Long-term evolution of functional limitations in stroke survivors compared to stroke-free controls: findings from 15 years of follow-up across three international surveys of ageing

Andres Gil-Salcedo, MSc[1,] Aline Dugravot, MSc[1,] Aurore Fayosse, MSc[1], Louis Jacob, MD, PhD[1,2,3], Mikaela Bloomberg, MSc[4], Séverine Sabia, PhD[1,4], Alexis Schnitzler MD, PhD[1,5]

[1]Université de Paris, Inserm U1153, Epidemiology of Ageing and Neurodegenerative diseases, France

[2]Research and Development Unit, Parc Sanitari Sant Joan de Déu, CIBERSAM, Dr. Antoni Pujadas, 42, Sant Boi de Llobregat, Barcelona 08830, Spain

[3]Centro de Investigación Biomédica en Red de Salud Mental (CIBERSAM), Madrid, Spain

[4]Department of Epidemiology and Public Health, University College London, UK

[5]Université Versailles Saint Quentin en Yvelines, EA 4047 Handi-Resp, Service de neurologie hôpital A.,Mignot, Garches, France

CORRESPONDING AUTHOR:

Andres Gil-Salcedo

10 avenue de Verdun, 75010 Paris, France

Email: andres.gil-salcedo@inserm.fr

Cover title: **Long-term evolution of functional limitations in stroke survivors compared to stroke-free controls**

Tables 1; Figures 3.

WORD COUNT: ABSTRACT: 299; WORD COUNT: 6547

Abstract

Background and Purpose

In the chronic phase 2-5 years post-stroke, limitations in activities of daily living (ADL) and instrumental activities of daily living (IADL) initially plateau before steady increasing. However, the impact of age and differences in initial levels of disability on the evolution of these limitations remains unclear. As such, this study aims to evaluate differences in long-term evolution of ADL/IADL limitations between stoke survivors and stroke-free population, and how limitations differ by initial level of disability for stroke survivors.

Methods

33,660 participants (5,610 first-ever stroke cases with no recurrence during follow-up and 28,050 stroke-free controls) aged ≥50 from the Health and Retirement Study, Survey of Health, Ageing and Retirement in Europe, and English Longitudinal Study of Ageing were assessed for number of ADL/IADL limitations during the post-stroke chronic phase (for cases) and over follow-up years 1996-2018 (for controls). 3,718 stroke cases were additionally categorized by disability level using the modified Rankin Scale (mRS) 1-2 years post-stroke. Evolution of ADL/IADL limitations was assessed in stroke cases and controls, and by mRS (0-1, 2-3, 4-5) using linear mixed models. Models were stratified by age group (50-74 and ≥75 years) and adjusted for baseline characteristics, health behaviours, BMI and comorbidities.

Results

Findings showed relative stability of ADL/IADL limitations during 3-6 years post-stroke followed by an increase for both populations, which was faster for younger stroke cases, suggesting a differential age-effect ($p<0.001$). Disability level at 1-2 years post-stroke influenced the evolution of limitations over time, especially for severe disability (mRS 4-5) associated with a reduction in limitations at 5-6 years post-stroke.

Conclusions

Our findings showed that during the post-stroke chronic phase functional limitations first plateau and then increase and the evolution differs by disability severity. These results highlight the importance of adaptive long-term health and social care measures for stroke survivors.

Abbreviations

ADL	Activities of daily living
IADL	Instrumental activities of daily living
HRS	Health and Retirement Study
SHARE	Survey of Health, Ageing and Retirement in Europe
ELSA	English Longitudinal Study of Ageing
BMI	Body mass index
mRS	modified Rankin Scale
SD	Standard deviation
CI	Confidence intervals

INTRODUCTION

Among post-stroke survivors, it is estimated that more than 20% experience limitations in activities of daily living (ADLs)[1, 2] and more than 30% in instrumental activities of daily living (IADLs),[2, 3] and these percentages increase in the years following the stroke event.[4] This makes stroke the primary cause of long-term disability in the United States[5] and one of the most common causes of disability in the World Health Organizations European regions[6] especially in ageing populations,[5, 7] and the burden of stroke is projected to increase in the coming decades.[2, 5]

Following the acute phase post-stroke during which limitations in ADLs and IADLs vary widely, usually limitations decrease in the sub-acute phase,[2, 8-10] plateau in the chronic phase 2 to 5 years after stroke,[2, 11-14] and then increase in subsequent years.[3, 15] Despite extensive literature on activity limitations in the sub-acute phase,[16] few studies have examined the chronic phase.[16, 17] One study examines activity limitations in stroke patients over 10 years of follow-up,[2] but none have compared the change in ADL and IADL limitations between post-stroke and stroke-free populations. It is therefore important to assess whether the evolution of limitations in the post-stroke chronic phase differs from normal ageing.[1, 18]

Studies of the post-stroke chronic phase frequently dichotomise the ADL and IADL scales (with/without limitations), ignoring both changes in number of ADL and IADL limitations[19] and the severity of limitations at start to chronic phase, a possible predictor of prognosis.[16, 20] To address these considerations, this study will both 1) evaluate differences in changes of IADL and ADL limitations over time between stroke-free and post-stroke respondents at different ages and assess age-effect differences; and 2) assess the effect of severity of disability at the beginning of the post-stroke chronic phase on ADL and IADL limitations using 20 years of data from three large-scale cohort studies undertaken in Europe and the United States.

METHODS

Data from all three surveys used in this observational study are freely available to the scientific community through their respective websites (https://hrs.isr.umich.edu; https://www.elsa-project.ac.uk; http://www.share-project.org).

Study population

Participants were drawn from three studies[21]: the Health and Retirement Study (HRS),[22] the Survey of Health, Ageing and Retirement in Europe (SHARE),[23] and the English Longitudinal Study of Ageing (ELSA).[24] Core participants included individuals aged 50 years or more. The HRS comprises a nationally representative sample of the population of the United States born in 1931-1941 (data available since 1992) and born in 1942-1947 (data available since 2004). SHARE is a cross-national survey established in 2004 that includes around 140,000 individuals from 27 European countries and Israel. ELSA was established in 2002 as a representative sample of the English population born before 1953. Details of these studies are provided elsewhere.[22-24] This observational study was carried out following the STROBE guideline and the flow diagram is available in supplementary material (Table IX).

Two study samples were defined: sample 1 included all first-ever stroke cases with no recurrence during follow-up with data on limitations and covariates for at least one wave during the post-stroke chronic phase (defined as one-year post-stroke) and 5 controls for each case drawn from the stroke-free population at the end of follow-up. Controls were matched to cases on survey, sex, wave, and age (within 2 years of the matched case at the time of stroke; see expanded methods, case-control selection).[25] Index year (time=0) in the analysis was defined as year of stroke event for cases, and for controls as the year of wave of participation closest to the year when the matching stroke case was reported. Participants who reported prevalent stroke at study inception and recurrent stroke were excluded to ensure stroke date and initial limitation level could be accurately ascertained. Sample 2 included all stroke cases from sample 1

who had data on ADL and IADL limitations at beginning of the post-stroke chronic phase (1-2 years post-stroke). In both samples, the follow-up period was defined between the index date and the last wave of participation in the survey.

Ascertainment of stroke

Information on stroke status and onset date was collected at each wave (every 2 years) and self-reported by participants or proxies using the following questions: "Has a doctor ever told you that you had a stroke?" for HRS, and "Has a doctor told you that you have any of the conditions on this card [indicating history of health conditions]?" for ELSA and SHARE.

ADL and IADL limitations

Data on ADLs and IADLs were drawn from waves 1996 to 2018 for HRS, 2002 to 2018 for ELSA, and 2004 to 2016 for SHARE (except 2008) in a similar manner.[26] Data were collected through face-to-face interviews in ELSA and SHARE and telephone interviews in HRS. Participants were asked if they experienced any difficulty with IADLs or ADLs lasting longer than three months due to a "physical, mental, emotional or memory problem" ("yes" or "no"). ADLs included dressing, walking across a room, bathing/showering, eating, getting in/out of bed, using the toilet, and urinary continence.[27] IADLs included using a map, preparing a hot meal, shopping for groceries, using the telephone, taking medications, and managing money.[28] The questionnaires were completed by the participant or his/her proxy. Scores ranged from 0 to 7 for ADLs and 0 to 6 for IADLs based on count of the limitations, where 0 indicated the absence of limitations and 7 (for ADLs) or 6 (for IADLs) indicated respondents were fully limited.

Disability level

The disability level at the beginning of the post-stroke chronic phase (1-2 years after diagnosis) was assessed using the modified Rankin Scale (mRS), commonly used to determine the severity of disability level and degree of impairment in ADLs and IADLs after stroke.[29] This scale is composed of scores from

0 to 6, with scores indicating no symptoms, no significant disability, slight disability, moderate disability, moderately severe disability, severe disability, and death respectively. Three levels of mRS score were estimated using ADLs and IADLs between the first and second year post-stroke: 0-1 (no limitations in ADLs or IADLs); 2-3 (some limitations in ADLs and/or IADLs but able to walk across room); and 4-5 (multiple limitations in ADLs and/or IADLs including inability to walk across room).[30, 31]

Covariates

Sociodemographic variables were drawn from the closest wave following the index date. They included sex, age, education (based on previously harmonised education category) [32] and marital status ("married or cohabiting" versus "single, divorced or widowed"). Other covariates were assessed during the follow-up period at the same time as ADL and IADL assessment. Health behaviours included smoking status (non-smoking and current smoking), alcohol consumption over the last 6 months (abstainers (<once a month), moderate drinkers (≥1 per month and <5 days/week) and frequent drinkers (≥5days/week)), and practice of moderate-to-vigorous physical activity at least three times a week. Body mass index (BMI) was estimated based on self-reported weight and height and categorized as <18.5, 18.5-25, 25-30, and >30 kg/m². In ELSA, information on BMI was available every 2 waves and data were carried forward for missing waves. Morbidities included self-report of medical diagnosis of heart problems, high blood pressure, diabetes, lung diseases, arthritis, cancer, chronic pain, and sleep disorders.

Statistical analysis

The characteristics of the participants at the first interview from index date were described by stroke status in sample 1 (stroke and stroke free subjects) and by disability level (mRS 0-1, 2-3 and 4-5) after sub-acute phase in sample 2 (stroke population). Pearson's chi-squared test was used to assess differences between groups in sociodemographic factors, health behaviours, BMI, and number of morbidities. For continuous ADL and IADL limitation scores, t-test and analysis of variance were used to describe

differences across groups. All statistical analyses were carried out using STATA statistical software version 15.1 (Stata-Corp, College Station, Texas).

Analysis 1: Evolution of ADLs and IADLs limitations in stroke cases and controls

In sample 1, changes in ADL and IADL limitation scores were separately assessed in stroke cases and controls over the follow-up period using linear mixed models. Random effects for the intercept at the survey level (HRS, SHARE and ELSA) and for intercept and slope for individuals were included to account for variations across surveys as well as within individuals. Model 1 initially included time, stroke status and sociodemographic variables (assessed at index year), and index year. Cubic time and lower order interactions were included in the model based on the likelihood ratio test ($p<0.001$). Model 2 was then additionally adjusted for health behaviours, BMI, and number of morbidities as time-dependent variables.

A significant interaction was found between age at index year and stroke status, both at the intercept and with time ($p<0.003$) leading us to stratify the analysis into two age groups (individuals aged 50-74 years at index year and those aged ≥75 years) using the median age of sample 1. Results were presented over a period of 15 years for the age group 50-74 years, and 12 years for age group ≥75 years, based on the mean follow-up duration plus two standard deviations (SDs) within each age group.

Analysis 2: Evolution of ADLs and IADLs limitations in stroke cases as a function of disability level

In sample 2, comprising stroke cases with ADL and IADL data at the start of the chronic phase, we examined differences in ADL and IADL limitation scores by level of disability (mRS levels) at maximum 2 years post-stroke using linear mixed models as described for analysis 1. As there was an interaction between age at stroke event and level of disability both at the intercept and over time for ADLs ($p<0.001$) and at intercept for IADLs ($p<0.001$), analyses were stratified by age groups as in

analysis 1. A cubic time term was retained in the model for age group 50-74 years, and a quadratic time term for those aged ≥75 years based on the likelihood ratio test.

Results were plotted with the mean ADL and IADL limitation score as function of time since index year estimated by the fully adjusted linear mixed models with 95% confidence intervals (95%CI). Corresponding estimates are presented in the supplementary materials (Tables III-VI).

Sensitivity analysis

To test the robustness of our results several sensitivity analyses were carried out. First, in order to assess potential selection bias between sample 1 and 2, analysis 1 was replicated using stroke cases retained in analysis 2 (sample 2) and their matched controls. Second, analyses were repeated separately in HRS, SHARE, and ELSA to test the influence of each study. Third, as the follow-up period differs between the three studies (means (range): HRS=6.6 (0-20), SHARE=3.6 (0-13), ELSA=5.8 (0-16)), we repeated the analyses restricted to 10 years of follow-up to evaluate the influence of follow-up periods of different lengths. Finally, earlier mortality of individuals with higher levels of disability[20, 33] may impact estimates of change in limitations in stroke survivors; as such, participants who died during follow-up were excluded to assess the effect of mortality on results by disability level (mRS).

RESULTS

Of the 189,653 participants in the 3 surveys, 70,260 were excluded due to missing data on ADLs, IADLs (details in Supplementary table VIII) or sociodemographic variables. Of the 12,464 individuals reporting a history of stroke, 6,854 were excluded due to prevalent stroke at study inception (2,082), due to recurrent stroke event (815) or if their last participation was less than 1-year post-stroke (3,957). In total, 5,610 stroke and 28,050 controls were retained in sample 1. Of these 5,610 stroke cases, 1,897 individuals did not have data in the first 2 years post-stroke, resulting in 3,718 respondents retained in sample 2 for analysis by disability level (Figure 1).

At first interview from index year, compared to stroke-free controls, stroke cases were on average slightly older, more likely to be single/divorced/widowed, less educated, current smokers, non-drinkers, and less likely to take part in moderate and vigorous physical activities. They also presented with a higher number of morbidities as well as higher ADL and IADL limitation scores (all $p<0.005$) (Table 1). These differences were evident in both age groups, with the exception of no difference in marital status and education level by stroke status in the group aged ≥75 years (Table I). Among stroke survivors (sample 2), compared to participants in the lowest level of disability (0-1 mRS), those in the intermediate (2-3 mRS) and highest (4-5 mRS) levels of disability were more likely to be older, women, from the lower education group, single/divorced/widowed, non-current drinkers, less physically active, and to have a lower BMI. In addition, those with intermediate and high disability scores had higher ADL and IADL scores (Table 1). These differences were observed in both age groups (Table II). Mortality was higher among those with the highest level of disability at the beginning of the post-stroke chronic phase compared to those in the lowest level of disability (30.65 vs 8.76%, $p<0.001$, details in Supplementary table III).

Evolution of ADL and IADL limitations in stroke cases and controls

The mean follow-up was 5.6 (SD=4.6) years for stroke cases and 3.3 (SD=3.9) years for controls in the group aged 50-74 and 4.4 (SD=3.4) and 2.3 (SD=2.5) years for stroke cases and controls respectively in the age group ≥ 75 years. Compared with the stroke free controls, strokes cases had on average higher ADL and IADL (Figure 2) limitation scores at year 1 following the stroke event as well as longer follow-up periods in both age groups ($p <0.001$ for all, Table IV and V).

Change in ADL limitations differed between stroke cases and their controls in both age groups (p interaction stroke status and time <0.001 for both age groups). Figure 2 shows that among cases, for respondents aged 50-74 years ADL limitations were relatively stable during the first 5 years with an

increase of 0.06 (95%CI: 0.02 to 0.14) points. By contrast the increase in scores for controls was to 0.14 (95%CI: 0.11-0.18) points over the same period (p=0.050). Between year 5 and 15 there was a more pronounced increase in limitations among stroke cases (0.87 (95%CI: 0.67-1.07)) than non-cases (0.46 (95%CI: 0.29-0.64); p for difference between stroke and control <0.001). For participants aged ≥75 years, ADL scores plateaued between years 1 and 5 for stroke cases (difference in ADL limitations between year 1 and 5 = 0.20 (95%CI: 0.09-0.32)) compared to an increase in ADL scores among controls over the same period (0.47 (95%CI: 0.41-0.52)). After this period, increase in ADL score was similar between cases and controls (p =0.245, Table IV).

Overall, similar trends were observed for change in IADL limitations. In the age group 50-74 years at index year, over the 14-year period of follow-up stroke cases showed an increase of 0.67 (0.50-0.84) points in IADL score compared to 0.40 (0.26-0.55) points among controls (p for difference <0.001). In the group aged ≥75 years, over the 11-year of follow-up, IADL score increased by 1.25 (1.00-1.50) among stroke cases compared to 1.40 (1.16-1.64) among the controls (p=0.246) (Table V).

Evolution of ADL and IADL limitations in stroke cases as a function of disability level

Among stroke survivors followed from the beginning of the chronic phase, the mean follow-up was 5.3 (SD=4.8) years for respondents aged 50-74 and 3.7 (SD=3.2) years for those aged ≥75 years. Change in ADL and IADL limitation scores differed by the level of disability at year 1, particularly among the most severely disabled at baseline (p<0.001 for intercept, p<0.001 for time terms, for both disability level) (Figure 3).

For stroke cases aged 50-74, the change in ADL limitation score between disability levels 0-1 and 2-3 was similar while the respondents at level 4-5 showed a decrease in limitation score of 0.37 (95%CI:

0.08-0.67) during the first 6 years post-stroke followed by a sharp increase of 0.81 (95%CI: 0.29-1.34) between year 9 and 15. For individuals aged 75 or over, respondents with disability scores in categories 2-3 and 4-5 showed a slower increase in limitation score compared to category 0-1 (Figure 3, Table VI).

Evolution of the IADL limitation score according to level of disability at year 1 post-stroke showed a marked difference between disability level 4-5 and the other levels in both age groups. Levels 0-1 and 2-3 showed a consistent increase during follow-up for both age groups (increase of 1.29 (95%CI: 0.88-1.71) for level 0-1 and 1.26 (95%CI: 0.87-1.66) for level 2-3 in the age group 50-74 over 14 years; 3.13 (95%CI: 2.46-3.79) for level 0-1 and 2.77 (95%CI: 1.90-3.35) for level 2-3 in the age group ≥75 years over 11 years). Stroke survivors with disability level 4-5 showed a decrease in the limitation score (1.57 (95%CI: 1.31-1.82)) over the first 6 years for respondents aged 50-74 and (0.84 (95%CI: 0.56-1.12)) over 3 years for those aged ≥75 years (Figure 3, Table VII); limitations then increased sharply to the end of follow-up.

Sensitivity Analysis

When analysis 1 was repeated including only those stroke cases who were also included in analysis 2, the results were broadly comparable to the main analysis, suggesting selection bias was unlikely to have affected the findings in analysis 2 (Figure I). Analyses stratified by study showed similar trends in each HRS, SHARE, and ELSA, indicating that results from the main analysis were not driven by a specific cohort (Figure III and III). In analyses limited to 10 years of follow-up, findings in the three cohorts were similar to main analyses suggesting differing length of follow-up between studies did not overly influence the results (Figure IV). Finally, analyses excluding 1,058 stroke cases with mortality reported during follow-up from sample 2 (mRS 0-1=194, 2-3=554, 4-5=310, Table III) showed similar trends to the main results suggesting results from the main analysis were not driven by mortality among cases over the follow-up period (Figure V).

DISCUSSION

In this international longitudinal study of 5,610 stroke cases and 28,050 matched controls, limitations in ADLs and IADLs showed differences during follow-up between the two populations. Relative stability of number of ADL and IADL limitations was observed at 5-6 years and 3 years post-stroke in participants experiencing stroke at ages 50-74 and ≥75 years respectively. Limitations then increased in both groups, although in those cases aged 50-74 years this increase was more pronounced than in controls. This suggests that age contributes to increase in limitations in both groups the stroke and stroke-free population. However there was a differential effect of age between the post-stroke and stroke-free population in the long term, with an initial period of stability followed by a faster increase of limitations in younger stroke cases than in stroke-free participants. Analysis by disability level at the beginning of the post-stroke chronic phase based on more than 3,000 stroke survivors showed disability level 1-2 years post-stroke influenced the change in ADL and IADL limitations over time. At the most severe level of choric phase disability (mRS score 4-5), a possible reduction of number of ADL and IADL limitations was observed in the first 5-6 years post-stroke in those aged 50-74, and a reduction of number of IADL limitations only for those aged 75 or over.

Comparison with previous studies

The post-stroke chronic phase has been described as a stable period with no significant changes in ADL and IADL limitations beyond the first year after stroke,[2, 9, 11, 14, 34, 35] while other studies indicate a steady increase in limitations observed during the period 3-5 years post-stroke.[12, 13, 20] In agreement with previous studies undertaken over longer follow-up periods,[2, 34, 36] our results suggest a relative stability of limitations in ADLs and IADLs 4-6 years post-stroke followed by a progressive increase in limitations. With respect to age effect, one previous study[18] suggested that age impacts limitations in ADL and IADL similarly in the general population and stroke survivors. Our study showed a different effect of age in populations aged 50-74, where limitations increased more quickly with age for stroke cases than controls.

In those aged ≥75 years the effect of age was the same in both populations. The use of number of limitations rather than a dichotomised variable, being more sensitive to subtle changes, and the stratification by age, may explain differences in findings compared with other studies.

Analysis by disability level at the beginning of the chronic phase allowed us to observe differences in limitation trends, most notably among stroke cases with severe disability (mRS 4-5); this is in accordance with findings observed for other outcomes such as mortality.[20, 33] However, our results showed a decrease in limitations among stroke survivors with severe disability that has not been reported previously, although this finding should be interpreted with caution given the absence of other clinical measures in this study. To our knowledge this is the first study to examine how severity of disability at the beginning of the chronic phase impacts the evolution of functional limitations among stroke survivors.

Strengths and limitations

The present study has several strengths including results presented for a 15-year period and a large international post-stroke population. Because the present study was undertaken in a large international population over a long follow-up period, our analytic sample included large case numbers in each age stratum and post-stroke disability category, allowing us to robustly examine results by age and evaluate the association of post-stroke disability level with ADL and IADL limitation. Number of ADL and IADL limitations were then used to evaluate changes in functional limitation over time as these measures are more sensitive, allowing for precise identification of differences in functional trajectory between stroke cases and controls. We conducted several sensitivity analyses to explore potential biases due to selection/attrition and results were consistent across samples.

Our findings should be considered in light of the limitations of the study. 1) There was a lack of information on stroke subtypes, and stroke and comorbidities were self-reported or reported by a proxy, potentially introducing a recall bias. However, studies that compared the prevalence of self-reported chronic conditions with data from electronic medical records found an agreement for between 79% and

96% for stroke,[40, 41] with a specificity of 99%.[40] 2) Information on dementia diagnosis was unavailable before 2010 in HRS, and as such we did not adjust for dementia in the models despite a possible unequal distribution in stroke cases and controls. 3) Although mRS was derived based on ADL limitation in this study, mRS represents a distinct concept from count of ADL and IADL limitations alone. mRS was used to categorise respondents' post-stroke disability severity, giving a more clinically significant and comprehensible characterisation of disability at the beginning of the sub-acute period than simple count of ADL and IADL limitations. 4) ADL and IADL limitation data were missing in a high proportion of the whole population (stroke cases and controls in three surveys), and a selective loss of data cannot be excluded. However, despite the possibility to have a stroke population with minor deficits, a significant difference of evolution between levels of disability is suggested by our findings. 5) We used data from three different surveys where limitation was not assessed equally, however agreement between the cohorts have been previously assessed, although sensitivity analysis suggests our results are not driven by one cohort.[21, 26]

Future analyses should focus on low-middle income countries where access to rehabilitation and health services may be more restricted. Also, similar studies accounting for the number of limitations (continuous measure) supported by medical records may provide a clearer understanding of the evolution of limitations in stroke survivors in the long-term.

CONCLUSION

Our findings suggest that during the post-stroke chronic phase functional ADL and IADL limitations plateau and then have periods of increase. The influence of age is different for stroke survivors compared to stroke-free people and the evolution may differ by disability severity. These findings highlight the need for further exploration of the long-term outcomes of stroke survivors and the importance of adapting long-term health and social care measures to individual needs of stroke survivors.

ACKNOWLDEGMENTS

We are grateful to the respondents of the studies for their time and all members of the HRS, SHARE and ELSA study teams. MSc Andres Gil, Dr Alexis Schnitzler, PhD Séverine Sabia, MSc Aline Dugravot and MSc Aurore Fayosse conceived and designed study. MSc Andres Gil and Dr Alexis Schnitzler analysed the data and drafted the article. All authors interpreted the results and contributed in critical revision on the article

ETHICS AND CONSENT

HRS was reviewed by the institutional review board. All participants receive a written informed consent information document at each interview (https://hrs.isr.umich.edu/sites/default/files/biblio/HRS_IRB_Information-10-2017.pdf). SHARE was reviewed and approved by the ethics committee of Mannheim University initially and then by the Ethics Council of the Max Planck Society (see www.share-project.org). ELSA is reviewed at each data collection by NHS Health Research Authority National Research Ethics Committee.

FINANCIAL DISCLOSURE STATEMENT

The HRS is sponsored by the National Institute on Aging and is conducted by the University of Michigan. The SHARE data collection has been primarily funded by the European Commission through the FP5, FP6 and FP7. Additional funding from the German Ministry of Education and Research, the U.S. National Institute on, and from various national funding sources is gratefully acknowledged (see www.share-project.org). The ELSA funding is provided by the National Institute of Aging in the United States and a consortium of UK government departments coordinated by the Office for National Statistics. The developers and funders of ELSA and the Archive do not bear any responsibility for the analyses or interpretations presented here. Andres GIL-SALCEDO is supported by the Université de Paris, Alexis Schnitzler receives personal fees and non-financial support from IPSEN, ALLERGAN and

MERZ outside of this study. Severine Sabia is supported by the French National Research Agency (ANR-19-CE36-0004-01). Mikaela Bloomberg is supported by Economic and Social Research Council (ES/P000592/1). Dr Sabia reports grants from ANR, french national research agency outside the submitted work. Dr Schnitzler reports grants, personal fees, and non-financial support from IPSEN, grants, personal fees, and non-financial support from ALLERGAN, and grants, personal fees, and non-financial support from MERZ outside the submitted work.

DISCLOSURES: None

SUPPLEMENTAL MATERIALS

Expanded Methods, case-control selection

Online Tables I–IX

Online Figures I–V

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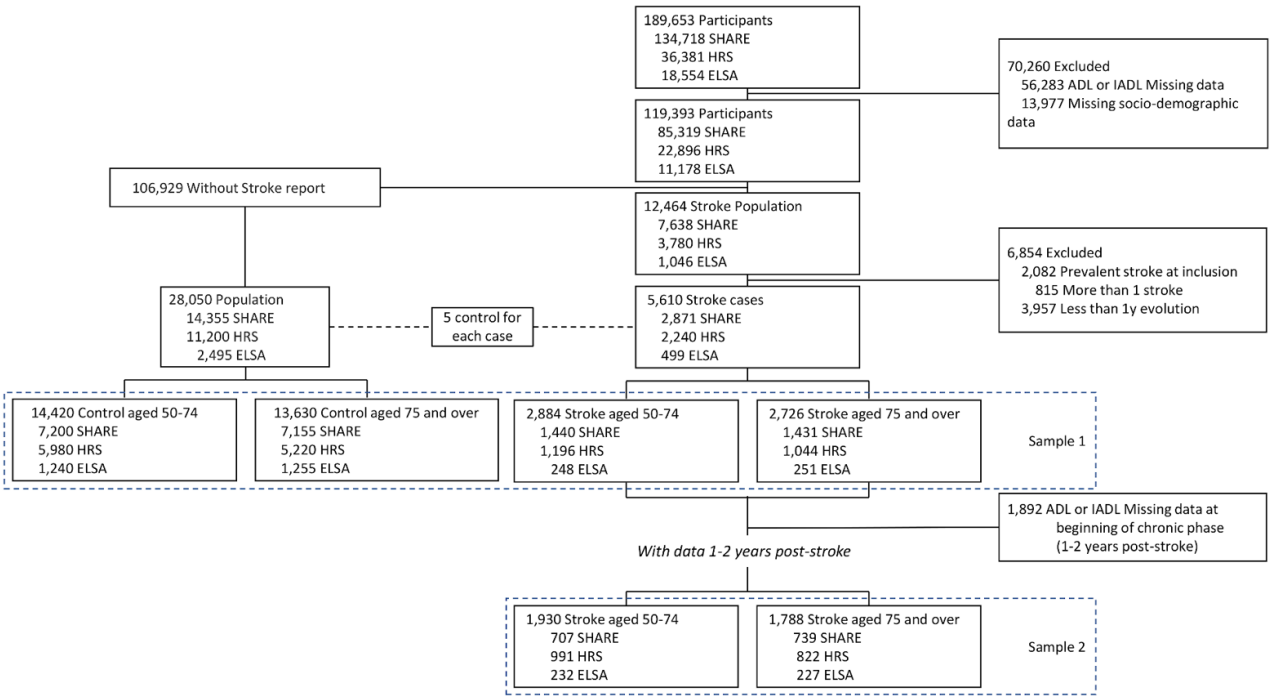
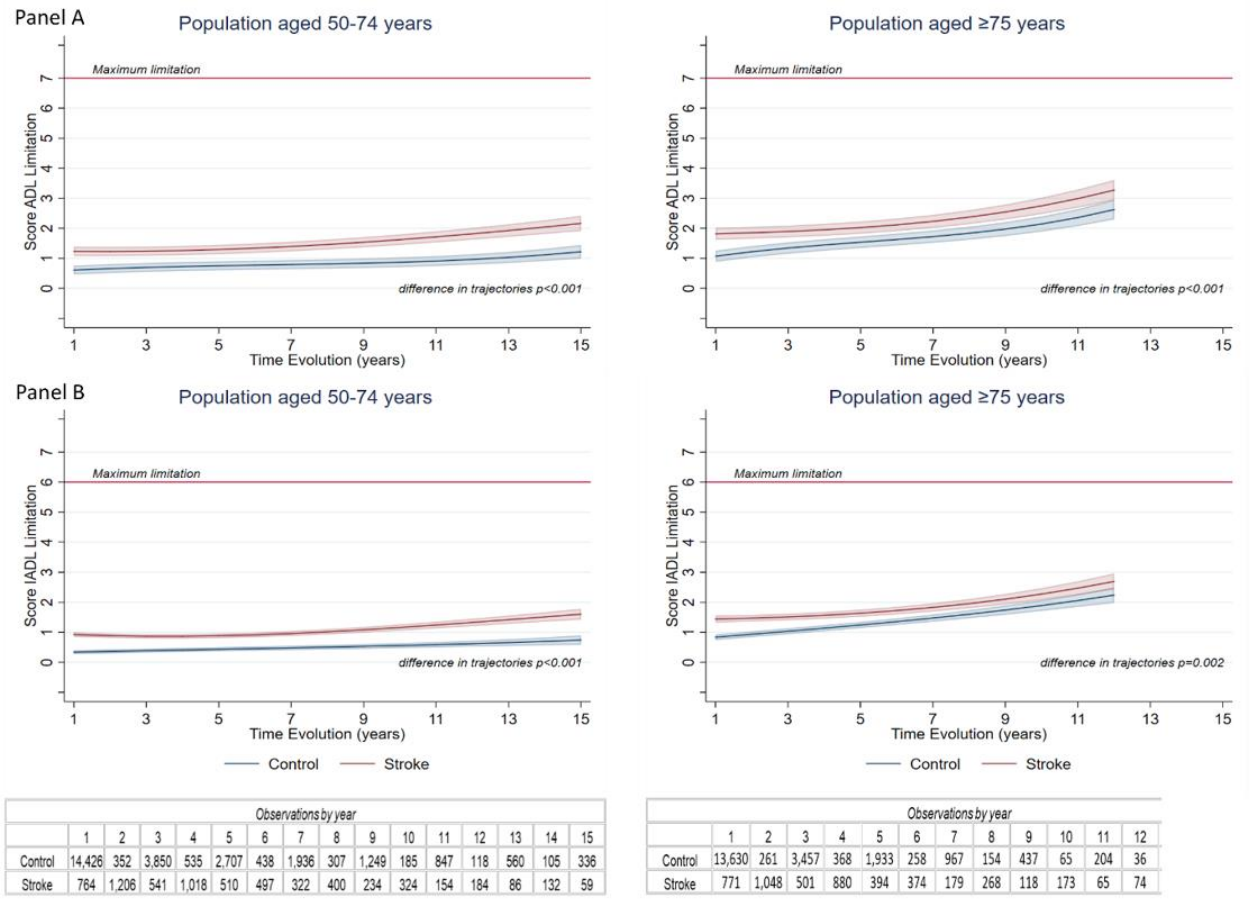
Fig 1. Flowchart of the study samples.



Controls matched on sex, wave, survey and age within a 2 years range**.**

Fig 2. Evolution of score of ADL and IADL limitations in stroke survivors in chronic phase versus controls.



Observations by year

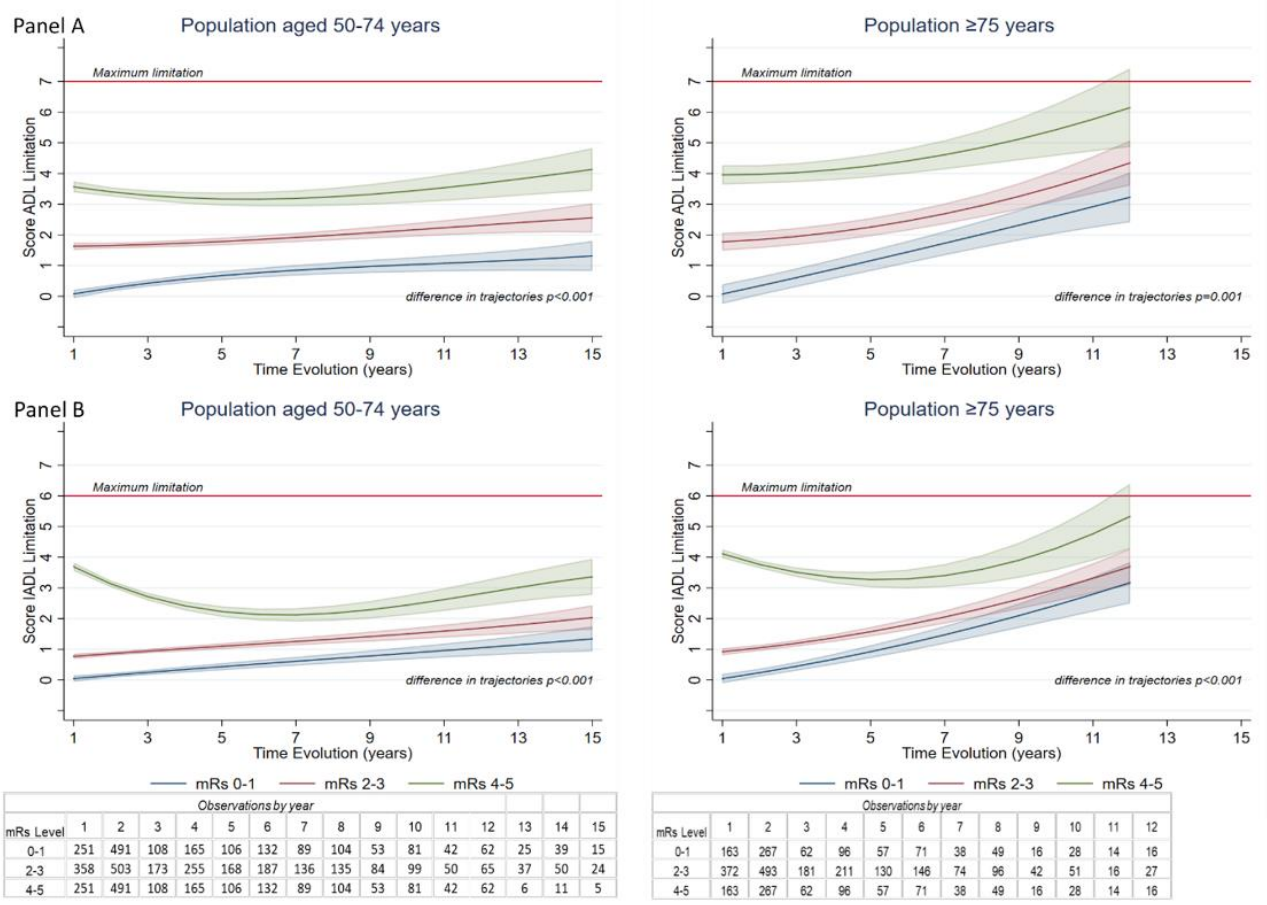
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Control	14,426	352	3,850	535	2,707	438	1,936	307	1,249	185	847	118	560	105	336
Stroke	764	1,206	541	1,018	510	497	322	400	234	324	154	184	86	132	59

Observations by year

	1	2	3	4	5	6	7	8	9	10	11	12
Control	13,630	261	3,457	368	1,933	258	967	154	437	65	204	36
Stroke	771	1,048	501	880	394	374	179	268	118	173	65	74

Estimated from linear mixed model with time in cubic form adjusted for all covariates. Panel A for ADL limitation evolution, Panel B for IADL limitation evolution. Estimations are presented for a 15-year follow-up (corresponding to mean follow-up + 2 SD) for population aged 50-74 years and a 12-year period for those aged ≥75 years. Corresponding estimates in Table III-IV.

Fig 3. Evolution of ADL and IADL limitations score in stroke survivors by modified Rankin Scale (mRS) at beginning of chronic phase.



Observations by year

mRs Level	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0-1	251	491	108	165	106	132	89	104	53	81	42	62	25	39	15
2-3	358	503	173	255	168	187	136	135	84	99	50	65	37	50	24
4-5	251	491	108	165	106	132	89	104	53	81	42	62	6	11	5

Observations by year

mRs Level	1	2	3	4	5	6	7	8	9	10	11	12
0-1	163	267	62	96	57	71	38	49	16	28	14	16
2-3	372	493	181	211	130	146	74	96	42	51	16	27
4-5	163	267	62	96	57	71	38	49	16	28	14	16

Estimated from linear mixed model with time in cubic form adjusted for all covariates. Time in cubic form for stroke survivors age 50-74 and quadratic form for those aged 75 and over. Panel A for ADL limitation evolution, Panel B for IADL limitation evolution. Estimations are presented for a 15-year follow-up (mean follow-up + 2 SD) for population aged 50-74 years and a 12-year period for those aged ≥75 years. Corresponding estimates in Table V-VI.

Table 1. Characteristics of the study samples at baseline according to stroke status (Sample 1) and disability level at beginning of chronic phase in stroke cases (Sample 2)*.

	Sample 1			Sample 2: stroke cases			
				Modified Ranking Scale			
Characteristics	**Control**	**Stroke**	***p***	**0-1**	**2-3**	**4-5**	***p***
	(N=28050)	(N=5610)		(N=1159)	(N=1690)	(N=869)	
Sex:							
Men	12915 (46.0)	2583 (46.0)	0.986	607 (52.4)	701 (41.5)	366 (42.1)	<0.001
Women	15135 (54.0)	3027 (54.0)		552 (47.6)	989 (58.5)	503 (57.9)	
Age (years)							
50-66	7067 (25.2)	1305 (23.3)		346 (29.9)	391 (23.1)	169 (19.5)	
67-75	8020 (28.6)	1579 (28.2)	0.002	387 (33.4)	449 (26.6)	188 (21.6)	<0.001
75-82	6823 (24.3)	1402 (25.0)		263 (22.7)	431 (25.5)	194 (22.3)	
82+	6140 (21.9)	1324 (23.6)		163 (14.1)	419 (24.8)	318 (36.6)	
Education level							
Low	8608 (30.7)	1934 (34.5)		322 (27.8)	643 (38.0)	387 (44.5)	
Middle	13649 (48.7)	2643 (47.1)	<0.001	579 (50.0)	789 (46.7)	363 (41.8)	<0.001
High	5793 (20.6)	1033 (18.4)		258 (22.3)	258 (15.3)	119 (13.7)	
Marital status							
Single/divorced/widowed	11354 (40.5)	2447 (43.6)	<0.001	446 (38.5)	796 (47.1)	398 (45.8)	<0.001
Married/Cohabiting	16696 (59.5)	3163 (56.4)		713 (61.5)	894 (52.9)	471 (54.2)	
Smoking status							
Non smoking	24024 (85.7)	4531 (80.8)	<0.001	971 (83.8)	1448 (85.7)	745 (85.7)	0.314
Current smoking	4026 (14.3)	1079 (19.2)		188 (16.2)	242 (14.3)	124 (14.3)	
Alcohol consumption							
Non drinkers	18018 (64.2)	4138 (73.8)		744 (64.2)	1294 (76.6)	751 (86.4)	
Moderate drinkers	7698 (27.4)	1127 (20.1)	<0.001	330 (28.5)	294 (17.4)	90 (10.4)	<0.001
Heavy drinkers	2334 (8.3)	345 (6.1)		85 (7.3)	102 (6.0)	28 (3.2)	
MVPA‡							
No	13998 (49.9)	3562 (63.5)	<0.001	544 (46.94)	1185 (70.1)	767 (88.3)	<0.001
Yes	14052 (50.1)	2048 (36.5)		615 (53.1)	505 (29.9)	102 (11.7)	
BMI (kg/m²)							
<18.5	606 (2.2)	129 (2.3)		18 (1.6)	40 (2.4)	41 (4.7)	
18.5-25	8852 (31.6)	1756 (31.3)	0.645	327 (28.2)	525 (31.1)	318 (36.6)	<0.001
25-30	10926 (38.9)	2153 (38.4)		489 (42.2)	611 (36.2)	292 (33.6)	
>30	7666 (27.3)	1572 (28.0)		325 (28.0)	514 (30.4)	218 (25.1)	
Number of comorbidities							
0	3923 (14.0)	488 (8.7)		134 (11.5)	95 (5.6)	85 (9.8)	
1	6668 (23.8)	1119 (20.9)	<0.001	299 (25.8)	233 (13.8)	145 (16.7)	<0.001
2	7133 (25.4)	1412 (25.2)		316 (27.3)	426 (25.2)	195 (22.4)	
3 or more	10326 (36.8)	2591 (46.2)		410 (35.4)	936 (55.4)	444 (51.1)	
ADL limitation Score (0-7)†							
Mean (SD)	0.8 (1.4)	1.5 (2.0)	<0.001	0.00 (0.0)	1.8 (1.6)	3.9 (2.2)	<0.001
IADL limitation Score (0-6)†							
Mean (SD)	0.6 (1.2)	1.3 (1.8)	<0.001	0.00 (0.0)	0.9 (1.0)	3.9 (1.6)	<0.001

*Values are numbers (percentages). †Score corresponds to number of ADL or IADL limitations. ‡Moderate or vigorous physical activity at least 3 times a week.

SUPPLEMENTARY MATERIAL

Expanded Methods

Matching case-control process

Stroke population was composed by 5,616 cases, to each case 5 randomly controls from 106,929 without report of stroke (Fig 1). Matching was done according sex, phase to onset to stroke control, survey (HRS, SHARE and ELSA) and age (±2 years). Based in the literature, we chose to match using sex and age as factors to increase of limitations (2,3,19), survey and phase was used to reduce the possible influence of the regions and the year when the acute episode occur. We also use as possible few number of matching variables to reduce the risk to have to population with too similar outcome and underestimate the association between stroke status and trajectories of ADL/IADL limitations. (25)

To control selection process was: 1) We sort the stroke population by age, allowing the aged subjects be matched first, due to reduce number of aged people in control population. 2) All possible controls was identity matching first by sex, phase and survey, 3) we keep all controls with a age range of 2 year at date to onset stroke for case; 4) with all possible control identify, 5 formal controls were selected randomly and retire to database of controls; 5) the possible control than was not selected were re-included in the first database of controls 6) the processed was repeated with each case from more aged until more younger.

Table I. Characteristics of the study samples a baseline according stroke status and stratified by age*.

Characteristics	Matched Controls (N=14,420)	Stroke Cases aged 50-74 (N=2,884)	*p*	Matched Controls (N=13,630)	Stroke Cases aged 75 or over (N=2,726)	*p*
Sex						
Men	7,170 (49.7)	1,434 (49.7)	1	5,745 (42.2)	1,149 (42.2)	1
Women	7,250 (50.3)	1,450 (50.3)		7,885 (57.9)	1,577 (57.9)	
Age						
Mean (SD)	66.2 (5.8)	66.7 (5.8)	<0.001	82.4 (5.2)	83.1 (5.0)	<0.001
Education level						
Low	3,459 (24.0)	876 (30.4)		5,149 (37.8)	1,058 (38.8)	
Middle	7,684 (53.3)	1,476 (51.2)	<0.001	5,965 (43.8)	1,167 (42.8)	0.584
High	3,277 (22.7)	532 (18.5)		2,516 (18.5)	501 (18.4)	
Marital status						
Single/divorced/widowed	4,752 (32.9)	1,083 (37.6)	<0.001	6,602 (48.4)	1,364 (50.0)	0.122
Married/Cohabiting	9,668 (67.1)	1,801 (62.5)		7,028 (51.6)	1,362 (50.0)	
Smoking status						
non smoking	11,784 (81.7)	2,195 (76.1)	<0.001	12,240 (89.8)	2,336 (85.7)	<0.001
Current	2,636 (18.3)	689 (23.9)		1,390 (10.2)	390 (14.3)	
Alcohol consumption						
Non-current drinker	8,353 (57.9)	2,036 (70.6)		9,665 (70.9)	2,102 (77.1)	
Current drinker	4,769 (33.1)	659 (22.9)	<0.001	2,929 (21.5)	468 (17.2)	<0.001
Heavy drinker	1,298 (9.0)	189 (6.6)		1,036 (7.6)	156 (5.7)	
Moderate to vigorous physical activity at least 3 times a week						
Non	6,125 (42.5)	1,644 (57.0)	<0.001	7,873 (57.8)	1,918 (70.4)	<0.001
Yes	8,295 (57.5)	1,240 (43.0)		5,757 (42.2)	808 (29.6)	
BMI						
<18.5	197 (1.4)	57 (2.0)		409 (3)	72 (2.6)	
18.5-25	3,835 (26.6)	750 (26.0)	0.008	5,017 (36.8)	1,006 (36.9)	0.561
25-30	5,603 (38.9)	1,063 (36.9)		5,323 (39.1)	1,090 (40.0)	
>30	4,785 (33.2)	1,014 (35.2)		2,881 (21.1)	558 (20.5)	
Number of comorbidities						
0	2,301 (16.0)	239 (8.3)		1,622 (11.9)	249 (9.1)	
1	3,557 (24.7)	572 (19.8)	<0.001	3,111 (22.8)	547 (20.1)	<0.001
2	3,558 (24.7)	723 (25.1)		3,575 (26.2)	689 (25.3)	
3 or more	5,004 (34.7)	1,350 (46.8)		5,322 (39.1)	1,241 (45.5)	
ADL limitation Score (0-7) †						
Mean (SD)	0.5 (1.1)	1.2 (1.8)	<0.001	1.0 (1.7)	1.9 (2.2)	<0.001
IADL limitation Score (0-6) †						
Mean (SD)	0.3 (0.8)	0.9 (1.5)	<0.001	0.8 (1.5)	1.6 (2.0)	<0.001

*Values are numbers (percentages). Percentages are reported in column.
†Score correspond to number of ADL or IADL limitations.

Table II. Characteristics of the study samples a baseline according stroke status, according to the disability level and stratified by age*.

Characteristics	Stroke Cases aged 50-74 Modified Ranking Scale 0-1 (N=733)	2-3 (N=840)	4-5 (N=357)	*p*	Stroke Cases aged 75 or over Modified Ranking Scale 0-1 (N=426)	2-3 (N=850)	4-5 (N=512)	*p*
Sex								
Men	382 (52.1)	388 (46.2)	186 (52.1)	0.036	225 (52.8)	313 (36.8)	180 (35.2)	<0.001
Women	351 (47.9)	452 (53.8)	171 (47.9)		201 (47.2)	537 (63.2)	332 (64.8)	
Age								
Mean (SD)	66.5 (5.8)	66.4 (6.1)	66.6 (5.9)	0.979	81.7 (4.3)	83.2 (5.1)	84.8 (5.3)	<0.001
Education level								
Low	185 (25.2)	290 (34.5)	159 (44.5)		137 (32.2)	353 (41.5)	228 (44.5)	
Middle	390 (53.2)	425 (50.6)	154 (43.2)	<0.001	189 (44.4)	364 (42.8)	209 (40.8)	<0.001
High	158 (21.6)	125 (14.9)	44 (12.3)		100 (23.5)	133 (15.7)	75 (14.7)	
Marital status								
Single/divorced/widowed	249 (34.0)	352 (41.9)	132 (37.0)	0.005	197 (46.2)	444 (52.2)	266 (52.0)	0.105
Married/Cohabiting	484 (66.0)	488 (58.1)	225 (63.0)		229 (53.8)	406 (47.8)	246 (48.1)	
Smoking status								
non smoking	596 (81.3)	673 (80.1)	284 (79.6)	0.746	375 (88.0)	775 (91.2)	461 (90.0)	0.206
Current	137 (18.7)	167 (19.9)	73 (20.5)		51 (12.0)	75 (8.8)	51 (10.0)	
Alcohol consumption								
Non-current drinker	468 (63.9)	638 (76.0)	314 (88.0)		276 (64.8)	656 (77.2)	437 (85.4)	
Current drinker	214 (29.2)	156 (18.6)	35 (9.8)	<0.001	116 (27.2)	138 (16.2)	55 (10.7)	<0.001
Heavy drinker	51 (7.0)	46 (5.5)	8 (2.2)		34 (8.0)	56 (6.6)	20 (3.9)	
Moderate to vigorous physical activity at least 3 times a week								
Non	313 (42.7)	557 (66.3)	309 (86.6)	<0.001	231 (54.2)	628 (73.9)	458 (89.5)	<0.001
Yes	420 (57.3)	283 (33.7)	48 (13.5)		195 (45.8)	222 (26.1)	54 (10.6)	
BMI								
<18.5	13 (1.8)	14 (1.7)	19 (5.3)		5 (1.2)	26 (3.1)	22 (4.3)	
18.5-25	172 (23.5)	208 (24.8)	109 (30.5)	<0.001	155 (36.4)	317 (37.3)	209 (40.8)	0.002
25-30	295 (40.3)	294 (35.0)	113 (31.7)		194 (45.5)	317 (37.3)	179 (35.0)	
>30	253 (34.5)	324 (38.6)	116 (32.5)		72 (16.9)	190 (22.4)	102 (19.9)	
Number of comorbidities								
0	71 (9.7)	45 (5.4)	33 (9.2)		63 (14.8)	50 (5.9)	52 (10.2)	
1	194 (26.5)	114 (13.6)	45 (12.6)	<0.001	105 (24.7)	119 (14.0)	100 (19.5)	<0.001
2	208 (28.4)	193 (23.0)	71 (19.9)		108 (25.4)	233 (27.4)	124 (24.2)	
3 or more	260 (35.5)	488 (58.1)	208 (58.3)		150 (35.2)	448 (52.7)	236 (46.1)	
ADL limitation Score (0-7) †								
Mean (SD)	0	1.6 (1.5)	3.6 (2.2)	<0.001	0	1.9 (1.7)	4.1 (2.3)	<0.001
IADL limitation Score (0-6) †								
Mean (SD)	0	0.8 (0.9)	3.6 (1.6)	<0.001	0	0.9 (1.1)	4.1 (1.5)	<0.001

*Values are numbers (percentages). Percentages are reported in column.

†Score correspond to number of ADL or IADL limitations.

Table III. Mortality proportion of stroke survivors according to the modified Rankin scale (mRs) at the beginning of the chronic phase by years of follow-up*.

Years of Follow-up	mRs 0-1	mRs 2-3	mRs 4-5	Total
1-2	17 (8.76)	71 (12.82)	95 (30.65)	183
3-4	46 (23.71)	143 (25.81)	111 (35.81)	300
5-6	33 (17.01)	102 (18.41)	43 (13.87)	178
7-8	15 (7.73)	87 (15.7)	33 (10.65)	135
9-10	26 (13.4)	48 (8.66)	13 (4.19)	87
>10	57 (29.38)	103 (18.59)	15 (4.84)	175
Total	194 (100)	554 (100)	310 (100)	1058

*Values are numbers (percentages). Percentages are reported in columns.

Table IV. Means of ADL limitation score in stroke survivors in chronic phase and controls stratified by age*.

	ADL mean score (95% Confidence interval)					
	aged 50 - 74			aged 75 or over		
Years after stroke	Control	Stroke	*P for difference*	Control	Stroke	*P for difference*
1	0.61 (0.46-0.75)	1.23 (1.07-1.39)	<0.001	1.07 (0.88-1.25)	1.82 (1.61-2.02)	<0.001
2	0.66 (0.51-0.80)	1.23 (1.08-1.38)	<0.001	1.22 (1.03-1.41)	1.85 (1.66-2.04)	<0.001
3	0.70 (0.55-0.84)	1.24 (1.08-1.39)	<0.001	1.34 (1.15-1.53)	1.89 (1.70-2.09)	<0.001
4	0.73 (0.58-0.87)	1.26 (1.10-1.41)	<0.001	1.44 (1.26-1.63)	1.95 (1.75-2.15)	<0.001
5	0.75 (0.60-0.90)	1.29 (1.14-1.45)	<0.001	1.54 (1.34-1.73)	2.02 (1.82-2.23)	<0.001
6	0.77 (0.62-0.92)	1.34 (1.18-1.49)	<0.001	1.63 (1.43-1.82)	2.11 (1.91-2.32)	<0.001
7	0.79 (0.64-0.94)	1.39 (1.23-1.55)	<0.001	1.72 (1.52-1.93)	2.23 (2.01-2.45)	<0.001
8	0.81 (0.66-0.96)	1.46 (1.30-1.62)	<0.001	1.83 (1.62-2.05)	2.37 (2.14-2.60)	<0.001
9	0.84 (0.68-0.99)	1.54 (1.37-1.70)	<0.001	1.97 (1.74-2.20)	2.54 (2.29-2.79)	<0.001
10	0.87 (0.71-1.03)	1.62 (1.44-1.80)	<0.001	2.14 (1.89-2.39)	2.75 (2.48-3.02)	<0.001
11	0.91 (0.74-1.07)	1.71 (1.53-1.90)	<0.001	2.36 (2.08-2.64)	2.99 (2.69-3.29)	<0.001
12	0.96 (0.79-1.13)	1.82 (1.62-2.01)	<0.001	2.62 (2.30-2.95)	3.27 (2.93-3.61)	<0.001
13	1.03 (0.85-1.21)	1.92 (1.72-2.13)	<0.001	-	-	-
14	1.11 (0.91-1.31)	2.04 (1.81-2.27)	<0.001	-	-	-
15	1.22 (0.99-1.45)	2.16 (1.91-2.42)	<0.001	-	-	-

*Estimated from linear mixed model with time in cubic form adjusted for socioeconomic variables, phase at inclusion at baseline, heath behaviours, BMI, and number of comorbidities. Score ranges from 0=no-limitation to 7=maximum limitation. Controls from stroke-free population at the end of follow-up and matched on survey, sex, wave at stroke event report, and age within a 2-year range. Estimations are presented for a 15-year follow-up (corresponding to mean follow-up + 2 SD) for population aged 50-74 years and a 12-year period for those aged ≥75 years.

Table V. Means of IADL limitation score in stroke survivors in chronic phase and controls stratified by age*.

	IADL mean score (95% Confidence interval)					
	aged at 50 - 74			aged at 75 or over		
Years after stroke	Control	Stroke	*P for difference*	Control	Stroke	*P for difference*
1	0.34 (0.27-0.40)	0.93 (0.84-1.01)	<0.001	0.83 (0.74-0.93)	1.44 (1.32-1.56)	<0.001
2	0.36 (0.30-0.43)	0.89 (0.81-0.96)	<0.001	0.93 (0.84-1.03)	1.47 (1.36-1.58)	<0.001
3	0.39 (0.32-0.45)	0.87 (0.79-0.94)	<0.001	1.03 (0.94-1.13)	1.51 (1.40-1.62)	<0.001
4	0.41 (0.34-0.48)	0.87 (0.79-0.94)	<0.001	1.14 (1.04-1.24)	1.56 (1.45-1.68)	<0.001
5	0.43 (0.36-0.50)	0.88 (0.80-0.96)	<0.001	1.24 (1.14-1.35)	1.63 (1.52-1.75)	<0.001
6	0.46 (0.39-0.53)	0.91 (0.83-0.99)	<0.001	1.35 (1.24-1.46)	1.72 (1.60-1.85)	<0.001
7	0.48 (0.41-0.55)	0.96 (0.87-1.04)	<0.001	1.47 (1.35-1.59)	1.83 (1.69-1.96)	<0.001
8	0.50 (0.43-0.58)	1.02 (0.93-1.10)	<0.001	1.60 (1.47-1.74)	1.95 (1.80-2.11)	<0.001
9	0.53 (0.45-0.61)	1.08 (0.99-1.18)	<0.001	1.74 (1.59-1.89)	2.10 (1.93-2.27)	<0.001
10	0.56 (0.47-0.64)	1.16 (1.06-1.26)	<0.001	1.89 (1.71-2.07)	2.27 (2.07-2.47)	<0.001
11	0.59 (0.50-0.68)	1.24 (1.13-1.35)	<0.001	2.06 (1.85-2.27)	2.47 (2.24-2.70)	<0.001
12	0.62 (0.52-0.72)	1.33 (1.20-1.45)	<0.001	2.24 (1.98-2.49)	2.69 (2.42-2.96)	<0.001
13	0.66 (0.54-0.77)	1.42 (1.28-1.56)	<0.001	-	-	-
14	0.70 (0.57-0.83)	1.51 (1.35-1.67)	<0.001	-	-	-
15	0.74 (0.58-0.90)	1.60 (1.42-1.78)	<0.001	-	-	-

*Estimated from linear mixed model with time in cubic form adjusted for socioeconomic variables, phase at inclusion at baseline, heath behaviours, BMI, and number of comorbidities. Score ranges from 0=no-limitation to 6=maximum limitation. Controls from stroke-free population at the end of follow-up and matched on survey, sex, wave at stroke event report, and age within a 2-year range. Estimations are presented for a 15-year follow-up (corresponding to mean follow-up + 2 SD) for population aged 50-74 years and a 12-year period for those aged ≥75 years.

Table VI. Means of ADL limitation score in stroke survivors by modified Rankin scale (mRs) at beginning of chronic phase stratified by age*.

	ADL mean score (95% Confidence Interval)					
Years	aged at 50 - 74			aged at 75 and over		
follow up	mRs 0-1	mRs 2-3	mRs 4-5	mRs 0-1	mRs 2-3	mRs 4-5
1	0.08 (-0.06 - 0.21)	1.63 (1.51 - 1.74)	3.56 (3.39 - 3.74)	0.07 (-0.25 - 0.39)	1.77 (1.49 - 2.06)	3.95 (3.64 - 4.27)
2	0.26 (0.16 - 0.37)	1.65 (1.56 - 1.74)	3.40 (3.26 - 3.55)	0.34 (0.04 - 0.64)	1.84 (1.57 - 2.12)	3.97 (3.68 - 4.27)
3	0.42 (0.31 - 0.54)	1.69 (1.59 - 1.78)	3.29 (3.13 - 3.45)	0.61 (0.30 - 0.91)	1.95 (1.67 - 2.23)	4.03 (3.72 - 4.34)
4	0.56 (0.43 - 0.69)	1.73 (1.62 - 1.84)	3.21 (3.02 - 3.40)	0.88 (0.56 - 1.20)	2.08 (1.80 - 2.37)	4.12 (3.79 - 4.46)
5	0.67 (0.53 - 0.82)	1.78 (1.66 - 1.91)	3.17 (2.96 - 3.38)	1.16 (0.82 - 1.49)	2.25 (1.96 - 2.55)	4.25 (3.88 - 4.62)
6	0.77 (0.61 - 0.92)	1.85 (1.71 - 1.98)	3.16 (2.93 - 3.40)	1.44 (1.08 - 1.80)	2.45 (2.14 - 2.77)	4.41 (4.00 - 4.82)
7	0.85 (0.68 - 1.02)	1.92 (1.77 - 2.06)	3.19 (2.93 - 3.45)	1.73 (1.34 - 2.12)	2.69 (2.35 - 3.02)	4.61 (4.14 - 5.08)
8	0.91 (0.73 - 1.10)	1.99 (1.82 - 2.16)	3.24 (2.95 - 3.53)	2.02 (1.58 - 2.45)	2.95 (2.58 - 3.33)	4.85 (4.28 - 5.41)
9	0.97 (0.76 - 1.18)	2.07 (1.88 - 2.26)	3.32 (2.99 - 3.65)	2.31 (1.82 - 2.81)	3.25 (2.82 - 3.68)	5.12 (4.43 - 5.80)
10	1.02 (0.79 - 1.26)	2.15 (1.94 - 2.36)	3.42 (3.04 - 3.80)	2.61 (2.04 - 3.19)	3.58 (3.08 - 4.09)	5.42 (4.58 - 6.27)
11	1.07 (0.81 - 1.34)	2.23 (1.99 - 2.48)	3.54 (3.11 - 3.96)	2.92 (2.24 - 3.60)	3.95 (3.34 - 4.56)	5.77 (4.73 - 6.81)
12	1.12 (0.82 - 1.42)	2.32 (2.03 - 2.60)	3.67 (3.19 - 4.15)	3.23 (2.41 - 4.04)	4.35 (3.61 - 5.08)	6.15 (4.87 - 7.43)
13	1.18 (0.83 - 1.52)	2.40 (2.07 - 2.73)	3.82 (3.28 - 4.36)	-	-	-
14	1.24 (0.84 - 1.65)	2.48 (2.09 - 2.87)	3.97 (3.36 - 4.58)	-	-	-
15	1.31 (0.83 - 1.80)	2.55 (2.08 - 3.03)	4.13 (3.44 - 4.83)	-	-	-

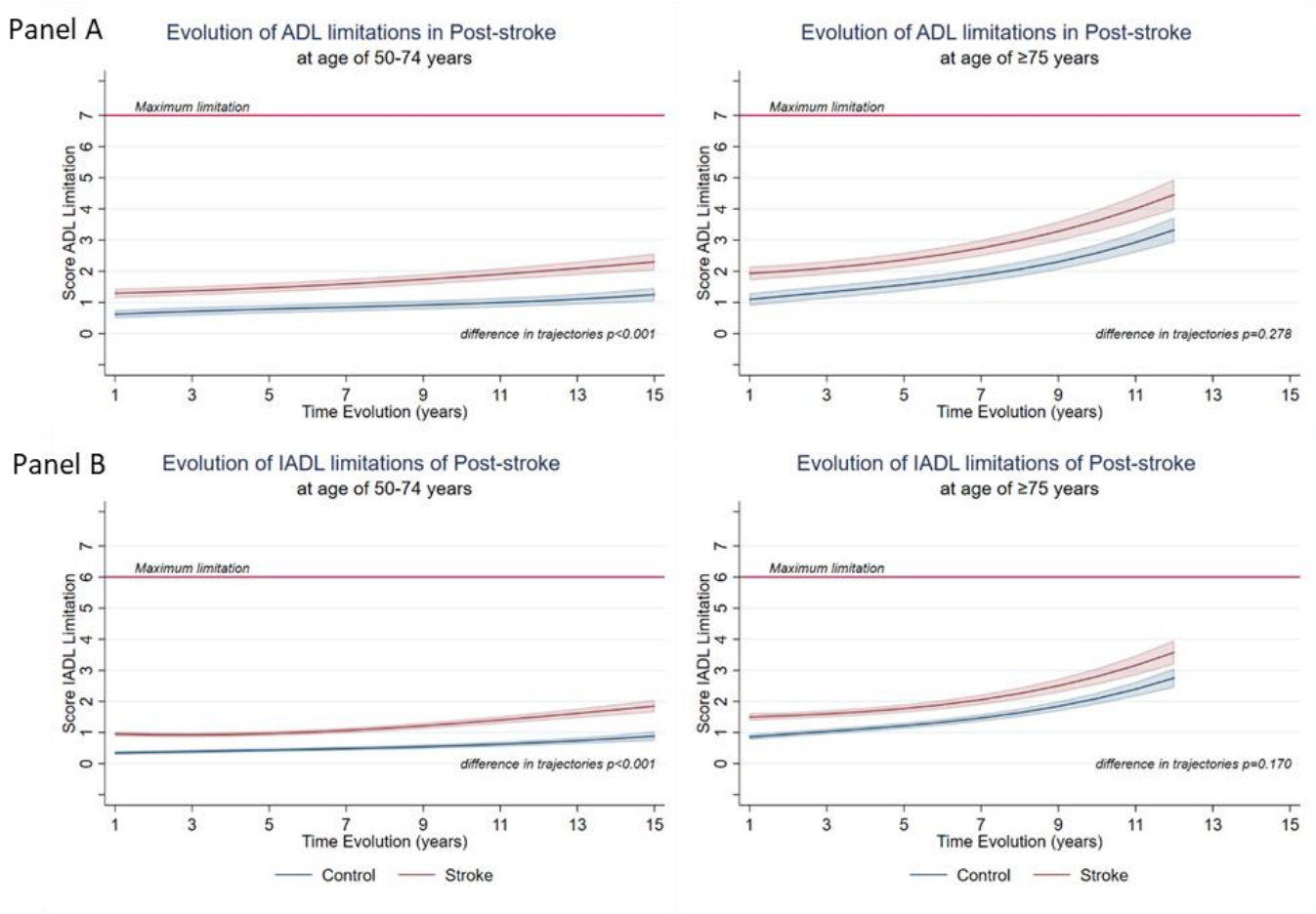
*Estimated from linear mixed model adjusted for socioeconomic variables, phase at inclusion at baseline, heath behaviours, BMI, and number of comorbidities. Time in cubic form for stroke survivors age 50-74 and quadratic form for those aged 75 and over. Score range from 0=no-limitation to 7=maximum limitation. Estimations are presented for a 15-year follow-up (corresponding to mean follow-up + 2 SD) for population aged 50-74 years and a 12-year period for those aged ≥75 years.

Table VII. Means of IADL limitation score in stroke survivors by modified Rankin scale (mRs) at beginning of chronic phase stratified by age*.

Years follow up	IADL mean score (95% Confidence Interval) aged at 50 - 74 mRs 0-1	aged at 50 - 74 mRs 2-3	aged at 50 - 74 mRs 4-5	aged at 75 and over mRs 0-1	aged at 75 and over mRs 2-3	aged at 75 and over mRs 4-5
1	0.04 (0.04 - 0.04)	0.77 (0.77 - 0.77)	3.69 (3.69 - 3.69)	0.04 (-0.11 - 0.19)	0.92 (0.81 - 1.03)	4.11 (3.97 - 4.25)
2	0.15 (0.15 - 0.15)	0.86 (0.86 - 0.86)	3.13 (3.13 - 3.13)	0.23 (0.11 - 0.36)	1.04 (0.95 - 1.14)	3.76 (3.64 - 3.89)
3	0.25 (0.25 - 0.25)	0.94 (0.94 - 0.94)	2.71 (2.71 - 2.71)	0.44 (0.30 - 0.59)	1.19 (1.09 - 1.30)	3.51 (3.35 - 3.66)
4	0.34 (0.34 - 0.34)	1.02 (1.02 - 1.02)	2.42 (2.42 - 2.42)	0.67 (0.50 - 0.85)	1.37 (1.24 - 1.50)	3.34 (3.14 - 3.54)
5	0.43 (0.43 - 0.43)	1.10 (1.10 - 1.10)	2.23 (2.23 - 2.23)	0.92 (0.71 - 1.13)	1.57 (1.42 - 1.72)	3.27 (3.02 - 3.52)
6	0.52 (0.52 - 0.52)	1.17 (1.17 - 1.17)	2.13 (2.13 - 2.13)	1.19 (0.94 - 1.43)	1.80 (1.62 - 1.98)	3.29 (2.99 - 3.59)
7	0.61 (0.61 - 0.61)	1.25 (1.25 - 1.25)	2.12 (2.12 - 2.12)	1.47 (1.18 - 1.76)	2.05 (1.84 - 2.26)	3.40 (3.03 - 3.77)
8	0.70 (0.70 - 0.70)	1.33 (1.33 - 1.33)	2.18 (2.18 - 2.18)	1.77 (1.44 - 2.11)	2.33 (2.07 - 2.59)	3.60 (3.15 - 4.06)
9	0.78 (0.78 - 0.78)	1.41 (1.41 - 1.41)	2.29 (2.29 - 2.29)	2.09 (1.70 - 2.49)	2.63 (2.31 - 2.95)	3.90 (3.33 - 4.47)
10	0.87 (0.87 - 0.87)	1.50 (1.50 - 1.50)	2.44 (2.44 - 2.44)	2.43 (1.96 - 2.91)	2.96 (2.56 - 3.35)	4.28 (3.58 - 4.99)
11	0.96 (0.96 - 0.96)	1.59 (1.59 - 1.59)	2.62 (2.62 - 2.62)	2.79 (2.23 - 3.36)	3.31 (2.82 - 3.80)	4.76 (3.89 - 5.63)
12	1.05 (1.05 - 1.05)	1.69 (1.69 - 1.69)	2.81 (2.81 - 2.81)	3.17 (2.50 - 3.84)	3.69 (3.09 - 4.29)	5.33 (4.27 - 6.39)
13	1.14 (1.14 - 1.14)	1.79 (1.79 - 1.79)	3.01 (3.01 - 3.01)	-	-	-
14	1.24 (1.24 - 1.24)	1.91 (1.91 - 1.91)	3.20 (3.20 - 3.20)	-	-	-
15	1.34 (1.34 - 1.34)	2.03 (2.03 - 2.03)	3.36 (3.36 - 3.36)	-	-	-

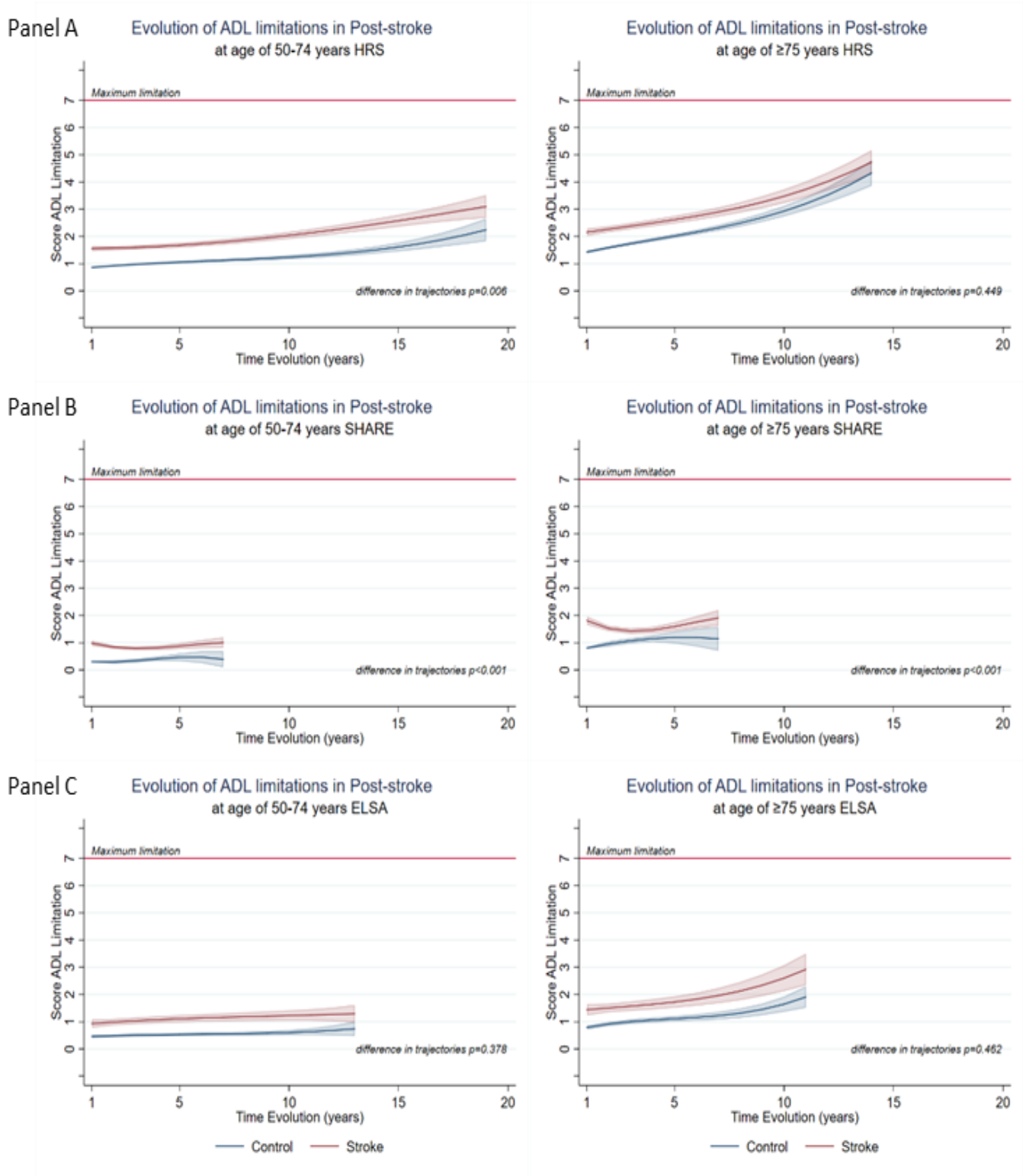
*Estimated from linear mixed model adjusted for socioeconomic variables, phase at inclusion at baseline, heath behaviours, BMI, and number of comorbidities. Time in cubic form for stroke survivors age 50-74 and quadratic form for those aged 75 and over. Score range from 0=no-limitation to 6=maximum limitation. Estimations are presented for a 15-year follow-up (corresponding to mean follow-up + 2 SD) for population aged 50-74 years and a 12-year period for those aged ≥75 years.

Figure I. Evolution of ADL and IADL limitation scores in stroke survivors in chronic phase followed from ±2 years post-stroke versus controls stratified by age*.



*Estimated from linear mixed model with time in cubic form adjusted for socioeconomic variables, phase at inclusion at baseline, heath behaviours, BMI, and number of comorbidities. Score range from 0=no-limitation to 7 or 6=maximum limitation. Panel A for ADL limitation evolution, Panel B for IADL limitation evolution. Controls from stroke-free population at the end of follow-up and matched on survey, sex, wave at stroke event report, and age within a 2-year range. Estimations are presented for a 15-year follow-up (corresponding to mean follow-up + 2 SD) for population aged 50-74 years and a 12-year period for those aged ≥75 years.

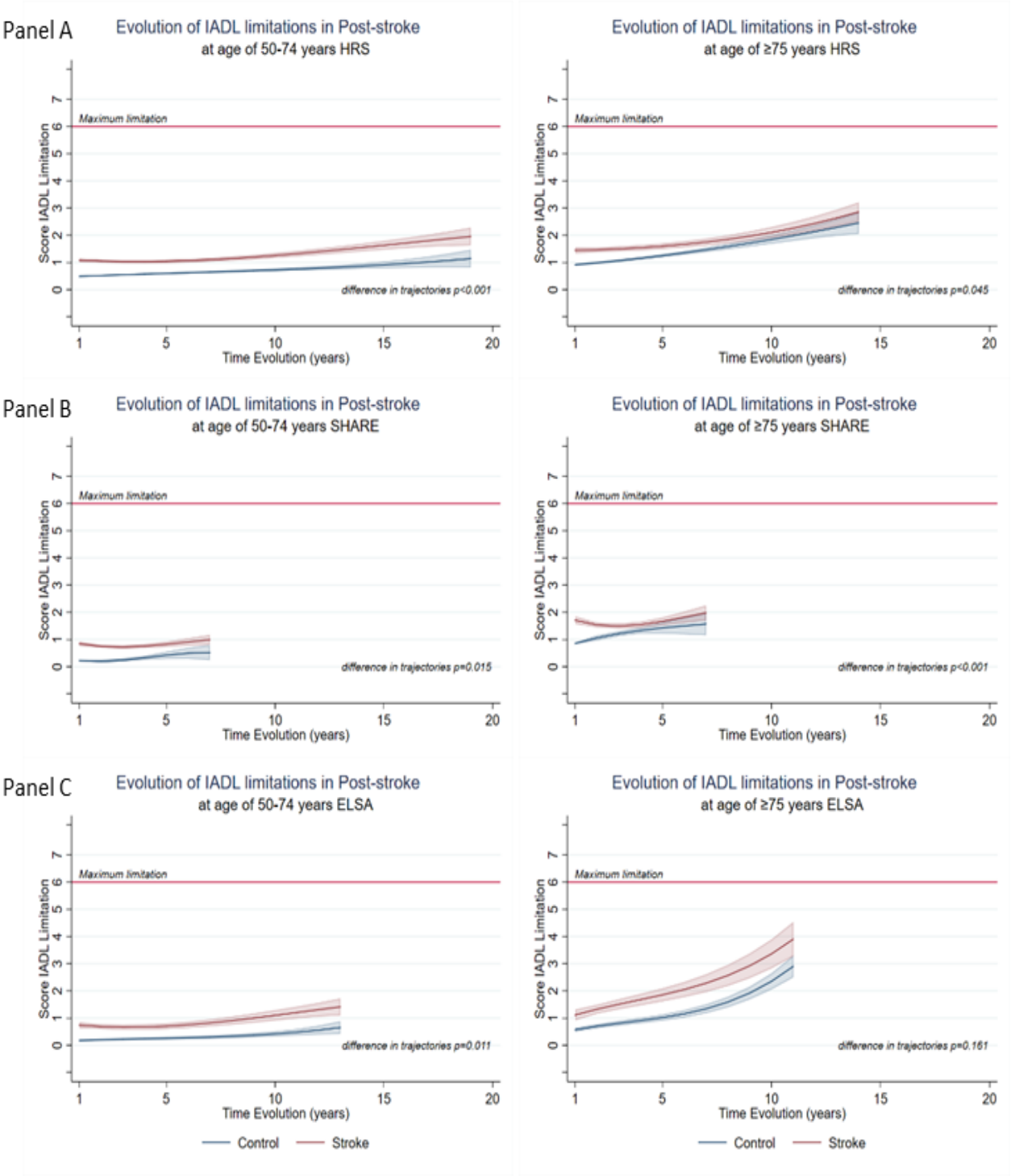
Figure II. Evolution of ADL limitation score in stroke survivors in chronic phase versus controls stratified by survey and age*.



*Estimated from linear mixed model with time in cubic form adjusted for socioeconomic variables, phase at inclusion at baseline, heath behaviours, BMI, and number of comorbidities. Score ranges from

0=no-limitation to 7=maximum limitation. Controls from stroke-free population at the end of follow-up and matched on survey, sex, wave at stroke event report, and age within a 2-year range. Panel A for individuals from HRS, Panel B for individuals from SHARE, panel C for individuals from ELSA.

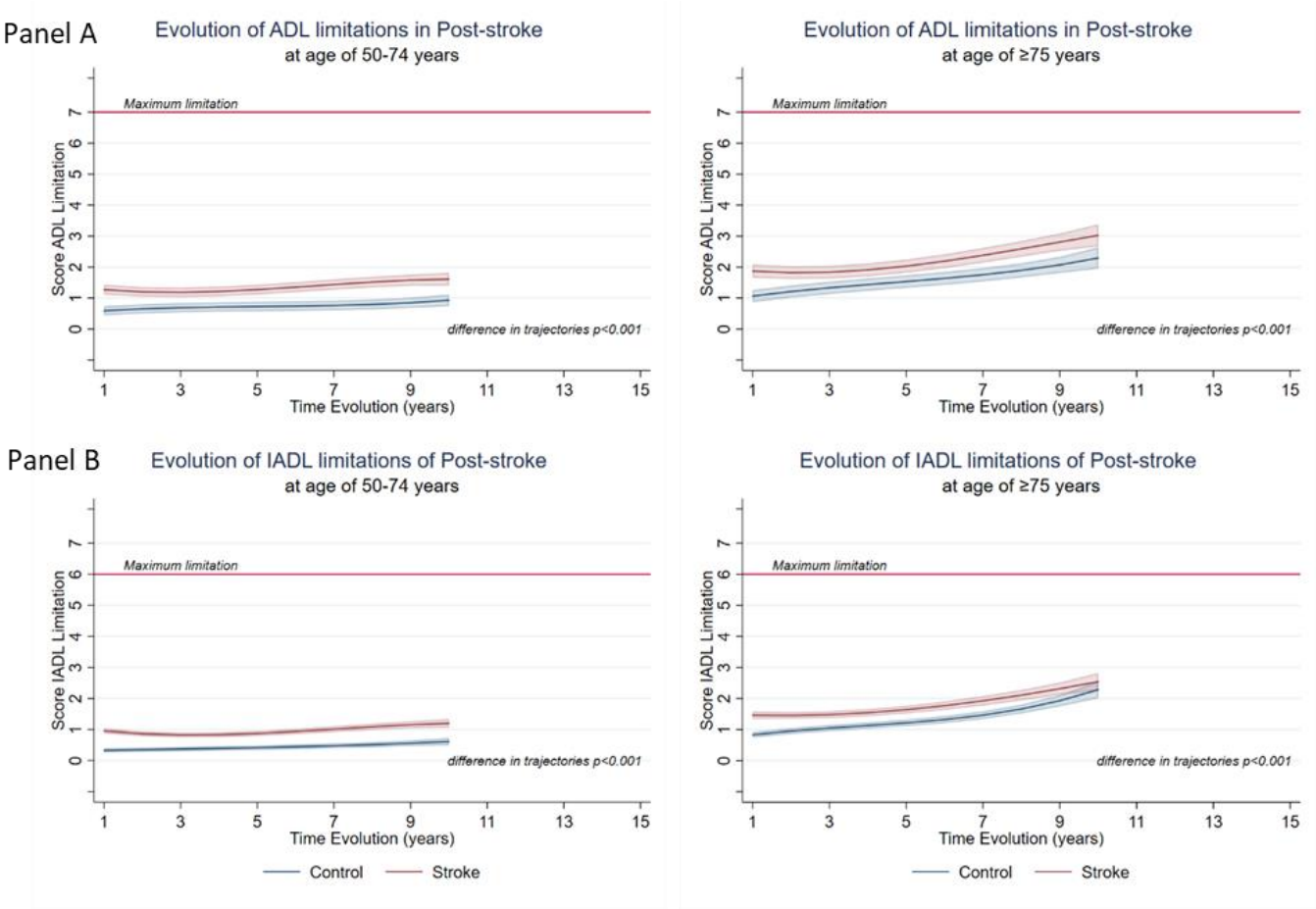
Figure III. Evolution of IADL limitation score in stroke survivors in chronic phase versus controls stratified by survey and age*.



*Estimated from linear mixed model with time in cubic form adjusted for socioeconomic variables, phase at inclusion at baseline, heath behaviours, BMI, and number of comorbidities. Score ranges from 0=no-limitation to 6=maximum limitation. Controls from stroke-free population at the end of follow-

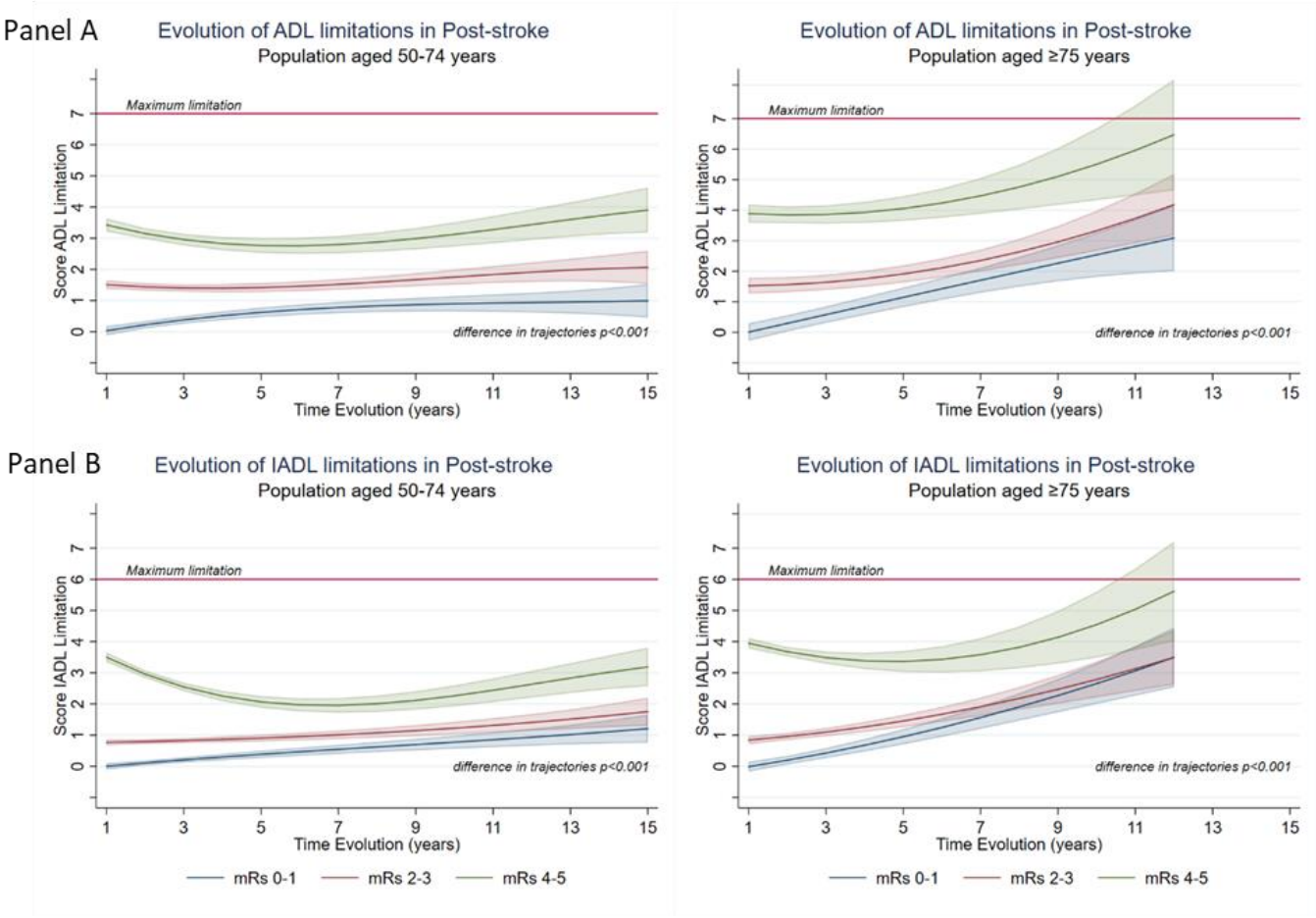
up and matched on survey, sex, wave at stroke event report, and age within a 2-year range. Panel A for individuals from HRS, Panel B for individuals from SHARE, panel C for individuals from ELSA.

Figure IV. Evolution of score of ADL and IADL limitation in stroke survivors in chronic phase versus controls stratified by age in analysis with follow-up restricted at 10 years*.



*Estimated from linear mixed model with time in cubic form adjusted for socioeconomic variables, phase at inclusion at baseline, heath behaviours, BMI, and number of comorbidities. Score ranges from 0=no-limitation to 7 or 6=maximum limitation. Controls from stroke-free population at the end of follow-up and matched on survey, sex, wave at stroke event report, and age within a 2-year range. Panel A for ADL limitation evolution, Panel B for IADL limitation evolution.

Figure V. Evolution of ADL and IADL limitation score in stroke cases by modified Rankin scale (mRs) at beginning of chronic phase without mortality report during follow-up stratified by age*.



*Estimated from linear mixed adjusted for socioeconomic variables, phase at inclusion at baseline, heath behaviours, BMI, and number of comorbidities. Time in cubic form for stroke survivors age 50-74 and quadratic form for those aged 75 and over. Score range from 0=no-limitation to 7 or 6=maximum limitation. Estimations are presented for a 15-year follow-up (corresponding to mean follow-up + 2 SD) for population aged 50-74 years and a 12-year period for those aged ≥75 years. Panel for ADL limitation evolution, Panel B for IADL limitation evolution.