

# **Correlates of objectively measured physical activity among Norwegian older adults: The Generation 100 study**

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### **Abstract**

The aim of this study was to identify how demographics and physical activity history, environmental and biological correlates are associated with objectively measured physical activity (PA) among older adults. PA was assessed objectively in 850 older adults (70-77 years, 47.6% females) using the Actigraph GT3X+ activity monitor. Hierarchical multiple regression analysis was used to identify important PA correlates. The included correlates explained 27.0% of the variance in older adult's PA. Cardiorespiratory fitness (CRF), gender and season were the most important correlates, explaining 10.1%, 3.9% and 2.7% of the variance, respectively. PA was positively associated with CRF, females were more physically active than males and PA increased in warmer months compared with colder months. This is, to our knowledge, the largest study of PA correlates in older adults that has combined objectively measured PA and cardiorespiratory fitness. Our findings provide new knowledge of how different correlates are associated with PA.

**Keywords:** Physical activity, older adults, correlates, Generation 100

## **Introduction**

It is well established that physical activity (PA) is an important factor for current and future health. A moderate to high level of PA is associated with reduced risk of cardiovascular disease, cancer, diabetes, and mental health disease (Physical Activity Guidelines Advisory Committee, 2008; Taylor et al., 2004; U.S. Department of Health and Human Services, 1996). Becoming physically active even in older age has been shown beneficial for health. Older adults who report to be physically active reach a disability threshold 14 years later in life compared to those who report to be physically inactive (Hamer, Lavoie, & Bacon, 2013; Peeters, Dobson, Deeg, & Brown, 2013). The number of older adults (aged 70 or older) meeting the PA recommendation is shown to vary, i.e. 6% of Norwegian and 20% of US older adults meet the recommendation (Lohne-Seiler, Hansen, Kalle, & Anderssen, 2014; Tucker, Welk, & Beyler, 2011). To develop well designed PA interventions, a better understanding of important factors (correlates), that are associated with overall PA in older adults, is needed (A. E. Bauman et al., 2012).

PA behavior in older adults has been shown to be associated with demographical correlates such as gender and age (Kaplan, Newsom, McFarland, & Lu, 2001; McMurdo et al., 2012), education, PA history and physically demanding work (Chung, Domino, Stearns, & Popkin, 2009; Friedman et al., 2008; Pan et al., 2009), environmental correlates such as social support, living situation and season (Booth, Owen, Bauman, Clavisi, & Leslie, 2000; Palacios-Cena et al., 2011; Van Cauwenberg et al., 2011; Witham et al., 2014), and biological correlates such as body mass index (BMI) and heart disease (Chad et al., 2005; Ortlieb et al., 2014). Cardiorespiratory fitness (CRF) is also found to be associated with PA (Novak et al., 2009), with more fit people spending more time being active compared to less fit people (19). However, directly measured CRF has never been included in a large sample study of PA correlates in older adults.

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The most common method to assess PA in older adults is by using a questionnaire with only very few studies utilizing objective measures of PA (Sun, Norman, & While, 2013). Self-reported PA is shown to have some limitations compared to objectively measured PA, such as susceptibility to over-estimation, recall and cultural difference bias, especially in older adults (Sallis & Saelens, 2000; Santos-Lozano et al., 2012; Washburn, 2000). Studies on objective measures of PA and its association to PA correlates in older adults are therefore needed. The aim of this study was to identify how correlates, including directly measured CRF, were associated with objectively measured PA in older adults.

### **Methods**

#### **Design and participants**

The present study was a cross-sectional sub-study from the larger study, Generation 100 (<http://www.ntnu.edu/cerg/generation100>). All males and females born between years 1936 to 1942, with a permanent address in the municipality of Trondheim were invited to participate. Further details regarding eligibility were published elsewhere (Stensvold et al., 2015).

The present study was approved by the Regional Committee for Medical Research (REK 2013/1903 B), and addresses baseline data from the Generation 100 study (August 2012 to June 2013). All participants gave their written informed consent, and the study was conducted in conformity with the declaration of Helsinki. Individuals with complete and valid objectively measured PA, clinical and questionnaire data were included in the present study. A total of 850 participants, 445 (52%) males and 405 (48%) females, with an age ranging from 70-77 at baseline were included in the analysis. Descriptive characteristics of the participants are presented in Table 1.

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### **Measurement of physical activity**

The triaxial Actigraph GT3X+ accelerometer (Actigraph, Pensacola, Florida, USA) was used to measure overall PA in this study sample of older adults. Actigraph GT3X+ is a small lightweight activity monitor that measures and records accelerations. It uses a solid state triaxial accelerometer to collect motion data on three axes; vertical (Y), horizontal right–left (X) and horizontal front–back axis (Z). The Actigraph also includes the vector summed value known as ‘vector magnitude’ (triaxial) (Santos-Lozano et al., 2012). Acceleration is converted into activity counts that increase linearly with the magnitude of the acceleration. The present study used triaxial data, which measures more complex movement patterns in all three planes of motion compared with vertical locomotion (uniaxial). Each sample was summed over a user specified interval of time called an ‘epoch’. The epoch was set to a 10-s interval. The outcome variable was reported in minutes, more specifically, mean number of triaxial counts·min<sup>-1</sup> (CPM). The activity counts reflect the intensity of bodily movement, thus the higher number of counts measured, the more active a person is (Hall, Howe, Rana, Martin, & Morey, 2013). CPM was used as an outcome variable in this study due to its robustness as it is not influenced by any external criteria (i.e. intensity threshold) other than wear time (Troiano et al., 2008). An absolute intensity threshold to determine proportions meeting PA recommendations is commonly used (Sun et al., 2013). Absolute thresholds have been criticized for neglecting relative PA intensity (Ozemek, Cochran, Strath, Byun, & Kaminsky, 2013). Additionally, the aim of the study was not to determine the proportion of our population sample that meets PA recommendation, but rather to investigate correlates of overall PA. For these reasons we found CPM to be the most suitable outcome variable.

The monitor was placed around the waist of the participants the day they came in for clinical testing, and the participants were told to wear it for 7 consecutive days (including day and night). The Actilife software version 6.11.5 (Actigraph, Pensacola, Florida, USA) was

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used to analyze accelerometer data. All data between 6:00 a.m. and midnight were included in the analysis. Non-wear time, defined as intervals of at least 60 consecutive minutes with zero counts with allowance of 1-2 minutes with counts greater than zero, was excluded from the analysis. Data were considered valid if the subject had at least 4 days of at least  $600 \text{ min}\cdot\text{d}^{-1}$  ( $10 \text{ hours}\cdot\text{d}^{-1}$ ) recorded (Troiano et al., 2008). In total, 77.8% of the participants wore the accelerometer for 7 valid days, additionally 17.9% wore it for 6 valid days, and 4.3% wore it for 4-5 days. The average daily wear time was 964.0 minutes ( $\approx 16$  hours); 961.6 minutes for females and 966.3 minutes for males, respectively.

### **Demographics and activity history**

Self-reported data from the Generation 100 study (questionnaires) were used to examine the following correlates: Gender, age, physical activity at the age of 40 (PA at 40), physically demanding work (during working career) and education. Gender was dummy-coded (female vs. male); age was continuous (70-77); PA at 40 was an ordinal variable from a 5 point scale measuring PA frequency (“never” – “almost every day”); physically demanding work was an ordinal 4 point scale variable dichotomized into no (work that mostly involves sitting) vs. yes (work that requires much walking, lifting and heavy physical labor); and education was dichotomized into low education (not attended College or University) vs. high education (attended College or University). Interaction effects were tested for education and gender.

### **Environmental correlates**

Environmental correlates included both social and physical environmental correlates. Social support (from family/friends/peers) and living situation were considered as social environmental correlates. Social support was measured using a 6-item scale, where the participants rated separately how often their family/friends/peers had been supportive of their PA. The response to each item was based on a 5-point scale, ranging from never to very often.

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Since Cronbach's alpha was 0.881, Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) was 0.860 and Bartlett's test of sphericity was statistically significant ( $p < 0.001$ ), the scale had an acceptable reliability and criterion-related validity. A mean score of all constituent items was computed, with higher score indicating a greater amount of support for PA. Only participants with a response rate of 100% for the respective items were included when the mean scores were computed (no allowance for missing item). Furthermore, the participants were asked about their living situation (alone vs. not alone). Physical-environmental correlates included two items: The participant's "perceived importance of using the neighborhood to be physically active" (neighborhood importance for PA) and "perceived importance of being outdoors when they are physically active" (outdoor importance for PA). Both correlates were dichotomized (not important vs. important). Furthermore, season was included as a physical-environmental correlate. Based on the Norwegian climate, more specifically Trondheim, the season variable (months) was dichotomized into "colder" (November-March) and "warmer" (April-October) months. The colder months have high probability of snow, ice and relatively few hours of daylight.

### **Biological correlates**

Biological correlates included heart disease, CRF ( $VO_{2peak}$ ) and BMI. Heart disease was dichotomized (no presence vs. presence), where presence means that the participants have reported at least one heart disease (myocardial infarction, angina pectoris, heart failure, atrial fibrillation, or other heart disease). Testing of  $VO_{2peak}$  ( $mL \cdot kg^{-1} \cdot min^{-1}$ ) was performed either as walking on a treadmill (97.3%) or cycling (2.7%) on a stationary bike. Participants with previous heart diseases were tested under ECG monitoring, and the American College of Cardiology/American Heart Association guidelines for exercise testing of patients with known cardiovascular disease was followed (Stensvold et al., 2015).  $VO_{2peak}$  was used to include participants that did not attain the requirements of a maximal test. A person's  $VO_{2peak}$

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was measured as the mean of the three successively highest 10-s VO<sub>2</sub> registrations. Weight and height were objectively measured (clinic) to the nearest kilogram and millimeter, respectively. BMI was calculated as body weight (kg) divided by the squared value of height (m) (kg/m<sup>2</sup>). Both VO<sub>2peak</sub> (CRF) and BMI were used as continuous variables in the statistical analysis.

### **Analysis**

All statistical analyses were performed with PASW Statistics 21 for Windows (IBM Corporation, Somers, NY, USA). Descriptive data were presented as proportions/means and standard deviations (SD) (Table 1). An independent-samples t-test was used to study the association between gender and objectively assessed overall PA (CPM) and the continuous PA correlates (age, PA at 40 years, BMI, CRF, and social support). Chi square test was used to study the association between gender and the dummy-coded PA correlates (heart disease, physical demanding work, education, living situation, neighborhood importance for PA, outdoor importance for PA and season). To analyse the relationships between the outcome variables, overall PA, and the sets of potential correlates for PA, hierarchical regression was applied. The analysis was built up from consecutive blocks containing categories of correlates. This approach ensured that increases in the explained variance in overall PA between participants (multiple correlations squared and R squared change) by adding a new block, can be attributed solely to the variables in the added block. Demographics and activity history correlates were entered in block 1 as a non-modifiable reference for the following blocks. Environmental correlates, that are modifiable, were entered in block 2 together with season. The modifiable factors VO<sub>2peak</sub> and BMI, in addition to heart disease, were entered as biological correlates in block 3. Preliminary analyses (normality, heteroscedasticity and collinearity) were conducted to ensure that there was no violation of the assumptions of linear regression. Unstandardized coefficients ( $\beta$ ) and the individual contribution of each correlate to



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the explained variance (semi-partial correlation squared) were reported. A  $p$  value  $< 0.05$  was required to declare statistical significance.

### Results

#### Descriptive data

The proportion of females and males were 48% and 52%, respectively, and mean age  $72.4 \pm 2.0$  years for males and  $72.5 \pm 1.9$  years for females (Table 1). The mean overall CPM was  $507.6 \pm 158.0$ . Females had a significantly higher overall PA than males ( $524.3 \pm 151.0$  and  $492.4 \pm 162.3$  CPM, respectively). Males had significantly higher education and BMI, CRF, and presence of heart disease compared to females. More females than males have had a physically demanding work, were living alone, and reported higher social support. Males reported greater importance of using the neighbourhood to be physically active than females. There were no significant gender differences in age, PA at 40 years, outdoor importance for PA, and season (“warmer” and “colder” months).

#### Hierarchical regression

Demographics and PA history included in Block 1 accounted for 5.0% of the variance in older adults' overall PA ( $R^2 = 0.050$ ,  $p < 0.001$ ) (Table 2). In Block 1 PA at 40 years and gender were the two correlates explaining most of the variance in current overall PA. When including the five environmental correlates in Block 2, the explained variance in overall PA increased to 11.2% ( $R^2 = 0.112$ ,  $p < 0.001$ ), with season (2.4%) and PA at 40 years (2.1%) having the strongest explanatory power. In Block 3 that also includes biological correlates, the explained variance increased to 27.0% ( $R^2 = 0.270$ ,  $p < 0.001$ ). Each of the biological correlates individually contributed to increase the explanatory power, with CRF being the most important correlate, contributing with 10.1% of the explained variance ( $p < 0.001$ ).

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Altogether, nine of the 13 correlates contributed significantly to the explained variance in older adults' overall PA. Gender had the second strongest explanatory power in the model (3.9%), where females had a higher overall PA than males. The overall PA was inversely associated with age for both genders. Those who reported higher PA frequency at the age of 40 had also a higher current objectively measured PA. Furthermore, an interaction effect was found between education and gender, where higher education was positively associated with PA for males, but not for females. Physically demanding work was not associated with overall PA. The environmental correlates have mixed association with overall PA. While social support and living situation did not associate with overall PA, both outdoors and season were positively associated with overall PA. Neighbourhood was not associated with overall PA. Those who reported presence of heart disease had a lower overall PA than those who reported no presence of heart disease. Furthermore, an increasing BMI had a negative association with overall PA, while an increasing CRF had a positive association with overall PA.

### **Discussion**

To our knowledge, this is the largest of PA correlate studies where both PA and CRF have been measured objectively in older adults. The main finding was that CRF, measured as  $VO_{2peak}$ , had the strongest association to PA. Most research examining the relationship between PA and CRF, has used PA as an independent variable and CRF as a dependent variable. In this tradition, Aspenes et al. (Aspenes, Nauman, Nilsen, Vatten, & Wisloff, 2011) found that self-reported PA level at baseline was positively associated with CRF 23 years later, while Loe et al. (Loe, Rognmo, Saltin, & Wisloff, 2013) found a poor overall correlation ( $r=0.24$ ) between self-reported PA level and oxygen uptake. In contrast to these studies we used CRF as an independent variable in our statistical analysis. Our results showed that CRF was the correlate that explained most of the variance in overall PA in older adults,

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meaning that more fit older adults were more physically active than less fit older adults. The authors acknowledge that since this was a cross-sectional study, there is a potential reverse direction of effect. An older adult's high CRF might be a result of a high overall PA. Novak et al. hypothesized that since CRF is determined partially by genetics and partially by PA levels, those with high CRF will also have high PA levels. Similar to our result, they showed that more fit people spent more time being active compared with less fit people. The authors concluded that endurance capacity (measured as  $VO_{2max}$ ), and not body size, was the best determinant of daily activity levels (Novak et al., 2009). This, and finding CRF to have the highest individual explanatory power in our study, suggests that older adults' overall PA would benefit from an increased CRF. High intensity training (HIT) is found to be the most efficient way of improving adults' CRF (Moholdt et al., 2012; Nes et al., 2012; Tjonna et al., 2013). It is however not clear how HIT can be implemented as a sustainable training regime in the older population. More research is therefore required on how HIT might be delivered into the community for older adults.

In our study we found body size, measured as BMI, to be inversely proportional to PA levels, which is supported by other studies (Kaplan et al., 2001; Ortlieb et al., 2014; Palacios-Cena et al., 2011). A strong inverse association between CRF and BMI has been reported previously (Radovanovic et al., 2014), which could possibly account for some of the variation in PA levels observed in lean versus obese people. Importantly, more research on this subject is needed. Furthermore, we found that older adults with heart disease had a lower PA than those without heart disease. This association is less understood in literature (Chad et al., 2005; Papadopoulou et al., 2003). Our results indicate that CRF, BMI and heart disease should all be incorporated in both future research and interventions regarding older adults' PA, especially CRF. Additionally, this study stresses the importance of CRF compared with BMI (body shape/size) when developing PA interventions.

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Females in our study were significantly more active than males. This contrasts findings of earlier studies (Booth et al., 2000; Chad et al., 2005; Jefferis et al., 2014; Kaplan et al., 2001; Lohne-Seiler et al., 2014). The differences in these results and those of our study could be attributed to the methodologies utilized. Only studies by Lohne-Seiler et al. and Jefferies et al. used objectively measured PA. Both of these studies have used uniaxial data. Lohne-Seiler et al. included only 118 females and 134 males aged 70-79 and found no differences between genders in overall PA. Jefferies et al. measured moderate-to-vigorous physical activity (MVPA) and not overall PA in a larger age interval including participants from 70-93 years of age and found males to be more active than females in higher intensities (Jefferis et al., 2014). When compared to the studies utilizing self-reported data differences in results could be attributed to the recall bias associated with self-reported measures where females tend to neglect reporting low intensity activities and activities of routine nature such as household chores (Orsini, Bellocco, Bottai, Pagano, & Wolk, 2006; Washburn, 2000). Moreover, previous studies have shown that activity levels decrease with age (Kaplan et al., 2001; Lohne-Seiler et al., 2014; McMurdo et al., 2012; Sun et al., 2013). Interestingly, despite the narrow age-span in our study, higher age was associated with significantly lower PA levels. The decrease in PA level seen with increased age, even in a relatively healthy older population, does alarm the need for strategies so that people can sustain their PA level throughout life.

Studies report conflicting findings when it comes to association between education and PA in older adults. This could be due to methodological differences, i.e. self-reported PA, and different outcome measures of PA and education (Kaplan et al., 2001; Palacios-Cena et al., 2011; Pan et al., 2009). The present study found that higher education was positively associated with PA for males, but not for females. It is reasonable to assume that individuals with higher education have better prerequisites to act according to health messages promoting

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PA. Lack of association between education and PA in females could be explained by females in this age group having more household activities than males, potentially constituting the majority of their daily PA. In contrast to earlier studies, our results showed no association between former physically demanding work and current PA (Chung et al., 2009). The conflicting results could be due to a difference between self-reported- versus the objectively assessed PA. More research is needed to understand if and how the total PA changes after transition into retirement (Barnett, van Sluijs, & Ogilvie, 2012). We found a positive association between PA at the age of 40 (measured by frequency of exercise) and current PA. Our result was in line with previous findings that PA early in life is positively associated with PA later in life (Friedman et al., 2008). Analyzing lifespan changes in PA are important but challenging, since major life events may affect PA behavior (e.g. health status, work situation, living situation, relationship status etc.) (Engberg et al., 2012).

Our results showed no association between older adults` PA and social support and living situation. The lack of association of PA with social support was also seen in a British study of older adults (Jefferis et al., 2014). This contrasts a recent study by Jackson et al. (Jackson, Steptoe, & Wardle, 2015) finding males and females to be strongly influenced by their partner`s behavior in relation to making health behavior changes. An explanation for the conflicting result could be due to study differences, i.e. study sample with only couples (age  $\geq 50$ ), and their use of a self-reported measure of PA (Jackson et al., 2015). The physical environment was of greater importance for the explained variance in PA among older adults, than social environment. Season had the third strongest influence on the explained variance in overall PA. In line with previous studies, older adults were less physically active during “colder” months (November to March), than “warmer” months (April to October) (McMurdo et al., 2012; Witham et al., 2014). One explanation for this could be that “colder” months (in Trondheim, Norway) consist of more snow, higher prevalence of ice and relatively fewer

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hours of daylight. Furthermore, while we found no relationship between neighborhood importance for PA and overall PA, we found outdoor importance for PA to have a positive relationship with PA. In order to stimulate older adults to be physically active, our results indicate that the outdoors should be prioritized in future public health interventions. A comprehensive study of the association between neighborhood walkability and older adults' PA, concluded that special attention should be paid to low income neighborhood residents (Van Holle et al., 2014). This field of research is less understood in this age group, and more research is required (Booth et al., 2000; Strath et al., 2012; Van Cauwenberg et al., 2011).

Additional regression analyses, including the same correlates as in table 2, showed identical associations and explained variance when using uniaxial CPM instead of triaxial CPM. Furthermore, performing the same analysis on triaxial CPM without a time filter (including data between midnight and 6:00 a.m.) resulted in identical associations as in Table 2, but had a lower explained variance (24%). Moreover, using time spent in MVPA instead of CPM, yielded similar associations but reduced the explained variance to 15% and 19%, for uniaxial MVPA (MVPA>1952 CPM) (Freedson, Melanson, & Sirard, 1998) and triaxial MVPA (MVPA>2690 CPM) (Sasaki, John, & Freedson, 2011), respectively. This suggests that our results (hierarchical linear regression analysis) seem to be independent of which PA outcome was chosen.

We are aware that our study had some limitations. The results from this study should be interpreted with an understanding that the data were from a cross-sectional study. Cross-sectional studies are suggested as an efficient and empirical way of screening a large variety of potential correlates of PA. The statistical associations from cross-sectional studies do not allow causal inferences, but they can provide a basis for generating further hypotheses (A. E. Bauman et al., 2012; Adrian E. Bauman, Sallis, Dzewaltowski, & Owen, 2002). The waist worn accelerometer used in this study records ambulatory activity well, but can underestimate

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activities such as cycling, skiing, resistance exercise, and upper body movements. In this sample of older adults walking was the most frequently reported activity type, and walking is known to be well captured by waist worn accelerometers. One limitation of this study was the use of self-reported single-items to determine the importance of neighborhood and outdoors for PA, and physically demanding work. All three variables were dichotomized before the statistical analyses, making them less susceptible for misinterpretation. We recognize that adding a multidimensional measure of environmental importance for PA would have strengthened the study. For example, objective measures of neighborhood walkability, sidewalk conditions etc. Furthermore, it should be noted that the present study uses a retrospective measure of PA at age 40, which makes it vulnerable for recall bias (Friedman et al., 2008).

A strength of the present study was that it included a large study sample with both males and females from an older population. This gives us the opportunity to study overall PA and its association with PA correlates, exclusively in older adults. In addition, Generation 100 is the largest Norwegian study on older adults (70-77 years) using objective assessment of PA. Earlier research has stated a need for studies on older adults which employ validated measurements of PA (Sun et al., 2013).

Another strength of our study was the inclusion of a broad range of correlates to explore the associations with overall PA. Including multiple levels and contexts, such as individual and environmental correlates, provides a better understanding of PA behavior (A. E. Bauman et al., 2012). The chosen correlates in this study explained 27% of the variance in PA, which is in accordance with other correlate studies (Hansen, Ommundsen, Holme, Kollé, & Anderssen, 2013; McMurdo et al., 2012). However, the authors acknowledge that it is difficult to compare the explained variance between studies, due to differences in both sample and analyzed variables. In addition to the correlates included, one should be aware of other

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potential correlates of PA (A. E. Bauman et al., 2012; Adrian E. Bauman et al., 2002), e.g. genetics and evolutionary biology (Lightfoot, 2013). Moreover, the strongest single correlate of overall PA, CRF, was measured by direct ergospirometry instead of using estimated CRF values or substitute measures of CRF, which is more common in large population-based public health studies (Aspenes et al., 2011).

The analyzed sample was relatively healthy and more educated compared to the invited, but not participating, subjects (Stensvold et al., 2015), so any generalization regarding our findings on other populations are cautioned. Furthermore, our participants were relatively more educated and fewer of them reported physically demanding work compared to age matched data from Statistics Norway (Kristiansen, 2015; Mørk, 2011). However, our gender-related findings regarding physically demanding work were no different from those reported by Statistics Norway. Despite this, our sample consists of participants with a wide range of PA levels and CRF values. More studies of PA correlates in different populations of older adults are therefore needed to confirm our findings.

### **Conclusions**

The complete set of correlates explained 27.0% of the variance in overall PA level in older adults. CRF was the most important correlate, explaining 10.1% of the variance, followed by gender (3.9%) and season (2.7%). Females were more physically active than males and PA decreased with increasing age for both genders. Furthermore, education was positively associated with PA for males, not for females. The correlates outdoor importance for PA and “season” were positively associated with older adults` PA. This is, to our knowledge, the largest of PA correlate studies in older adults that has combined objectively measured PA and directly measured CRF. The present study provides new knowledge of how different correlates are associated with overall PA in older adults.



### **Competing interests**

The authors declare that they have no competing interests.

### **Authors' contributions**

HV and NPA contributed equally to this work and should *both* be considered first authors. All authors contributed to the conception and design of the study. All authors were responsible for the collection of the Generation 100 data in corporation with colleagues at CERG NTNU, Norway. HV and NPA provided the data for analysis, undertook the data analysis, and drafted the manuscript. All authors provided critical insight, and revisions to the manuscript. All authors read and approved the final version of the manuscript submitted for publication.

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**Table 1:** Participant characteristics

Variables	Female n 405	Male n 445	All n 850	Gender differences
CPM	524.3±151.0	492.4±162.3	507.6±158.0	P < 0.001
Age, yr	72.5±1.9	72.4±2.0	72.4±1.9	ns
PA at 40yrs old (0=never, 4=daily)	2.5±0.9	2.5±1.0	2.5±0.9	ns
Physical demanding work (yes %)	45.9	34.2	39.8	P < 0.001
Education (high %)	47.9	59.6	54.0	P < 0.001
Living situation (alone %)	38.3	10.8	23.9	P < 0.001
Social support (0=no support, 5=very supported)	1.6±0.8	1.5±0.8	1.5±0.8	P < 0.05
Neighbourhood importance for PA (yes %)	74.8	61.3	67.8	P < 0.001
Outdoor importance for PA (yes %)	73.8	69.7	71.6	ns
Season ("Colder months" %)	49.1	52.8	51.1	ns
Heart disease (yes %)	6.4	17.3	12.1	P < 0.001
BMI (kg/m <sup>2</sup> )	25.2±3.5	26.0±3.0	25.6±3.3	P < 0.01
CRF	26.6±4.9	32.4±6.7	29.6±6.5	P < 0.001

Values are means (SD) or percentage distributions

Abbreviations: CPM, counts·min<sup>-1</sup>; PA, physical activity; BMI, Body mass index; CRF, Cardiorespiratory fitness measured as VO<sub>2peak</sub> (ml/min/kg); ns, non-significant; SD, standard deviation

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**Table 2:** Hierarchical regression analysis of correlates of overall physical activity

n = 850	Block 1			Block 2			Block 3		
	$\beta$	(SE)	Partial $r^2$	$\beta$	(SE)	Partial $r^2$	$\beta$	(SE)	Partial $r^2$
CPM	1011.3	198.6		1058.6	201.6		838.7	199.4	
Demographics and activity history									
Gender (male)	-60.2	15.8	0.017***	-49.2	15.9	0.011***	-89.2	15.3	0.039***
Age	-7.6	2.7	0.009**	-10.5	2.3	0.017***	-6.5	2.6	0.008**
PA at 40yrs old	27.3	5.9	0.025***	24.5	5.8	0.021***	13.6	5.3	0.008**
Physical demanding work (yes)	-5.3	11.2	0.000	-7.5	11.0	0.000	-2.5	10.0	0.000
Education (high)	-4.6	15.5	0.000	-8.5	15.1	0.000	-15.9	13.7	0.002
Education $\times$ Gender	43.5	22.0	0.005*	46.8	21.3	0.006*	42.2	19.4	0.006*
Environmental correlates									
Living situation (not alone)				-7.7	12.8	0.000	-8.4	11.6	0.000
Social support				5.4	6.7	0.000	6.5	6.1	0.001
Neighbourhood importance for PA (yes)				24.8	11.8	0.005*	8.4	10.8	0.001
Outdoor importance for PA (yes)				38.6	12.4	0.014***	22.2	11.3	0.004*
Season (“Warmer months”)				25.3	5.6	0.024***	24.7	5.1	0.027***
Biological correlates									
Heart disease (yes)							-37.9	14.7	0.008**
BMI							-6.1	1.6	0.017***
CRF							8.9	0.9	0.101***
Explained variance ( $R^2$ )		Block 1:	0.050***		Block 2:	0.112***		Block 3:	0.270***

\*  $p \leq 0.05$ , \*\*  $p \leq 0.01$ , \*\*\*  $p \leq 0.001$

Abbreviations:  $\beta$ , unstandardized beta coefficient; SE, standard error of the mean CPM, counts·min<sup>-1</sup>; PA, physical activity; BMI, Body mass index (kg/m<sup>2</sup>); CRF, Cardiorespiratory fitness measured as VO<sub>2peak</sub> (ml/min/kg)