Social Science & Medicine 405 (2026) 119608

Contents lists available at ScienceDirect

Social Science & Medicine

journal homepage: www.elsevier.com/locate/socscimed

Trajectories and inequalities in routine healthcare uptake from adolescence to retirement: A sequence analysis across 14 European countries

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ARTICLE INFO

Keywords:
Life course
Socioeconomic disadvantage
Routine healthcare
Trajectories
Europe

ABSTRACT

Background: Regular uptake of routine healthcare services can support disease prevention, early detection, monitoring, and timely treatment. Socioeconomically disadvantaged populations often face barriers to healthcare use. However, little is known about how routine healthcare uptake, and inequalities within it, unfold across the life course, or whether these trajectories differ by gender and birth cohort.

Methods: We used retrospectively collected SHARELIFE data from wave 3 (2008/09) of the Survey of Health, Ageing, and Retirement in Europe (SHARE) (n = 27′960). We constructed annual binary sequences of self-reported regular uptake from ages 16 to 65 for blood pressure measurement, blood tests for sugar or cholesterol, vision checks, mammography, and gynecological visits. We used sequence analysis to identify service-specific clusters of routine healthcare uptake trajectories. We then used multilevel multinomial regression models to examine associations with life-course socioeconomic disadvantage and birth cohort and assessed gender differences where applicable.

Results: Regular healthcare uptake generally increased with age across all services. In the pooled analyses, three broad trajectory types were identified across services: low uptake, uptake mainly in later life, and uptake throughout life. Trajectory membership differed by life-course socioeconomic disadvantage, country, and birth cohort, but not meaningfully by gender. Higher life-course socioeconomic disadvantage was associated with lower odds of belonging to high uptake trajectories compared with low uptake trajectories.

Conclusions: Routine healthcare uptake across adulthood followed age-patterned trajectories that varied by socioeconomic disadvantage, birth cohort, and country of residence. These findings suggest that social stratification influences long-term patterns of routine healthcare uptake across the life course and highlight the importance of addressing inequalities in access to and engagement with routine healthcare services.

1. Introduction

Regular uptake of primary healthcare is important for early disease detection and timely treatment when necessary, improving preventive care effectiveness (Demaio et al., 2014). Much of the existing evidence on regular healthcare use comes from primary healthcare, which encompasses services provided by general practitioners and other healthcare professionals and is often the first point of contact with the medical system for many Europeans, shaping lifelong health. Consistent healthcare uptake has been associated with lower hospitalization (Khazen et al., 2023; Moorin et al., 2020) and mortality (Khazen et al., 2023) rates as well as lower costs of care (Rose et al., 2019) in patient

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https://doi.org/10.1016/j.socscimed.2026.119608
Received 15 December 2025; Received in revised form 14 July 2026; Accepted 15 July 2026
Available online 16 July 2026

populations. Building on this evidence, our study focuses on routine healthcare uptake over the life course, including repeated uptake of selected screening, monitoring, and check-up services.

However, it is well established that not all populations access healthcare equally. In Europe, socioeconomically disadvantaged populations have significant difficulties in accessing primary healthcare (Baeten et al., 2018). Whether similar inequalities are observed in the regularity of routine healthcare uptake over the life course is less clear. One observational study among patients with chronic conditions exploring area-level socioeconomic status found no association with regularity of primary care (Rose et al., 2023). Further differences have been observed between men and women, with women generally more likely to participate in primary healthcare (Cylus et al., 2011). However, evidence is limited regarding gender differences in regular healthcare uptake over time, with one study suggesting that men are less likely to display regular uptake (Rose et al., 2023).

Birth cohort and country of residence – representing time and place – could also influence healthcare uptake as highlighted in life-course research (Elder Jr and Shanahan, 2006). Cohort effects are particularly pertinent, as European healthcare systems and screening recommendations have substantially evolved over the 20th century (Missinne, 2015). Cohort effects, here, means differences in life-course experiences between cohorts due to historical timing, i.e. the difference of being 40 years old in 2025 or 40 years old in 1925. For example, one study, based on SHARELIFE data, finds that age differences in mammography screening uptake reflect the period effects of national screening policies rather than "true" age differences (Missinne and Bracke, 2015). Country of residence can impact healthcare uptake through health insurance systems, screening programs, and availability of services.

Despite these insights, several gaps remain in understanding how birth cohorts influence healthcare uptake. While some studies have explored cohort effects on health outcomes (Keyes et al., 2010), there is limited research focusing on how these effects translate into differences in regular healthcare uptake. Moreover, existing studies often do not account for the interplay between cohort effects and socioeconomic factors, gender, and country-specific differences. This lack of comprehensive analyses hinders our understanding of the determinants of healthcare uptake across the life course. Thus, there is a gap in the evidence regarding the interaction of micro-level (socioeconomic disadvantage, gender) and macro-level (birth cohort, country) predictors of healthcare uptake trajectories.

Two theoretical perspectives may help shed light on this link: the fundamental cause theory and the cumulative disadvantage hypothesis. The fundamental cause theory (FCT) posits that inequalities in health (care) are due to an unequal distribution of resources like beneficial social connections, wealth, income, etc. that act as an upstream determinant of health disparities (Phelan et al., 2010). The cumulative advantage/disadvantage hypothesis (CAD) highlights how (dis)advantages tend to accumulate across the life course, both over time and over different areas of disadvantage, leading to a widening of health inequalities as individuals age (Dannefer, 2003). These theoretical frameworks offer complementary perspectives for interpreting how social structure and time shape healthcare trajectories. From an FCT perspective, differences in healthcare uptake across socioeconomic groups can be understood as reflecting enduring social inequalities that persist even as healthcare systems and recommendations change. CAD, on the other hand, emphasizes the dynamic process by which early-life socioeconomic disadvantage leads to fewer opportunities and weaker engagement with healthcare over time, thereby reinforcing inequalities across the life course. Together, these perspectives underscore the importance of examining both individual-level (e.g., socioeconomic disadvantage, gender) and contextual (e.g., birth cohort, country) influences when analyzing longitudinal patterns of healthcare uptake.

Most studies on healthcare uptake rely on cross-sectional data, thereby limiting longitudinal insights. Understanding trajectories in healthcare use (including increases, decreases, and fluctuations) is an important step in better understanding routine healthcare uptake across the life course and its variation by socioeconomic disadvantage, gender, birth cohort, and country. This study aims to contribute to the growing interest in healthcare trajectories (Haenssgen and Ariana, 2017) by analyzing trajectories of routine healthcare uptake over the life course in a cohort of older community-dwelling Europeans using sequence analysis (Liao et al., 2022). We have two research aims:

Aim 1: To characterize routine healthcare uptake trajectories in Europe from adolescence (age 16) to retirement (age 65), and to assess whether these trajectories differ by gender, healthcare service (blood pressure, blood test, vision, mammography, gynecology), or country of residence.

Aim 2: To examine the association between life-course socioeconomic disadvantage and routine healthcare trajectories and assess whether this association varies by birth cohort or country of residence.

2. Methods

2.1. Data source

We used data from the Survey of Health, Ageing and Retirement in Europe (SHARE) (Börsch-Supan et al., 2013). SHARE is a nationally representative cohort study of community-dwelling Europeans aged 50+ across 28 European countries, and collects data on health, social, economic, and behavioral markers (Bergmann et al., 2017; Schröder, 2011). Wave 3 of SHARE, called SHARELIFE, took place in 2008/9 and focused on people's life histories (Börsch-Supan, 2022). Using life history calendars (Freedman et al., 1988), around 30,000 participants from 14 European countries recalled key aspects of their life histories including childhood circumstances, employment trajectories, and healthcare use. SHARELIFE was used for this study because it contains information on routine healthcare uptake across the life course, including frequency, timing, and continuity of use across multiple healthcare services. Wave 7 of SHARE (2017/18) included a SHARELIFE questionnaire but without these questions; therefore, only wave 3 was used. Our analytical sample was split into two sub-samples to retain the highest number of participants for each research aim (Fig. 1).

2.2. Outcome, exposure, and covariates

The **outcome** is sequences of routine healthcare uptake between the ages of 16 and 65. For this, we used a series of questions featured in the healthcare module of SHARELIFE assessing regular healthcare uptake regarding blood pressure, blood test (cholesterol, blood sugar), vision, gynecological check-ups, and mammography. All questionnaire items used to derive the outcome are provided in Supplementary materials A.

Throughout this article, we use the term routine healthcare uptake to describe individuals' repeated self-reported uptake of selected healthcare services over the life course. These services are partly preventive, but may also reflect diagnostic or monitoring practices, and may be delivered in primary care, specialist care, or organized screening programs depending on the national health system and historical period.

Year-by-year trajectories were created with two states: regular healthcare uptake (1) and no regular healthcare uptake (0). Regular healthcare was defined as a minimum of once every two years using the question, "When you were having [your blood pressure checked] regularly, how often was that on average?". Respondents who replied with "Less often (than once every two years)" were categorized as not having received regular healthcare in that year.

The **exposure** is a life-course socioeconomic disadvantage score, covering childhood, midlife, and later life, based on previous studies (Jungo et al., 2022; Wahrendorf et al., 2013). Each life-course period was weighed the same with four disadvantage points possible, for a total life-course disadvantage score ranging from no disadvantage (0) to high disadvantage (12). For childhood, we used four household indicators at the age of 10: occupational position of the main breadwinner, number of

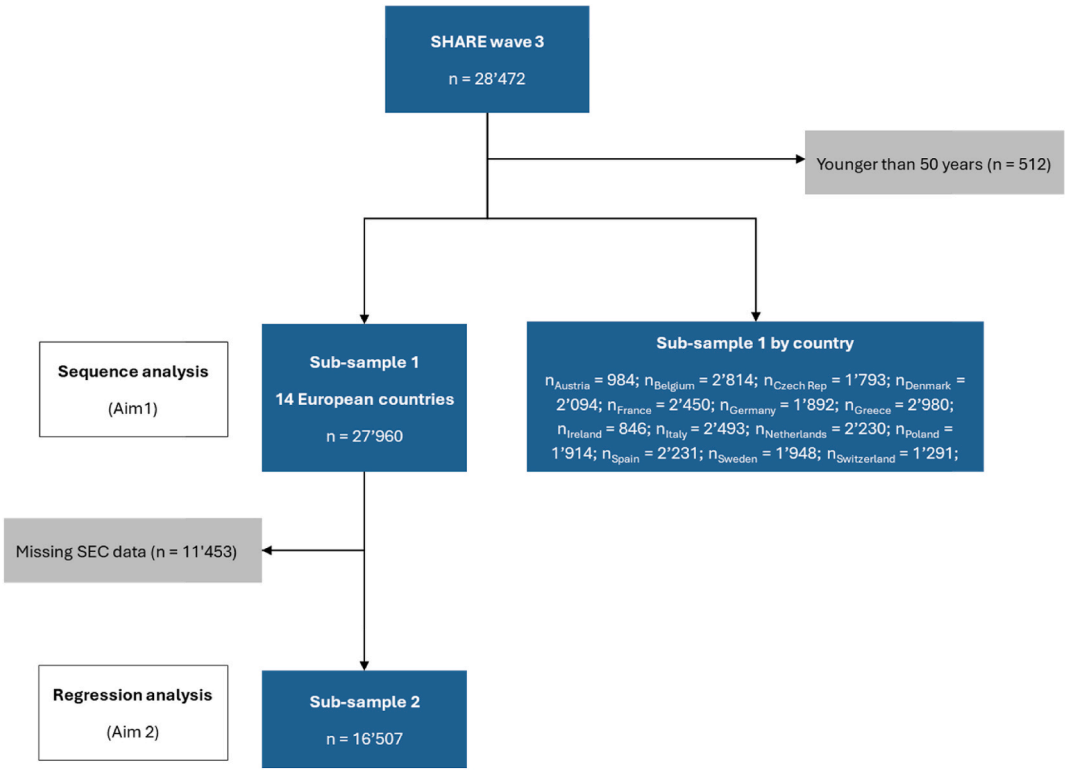

Fig. 1. Flow chart of participant selection
SEC = socioeconomic conditions.

books in the household, household overcrowding, and housing quality (Wahrendorf and Blane, 2015). For midlife, we used participants' highest educational attainment. For later life, we used the occupational class of the main or last occupation and household financial strain. Further information on questionnaire items and their categorization can be found in Supplementary materials A.

We used the life-course socioeconomic disadvantage score as a summary indicator of life-course accumulated disadvantage rather than as a strictly temporally prior exposure. Because some components, such as educational achievement, main or last occupation and financial strain, may overlap with or occur after parts of the healthcare uptake sequence, the models should be interpreted as estimating associations between life-course socioeconomic disadvantage and uptake trajectory membership, rather than causal effects.

Covariates were country (Austria, Belgium, Czech Republic, Denmark, France, Germany, Greece, Ireland, Italy, Netherlands, Poland, Spain, Sweden, Switzerland) and birth cohort (1908–1938, 1939–1945, 1946–1959) to account for regional and temporal variations.

2.3. Statistical analysis

Our analyses proceeded in four steps. First, we constructed individual sequences of routine healthcare uptake from age 16 to age 65, or to the participant's age at SHARELIFE if younger than 65. Second, we used sequence analysis to identify groups of similar uptake trajectories for each healthcare service. Third, we compared the resulting trajectory groups according to available childhood and adult health indicators using cross-tabulations, in particular to assess whether high-uptake trajectories appeared to be mainly driven by poorer health or service-specific health need. These analyses were descriptive and were not intended to estimate the effect of healthcare uptake trajectories on later health. Fourth, we used multilevel multinomial logistic regression models to examine whether life-course socioeconomic disadvantage and birth cohort were associated with membership in medium or high uptake trajectories compared with low uptake trajectories, while accounting for country-level clustering.

2.3.1. Sequence analysis

To address Aim 1, we performed sequence analysis. To construct annual sequences, we first initialized all observed years from age 16 to age 65, or to age at SHARELIFE if younger than 65, as no regular uptake. We used age 65 as the upper bound because it represents the transition into older adulthood, when healthcare uptake increasingly reflects age-related morbidity rather than established life-course patterns of preventive care. For participants reporting regular uptake of a given service, years from the reported start year onward were coded as regular uptake. If participants reported that they had not always used the service regularly since the start year, the SHARELIFE questionnaire asked them to identify broad age intervals without regular uptake: 16–25, 26–40, 41–55, and 56–65 years. In these cases, all years within the indicated interval were coded as no regular uptake. Thus, although sequences were represented annually for sequence analysis, parts of the sequence necessarily reflect interval-level information from the questionnaire: broad age intervals reported by participants were translated into annual states by uniformly applying the reported uptake status to each year within the interval. Participants with missing information on the timing or frequency of uptake that prevented sequence construction were excluded from the service-specific analysis. As a sensitivity analysis, to assess whether this uniform annual coding of interval-based responses affected the main trajectory interpretation, we collapsed the annual sequences back into the four SHARELIFE age intervals. Each interval was coded as regular uptake if regular uptake was present in at least half of the observed annual states within that interval. We then summarized the resulting interval-level patterns to assess whether the same broad trajectory patterns were evident when uptake was summarized at the questionnaire-interval level.

Next, we clustered sequences into similar trajectories using the optimal matching (OM) algorithm in the *TraMineR* R package

(Gabadinho et al., 2011). Full details on the cost settings, distance normalization, handling of missing positions, and clustering algorithm are provided in Supplementary materials A. OM is the most common way of computing dissimilarities between sequences describing life trajectories and is particularly suited for sequences of unequal length. To determine the number of clusters for each healthcare service, we used the average silhouette width (ASW) measure (Kaufman and Rousseeuw, 2009). We followed the recommendation of Kaufman and Rousseeuw (2009) of an ASW of at least 0.51 denoting a reasonable clustering structure, combining it with our own interpretation of meaningful clusters. We performed these steps for the pooled sample and subsequently for each country separately.

2.3.2. Regression analysis

To address Aim 2, we used multilevel multinomial logistic regression models to estimate associations between life-course disadvantage and clusters of routine healthcare uptake. Analyses were stratified by gender (men, women) to capture potential gender differences and to account for services only available to women (mammography, gynecological check-ups). SHARELIFE records gender using two categories, male and female. This measure does not explicitly capture gender identity nor sex assigned at birth but may reflect both biological and social differences relevant to healthcare uptake. Given our focus, we use the term gender when discussing differences in uptake patterns, while acknowledging the limitations of this binary survey measure.

The models included fixed effects for life-course disadvantage and birth cohort, with random intercepts for countries to account for cross-national heterogeneity. To quantify this heterogeneity, we computed the Median Odds Ratio (MOR) for each service and uptake category. The MOR is an interpretable measure of the median difference in odds of belonging to a higher uptake category when comparing two individuals with identical covariates from two randomly chosen countries (Merlo et al., 2006). Life-course disadvantage was entered in its original scale, as described above, such that coefficients reflect the result of a one-point increase on the disadvantage scale. We additionally tested whether associations between life-course socioeconomic disadvantage and uptake trajectories differed by birth cohort by adding interaction terms between life-course disadvantage and birth cohort.

Multilevel multinomial logistic regression models were estimated using the *brms* package in R, which implements Bayesian models in Stan using Hamiltonian Monte Carlo (Bürkner, 2017). Models included fixed effects for life-course socioeconomic disadvantage and birth cohort, and random intercepts for country. We used the default priors implemented in *brms*; no custom priors were specified. Four chains of 4′000 iterations each, including 2′000 warm-up iterations, were run. Convergence was assessed using R-hat values and bulk and tail effective sample sizes. Results are reported as odds ratios with 95% credible intervals. A Bayesian framework was used because *brms* provides a flexible implementation of multilevel multinomial logistic regression with country-level random intercepts and returns full posterior distributions for model parameters, allowing uncertainty to be summarized using credible intervals.

Data preparation was conducted with *tidyverse* packages (Wickham et al., 2019), and visualization of results was performed with *ggseqplot* of the *TraMineR* package. All analyses were performed in R version 4.4.2.

2.3.3. Sensitivity analyses

We conducted several sensitivity analyses. First, to assess whether the annual coding of interval-based SHARELIFE responses affected the main trajectory interpretation, we collapsed annual sequences back into the original SHARELIFE age intervals and summarized the resulting interval-level patterns. Second, to assess robustness to the choice of substitution costs, we repeated the sequence analysis using transition-rate-based substitution costs while keeping the clustering algorithm unchanged. We summarized the resulting cluster profiles using average silhouette width, cluster size, and broad trajectory interpretation. Third, to address temporal ordering of the life-course disadvantage score, we repeated the regression models using childhood socioeconomic disadvantage only. Fourth, to assess whether associations were robust to early-life health need, we repeated the regression models additionally adjusting for self-rated childhood health. Finally, we tested interactions between life-course disadvantage and birth cohort.

3. Results

3.1. Participant characteristics

Characteristics of the two analytic samples are reported in Table 1. For the first analytical sub-sample (sequence analysis), mean age at baseline was around 66 years and there were slightly more women (55%) than men. Close to half were born after 1945 (42%), while 23% were born during the Second World War (1939–1945), and 35% earlier. The second analytical sub-sample (regression analysis) differs from the first sub-sample by having more women (59% compared to 55%) and being slightly older with a mean age of 69 years and thus a higher percentage of participants born before the Second World War (45% compared to 35%). The median life-course socioeconomic disadvantage was 6 on a range from 0 (no disadvantage) to 12 (high disadvantage) (Table S1 and Fig. S1). In the second sub-sample, there were no substantial differences between men and women in baseline characteristics (Table S2). However, men and women differed in some aspects of their life-course socioeconomic disadvantage. Men were more likely to have a tertiary education or higher (20% compared to 12% in women), to have a high occupation (30% compared to 13%), and much less likely to never have worked in their lives (1% compared to 18%). Men had a median disadvantage score of 5 compared to 6 in women, leaning slightly more towards advantage.

3.2. Trajectories of routine healthcare uptake

We have created sequences of self-reported regular healthcare uptake for each participant between the ages of 16 and 65 or alternatively 16 and age at wave 3 for those younger than 65. Frequencies of each

Table 1
Baseline characteristics of two sub-samples.

Characteristics	Sequence analysis n (% or SD)	Regression analysis n (% or SD)
Number of participants	27′960	16′507
Gender		
Female	15′485 (55.4%)	9′687 (58.7%)
Male	12′475 (44.6%)	6′820 (41.3%)
Age at baseline (years), mean and SD	66.4 (±9.8)	69.2 (±9.1)
Birth cohorts		
1908 – 1938	9′713 (34.7%)	7′451 (45.1%)
1939 – 1945	6′454 (23.1%)	4′583 (27.8%)
1946 – 1959	11′793 (42.2%)	4′473 (27.1%)
Countries		
Austria	984 (3.5%)	692 (4.2%)
Belgium	2′814 (10.0%)	1′803 (10.9%)
Czech Republic	1′793 (6.4%)	1′030(6.2%)
Denmark	2′094 (7.5%)	1′063(6.4%)
France	2′450 (8.8%)	1′449(8.8%)
Germany	1′892 (6.8%)	1′076 (6.5%)
Greece	2′980 (10.7%)	1′690 (10.2%)
Ireland	846 (3.0%)	335 (2.0%)
Italy	2′493 (8.9%)	1′781 (10.8%)
Netherlands	2′230 (8.0%)	1′212 (7.3%)
Poland	1′914 (6.8%)	1′230 (7.4%)
Spain	2′231 (8.0%)	1′433 (8.7%)
Sweden	1′948 (7.0%)	1′022 (6.2%)
Switzerland	1′291 (4.6%)	691 (4.2%)

SD = standard deviation. n = number.

healthcare service uptake (blood pressure, blood test, vision, gynecology, mammography) can be found in Fig. S2. Overall, we observed a trend of increasing regular healthcare uptake with increasing age, with an increasing uptake especially between ages 40 and 50. Gynecology uptake was the only healthcare service with a slight decrease, around ages 55 to 65. We observed no considerable differences between men and women in their overall uptake patterns for blood pressure, blood test, and vision check-ups (Fig. S3).

We have identified three clusters of uptake trajectories (hereafter, "trajectories") that emerged for all five healthcare services separately (Fig. 2). Clustering quality was reasonably high (blood pressure: 0.60, blood test: 0.62, vision: 0.66, gynecology: 0.66, mammography: 0.59), suggesting meaningful clustering. The first uptake trajectory generally describes a low frequency (≤20%) of self-reported healthcare uptake, concentrated in later life (age 50+) exclusively, with a high frequency of no regular healthcare uptake. The second uptake trajectory showed a gradual increase in the frequency of self-reported uptake starting in mid-life (approximately age 40), with a high frequency (≥80%) of regular healthcare uptake in later life (age 50+). Finally, the third uptake trajectory describes a high frequency of regular healthcare uptake already starting early in life (approximately age 25), with a very high relative frequency (≥90%) of regular uptake in mid-life and later life (approximately age 40+). These three trajectories can be summarized as irregular uptake throughout the life course, regular uptake in later life, and regular uptake throughout the life course, and will be labelled "low", "medium", and "high" for simplicity henceforth. Similar to the overall uptake patterns, there were no differences between men and women regarding the three trajectories.

Sequence analyses performed by country showed some country variations (Supplementary materials B, Figure S4 – S78). First, the frequencies of healthcare uptake differed by country, for example blood pressure uptake at age 65 was higher in France (approx. 75%) compared to Denmark (approx. 30%). Second, the optimal number of clusters ranged from two to four, depending on healthcare service and country. Overall, the same trend of increasing uptake with increasing age was observed. Mammography uptake showed the biggest variations by country, likely reflecting differences in screening policies – with some countries having implemented organized screening programs, while others relying primarily on opportunistic screening.

3.3. Health status and uptake trajectories

To assess whether high-uptake trajectories reflect poor health status, we performed descriptive analyses of health measurements available in SHARELIFE. To assess health in childhood (ages 0–15), we used self-rated health in childhood, whether participants missed school for one month or more because of a health condition, and whether participants were hospitalized for one month or more. Additionally, we used data on self-reported difficulty seeing even with eyeglasses in childhood, to cross-tabulate against vision trajectories specifically. To assess health in adulthood, we used self-rated health and self-reported long-term illnesses (≥one year duration). These were cross-tabulated against relevant healthcare trajectories: angina or heart attack or other heart disease (blood pressure), diabetes or high blood sugar (blood test), eyesight

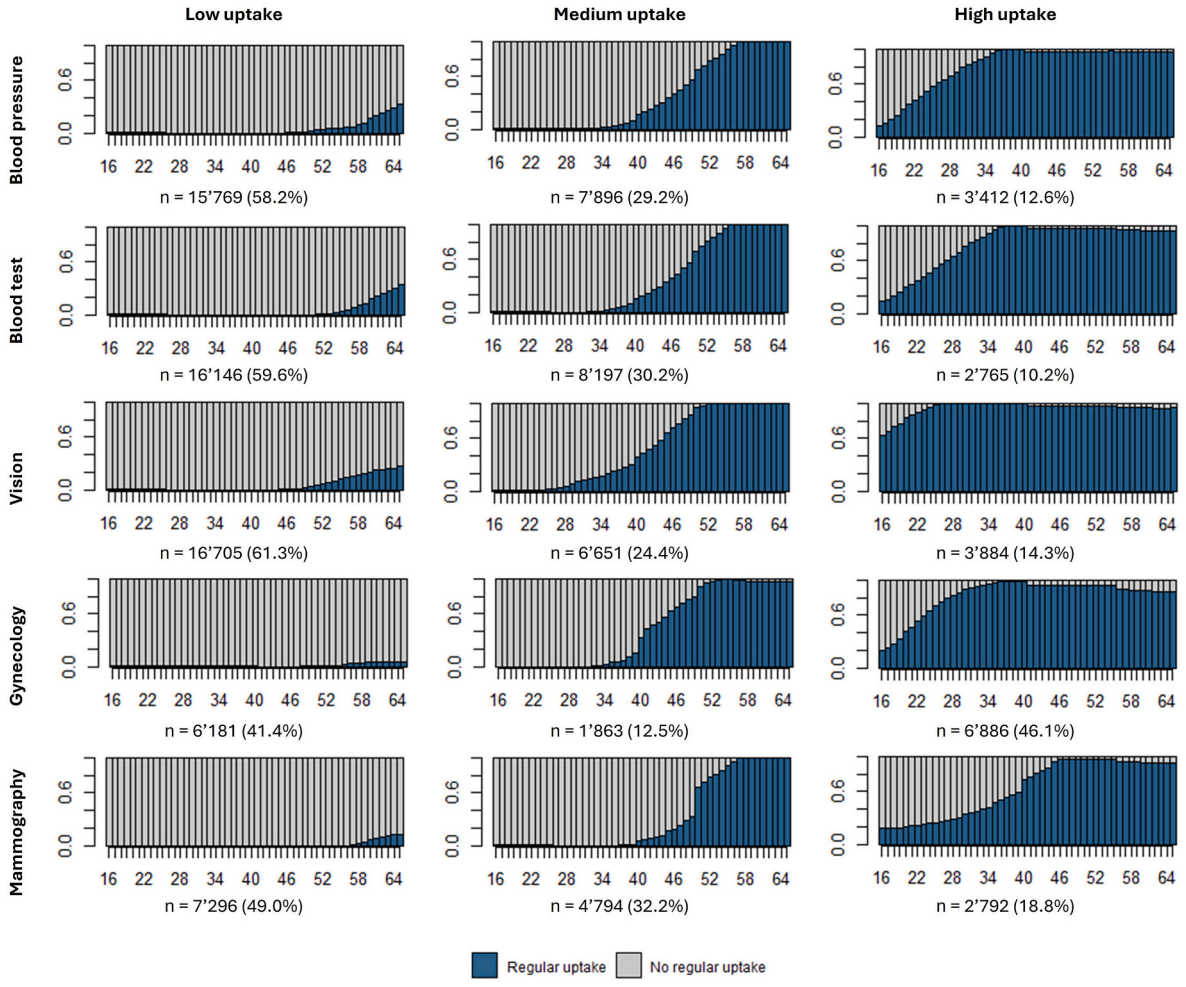

Fig. 2. Clusters of routine healthcare trajectories
Gynecology and mammography are only assessed in women. X-axis = age of participant (16-65). Y-axis = relative frequency of healthcare uptake.

problems (vision), gynecological problems (gynecology), and cancer or malignant tumor (mammography).

Associations between healthcare uptake clusters and self-reported health in childhood and adulthood were assessed using Pearson's chi-squared tests. Cross-tabulations were generated to show the distribution of health status (good vs. poor) across the three uptake clusters (low, medium, high), and p-values were reported to indicate whether observed differences were statistically significant. These cross-tabulations were exploratory and descriptive. They were intended to assess whether trajectory groups differed in available indicators of health and service-specific health need, rather than to estimate causal effects of healthcare uptake on health outcomes. Further information on variables and their specific questionnaire items can be found in Supplementary materials A.

Our sensitivity analyses exploring health as a potential explanation for differences in healthcare uptake showed that it might explain some, yet not all variations (Table S3 – S6). Self-rated health in childhood, missing school for at least one month due to health reasons, and being hospitalized for at least one month, showed similar trends: overall, the percentage of participants with poor health was highest in high or medium uptake trajectories, but only by a few percentage points. For example, participants with poor self-rated health in childhood made up 7% of low, 7% of medium, and 11% of high blood pressure uptake (Table S3 – S4). Eye issues in childhood despite wearing eyeglasses showed a clearer trend: 1% of participants belong to the low vision uptake trajectory, 8% to medium, and 1% to the high uptake trajectory (Table S5). For adulthood, self-rated poor health was most common in low and medium trajectories, but again not by a big margin. For example, participants with poor self-rated health in adulthood made up 39% of low, 43% of medium, and 36% of high blood pressure uptake (Table S3). Similar to eye issues in childhood and vision uptake, the prevalence of participants ever having experienced specific illnesses, like a heart attack, was highest in medium, sometimes high, uptake trajectories (Table S6). Overall, participants reporting poorer health either in childhood or adulthood were slightly more prevalent in medium and high uptake trajectories, but the differences were modest. This suggests that high uptake trajectories are unlikely to be driven solely by poorer health, although residual differences in health need not captured by the available indicators cannot be ruled out.

3.4. Association of life-course socioeconomic disadvantage and birth cohorts with regular healthcare trajectories

Across all healthcare services, higher life-course socioeconomic disadvantage was associated with lower odds of belonging to the high uptake trajectory compared with the low uptake trajectory (Table 2). The strength of the association ranged from 0.84 OR (95% credible intervals (CrI): 0.82 – 0.85) for vision to 0.94 (0.92 – 0.96) for blood pressure. Associations with medium uptake were weaker and less consistent: they were most apparent for gynecology (0.89; 0.87 – 0.92), mammography (0.89; 0.87 – 0.92), and vision (0.92; 0.91 – 0.94), and absent for blood test (0.98; 0.97 – 1.00) and blood pressure (0.99; 0.97 – 1.01).

Birth cohorts displayed a strong and consistent association. Across all outcomes, younger cohorts (1939–1945, 1946–1959) showed consistently higher odds of medium and high uptake compared with the reference cohort (1908–1938). Focusing on high compared to low uptake, the strength of this association ranged from 1.65 (1.47 – 1.86) for vision to 3.00 (2.58 – 3.46) for mammography for the WWII birth cohort (1939–1945), and from 1.85 (1.65 – 2.09) for vision to 4.13 (3.54 – 4.81) for mammography for the post-WWII cohort (1946–1959). Interaction models provided no evidence that associations between life-course disadvantage and uptake trajectories differed by birth cohort (Table S7).

Country-level variation in uptake was evident across all healthcare services. Median odds ratios ranged from 1.52 to 2.41 in the medium uptake cluster and 1.54 to 2.81 in the high uptake cluster, indicating moderate to substantial cross-national differences even after adjusting for individual life-course disadvantage and birth cohort (Table S8). The strongest country-level clustering was observed for mammography, potentially due to differences in screening programs, while vision checks showed more moderate heterogeneity. Finally, gender-stratified models did not suggest major differences in the association between life-course disadvantage and high uptake trajectories. However, some gender-specific cohort patterns were visible, particularly for high blood pressure and blood test uptake, where later birth cohorts showed stronger associations among women, and for high vision uptake, where cohort differences were somewhat stronger among men (Table S9).

Table 2
Associations of life-course disadvantage and birth cohorts with routine healthcare uptake clusters.

	Medium vs. low uptake OR (95% CrI)	High vs. low uptake OR (95% CrI)
Blood pressure		
Life-course disadvantage	0.99 (0.97 – 1.01)	0.94 (0.92 – 0.96)
Cohort 1939-1945	2.03 (1.86 – 2.22)	2.10 (1.85 – 2.38)
Cohort 1946-1959	1.88 (1.71 – 2.05)	2.32 (2.04 – 2.63)
Blood test		
Life-course disadvantage	0.98 (0.97 – 1.00)	0.92 (0.90 – 0.95)
Cohort 1939-1945	2.56 (2.34 – 2.82)	2.20 (1.93 – 2.53)
Cohort 1946-1959	3.65 (3.33 – 4.02)	3.11 (2.72 – 3.57)
Vision		
Life-course disadvantage	0.92 (0.91 – 0.94)	0.84 (0.82 – 0.85)
Cohort 1939-1945	1.48 (1.34 – 1.63)	1.65 (1.47 – 1.86)
Cohort 1946-1959	1.39 (1.26 – 1.52)	1.85 (1.65 – 2.09)
Gynecology		
Life-course disadvantage	0.89 (0.87 – 0.92)	0.85 (0.83 – 0.87)
Cohort 1939-1945	2.36 (1.99 – 2.79)	2.34 (2.08 – 2.63)
Cohort 1946-1959	3.47 (2.92 – 4.09)	3.48 (3.11 – 3.92)
Mammography		
Life-course disadvantage	0.89 (0.87 – 0.92)	0.86 (0.84 – 0.88)
Cohort 1939-1945	4.71 (4.06 – 5.44)	3.00 (2.58 – 3.46)
Cohort 1946-1959	11.58 (10.03 – 13.39)	4.13 (3.54 – 4.81)

OR = odds ratios. CrI = credible intervals. Models included birth cohort and country-level random intercepts. Cohorts are compared to 1908–1938. Gynecology and mammography are only assessed in women.

3.5. Sensitivity analyses

Sensitivity analyses supported the main interpretation. Collapsing annual sequences back into the original SHARELIFE age intervals reproduced the same broad uptake patterns: low or mainly late uptake, later-life uptake, and sustained or earlier uptake (Table S10). Other/interrupted interval-level patterns were rare for all services, ranging from 1% to 6%. Repeating the sequence analysis using transition-rate-based substitution costs also reproduced the same broad cluster profiles (Table S11). In regression models using childhood socioeconomic disadvantage only, higher childhood disadvantage was associated with lower odds of high uptake across all healthcare services (Table S12). Additional adjustment for self-rated childhood health did not change the associations between life-course disadvantage and uptake trajectories (Table S13).

4. Discussion

This study described life-course patterns of regular healthcare uptake and explored their association with life-course socioeconomic disadvantage, gender, birth cohort, and country of residence. Using SHARELIFE data, this is, to our knowledge, the first analysis of retrospective sequences of healthcare uptake from ages 16 to 65. We observed an

overall trend of increasing regular healthcare uptake with increasing age with no differences between men and women. In the pooled analysis, three uptake trajectories emerged across all healthcare services: irregular uptake ("low"), regular uptake in later life ("medium"), and regular uptake throughout life ("high"). Country-specific sequence analyses showed broadly similar age-related increases in uptake, although the number and separation of clusters varied across countries and services.

We explored the association between life-course socioeconomic disadvantage and the three uptake trajectories. The results of our multilevel regression model indicate that the odds of belonging to a high uptake trajectory were lower among participants with higher life-course disadvantage and among those born in earlier cohorts. We found no meaningful differences between men and women in the association between life-course disadvantage and high uptake trajectories, while country-level random intercepts and MORs indicated moderate to substantial cross-national variation in trajectory membership. Overall, we describe a pattern of regular healthcare uptake in older adults that increases with age regardless of gender and is strongly influenced by context, i.e. the country and time period participants were born into.

Few studies have explored sequences of healthcare uptake over the life course, with most relying on non-survey data sources such as insurance claims or electronic health records. One study using SHARE data, though not longitudinally, found educational differences in specialist but not general practice visits, paralleling our finding that disadvantage had stronger associations for specialized services (vision, gynecology, mammography) than general services (blood pressure, blood test) (Terraneo, 2015). What makes our study unique is its use of survey-based, retrospective life-course data to bring a longitudinal perspective to healthcare uptake. By applying sequence analysis, we were able to estimate distinct patterns of routine healthcare uptake over the life course, offering new insights into how preventive care engagement unfolds across time and social contexts.

Our sequence-based approach complements, rather than replaces, existing measures of healthcare utilization such as having a usual source of care, continuity of care, and temporal regularity of primary care visits. These measures capture important dimensions of access, relationship continuity, and spacing of visits, often over shorter observation windows or in patient populations. In contrast, routine healthcare uptake trajectories describe long-term patterns in the repeated uptake of specific services across age. This provides a life-course perspective on when routine healthcare engagement begins, whether it is sustained, and whether such patterns differ by socioeconomic position, gender, birth cohort, and country. This perspective may be especially useful for studying how preventive and routine healthcare engagement develops, stabilizes, or remains absent over the life-course, and whether such patterns are socially stratified. However, it should be acknowledged that the construct operationalized here remains relatively crude, constrained by the retrospective and interval-based nature of the available data. Future refinements, drawing on more granular and ideally prospective longitudinal data, will be needed to capture the full complexity of life-course healthcare trajectories. Future research should examine how these trajectories relate to other measures of healthcare utilization and whether they help identify life stages at which inequalities in routine and preventive healthcare become established.

Our findings indicate that time (birth cohort) and place (country of residence) influence healthcare uptake. One study using the same dataset (SHARELIFE) and exploring similar cohorts (born 1925–1934, 1935–1944, 1945+) observed similar cohort trends: the uptake of routine healthcare increased with each new cohort (Sirven and Or, 2011). Comparing variations in preventive care utilization across Europe, another study found that preventive service uptake varies substantially by country, socioeconomic factors like education and income, and health system features like public health expenditure and general practitioner density (Jusot et al., 2012). These patterns likely reflect both the natural evolution of health needs with age and the growing availability of routine healthcare.

These findings point to meaningful temporal and cross-national variation, but they should be interpreted as evidence of historical and contextual patterning rather than as estimates of specific cohort or health-system effects. First, birth cohort differences should be interpreted as markers of historical context rather than as pure cohort effects. Because participants from different birth cohorts reached midlife and later adulthood in different calendar periods, observed differences may reflect both cohort experiences and period changes, including the expansion of preventive services, changing screening recommendations, and the introduction of organized breast cancer screening programs. Birth cohort was included in the models because the cumulative advantage/disadvantage hypothesis suggests that the historical context into which individuals are born, and the life-course experiences that follow may shape healthcare uptake trajectories. Our analysis was not designed to separate age, period, and cohort effects. Second, the country-level variation observed in the multilevel models indicates that uptake trajectories differed across national contexts. However, our models did not include country-level health system characteristics, screening policies, or measures of service availability. The MORs should therefore be interpreted as evidence of cross-national variation, not as evidence for specific institutional mechanisms. Future research linking individual-level trajectory data to historical policy and health system indicators would be needed to examine these mechanisms.

We have found no meaningful differences between men and women. This is partially in contrast to existing literature. Regarding overall healthcare uptake, several studies suggest that women have a higher uptake than men (Cylus et al., 2011; Wang et al., 2013), which we did not observe in our analysis. This discrepancy may be explained by the fact that our study focused specifically on the regularity of healthcare uptake over time, whereas previous studies often assess overall or one-time utilization. Regarding the association of socioeconomic disadvantage with healthcare uptake, some gender differences have been reported dependent on the outcome in question. For example, for coronary heart disease, one meta-analysis found a greater excess risk associated with lower educational attainment in women compared with men (Backholer et al., 2017). On the other hand, for mortality, one review found that male mortality was more unequal than female mortality across socioeconomic groups (Mustard and Etches, 2003). Our study found no such differences. Two potential reasons for this are, first, that gender differences in utilization tend to diminish at older ages as healthcare use becomes more strongly driven by morbidity rather than help-seeking preferences. Second, our analytic approach, including reducing trajectories to binary states and clustering across different healthcare services, may have masked more subtle gender-specific patterns.

In describing different trajectories of healthcare uptake, the question arises of which trajectory aligns most closely with evidence-based recommendations of regular healthcare uptake, including preventive healthcare. Answering this question is complex. For one, we have grouped participants together according to their age; however, the same age carried different recommendations at different historical periods. Additionally, healthcare recommendations differ between countries (OECD, 2021). Therefore, judging which trajectories follow best the recommendations and which do not is impossible. Secondly, one has to distinguish between the five different healthcare services that were included in this study. They include screening practices (e.g., mammography), general health check-ups (e.g., gynecology) as well as composite tests like blood tests, combining cholesterol and blood sugar assessments. The level of evidence varies between these services, with uptake recommendations most clear for regular mammography screenings after a certain age (Ren et al., 2022). Moreover, recommendations evolve over time and have most likely changed during the period covered by the observed trajectories.

A second question that arises is whether high regularity in healthcare uptake is associated with better health. While the link between our observed healthcare trajectories and subsequent health is beyond the

scope of this study, we can look for evidence in the literature. One Cochrane review assessed whether regular health check-ups were beneficial at a population level to reduce morbidity and mortality from disease (Krogsbøll et al., 2012). In comparing findings from 14 randomized trials including over 180′000 adult participants, the authors find that "health checks led to more diagnoses and more medical treatment for hypertension, as expected, but, as these did not improve mortality or morbidity, they may be considered harms rather than benefits." It is therefore important to note that while the most socioeconomically advantaged participants in this study generally reported trajectories of high healthcare uptake across the life course and across different healthcare services, whether these trajectories confer health benefits is unclear. Further, the services studied here represent specific routine, preventive, screening, or monitoring practices, some of which have more clearly established age- or risk-specific recommendations than others. For this reason, high uptake should not automatically be interpreted as high-value or appropriate care. The value of these trajectories depends on the service, the individual's risk profile and health needs, the national healthcare context, and the historical period in which uptake occurred. Future work should therefore examine whether routine healthcare uptake trajectories correspond to guideline-concordant care, underuse, or potential overuse.

There are several limitations to note when interpreting our findings. Our outcome is retrospectively self-reported healthcare uptake. This opens the possibility to recall bias as well as social desirability bias. Further, given the way the relevant questions were asked in SHARE, we were restricted to healthcare uptake in pre-defined age periods (e.g., from age 26 to 40), and thus unable to describe dynamic year-by-year changes. In choosing to work with SHARE data we further encounter a healthy participant bias, since participants have survived to age 50 at minimum and are community-dwelling. A further limitation concerns temporal ordering. The life-course socioeconomic disadvantage score included childhood, midlife, and later-life indicators. While childhood conditions and education precede most of the healthcare uptake sequence, later-life occupational and financial indicators may overlap with, or occur after, some parts of the sequence. Because not all components of the composite score can be assumed to precede the uptake trajectories, these analyses should not be interpreted causally. Rather, they estimate associations between accumulated life-course disadvantage and uptake trajectory membership. Nevertheless, sensitivity analyses using childhood disadvantage only showed similar patterns.

Regarding our methods, we have only two possible states in our sequence analysis (regular healthcare uptake, no regular healthcare uptake), potentially limiting the number of clusters found. Additionally, the data structure did not allow us to disentangle age, period, and cohort effects in a formal age-period-cohort framework. The observed birth cohort differences therefore cannot be interpreted as independent cohort effects, but rather as differences across groups whose healthcare trajectories unfolded in different historical periods. Finally, regular healthcare participation is potentially underestimated due to missing data; while all participants reporting no uptake could be included in the analytic sample, those participants reporting regular uptake but missing any timing information regarding their uptake had to be excluded, ranging in numbers from 595 (2%) for gynecology to 1′026 (4%) for vision. Overall, it is important to note that our healthcare trajectories are – due to data and method restrictions – a simplified overview of complex behavioral patterns.

Nevertheless, this study also has strengths. To our knowledge, it is the first study to assess sequences of healthcare uptake using SHARELIFE. As part of the SHARE cohort, the data is nationally representative, comparatively large, and longitudinal, allowing us to describe healthcare sequences across 50 years, from adolescence to retirement. Since the same set of questions was asked across different healthcare services, we could compare them. We also explored routine healthcare uptake trajectories in a community-dwelling population rather than a patient population which few studies have done before. Finally, we were able to account for country-level differences by using multi-level models, thus combining individual-level and macro-level predictors of healthcare uptake.

5. Conclusions

This study provides insights into life-course patterns of regular healthcare uptake in Europe. By applying sequence and clustering methods to SHARELIFE data, we identified patterns of healthcare uptake that increase with age and are shaped by historical context and country of residence, rather than by gender. Socioeconomic disadvantage was consistently associated with lower uptake, underscoring the role of social stratification in shaping health behaviors over time. These patterns align with increasing health needs and expanding preventive services in later life. This study demonstrates the potential of sequence-based approaches to illuminate complex patterns of healthcare behavior and their social determinants over the life course. Future work should examine how these trajectories predict later-life health and whether targeted policies can reduce the observed inequalities.

Ethics approval

This study is a secondary analysis of anonymised scientific-use data from the Survey of Health, Ageing and Retirement in Europe (SHARE). No additional ethics approval was required for the present analysis, as no new data were collected and no participants were contacted by the authors. The SHARE study itself is subject to ethics review procedures and informed consent requirements.

Funding

This study was funded by the Swiss National Science Foundation (grant number: 219687).

CRediT authorship contribution statement

Cornelia Wagner: Conceptualization, Data curation, Formal analysis, Methodology, Writing – original draft, Writing – review & editing. **Vladimir Jolidon:** Writing – review & editing. **Bernadette WA. van der Linden:** Writing – review & editing. **Katrijn Delaruelle:** Writing – review & editing. **Jacques-Antoine Gauthier:** Methodology, Writing – review & editing. **Sorana Toma:** Funding acquisition, Writing – review & editing. **Piet Bracke:** Funding acquisition, Writing – review & editing. **Claudine Burton-Jeangros:** Funding acquisition, Writing – review & editing. **Stéphane Cullati:** Conceptualization, Funding acquisition, Supervision, Writing – review & editing.

Declaration of competing interest

None.

Acknowledgements

The authors acknowledge the LIVES Centre for its institutional support of this project.

This paper uses data from SHARE Wave 3 (DOI: **10.6103/SHARE.w3.900**), see Börsch-Supan, Brandt [14] for methodological details.

The SHARE data collection has been funded by the European Commission, DG RTD through FP5 (QLK6-CT-2001-00360), FP6 (SHARE-I3: RII-CT-2006-062193, COMPARE: CIT5-CT-2005-028857, SHARELIFE: CIT4-CT-2006-028812), FP7 (SHARE-PREP: GA N°211909, SHARE-LEAP: GA N°227822, SHARE M4: GA N°261982, DASISH: GA N°283646) and Horizon 2020 (SHARE-DEV3: GA N°676536, SHARE-COHESION: GA N°870628, SERISS: GA N°654221, SSHOC: GA N°823782, SHARE-COVID19: GA N°101015924) and by DG Employment, Social Affairs & Inclusion through VS 2015/0195, VS 2016/

0135, VS 2018/0285, VS 2019/0332, VS 2020/0313, SHARE-EUCOV: GA N°101052589 and EUCOVII: GA N°101102412. Additional funding from the German Federal Ministry of Education and Research (01UW1301, 01UW1801, 01UW2202), the Max Planck Society for the Advancement of Science, the U.S. National Institute on Aging (U01_AG09740-13S2, P01_AG005842, P01_AG08291, P30_AG12815, R21_AG025169, Y1-AG-4553-01, IAG_BSR06-11, OGHA_04-064, BSR12-04, R01_AG052527-02, R01_AG056329-02, R01_AG063944, HHSN271201300071C, RAG052527A) and from various national funding sources is gratefully acknowledged (see www.share-eric.eu).

During the preparation of this work the authors used ChatGPT (GPT-5.1; OpenAI) to improve clarity and readability. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.socscimed.2026.119608.

Data availability

Data is available via registration to the SHARE project website (see www.share-project.org).

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