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Physical performance in relation to birth cohort: A comparison of 60 year old Swedish men and women born twelve years apart

Lena Sandin Wranker*, Sölve Elmståhl, Henrik Ekström

Department of Clinical Sciences, Division of Geriatric Medicine. Lund University, Lund, Sweden

1. Introduction

It is well-known that individuals with healthier lifestyles and behaviors are at lower risk of disease and disability when they are older and that a healthy lifestyle reduces the risk of disability and premature death. Comparisons between birth cohorts are conducted by researchers to follow disease development, predict the outcome of healthy behavior or evaluate the impact of public health strategies (Hotta et al., 2018).

There are strong associations between impaired physical ability and mortality in the older population (Keevil et al., 2018) and a slow walking speed increases the risk of future disability (Shimada, Makizako, Doi, Tsutsumimoto, & Suzuki, 2015). Previous studies have also shown gender differences in the development of age related mobility reduction (Makizako et al., 2017). Comparison between the sexes and different movement parameters revealed that it is primarily a decrease in walking speed that indicates health deterioration in older women (Makizako et al., 2017). A walking speed below 1 m/s entails an increased risk of health deterioration among older adults, while faster walking speeds are associated with better odds of a long life (Cesari et al., 2005). Walking speed can be used as a measure to identify older people at risk of negative health trends and premature death (Abellan van Kan et al., 2009).

The chair stand test, where an individual is asked to rise five times as quickly as possible, can also be used as an indicator of frailty (Pinheiro, Carneiro, Coqueiro, Pereira, & Fernandes, 2016). Moreover, Tiedemann, Shimada, Sherrington, Murray, and Lord, (2008) reported associations between the chair stand test and risk of falling, where individuals who were able to complete the test but took more than 60 s to do so were more often instable and likely to fall.

Another test of physical ability that may reflect aging or soreness and risk of disability is the handgrip strength test. When used as a test of aging and the onset of frailty it can indicate the beginning of a deterioration (Makizako et al., 2017). A weaker hand grip has also been shown to predict all-cause morbidity rates and mortality due to respiratory or cardiovascular disease (Strand et al., 2016).

It has been clearly demonstrated that chronological aging and changes in anthropometry, cognition, and morbidity are of crucial importance for physical performance and should be considered in the assessment of physical tests such as walking speed, chair stand and grip strength. Another issue associated with the age effect is the importance of birth cohort. Previous studies of 75 year old birth cohorts born 30 years apart in 1901 and 1930 have shown that both men and women born in the later cohort were less dependent on ADL and able to perform more leisure activities, which suggests a shift of functional dependence and a more active lifestyle among the later born cohort (Falk et al., 2014). Another study of 75 year old cohorts born 19 years apart in 1911 and 1930 examined slow gait speed (< 1 m/s) where no differences between the cohorts was found after adjustment for height (Hörder, Skoog, Johansson, Falk, & Frändin, 2015).

However, whether birth cohort can be decisive for how well physical tests are performed by the younger old is less well known. Thus, the aim of present cohort study was to identify possible differences in the performance of walking speed, chair stand and handgrip strength tests between two birth cohorts of 60 year old men and women born twelve years apart in 1941-43 and 1952-54.

2. Material and methods

2.1. Study population and research context

The study population was drawn from the Good Aging in Skåne (GÅS) Project, which is part of the Swedish National Study on Ageing and Care (SNAC) (Lagergren et al., 2004), (Ekström & Elmståhl, 2006). Participants aged 60 years were randomized from the population registers in five municipalities in the county of Skåne in southern Sweden, covering both urban and rural areas. The first randomization from 2001 to 2004 included a birth cohort born in the period 1941-43, while the second randomization from 2012 to 2016 involved a birth cohort born in the period 1952-54.

Out of a total of 1131 and 1325 potential participants who were invited by letter in the respective randomizations, 710 (62.8%) and 930 (70.2%) agreed to participate. The study had just one inclusion criterion; the participants should have performed at least one of the walking tests without using a walking aid. This resulted in the exclusion of 157 (9.6%) individuals, of whom 144 had not performed any of the walking tests and 13 were dependent on a walking aid. The final study

* Corresponding author at: Lund University, Department of Clinical Sciences, Division of Geriatric Medicine, Jan Waldenströms gata 35, 205 02 Malmö, Sweden.
E-mail addresses: lena.sandin_wranker@med.lu.se (L.S. Wranker), solve.elmstahl@med.lu.se (S. Elmståhl), Henrik.ekstrom@med.lu.se (H. Ekström).

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Table 1
Physical performance in relation to birth cohort from the Good Aging in Skåne (GÅS) project. Study of characteristics of 60 year old male birth cohorts born 1941-43 and 1952-54.

Men 60 years, birth cohort Years of examination	1941–43 n = 353 2001–2004	1952–54 n = 408 2013–2015	p-value
Height (cm), mn (sd)	176.8 (6.7)	177.9 (7.1)	0.030
Weight (kg), mn (sd)	86.9 (15.3)	89.1 (13.9)	0.038
BMI			
Normal/underweight, n (%)	94 (26.6)	90 (22.1)	
Overweight, n (%)	171 (48.4)	206 (50.5)	
Obese, n (%)	88 (24.9)	112 (27.5)	0.324
Marital status			
Married/cohabiting, n (%)	254 (72.8)	295 (72.5)	
Single/widowed/divorced, n (%)	95 (27.2)	112 (27.5)	0.927
Education			
Elementary school, n (%)	140 (40.1)	110 (27.2)	
Secondary school, n (%)	109 (31.2)	149 (36.8)	
≥1 year at university, n (%)	100 (28.7)	146 (36.0)	0.001
Smoking habits			
Never smoked, n (%)	100 (28.7)	145 (35.6)	
Former smoker, n (%)	154 (44.1)	194 (47.7)	
Current smoker, n (%)	95 (27.2)	68 (16.7)	0.002
Physical activity past year			
Mostly sedentary, n (%)	72 (20.7)	73 (18.0)	
Light activity, n (%)	148 (42.7)	181 (44.7)	
Strenuous activity, n (%)	127 (36.6)	151 (37.3)	0.631
Pain			
Back/pelvis, n (%)	91 (26.9)	122 (29.9)	0.370
Lower extremities, n (%)	63 (19.0)	83 (20.3)	0.657
Upper extremities, n (%)	70 (20.8)	105 (25.7)	0.117
Comorbidity			
Pulmonary disease: tuberculosis/asthma/ COPD, n (%)	31 (8.8)	43 (10.5)	0.422
Heart disease: infarction/angina/heart failure, n (%)	56 (15.9)	59 (14.5)	0.600
MMSE ≤ 27 p	122 (35.3)	130 (32.8)	0.485

population after the first and second randomization consisted of 1483 (60.4%) participants. The first randomization included 353 (51.2%) men and 337 (48.8%) women and the second randomization 408 (51.4%) men and 385 (48.6%) women (Table 1).

Walking speed and grip-strength tests took place at the medical research center, while the chair stand test was performed either at the research center or in the home of the participants. In addition to physical tests, data on socio-demography, lifestyle habits, and medical history were collected from medical and psychological examinations, self-report questionnaires or interviews. To control for the medical history reported diseases were verified by means of the National Diagnosis Registry after permission from the participants.

2.2. Physical tests

Physical tests comprised walking speed, chair stands and handgrip strength. All tests took place on one occasion. The participants wore everyday clothes and shoes and were given detailed instructions about how to perform the tests, which took place under the supervision of a trained registered nurse. In view of the aims of the present study and to avoid incorrect results for the walking test, participants who used any kind of walking aid were excluded.

2.2.1. Walking speed

The participants walked 30 m with one turn at 15 m at normal (comfortable) and maximum speed without running. The time was recorded after 15 m and 2 × 15 m. In this study, the walking speed is reported for 2 × 15 m at normal and maximum speed. The 2 × 15 m walking test is more complex than the 15 m walking test as the turn provokes balance problems (Bramell-Risberg, Jarnlo, & Elmståhl, 2012). The test was performed once. High intra class correlation (ICC > 0.90) as an indication of reliability has been reported for both the normal and maximum speed for walking 2 × 15 m (Jarnlo & Nordell, 2003). It has been demonstrated that walking speed is correlated to lower extremity muscle strength (Bohannon, 1997).

2.2.2. The chair stand test

The chair stand test for lower extremity strength was carried out sitting on a chair with a 45 cm high seat with the arms folded. Participants were asked to stand up 5 times in succession as quickly as possible. The test was performed once and the time for 5 stands was recorded. High intra class correlation has been shown, ICC = 0.84 (Tiedemann et al., 2008)

2.2.3. Handgrip strength

Handgrip strength was measured with the Grippit® (Hammer & Lindmark, 2003) a gauge which electronically determines the handgrip force. The test was performed in accordance with standardized instructions described elsewhere (Nordenskiöld & Grimby, 1993). The actual test was carried out twice for the right hand and twice for the left hand. The maximum contraction value of either the right or left hand was used for further analysis. A high intraclass correlation coefficient between tests were noted (ICC = 0.97 for left and right hand) (Bramell-Risberg et al., 2012).

2.2.4. Birth cohort, socio-demographics and life style variables

It should first be said that in this study the common characteristics shared by the participants were period of birth and cohort effect, here expressed through physical tests and referring to a periodic effect that affects the responses of different birth cohorts, e.g. behaviors or opinions that are typical of each cohort under study (Keyes, Utz, Robinson, & Li, 2010).

Socio-demographics included age, sex, marital status, and educational level. Marital status was dichotomized into married/cohabitant or living alone (single/widowed/divorced). Education was divided into three groups; graduation from elementary school, secondary school or at least one year of university studies. Life style variables included smoking habits and physical activity at home or during leisure time. Smoking habits were categorized as current smoker, former smoker or non-smoker. Physical activity was divided into the following three categories: Mostly sedentary; no strenuous activities at all or simple household tasks like heating food. Light activities: non-strenuous physical activity for 2–4 hours per week, e.g. walking, gardening, and regular housework. Strenuous activities: more exhausting exercise 1–3 hours per week, e.g. gymnastics, swimming, heavier gardening or heavy household work.

2.2.5. Health variables

Health variables covered body mass index (BMI = weight (kg)/ height (m^2)), pain during the past 4 weeks from the back/pelvis, leg/ foot or shoulders/arms/hands. Pulmonary events in adulthood included tuberculosis, asthma or chronic obstructive pulmonary disease (COPD). Heart diseases included infarction, angina, and heart failure. Stroke included any type of brain infarction or hemorrhage. Global cognitive function was assessed using the Mini Mental State Examination (MMSE), with scores ranging from 0 to 30 points. Based on a cut-off of ≤27 points participants were dichotomized as cognitively intact or suffering from *"some degree of"* cognitive impairment (Folstein, Folstein, & McHugh, 1975).

2.3. Ethics

The study was conducted in accordance with the Helsinki Declaration and approved by the regional ethics committee at Lund

Table 2
Physical performance in relation to birth cohort from the Good Aging in Skåne (GÅS) project. Study of characteristics of 60 year old female birth cohorts born 1941–43 and 1952–54.

Women 60 years, birth cohorts / Years of examination	1941–43 n = 337 2001–2004	1952–54 n = 385 2013–2015	p-value
Height (cm), mn (sd)	164.2 (6.0)	163.8 (6.9)	0.288
Weight (kg), mn (sd)	71.3 (12.9)	73.4 (14.5)	0.037
BMI			
Normal/underweight	144 (42.7)	135 (35.1)	
Overweight	122 (36.2)	145 (37.7)	
Obese	71 (21.1)	105 (27.3)	0.059
Marital status,			
Married/cohabiting, n (%)	204 (61.1)	255 (66.2)	
Single/widowed/divorced	130 (38.9)	130 (33.8)	0.151
Education			
Elementary school, n (%)	124 (37.3)	79 (20.6)	
Secondary school, n (%)	109 (32.8)	148 (38.5)	
≥1 year at university, n (%)	99 (29.8)	157 (40.9)	< 0.001
Smoking habits			
Never smoked, n (%)	115 (34.4)	132 (34.3)	
Former smoker, n (%)	126 (37.7)	182 (47.3)	
Current smoker, n (%)	93 (27.8)	71 (18.4)	0.005
Physical activity			
Mostly sedentary, n (%)	40 (12.0)	21 (5.5)	
Light activity, n (%)	167 (50.0)	197(51.3)	
Strenuous activity, n (%)	127 (38.0)	166 (43.2)	0.006
Pain			
Back/pelvis, n (%)	106 (32.8)	135 (35.1)	0.530
Lower extremities, n (%)	75 (23.5)	119 (30.9)	0.029
Upper extremities, n (%)	99 (30.7)	132 (34.3)	0.304
Comorbidity			
Pulmonary: tuberculosis, asthma/COPD, n (%)	37 (11.0)	51 (13.2)	0.353
Heart: infarction/angina/heart failure, n (%)	25 (7.4)	33 (8.6)	0.578
MMSE ≤ 27 p	111 (33.5)	97 (25.7)	0.023

University in 2002, registration no. LU 744-00. All participants provided their written consent to participate and allow retrieval of information from the National Patient Register.

2.4. Data analyses

Mean differences between the cohorts for men and for women regarding age, height, and weight were tested with the Student *t*-test. Smoking, physical activity, pain, heart disease, and lung disease were tested by the chi-squared (χ^2) test (Table 1). Differences in walking speed, chair stands, and grip strength between the cohorts were tested with the Student *t*-test for independent samples. Effect size (ES) was calculated as Cohen's d for significant differences, where an ES of 0.2, 0.5, and 0.8 were considered small, medium, and large effects respectively (Polit & Beck, 2008 pp. 602-605) (Table 2).

To test for possible confounders multiple linear regression models were constructed with each physical test as a dependent variable and birth cohort as an independent variable. Included variables were those in the descriptive analyzes comparing the cohorts that showed a p-value ≤0.30 (Table 1). The higher p-value, as opposed to the more common $p < 0.05$, was chosen in order to reduce the risk of type II-error, i.e. excluding variables that might influence any of the physical tests (Altman, 1999 pp. 349-351). In all other analyzes p values of < 0.05 were considered statistically significant and all tests were two-sided. With the exceptions of height and weight, all independent variables were either dichotomized or trichotomized. For marital status, education, smoking habits, and physical activity dummies were used in the regression models.

Analyzes were conducted so that all confounding variables ($p \leq 0.30$) were entered simultaneously into the regression model. B-coefficients and p-values were then examined and the variable with the highest p-value was excluded, followed by a new analysis. This procedure was repeated until all variables in the model showed a p-value of < 0.1, or until the independent variable "Birht cohort" showed the highest p-value, i.e., the next variable to be excluded from the model. In the regression models, all variables were tested for multicollinearity from the beginning and after excluding BMI with collinearity to height, none of the models showed a VIF (variance inflation factor) exceeding an unacceptable value of > 5 (Menard, 1995). Normality was controlled for by inspecting histograms of the residuals and linearity and homoscedastic by examining scatter plots of residuals for each regression model. No unacceptable deviations were noted (Tabchnick & Fidell, 2007). All analysis was carried out using SPSS software 21.0 (IBM 211 Corporation, Armonk, NY, USA).

3. Results

3.1. Characteristics of the study population

Tables 1 and 2 present characteristics of women and men stratified for birth cohort.

When comparing the male birth cohorts, those born later were found to be both taller and heavier. The proportion of those with a higher education also increased and smoking had become less common, although there were no significant differences in pain and morbidity (pulmonary and heart diseases) between the cohorts.

When comparing the female birth cohorts, there are significant differences in weight gain in the later cohort, while height is almost the same. Living as a single had become more common in the later cohort, a larger proportion had higher education, were more physically active, and the proportion of smokers had decreased.

3.2. Physical tests

A pattern that emerged when comparing the birth cohorts is that in all tests, with the exception of hand-grip strength, the later born cohorts performed significantly better, although the magnitude of the effect varied between small to moderate. For both sexes, the chair stand test showed the largest difference in effect size between the cohorts, while in the walking tests the magnitude of the effect was greater for 2 × 15 m at maximum walking speed compared to normal speed (Table 3).

The regression models revealed that being born in the later birth

Table 3
Physical performance in relation to birth cohort from the Good Aging in Skåne (GÅS) project. Comparisons of 15 m and 2 × 15 m normal and maximum walking speed and chair stand tests between male and female birth cohorts 60 years old born 1941-43 and 1952-53.

Birth cohorts	1941–43			1952–54				
Men	n	mn	sd	n	mn	sd	p	Es[a]
Walking 2 × 15 m								
normal speed (s)	353	21.91	3.39	408	20.87	3.44	< 0.001	0.30
maximum speed (s)	353	16.82	3.17	405	15.66	2.82	< 0.001	0.39
Chair stands (s)	351	9.72	2.86	402	8.40	2.62	< 0.001	0.48
Grip strength (N)	353	424.3	93.2	408	425.8	103.2	0.841	–
Women								
Walking 2 × 15 m								
normal speed (s)	337	22.22	3.62	385	21.37	3.45	0.001	0.24
maximum speed (s)	337	18.23	3.34	385	16.95	2.91	< 0.001	0.41
Chair stands (s)	332	10.69	3.79	373	8.78	2.75	< 0.001	0.58
Grip strength (N)	335	231.4	65.5	384	240.3	59.1	0.060	–

[a] Effect size, Cohens *d*.

Table 4
Physical performance in relation to birth cohort from the Good Aging in Skåne (GÅS) project. Regression models with walking speed and chair stands as dependent variables and birth cohort, height, weight, education, smoking habits, and pain as independent variables[a].

Men	n	B-coefficients	SE	95% CI	p-value	R[b]
Walking 2 × 15 m norm. speed (s)	736					0.118
Birth cohort, 1941–43/ 1952–54[b]		−0.769	0,246	−1.252/ −0.286	0.002	
Height (cm)		−0.119	0,020	−0.158/ −0,081	< 0.001	
Weight (kg)		0.053	0,009	0,035/ 0.071	< 0.001	
Secondary school		−0.601	0.297	−1.184/ −0.017	0.044	
University studies		−1.158	0.303	−1.752/ −0.564	< 0.001	
Current smoker		1.066	0.287	0.484/ 1.648	< 0.001	
Walking 2 × 15 m max. speed (s)	733					0.164
Birth cohort, 1941-43/ 1952-54		−0.880	0.210	−1.292/ 0.468	< 0.001	
Height (cm)		−0.093	0.017	−0.126/ 0.061	< 0.001	
Weight (kg)		0.042	0.008	0.027/ 0.058	0.007	
Secondary school		−0.801	0.253	−1.297/ −0.302	0.002	
University studies		−1.360	0.259	−1.868/ −0.852	< 0.001	
Former smoker		0.579	0.235	0.118/ 1.041	0.014	
Current smoker		1.227	0.288	0.769/ 1.914	< 0.001	
Pain upper extremity		0.750	0.245	0.269/ 1.792	0.003	
Chair stands (s)	728					0.094
Birth cohort, 1941-43/ 1952-54[b]		−1.178	0.202	−1.574/ −0.782	< 0.001	
Weight (kg)		0.021	0.007	0.008/ 0.035	0.002	
Secondary school		−0.576	0.242	−1.051/ −0.102	0.017	
University studies		−0.923	0.246	−1.406/ −0.441	< 0.001	
Current smoker		0.553	0.243	0.077/ 1.030	0.023	
Pain upper extremities		0.634	0.235	0.173/ 1.085	0.007	
Grip strength	736					0.104
Birth cohort, 1941-43/ 1952-54		−5.911	7.024	−19.700/7.878	0.400	
Height		3.459	0.556	2.367/4.551	< 0.001	
Weight		0.492	0.263	−0.024/1.007	0.061	
University studies		9.626	7.285	−4.675/23.928	0.187	
Current smoker		−18.361	8.492	−35.033/-1.689	0.031	
Pain upper extremities		−29.996	8.205	−46.105/-13.887	< 0.001	

[a] Before removing non-significant variables one by one in a backward manner, regression models were initially adjusted for height, weight, education, smoking habits, and pain in upper extremities.
[b] Birth cohort 1941-43 as reference.

cohort was associated with a faster walking test and a faster chair stand test even after the models had been adjusted for covariates significantly associated with faster performances. In terms of differences between men and women, the regression models showed that in addition to birth cohort, being tall, weighing less, having a higher education, being a non-smoker, and being free from pain were associated with faster walking speed and chair stands among men. The result was similar for women; in addition to birth cohort, weighing less, having a higher education, being a non-smoker, performing physical activities, and being free from pain were associated with faster walking speed and chair stands (Tables 4 and 5).

4. Discussion

In this study, we have described differences in physical performance among men and women in two 60 year old birth cohorts born 12 years apart. Both men and women in the later birth cohort performed better in the walking test and the chair stand test, while no significant difference was found in handgrip strength. Despite the small or moderate effect sizes, the significant differences between the cohorts implies that comparing sixty year old birth cohorts or assessing levels of physical performance based on previous standardized values should be done with caution, despite the significant covariates presented here.

A question is why was there no difference in grip strength between the cohorts, despite the difference in walking and chair stands? An explanation could be that walking and chair stands are more complex movements that in addition to muscle strength also require balance and coordination, while in the case of chair stands psychological factors such as anxiety or fear of rising and losing one's balance could play an important role (Lord, Murray, Chapman, & Tiedeman, 2002). Even if not included in this study, the less complex test of walking 1 × 15 m was measured. The later born cohort showed a significant faster walking even though the magnitude of the ES was small.

Based on the results from both the descriptive characteristics and regression models we can see, as might be expected, that height, weight, education, physical activity, and smoking habits are significant aspects that explain the differences in physical performances between the birth cohorts.

For both men and women, higher education and a decreasing proportion of smokers are especially likely to explain the difference between the cohorts. In addition, the proportion of physical activity for women is much greater in the later cohort. The cohort difference in the MMSE among women is also notable, which is probably a result of better education. The later cohort had a significantly better result, even though the MMSE did not turn out to be significant in the regression models.

This progress in physical performance over time can be referred to as the "success-of-success effect" (Christensen et al., 2013). The later cohorts benefitted from several social improvements such as better health care, better education with access to higher education, less physical work, and new findings about the negative health effects of tobacco smoking or the importance of dietary habits and exercise. It is likely that these and other changes in society intended to improve human health and quality of life also affected physical performance as reported here. Although neither men nor women exhibited any significant differences between cohorts in cardiovascular or lung diseases at this point, the improvement in physical tests with their mortality and morbidity associations could suggest that disability, dependence in the

Table 5
Physical performance in relation to birth cohort from the Good Aging in Skåne (GÅS) project. Linear regression models with walking speed and chair stands as dependent variables and birth cohort, height, weight, education, smoking habits, physical activity, pain, and MMSE as independent variables[a].

Women 60 years	n	B-coefficients	SE	95% CI	p-value	R^b
Walking 2 × 15 m normal speed	686					0.231
Birth cohort, 1941–43/ 1952-54[b]		−0.759	0.243	−1.237/ −0.281	0.002	
Height (cm)		−0.123	0.019	−0.161/ −0.085	< 0.001	
Weight (kg)		0.064	0.009	0.046/ 0.082	< 0001	
Secondary school		−0.819	0.302	−1.411/ −0.227	0.007	
University studies		−1.075	0.309	−1.681/ −0.469	0.001	
Current smoker		0.825	0.289	0.259/ 1.392	0.004	
Physical activity, light		−0.972	0.441	−1.838/ −0.107	0.028	
Physical activity, strenuous		−1.884	0.455	−2.738/ −0.950	< 0.001	
Pain lower extremities		1.595	0.266	1.073/ 2.118	< 0.001	
Walking 2 × 15 m maximum speed	686					0.318
Birth cohort, 1941-43/ 1952-54[2]		−1.181	0.204	−1.582/ −0.779	< 0.001	
Height (cm)		−0.119	0.016	−0.151/ −0.087	< 0.001	
Weight (kg)		0.062	0.008	0.047/ 0.077	< 0.001	
Secondary school		−0.687	0.253	−1.184/ −0.190	0.007	
University studies		−1.133	0.259	−1.642/ −0.624	< 0.001	
Current smoker		0.929	0.242	0.453/ 1.405	0.001	
Physical activity, light		−1.217	0.370	−1.943/ −0.491	0.001	
Physical activity, strenuous		−2.039	0.382	−2.790/ −1.289	< 0.001	
Pain lower extremities		1.543	0.223	1.105/ 1.982	< 0.001	
Chair stands (s)	670					0.245
Birth cohort, 1941-43/ 1952-54[2]		−1.692	0.224	−2.069/ −1.188	< 0.001	
Weight (kg)		0.070	0.008	0.054/ 0.086	< 0.001	
Marital status, living alone		0.796	0.232	0.340/ 1.253	0.001	
University studies		−0.543	0.234	−1.002/-0.083	0.021	
Current smoker		0.764	0.272	0.230/ 1.299	0.005	
Physical activity, light		−0.769	0.412	−1.577/0.039	0.062	
Physical activity, strenuous		−1.480	0.422	−1.507/ −0.485	< 0.001	
Pain lower extremities		0.683	0.250	0.324/ 1.465	0.006	
MMSE ≤ 27 p		0.440	0.249	−0.049/0.929	0.078	
Grip strength	683					0.140
Birth cohort, 1941-43/ 1952-54[b]		5.077	4.451	−3.663/13.817	0.254	
Height		2.269	0.339	1.604-2.935	< 0.001	
Marital status, living alone		−7.445	4.547	−16.373/1.483	0.102	
Secondary school		9.111	4.652	−0.023/18.246	0.051	
Physical activity, light		19.966	8.141	3.981/35.950	0.014	
Physical activity, strenuous		32.157	8.361	15.740/48.574	< 0.001	
Pain lower extremities		−14.682	4.920	−24.343/−5.021	0.003	
MMSE ≤ 27 p		−12.419	4.957	−22.151/−2.687	0.012	

[a] Before removing non-significant variables one by one in a backward manner, regression models were initially adjusted for height, weight, marital status, education, smoking habits, light and strenuous physical activity, MMSE, and pain in lower extremities.
[b] Birth cohort 1941-43 reference.

activities of daily living (ADL) or health deterioration have been shifted to a more advanced age in the later born cohort. In addition to an increasingly older population, especially in developed countries, (Kontis et al., 2017) it is likely that such a shift will place new demands on the design of national healthcare programs (Crimmins, 2004).

However, as this study shows, a birth cohort includes several factors that cannot be fully understood. Although we attempted to include variables that we hypothesized should be associated with the chosen physical tests and vary significantly between the birth cohorts, much of the variance in the walking and the chair stand tests remains unexplained. Further hypothesis explaining differences can only be speculative. The later cohort might be more likely to assimilate new knowledge or recent trends such as wellness programs or healthy lifestyle movements. The fact that the participants from the earliest cohort were born during World War II with poverty and lack of food affecting their anthropometry in their first year of life could also be part of the explanation (Guerrero-Serdan, 2009). These possible confounders are just a few examples of factors that may partly explain what we now summarize as the cohort effect.

A question is whether improved physical performance, as shown in this study, will continue or whether the differences will level-off over time. A continued trend of insight into the importance of healthier living habits, improved healthcare, and enhanced education opportunities indicate reduced differences between future cohorts. However, there is an uncertainty in cohort studies as it can be difficult to capture significant underlying variables, especially those related to attitudes or trends in society.

A strength of this study is that the examinations were performed with identical methods on both occasions. The large participation rate in both cohorts (62.8% and 70.2%) and the fact that the participants represent a randomized general population covering both rural and urban areas are also among the study's strengths. A limitation is that the walking speed and grip-strength tests could only be carried out at the research center and a selection bias excluding the frailest individuals cannot be ruled out. Nevertheless, this should be considered a minor problem as most of such individuals would not have been included in the study as they do not meet the inclusion criterion of being independent and not reliant on walking aids. A potential source of bias is that participants were included over a period of three years and although it is not a long time in this context, we cannot exclude the possibility that even within this short timeframe changes might have occurred that affected the physical tests reported herein. Another possible limitation is that data of other covariates previously shown to influence walking speed such as; diabetes (Allet et al., 2008), high blood pressure (Odden et al., 2016), osteoporosis (Dostanpor, Dobson, & Vanicek, 2018), inflammation (Elbaz et al., 2013), depression

(Sanders, Bremmer, Comijs, Deeg, & Beekman, 2016), use of anxiolytics (Gray et al., 2003), or lipid lowering drugs (Dumurgier, Singh-Manoux, Tavernier, Tzourio, & Elbaz, 2014), have not been available for inclusion in the analyses.

Contributors

Study design: H.E., and S.E.
Data collection: H.E. and S.E.
Data analysis: H.E., S.E. and L.S.W.
Drafting the manuscript: L.S.W., S.E., and H.E.

Conflict of interest

The authors declare no competing interests.

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