Trends in physical and cognitive performance among community-dwelling older adults in Switzerland

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ABSTRACT

Background. With population aging, a key question is whether new cohorts of older people are in better health than previous ones. This study aimed to compare the physical and cognitive performance of community-dwelling older adults assessed at similar age in 2005, 2010, and 2015.

Methods. This repeated cross-sectional analysis used data from the Lausanne cohort 65+, a three random sample population-based study. Performance of participants aged 66–71 years in 2005 (N=1309), 2010 (N=1253) and 2015 (N=1328) was compared using a battery of six physical and four cognitive tests. Analyses included tests for trend across samples and multivariable linear regression models.

Results. Adjusted performance in all four timed physical tests (gait speed, Timed Up-and-Go, five times chair stand, and Moberg Picking-Up) improved across samples from 2005 to 2015, by +12.7% (95% CI +10.5%; +14.9%) to +20.4% (95% CI +17.7%; +23.0%) in females, and by +10.6% (95% CI +8.7%; +12.4%) to +16.7% (95% CI +13.4%; +20.0%) in males. In contrast, grip strength and balance did not improve across samples. Adjusted cognitive performance showed no change in the Trail Making Test, but worsened significantly across samples for the Mini-Mental State Examination, verbal fluency, and the clock drawing test in both females (-1.9% (95% CI -2.7%; -1.1%) to -6.7% (95% CI -8.9%; -4.6%)) and males (-2.5% (95% CI -3.4%; -1.6%) to -8.0% (95% CI -11.1%; -4.9%)).

Conclusions. Over the last decade, performance of adults aged 66–71 years improved significantly in timed physical tests but worsened in most cognitive measures among later-born samples.

Keywords. Physical performance, Cognition, Functional performance, Public health

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INTRODUCTION

From 1900 to 2000, human life expectancy gained 25 years (1). As a result, the proportion of people aged 65 years and over doubled from the mid-1950s to nowadays in Switzerland (2) and many other countries world-wide (3). This demographic shift is still ongoing and represents a potential burden on health care systems. In this context, a key question for public policies is whether future cohorts of older people will be healthier than those of yesterday and today (4).

Three main scenarios have been proposed. According to the optimistic theory of Fries (compression of morbidity (5)), the onset of disability will be delayed along with improved life expectancy, thanks to medical progress and healthy life styles. In contrast, a pessimistic view (expansion of morbidity (6, 7)) posits that mortality gains will be achieved essentially through extension of years of life in poor health and functional dependency in older people, as a consequence of improvements in secondary prevention. Finally, an intermediate scenario (dynamic equilibrium (8)) forecasts an increase in prevalence but a decrease in the severity of chronic diseases that should leave the period spent in a highly disabled state relatively constant.

Research on health trends mainly focused on the ability to perform activities of daily living, as reported by older people themselves (9-12), while few studies directly assessed physical and cognitive health trends using performance tests. Conflicting trends were reported regarding gait speed, grip strength, chair stands, balance, and lung function (13-16). The prevalence of dementia has decreased over the last decades in the United States (17), Australia (18), and Sweden (19), but trends are less clear when considering earlier stages on the spectrum of cognitive functioning (14, 20, 21).

To further investigate these conflicting trends, the Lausanne cohort Lc65+ population-based study provides a key opportunity to compare three cohorts born before, during, and at the end of the Second World War. These birth cohorts appear historically relevant, in view of the long-term impact that an early childhood marked by the consequences of the Second World War seems to have on health deficits in older age (22). Therefore, the present study used baseline data from three representative samples of community-dwelling older adults enrolled in the Lc65+ study, in order to compare physical and cognitive functioning assessed at the same age using validated performance tests in 2005, 2010, and 2015.

METHODS

Population

Data used in the present study come from the Lausanne cohort 65+ (Lc65+) — a population-based study initiated in 2004 to investigate age-related frailty in old age (23). Three samples were randomly selected from the community-dwelling population in Lausanne (the capital of canton Vaud, Switzerland) in 2004, 2009, and 2014. These samples were representative of persons aged 65 to 70 years born respectively before (Pre-war: 1934-1938, N=3053), during (War: 1939-1943, N=3179), or at the end (Baby boom: 1944-1948, N=3655) of the Second World War. Individuals living in an institution or unable to respond due to advanced dementia were not included. As indicated in Figure 1, around half of the invited participants returned a valid enrollment questionnaire in each of the three samples. Previous analyses indicated that the socioeconomic characteristics (nationality, marital status, place of birth, living arrangement, and professional activity) of participants recruited in 2004 closely reflected the general population of the same age group in Lausanne (23). The present study used data from physical and cognitive performance tests conducted one year after enrollment, namely in 2005 (N=1309), 2010 (N=1253), or 2015 (N=1328), thereafter referred to as Pre-war, War and Baby boom samples, respectively. The demographic and objective health indicators available at study enrollment did not differ significantly between participants included or excluded from the present analyses (see eTable 1 in the Supplement).

The protocol was approved by the Ethics Committee of the Faculty of Biology and Medicine of the University of Lausanne (19/04). Written informed consent was obtained from the participants.

Physical and cognitive performance

Physical and cognitive assessments were performed by medical research assistants according to a standardized protocol. As detailed elsewhere (23), a rigorous methodology was followed to train the medical research assistants and to ensure reliability across the three samples. Physical performance assessment comprised tests used in the Short Physical Performance Battery (i.e. gait speed, five times chair stand test and standing balance) (24), and it also included the timed Up-and-Go (25), the Moberg Picking-Up Test (26), and grip strength. Cognitive performance tests included the Mini-Mental State Examination (MMSE) (27), the Trail Making Test (B-A: time difference between parts A and B) (28), the verbal fluency test (29), and the clock drawing test (30). A detailed description of all physical and cognitive performance tests is provided in eMethods in the Supplement.

Covariates

Body weight was assessed using an electronic scale accurate to ± 0.05 kg. Height was measured using a wall-mounted stadiometer to the nearest 0.1 cm. Participants were measured in light clothes and without shoes. Given the strong association between education and cognition (31), the highest level of education achieved was considered as a potential confounding factor. It was classified according to the International Standard Classification of Education (ISCED) (32): 'basic compulsory' (ISCED level 0–2), 'apprenticeship' (ISCED level 3), 'baccalaureate/professional degree' (ISCED level 4–5) or 'university/high school' (ISCED level 6–8). Detailed sociodemographic characteristics of the three samples were reported previously (33).

Statistical analysis

All analyses were stratified by sex because several characteristics are known to differ according to sex (e.g. height, grip strength), and because trends in physical and cognitive performance may differ between females and males. Sampling weights were used to maximize age and sex representativeness. Descriptive statistics (mean and standard deviation) were used to compare the characteristics of Pre-war, War, and Baby boom samples. The significance of the trends across samples was assessed using linear regression. Ten-year changes in performance tests (i.e. Baby boom sample (assessed in 2015) compared to Pre-war sample (assessed in 2005)) were calculated using linear regression models, which allowed adjusting for age and other potential confounders. Change in gait speed was adjusted for height; change in timed Up-and-Go and in five times chair stand test for height and BMI; change in grip strength for BMI; changes in cognitive performance tests for education. Performance changes in Timed Up-and-Go, five times chair stand test, Moberg Picking-Up, and Trail Making test were reverse coded so that positive changes indicate improvement. Analyses were conducted using Stata 15.0 software (StataCorp, College Station, TX). Significance was set at $p<0.05$, with Bonferroni adjustment for multiple testing.

A sensitivity analysis was conducted to explore the potential influence of habits, behavioral factors (hazardous drinking, smoking, low physical activity), and depressive symptoms on the main findings. These variables were added as covariates in the calculation of adjusted 10-year changes. Because of missing values in these variables, the sample size in the sensitivity analysis was 3681 instead of 3890. A second sensitivity analysis was performed to examine trends in proportions at lower and upper performance levels. A cut-off was set at the 20th and 80th sex-specific percentiles of the earliest sample (i.e. Pre-war). For the MMSE, the commonly used cut-off <24 was applied instead of the 20th percentile. Given the trend towards increasing levels of education across cohorts of older people (31), a third sensitivity analysis consisted in estimating the 10-year changes in the cognitive performance tests with and without adjustment for education.

RESULTS

Table 1 displays and compares the main sex-specific characteristics across Pre-war, War, and Baby boom samples. In both females and males, the level of education increased significantly across samples ($p<0.001$). A significant trend towards increasing height was also observed in both females ($p=0.001$) and males ($p<0.001$). From 2005 to 2015, height increased by 1.04 cm in females and 2.08 cm in males. No significant trend was observed in country of birth, weight and BMI.

Physical and cognitive performance tests

As indicated in Table 2, a significant trend towards increasing gait speed across samples was observed in both sexes ($p<0.001$). Over the 10-year study period, gait speed increased by 0.16 $m \cdot s^{-1}$ in females and 0.14 $m \cdot s^{-1}$ in males. Similarly, a significant decreasing trend was observed in the completion time of the Timed Up-and-Go, five times chair stand test, and Moberg Picking-Up Test ($p<0.001$ in both sexes). In contrast, results showed either no trend (grip strength in females, standing balance in both sexes) or a trend towards lower performance (grip strength in males, $p<0.001$) in later-born samples.

As detailed in Table 3, results in the MMSE score, verbal fluency, and the clock drawing test indicated a significant decreasing trend across samples in both females ($p=0.01$, $p=0.003$, and $p<0.001$, respectively) and males ($p=0.002$, $p<0.001$, and $p<0.001$, respectively). In contrast, no significant trend was observed in the Trail Making Test (B-A).

Adjusted 10-year changes

Figure 2 illustrates 10-year changes after adjustment for appropriate covariates. From the Pre-war to the Baby boom sample, four physical tests improved significantly in both females (gait speed +13.8% (95% confidence interval (CI) +12.2%; +15.5%), Timed Up-and-Go +16.7% (95% CI +14.6%; +18.7%), five times chair stand +20.4% (95% CI +17.7%; +23.0%), and Moberg Picking-Up Test +12.7% (95% CI +10.5%; +14.9%)) and males (gait speed +10.6% (95% CI +8.7%;

+12.4%), Timed Up-and-Go +11.7% (95% CI +9.3%; +14.2%), five times chair stand +16.7% (95% CI +13.4%; +20.0%), and Moberg Picking-Up Test +12.7% (95% CI +10.2%; +15.1%)). Grip strength did not change significantly in females (+0.5% (95% CI -1.5%; +2.5%)) and worsened significantly in males (-4.7% (95% CI -6.9%; -2.4%)) across samples, whereas standing balance remained stable across samples in both females (-1.0% (95% CI -3.0%; +0.9%)) and males (-2.4% (95% CI -4.5%; -0.4%)). Three cognitive tests worsened significantly across samples in both females (MMSE -1.9% (95% CI -2.7%; -1.1%), verbal fluency -5.4% (95% CI -7.7%; -3.0%), and clock drawing test -6.7% (95% CI -8.9%; -4.6%)) and males (MMSE -2.5% (95% CI -3.4%; -1.6%), verbal fluency -8.0% (95% CI -11.1%; -4.9%), and clock drawing test -6.0% (95% CI -8.3%; -3.8%)).

Sensitivity analyses

In the regression models that incorporated behavioral factors and depressive symptoms as covariates, adjusted 10-year changes in physical and cognitive performance remained essentially unchanged (see eFigure 1 in the Supplement). The trends of the proportions in the lower and upper distribution are provided in eTable 2 and eTable 3 in the Supplement. Generally, significant trends previously reported in the main analysis were confirmed at both lower and upper ends in this more detailed analysis. Of note however, while the proportion of participants with MMSE scores lower than 24 did not increase significantly across samples in females (p=0.71), and increased with marginal significance over the Bonferroni-adjusted level in males (p=0.04), a highly significant decreasing trend was observed at upper performance level in both females (p=0.002) and males (p=0.004). The results of the third sensitivity analysis are provided in eFigure 2 in the Supplement, which illustrates that the decreasing trend across samples observed in three cognitive performance tests (i.e. MMSE, verbal fluency, and clock drawing test) was significant both with and without adjustment for education, though not at the Bonferroni-adjusted level for one of them (unadjusted MMSE in females).

DISCUSSION

Main findings

In the context of population aging, whether today's older people are in better health than their predecessors is a key concern for policy makers, researchers, clinicians, and for individuals and their relatives. The present results suggest opposite trends in physical and cognitive performance of community-dwelling older adults over the last decade. Whereas trends in the four timed physical performance tests were consistent with the compression of morbidity, results for most cognitive tests indicated a trend towards expansion of morbidity.

In a previous study on the same samples, no significant trend was observed from 2004 to 2014 in a large set of subjective health measures, including self-reported disability in activities of daily living (33). Hence, people enter in old age with differences in objectively measured physical and cognitive health compared to their later-born peers that do not translate into differences in health perception. It is possible that trends in physical and cognitive performance compensate each other, leaving health perception unchanged. Alternatively, the impact of changes in physical and cognitive health on functional ability and health perception could be attenuated through interactions with the physical, social and societal environments framing older people's lives.

Physical performance tests

Results from this study add important information to the current literature on trends in physical performance in recent cohorts of older persons. All the four timed physical performance tests showed encouraging trends, suggesting that Baby boomers enter into old age with better physical function than their peers born ten years earlier. Moreover, some of these improvements did not only reach statistical significance, but also achieved a magnitude of change well above what has been shown to be clinically meaningful (34, 35). In particular, the 10-year increase in gait speed of 0.16 $m \cdot s^{-1}$ in females and 0.14 $m \cdot s^{-1}$ in males is over the cutoffs estimated for small (0.05 $m \cdot s^{-1}$) and substantial (0.10 $m \cdot s^{-1}$) meaningful changes. In contrast to these observations, grip strength and standing balance did not increase across samples. A significant decrease across samples was even observed in males. This corroborates a recent study that did not report a difference in grip strength between 2004-2005 and 2013 for seven European countries combined, but with region-stratified analyses indicating a slight decrease in Central Europe (including Switzerland) as opposed to improvement in Northern and Southern Europe (14). Consistent with the present results, Santoni et al. reported decreased impairments in five times chair stand test and gait speed from 2001-2004 to 2013-2016, but no significant change in the prevalence of impairment in balance (13). Finally, Christensen et al. observed inconsistent differences in three physical performance tests (grip strength, chair stand, and gait speed) between 1998 and 2010 among nonagenarians born 10 years apart (15).

An additional original contribution of the present study was to extend observations on upper limb function in more recent cohorts of older persons. Indeed, most previous studies restricted their observation to strength measures (most frequently grip strength), whereas the present study shows similar improvement in measures of coordination and motor processing speed (i.e. Moberg Picking-Up Test). Overall, these results strongly suggest improvement in physical performance in younger cohorts of older persons. This favorable trend may result from differential influences of the Second World War on aging cohorts born before, during, or at the end of the war (22). Whereas prenatal exposure to the war does not seem linked with poorer health in older age (36), adverse events experienced during childhood have broad effects on neural, endocrine, immune, and metabolic physiology in later life (37), and have been linked with increased telomere length, a marker of cellular senescence (38).

Cognitive performance tests

The current study offers new insight and raises unique issues about cognitive performance trends in recent cohorts of older persons. Contrary to the so-called Flynn effect (i.e. secular improvement in cognitive performance) reported in recent European studies (14, 21), the results of three cognitive performance tests (i.e. MMSE, verbal fluency, and clock drawing test) converged towards a decrease across samples by around five percent in the cognitive capacities over ten years. Even though these changes appear far from clinically meaningful, the results also suggest that this trend applies mainly to higher levels of cognitive performance. The decline in cognitive performance across samples may actually be driven by a decreasing motivation to engage in effortful cognitive activities (referred to as need for cognition). Although recent trends in this motivational trait are unknown, a longitudinal study reported a significant association between need for cognition and positive change in cognitive status two years later (39).

Although recent evidence tends to support the Flynn effect (14, 17, 21), the present findings are in line with secular trends from 1993 to 2012 of modest decline reported in older US adults (20). Similarly, data from the Longitudinal Aging Study Amsterdam indicated an increase in incidence rates of persistent cognitive decline from 2.5% in 1992 to 3.4% in 2012 (40). Conflicting findings may be due to differences in measurements, periods covered, age at assessment, and sample characteristics.

Diverging trends in physical and cognitive performance tests

The literature shows that individuals who perform well in physical tests tend to have high scores in cognitive tests as well (41). This positive association was also noticed in the present study in both females and males (see eTable 4 in the Supplement), but diverging trends were still found in physical and cognitive performance. In fact, improvements in physical performance were observed only in tests for which time was recorded (i.e. gait speed, Timed

Up-and-Go, five times chair stand, and Moberg Picking-Up Test). In contrast, no improvement was observed in grip strength and standing balance, which do not involve speed-related skills. Taken together, these trends in physical tests point to improvements in the processing speed when performing movements or tasks. Such characteristics appear of increasing importance in today's accelerating world. From this perspective, the improving trend in speed-related physical performance and the decreasing trend in cognitive performance may be signs of an adaptation of older people to modern societies (e.g. cognitive overflow related to information and communication technology). This hypothesis is supported by emerging evidence from computational neuropsychiatry. By organizing brain processing in fast (emotional, stereotypic) and slow (logical, conscious) timescales, recent studies suggest that slowness of cognition combined with fast reactions can help to cope with an accelerating pace of life (42). Thus, the trends observed in the present study may actually reflect changes in the optimal balance between fast and slow cognition.

Strengths and limitations of the study

The present study has overcome limitations of most similar previous studies as its design allowed comparing an extensive set of physical and cognitive performance tests among three representative samples of community-dwelling older adults, assessed at similar age in 2005, 2010, and 2015, using a strictly standardized methodology, and controlling for a number of potential confounders. Yet, several potential limitations should be mentioned. First, age ranged from 66 to 71 years. Although useful in terms of samples homogeneity, it prevented generalizing the results to younger or older subgroups. Second, the trends observed may reflect a cohort effect (i.e. being part of the Pre-war, War or Baby boom sample), a period effect (being assessed in 2005, 2010 or 2015) or a combination of both effects. The differentiation of these effects is complicated by the exact linear dependency of age, period, and cohort (cohort = period – age) (43). Nevertheless, the trends addressed in this study depend on the cumulative effect of cohort and period. From a public health perspective, the relevance of distinguishing their specific effects therefore appears limited. Third, this cross-sectional comparison across the three samples could not determine whether improvements observed in the more recent samples resulted from higher performance achieved at younger age, from a flatter slope of decline, or from their combination. Future longitudinal analyses should address this issue. Finally, no population data were available to verify if representativeness at study enrollment in terms of age, sex and socio-economic characteristics are generalizable to performance tests.

Conclusion

This three random sample population-based study of community-dwelling Swiss older adults found diverging trends regarding physical and cognitive performance over the last decade. While improvements in speed observed across samples using multiple physical performance tests were consistent with the compression of morbidity theory, results for cognitive performance suggest a slight secular decline, particularly at high levels of cognition. These findings call for close monitoring of older adults' cognitive performance and actions to prevent cognitive decline in the coming decades. Future longitudinal analyses are needed to better characterize the dynamics of these trends.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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CONTRIBUTORS

YH did the statistical analyses and drafted the manuscript. BSE designed and conducted the data collection as the principal investigator of the Lc65+ study. All authors contributed to the study concept and design, to the interpretation of data, to the critical review of the manuscript, and approved the final version.

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Table 1. Main characteristics of community-dwelling older adults from the Pre-war, War, and Baby boom samples

Characteristics	Females (N=2255)				Males (N=1635)			
	Pre-war	**War**	**Baby boom**	**B (95% CI)** [a]	**Pre-war**	**War**	**Baby boom**	**B (95% CI)** [a]
Education (N=3883, %)								
Basic compulsory	30.7	22.6	15.7	0.19 *	17.7	10.9	10.9	0.18 *
Apprenticeship	36.6	39.1	40.3	(0.14; 0.24)	42.7	41.3	32.3	(0.12; 0.24)
Baccalaur./prof. degree	25.4	25.6	25.3		20.2	24.6	24.7	
University/high school	7.3	12.7	18.7		19.5	23.2	32.0	
Country of birth (N=3885, %)								
Switzerland	74.0	74.4	72.2	-0.01	72.7	67.8	70.3	-0.01
Other	26.0	25.6	27.8	(-0.04; 0.01)	27.3	32.2	29.7	(-0.03; 0.01)
Weight (N=3877, kg)								
Mean	68.38	68.29	68.31	-0.03	81.78	83.48	82.72	0.44
Standard deviation	13.50	13.16	13.28	(-0.71; 0.64)	12.53	14.00	13.94	(-0.35; 1.22)
Height (N=3885, cm)								
Mean	159.95	160.94	160.98	0.51 *	171.68	172.72	173.76	1.04 *
Standard deviation	6.17	6.16	6.34	(0.20; 0.83)	6.94	6.66	6.95	(0.63; 1.45)
Body mass index (N=3877, %)								
Underweight [b]	2.6	1.9	2.1	-0.18	0.0	0.6	0.5	-0.19
Normal weight [c]	38.8	43.4	44.2	(-0.44; 0.08)	23.0	23.4	28.2	(-0.43; 0.06)
Overweight [d]	35.1	34.1	31.8		52.7	48.3	48.9	
Obesity [e]	23.5	20.6	21.8		24.3	27.8	22.4	

Notes: B = unstandardized coefficient; CI = confidence interval

[a] Linear regression

[b] Body mass index <18.5 $kg \cdot m^{-2}$; [c] Body mass index 18.5 to <25 $kg \cdot m^{-2}$;

[d] Body mass index 25 to <30 $kg \cdot m^{-2}$; [e] Body mass index ≥30 $kg \cdot m^{-2}$

* Significant at the Bonferroni-adjusted level (four comparisons for females and males)

Table 2. Trends in physical performance tests among community-dwelling older adults

Characteristics	Females (N=2255)				Males (N=1635)			
	Pre-war	War	Baby boom	B (95% CI) [a]	Pre-war	War	Baby boom	B (95% CI) [a]
Gait speed (N=3784, m·s^{-1})								
Mean	1.11	1.25	1.27	0.08 *	1.19	1.32	1.33	0.07 *
Standard deviation	0.19	0.19	0.18	(0.07; 0.09)	0.18	0.20	0.19	(0.06; 0.08)
Timed Up-and-Go (N=3752, s)								
Mean	12.85	10.68	10.60	-1.10 *	12.33	10.54	10.77	-0.75 *
Standard deviation	3.13	2.47	2.24	(-1.24; -0.96)	2.58	2.21	2.51	(-0.90; -0.59)
Five times chair stand test (N=3654, s)								
Mean	12.02	10.85	9.61	-1.21 *	10.95	10.25	9.19	-0.89 *
Standard deviation	3.29	2.81	2.77	(-1.37; -1.05)	2.88	2.44	3.13	(-1.07; -0.71)
Grip strength (N=3863, kg)								
Mean	23.66	24.54	23.81	0.06	40.07	40.30	38.09	-1.03 *
Standard deviation	4.84	5.01	4.61	(-0.18; 0.30)	7.81	7.95	7.72	(-1.49; -0.57)
Moberg Picking-Up Test (N=3876, s)								
Mean	13.68	12.84	11.93	-0.87 *	14.60	13.72	12.75	-0.93 *
Standard deviation	3.23	2.80	2.77	(-1.02; -0.72)	3.12	3.08	2.95	(-1.11; -0.75)
Standing balance (N=3864, 0-4)								
Mean	3.74	3.82	3.70	-0.02	3.82	3.82	3.73	-0.05
Standard deviation	0.72	0.64	0.70	(-0.06; 0.02)	0.64	0.60	0.68	(-0.09; -0.01)

Notes: B = unstandardized coefficient; CI = confidence interval

[a] Linear regression

* Significant at the Bonferroni-adjusted level (six comparisons for females and males)

Table 3. Trends in cognitive performance tests among community-dwelling older adults

Characteristics	Females (N=2255)				Males (N=1635)			
	Pre-war	**War**	**Baby boom**	**B (95% CI)** [a]	**Pre-war**	**War**	**Baby boom**	**B (95% CI)** [a]
MMSE score (N=3857, 0-30)								
Mean	27.59	27.73	27.34	-0.13	27.44	27.49	27.04	-0.21 *
Standard deviation	2.12	2.16	2.17	(-0.24; -0.02)	2.14	2.14	2.32	(-0.34; -0.07)
Trail Making Test B-A (N=3566, s)								
Mean	73.11	68.33	69.23	-1.89	69.27	70.36	66.60	-1.42
Standard deviation	46.65	41.23	55.55	(-4.60; 0.82)	43.81	44.52	54.57	(-4.49; 1.66)
Verbal fluency (N=3652, words)								
Mean	20.24	19.99	19.47	-0.39 *	17.48	16.94	16.43	-0.53 *
Standard deviation	4.59	4.50	4.37	(-0.62; -0.16)	4.49	4.10	4.47	(-0.80; -0.25)
Clock drawing test (N=3869, 0-10)								
Mean	8.39	8.26	7.97	-0.21 *	8.63	8.50	8.22	-0.21 *
Standard deviation	1.79	1.61	1.85	(-0.31; -0.12)	1.61	1.49	1.72	(-0.30; -0.11)

Notes: MMSE = Mini-Mental State Examination; B = unstandardized coefficient; CI = confidence interval

[a] Linear regression

* Significant at the Bonferroni-adjusted level (four comparisons for females and males)

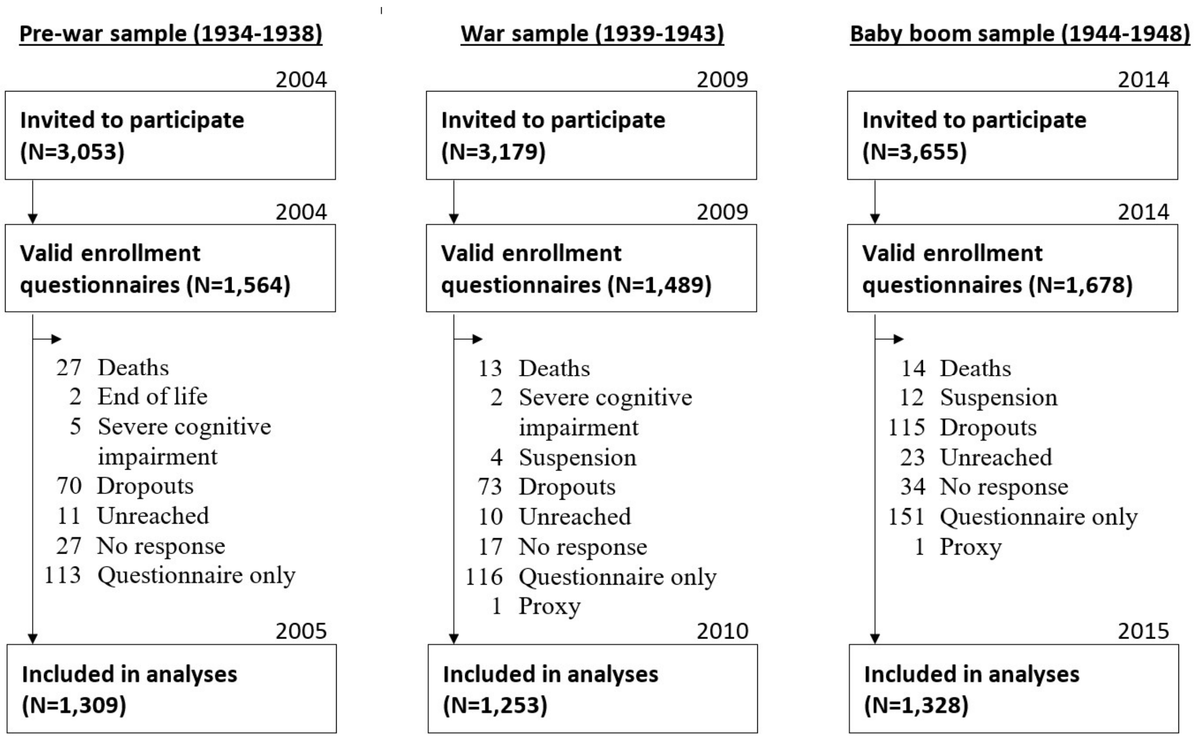

Figure 1. Selection procedure of study participants

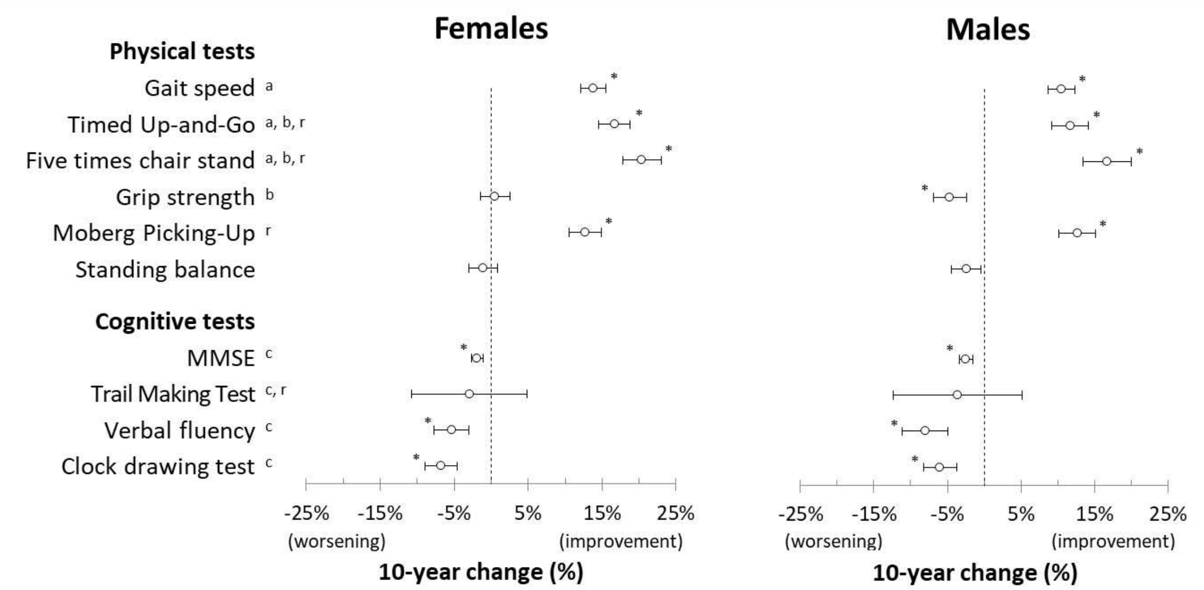

Figure 2. Adjusted 10-year changes in physical and cognitive performance tests (% of 2005 values)

Notes: Error bars indicate 95% confidence intervals; MMSE = Mini-Mental State Examination

[a] adjusted for height; [b] adjusted for BMI; [c] adjusted for education; [r] reverse coded so that positive changes indicate improvement; [*] Significant at the Bonferroni-adjusted level (six physical tests comparisons and four cognitive tests comparisons for females and males)

SUPPLEMENTARY MATERIAL

Trends in physical and cognitive performance among community-dwelling older adults in Switzerland

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eMethods. Detailed description of performance tests

Physical performance tests

Gait speed was assessed on a well-lighted 20-meter walkway with participants walking at usual speed from a starting line to a finish line marked on the ground. A stopwatch was started when the first foot of the participant crossed the starting line, and was stopped when one of the participant's feet completely crossed the finish line.

The timed Up-and-Go is a test of basic functional mobility (1). It was recorded as the time (seconds) needed to stand up from a seated position without the help of arms, walk 3 m, turn around, walk back to the chair and sit down without the help of arms. A stopwatch was started as soon as the participant started moving, and was stopped when the participant was seated (pelvis and thighs on the chair, immobile trunk).

The five times chair stand test is a widely used indicator of lower limb strength (2, 3). It was recorded as the time (seconds) needed to stand up five times from a seated position. Participants were asked to have their legs and back straight in the standing position, and to keep their arms crossed on the chest during the test.

The Moberg Picking-Up Test was developed to assess hand function (4). It consists in measuring the time (seconds) needed to pick up twelve small objects one by one with the dominant hand, and to put them into a small container as quickly as possible and in any order. In the Lc65+ study, the Moberg Picking-Up Test was introduced to measure perceptual and motor processing speed.

Grip strength was assessed on the right hand using a Jamar-type hydraulic hand dynamometer. Participants sat in a chair without armrests and held the dynamometer with the shoulder in adduction (arm to body), elbow bent at 90°, forearm in neutral position, and wrist at 0-30° dorsiflexion and 0-15° ulnar inclination. The best performance of three trials was expressed in kilograms (kg).

Standing balance was assessed on a 0 to 4 score according to the Established Populations for the Epidemiologic Study of the Elderly (EPESE) protocol (3):

- Score 4: Able to hold a full tandem stand for 10 s
- Score 3: Able to hold a full tandem stand for 3 to 9 s
- Score 2: Unable to hold a full tandem stand for more than 2 s but able to hold a semitandem stand for 10 s
- Score 1: Able to hold a side-by side stand for 10 s
- Score 0: Unable to hold a side-by side stand for 10 s

Cognitive performance tests

The Mini-Mental State Examination (MMSE) is a valid test of overall cognitive functioning (5) that provides a score ranging from 0 to 30, with higher score indicating better cognition. The test was performed in French, but two parts (i.e. the serial sevens and the sentence to write) could be done in the participant's mother tongue if this was deemed more appropriate.

The Trail Making Test (and its two parts A and B) is a commonly used neuropsychological instrument that assesses a number of different cognitive constructs, including visuomotor tracking, motor and executive processing speed, divided attention (part B), cognitive flexibility (part B), as well as working memory (part B) (6). It is recorded as the time (seconds) needed to draw a line connecting circles numbered from 1 to 25 (part A), or connecting alternatively numbers (from 1 to 13) and letters (from A to L) (part B), as quickly and with as few errors as possible (7). Assuming that both parts A and B have similar demands in terms of perceptual and motor processing speed, the difference score B-A corresponds to the increment of cognitive difficulty between parts A and B of the test, which was shown to be a better indicator of executive functioning than part A, part B, or the ratio B/A (8).

The verbal fluency test is commonly used to assess cognitive performance, and is considered as an indicator of verbal and executive control abilities (9). Participants were asked to quote the highest number of fruits and vegetables in one minute. The total number of correct words was recorded. A word repeated twice was counted only once. The test was performed in French. If non-native French speakers mentioned some words in their mother tongue, a translation was requested from them at the end of the test and the words were counted if correct.

The clock drawing test is a cognitive screening test. Participants were asked to remove their watch (if any) and to draw a clock, starting with a circle and then inserting all the numbers and setting the hands to "10 after 11". A score was calculated using Rouleau et al.'s rating scale (10), which is based on the representation of the clockface (2 points), the layout of numbers (4 points), and the position of the hands (4 points). The score ranged from 0 to 10, with higher score indicating better cognition.

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eTable 1. Comparison of participants included or excluded from analyses on the demographic and objective health indicators available at study enrollment

Characteristics	Excluded from analyses (N=841)	Included in analyses (N=3890)	p-value [a]
Sex			
Females	480 (57.1%)	2255 (58.0%)	0.634
Males	361 (42.9%)	1635 (42.0%)	
Age			
66	164 (19.5%)	832 (21.4%)	0.265
67	164 (19.5%)	817 (21.0%)	
68	160 (19.0%)	769 (19.8%)	
69	180 (21.4%)	760 (19.5%)	
70	173 (20.6%)	712 (18.3%)	
Number of chronic conditions [b]			
0	198 (24.0%)	939 (24.2%)	0.179
1	276 (33.5%)	1413 (36.4%)	
≥2	351 (42.6%)	1526 (39.4%)	
Number of drugs [c]			
0	139 (16.9%)	759 (19.8%)	0.103
1	205 (24.9%)	1042 (27.1%)	
2	202 (24.6%)	879 (22.9%)	
3	139 (16.9%)	628 (16.4%)	
4	74 (9.0%)	300 (7.8%)	
≥5	63 (7.7%)	231 (6.0%)	

[a] Pearson Chi-squared test

[b] Number of chronic conditions ever diagnosed by a physician, as reported by participants among a total of 11 proposed conditions: hypertension, coronary heart disease, other heart diseases, stroke, diabetes mellitus, chronic respiratory disease, osteoporosis, arthritis, cancer, gastrointestinal ulcer, and Parkinson's disease

[c] Number of drugs taken at least once per week to treat: hypertension, hypercholesterolemia, heart disease, asthma, diabetes (insulin), diabetes (pills), joint pain or inflammation, other types of pain (headaches, back pain, etc.), sleep problems (sleeping pills), anxiety or depression, menopause or osteoporosis (hormones), other problems (up to three)

eTable 2. Trends in proportions in the lower and upper distribution (females)

Characteristics	Pre-war (N=770)	War (N=739)	Baby boom (N=746)	p-value [a]
Gait speed				
$\leq 0.97\ m \cdot s^{-1}$	19.2%	8.0%	5.2%	<0.001 [*]
$\geq 1.26\ m \cdot s^{-1}$	23.8%	51.7%	57.0%	<0.001 [*]
Timed Up-and-Go				
≥ 14.7 s	25.7%	6.2%	7.1%	<0.001 [*]
≤ 10.6 s	18.8%	57.4%	56.7%	<0.001 [*]
Five times chair stand test				
≥ 14.1 s	27.1%	15.0%	12.2%	<0.001 [*]
≤ 9.4 s	18.3%	30.3%	52.3%	<0.001 [*]
Grip strength				
≤ 20.0 kg	20.6%	16.6%	19.8%	0.68
≥ 27.2 kg	26.0%	32.7%	23.3%	0.26
Moberg Picking-Up Test				
≥ 15.5 s	20.5%	13.7%	6.7%	<0.001 [*]
≤ 11.4 s	20.0%	34.0%	49.5%	<0.001 [*]
MMSE score				
< 24	5.6%	5.0%	6.0%	0.71
> 28	42.3%	47.1%	34.3%	0.002 [*]
Trail Making Test B-A				
≥ 99 s	27.4%	24.1%	24.0%	0.13
≤ 38 s	18.3%	20.7%	26.1%	<0.001 [*]
Verbal fluency				
≤ 16 words	18.8%	21.5%	23.3%	0.03
≥ 24 words	26.5%	26.1%	22.7%	0.09

Note: MMSE = Mini-Mental State Examination

[a] Test for trend across samples

[*] Significant at the Bonferroni-adjusted level (ten physical tests comparisons and six cognitive tests comparisons)

eTable 3. Trends in proportions in the lower and upper distribution (males)

Characteristics	Pre-war (N=539)	War (N=514)	Baby boom (N=582)	p-value [a]
Gait speed				
≤ 1.05 $m \cdot s^{-1}$	19.5%	6.6%	6.0%	<0.001 *
≥ 1.33 $m \cdot s^{-1}$	22.8%	50.2%	51.4%	<0.001 *
Timed Up-and-Go				
≥ 13.9 s	23.4%	6.8%	7.2%	<0.001 *
≤ 10.4 s	19.3%	54.3%	52.1%	<0.001 *
Five times chair stand test				
≥ 12.7 s	24.1%	17.3%	13.7%	<0.001 *
≤ 8.8 s	19.1%	28.0%	49.0%	<0.001 *
Grip strength				
≤ 34.0 kg	21.3%	18.7%	32.0%	<0.001 *
≥ 46.3 kg	22.3%	21.6%	13.2%	<0.001 *
Moberg Picking-Up Test				
≥ 16.5 s	20.6%	13.4%	6.7%	<0.001 *
≤ 12.2 s	19.9%	31.9%	48.8%	<0.001 *
MMSE score				
< 24	5.0%	5.1%	7.9%	0.04
> 28	36.7%	38.7%	28.7%	0.004 *
Trail Making Test B-A				
≥ 94 s	28.6%	29.0%	24.6%	0.13
≤ 37 s	18.6%	20.6%	24.9%	0.009
Verbal fluency				
≤ 14 words	25.8%	28.2%	32.0%	0.02
≥ 21 words	26.9%	25.3%	24.9%	0.45

Notes: MMSE = Mini-Mental State Examination

[a] Nonparametric test for trend across ordered groups

* Significant at the Bonferroni-adjusted level (ten physical tests comparisons and six cognitive tests comparisons)

eTable 4. Pairwise correlations between physical and cognitive performance tests, by sex [a]

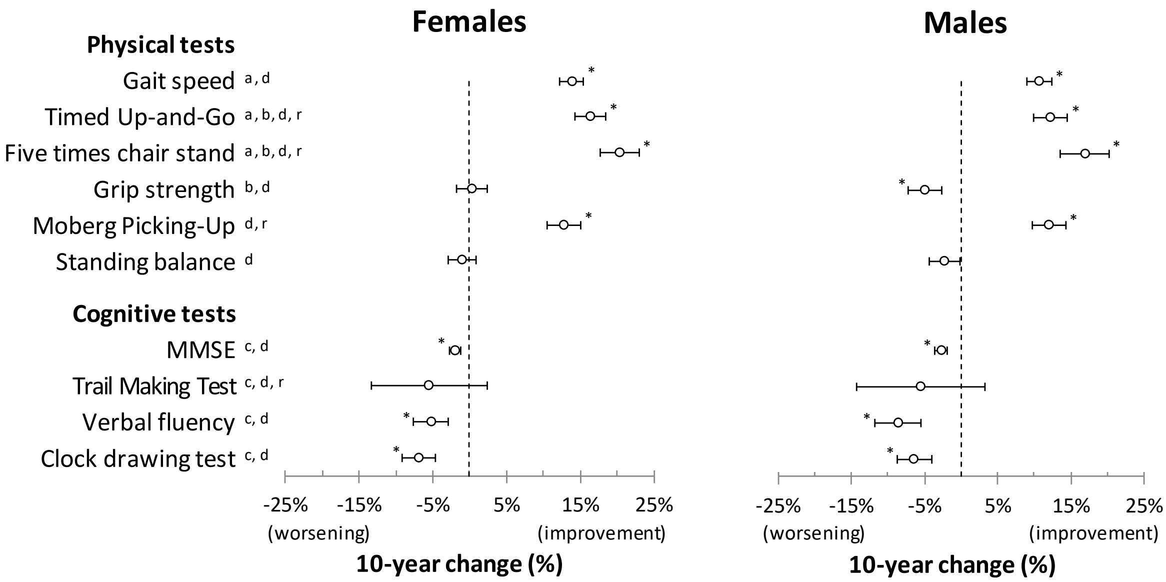
	1	2	3	4	5	6	7	8	9	10
Physical performance										
1. Gait speed	–	0.68 *	0.40 *	0.16 *	0.30 *	0.10 *	0.06	0.15 *	0.08	0.04
2. Timed Up-and-Go	0.71 *	–	0.46 *	0.10 *	0.30 *	0.13 *	0.05	0.12 *	0.07	0.02
3. Five times chair stand	0.43 *	0.52 *	–	0.08	0.35 *	0.07	-0.01	0.09 *	0.03	0.00
4. Grip strength	0.22 *	0.19 *	0.11 *	–	0.06	0.07	0.07	0.12 *	0.05	0.13 *
5. Moberg Picking-Up Test	0.30 *	0.30 *	0.32 *	0.13 *	–	0.07	0.04	0.18 *	0.02	0.08
6. Standing balance	0.10 *	0.14 *	0.08 *	0.08 *	0.08 *	–	0.07	0.02	0.05	0.01
Cognitive performance										
7. MMSE score	0.08 *	0.09 *	0.01	0.10 *	0.03	0.13 *	–	0.24 *	0.17 *	0.17 *
8. Trail Making Test B-A	0.11 *	0.13 *	0.14 *	0.11 *	0.11 *	0.07 *	0.25 *	–	0.21 *	0.19 *
9. Verbal fluency	0.08 *	0.07	0.04	0.08 *	0.03	0.06	0.21 *	0.25 *	–	0.11 *
10. Clock drawing test	-0.01	-0.01	-0.01	0.05	0.02	0.07	0.19 *	0.22 *	0.18 *	–

Notes: MMSE = Mini-Mental State Examination; TMT = Trail Making Test

[a] Spearman's rhos for females and males are reported below and above the diagonal, respectively.

[*] Significant at the Bonferroni-adjusted level (forty-five correlations for females and males)

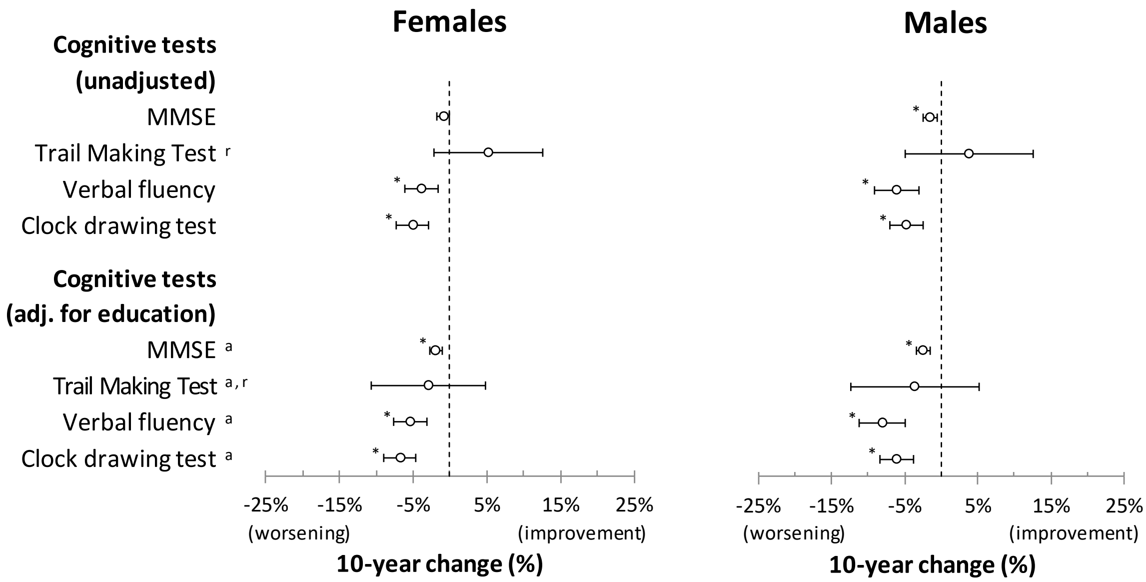
eFigure 1. Sensitivity analysis: fully adjusted 10-year changes in physical and cognitive performance tests (% of 2005 values)



Notes: MMSE = Mini-Mental State Examination

[a] adjusted for height; [b] adjusted for BMI; [c] adjusted for education; [d] adjusted for hazardous drinking, smoking, low physical activity, and depressive symptoms; [r] reverse coded so that positive changes indicate improvement; [*] Significant at the Bonferroni-adjusted level (six physical tests comparisons and four cognitive tests comparisons for females and males)

eFigure 2. Sensitivity analysis: 10-year changes in cognitive performance tests unadjusted and adjusted for the level of education (% of 2005 values)



Notes: MMSE = Mini-Mental State Examination

[a] adjusted for education; [r] reverse coded so that positive changes indicate improvement; [*] Significant at the Bonferroni-adjusted level (four comparisons for females and males)