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Leisure-time and Occupational Physical Activity in Early and Late Adulthood in Relation to Later Life Physical Functioning

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ABSTRACT

BACKGROUND: Physical activity (PA) has beneficial effects on older age physical functioning, but longitudinal studies with follow-ups extending up to decades are few. We investigated the association between leisure-time (LTPA) and occupational physical activity (OPA) from early to late adulthood in relation to later life performance-based physical functioning.

METHODS: The study involved 1260 persons aged 60-79 years who took part of the assessments of physical functioning (Short Physical Performance Battery (SPPB), 10 meters maximal walking test, grip strength test). Participants' data on earlier life LTPA/OPA (age range 25-74 years) were received from the previous studies (average follow-up 13.4 years). Logistic, linear and censored regression models were used to assess the associations between LTPA/OPA earlier in life and subsequent physical functioning.

RESULTS: High level of LTPA earlier in life was associated with lower risk of having difficulties in SPPB (OR 0.37,95%CI 0.24-0.58) and especially in chair rise (OR 0.42,95%CI 0.27-0.64) in old age. Heavy manual work predicted difficulties in SPPB (OR 1.91,95%CI 1.22-2.98), in chair rise (OR 1.75,95%CI 1.14-2.69) and poorer walking speed (β=0.10, p=0.005).

CONCLUSIONS: This study highlights the importance of LTPA on later life functioning, but also reminds the inverse effects that may be caused by heavy manual work.

INTRODUCTION

Adequate mobility and physical functioning are essential for independent living in old age. Common indicators of physical functioning and mobility include walking speed, muscle strength and also other performance-based measures, such as ability to stand up from the chair and standing balance. Good ability to perform these activities is associated with better ability to cope with the activities of daily living[1]. Good physical functioning correlates with better subjective wellbeing[2], lower depression rates[3], better self-rated health[4] and better cognitive capacity[5]. Persons with decreased physical functioning have an increased risk for several adverse health events including falls and other injuries[6], hospitalization[7] and mortality[7,8.]

Despite the fact that poor physical functioning in older age predicts adverse health events, the lifestyle determinants of old age performance-based physical functioning have not been widely investigated. It has been reported that midlife physically strenuous work, excess body weight, smoking, and the presence of chronic conditions predict frailty and poorer muscle strength in later life[9,10], and high body mass index (BMI), low handgrip strength, impaired squatting and running difficulties predict walking limitations[11]. Physical inactivity in leisure time earlier in life correlates with later life physical functioning and frailty[12, 13], but the type of physical activity (PA) modifies the associations[14,15]. A study by Hinrichs at al. (2014)[14] showed that leisure-time PA (LTPA) and occupational PA (OPA) at the mean age of fifty years have inverse effects on self-reported mobility after the age of 70 years so that LTPA is beneficial, but physically demanding occupation is associated with higher number of self-reported mobility limitations.

To the best of our knowledge, there are no previous studies investigating the association between LTPA and OPA from early to late adulthood from early to late adulthood (ages 18-70 years) and later life physical functioning with the follow-up period for several decades and standardized performance-based outcome measures. Further, it is unclear whether age at the time of physical activity assessment modifies the association between physical activity and older age physical functioning.

Using the baseline data from the Finnish Geriatric Intervention Study to Prevent Cognitive Impairment and Disability (FINGER), linked with the participants' earlier data from previous large population-based studies, we had a unique opportunity to assess these relationships using the follow-up period of 40 years. We hypothesize that PA earlier in life is an important determinant of older age physical functioning and thus an essential part of interventions when aiming at promoting healthy aging from life-course perspective. In addition, it is also important to investigate what kind of physical activity has most beneficial effects.

MATERIALS AND METHODS

Participants

This study utilizes the baseline data from the FINGER[16]. The study includes altogether 1260 persons aged 60-79, who were recruited from the previous population-based surveys; the National FINRISK study in 1972 (12 persons), 1977 (101 persons), 1982 (68 persons), 1987 (74 persons), 1992 (159 persons), 1997 (229 persons), 2002 (217 persons) or 2007 (239 persons)[17], or the Finnish type 2 diabetes prevention program's population survey 2004 or 2007 (FIN-D2D, 161 persons)[18]. Participants for the Finger study had to have cognitive performance at the mean level or slightly lower than expected for age. Exclusion criteria included present malignant diseases, major depression, dementia/substantial cognitive decline, MMSE <20 points, symptomatic cardiovascular disease, re-vascularisation within one year, severe loss of vision, hearing or communicative ability, conditions preventing co-operation as judged by the study physician, as well as coincident participation in any other intervention trial. The FINGER study protocol, recruitment of the participants and baseline characteristics are reported in detail earlier[16,19]. To investigate the associations between PA earlier in life and older age physical functioning, participants' data from the FINRISK and FIN-D2D studies were merged to the FINGER baseline data.

Physical activity earlier in life (the FINRISK Study and FIN-D2D questionnaires from 1972-2007)

LTPA was assessed with the question, "How much do you exercise and stress yourself physically in your leisure time?" Response options were 1) In my leisure time, I read, watch TV, and work in the household with tasks which do not make me move much and which do not physically tax me, 2) In my spare time, I walk, cycle or am otherwise physically active at least 4 hours per week, excluding travel to work, 3) In my spare time, I do physical exercises to maintain my physical condition for at least 3 hours per week, 4) In my spare time, I regularly exercise several times a week in competitive sports or other heavy sports. Answers were categorized into 1) Sedentary (option 1), 2) Moderately active (option 2), and 3) Very active (options 3 and 4).

OPA was asked using a single question on activities usually performed during work. Of the following four descriptions, the participants were asked to choose the option which best describes their work: 1) work is mainly sitting, 2) moderately straining work, mainly walking, but no lifting of heavy objects or handling heavy objects, 3) lots of walking, lifting and climbing stairs, 4) heavy manual work (heavy lifting, handling heavy objects). Responses were grouped into three categories: 1) Sedentary work (option 1), 2) moderately straining work (option 2), 3) heavy manual work (options 3 and 4). If the person was not working, he/she was instructed to choose option 1. When analyzing the association between OPA and older age physical functioning we used the data only from persons 60 years and younger (n=760) at the time of OPA assessment due to limited number of persons with heavy manual work in the oldest age group and in order to diminish reverse causality.

Other earlier life assessments

All survey methods of FINRISK and FIN-D2D studies were carefully standardized and complied with international recommendations. Education (primary, secondary and post-secondary education) was reported as years of formal education. BMI was calculated as weight (in kilograms) divided by height squared (in meters). Smoking was asked with the questions: “Have you ever smoked” with response options “yes” and “no”. Information on physician diagnosed cardio/cerebrovascular, respiratory and musculoskeletal diseases (myocardial infarction, stroke, high blood pressure, heart failure, coronary artery disease, asthma, arthritis or other joint disorder) were assessed with self-reported questionnaires. Sum score of chronic conditions was calculated. Self-rated health was assessed using a Likert-type question, ‘How is your current health?’ with the following response options: 1 = very good, 2 = relatively good, 3 = an average, 4 = relatively poor and 5 = very poor. Follow-up time (in years) was calculated from the date of the earlier assessment until the date of FINGER baseline assessment.

Measures in later life (FINGER study baseline in 2009–2011)

Physical functioning

The Short Physical Performance Battery (SPPB)[20] was administered to all FINGER participants during the baseline measurements (information available for 1210 participants). The SPPB consists of three subtests: a hierarchical test of balance, 4 meters walk at usual pace and a timed test of five repetitions of rising from a chair and sitting down. Each of these tests was scored from 0 (worst performance) to 4 (best performance). In the standing balance test, participant was first asked to stand with their feet positioned side-by-side as close together as possible (>10 seconds=1 point). Secondly he or she was asked to hold a semi-tandem position, i.e. put the heel of one foot alongside the big toe of the other foot (>10 seconds=1 point). Third position was tandem position, i.e. heel of one foot was put in front of the other foot as standing along the straight line, heel touching the toe (3-9.99 seconds=1 point; >10 seconds=2 points). Each position had to be held for 10 seconds, but if the performance in prior position failed, further positions were not tested. Four meter walking test was performed at a usual pace. Walk was performed twice and the one done in shorter time was recorded as a result (<4.82 seconds=4 points; 4.82-6.20 seconds=3 points; 6.21-8.70 seconds=2 points; >8.7 seconds= 1 point; not able to perform the test=0 points). For the chair stand test, the participant was asked to stand up and sit down in a chair five consecutive times as quickly as possible with arms folded over the chest. The time required to perform the test was measured (<11.19 seconds=4 points; 11.20–13.69 seconds=3 points; 13.70–16.69 seconds=2 points; >16.7 seconds=1 point; > 60 seconds or unable to perform the test=0 points). A total SPPB score (sum of all 3 tests) varied between 0-12.

Hand grip strength

Hand grip strength was measured using hydraulic hand dynamometer (Saehan SH 500, Saehan Co, Korea). Measurement was done sitting, forearm resting down loosely beside the body, flexed to 90° from the elbow. Participant was asked to hold the dynamometer upright with the hand she/he told to be the dominant hand. Width of the dynamometer handle was adjusted in the position 2 for women and 3 for men. Participant was instructed to squeeze the handle, without a change in the upper body or forearm position, as hard as possible. The participant was allowed to practice the test performance. Two measurements were carried out with short rest between the performances. Best performance was recorded as a test result in kilograms. If the participant reported pain or other reasons, such as severe arthritis or rheumatoid arthritis, limiting the safe performance of the test, the test was not executed. Data on grip strength is available for 1185 persons.

10 meter maximal walking speed

The test was carried out in the corridor of the research site, the beginning and the end of the track was marked to the floor. The tester checked out that participant wore appropriate shoes for safe walking. Two meters was allowed for acceleration and participant was instructed to walk as fast as possible without compromising safety and instructed not to slow down the walk in the end of the track and stop only until the tester told to do so. Test was done twice with short rest between the performances. Faster walking time was recorded as the result. Data on maximal walking speed is available for 1208 persons.

Other later life measurements

Leisure-time physical activity in FINGER baseline was assessed using the question "How often do you participate in leisure-time physical activity that lasts at least 20 minutes and causes breathlessness and sweating? Response options were 1=5 times a week or more often, 2=4 times a week, 3=3 times a week, 4=2 times a week, 5=once a week, 6=less than once a week and 7=not at all due to disease or physical disability. Responses were classified into three groups: 1=3 times a week or more, 2=1-2 times a week and 3=less than once a week. Self-rated health was asked as in earlier life assessment.

Statistical analyses

Population characteristics are reported as frequencies and percentages for categorical variables and means and their standard deviations for continuous variables, and differences were tested with Chi square tests and one-way ANOVA. The associations between LTPA/OPA and risk of subsequent difficulties in SPPB test and its components were investigated using logistic regression. Persons who scored lower than maximum (< 4 for SPPB components and <12 for total SPPB score) were classified as having difficulties. The association between LTPA/OPA and SPPB score was analyzed using censored regression models (cnreg in Stata 11), because the SPPB contained tests that most of the participants were able to perform without difficulties and a score SPPB score distribution had a large cluster at the highest value. Linear regression models were used to assess the association between LTPA/OPA and hand grip strength, usual pace and maximal walking speed and chair stand. Normality of the continuous outcome variables was tested with Skewness/Kurtosis test (sktest in Stata 11). Due to non-normal distribution in all continuous variables, transformation using Stata's lnskew0 command was conducted. All regression models were first adjusted for age, sex, education and follow-up time and then for earlier life BMI, smoking, chronic conditions and self-rated health. Results are reported as Regression Coefficient estimates (Coef) and p-values for linear and censored regression models and ORs and 95% Confidence Intervals (CIs) for logistic regression models. Sensitivity analyses for participants with follow-up period >5 years (n=926) and participants with >10 years (n=643) were conducted in order to diminish the possibility of the reverse causality.

RESULTS

Population characteristics in earlier life assessments

From 1260 participants, 672 (53.3%) were men. Participants' mean age at the time of the earlier LTPA/OPA assessment was 52.6 (SD 10.7, range 25-74 years) and 254 persons (20.3%) were very active, 769 (61.4%) were moderately active and 230 (18.4%) were sedentary at their leisure time. Among very active persons, there were more men (65%) than women. The proportion of very active participants was relatively stable across the age groups; 28%, 18%, 19% and 20% in the age groups of <40 years (n=129), 40-49 years (n=183), 50-59 years (n=395), 60+ years (n=553), respectively. Very active persons had lower BMI (p<0.001) and less commonly rated their health as poor (p<0.001) compared with moderately active and sedentary.

Altogether 751 persons aged ≤60 years answered the question regarding OPA. Heavy manual work was reported by 189 (25.2%) participants, 232 (30.9%) had moderately straining work and 330 (43.9%) had sedentary work. Level of LTPA did not differ according to OPA (p=0.740). There were no gender differences in OPA (p=0.209). Compared with age of the participant who reported moderately straining (mean age 48.3 years) or heavy manual work (mean age 47.6 years), those with sedentary work were significantly older (mean age 51.7 years) (p<0.001).

Heavy manual workers had fewer years of education than participants in other OPA groups ($p<0.001$).

Later life characteristics

The average follow-up time from earlier LTPA/OPA assessment until FINGER baseline assessments was 13.4 years (SD 10.1; range 1.8 to 39.6 years; median 12.7 years; 25% percentile 4.2 years, 50% percentile 12.7 years, 75% percentile 19.1 years). For those aged 60 years or less at the time of earlier LTPA/OPA assessment, mean follow-up time was 18.7 years, SD 9.6, range 2.0-39.6 years. At the time of later life assessment, participants' age range was 60-79 years (mean age 69.4, SD 4.7). Men were slightly younger (69.1 years) than women (69.7 years) ($p=0.04$) and women had higher BMI (women mean 28.8, men mean 27.7, $p<0.001$). Altogether 186 persons (15%) of participants had difficulties (less than 4 points) in balance test, only 54 persons (4%) had difficulties (less than 4 points) in walking test and 706 persons (58%) had difficulties (less than 4 points) in chair rise test. LTPA and good self-rated health were cross-sectionally associated with better physical functioning. Mid- and late life characteristics according to later life physical functioning are presented in Table 1.

Leisure-time physical activity earlier in life and older age physical functioning in later life

The associations between earlier life LTPA/OPA and later life SPPB are presented in Figures 1 and 2. Compared with sedentary persons, very active persons had lower risk of having difficulties in SPPB test (OR 0.37, 95% CI 0.24-0.58) at later life. The strongest association was seen between LTPA and chair stand, but for other components of SPPB associations were not statistically significant. Compared to sedentary persons, very active persons had higher total score in SPPB (Regression Coefficient Estimate (Coef) 0.75, 95% CI 0.35-1.14, $p<0.001$), and the association was more pronounced in men (Coef 0.93, 95% CI 0.39-1.46, $p=0.001$) and in older age groups (Table 2.). Both very active men and women performed better in chair stand test. Highest activity level predicted faster performance in usual pace walking test in the model adjusted for age, sex, education and follow-up time ($\beta = -0.06$, 95% CI -0.09- -0.02, $p = 0.004$), but the additional adjustments reduced the estimates. Similar results were observed in 10 meters maximal walking test; in the model adjusted for age, sex, education and follow-up time, highest activity level was associated with better time in maximal walking test ($\beta = -0.15$, 95% CI -0.22- -0.08, $p <0.001$), but after the additional adjustments the association did not remain significant. Women reporting moderate level of earlier life LTPA had better grip strength in late life compared with sedentary ($\beta = 0.02$, 95% CI 0.004-0.03, $p = 0.011$) but otherwise the associations between LTPA and hand grip strength were insignificant.

The sensitivity analyses including participants with follow-up of more than 5 (n=923) and more than 10 (n=641) years were in line with the results of the whole group. Very active persons were at lower risk of having difficulties in SPPB (persons with follow-up with 5 years or more OR 0.46, 95% CI 0.28-0.78; follow-up 10 years or more OR 0.53, 95% CI 0.29-0.96), and in chair stand (follow-up ≥5 years OR 0.49, 95% CI 0.30-0.82; follow-up ≥10 years OR 0.54, 95% CI 0.30-0.98). They also achieved better time in chair stand (follow-up ≥5 years β=-0.15, 95% CI -0.21- -0.09, $p<0.001$, follow-up ≥10 years β=-0.14, 95% CI -0.21- -0.08, $p<0.001$) and higher total scores in SPPB (follow-up ≥5 years Coef = 0.74, 95% CI 0.26-1.22, $p=0.003$, follow-up ≥10 years Coef=0.69, 95% CI 0.13-1.24, $p = 0.015$).

Occupational physical activity and later life physical functioning

Compared with persons with sedentary work, those with heavy manual work in earlier life had higher risk of having difficulties in SPPB (OR 1.91, 95% CI 1.22-2.98) and in chair stand (OR 1.75, 95% CI 1.14-2.69). The association between high OPA and difficulties in balance test and walking test were not statistically significant. In censored regression models, high OPA was associated with lower total SPPB score only among persons aged 50-60 years at the time of OPA assessment (Table 3.). In linear models the significant association between high OPA and poorer time in chair stand was observed only in persons aged <40 years at the time of OPA assessment (Table 3.). Compared with sedentary work, moderately straining work predicted better usual pace walking (β = -0.04, 95% CI -0.08- -0.006, p=0.025). In gender stratified analyses, this association was significant only in women (β = -0.08, 95% CI -0.13- -0.02, p=0.007) and in age-stratified analyses, among persons aged <40 years at the time of OPA assessment (β = -0.09, 95% CI -0.17- -0.002, p=0.046). Heavy manual work earlier in life was associated with poorer maximal walking speed (β = 0.10, 95% CI 0.03-0.17, p=0.005), in stratified analyses association remained only in men (β=0.12, 95% CI 0.02-0.23, p=0.018) and among persons aged 50-59 years at the time of OPA assessment (β = 0.14, 95% CI 0.04-0.23, p=0.004). The association between OPA and hand grip strength was insignificant in all models.

When testing the equality of coefficients on the independent variables from regression models, we found that in the models showing significant associations between LTPA/OPA and older age physical functioning, regression coefficients were not equal (p<0.05) supporting the present categorizations of the predictive variables. Regression coefficients were equal (p=0.15) in the linear regression model investigating the association between OPA and 4 meter walking, and in the linear model investigating the association between OPA and 10 meter walking (p=0.08).

However, the OPA categories include different types of work-related physical activities and therefore current categorizations are justifiable.

DISCUSSION

This study showed association between LTPA earlier in life and better physical functioning in older age, whereas heavy manual work increased the risk of functional limitations. This data of relatively healthy and well-functioning older people showed strongest associations between highest level of LTPA and more demanding measures of physical functioning (chair stand, maximal walking test) and total SPPB score. For the participants who were older (>50 years) at the time of reporting their LTPA, the higher activity level was associated with a better physical functioning in later life.

The results are in line with previous studies which have presented cross-sectional[21] and longitudinal associations between LTPA and better older age mobility and physical functioning[15,22]. Our study with exceptionally long follow-up from early adulthood until older age and detailed performance-based measures of physical functioning broadens the current knowledge. Even if our study population included relatively few people with major difficulties in physical functioning we were able to show the advantages of the physical activity. This may indicate that physically active people are also more prone to reach the disability threshold (e.g need for help with daily activities) later than sedentary people. This is supported by findings from other previous studies, which have investigated the associations between physical activity and disability[22,23]. PA is thus essential to prevent age-related decline in physical functioning and mobility. In addition, the age-stratified analyses showing that LTPA already at the age of 40-49 and also in older ages was associated with better older age functioning, gives further support to lifelong benefits of PA.

For over half of the participants, there were more than 10 years between the earlier life LTPA assessment and the later life assessments of physical functioning. Sensitivity analyses for this group demonstrated evident longitudinal association. We also observed a cross-sectional association between later life vigorous LTPA and physical functioning. It is known that physical activity earlier in life correlates with activity level later on[24], which means that both the longitudinal and cross-sectional associations reflect the effect of lifelong LTPA on better physical functioning later in life. However, the cross-sectional finding may also indicate reverse causality because older people with mobility difficulties often reduce their physical activity level[25].

This study showed that moderate OPA had beneficial effects on later life walking ability, but heavy manual work earlier in life may accelerate the physical decline. Strenuous work may have rather long term effects, which was suggested by the finding that those reporting heavy manual work at the age of 25-39 years had poorer performance in chair stand test at the average age of 69 years. In addition, for those who had done heavy manual work at the age of 50-60 years had difficulties in SPPB test and poorer performance in maximal walking test later on. Recently, similar results have been reported by Hinrichs et al. (2014)[14] and Mänty et al. (2014)[15], but these studies had either relatively short follow-up period or the older age outcomes were assessed by self-reports. These findings give ground to conclude that lifelong LTPA is beneficial for older age functioning, but activity through strenuous may even have the opposite effects. There are several factors contributing the adverse effects of OPA on later life functioning. Heavy and physically monotonous or repetitive work impose harmful strain on the neck, shoulders, low back, upper- and forearms and may inflict multi-site musculoskeletal pain[26-28], which may manifest in mobility limitations or disability[29] and also lead to early disability pension[30]. People doing strenuous manual work are also prone to mental stress[31], known to increase the risk for physical disability via biological and lifestyle pathways[31-34]. Heavy manual workers have more often low income and poor socioeconomic status, which is linked to higher prevalence of chronic conditions and disability[35]. Possible reasons for more rapid decline in physical functioning in later life may be that unfavourable lifestyle and unhealthy habits tend to be more common among employees in manually skilled occupations than white-collar workers[36]. In contrast, for those with less strenuous work, the type and intensity of OPA is not suitable to obtain favourable training effects.

One shortcoming of this study is self-reported and relatively crude measure of PA, which may cause under- or overestimation of the true PA. Also, we cannot completely rule out that some people had difficulties in physical functioning already at the time of the earlier life assessment, due to which they have reduced their PA. Therefore findings on a relationship between older age LTPA and better physical functioning may indicate short-term protective effects but could also reflect reverse causality. Because PA assessments in early and in later life were not fully comparable, we did not have possibility to assess changes in PA during the follow-up. Also due to well-functioning Finger study population, distributions in functional capacity test variables were skewed and variability was limited. Major strengths of this study include exceptionally long follow-up period extending up to forty decades for some participants. Wide age range at the time of PA assessment gave us possibility to investigate the effect of age on the results. Further, physical functioning in old age was assessed using valid and reliable performance-based measures.

Based on these results, LTPA is one of the key components in promoting healthy, active and independent old age. Already minor decline in mobility functions precedes more severe difficulties in essential functioning such as walking and basic activities of daily living[37]. Therefore prevention of functional decline as early as possible is essential. This study highlights the importance of lifelong PA and encourages implementation of PA interventions for people in all ages. Intervention studies aiming at increasing LTPA and diminishing the adverse effects of physically straining work would provide additional information on possible ways to support healthy ageing. Promoting physically active life-style may postpone the decline in functional abilities[38], compensate the adverse effects caused by heavy manual work[14], and thus lead to healthier and more independent old age.

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TABLES:

Table 1. Early and late life characteristics of participants with or without difficulties in Short Physical Performance Battery in FINGER baseline assessment.

	No difficulties in SPPB in later life (n=460)	Difficulties in SPPB in later life (n=750)	p-value
Earlier life assessment (data from 1971-2007)[1]			
Sex (n=1210)			
Men (n=648)	306 (66.5)	342 (45.6)	
Women (n=562)	154 (33.5)	408 (54.4)	**<0.001**
Age (n=1210)	55.8±10.5	56.1±10.9	0.486
Education (years)(n=1199)	10.3±3.4	9.7±3.3	**0.004**
BMI (n=1208)	26.8±3.5	28.1±4.7	**<0.001**
Sum of chronic diseases (n= 1159)	0.5±0.8	0.7±0.8	**<0.001**
Leisure-time physical activity (n=1203)			
Sedentary (n=221)	54 (11.8)	167 (22.5)	
Moderately active (n=741)	275 (59.9)	466 (62.6)	
Very active (n=241)	130 (28.3)	111 (14.9)	**<0.001**
Occupational physical activity (n=725)[2]			
Sedentary work (n=320)	134 (48.0)	186 (41.7)	
Moderately straining work (n=221)	88 (31.5)	133 (29.8)	
Heavy manual work (n=184)	57 (20.4)	127 (28.5)	**0.047**
Smoking (ever) (n=1202)	261 (57.0)	377 (50.7)	**0.033**
Self-rated health (n=1205)			
Very good	55 (12.0)	31 (4.2)	
Good	229 (50.0)	298 (39.9)	
Average	155 (33.8)	343 (45.9)	
Quite poor	18 (3.9)	70 (9.4)	
Poor	1 (0.2)	5 (0.7)	**<0.001**
Follow-up time between earlier and later life assessments (n=1210)	13.1±9.7	13.8±10.4	0.252
Later life assessment (FINGER baseline 2009-2011)			
Age (n=1210)	68.6±4.7	69.4±4.6	**<0.001**
Body mass index (n=1200)	27.1±3.9	28.8±5.1	**<0.001**
Vigorous leisure-time physical activity(n=1189)			
Less than once a week	54 (11.8)	159 (21.7)	
1-2 times per week	120 (26.3)	198 (27.0)	
≥3 times a week	282 (61.8)	376 (51.3)	**<0.001**
Self-rated health (n=1200)			
Very good	55 (12.1)	44 (5.9)	
Good	274 (60.5)	349 (46.7)	
Average	119 (26.3)	322 (43.1)	
Poor	5 (1.1)	32 (4.3)	**<0.001**
Chair stand time (sec.) (n=1194)	9.9±0.9	13.6±2.9	**<0.001**
Women (n=554)	10.0±0.8	13.9±2.9	**<0.001**
Men (n=640)	9.8±1.0	13.3±2.8	**<0.001**
Walking 4 meters (n=1210) (time in seconds)	3.1±0.5	3.6±1.0	**<0.001**
Women (n=562)	3.1±0.4	3.7±1.1	**<0.001**

Men (n=648)	3.1±0.5	3.5±0.7	**<0.001**
Maximal walking 10 meters (n=1208) (time in seconds)	4.7±0.7	6.0±1.7	**<0.001**
Women (n=561)	5.0±0.6	6.4±1.8	**<0.001**
Men (n=647)	4.5±0.7	5.5±1.5	**<0.001**
Grip strength (n=1184)(kg)	37.4±10.1	30.9±10.1	**<0.001**
Women (n=552)	27.2±5.3	24.0±5.9	**<0.001**
Men (n=632)	42.6±7.8	39.0±7.8	**<0.001**

[1] Data from the FINRISK and D2D Studies

[2] Analyses are restricted to persons aged 60 or less at the time of assessment.

Table 2. Associations between leisure-time physical activity earlier in life and physical functioning in later life. Moderately active and very active persons are compared to the sedentary.

	Regression coefficients and p-values[1]				
	Chair stand (time)	**4m normal walking (time)**	**10m maximal walking (time)**	**Grip strength (kg)**	**SPPB score[2]**
All participants					
Sedentary	0	0	0	0	0
Moderately active	**-0.08 (<0.001)**	-0.02 (0.304)	-0.02 (0.442)	0.005 (0.281)	**0.50 (0.001)**
Very active	**-0.15 (<0.001)**	-0.02 (0.343)	-0.05 (0.201)	0.01 (0.235)	**0.75 (<0.001)**
Stratified by sex					
Men					
Sedentary	0	0	0	0	0
Moderately active	**-0.08 (0.007)**	-0.01 (0.549)	-0.01 (0.813)	-0.001 (0.401)	**0.53 (0.016)**
Very active	**-0.16 (<0.001)**	-0.04 (0.149)	-0.07 (0.150)	0.001 (0.909)	**0.93 (0.001)**
Women					
Sedentary	0	0	0	0	0
Moderately active	**-0.08 (0.005)**	-0.02 (0.502)	-0.04 (0.300)	**0.02 (0.011)**	**0.49 (0.028)**
Very active	**-0.12 (0.002)**	0.01 (0.649)	0.01 (0.860)	0.01 (0.125)	0.50 (0.096)

[1] Models adjusted for sex, education, follow-up time, Body Mass Index, smoking, chronic conditions and self-rated health.

[2] Regression estimates from the censored regression models are presented.

Table 3. Associations between occupational physical activity earlier in life and physical functioning at the mean age of 69 years. Persons with moderately straining or hard manual work are compared to persons with sedentary work. Only persons aged 60 or less at the time of occupational activity assessment are included (n=751)

	Regression coefficients and p-values[1]				
	Chair stand (time)	**4m normal walking (time)**	**10m maximal walking (time)**	**Grip strength (kg)**	**SPPB score[2]**
All participants					
Sedentary work	0	0	0	0	0
Moderately straining work	-0.006 (0.776)	**-0.04 (0.025)**	0.03 (0.411)	0.002 (0.750)	0.07 (0.697)
Heavy manual work	0.04 (0.061)	-0.01 (0.620)	**0.10 (0.005)**	-0.004 (0.455)	-0.37 (0.067)
Stratified by sex					
Men					
Sedentary work	0	0	0	0	0
Moderately straining work	-0.02 (0.522)	-0.02 (0.502)	0.05 (0.272)	0.0003 (0.966)	0.20 (0.439)
Heavy manual work	0.03 (0.388)	-0.004 (0.881)	**0.12 (0.018)**	-0.005 (0.541)	-0.22 (0.421)
Women					
Sedentary work	0	0	0	0	0
Moderately straining work	0.0002 (0.996)	**-0.08 (0.007)**	-0.01 (0.816)	0.003 (0.677)	-0.01 (0.974)
Heavy manual work	0.06 (0.113)	0.02 (0.531)	0.06 (0.163)	-0.004 (0.621)	-0.48 (0.105)

[1] Models adjusted for sex, education, follow-up time, BMI, smoking, chronic conditions and self-rated health.

[2] Regression estimates from the censored regression models are presented

Table 4. Associations between leisure time (LTPA) and occupational physical activity (OPA) earlier in life and risk of having difficulties in Short Physical Performance Battery (SPPB) in later life.

	Risk of having difficulties in Short Physical Performance batter (SBBP) in later life[1]			
	Walking 4 meters < 4 points	**Chair stand < 4 points**	**Balance test < 4 points**	**SPPB total score < 12 points**
Earlier life physical activity	**OR (95% CI)**	**OR (95% CI)**	**OR (95% CI)**	**OR (95% CI)**
LTPA				
Sedentary	1	1	1	1
Moderately active	0.94 (0.43-2.02)	**0.60 (0.42-0.86)**	0.81 (0.52-1.26)	**0.57 (0.39-0.83)**
Very active	1.54 (0.59-4.02)	**0.42 (0.27-0.64)**	0.89 (0.51-1.57)	**0.37 (0.24-0.58)**
OPA				
Sedentary work	1	1	1	1
Moderately straining work	0.53 (0.20-1.39)	1.11 (0.76-1.63)	0.90 (0.52-1.55)	1.11 (0.75-1.63)
Heavy manual work	1.04 (0.43-2.56)	**1.75 (1.14-2.69)**	1.17 (0.66-1.06)	**1.91 (1.22-2.98)**

[1] Models are adjusted for age, sex, follow-up time, education, Body mass index, smoking, chronic conditions and self-rated health.