) for frailty compared with performing regular PA [men: 1.90 (95%CI: 1.50–2.42); women: 1.65 (95%CI: 1.25–2.18)]; HRs for low protein intake were 1.16 (95%CI: 0.93–1.46) for men and 1.05 (95%CI: 0.80–1.37) for women. And HR for poor social network were 0.92 (95%CI: 0.74–1.15) for men and 1.72 (95%CI: 1.31–2.27]) for women. In general, persons with a combination of two of the assessed risk factors had a higher risk for frailty compared with those with no or only one of the risk factors. However, no significant synergy index could be found. Conclusion: The results illustrate the importance of PA, but also of nutritional and social network to prevent frailty.

Introduction

Frailty is a geriatric condition which can be characterized by exhaustion, weight loss, slowness, weakness, and low activity. As it is associated with numerous adverse health outcomes (e.g. falls, hospitalization), it is considered one of the most severe health issues. There are several tools to categorize frailty, one of them is the ‘Frailty Instrument for primary Care of the Survey of Health, Ageing and Retirement in Europe’ (SHARE-FI), a sex-specific validated calculator, measuring variables that approximate the most commonly accepted frailty concept of Fried and colleagues.

Physical activity (PA), nutrition and social networks, have been identified as influential factors on frailty: As PA maintains muscle mass, functional status, can prevent chronic and psychological diseases, and in turn improves social outcomes, PA was shown to be an important factor in frailty prevention. Therefore, a multicomponent training consisting of endurance, strength and balance training is recommended. The positive effects of PA on the development of frailty have been shown in the English Longitudinal Study of Ageing (ELSA), where people who performed vigorous activities at least once a week had a reduced risk for the progression of frailty. Another study found that lower PA was associated with higher frailty scores.

Malnutrition also contributes to frailty development, with both quantitative (energy intake) and qualitative (nutrient quality) factors being of great importance. It has been shown that frail individuals have poorer dietary patterns, specifically an insufficient consumption of protein. A higher intake of total protein was significantly inversely associated with a lower prevalence of frailty in elderly Japanese women, regardless of the protein source.

Next to PA and nutrition, social network is an equally important factor in frailty. A meta-analysis including 308 849 subjects, with an average follow-up 7.5 years, has found a 50% increased likelihood of survival for subjects with adequate social relationships. Additionally, data from older adults have shown that loneliness and social isolation has been associated with a greater risk of being inactive. Examining the longitudinal relationship between physical and social domains, a 4-year follow-up cohort study has revealed that social frailty (declines in social networks, activities or roles) can lead to the development of physical frailty. Additionally, a randomized controlled trial has demonstrated that social support can improve frailty symptoms significantly.

As previously shown, PA, low protein intake and poor social network were blamed to be risk factors for developing frailty. Most of this evidence comes from cross-sectional studies and longitudinal studies are largely missing. Additionally, to our knowledge, there is no study looking at the interactions of PA, nutrition and social network in one data-set. Thus, the aim of this study was to assess the influencing factors of these parameters in an 11-year follow-up study on European level. An additional aim was to assess the combination of these factors.

Methods

Study design

We used the longitudinal data-set from the SHARE, including wave 1 (2004–06), wave 2 (2006–10), wave 4 (2011–12), wave 5 (2013)