Master's thesis

NTNU
Norwegian University of Science and Technology
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Everyday physical activity and the fear of falling among healthy community-dwelling older adults during a year with the COVID-19 pandemic: A longitudinal study.

Evaluation of Sterk & Stødig: A group exercise program for preventing functional decline and falls among community dwelling older adults

Master's thesis in Physical activity and Health - Exercise Physiology
Supervisor: Arnhild Jenssen Nygård
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Everyday physical activity and the fear of falling among healthy community-dwelling older adults during a year with the COVID-19 pandemic: A longitudinal study.

Summary

The gradual reopening of the society during the last 12 months increased daily physical activity among the older adults living in Trondheim and Orkland municipality, significantley.

Study design

Longitudinal study

12 Months Follow-up

Participants recruited from Trondheim and Orkland municipality, Norway

Population

95 Participants

Mean age 77.8

87.4 % Women

The Norwegian health directorate recommend minimum 150 minutes of moderate-intensity physical activity per week

The average number of minutes spent in walking and running activity increased from 132.9 minutes/week to 232.93 minutes/week among the participants.

The fear of falling among the elderly restrict physical activity in daily life, even with a higher physical function.

This analysis shows an association between levels of daily physical activity and the fear of falling, and that an open society is important for the older adults to engage in physical activity.

Promotion of physical activity when ageing is important when it comes to facilitate healthy aging

Abstract

Background: Improvements in health status over the last years has led to an increase in the proportion of older adults. This demographic change predicts new challenges in healthcare systems and require a new direction of thinking. Physical activity is shown to be an essential factor in the prevention of lifestyle and age-related disabilities. The wider impact of the COVID-19 pandemic and lockdown of the society together with an increasing ageing population allows important questions regarding modifiable factors in health promotion and successful ageing.

Research question: The aim of this thesis is to examine how the gradual reopening of the society during a year with the COVID-19 pandemic change daily physical activity among healthy community-dwelling older adults. A further aim is to investigate if there is any association between PA and the fear of falling among older adults.

Design: A population-based one-armed longitudinal study.

Methods: 95 community-dwelling older adults that participates in the Sterk & Stødig group-exercise in Trondheim and Orkland municipality (83 women and 12 men (77.8$\pm$6.4 years). The data collection consisted of questionnaires, clinical measurements, assessment of physical function and physical activity monitoring. Objective measurements of physical activity was measured by Axivity activity (AX3) accelerometer and the fear of falling was assessed subjectively by the Short FES-I questionnaire. Data was collected between October 2020 and December 2021.

Results: The participants in the present study were a group of older adults with little variety including age, characteristics, physical activity and function. The participants significantly increased their time (minutes in walking and running) in physical activity after 12 months follow-up compared to baseline. There was no significant difference in the fear of falling after 12 months follow-up, but there was a statistically significant higher odds of not increasing their time in PA with higher concerns about falling.

Conclusion: After 12 months follow-during the COVID-19 pandemic, the participants in the present study increased their physical activity in daily life (minutes in walking and running) significantly compared to baseline. There was no difference in the measured fear of falling by the Short FES-I questionnaire, but the regression analysis showed that the participants with lower concerns about falling were more likely to spend more time in physical activity.

Sammendrag

Bakgrunn: Forbedringer i helsetilstand gjennom de siste årene har ført til en økning i andelen eldre i befolkningen. Denne demografiske endringen kan forutsi nye utfordringer i helsevesenet og kreve en ny tankegang. Fysisk aktivitet har vist seg å være en vesentlig faktor for forebygging av livsstil- og aldersrelaterte funksjonsnedsettelser. Den bredere innvirkningen av COVID-19-pandemien og nedstengningen av samfunnet sammen med en økende aldrende befolkning gjør rom for nye og viktige spørsmål angående modifiserbare faktorer herunder helsefremming og vellykket aldring.

Forskningsspørsmål: Målet med denne studien er å undersøke hvordan den gradvise gjenåpningen av samfunnet i løpet av et år med covid-19-pandemi kan endre daglig fysisk aktivitet blant friske eldre voksne i lokalsamfunnet. Ytterligere formål er å undersøke om det er noen sammenheng mellom Fysisk aktivitet og frykten for å falle blant eldre voksne.

Design: En populasjonsbasert enarmet longitudinell studie.

Metode: Deltakerne i denne studien 95 eldre voksne som trener i Sterk & Stødig-gruppene i Trondheim og Orkland kommune (83 kvinner og 12 menn (77,8±6,4 år). Datainnsamlingen besto av spørreskjemaer, kliniske målinger, vurdering av fysisk funksjon og fysisk aktivitetsovervåking. Objektive målinger av fysisk aktivitet ble målt med Axivity Activity (AX3) akselerometer og frykten for å falle ble vurdert subjektivt av Short FES-I spørreskjemaet. Data ble samlet inn mellom oktober 2020 og desember 2021.

Resultat: Deltakerne i denne studien var en gruppe eldre voksne med lite variasjon i alder, egenskaper, fysisk aktivitet og funksjon. Deltakerne økte signifikant tiden (minutter i gange og løping) i fysisk aktivitet etter 12 måneders oppfølging sammenlignet med baseline. Det var ingen signifikant forskjell i frykten for å falle etter 12 måneders oppfølging, men det var en statistisk signifikant høyere odds for å bli mindre fysisk aktiv med høyere bekymring for å falle blant deltakerne.

Konklusjon: Etter 12 måneder med covid-19-pandemi økte deltakerne i denne studien sin fysiske aktivitet i dagliglivet (minutter i gange og løping) betydelig sammenlignet med baseline. Det var ingen forskjell i målt frykt for å falle ved det korte FES-I spørreskjemaet, men regresjonsanalysen viste at deltakerne med lavere bekymringer for å falle hadde større sannsynlighet for å bruke mer tid på fysisk aktivitet.

Acknowledgements

Over the years there has been a growing interest for elderly and the elderly's health. The work with my master thesis has given me more insight and new valuable knowledge within my area of interest and not at least in research. For this there is several people I would like to thank.

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Maren Lie

Trondheim, May 2022

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Introduction

Improvements in life expectancy for both men and women have increased over the past century, leading to a rapidly growing older population in the society. According to the world health organization (WHO) there will in near future be a higher proportion of older adults aged 65 years or older (1), and by 2050 the population aged 85 years or older is estimated to increase more than threefold globally (2). Statistics Norway estimates that in 2030, older people will outnumber children in Norway (3). The demographic change towards an elderly population predicts new challenges that may have a great impact on both individual and social level (4). Several people are living longer and healthier lives, yet not all of these extra years come in the guise of healthy years, but years with diseases and disabilities (4). Ageing is associated with functional and physiological changes, and by the age of 65 years, the number of disabilities increases and most of the people in this age group will have more than one chronic condition (5). Age-related deterioration with several chronic conditions may lead to more complex health care needs with further accelerated decline in health status, increased risk of functional decline and augmented need for health care. In total, the social expectations of an increasing older population with increased years with disability and illness will set the future demands for healthcare services (6). To manage the future challenge and provide adequate healthcare for the increasing older population, there is a need to maintain independency among the older population for as long as possible by shifting the focus from treatment to prevention of age-related functional decline.

With increasing age, age-related changes also occur, and the aging process is characterized by metabolic changes, reduced maximal oxygen uptake, sarcopenia, and reduced muscle mass and strength, which all can contribute to reduced levels of activity, functional decline and greater risk of several non-communicative diseases (NCD) such as: diabetes type 2, cardiovascular diseases, pulmonary diseases, osteoporosis, and some type of cancers (7). Further, the sensory, motor, and cognitive systems gradually deteriorate with age, which is essential for proper postural control and balance. Balance impairments are associated with increased risk for falling among older adults, where falls often occur in situations that affect postural stability during gait, turning and reaching activities (8) . Gait characteristics also change with age, and gate performance and gait speed is an indicator for general health status and a strong predictor of risk for falls and institutionalization, as well as development of the fear of falling among older adults (4, 9).

Physical activity (PA) and exercise are believed to be the most effective intervention to slow down the age-related progression of functional decline and the negative physical and mental consequences that follows, as well as increase the physical capacity among older adults (10). PA and social engagement are important aspects to improve including the quality of life and maintain health in older adults. Even though there is a large focus on physical activity and following health benefits, there is still increasing sedentary behaviour among the elderly. Inactivity and sedentary lifestyle is estimated to be the fourth leading cause of death with higher risk of NCD, and increased functional decline among older adults (7). Increased sedentary behaviour is also associated with a higher risk of falls, development of reduced functional ability, and further be a threat to the elderly's independency and their quality of life. This in turn can put a greater pressure on social- and health care systems through treatment and institutionalization (2, 4, 5). To deal with these future challenges where more people will need health care that has to be provided by fewer people as well as the economic burden of treatment, there is of greater importance that the governments prioritize public services for the older adults. Thus, there is a need for innovative policies within health care, housing, and infrastructure to keep the aging population active, healthy, and independent for as long as possible.

Physical Activity

PA is shown to be one of the most important health promotion to prevent onset and progression of functional decline, reduce the risk of NCD, dementia, osteoporosis, falls and fall-related injuries, concomitant promote independence among older adults (10, 11). In fact, PA and exercise have shown to be the most effective interventions to improve quality of life and functionality among older adults (11, 12). Physical activity is defined as "Any bodily movement produced by skeletal muscles that result in energy expenditure" (13). PA normally describes the amount, type, frequency, and duration of activity the individual does during a day and often categorized as structural physical activity and incidental physical activity. Structural PA or "exercise" is planned, structured, repetitive, and purposeful physical activity, where Incidental PA is unplanned and consists of daily activities (14). There are several different ways to engage in physical activity, and what the different individual associate with physical activity or exercise can differ depending on age, gender, and their physical health. PA can be performed through leisure time such as endurance exercise, resistance exercises or different types of sports, or through means of transportation for instance walking, jogging, or cycling, or as a part of work which requires lifting or other active tasks. It can also include everyday life activities such as domestic work, cleaning, cooking, doing laundry and other care duties. PA can also consist of taking the stairs instead of the elevator, walk instead of taking the car or other means of transport (13). Nevertheless, regular PA with sufficient duration, intensity, and frequency promote improvements in physical, mental, and cognitive function among older adults, and can enable independency and healthier lives for a longer period (10).

Older adults are recommended to follow the same guidelines for physical activity and exercise as younger adults (15, 16). The Norwegian health directorate recommends a minimum of 150 minutes of moderate-intensity physical activity or 75 minutes of vigorous-intensity physical activity per week, or a combination (16). For an even higher health benefit, older adults should increase moderate physical activity to 300 minutes per week (15). Exercises that are intended to increase balance and muscle strength should be preferred, and older adults are also recommended to perform both strength- and balance exercises two to three times a week. For the older adults with reduced mobility and balance, strength- and balance exercise are recommended for 3 times a week or even more (16).

Although guidelines and recommendations for physical activity is commonly known, also among the elderly, existing literature demonstrates that there is decreasing levels of physical activity among older adults, and that they are less active than the recommendations given by health authorities (7, 10, 17). Paradoxically, older adults often believe themselves to be too old or frail to exercise, but also believe in the potential to that physical activity is important to maintain or improve for the physical- and mental health and well-being, but lack of motivation, social support or laziness can prevent them from participating. Without belief or proper motivation, promotion of physical activity seem to be a notoriously difficult task in the elderly population (18). A review of older people´s perspective on participating in physical activity refers to that the older population consider support from other individuals to be essential to participate in physical activity. Social contact and the joy of seeing familiar faces (19). Therefore, it is of great importance to identify the factors that motivate and the factors that are perceived as barriers for older adults to become more physically active. Consequently, understanding the different needs and perspectives among the elderly, promoting adherence to physical activity, raising knowledge regarding health benefits from physical activity, as well as minimizing exaggerated periods of sedentary behavior are important aspects to consider in future discussion regarding the design in health services and preventative work (18, 20).

Falls and fear of falling

Falls account for the largest proportion of injuries among older adults aged 65 years and older, and one third of these individuals experience a fall each year (8). This number seems to increase to almost one half by the time they reach 80 years (21, 22). A fall can be defined as "an event that results in a person coming to rest on the ground or other lower level unintentionally, which is not a result of a major instinct event (such as stroke) or overwhelming hazard" (8). A fall can be experienced by any individual, although falls have been identified as a common and significant problem among older adults. Fall do not only lead to injuries, but can also lead to limitations in daily life activities. Falls among the elderly often contributes to decline in physical and functional capacities and further induce post-fall syndromes such as fear of falling, depression and reduced quality of life (21, 22). Furthermore, falls also represent a significant economic burden on society and health care services and are often the main reason for institutionalization and loss of independence in older adults (22, 23). Fear of falling (FOF) is often referred to as enduring concern about falling and leading to avoidance of daily activities that the individual is capable of performing (24).

Inactivity and sedentary behavior

Sedentary behavior is shown to be an health risk that comes in addition to, and distinct from too little exercise, and the World Health Organization (WHO) defines sedentary behavior as any waking behavior characterized by an energy expenditure of 1.5 metabolic equivalents (MET), undertaken while in a sitting, reclining, or lying position during waking hours (15, 20). One MET, a measure of the energy cost of physical activities, is defined as the amount of oxygen consumed while sitting at rest, which is approximately equal to 3.5 milliliter of oxygen per kilogram of body mass per minute (1 kcal/kg per hour), or 1 MET is equal that of resting metabolism (25). Inactivity and sedentary behavior are considered as one of the major threats to the public health worldwide. Existing literature refers to that older adults are less active than younger adults (15, 20). There is estimated that older adults spend approximately 80% of their time in sedentary behavior during waking hours, which represents 8 – 12 hours a day (15, 20). Low physical activity and increased sedentary behavior is associated with reduced life expectancy and development of chronic diseases and all-cause mortality (20). WHO has created several recommendations for behavior change to reduce the burden of non-commendable diseases and disabilities among older adults, yet globally, 81% of the proportion of this population do not reach the global recommendations for physical activity (15). Regular physical activity is associated with several health benefits, and the importance of an active lifestyle seems to be well known in the society, also among the elderly. Somehow, most of the older adults remain sedentary which in term can contribute to the onset or increasing the severity of several chronic diseases, functional decline, as well as increased fall risk and premature death (20).

Group exercise and "Sterk & Stødig"

Different strategies on how the elderly can become more physically active is of importance, especially by the time of retirement where there still is a potential to reduce age-related functional decline (26). Many aspects of physical function deteriorate with increased age and inactivity and older adults are at increased risk of physical inactivity due to decline in activity levels and functional capacity (10, 27). Exercise interventions have been found to be effective to address these impairments with aging and therefore likely to reduce the risk of falling and the development of the fear of falling and adverse health outcomes (7).The Otago program and The Falls Management Exercise (FaME), shows great effect in fall prevention, functional decline and reduction of the risk of falling and admission in nursing homes among the elderly with already established functional decline (28), but few studies have targeted older people in the early phase of the trajectory of functional decline with possible preventative interventions (29). "Sterk & Stødig" (Strong & Steady (S&S)) addresses the elderly people living at home who manage activities in daily life (ADL), without much assistance from the municipality. It is developed as a collaboration between the physiotherapy unit in Trondheim, and NTNU. S&S intends to run a low-cost- and effective, low-threshold exercise offer to increase physical function, reduce the risk of falling and to empower elderly to self-manage their own health and function (30). Interventions like group exercise is shown to be effective in improvements in both strength and balance, but also a motivational factor among the elderly due to the social aspect and the importance of the sense of a group affiliation (19).

The COVID-19 Pandemic

In March 2020, WHO declared COVID-19 a global pandemic and had as of January 2022 claimed >5.5 million lives globally (31). The COVID-19 pandemic is an extraordinary global emergency and led to the introduction of unprecedented measures in peacetime in order prevent the spread of the virus. Governments were enforcing measures such as quarantine, travel bans, isolation, and social distancing (32). As a natural consequence, the barriers of physical activity have increased as well as mental health status and quality of life has were reduced, which in turn can cause changes in sickness and total mortality (33).

The new implemented behavioral strategies advised by health authorities, such as lockdown of the society, social distance and home isolation has changed people's daily life significantly, especially for the population of older adults which are at higher risk for more serious and potentially fatal illness due to the COVID-19 virus (34). Self-isolation and social distancing may increase the risk of inactivity and sedentary behaviors, particularly for the elderly. The prolonged time spent at home with interruption to habitual physical activity in daily life creates a concern to a more progressive loss of physical function and mobility among the elderly, and such disablement may lead to a higher risk for falls and fall risk variables and a greater threat for their independence (34, 35).

The aim of the thesis

The wider impact of the COVID-19 pandemic and the ageing population allows important questions regarding modifiable factors in health promotion and successful ageing, where older adults can live healthy independent lives for a longer time, with less risk of disabilities and diseases. To achieve more knowledge regarding population levels of PA among older adults this study aims to examining how the gradual reopening of the society during a year with the COVID-19 pandemic affected daily physical activity and the fear of falling among community-dwelling older adults that participates in the S&S-groups in Trondheim and Orkland municipality. Further, the present study will investigate if there is any association between PA and the fear of falling among older adults.

The original aim of the study was to assess whether the S&S group-exercise intervention influenced daily physical activity and the fear of falling among community dwelling older adults. Since the outbreak of the COVID-19 pandemic the S&S-groups has periodically been closed, and the participants have not received sufficient exercise in the different groups. Therefore, we had to change the aim of the present study throughout the study period.

Based on previous research on healthy older adults, we hypothesized that the levels of physical activity would increase in line with the reopening process of the society, and that the fear of falling would decrease related to increased physical activity among the participants.

Method

Study Design

The present study is a population-based one-armed longitudinal study examining the change in physical activity in daily life and the fear of falling among healthy community-dwelling older adults during a year with the COVID-19 pandemic. This study is a sub study of the larger study called “Evaluation of Sterk & Stødig: A group exercise program for preventing functional decline and falls among community dwelling older adults”.

Data was collected between September 2020 and December 2021 and consist of questionnaires, clinical measurements, assessment of physical function and physical activity monitoring. The assessments were performed at baseline and follow-up at 6- and 12 months. All testing was done by trained personnel, and all the participants filled out questionnaires and completed the physical function tests at the test station. The participants in the present study are older adults that participants in the S&S exercise-groups, and these groups closed down at Mars 13, 2020 due to the COVID-19 outbreak. The S&S-groups stared to reopen again around the testing at baseline, and the participants in the study had been offered at least one exercise in this groups before tested at baseline. All examination were performed at St. Olavs University Hospital in Trondheim or at the physiotherapy department´s facilities in Orkland municipality at baseline and at the 6- and 12-months follow-up, from September - December 2020, April – June 2021 and October - December 2021. During the period before testing at baseline and 6 months follow-up, restrictions such as quarantines, one meter distance, face masks and social distancing were applicable. There were few or no restrictions at 12 months follow-up (32).

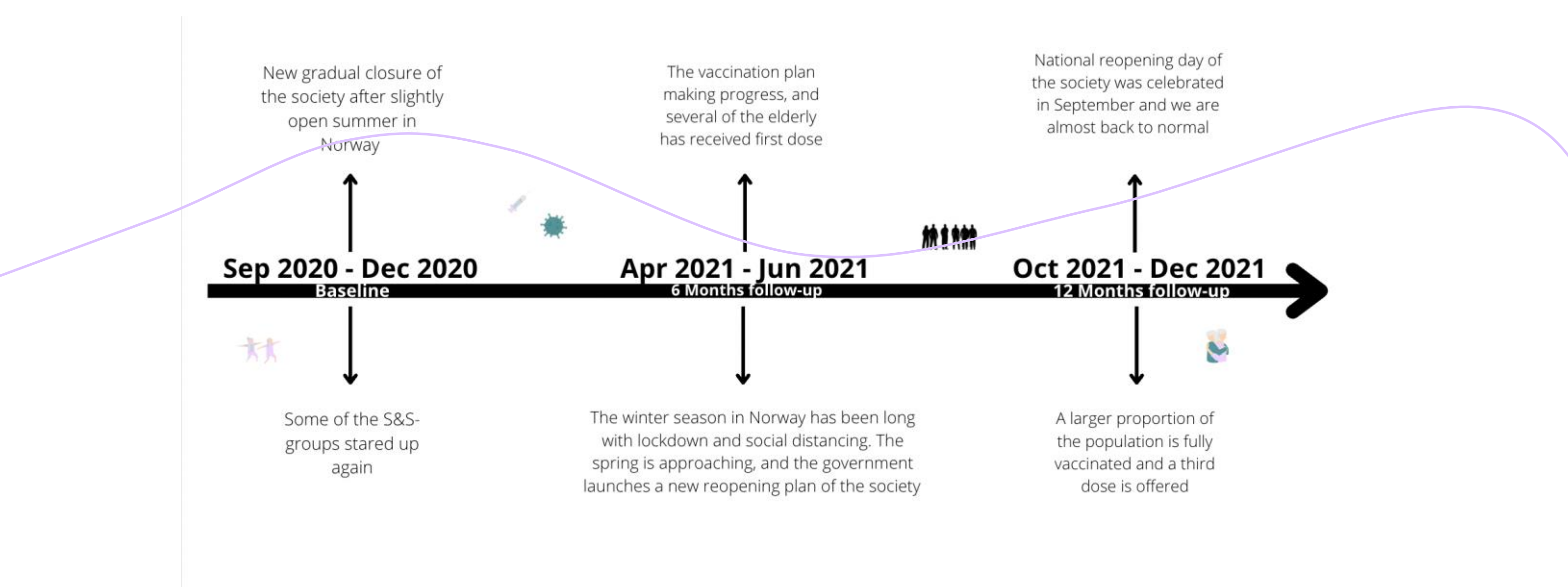

Figure 1. shows a small overview of the corona situation through the different test periods in the present study (32).

Participants

The participants in this study are community-dwelling older adults, men and women who participates in the S&S-groups in Trondheim and Orkland municipality. The participants in the S&S-groups are older adults aged 65 years and older and should be able to travel to training facilities on their own, with no big cognitive impairments (diagnosed with dementia) or have little or no need for homecare. They should also be able to walk without a walking aid indoor and be physically able to take part in a group-exercise class. As stated by these inclusion criteria, no specific exclusion criteria was set. All participants had to give their written, informed consent to be a part of the study.

Participation in the study was voluntary and the participants received a written information and signed an informed consent on the first day of testing. The informed consent included information about the study and data collection. Data was collected between September 2020 and December 2021, and the current study includes all participants tested in this period. Due to the corona pandemic (COVID-19), the participants have not been offered sufficient group exercise for some periods during the test-periods.

Procedure

All the existing participants in Sterk & Stødig exercise groups in Trondheim and Orkland municipality were invited to participate through the physiotherapist responsible for the Sterk & Stødig groups in the relevant municipality. All examination were performed at St. Olavs University Hospital in Trondheim or at the physiotherapy department´s facilities in Orkland municipality. Each participant filled out the questionnaires and completed the physical examination tests at the test stations. The physical function of each induvial participant was tested by Short Physical Performance Battery (SPPB). After the physical testing, all participants were asked to wear Axivity activity sensors (AX3) for seven continuous days. The participants were asked to deliver the monitors to us by prepaid post after seven days of monitoring. At last, the participants got a summary of what they had done and further information about the project.

Material and Equipment

Questionnaires

The questionnaires included information regarding health status, disease/illness, life situation and activities in daily lives (see *Appendix 1*). All the participants in the study filled out questionnaires that included questions on background information (age, gender, falls, use of walking aids, self-reported physical activity etc..), health-related quality of life by using EuroQol-5D-5L (EQ-5D), fear of falling by using the Short Fall Efficacy Scale International (Short FES-I), and ADL by using selected items from Nottingham I-ADL. Most background questions were the same ones as used in HUNT survey (36).

EuroQol-5D-5L (EQ-5D)

The EQ-5D is a standardized measure of health-related quality of life developed by the EuroQol Group to provide a simple generic questionnaire for clinical use and calculate cost-benefit in population health surveys (37). The descriptive self-reported questionnaire system compromises five dimensions of health domains; mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Each dimension has 5 levels ordinal scale: no problems, slight problems, moderate problems, severe problems, and extreme problems. When filling out this questionnaire the participant is asked to indicate his/her health state by ticking the box next to the most appropriate statement in each of the five dimensions (See *Appendix 2*). The Norwegian version of 5Q-5D-5-L was used in this study to investigate health-related quality of life. Also a standing vertical visual analogue scale (VAS-scale) is also scored for perceived health status (1-100), where the endpoints are labelled "The best health you can imagine" and "The worst health you can imagine"(38).

Physical Activity

The questions about physical activity which were the same ones used in HUNT survey (see *Appendix 3*) included questions about frequency, intensity and duration of their physical activity during the last week (36). The frequency question was "how often do you exercise on average?", with the response options; never, less than once a week, once a week, 2-3 times a week, a week and nearly every day. The intensity question was "If you exercise, how hard do you exercise on average?" with the response options; no sweating or heavy breathing, sweating and heavy breathing, and nearly exhausted. The participants also responded to the question about duration "How long do you exercise on average?" with the options; less than 15 minutes, 15-29 minutes, 30 minutes to one hour, or more than one hour.

Falls Efficacy Scale-International

The Falls Efficacy Scale-International (FES-I) is a common measuring tool for the "fear of falling" or "concerns about falling among community-dwelling older adults and developed as a part of the Prevention of Falls Network Europe (ProFaNE) project, 2003 (39). It is a self-reported questionnaire consisting of different questions measuring the level of concern about falling during social and physical activities inside and outside the home, whether the person does the activity or not. The original FES-I contains of 16 questions, and the shortened version of FES-I containing 7 questions extracted from the original FES-I. In this present study the Short Falls Efficacy Scale-International was used (see *Appendix 4*). The participant were instructed to score their concerns about falling during the respective activity on a scale of 1-4, where 1 is not concerned at all, and 4 is very concerned. A "cut-off" score is defined and can categorize the fear of falling in different subgroups that correspond to the participants levels of concern: 7-8 points (low), 9-13 points (moderate) and 14-28 points (high). FES-I has shown good internal and test-retest reliability of measuring the fear of falling in community-dwelling older adults, and in addition, the questionnaire is also validated and translated to Norwegian (39).

Physical examination

Short Physical Performance Battery (SPPB)

The short physical performance battery (SPPB) is a screenin gtool for testing physical function in the elderly (see *Appendix 5*). It is a valid tool for assessing physical function in older persons and has shown good predictability for future functional decline and increased need for health care services (40, 41). The test requires measuring tape, tape, stopwatch, and a chair. The Short Physical Performance Battery starts with testing of static balance in three different ten-second stance positions; side-by-side stand (feet together), semi-tandem (the side of the heel of one foot touching the big toe of the other foot), and tandem stand (the heel of one foot in front of touching the toes of the other foot). The second test measures regular walking speed carried out in a marked length of 4 meters. The 4-meter gait speed test was completed for two times, and best time score was counted. The final test measured the strength of the lower extremities by the time to perform 5 sit-to-stands from a chair. The SPPB test normally takes 5-10 minutes, and each subtest is scored on time and then converted in to points (0-4). The total score in the test is from 0 – 12 points where and lower score (0-6) indicates a lower level of function. A medium score ranges from 7-9 points, and high score ranges from 10-12 points (40). A score below 10 indicates an increased risk for disability and a score below 8 indicates an initial loss of function in activities of daily living. (41). A manuscript was used by the test personnel to ensure standardization between participants, as well as between the three testing periods. An increase in total SPPB score of 1 is regarded as a clinically meaningful improvement (41).

Everyday Physical activity

Everyday physical activity was objectively measured by AX3 Axivity activity sensors (Axivity Ltd, Newcastle, United Kingdom) which is a data logger ideal for collecting longitudinal movement data (42). Each participant was equipped with two Axivity AX3 triaxial accelerometers for one week at baseline, 6- and 12 months follow-up. The axivity AX3 is a small (23 x 32.5 x 8.9 mm) and light weight (11 g) triaxial accelerometer with a sample rate configurable between 12.5 and 3200 Hz, and a measurement range between ± 2 g and ± 16 g with internal memory of 512MB. The axivity AX3 sensors can store 14 days of continuous data sampled at 200 Hz, waterproof and has a temperature sensor with the range of 0°C - 40°C which can be used for accurate wear time detection. The accelerometers in this study were initialized to record at 50 Hz with a range of ± 8g (42). The accelerometers were synchronized before application, and time synchronization was done by hitting them against each other three times. Before attaching the sensors, the area was disinfected by Cutisoft injection wipe with 70% alcohol. One of accelerometer was positioned on the anterior aspect of right thigh, approximately 10 cm above the patella. The second accelerometer was positioned on their lower back (approximately 3rd lumbar vertebra), offset from the spine. The sensors were attached using Opsite Flexifix Transparent Conformable Film Roll. The film is waterproof, and the acrylic adhesive minimize the risk of skin damage on removal. The sensors were mounted with the USB-port and a small arrow pointing downward. To ensure that the accelerometers was properly attached and as comfortable as possible, the thigh mounted accelerometer was fastened while the participants knee was flexed in approximately 90-degrees, and accelerometer on the back was fastened while the participant landed forward. The sensors were worn at three separate 1-week periods to investigate the physical activity level in the participants: at baseline, after 6 months and after 12 months. After the 1-week of use the participants removed the sensors from body and sent them back by post. Derived activity information includes time sitting, standing, and walking as well as number of steps and length of activity and sedentary bouts. In the present study the derived activity from the sensors only includes time in walking and running. All sensors were setup and downloaded using OmGui software (version V1.0.0.43; Open Movement, Newcastle University, United Kingdom).

Outcome Measures

Participant Characteristics

Age, height, weight, gender body mass index (BMI) calculated by weight (kg) divided by height squared (m^2) were included variables as participant characteristics.
Information about education, medication use, living situation, use of walking aid, falls last 6 months, self-reported activity levels, self-reported health and VAS-score for health were retrieved through the questionnaires. SPPB-score was collected through the physical tests and the gait speed was then extracted from the SPPB-scores.

Do you live with someone (Alone, spouse/partner, others), *Do you use any walking aids?* (No, outside, inside), *How many falls the last six months?* (number), *How many prescribed medications do you use in total?* (number). *Which of the following medical diagnosis do you have?* (Yes/No). Level of education was reported as the highest level of education the participant finished. Primary school (1), 1–2-year high school (2), high school/3 years in high school (3), trade certificate or journeyman´s certificate (4), college, less than 4 years (5), college, 4 years or more (6). Self-reported health was retrieved through ticking the box that describes you best and at the score their current health on an analog scale from 0-100 (0= worst and 100=best).

Educational level was categorized into two different levels *primary and secondary education* (primary, lower and upper secondary school, vocational school/apprentice) and *higher education (3 years or more)* (college and university for 3 years or more). Short FES-I score was further categorized into two subgroups *Low concern about falling* and *moderate to high concern about falling*. This was done to distinguish the participants who was concerned about falling from those who were less or not worried.

Physical Activity data processing

PA accelerometer raw data was stored on a 512 MB internal memory and downloaded as binary file. Further the recorded activities from the accelerometers was labeled by a coding scheme with definitions for the different activities, for the present study the labeled activity of walking and running was carried out, and further processing of the activity data was done in MatLab (version

R2021c) and output variables were exported into excel (Microsoft Excel for Office 365, version 1908) before statistical analyses. The AX3 accelerometers detect walking and running with overall accuracy of 92.9 % and 97.4 % obtained in free-living environment by using two accelerometers positioned on the thigh and lower back, combined (42). Non-wear time was excluded from the analyses because of some issues with the temperature measurement in the accelerometers. Data were considered valid if the participants wear the sensors for all 7 recording days in all the three measuring periods. Wear-time for day 1 and day 7 was also excluded from the analysis because we wanted fully days of activity recording, and that left us with 5 continues days of recorded material. The registered accelerometer time was calculated and categorized in different PA levels which reflect the intensity of bodily movement. In this present study we only extracted time (minutes) spent in walking and running from the participants, which reflect the level of moderate intensity PA from WHO´s PA recommendations (15). Recording time were set to the waking daytime, which was defined between 6:00 a.m. and midnight.

Statistical analyses

All statistical analyses were performed in SPSS Version 28. Descriptive statistics (mean, median, standard deviation, interquartile ranges, proportions and percentage) were calculated to describe the characteristics of the participants. Visual inspections of Q-Q plots were conducted to determine normality of variables. Nonparametric variables were visually inspected for possible outliers before further analysis. Continuous variables are presented as mean (SD) and categorical variables as n (%), unless stated otherwise. The different results (baseline, 6 months- and 12 months follow-up) for the participants were checked for normality by visual inspection of Q-Q plots, histograms, and by Shapiro-Wilk test. Nonparametric tests were used with non-normal distributions.

Descriptive statistics are presented for all participants. Chi-Square, Mann Whitney U tests and independent samples t-test were used to examine differences in the participants that was included in the analysis and the participants that withdraw from the study. The results are reported for those variables where there was a significant *p*-value.

The variable distribution of the Short FES-I scores and the data-measures of time in walking and running did not follow a straight line the Q-Q plot and the histograms did not show an overall normal distribution. Therefore, these distributions were assumed not to be normally distributed. The data set were then tried log transformed and checked for normality, but the data were still not considered normal distributed. The Friedman test (non-parametric statistical test) was used to investigate the group-change over time for the three test periods for both Short FES-I score data and the physical activity data. The statistical significance was set a *p* less than 0.05.

Regression analysis

To examine whether there was an association between level of physical activity (walking/running) and the fear falling of falling, a binary logistic regression analysis was performed. Physical activity data was categorized into two groups expressed as *Unchanged or higher levels of activity* and *lower levels of activity* to differentiate between the changes in activity levels during the last 12 months. The group with *Unchanged or higher levels of activity* was the participants that achieved *unchanged* or *higher* levels of minutes spent in walking and running per week after 12 months, compared with baseline. The group with *lower levels of activity* was the participants that achieved *lower* levels of minutes spent in walking and running per week after 12 months, compared with baseline. Levels of PA were set as the dependent variable with the *Higher levels of activity* as the reference group, and the Short FES-I and age as the independent variables. Analyses are presented as odds ratio (OR) with 95% confidence interval (CI), and the statistical significance level was set to a *p* less than 0.05.

Ethical considerations

Participation in this study was voluntary and all the participants signed an informed consent prior to any testing. The participants could at any time withdraw their consent and leave the study without any explanation. As part of the "Evaluation of Sterk & Stødig", the present study was approved by the Regional Committee for Medical and Health Research Ethics in Norway (REK).

Results

A total of 95 subjects participated in this study, of which 83 women (87,4%) and 12 men (12,6%). There was a loss to follow-up for a total of 33 subjects, were 17 subjects drop-out at 6 months follow-up and 16 subjects drop-out at 12 months follow-up. After the analysing of the accelerometer data, there was a sample data of included variables for 42 persons. A flow chart of the participants through the study period is presented in figure 2.

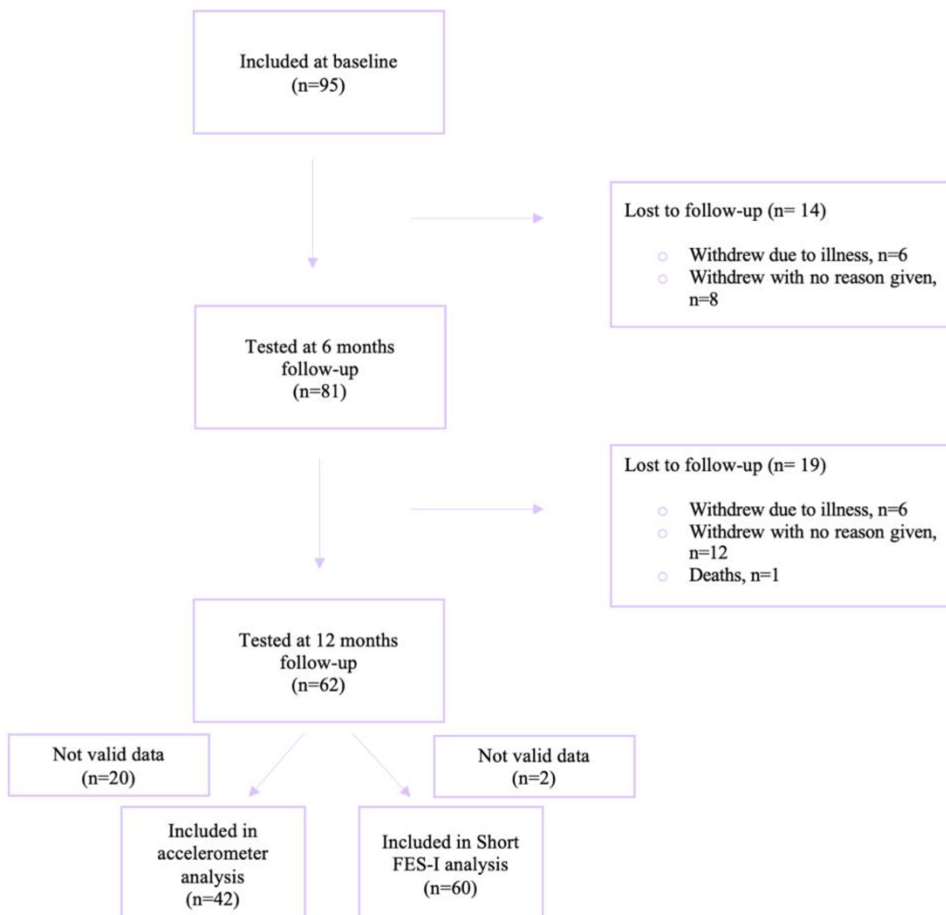

Figure 2. Flowchart of study progression and participant flow.

Participant characteristics

Table 1. presents the baseline characteristics for the continuous variables and Table 2. presents the baseline characteristics for the categorical variables. Results from the Chi-Square tests, Mann-Whitney U test, and independent-sample t-tests are presented in Table 1. and Table 2. for variable differences between the participants who was included in the analysis and the participants that withdraw from the present study.

Table 1. Descriptive baseline characteristics of the participants for continuous variables and results from Chi-Square test and Mann-Whitney U tests between the participants included in analysis and the drop-outs.

	All N=95	**In analyse N=42**	**Drop-outs N=53**
Age (years), mean (SD)	77.8 (6.4)	78.2 (5.4)	77.4 (7.1)
Sex, n (%)			
Female	83 (87.4)	38 (90.5)	45 (84.9)
Height (cm), mean (SD)	164.68 (12.20)	163.90 (16.83)	165.26 (7.07)
Weight (kg), mean (SD)	69.82 (10.92)	72.62 (12.11)	67.61 (9.42)
BMI, mean (SD)	27.1 (16.15)	30.2 (24.19)	24.6 (3.19)
Prescribed medications, mean (SD)	3.34 (2.70)	3.30 (3.16)	3.38 (2.22)

Table 2. Descriptive baseline characteristics of the participants for categorical variables and results from Chi-Square test, Mann-Whitney U test, and independent-sample t-tests between the participants included in analysis and the drop-outs.

	N=95	**N=42**	**N=53**
Education level, n (%)	(n=94)	(n=41)	(n=53)
Primary- and secondary education	**71 (75.5)**	30 (73.1)	41 (77.4)
Higher education (3 years or more)	23 (24.5)	11 (26.9)	12 (22.6)
Living with someone, n (%)			
Yes	49 (51.6)	17 (40.5)	32 (60.4)
Walking aid, n (%)*$_1$			
No	89 (93.7)	37 (88.1)	52 (98.1)
Fall over the last 6 months, n (%)	26 (27.4)	11 (26.2)	15 (28.3)
Short FES-I score, median [IQR]	8.0 [7-9]	8.0 [7-10]	8.0 [7-9]
Short FES-I subgroups, n (%)			
Low concern	53 (55.8)	27 (64.3)	26 (49.1)
Moderate to High concern	42 (44.3)	15 (35.7)	27 (50.9)
Self-reported Activity, n (%)			
Frequency*$_2$			
Never	0 (0)	0 (0)	0 (0)
Less than once a week	2 (2.2)	1 (2.5)	1 (1.9)
Once a week	8 (8.6)	3 (7.5)	5 (9.4)
2-3 days per week	35 (37.6)	11 (27.5)	24 (45.3)
4-6 days per week	44 (47.3)	21 (52.5)	23 (43.4)
Almost every day	4 (4.3)	4 (10.0)	0 (0)
Intensity			
I go easy without being out of breath	32 (34.8)	15 (37.5)	17 (32.7)
I go so hard that I get sweaty and out of breath	60 (65.2)	25 (62.5)	35 (67.3)
I go almost all out	0 (0)	0 (0)	0 (0)
Duration			
Less than 15 minutes	0 (0)	0 (0)	0 (0)
15-29 minutes	12 (13.0)	6 (15.0)	6 (11.5)
30-60 minutes	57 (62.0)	24 (60)	33 (63.5)
More than 60 minutes	23 (25.0)	10 (25)	13 (25.0)
EQ-5D-5SL, mean (SD)	1.31 (0.30)	1.37 (0.43)	1.25 (0.44)
VAS – Health, mean (SD)	77.8 (14)	76.28 (14.86)	79.02 (13.34)
SPPB score, Median [IQR] *$_3$	12 [11-12]	11 [10-12]	12 [11-12]
Gait speed (m/s), mean (SD)	1.08 (0.24)	1.06 (0.25)	1.120.21)

Medical diagnosis (previous and present), n (%)	
Angina	7 (7.4)
Heart attack	10 (10.5)
Heart failure	7 (7.4)
Atrial fibrillation	12 (12.6)
Stroke	5 (5.3)
Asthma	13 (13.7)
Kidney disease	4 (4.2)
Diabetes	9 (9.5)
Cancer	21 (22.1)
Rheumatoid arthritis	4 (4.2)
Bechterews disease	2 (2.1)
Osteoarthritis	43 (45.3)
Osteoporosis	20 (21.1)
Femoral neck fracture	4 (4.2)
Fracture spine	5 (5.3)
Fracture other	20 (21.1)
Mental illness	13 (13.7)

Marked with * are significantly *p*-values.
*$_1 p$=0.046
*$_2 p$=0.049
*$_3 p$=0.001

In total there were 95 participants at baseline, with a predominance of women with a mean age of 77.8 (SD= 6.4) who participated in this study. Mean BMI of the participants was 27.04 (SD= 16.15). The SPPB score was 12 (median) and 47.3 % reported that they were active for 4-6 days a week. Further, 48.4 % reported that they were married or living with someone and 77.4 % had secondary or higher education level. All the participants completed the walking test in SPPB without walking aids with a standing start.

Physical activity

Table 3. presents the median and IQR values of the time spent walking and running in minutes for the 42 participants with valid wear-time during all periods of measurement at baseline, 6 months- and 12 months follow-up, respectively. Table 4. presents the results from the Friedman test with mean ranks from the different measuring periods among the participants that was included in the analysis, the test statistic value Chi-Square, and the *p*-value. As shown in Table 4. and figure 3. the participants significantly increased the number of minutes spent walking and running from baseline and 6 months follow-up to 12 months follow-up ($P > 0.001$). Table 4. and figure 3. also shows a slight decrease from baseline to 6 months follow-up, but this was not significant.

Table 3. Median and IQR values for the accelerometer-measured physical activity variables in minutes for the total sample of participants that was included in analysis.

	N	*Lower IQR*	*Median*	*Higher IQR*
Baseline	42	62.53	132.29	254.39
6 Months follow-up	42	82.89	112.35	244.25
12 Months follow-up	42	157.36	232.93	435.35

Table 4. Mean ranks between the three measuring periods of accelerometer-measured physical activity and the results from the Friedman test.

	Mean rank
Baseline	1.79
6 Months follow-up	1.69
12 Months follow-up	2.52

N	42
Chi-Square	17.476
df	2
P-Value	> 0.001

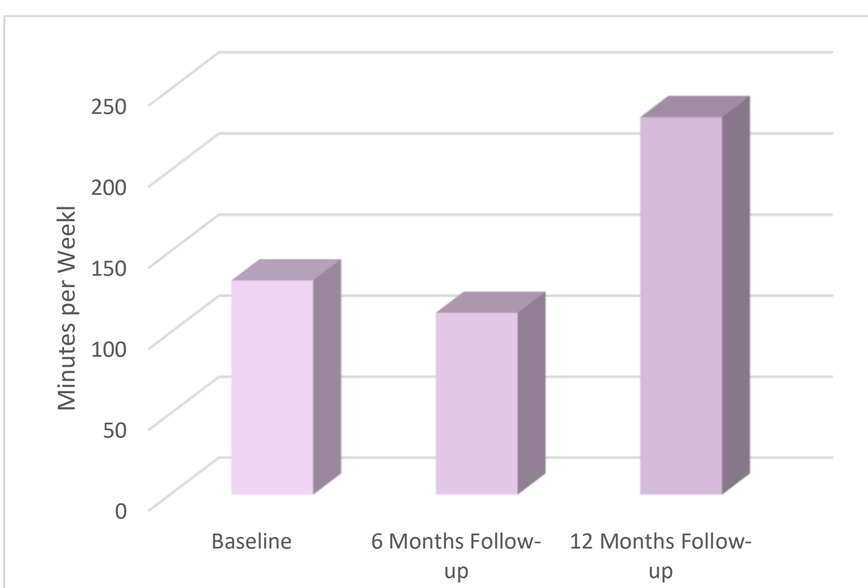

Figure 3. Median minutes per week spent in walking and running for the 42 participants that were included in the analysis.

Table 4. presents the results from the Friedman´s test which shows that the average minutes per week expressed as median differed significantly from baseline to after 12 months with a Chi-square value of 17.476, and a p >0.001.

Fear of falling (Short FES-I)

Table 5. presents the median and IQR values of the fear of falling (Short FES-I) for all the participants that responded to the Short FES-I questionnaire at baseline, 6 months follow-up and 12 months follow-up, respectively. Table 5. shows a very small reduction in median score of the fear of falling for the participants from baseline to 12 months follow-up. The results from the Friedman test presented in Table 6. shows no statistically significant change in the fear of falling among the participants from baseline, 6 months, and 12 months follow-up with a Chi-Square value of 3.710 and a p>0.156.

Table 5. Median and IQR values for the Short FES-I questionnaire variables for the total sample of participants that answered Short FES-I at all testing periods.

	N	*Lower IQR*	*Median*	*Higher IQR*
Baseline	60	7.0	8.0	9.0
6 Months follow-up	60	7.0	8.0	9.0
12 Months follow-up	60	7.0	7.5	9.0

Table 6. Mean ranks between the three testing periods of Short FES-I questionnaire and the results from the Friedman test.

	Mean rank
Baseline	2.15
6 Months follow-up	1.93
12 Months follow-up	1.93

N	60
Chi-Square	3.710
df	2
P-Value	0.156

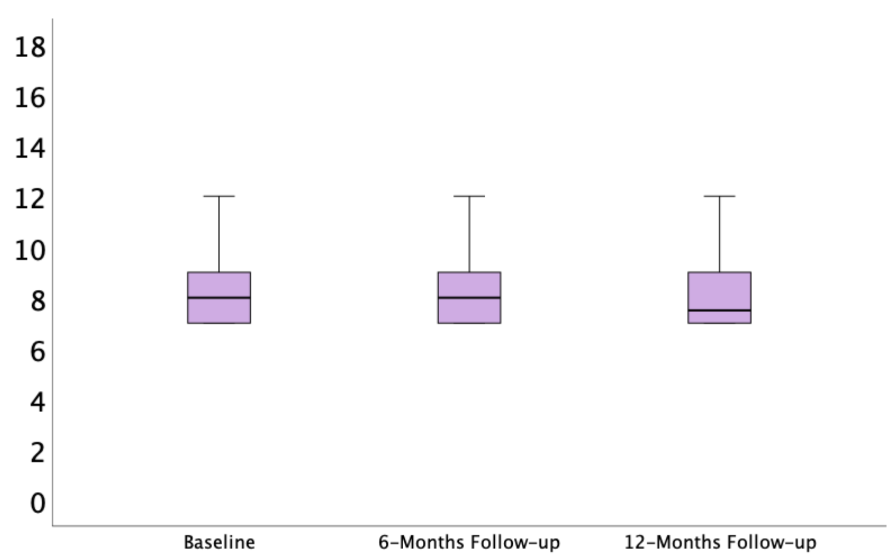

Figure 4: Median of the Short FES-I for the participants at baseline, 6 months follow-up, and 12 months follow-up.

Logistic regression analysis of the association between PA and the fear of falling

The association between PA and the fear of falling was investigated by using a regression analysis, which included the participants that had valid data for the relevant variables (accelerometer data and Short FES-I score). Table 7. presents the logistic regression analysis between accelerometer-measured PA and the fear of falling cut-off values. The cut-off value of low concern about falling was set as the reference value, and levels of PA was set as the dependent variable. The regression analysis was adjusted for age.

Table 7: The odds ratio (OR) and 95% confidence intervals (CI) for Short FES-I cut-off values by physical activity.

	OR	***95% CI***	***P-value***
Moderate/high FOF	1.8	1.07 – 3.01	0.027
Low FOF (ref.)			
Age	0.965	0.85 – 1.11	0.608

The logistic regression analysis shows that participants that had moderate to high fear of falling had a higher odds of being less physical active (OR 1.8; 95% CI, 1.07-3.01) compared to participants with low fear of falling. The logistic regression analysis was significant with a *p* value of 0.027.

Discussion

The present study aimed to investigate whether the gradual reopening of the society during the last 12 months with the COVID-19 pandemic changed the everyday physical activity and the fear of falling among healthy community-dwelling older adults that participates in the S&S-groups in Trondheim and Orkland municipality.

The primary findings are that the average minutes spent in walking and running per week among the participants increased significantly after 12 months compared to baseline and 6 months follow-up (p=0.001). There was no statically significant change in the fear of falling among the participants after 12-months. Findings from the regression analysis show that the participants with a moderate to high fear of falling had higher odds of being less physical active after 12 months (OR 1.8), compared with the participants with lower fear about falling, even with the gradual reopening of the society. This finding was significant with a p-value of 0.027.

The hypothesis was that levels of daily physical activity would increase in accordance with the reopening of society after lockdown and further reduce the fear of falling. The present study also hypothesized that the fear of falling was associated with PA levels among the participants. Overall, we found a significant increase from baseline to 12 months follow-up in activity levels measured with the AX3 accelerometers, and a non-significant change in the level of fear of falling measured with Short FES-I.

Physical Activity

The last year has been pronounced by the COVID-19 pandemic followed by implementations of lockdown of the society, quarantines and social distancing (32). The wider impact of the pandemic has further resulted in reductions of physical activity and mental health implications among the older adults, as well as being more likely to experience severe COVID-19 infection (35, 43). The analysis from the Axivity activity accelerometers in the present study shows that our participants of older adults undertaking physical activity in the form of walking and running (minutes/week) has significantly increased from baseline to 12 months follow-up (p=0.001), during the pandemic. There was a decrease in activity observed between baseline and 6 months follow-up, but this was not significant.

In accordance to other studies during the COVID-19 pandemic and levels of physical activity among older adults, our findings is not entirely comparable. Several of these studies reports that the physical activity level among older adults has decreased during the pandemic, and that the older adults were doing less physical activity than normal (35, 43, 44). There is also shown that the pandemic had negative implications for well-being, mood, perceived stress and memory among the elderly (44). Even though findings from the present study may seem contraindicatory due to findings from similar studies showing that the older adults were less active and had reduced self-reported health status during the pandemic. The present study do not have any data from the participants before the outbreak of the COVID-19 pandemic and the lockdown of the society, and further no measures of the direct effects who are likely to have impacted the participants under the restrictions imposed.

When looking at the change in minutes spent in walking and running from baseline to 6 months follow-up, there was a slight decrease in measured minutes from the accelerometers. However, not significant. This was a time where the society had been closed again for a period of time (Dec20-Apr21 (32)). The health report from UK (43) found that 42 % of the older adults aged 75 years and older reported that their activity levels were lower than before this lockdown, and they also found that around a third of the older adults aged 60 years and older reported doing less exercise in the lockdown of January 2021, than the first lockdown of Mars 2020. This may reflect our findings from baseline to 6 months follow-up and might indicate that the levels of physical activity declined further in this period than in the first lockdown. The observed changes could also reflect common reduction in physical activity as a natural consequence of aging, but in the study by Hoffman et al. (35) the older adults reported that the pandemic was associated with changes in health and social activities, and that these changes appear to have led to decline in activity levels and worsening of physical function. In contrast, another study from UK (44) found a significant improvement in self-reported physical health and a significant increase in in total time engaging in physical activities in daily life among the elderly during the lockdown. This may seem counterintuitive, but it is plausible that those in this age group, who also are a vulnerable group to the pandemic become more aware of their own health. These findings could also be due to motivational factors. Self-determined extrinsic motivation for awareness of own health and physical function is considered as valuable motivators and a strong association for higher levels of physical activity among older adults (19). There is also likely to think that those in this age group, who are likely to be vulnerable for the coronavirus, may be making a more concerted effort to maintain or improve their health status and substantiate some of our findings as well as findings in the study from UK. However, there is shown that the group of older adults with an already difficulty in mobility where more likely to be exposed to the adverse effects of the COVID-19 itself and the restrictions that followed (35, 43) The UK study (44) and the present study had a study population with an overall healthy group of older adults, and not entirely comparable. Furthermore, it is of importance to notice that the present study investigated the change of physical activity during the gradual reponing of the society through the last year with pandemic, and that the above-mentioned studies looked at the consequences that followed by the closure and lockdown of the society. To the best of author knowledge there is no other studies to directly compare the findings in the present study with.

Further, the results showed a significant increase in the minutes spent physical active in walking and running among the participants from baseline to 12 months follow-up. The present study cannot state that this increase in physical activity among the participants has increased, decreased, or remained the same compared to before the pandemic and lockdown of the society. However, the result from the analysis shows an important finding, that the older adults that participated in the study has the potential to reattain their physical activity levels after a period with decreased activity. When looking at the baseline characteristics, our participants were a group of highly active and well-function older adults, and there is possible that they in general are more robust and motivated to engage in physical activities than average. Nevertheless, the increased physical activity among the participants may reflect the changes in the society at the period of time. The 12 months follow-up took place nearly after the national reopening of the society (sept 2021). At this time period, there were few or no restrictions, and the society was almost back to normal again (32). This in turn, could have led to higher levels of physical activity and may indicate an importance of autonomy for the likelihood of being able to engage in PA. Taken this in account, future focus should consider the COVID-19 pandemic related restrictions and the importance of PA to maintain physical and mental health, especially among the older adults.

Another finding from analysis of the accelerometer data is that our study population meet the national PA recommendations of 150 minutes of moderate intensity per week at 12 months follow-up (16), but not at baseline and 6 months follow-up. This might be due to coincidence, but there is shown that the overall PA levels during the pandemic was below the recommended 150 minutes per week in current age population (34). Since we do not have any data from before the lockdown, one might think that this increase in physical activity could reflect the gradual reopening of the society, and indicating that an open society without restrictions is of importance for maintain physical activity in daily life among older adults. The increase in activity could also be due to an overall healthy study population, but a study by Lohne-Seiler et al. (27) found that older adults in Norway aged 65 years and older have a higher mean physical activity levels than reported in other countries. The study also found that 21% of the participants fulfilled the current national recommendations in Norway, where a higher proportion aged 65 – 79 years old measured with accelerometers, similar to the present study. These findings is also supported by Aspvik et al. (45) who investigated PA levels among older adults in Norway measured with the GT3X+ accelerometer, and found that moderately and highly fit older adults were more physically active and more likely to fulfil the PA recommendations compared to unfit older adults, and that 70% of their study populations met the national PA recommendations. Out of these findings there seem to be a strong association between physical activity and health status, but we cannot determine any causality due to study design.

The fear of falling (Short FES-I)

The present study found no statistically significant difference in the fear of falling among the participants from baseline, 6-months follow-up and 12-months follow-up measured by the short FES-I measuring tool. To date, there is little clarity about the clinical significance of the change in FES-I, due to a lack of studies that have examined what is a clinically important change in the FES-I score. Also, few studies have investigated the fear of falling among healthy older adults without severe health issues. There is also a lack of studies that measures fear of falling as a primary outcome(22, 24). The average Short FES-I score observed in this study was low and did not change much over time, suggesting that a bigger part of the older adults did not experience difficulties with activities of daily living. These results are consistent with findings from Yardley et al. (39), that investigated initial validation of the Falls Efficacy Scale International. The FES-I refers to very basic activities of daily living where probably only frail or disabled older adults would be likely to have difficulty with, and it is thereby conceivable that more demanding activities may cause higher concern about falling among higher functioning older adults, such as the participants in this study. This has also been discussed as a problem with the FES-I in other studies (21, 39), and there is shown that the FES-I scale is more sensitive to differences and changes among frail older adults or older adults with impairments, and less sensitive to concerns of more active older adults. The latter part supports our findings of little change for neither increased nor decreased fear of falling. Although, FES-I is one of the best existing instrument for its purpose, measuring of fear of falling among older adults (39).

A study done by Fuzhong et al., found that there was a higher prevalence of fear of falling among older adults with poorly balance- and muscle function, problems with functional ability, and poor quality of life (46), the same findings is also observed in another study by Brouwer et al (47). Our subjects seem to be a relatively fit group of older adults, with no such problems. Both studies also found that a previous history of a fall may be a significant risk factor for develop a high fear of falling (46). In our study 27.4 % of the participants reported that they had experienced a fall during the last 6 months at baseline, and that the bigger counterpart reported no experience with a fall during the last 6 months (72,6%), which in term reflect a lower risk of being afraid of falls or developing a fear of falling. A study involving community-dwelling older adults aged 65 to 75 years suggest that a low concern about falling also might be related to a lower mean age in their study population, given that the rate of falls tends to increase with age, which is also may explain our findings with the mean age of the participants at baseline was 77.8 years old (SD=6.4).

Association between Physical Activity and the fear of falling

The third purpose of the present study was to investigate if there were any associations between physical activity and the fear of falling among the older adults that participated. Primary finding from the regression analysis on this association shows that the participants with moderate to high concerns about falling had higher odds of being less physical active (OR 1.8; 95% CI, 1.07-3.01) compared to participants with lower fear of falling, with a statistically significant p value (P=0.027).

In accordance with our findings, a larger study by Sawa et al. found a significant linear trend between levels of physical activity across fear of falling ($p < .01$) among community-dwelling older adults (48). They also stated that a high fear of falling was significantly associated with decreased levels of physical activity even after adjustment for confounding variables. Compared to Sawa et al., the present study cannot determine potential causality to that the more fear of falling older adults experience, the less active they were in daily life, since our participants had on average a very low concern about falling according to the Short FES-I score, but it is noteworthy that our association between levels of physical activity and the fear of falling are similar.

Another cross-sectional study by Lim et al. reported that habitual PA levels had no association with fear of falling among community-dwelling older adults (49). A weakness in this study is that they based this association by measuring the fear of falling and the physical activity levels among the study population by a telephone questionnaire. Self-reported physical activity levels has obvious strengths, but also weaknesses related to the precision of the measurements, and among older adults is factors including fluctuations in health status, problems with cognition and overestimations a common recall bias (42, 45). Older adults also seems to engage more in moderate intensity physical activity, and could make self-reported techniques less feasible in this age group (45). Associations of fear of falling could also be affected by other variables such as previous falls, frailty and mental health (46, 48). As previous mentioned, the participant in the present study is a group of highly active and well-functioning older adults. Therefore, it could be a plausible explanation that the included participants in this study is more active and well-functioning compared to other older adults in the same age group, and that our results is not applicable to frail or low functioning older adults. However, Sawa et al. did find that fear of falling was inversely associated with levels of PA, even after adjusting for confounding variables (48). Regardless of this, it is still important to consider other possible directional effects and explanations of the results. It is likely to think that decline in function, health status and quality of life could affect the older adult's judgement and feeling of own abilities, and further lead to more concerns about falling and reduced levels of activity (46). Such analysis of these relationships would improve the confidence and probably make causal inferences.

Methodical considerations

Participations

When looking at the baseline characteristics of the participants in the present study, they seem to be a group of quite fit and healthy older adults. Despite the high score in SPPB (Median=12.0), 51.6% of the participants reported that they were active in moderate intensity for 4 days a week or more. In accordance with the accelerometer measured PA levels after 12 months, the participants correspond to WHO´s recommendations of 150 minutes of moderate intensity PA peer week. Regarding this, one should be careful to generalize the study results to the whole population of the age group (mean age 77.8 (SD=6.4)) in Norway.

Also, this finding might be consistent with findings from other studies which indicates that older adults aged 65 -79 years have a higher activity level compared to the older adults aged 80 years or older (27, 45). However, we included only participants from the "S&S"-groups, which might represent the more active part of the elderly population, and even though we did not specify any exclusion criteria, we were looking for healthy older adults that could follow or take part in exercise programme. Our group of participants also consisted of people with more experience with physical activity. Whether sampling bias affected the validity of this study or not is uncertain, but the aim was to identify the change in healthy older adults.

87.4 % of the participants in the study were female, and therefore nor generalizable for the entire population of healthy older adults in the population. On another hand, females have a higher life expectancy than men, which in turn can indicate that there are a bigger proportion of females in older population and somehow a slightly more generalizable for current population. There is also shown that women tend overrepresent in health studies compared to men (27). Previous studies has shown that men seem to be more physical active than women, but accelerometer studies found no gender difference in levels of physical activity (27, 45), so it might not affect the results to same extent.

The participants also seem very satisfied with life according to the health-related quality of life (VAS-score) with a mean score of 77.6 % out of 100%. There were also a higher proportion of the participants that had I higher education level. Results from Gen100 suggest that the older adults that participate in health studies are more active, have higher education and better health compared with the ones that not participate in such studies (50). Being satisfied with life is important for good health.

Strengths and limitations

This study has methodological issues that should be considered.

One strength of this study is the use of the Axivity activity accelerometers, which is an objective measure of PA. Most of the previous research on PA levels has used self-reported forms of PA assessments such as questionnaires (45). Use of self-reported measurement of PA may lead to either overestimations or underreporting of own levels of activity and recall bias. Such limitations can be reduced by objective measurements, but the use of accelerometers is a relatively new method to assess PA level and carry out incorrect measurement, user errors and other weakness such as underestimate some activities like skiing, swimming, cycling and upper body movement. However, we only included data from activity spent in walking and running, and these are activities that the accelerometers captures quite well (42). This strengthens the generalizability of our results to similar population. A limitation with the accelerometer measurement in this study is how physical activity was analyzed. Even though the minutes-detecting algorithm gives valuable information regarding the participants physical activity, it does not give information regarding intensity or continuous minutes spent in walking and running activity. Physical activity could also be performed as swimming or cycling, but this was not taking account for in the analysis. Whether this would have an impact on the results is difficult to say, but it would be interesting to see. The fear of falling was measured by the Short FES-I measuring tool, and it is a widely accepted tool for the assessments of fear of falling among the elderly (39).

This study is a one-armed longitudinal study, and it is beneficial for detecting changes in our targeted population (older adults aged 65 year or older) with the same repeated measures of the same variables over a 12-month period. Such study is also beneficial because it is observational in that sense that we can observe the participants from time to time without interfering, this removes the potential for some bias. Also, because of the repeated measures of the same individuals, this study-design is in favor of a cross-sectional study by virtue of being able to exclude time-invariant unobserved induvial differences. Longitudinal studies do not require large number of participants and justify our sample size of 95 participants at baseline. The study also had a longer follow-up period, and thereby make the study and the results more reliable.

All testing happened at the same test-station with the same trained personnel, which ensure that the test procedures and test protocols are followed correctly and make the results more valid and reliable. This is an important aspect regarding quality of the study and the study results and make sure that all participants are being tested in the same way. This was also an advantage due to the opportunity to discuss unexpected challenges like interruptions or refusal to do certain test on daily basis and to create a sense of security for the participants.

There are some limitations that should be mentioned. Participants were included by invitation in the S&S exercise-groups in Trondheim and Orkland municipality, and the participation in this study was volunteer, which in turn may indicate that the targeted population was relatively fit and more motivated to maintain their activity levels even during periods of social distancing and lockdown and thereby limit the generalizability of the results. This is consistent with findings from Gen100 and that our results can not be generalizable to all older adults in Norway. We do not know how our findings corresponds with those in the same age group with poorer health.

The intervention period also offers limitations as well as being a strength. Loss to follow-up and adherence to the study over time could be difficult and end up as bigger issues. A greater limitation with this study is that there was a large drop out from the study, which minimize the sample size and decrease the amount of data collecting at follow-up. This influences the results in our study, since the 12-months follow-up do not reflect the baseline measurements and weaken the validity of the study. On the other hand, when comparing the baseline characteristics between the participants in the analysis and the ones that dropped out, there was small differences. In fact, the participants that dropped out from the study actually had a higher SPPB score and lower use of walking aids.

Conclusion

The present study investigated how the gradual reopening of the society during a year with the COVID-19 pandemic affected daily physical activity and the fear of falling among healthy community-dwelling older adults, and further to investigate if there was any association between PA and the fear of falling. The results showed that during one year of gradually reopening through the COVID-19 pandemic, the physical activity of time spent in walking and running per week increased among the older adults that participated. In addition, the present study also found that the participants with moderate to high concerns about falling had higher odds of being less physical active. We did not find any differences in the fear of falling from baseline to 12 months follow-up.

The findings in this present study shows some of the changes in physical activity level among healthy older adults during the lockdown and reopening periods of the society because of the COVID-19 pandemic. Even though the present study does not provide any data from before the outbreak of the pandemic, the current study reflects that an open society positively affects PA and health among the elderly. The findings may provide good point of departure for designing interventions to increase PA and mental health in order to maintain healthy lifestyle and improve independency and quality of life among older adults. The present study also replicate and extend previous evidence for an association between levels of daily physical activity and the fear of falling and suggest that a fear of falling among the elderly could restrict physical activity in daily life.

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Appendices

Appendix 1: Baseline questionnaire
Appendix 2: EQ-5D-SL
Appendix 3: Self-reported physical activity
Appendix 4: Short FES-I
Appendix 5: SPPB

Appendix 1: Baseline questionnaire

Spørreskjema

1. Bor du sammen med noen?
   ☐Nei, bor alene ☐Ja, ektefelle/samboer ☐Ja, andre

2. Bruker du ganghjelpemidler (f.eks. stokk elle rullator)
   ☐Nei ☐Ja, utendørs ☐Ja, innendørs

3. Er du bekymret for å falle?
   ☐Nei, ikke bekymret i det hele tatt ☐Ja, litt bekymret
   ☐Ja, nokså bekymret ☐Ja, svært bekymret

Daglige oppgaver

Nå kommer noen spørsmål om i hvor stor grad du vanligvis utfører forskjellige daglige oppgaver. Dersom du vanligvis ikke utfører en av oppgavene, svar som om du skulle utført den.

4. Går du omkring utendørs?
   ☐Nei ☐Med hjelp ☐Alene med vansker ☐Alene
5. Går du i trapper?
   ☐Nei ☐Med hjelp ☐Alene med vansker ☐Alene
6. Kommer du deg ut og inn av bilen?
   ☐Nei ☐Med hjelp ☐Alene med vansker ☐Alene
7. Går du på ujevnt underlag?
   ☐Nei ☐Med hjelp ☐Alene med vansker ☐Alene
8. Krysser du veier?
   ☐Nei ☐Med hjelp ☐Alene med vansker ☐Alene
9. Reiser du med offentlig transport?
   ☐Nei ☐Med hjelp ☐Alene med vansker ☐Alene
10. Tar du småvask/håndvask?
   ☐Nei ☐Med hjelp ☐Alene med vansker ☐Alene
11. Gjør du husarbeidet selv?
   ☐Nei ☐Med hjelp ☐Alene med vansker ☐Alene
12. Gjør du innkjøpene dine selv?
   ☐Nei ☐Med hjelp ☐Alene med vansker ☐Alene

Hukommelse

13. Har du problemer med hukommelsen?
    ☐Nei ☐Ja, litt ☐Ja, mye
14. Har hukommelsen endret seg siden du var yngre?
    ☐Nei ☐Ja, litt ☐Ja, mye

Har du problemer med å: (Sett ett kryss per linje)

15. Huske hendelser som skjedde for få minutter siden
    ☐Aldri ☐Av og til ☐Ofte
16. Huske navn på andre mennesker
    ☐Aldri ☐Av og til ☐Ofte
17. Huske datoer
    ☐Aldri ☐Av og til ☐Ofte
18. Huske å gjøre det du har planlagt
    ☐Aldri ☐Av og til ☐Ofte
19. Huske hendelser som skjedde for noen dager siden
    ☐Aldri ☐Av og til ☐Ofte
20. Huske hendelser som skjedde for år siden
    ☐Aldri ☐Av og til ☐Ofte
21. Holde tråden i samtaler
    ☐Aldri ☐Av og til ☐Ofte

Sykdom og medikamenter

Har du, eller har du noen gang hatt noen av følgende sykdommer/plager?
(Sett ett kryss per linje)

22. Angina	☐Nei	☐Ja
23. Hjerteinfarkt	☐Nei	☐Ja
24. Hjertesvikt	☐Nei	☐Ja
25. Atrieflimmer	☐Nei	☐Ja
26. Hjerneslag (hjerneinfarkt eller blødning)	☐Nei	☐Ja
27. Astma	☐Nei	☐Ja
28. Nyresykdom (utenom urinveisinfeksjon)	☐Nei	☐Ja
29. Diabetes (sukkersyke)	☐Nei	☐Ja
30. Kreftsykdom	☐Nei	☐Ja
31. Leddgikt (reumatoid artritt)	☐Nei	☐Ja
32. Bechterews sykdom	☐Nei	☐Ja
33. Slitasjegikt (artrose)	☐Nei	☐Ja
34. Benskjørhet (osteoporose)	☐Nei	☐Ja
35. Lårhalsbrudd	☐Nei	☐Ja
36. Brudd i håndledd/underarm/overarm	☐Nei	☐Ja
37. Brudd/sammenfall av ryggvirvler	☐Nei	☐Ja
38. Psykiske plager som du har søkt hjelp for	☐Nei	☐Ja

39. Hvor mange reseptbelagte medikamenter bruker du totalt?

☐ Medikamenter

Appendix 2: EQ-5D-SL

Opplevd helse

Under hver overskrift ber vi deg krysse av den **ENE** boksen som best beskriver helsen din I DAG.

GANGE

Jeg har ingen problemer med å gå omkring ❑

Jeg har litt problemer med å gå omkring ❑

Jeg har middels store problemer med å gå omkring ❑

Jeg har store problemer med å gå omkring ❑

Jeg er ute av stand til å gå omkring ❑

PERSONLIG STELL

Jeg har ingen problemer med å vaske meg eller kle meg ❑

Jeg har litt problemer med å vaske meg eller kle meg ❑

Jeg har middels store problemer med å vaske meg eller kle meg ❑

Jeg har store problemer med å vaske meg eller kle meg ❑

Jeg er ute av stand til å vaske meg eller kle meg ❑

VANLIGE GJØREMÅL *(f.eks. arbeid, studier, husarbeid, familie- eller fritidsaktiviteter)*

Jeg har ingen problemer med å utføre mine vanlige gjøremål ❑

Jeg har litt problemer med å utføre mine vanlige gjøremål ❑

Jeg har middels store problemer med å utføre mine vanlige gjøremål ❑

Jeg har store problemer med å utføre mine vanlige gjøremål ❑

Jeg er ute av stand til å utføre mine vanlige gjøremål ❑

SMERTER / UBEHAG

Jeg har verken smerter eller ubehag ❑

Jeg har litt smerter eller ubehag ❑

Jeg har middels sterke smerter eller ubehag ❑

Jeg har sterke smerter eller ubehag ❑

Jeg har svært sterke smerter eller ubehag ❑

ANGST / DEPRESJON

Jeg er verken engstelig eller deprimert ❑

Jeg er litt engstelig eller deprimert ❑

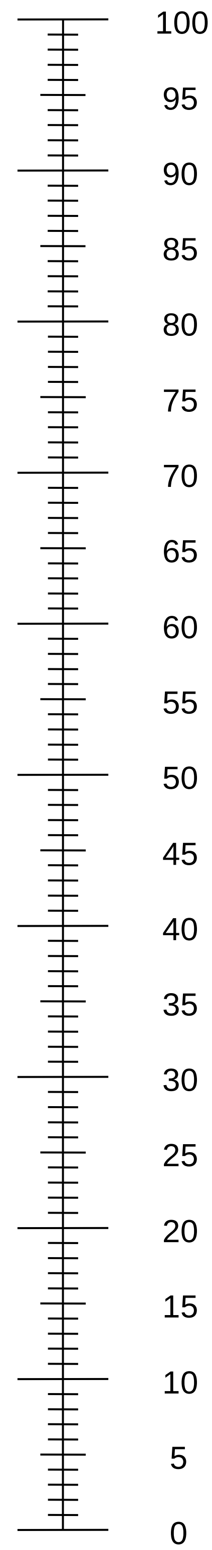
Jeg er middels engstelig eller deprimert ❑

Jeg er svært engstelig eller deprimert ❑

Jeg er ekstremt engstelig eller deprimert ❑

Den beste helsen du kan

- Vi vil gjerne vite hvor god eller dårlig helsen din er i DAG.
- Denne skalaen er nummerert fra 0 til 100.
- 100 betyr den beste helsen du kan tenke deg.
  0 betyr den dårligste helsen du kan tenke deg.
- Sett en X på skalaen for å angi hvordan helsen din er I DAG.
- Skriv deretter tallet du merket av på skalaen inn i boksen nedenfor.



HELSEN DIN I DAG = [ ]

Den dårligste helsen du kan tenke deg

Appendix 3: Self-reported physical activity

Mosjon

1. Har du stort sett deltatt på Sterk og stødig trening de periodene gruppene har vært åpne det siste halvåret?
   ☐ Ja ☐Nei

2. Dersom du har valgt å ikke delta på Sterk og stødig når gruppene har vært åpne, hva skyldes det? (flere kryss mulig)
   ☐Bekymret for smitte ☐Manglende motivasjon
   ☐Sykdom/skade/operasjon ☐Annet

3. Omtrent hvor ofte driver du med mosjon? Med mosjon mener vi at du f.eks. går tur, går på ski, sykler, svømmer eller driver trening/idrett.
   ☐Aldri ☐Sjeldnere enn en gang i uka ☐En gang i uka
   ☐2-3 dager/uka ☐4-6 dager/uka ☐Omtrent hver dag

4. Dersom du driver slik mosjon, en eller flere ganger i uka; hvor hardt mosjonerer du vanligvis?
   ☐Tar det rolig uten å bli andpusten eller svett
   ☐Tar det så hardt at jeg blir andpusten eller svett
   ☐Tar meg nesten helt ut

5. Omtrent hvor lenge holder du på hver gang?
   ☐Vanligvis mindre enn 15 min ☐Vanligvis 15-29 min
   ☐Vanligvis 30-60 min ☐Vanligvis mer enn 60 min

Appendix 4: Short FES-I

Bekymring for å falle

De følgende spørsmålene handler om hvor bekymret du er for at du kan komme til å falle. Vi ber deg om å svare ut fra hvordan du vanligvis utfører aktiviteten. Hvis du for tiden ikke utfører aktiviteten (for eksempel hvis noen andre går i butikken og handler for deg), vil vi be deg angi om du tror at du ville være bekymret for å falle HVIS du utførte aktiviteten. Kryss av for utsagnet som ligger nærmest opp til din egen opplevelse av, i hvor stor grad du er bekymret for å falle.

	Ikke bekymret i det hele tatt *1*	*Litt bekymret* *2*	*Ganske bekymret* *3*	*Veldig bekymret* *4*
Kle av eller på deg	*1* ☐	*2* ☐	*3* ☐	*4* ☐
Bade eller dusje	*1* ☐	*2* ☐	*3* ☐	*4* ☐
Reise deg opp fra, eller sette deg ned på en stol	*1* ☐	*2* ☐	*3* ☐	*4* ☐
Gå opp eller ned trapper	*1* ☐	*2* ☐	*3* ☐	*4* ☐
Strekke deg for å nå ting over hodehøyde eller bøye deg for å ta opp ting fra golvet	*1* ☐	*2* ☐	*3* ☐	*4* ☐
Gå opp eller ned en skråning	*1* ☐	*2* ☐	*3* ☐	*4* ☐
Delta i sosiale sammenkomster (f.eks. gudstjeneste, familiesammenkomst, møte)	*1* ☐	*2* ☐	*3* ☐	*4* ☐

FES-I Norwegian translated from English by Dr Jorunn L. Helbostad

Appendix 5: SPPB

Registreringsark dd/mnd/år:

ID/navn:

1. Balansetest

1.Samlede føtter 10 sekunder — 1. sek

↓

2.Semi-tandem 10 sekunder — 2. sek

↓

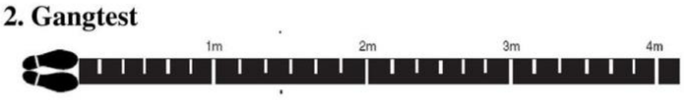
3.Tandem 10 sekunder — 3. sek

↓

Gå til gangtest

---

2. Gangtest



Ganghjelpemidler ved test (kryss av):

1. ☐ uten
2. ☐ krykke/stokk (er)
3. ☐ rollator
4. ☐ Annet (spesifiser)__________________

Tid test 1: sek

Tid test 2: sek

---

3. Reise/ sette seg

Pre-test

↓ I stand til

5 repetisjoner

→ Avslutt

Ikke i stand til

Setehøyde cm

Tid 5 repetisjoner uten armbruk: sek

Tester: