Master's thesis

NTNU
Norwegian University of Science and Technology
Faculty of Medicine and Health Sciences
Department of Neuromedicine and Movement Science

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Physical activity and life satisfaction among older adults in HUNT4 Trondheim 70+

Master's thesis in Human Movement Science
Supervisor: Beatrix Vereijken
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Kunnskap for en bedre verden

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Abstract

Background: Physical and mental health are closely related, and issues related to subjective wellbeing in old age are of growing interest. Even though studies have shown that physical activity may be associated with life satisfaction during aging, the studies are often limited to healthy older adults at selected age-groups. As the oldest and frailest older adults are rarely included in studies due to a high prevalence of age-related diseases and conditions, knowledge regarding the entire range of older adults is scarce. The Trøndelag Health Study aimed to include the entire spectrum of the older population regardless of living situation and health status through the sub-study HUNT4 Trondheim 70+. This study made it possible to examine the association between physical activity and life satisfaction among older adults.

Research questions: Two research questions were chosen: 1. *What are the characteristics of the participants in HUNT4 Trondheim 70+?* and 2. *What is the association between physical activity and life satisfaction among older adults?*

Design: A population-based, cross-sectional health study.

Methods: 1749 older adults participated in HUNT4 Trondheim 70+ (1011 women and 738 men (78.6±7 yrs). The data collection consisted of questionnaires, clinical measurements, interviews, assessment of physical and cognitive function in addition to physical activity monitoring. Physical activity (PA) was measured objectively during one week of monitoring, and the highest number of daily steps in walking was reported. Life satisfaction was assessed subjectively using a single item. The association between physical activity and life satisfaction was investigated using a regression analysis with adjusted models, including those participants with complete data on all relevant variables (n=957).

Results: The participants in HUNT4 Trondheim 70+ varied widely in age, characteristics, activity and function, ranging from 70-105 years and 9-42 500 steps on the most active day. Among the participants included in the subsample, those with the *second highest level of PA* had 73% higher odds for being satisfied with life compared to participants in the *lowest level of PA.* The test for trend was statistically significant for 2 of the three models.

Conclusion: The regression analysis showed that participants in higher levels of PA were more satisfied with life compared to participants being less physically active.

Keywords: Physical activity, number of steps, life satisfaction, older adults.

Sammendrag

Bakgrunn: Flere studier har vist at fysisk og mental helse er sterkt relatert til hverandre, og interessen for denne relasjonen har stadig økt de siste årene. Selv om flere studier har vist at fysisk aktivitet kan være assosiert med livskvalitet blant eldre, har de fleste studier i hovedsak undersøkt de friskeste eldre eller eldre i utvalgte aldersgrupper. De eldste og mest sårbare eldre har ofte blitt utelatt fra studier på grunn av høy forekomst av aldersrelaterte sykdommer. Som et resultat av dette har vi lite kunnskap om den eldre befolkningen som helhet. Gjennom *Helseundersøkelsen i Trøndelag* ønsket man derfor å se nærmere på bredden av den eldre befolkningen gjennom understudien HUNT4 Trondheim 70+. Helsedata som er tilgjengelig i denne studien gjør det mulig å undersøke sammenhengen mellom fysisk aktivitet og livskvalitet blant eldre.

Forskningsspørsmål: Det ble valgt to forskningsspørsmål for denne studien: 1. *Hva kjennetegner deltagerne i HUNT4 Trondheim 70+?* og 2. *Hva er sammenhengen mellom fysisk aktivitet og livskvalitet blant eldre?*

Design: Populasjonsbasert tverrsnittstudie av helsedata.

Metode: 1749 eldre deltok i HUNT4 Trondheim 70+ (1011 kvinner og 738 menn, 78.6±7 år). Datainnsamlingen bestod av spørreskjema, kliniske målinger, intervjuer, test av fysisk funksjon, kognitiv funksjon og registrering av aktivitetsdata. Fysisk aktivitet (FA) ble målt objektivt gjennom en uke, og utfallsmålet var antall steg på den mest aktive dagen i løpet av perioden. Livskvalitet ble målt subjektivt gjennom spørreskjema. Sammenhengen mellom fysisk aktivitet og livskvalitet ble undersøkt blant de deltagerne med rapporterte verdier på alle relevante variabler (n=957). Sammenhengen ble testet ved en logistisk regresjonsanalyse med justeringsmodeller.

Resultat: Deltagerne i HUNT4 Trondheim 70+ varierte i helsetilstand, alder og funksjon. Deltagerne var mellom 70-105 år og hadde et aktivitetsnivå som strekte seg fra 9-42 500 steg på den mest aktive dagen i løpet av perioden. Blant deltagerne som ble inkludert i regresjonsanalysen hadde deltagerne i den *nest mest aktive* gruppen 73% høyere odds for å rapportere god livskvalitet sammenlignet med deltagerne som var minst fysisk aktive. Test for lineær trend var statistisk signifikant for 2 av de tre modellene.

Konklusjon: Funnene i regresjonsanalysen viste at deltagerne med høyere aktivitetsnivå rapporterte bedre livskvalitet enn deltagerne som var mindre fysisk aktive.

Nøkkelord: Fysisk aktivitet, antall steg, livskvalitet, eldre.

Acknowledgements

I have always been interested in public health, physical activity and mental health, so when I got the chance to do my master thesis on health data from HUNT4 Trondheim 70+, I had to seize the opportunity. Thank you to the board of *The Trøndelag Health Study* for giving me the permission to perform this study.

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Introduction

The number of older adults is increasing worldwide and constitutes a significant part of the population in several countries (1). Today, about 10% of the Norwegian population is 70 years or older, and the percentage continues to increase (2). By the year 2060, about 20% of the population in Norway is expected to be 70 years or older (2). As life expectancy increases, many will experience deteriorating health as they age, requiring greater support from health care services. Aging is related to an elevated risk of metabolic and physiological changes, that again may increase the risk of chronic conditions and disability, and affect the level of wellbeing (3). As physical and mental health are closely related, issues related to health status and subjective wellbeing are of growing interest (4).

Subjective wellbeing is based on individuals' perceptions and interpretations related to current life situations (5). Conditions such as living with other people, staying in good health both physically and mentally, having a satisfying social life and someone to rely on, are typically considered to be important to maintain the wellbeing of older adults (5). There are several approaches to capture aspects of subjective wellbeing, but most international surveys use the life evaluation survey in studies of older adults which focuses on people's thoughts about the quality and goodness in their life, happiness, and overall life satisfaction (4).

Life satisfaction indicates how satisfied people are with their life, and is often assessed subjectively by using sets of questions or single items (6). Single items are beneficial in terms of reduced burden and ease of interpretation, which makes them appropriate for use in large heterogenous groups, such as older adults (6). Since subjective wellbeing is closely related to the current life situation, health status and feeling of independence often play an important role when assessing overall life satisfaction in old age (7).

The feeling of independence among older adults is partially linked to living situations that can vary from home-dwelling to living in health care institutions (8). While part of the older population lives independently at home, others need increased support in terms of home health care, a temporary stay in a care home to recover from illness or injury, or admission to long-term care (9). As admission to long-term care is often linked to lower physical function and loss of independence, maintaining physical function and independence during aging is important (10, 11).

Recent studies have shown that physical activity may be effective for maintaining physical function, independence and life satisfaction during aging (7, 12, 13). Older adults are generally recommended to stay physically active in moderate intensity for at least 30 minutes a day or 150 min per week (11, 14). For those with health conditions that prevent them from meeting the recommended level of physical activity, the focus should be on staying as active as possible based on individual abilities and conditions, and avoiding long periods of sedentary behaviour (15, 16).

For many older adults, walking is the preferred physical activity because it is simple, inexpensive and accessible everywhere (17). It is also a social activity that requires little skill and is therefore considered to be a relatively safe exercise alternative (18). Because the duration and speed of walking can be adjusted individually, it is achievable for many different groups of older adults, including older adults using walking aids such as walkers, crutches or canes (18).

Physical activity such as walking can be assessed objectively by using body-worn activity monitors (19). Activity monitors measure acceleration signals from body movements in several dimensions which enables detailed estimations of walking behaviour and spatio-temporal gait parameters (19, 20). A number of parameters can be derived from these signals, steps being the simplest and most frequently used when quantifying physical activity (21, 22).

Even though several studies have shown that physical activity and subjective wellbeing are closely related, the studies are often limited to specific groups of older adults, mainly healthy older adults at selected age-groups (13, 23, 24). As the oldest and frailest are rarely included in studies due to a high prevalence of age-related diseases and conditions, knowledge regarding the entire range of older adults is scarce (7, 12, 13, 25). To gain more knowledge regarding older adults at population level, *The Trøndelag Health Study* examined the health status among older adults living in Trondheim Municipality through the sub-study *HUNT4 Trondheim 70+*. This study aimed to collect health-related data across the entire range of older adults by various measurements including physical activity monitoring and questionnaire data. Data was collected in 2018-2019, and no articles have been published yet on the data from HUNT4 Trondheim 70+, making this current study unique.

Given the existing knowledge gaps described above, two research questions have been chosen for the current study.

1. *What are the characteristics of the participants in HUNT4 Trondheim 70+?*
2. *What is the association between physical activity and life satisfaction among older adults?*

First of all, as the HUNT4 Trondheim 70+ study focuses on all older adults aged 70 years and older, we expected to find a wide range in characteristics, activity and function in the study sample. Secondly, we expected to find a positive association between physical activity and life satisfaction among the wide spectrum of older adults.

Methods

Study design

This study is part of the larger study HUNT4 Trondheim 70+, a population-based, cross-sectional health study including older adults aged 70 years or older. Data was collected between October 2018 and June 2019 and consists of questionnaires, clinical measurements, interviews, assessment of physical and cognitive function, as well as physical activity monitoring.

Participants

All men and women born in 1948 or earlier with a residential address in Østbyen district in Trondheim Municipality were invited to participate (n=5087). All participants in HUNT4 Trondheim 70+ were 70 years or older, and included home-dwelling older adults and older adults living in care homes. Effort was made to include the entire spectrum of the older population regardless of living situation and health status. Therefore, no specific exclusion criteria were set, with the exception of terminal patients in care homes.

All older adults in the target group received invitation letters sent by the postal service during 2018 and 2019. The letters included information about the health study and data collection. Those who wished to participate in the health study where asked to contact HUNT4

Trondheim 70+. Home-dwelling older adults received a time for attendance at the field station. For those not able to attend the field station, a home visit from trained personnel was offered. Older adults living in care homes were invited and informed through formal and informal caregivers, and offered the assessment at their respective care homes.

All participants had to give their written, informed consent to be part of the health study. For older adults not able to consent, consent by proxy from a caregiver was required.

Materials and equipment

Objective monitoring of physical activity

Physical activity was measured objectively for one week using two Axivity AX3 activity monitors located at the lower back and thigh. The activity monitors register accelerations in 3 dimensions relative to the gravitational force. Analyses of the raw data from the lower back allows for calculations of different characteristics of physical activity, such as the number of steps, time spent in locomotion and cadence (steps per minute) (26).

Montreal Cognitive Assessment

Montreal Cognitive Assessment (MoCA) was included to evaluate general cognitive function (27). The specific MoCA-items included tasks focusing on short-term memory recall, visuospatial abilities, multiple aspects of executive function, evaluation of attention, concentration and working memory, language and orientation to time and place (28).
The MoCA-score was reported as a continuous scale with a maximum of 30 points.

Questionnaires

Two comprehensive health survey questionnaires were given to the participants. The questionnaires included information regarding health and health status, diseases/illnesses, life situation and activities in daily life. All participants received Questionnaire 1, while the second questionnaire was separated into two versions due to gender-specific questions.

Procedure

All data collection was done at the field station, through home visits or in care homes, except for the physical activity monitoring. The health survey started with a one-to-one health screening organized by trained personnel before the participants were asked to wear two activity monitors and fill out two comprehensive questionnaires.

The participants were tested for nutritional status, oral health, blood pressure, anthropometry, cognition and physical function in a room suitable for health screening. Evaluation of general cognitive function was performed during an interview through the MoCA-test (27). The MoCA-test included learning trials and recall, clock-drawing task, three-dimensional cube-copy task, a phonemic fluency task, target detection using tapping, serial subtraction task, digits forward and backward, three-item confrontation naming task (lion, camel, rhinoceros), repetition of sentences, fluency task and orientation to time and place (28).

At the end of the health screening, the participants were asked to wear two activity monitors for seven continuous days without removal and to behave habitually during the recording period. The exceptions for wearing the monitors were if participants experienced discomfort, spent time in a sauna or did magnetic resonance imaging (MRI) or equivalent. The personnel attached one monitor slightly to the right of the participants' fifth lumbar vertebra (L5), and the other monitor approximately 10 cm above the participants' right knee. The monitors were attached to the skin by using a transparent water- and bacteria proof adhesive film. The participants were asked to deliver the monitors at the field station after seven days of monitoring. For participants unable to do so, the monitors were retrieved at the participants residential address by study personnel.

When the health screening was completed and the monitors were positioned correctly, the participants were asked to fill out the two comprehensive health survey questionnaires. Those who participated at the field station were asked to fill out the questionnaires at the field station, where personnel were available for answering questions or assisting people with special needs. If participants were too tired, or for other reasons could not stay, they were asked to complete the questionnaires at home and deliver them at a later time. For those home-dwelling participants or participants living in care homes with limitations preventing them from filling out questionnaires, closest relatives were encouraged to support the participants in answering the questionnaires.

Variables and data analyses

Participant characteristics

The following variables were included as participant characteristics: age, gender, height, weight, body mass index (BMI) calculated by weight (kg) divided by height squared (m^2), and living situation (home-dwelling, care home).

Age was used both as a continuous variable and recoded into 5-year age-categories (70-74 years, 75-79 years, 80-84 years, 85-89 years, ≥ 90 years). The BMI scale was recoded into categories (underweight, normal weight, overweight, class I obesity, class II obesity, class III obesity) (29).

Questionnaire data

The following variables were collected through the questionnaires: *Do you live with someone?* (living alone, spouse/partner, other persons aged more than 18 years, persons under the age 18 years), *Do you have anyone who could give you help if you needed it?* (no/yes), educational level (9-10 years compulsory primary and lower secondary school, one or two years of academic or vocational school, 3 years of academic or vocational school, 3-4 years vocational school/apprentice, college or university less than four years, college or university four years or more), *Thinking about your life at the moment, would you say that you by and large are satisfied with life or are you mostly dissatisfied?* (very satisfied, satisfied, somewhat satisfied, neither satisfied or nor dissatisfied, somewhat dissatisfied, dissatisfied, very dissatisfied), smoking habits (never smoked, previously smoked occasionally, currently smoke occasionally, currently smoke daily, previously smoked daily), *Do you use walking aids?* (no, use walking aids outdoors, use walking aids both in- and outdoors, cannot walk), *Do you have any long-term illness that reduces your abilities in your daily life?* (no/yes), *Are you worried about falling?* (not worried, a little worried, pretty worried, very worried).

Do you live with someone? was computed into a new, dichotomized variable, *Do you live alone?* distinguishing between participants who answered that they were *living alone* from the remaining response alternatives related to living with other people. Educational level was categorized into three levels by *primary education* (primary and lower secondary school), *secondary education* (academic or vocational school/apprentice/upper secondary) and *tertiary education* (college or university). Life satisfaction was dichotomized into *satisfied* (very

satisfied, satisfied and somewhat satisfied) and *not satisfied* (neither satisfied or nor dissatisfied, somewhat dissatisfied, dissatisfied and very dissatisfied). Smoking habits were recoded into *never*, *previous* and *current*. *Do you use walking aids?* was categorized into three categories, *no, yes* (use walking aids outdoors, use walking aids both in- and outdoors) and *no, cannot walk*. Participants answering *no, cannot walk* were not included in the data analysis. *Are you worried about falling?* was dichotomized by merging the response alternatives *not worried at all* and *a little worried* into one category, and the remaining alternatives *pretty worried* and *very worried* into a second category. This was done to distinguish participants being considerably worried about falling from those less or not worried.

Physical activity data

In the current study, the algorithms used for data analyses were utilized on information from the activity monitor at the lower back only. The step-detection algorithms identified walking periods first and then counted the number of steps in detected walking periods. As a walking period was defined as ≥ 4 steps, only steps detected as part of a walking period were counted by the step-detecting algorithms (30, 31).

Preprocessing of activity data

Preprocessing of activity data was done in MatLab (version: 8.4 and 9.3, Mathworks Inc., Nantick, MA) and the output variables were exported into excel (Microsoft Excel for Office 365, version 1908). A total of 1330 participants were registered with activity data from the accelerometer located at the lower back. In the first step, locomotion and non-locomotion periods were detected. Locomotion periods were defined as periods with four or more steps (two strides or more) based on the acceleration norm (26). A total of 17 participants were excluded due to insufficient amounts of data caused by monitor malfunction/poor battery life.

The focus was daytime recording, which was defined between 6 am and 12 pm. In the second step of preprocessing, physical activity parameters were calculated based on locomotion detected from 6 am to 12 pm for each participant (n=1313). A total of 5 participants were excluded in this step, while the remaining 1308 participants were registered with several physical activity parameters in this step of preprocessing.

Quality check and data cleaning was then performed. Some issues were found due to a mismatch between detected number of days with activity data and actual wearing time. These issues affected the reported minimum, and hence mean and median values during the recording period for some participants.

Physical activity by number of steps

To avoid biases related to non-wearing issues, the maximum values for all participants were used in further analyses. Therefore, the number of steps included refer to each participant's highest number of daily steps detected during the recording period. After preprocessing physical activity data, a total of 1295 participants were registered with at least one valid day of activity monitoring.

Statistical analyses

All statistical analyses were performed in SPSS Version 25. Normality of variable distribution was tested by a Shapiro-Wilk test and visual inspection of histograms and Q-Q plots. Although the p-value reached significance for some of the variables, the data followed a straight line in the Q-Q plot and the histograms showed overall normal distributions. Therefore, all distributions were assumed to be normally distributed in all continuous variables, and parametric tests were used in all analyses.

Descriptive

Descriptive statistics are presented for all participants and per gender. Independent samples t-tests were used to examine gender differences in continuous variables. Cross-tables and Pearson chi-square test was used to examine whether there was an association between each of the categorical variables and gender, and the results are reported for those variables where the criteria of expected count ≥ 5 in all cells were met (32).

Regression analysis

To examine whether there was an association between the highest number of daily steps in walking periods and the odds of being satisfied with life, complete case-analyses and a logistics regression analysis were performed as measure of association. To be included in the regression analysis, the participants had to have at least 2 valid recording days (n=1284).

Three participants were excluded due to extreme values (35 924 steps, 38 543 steps and 42 344 steps). The threshold value was therefore set to < 31 500 steps to be included in the regression analysis, and a total of 1281 participants were registered with complete activity data based on the aforementioned criteria.

Physical activity (PA) was categorized into quartiles to differentiate between levels of PA expressed as number of steps within walking periods on the most active day during the recording period, *Lowest level of PA* (≤ 8114 steps), *Second lowest level of PA* (8115-11 549 steps), *Second highest level of PA* (11 550-15 898 steps) and *Highest level of PA* (≥ 15 899 steps). Levels of PA were set as the independent variables with the *Lowest level of PA* as the reference group. Life satisfaction was dichotomized into *satisfied* and *not satisfied* and set as the dependent variable.

Potential confounding variables included are based on previous health studies among older adults, and included age, gender, living situation, educational level, MoCA-score, long-term illness and fear of falling (13, 33-36). Educational level is an important confounding variable because higher education has been found to be related with increased life satisfaction (4). MoCA-score was entered due to the association between low MoCA-score, dementia and diminished quality of life (37, 38). Long-term illness was also included, as wellbeing and health is found to be closely related, rated life satisfaction could be affected by long-term illness (4). Fear of falling was included because it has been found to be associated with poor quality of life (39).

For the adjusted models, categorical variables were entered as dummy variables, while continuous variables were entered directly into the models, except for age which was categorized. Sociodemographic variables like age, gender and living situation were entered in model 1, while educational level was subsequently entered in model 2. MoCA-score, long-term illness and fear of falling were entered in model 3. A Spearman's correlation analysis was performed to examine the association between long-term illness and fear of falling, showing a very low Spearman's rho correlation of –0.144. Therefore, both variables were entered in model 3.

A separate test for linear trend was performed by replacing the physical activity (PA) quartiles with physical activity as a continuous variable. An interaction analysis between gender and

physical activity as a continuous variable showed no interaction ($p > 0.05$) and therefore the analysis was not stratified for gender. Adjusted analyses are presented as odds ratios (OR) with 95% confidence interval (CI), and the statistical significance level for all analyses was set to $p < 0.05$.

Ethical considerations

The study was approved by the Regional Ethical Committee for Medical and Health Research Ethics, (REK), ref.nr. 2019/51105. HUNT4 Trondheim 70+ was previously approved by REK by the application of HUNT4 70+, ref. nr. 2016/1880 and was conducted in accordance with the Declaration of Helsinki. Participation in HUNT4 Trondheim 70+ was voluntary, and the participants could withdraw from the study at any time without providing any reason.

Results

The result section consists of two parts. The first part reports participant characteristics for the entire sample in HUNT4 Trondheim 70+. The second part reports on the association between physical activity and life satisfaction, as well as characteristics of the subsample included in the regression analysis.

Participant characteristics in HUNT4 Trondheim 70+

A total of 1749 older adults participated in HUNT4 Trondheim 70+, of which 1011 women (57.8%) and 738 men (42.2%). All variables had missing data, from 4-525 participants (see remaining *n* in Tables 1-2). Table 1 presents the characteristics of the total study sample and per gender for continuous variables, as well as gender differences as tested by independent samples t-tests. As can be seen in Table 1, men were slightly younger, taller and heavier on average than women, and took more steps on their most active day. Men and women did not score significantly different on MoCA.

Table 1. Participant characteristics in HUNT4 Trondheim 70+ for continuous variables.

	All		Women		Men		p-value
Variables	n	mean (SD)	n	mean (SD)	n	mean (SD)	
Age, yr	1745	78.6 (7.0)	1008	79.6 (7.5)	737	77.4 (6.1)	<0.000*
Height, cm	1587	168.2 (9.6)	900	162.1 (6.7)	687	176.2 (6.6)	<0.000*
Weight, kg	1647	75.0 (15.2)	938	68.8 (13.4)	709	83.3 (13.4)	<0.000*
BMI (kg/m^2)	1578	26.6 (4.4)	892	26.3 (4.7)	686	27.0 (4.0)	0.004*
MoCA-score	1482	23.1 (4.7)	826	22.9 (5.1)	656	23.3 (4.1)	0.136
Number of steps	1295	11 174 (6 367)	707	10 549 (6 371)	588	11 924 (6 286)	<0.000*

Body mass index (BMI); Montreal Cognitive Assessment (MoCA).
**Significant differences between women and men as assessed by independent samples t-test.*

Figure 1 presents the distribution of age per gender. A substantial share of the participants were between 70-80 years among both genders. The majority of the participants 95 years and older were women.

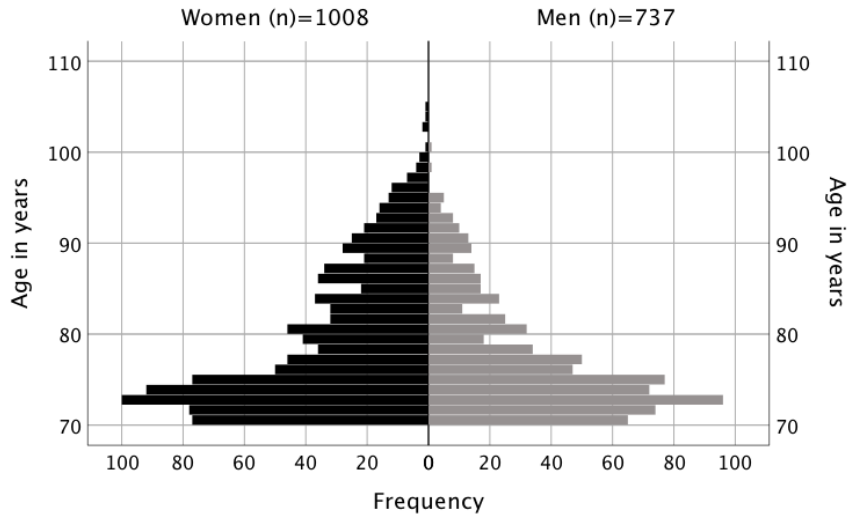

Figure 1. Distribution of age per gender.

Figure 2 presents the distribution of the highest number of daily steps in walking periods per gender. The distribution varied somewhat between genders, where the number of participants having less than 5 000 steps was highest among women, while the number of participants having more than 20 000 steps was highest among men.

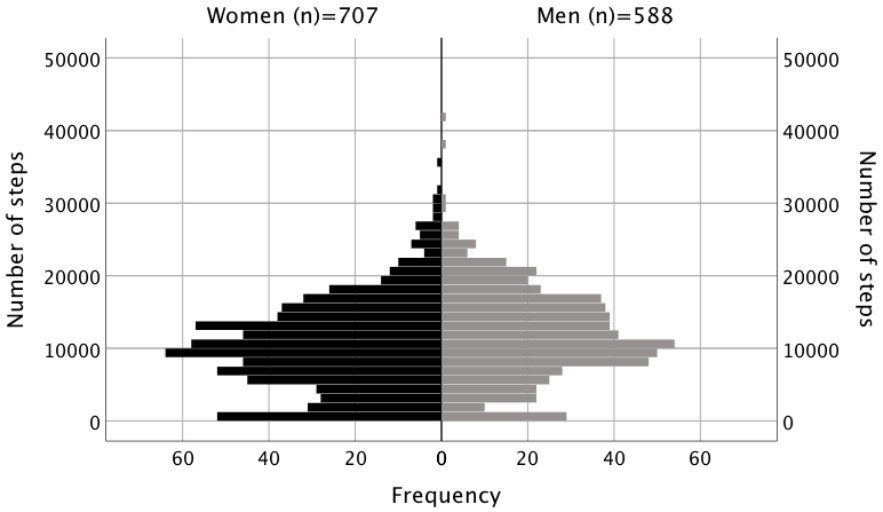

Figure 2. Distribution of the highest number of daily steps in walking periods per gender.

Table 2 presents the characteristics of the total study sample and per gender for categorical variables, as well as interaction with genders as tested by Pearson chi-square test. The far majority of participants were home-dwelling, with significantly more women than men living

in care homes. Significantly more women than men reported living alone, while virtually everyone reported having someone who could give help if needed. Relatively few participants had only primary education, with men having higher education on average than women.

Among participants who answered the question about smoking, significantly more women than men reported that they had never smoked. In addition, significantly more women reported use of walking aids, having long-term illness and being considerably worried about falling compared to men.

Table 2. Participant characteristics in HUNT4 Trondheim 70+ for categorical variables.

Variables	All (n, %)	Women (n, %)	Men (n, %)	p-value
Living situation (n)	1745	1008	737	<0.000*
Home-dwelling	1487 (85.2)	821 (81.4)	666 (90.4)	.
Living in a care home	258 (14.8)	187 (18.6)	71 (9.6)	.
Living alone (n)	1422	798	624	<0.000*
Yes	508 (35.7)	388 (48.6)	120 (19.2)	.
No	914 (64.3)	410 (51.4)	504 (80.8)	.
Have someone who could give help if needed (n)	1456	814	642	0.127
Yes	1408 (96.7)	782 (96.1)	626 (97.5)	.
No	48 (3.3)	32 (3.9)	16 (2.5)	.
Educational level (n)	1463	825	638	<0.000*
Primary education	194 (13.3)	151 (18.3)	43 (6.7)	.
Secondary education	558 (38.1)	354 (42.9)	204 (32.0)	.
Tertiary education	711 (48.6)	320 (38.8)	391 (61.3)	.
Smoking habits (n)	1224	717	507	0.003*
Never	588 (48.0)	372 (51.9)	216 (42.6)	.
Previous	561 (45.8)	300 (41.8)	261 (51.5)	.
Current	75 (6.1)	45 (6.3)	30 (5.9)	.
Use of walking aids (n)	1425	798	627	<0.000*
No	1188 (83.4)	628 (78.7)	560 (89.3)	.
Yes, inside or inside/outside	196 (13.7)	140 (17.5)	56 (8.9)	.
No, cannot walk	41 (2.9)	30 (3.8)	11 (1.8)	.
Any limiting long-term illness (n)	1388	775	613	0.016*
No	912 (65.7)	488 (63.0)	424 (69.2)	.
Yes	476 (34.3)	287 (37.0)	189 (30.8)	.
Fear of falling (n)	1428	791	637	<0.000*
Not worried at all	551 (38.6)	226 (28.6)	325 (51.0)	.
A little worried	672 (47.1)	409 (51.7)	263 (41.3)	.
Pretty worried	127 (8.9)	98 (12.4)	29 (4.6)	.
Very worried	78 (5.5)	58 (7.3)	20 (3.1)	.

**Significant correlation with gender as assessed by Pearson chi-square test.*

Figure 3 presents the percentage of BMI classification from *underweight* to *class III obesity* per gender. Only women were represented in the underweight category. The majority of the participants clustered in the categories of *normal weight* and *overweight*.

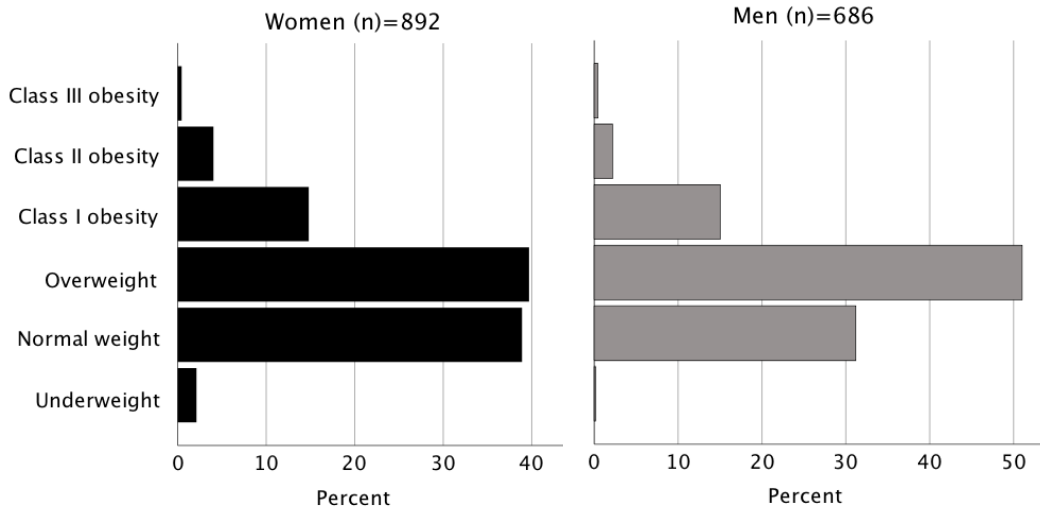

Figure 3. The percentage of BMI classification per gender.

Figure 4 presents the percentage of rated life satisfaction per gender. A total of 1437 participants reported their satisfaction with life. Overall, 90% reported one of the three response alternatives related to being satisfied with life. Among women, a total of 88% were reported being satisfied, while the percentage was 92% among men.

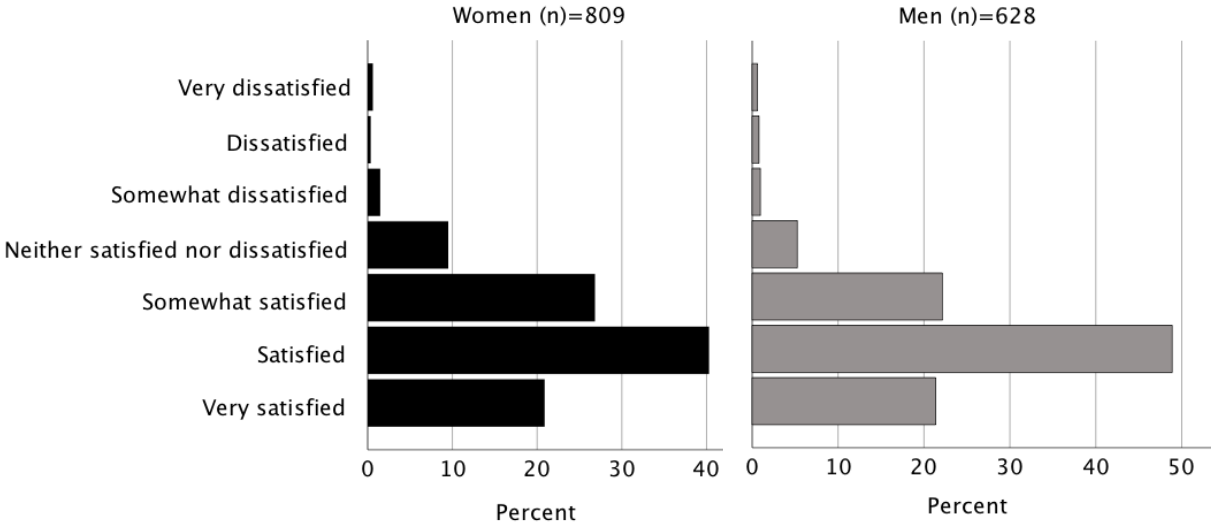

Figure 4. The percentage of rated life satisfaction per gender.

Association between physical activity and life satisfaction

The association between physical activity and life satisfaction was investigated using regression analysis, including only those participants in HUNT4 Trondheim 70+ that had complete data on all relevant variables. When combining accelerometer data, clinical data and questionnaire data, the subsample size for the regression analysis came to 957 participants, of which 505 (52.7%) women and 452 (47.3%) men. Table 3 presents the characteristics of this subsample in total and per gender for continuous variables, as well as gender differences as tested by independent samples t-test. As for the total sample reported above, women were older, shorter and lighter, and took fewer steps on their most active day compared to men. No significant differences were found in MoCA-score between men and women in this subsample either.

Table 3. Characteristics of the subsample included in the regression analysis for continuous variables in total and by gender.

Variables	All (n=957) mean (SD)	Women (n=505) mean (SD)	Men (n=452) mean (SD)	p-value
Age, yr	76.4 (5.0)	76.7 (5.3)	76.1 (4.7)	0.044*
Height, cm	169.4 (9.0)	163.2 (6.1)	176.3 (6.2)	<0.000*
Weight, kg	76.7 (13.6)	70.3 (12.1)	83.9 (11.5)	<0.000*
BMI (kg/m^2)	26.7 (3.9)	26.4 (4.3)	27.0 (3.4)	0.020*
MoCA-score	24.1 (3.5)	24.3 (3.7)	23.9 (3.3)	0.086
Number of steps	12 191 (5 756)	11 719 (5 932)	12 718 (5 512)	0.007*

Body mass index (BMI); Montreal Cognitive Assessment (MoCA).
**Significant differences between women and men as assessed by independent samples t-test.*

Table 4 presents the characteristics of this subsample included in the regression analysis for categorical variables in total and by gender, as well as interaction with gender as tested by Pearson chi-square test. A total of 947 (99%) participants were home-dwelling, while only 10 participants (1%) were living in care homes. As for the total sample reported above, Pearson chi-square test showed that educational level interacted significantly with gender, with men having higher educational level on average than women. Men and women did not differ on reported long-term illness, but significantly more women reported fear of falling. Finally, significantly more women were represented in the lowest levels of physical activity (PA) compared to men.

Table 4. Characteristics of the subsample (frequency, percentage) included in the regression analysis for categorical variables in total and by gender.

Variables	All (n=957)	Women (n=505)	Men (n=452)	p-value
Home-dwelling (n, %)	947 (99.0)	498 (98.6)	449 (99.3)	0.273
Educational level (n, %)				<0.000*
Primary education	90 (9.4)	71 (14.1)	19 (4.2)	.
Secondary education	369 (38.6)	224 (44.4)	145 (32.1)	.
Tertiary education	498 (52.0)	210 (41.6)	288 (63.7)	.
Any limiting long-term illness (n, %)	273 (28.5)	148 (29.3)	125 (27.7)	0.572
Fear of falling (n, %)	93 (9.7)	75 (14.9)	18 (4.0)	<0.000*
Levels of PA (n, %)				0.018*
Lowest level of PA	239 (25.0)	145 (28.7)	94 (20.8)	.
Second lowest level of PA	239 (25.0)	122 (24.2)	117 (25.9)	.
Second highest level of PA	240 (25.0)	127 (25.1)	113 (25.0)	.
Highest level of PA	239 (25.0)	111 (22.0)	128 (28.3)	.

Physical activity (PA).
**Significant correlation with gender as assessed by Pearson chi-square test.*

Figure 5 presents the percentage of rated life satisfaction per gender among the 957 participants included in the subsample. A total of 94% reported one of the three response alternatives related to being satisfied with life. Among women, 92% reported being satisfied, while the percentage was 95% among men.

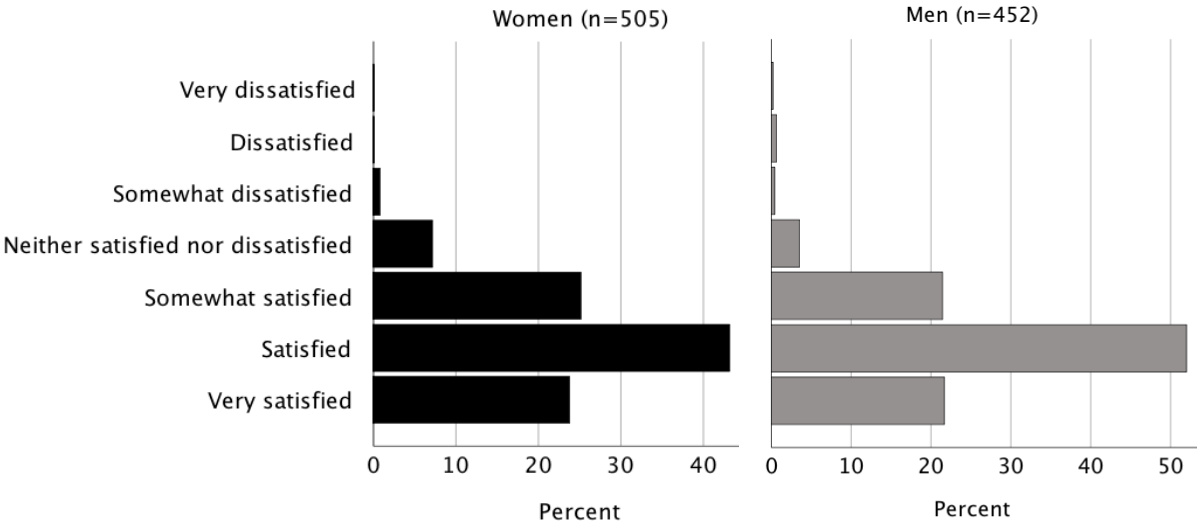

Figure 5. The percentage of rated life satisfaction per gender among the subsample.

Logistic regression analysis of the association between PA and life satisfaction

Logistic regression models of the association between the PA quartiles and life satisfaction are shown in Table 5. The quartile *Lowest level of PA* was set at the reference group. Age, gender and living situation were entered in the first model. Participants in the *Second highest level of PA* had the highest odds for being satisfied (OR 2.91; 95% CI, 1.32-6.38) compared to participants in the *Lowest level of PA*. When adding educational level to the first model, the odds for being satisfied was still highest among the participants in the quartile *Second highest level of PA* (OR 2.77; 95% CI, 1.26-6.11) compared to the reference group. However, education level had low impact on the association between levels of PA and life satisfaction as the odds of being satisfied was just a little lower in model 2 compared to model 1. The test for trend was significant in both model 1 (p=0.012) and in model 2 (p=0.017).

As MoCA-score, long-term illness and fear of falling are typically found to be associated with life satisfaction, they were considered as important confounding variables when examining the association between levels of physical activity and life satisfaction. By including MoCA-score, long-term illness and fear of falling in model 3, the odds for being satisfied was reduced in all levels of PA compared to the odds for being satisfied in model 1 and model 2. Among the PA quartiles, the strongest association was found in the *Second highest level of PA* in all three models. Participants in the *Second highest level of PA* had 73% (OR 1.73; 95% CI, 0.75-4.00) increased odds of being satisfied with life compared to participants in the *Lowest level of PA.* However, the estimate in model 3 was not statistically significant as illustrated from the wide confidence interval (p=0.601).

Table 5: Odds ratio (OR) and 95% confidence intervals (CI) for life satisfaction by PA quartiles.

	Model 1		Model 2		Model 3	
	OR	95% CI	OR	95% CI	OR	95% CI
Lowest level of PA[a]	1.00	Reference	1.00	Reference	1.00	Reference
Second lowest level of PA[b]	1.81	0.91 – 3.62	1.73	0.86 – 3.48	1.17	0.56 – 2.46
Second highest level of PA[c]	2.91	1.32 – 6.38	2.77	1.26 – 6.11	1.73	0.75 – 4.00
Highest level of PA[d]	2.59	1.19 – 5.65	2.51	1.14 – 5.49	1.30	0.56 – 3.00
Test for trend	*p = 0.012**		*p = 0.017**		*p = 0.601*	

Model 1*: adjusted for age, gender and living situation*
Model 2*: adjusted for Model 1 + educational level*
Model 3*: adjusted for Model 2 + MoCA-score, long-term illness and fear of falling*
Physical activity (PA); [a]Number of steps ≤ 8114; [b]Number of steps 8115-11 549; [c]Number of steps 11 550-15 898; [d]Number of steps ≥ 15 899.
**p <.05.*

Discussion

This study aimed to answer two research questions related to the participants in HUNT4 Trondheim 70+. As no articles have been published yet on the data from HUNT4 Trondheim 70+, the first research question focused on describing the characteristics of the older people that participated in HUNT4 Trondheim 70+. The second research question examined whether there is an association between levels of physical activity and reported life satisfaction using logistic regression analysis.

Participant characteristics in HUNT4 Trondheim 70+

The HUNT4 Trondheim 70+ study aimed explicitly, and managed, to include the entire range of older adults in Trondheim Municipality. The participant characteristics spanned from the youngest, healthiest, most physically active and most independent home-dwelling older adults to the oldest, frailest, less physically active and most dependent older adults living in care homes. In general, the oldest and frailest older adults have rarely been included in previous health studies due to the inclusion criteria of absence of illnesses and diseases (7). In addition, as attendance at a particular location often is required, older adults with health-related issues are less likely to participate compared to healthy older adults. However, in the current study,

home visits were offered for those not able to meet at the field station, as well as the older adults living in care homes were offered their assessment at their respective care homes. As extra effort was made to include the entire spectrum of the older population, the HUNT4 Trondheim 70+ study is therefore unique. In addition, the gender distribution was still quite equal compared to the overall gender distribution in previous sub-studies based on HUNT data, where women are overrepresented compared to men (40). Therefore, the gender distribution in HUNT4 Trondheim 70+ was equal to the gender ratio in the Norwegian population (41).

As approximately 2/5 of all women and 3/5 of all men reported having tertiary education, the overall educational level among the participants in HUNT4 Trondheim 70+ was relatively high compared to other studies on older adults (13, 41). The report *Norway: Health System Review* from 2013 also demonstrates that the Norwegian population is on the top list of the most highly educated in the world (42). In addition to being highly educated, a significant share of the participants reported that they had never smoked or did not currently smoke. Only a small part of the participants reported being current smokers. As ventilation and gas exchange efficiency is affected by smoking, current smokers and previous smokers typically differ from non-smokers as they are at higher risk of conditions or diseases related to the respiratory system (18). Overall, the low proportion of current smokers may indicate that the participants were in good health, and as health and wellbeing are found to be closely related (5), this may have affected rated life satisfaction.

More than 90% of the participants reported that they were somewhat to very satisfied with life. However, some differences were found in rated life satisfaction between genders with women being less satisfied with life compared to men. This is in line with the study by Pinto and colleagues who found that older women generally report lower satisfaction with life than older men (36). Some of the explanation could be related to women's higher risk of chronic diseases, pain and disability (36). A similar pattern was found in the current study, where a higher percentage of women reported having limiting long-term illness and being more worried about falling. Women also reported more use of walking aids compared to men, which may reflect more mobility problems that again may affect life satisfaction. In contrast, a previous study by Lysberg et al. (34) found that women scored higher on life satisfaction for most age-groups compared to men. However, the gender differences in the study by Lysberg et al. were modest in size and not statistically significant. As rated life satisfaction varies

widely among gender and age in different studies, this may indicate that there are several aspects affecting the rated life satisfaction, among them health-related issues.

Physical activity was reported as the highest number of daily steps while walking. In the current study, the number of steps reflected the wide range of older adults from the frailest to the healthiest older adults as it varied from 9-42 500 steps in walking periods on the most active day. About 86.5% of the participants had more than 4 000 steps on their most active day, while 74.3% of the participants had 7 000 steps or more. A total of 55.5% of the participants had more than 10 000 registered steps on their most active day. Based on the recommendations of 30 minutes of daily moderate to vigorous physical activity, Tudor-Locke et al. (43) found that among healthy older adults the physical activity recommendations were equivalent to taking between 7 000 to 10 000 daily steps. Based on these recommendations, the number of daily steps in the current study was quite high as approximately 3/4 of the participants had 7 000 steps or more, and more than half of the participants had at least 10 000 steps. However, as these findings are only based on the highest number of daily steps in walking, they do not reflect mean number of steps across multiple days. Therefore, the findings from the current study cannot be compared directly with previous studies.

Association between physical activity and life satisfaction

The primary finding from the regression analysis on the association between physical activity and life satisfaction was that the participants with higher levels of physical activity were more satisfied with life compared to participants that were less physically active. Interestingly, the participants with the *Second highest level of PA* had the highest odds for being satisfied with life in all models. However, after additional adjustment for cognitive function, long-term illness and fear of falling in the last model, this association turned out to be not statistically significant. Tests for trend showed that there was a dose-response association in both model 1 and 2, but not in model 3.

In accordance with the results from the current study, the review by Bize, Johnson and Plotnikoff (25) found a consistent association between level of physical activity and health-related quality of life (HRQoL) in older adults among several cross-sectional studies. However, the association varied between the different dimensions of HRQoL, with physical

function and vitality being the most consistently associated with the level of physical activity (25). Another review article by Vagetti et al. (44) was also focusing on the association between physical activity and quality of life among older adults. The latter review found that physical activity was positively associated with the domains of quality of life (QoL), functional capacity, general QoL, autonomy, activities, death and dying, intimacy, mental health, vitality and psychological domains, while the associations were moderate to inconsistent for other domains of QoL (44). It should be noted, however, that the evidence in this review by Vagetti et al. (44) was contradictory in terms of the dose-response association between physical activity and quality of life, as the association was dependent of the domains of quality of life in each of the studies. Therefore, as the context of physical activity and measures of QoL varies among studies, comparing life satisfaction from the current study with results from comprehensive instruments measuring QoL are challenging. However, as found in the review by Vagetti et al. (44), physical activity was associated with general QoL, and this domain may be comparable with the measure of overall life satisfaction used in the current study.

Age, gender and living situation

In the first regression model, adjustments were made for the sociodemographic variables age, gender and living situation. The participants included in the regression analysis were both younger and more physically active compared to the complete sample in HUNT4 Trondheim 70+, which indicates that the oldest, less physically active participants were not included in the regression analysis. Therefore, results might not be generalizable to the oldest, most inactive part of the population. This is consistent with a previous study that reported older adults aged 80-85 years to have a 50% lower level of physical activity compared to participants aged 65-70 years (13).

Only 10 participants (1%) included in the regression analysis were living in care homes, compared to 14.8% among all participants in HUNT4 Trondheim 70+. Only 83 of the 258 participants living in care homes had at least 2 valid days of activity monitoring, and this number was further reduced to 39 participants that also had data on life satisfaction. When adding MoCA-score, the proportion of participants living in care homes with complete data came to 15 participants. Three more participants were excluded when fear of falling were entered, in addition to a reduction of two more participants from the other variables included. An important note is that all 10 participants living in care homes were represented in the

lowest level of physical activity. One potential reason why the participants included in the subsample were more active, more satisfied with life, younger and healthier than the complete sample may therefore be related to the high proportion of home-dwelling older adults, and the low proportion of participants living in care homes.

Educational level

The proportion of participants having tertiary education ranged from 40-60% between genders, with the highest proportion of tertiary education among men. As higher education is found to be related to increased life satisfaction, education level was entered in model 2 (4). However, the difference in odds of being satisfied with life did not differ much between model 1 and model 2, being slightly lower in the second model, which may reflect that educational level had low impact on the association between physical activity levels and life satisfaction when age, gender and living situation were already entered in the model.

MoCA-score, limiting long-term illness and fear of falling

In the third and final model, MoCA-score, limiting long-term illness and fear of falling were added as adjustment variables. In this model the differences between levels of physical activity were no longer significant, suggesting that a combination of these variables might have influenced or mediated changes in level of physical activity across the groups. MoCA-score was included because of the general association between low MoCA-score, dementia and diminished quality of life (37, 38). Although the MoCA-test is validated for use among older adults, there are some limitations when evaluating general cognitive function (45). As virtually all tasks included are multifactorial and require ability in several domains, the MoCA-test does not substitute other in-depth neuropsychological assessments (45).

The variable *limiting long-term illness* was included as health-related issues might affect life satisfaction (4). A similar finding was reported by Hansen and Slagsvold who found that loss of health and partner were the most important causes of reduced wellbeing among older adults (35), and therefore long-term illness might have affected life satisfaction. An important limitation was that this variable did not distinguish between specific illnesses. Because of this, the type of illness and symptom severity might have varied widely among the participants reporting long-term illness which again may have affected level of physical activity and rated life satisfaction.

An important note is that fewer of the participants in the subsample reported any long-term illness and fear of falling compared to the complete sample. Having few participants with long-term illness or worried about falling likely has influenced reported satisfaction with life. The variable *fear of falling* was included as it is found to be associated with poor quality of life (39). A previous study also found that older women who experienced difficulties with outdoor mobility were more likely to report that they were moderately worried about falling compared to women who did not report difficulties with mobility (39). Interestingly, the study points out that the older women who experienced difficulties with outdoor mobility may have reduced their physical activity level over time, and as a consequence they were less concerned about falling (39). However, the fear of falling-question in the current study did not distinguish between different aspects as indoor/outdoor or seasonal differences. Therefore, weather conditions, such as slippery roads during winter months, might have affected participants' response depending on the date of participation.

Strength and limitations of the study

The main strength of this study was the effort that was made to include the entire population of older adults in HUNT4 Trondheim 70+, irrespective of age and function. This made it possible to describe characteristics of older adults across a wide spectrum of age, function and health. A second important strength is the large sample size which made it possible to examine the association between physical activity and life satisfaction using logistic regression analysis, including adjusted models. As the participants in HUNT4 Trondheim 70+ included the frailest participants in care homes which typically are less physically active compared to home-dwelling older adults, the level of physical activity among the entire range of older adults could be assessed (22).

One of the main limitations was related to the cross-sectional design. Even if this design is convenient for descriptive analyses, an important drawback is that it is not possible to infer the cause- and effect-relationship between physical activity and life satisfaction (46). Therefore, it is not possible to conclude to what extent physical activity influences life satisfaction, and to what extent life satisfaction may influence physical activity among the participants in the current study.

Another limitation was related to how physical activity was analyzed. Even though the step-detecting algorithm gives valuable information regarding the physical activity level of older adults, it does not give information regarding intensity. As physical activity in moderate and high intensity is recommended, examining differences in intensity of physical activity among the most active older adults could have given important additional knowledge (11, 14). According to the physical activity recommendations, staying as active as possible based on individual abilities and conditions and avoiding long periods of sedentariness is important (15, 16). Although sedentariness and sedentary periods were not examined in the current study, a low number of steps while walking on the most active day might indicate more time spent sedentary (16).

Critical reflections regarding the objective monitoring of physical activity

In the current study, physical activity was assessed objectively and reported as the highest number of daily steps during the monitoring period for each participant, thereby capturing physical activity independently of intensity levels. However, in the current study, the number of steps was related to walking periods with at least 4 steps. This means that single steps and strides are not counted, and therefore step count might be lower than the actual number of steps. This again likely affects those with the lowest physical function to a higher extent. Nevertheless, steps related to walking periods provide valuable information regarding physical activity level during daily life activities, and is commonly used to differentiate between walking and merely changing foot position while standing or shuffling. Furthermore, the highest number of daily steps might provide an indication of physical ability (22).

So far, the step-detecting algorithms related to acceleration signals are not validated for use among the frailest older adults (19, 30, 47). Several issues were found due to a mismatch between detected number of days with activity data and actual wearing time which affected reported minimum, and hence mean and median values during the recording period for some participants. To avoid biases related to non-wearing issues, the maximum values or the highest number of daily steps in walking periods were chosen as this is independent of non-wearing periods.

Number of daily steps in walking periods was based on daytime recording with a time frame from 6 am to 12 pm. As this time frame covers 18 hours of the day, most of the waking hours for older adults are likely covered. This was in line with the study by Arnardottir et al. (48)

who found that the majority of physical activity among a group of older adults was performed between 8 am and midnight. However, some participants might have had sleep disorders which again may have led to fragmented sleep and daytime sleepiness. As number of steps was based on the time frame from 6 am to 12 pm, the highest number of daily steps might have been underestimated for participants having circadian rhythm disorders.

Surprisingly, the association between level of physical activity and life satisfaction was strongest among the participants with the second highest level of PA, not for the participants being in the highest level of PA. It is not clear why we found this result. Further analysis of the data might help interpreting this finding. As the highest number of daily steps was reported in the current study, comparisons to previous studies reporting mean number of steps is more difficult. However, such comparisons might be useful if the differences and limitations are taken into consideration.

It is important to highlight that the participants represented in the quartile with the lowest level of PA were not necessarily sedentary, as the number of steps differed widely among each PA quartile. Even participants having as over 8 000 steps on the most active day were included in the quartile with the lowest level of PA. Further, to be in the quartile with highest level of PA, the participants had at least 15 889 steps in walking on their most active day. Previous studies have used different definitions and cut-off values for how active people are, and these differences influence how the HUNT4 Trondheim 70+ participants would have been classified. When comparing our quartiles to the study by Tudor-Locke and Bassett (49) for example, over 8 000 steps would have been categorized as *somewhat active,* while the study by Dohrn and colleagues (16) would have classified all participants having more than 5 000 steps as *active*. As can be seen in the regression subsample, even participants in the quartile with the lowest level of PA would have been classified as quite active for at least one day. Similarly, participants having more than 15 889 steps in the current study would have been categorized as *highly active* in the study by Tudor-Locke and Bassett (49). In addition, when comparing the results from the current study to previous studies, it is important to keep in mind that the current study was based on the highest number of daily steps in walking, while other studies typically use mean values of number of steps across multiple days.

Seasonal differences might also have affected the level of physical activity. A previous study by Jones and Gill (50) found that weather and climate affect the level of physical activity,

with participants typically being more active during the spring and summer compared to the winter. As the data collection in the current study spanned from October to June, seasonal differences might have influenced the level of physical activity. A previous study by *The Trøndelag Health Study* also found an association between seasonal variations and monthly variation in depression (51). Because of this, both physical activity level and life satisfaction might have been affected by seasonal variations.

Critical reflections regarding reported life satisfaction

Life satisfaction was assessed subjectively by asking the participants a single question about life satisfaction. This is considered to be advantageous when studying large heterogeneous groups of older adults because of reduced burden and ease of interpretation (6). In contrast, health-related quality of life (HRQoL) instruments such as the Medical Outcome Study SF-36 questionnaire may provide a more nuanced assessment of HRQoL (25). However, as the HUNT4 Trondheim 70+ study already consisted of two comprehensive questionnaires, adding more questions or tasks would probably not have been favourable due to a further increase of the total burden.

However, it is not unlikely that the older adults signing up for participation in general were more robust and motivated than those who did not want to participate, especially among home-dwelling older adults (36). A previous non-responders study from The Trøndelag Health Study (40) reported the most common reasons for not participating in health studies. Among people aged 70 years and older, follow-up in the health service or immobilization due to disease were the most common reasons for not participating in health studies. This finding may indicate that those participants who did not want to participate might have been less robust, less motivated or more immobilized compared to those older adults who chose to participate. More robust and motivated participants might be associated with being both healthier and more satisfied with life. Therefore, this potential selection bias might have affected the generalizability of the results.

Similarly, the overall health situation in the Norwegian population has increased during the last decades and is considered to be good (42). Health is important for being satisfied with life, and the Norwegian population is generally satisfied with life compared to other countries. According to the World Happiness Report from 2020, Norway was ranked as the fifth happiest country in the world (52).

Future research

In order to further investigate the association between physical activity and life satisfaction among older adults, future studies should focus on examining the direction of causality between the level of physical activity and life satisfaction. As a follow-up of the HUNT4 Trondheim 70+ study is planned, it might be possible examining changes in level of physical activity and life satisfaction over time in the same group of participants. As a result, we might get more information regarding the association between level of physical activity and life satisfaction among older adults at populational level.

In addition, it would be interesting to examine the association between the number of steps and life satisfaction by using algorithms validated for use among a wide range of older adults. Besides, future research should focus on examining a more accurate volume of steps required for optimal life satisfaction among the wide range of older adults (53). As restriction of total time spent sedentary have become part of the physical activity recommendations, the focus in future studies should also be on examining whether there is an association between duration of sedentary periods and health-related outcomes in a group of older adults.

Conclusion

The HUNT4 Trondheim 70+ study is a unique dataset on older adults, as it managed to include the entire range of older adults spanning from the youngest, healthiest, most physically active and most independent home-dwelling older adults to the oldest, frailest, less physically active and most dependent older adults living in care homes. In addition, the current study provides valuable insight on the association between level of physical activity and life satisfaction among the entire range of older adults, independently of age and function. This makes the findings from the current study useful for further research on physical and mental health among the older population. Further research on longitudinal data is necessary to examine how the level of physical activity and life satisfaction among the older adults change over time, which becomes possible when follow-up assessment of the participants in HUNT4 Trondheim 70+ are being performed.

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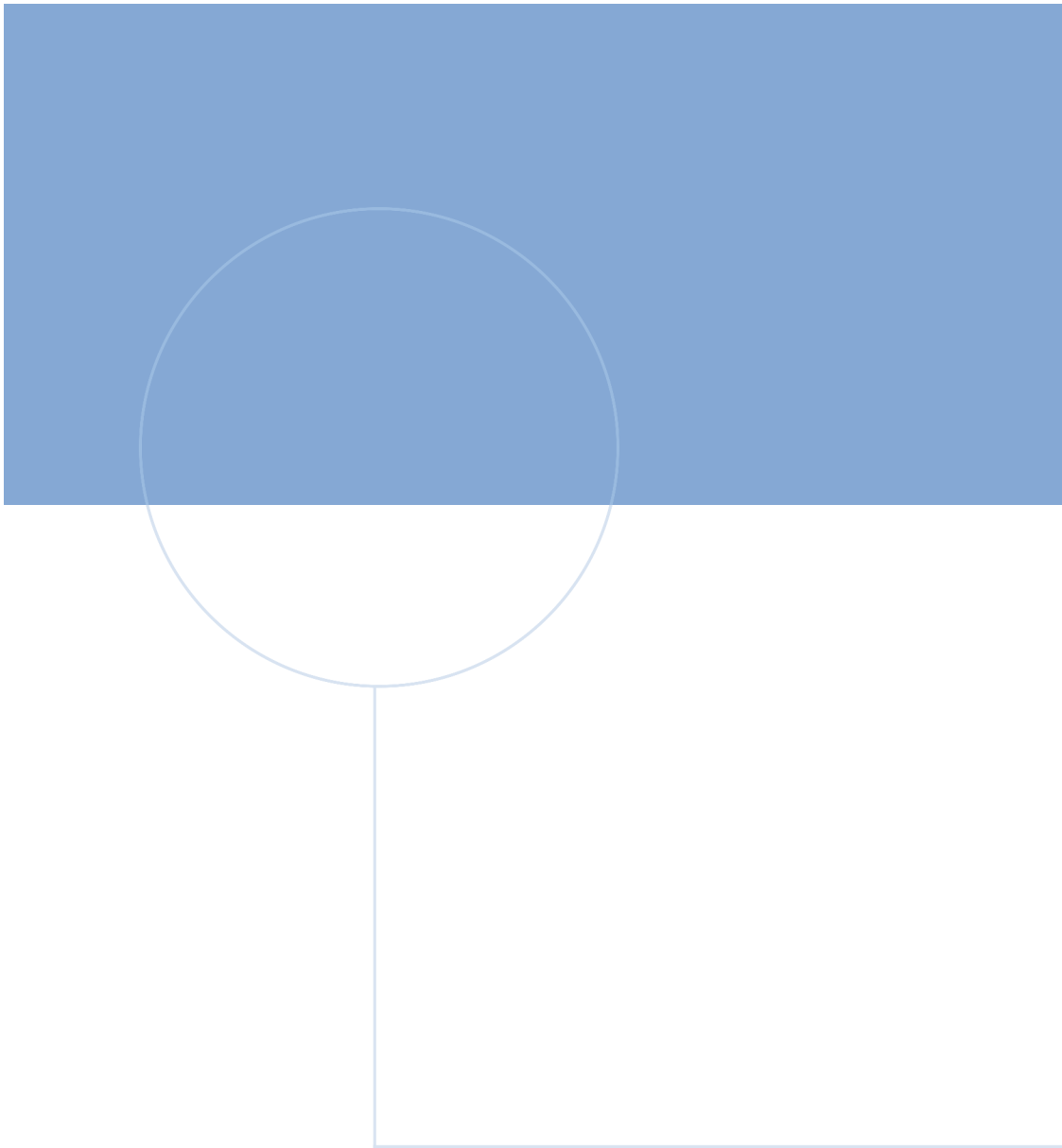

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