**Cohort Profile: Register RELOC-AGE: A nationwide Swedish register-based cohort about the links between housing, residential relocation and healthy ageing in 55 years old and older adults between 1987 and 2021**

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**Key Features (no abstract)** 200 words, now 144

* Register RELOC-AGE was established to study the links between housing choices, relocation and active and healthy ageing among people of 55 years and older through a Swedish population register-based sample.
* Approximately five million index participants born between 1908 and 1961 and their partners, the latter irrespective of their age, are included from the Total Population register with the study period between 1987 and 2021.
* The data come from ≥10 national Swedish registers that include information on health (e.g., underlying medical conditions, COVID-19, influenza and others relevant for the ageing population), demographic (e.g., sex, age, civil status), socioeconomic (e.g., income, education, occupation), housing (e.g., type, tenure, size) and relocation (e.g., dates and property number), and more.
* Proposals for possible collaboration should be sent to the Lund University Population Research Platform (LUPOP; [lupop@ed.lu.se](mailto:lupop@ed.lu.se)) as well as assoc. prof. Giedre Gefenaite [giedre.gefenaite@med.lu.se] or prof. Susanne Iwarsson [susanne.iwarsson@med.lu.se].

**Why was the cohort set up?**

Provide the **rationale** for setting up the cohort (including the original **research questions** it was set up to address), when it was established, **where** it is located and **how** it is funded.

The provision of housing that promotes active and healthy ageing in the population is a burning challenge, especially in societies experiencing the fastest rate of population ageing. Yet, there is a lack of evidence from population-based quantitative studies how to create age-friendly living environments, not the least by taking into account the complex contexts in which people age.1,2

One of the few comprehensive literature reviews available on the topic indicated that factors potentially influencing housing decisions among older people are many, very diverse, and have rarely been studied in depth by “embracing the transdisciplinary complexity”.10 To date, cross-sectional and small-scale longitudinal studies have shown that housing accessibility, measured as person – environment interaction,3,4 is associated with health-related outcomes in older people and those ageing with underlying neurological illnesses.5–8 These studies have also suggested that housing and health are linked through various pathways that may be study population dependent. Yet, longitudinal studies of scale that would be able to provide stronger causal evidence about housing and health links, and the underlying pathways, are lacking.

When it comes to residential relocation histories, studies beyond frail populations, single moves or over just a few years are also still very rare. Various demographic characteristics, such as sex, occupational history or marital status can determine relocation and health patterns and links along the process of ageing due to different obligations and responsibilities.2 There are considerable differences in residential mobility patterns, such as moving away (or not) from distressed neighbourhoods, among different migrant groups and even between cities in Sweden.9 Better understanding of the residential relocation histories and their links to health along the process of ageing is necessary to enable evidence-based housing planning, practices and policies for the future.

Since the start of the COVID-19 pandemic, living environments started receiving substantially more attention due to the hypothesised links between housing and health, not the least due to pandemic control measures such as (social) isolation. At the beginning of the pandemic, 90% of the population reported avoiding leaving their homes.10 Preliminary survey results suggested that worse built environment was associated with poorer mental health among students.16 Later studies have shown that residing in multi-family dwellings and row houses, as compared to detached houses was associated with a decrease in physical activity and an increase in sedentary behaviours in 60 to 80 years old adults with hypertension.11 Such findings point towards one’s home as an important health determinant in older age, with possibly even bigger impact when one is much more dependent on the home, such as upon presence of functional limitations. To date, longitudinal assessments of detailed living environment characteristics on direct and indirect health consequences of COVID-19, also placing them into context, such as comparing the effects across different influenza seasons (e.g., A(H1N1)09 pandemic, low/high influenza incidence seasons), are lacking.

To address the abovementioned lack of evidence regarding the links between housing, relocations and health along the process of ageing, we for the first time linked the person and housing data available from the population registers in Sweden. Through this, we developed an inter/nationally unique data infrastructure allowing us to study such questions in a representative Swedish Register RELOC-AGE cohort over the period of >30 years. We will explore (1) trends over time when it comes to housing types and tenures; (2) how do housing aspects and relocations affect future health outcomes; (3) the short- and long-term effects of adverse health events on housing choices and relocation patterns (e.g., to predict staying or relocation to different housing options), (4) how housing aspects are related to direct and indirect COVID-19 health outcomes, and how they compare to the effects during the A(H1N1)pdm09 influenza pandemic and other influenza epidemics. Furthermore, we will investigate how questions 1-4 are affected by demographic (e.g., sex, country of origin), socioeconomic (e.g. education, income) characteristics as well as civil status changes, adverse health events and/or loss of a partner.

The project is situated at the Department of Health Sciences and implemented in the context of the inter- and transdisciplinary Centre for Ageing and Supportive Environments (CASE) at Lund University (LU), Sweden. CASE bridges research at four faculties and collaborates with the LU Population Research Platform (LUPOP), providing the needed subject expertise and collaborations in an excellent research environment.

**Who is in the cohort?**

Register RELOC-AGE is a population-based cohort of the individuals born 1932-1961 from the [Swedish Total Population Register](https://www.scb.se/statistik/_publikationer/BE9999_2006A01_BR_BE96ST0603.pdf) (TPR) as they turned 55 years during 1987-2016 (2.9 million). For the characteristics included in the cohort see **Table 1**. To enrich the study population with more older individuals, we included 780,000 persons born 1908-1931 who were 56-79 years old and still alive in 1987. We chose the study start in 1987 as this was when the [National Patient Register](https://www.socialstyrelsen.se/register/halsodataregister/patientregistret/inenglish) (NPR) became nationwide. To be able to address the context in which the 55+ participants age, we included all the same data about their spouses or registered partners during the study period, irrespective of their age, resulting in a total sample of approximately five million participants. Persons with protected identity (0.01% in 2014,12 which nearly doubled by 2021) were not included.

Register RELOC-AGE currently includes data on relocations between 1990 - 2020, and for 2012 - 2020 very detailed data on 5 million housing units, such as type, tenure, size, building year and others, are available.

**Table 1**. The characteristics of the Register RELOC-AGE participants available in 2016 (N of persons ≥ 55 years old = 3 061 191).

|  |  |  |  |
| --- | --- | --- | --- |
| **Characteristic** |  | n | % |
| **Sex** | Women | 1603903 | 52.4% |
|  | Men | 1457288 | 47.6% |
| **Civil status** | Married/ registered partner | 1620447 | 52.9% |
|  | Single/divorced/widowed | 1440744 | 47.1% |
| **Age group** | 55-64 | 1127294 | 36.8% |
|  | 65-74 | 1090276 | 35.6% |
|  | 75-84 | 589242 | 19.2% |
|  | 85+ | 254379 | 8.3% |
| **Education** | College/university | 868630 | 28.5% |
|  | Primary/lower secondary | 865537 | 28.4% |
|  | Upper secondary | 1314693 | 43.1% |
| **Housing type** | Multi-family dwellings | 1193551 | 39.6% |
|  | (Semi-)detached dwellings | 1707525 | 56.6% |
|  | Special housing | 76285 | 2.5% |
|  | Other housing | 37916 | 1.3% |
| **Housing tenure** | Partly-owning | 637441 | 21.1% |
|  | Renting | 777706 | 25.8% |
|  | Missing | 466 | 0.0% |
|  | Owning | 1599664 | 53.1% |
| Hospitalization due to any cause during the past three years (2014-2016) | No hospitalizations  1-2 hospitalizations  ≥ 3 hospitalizations | 2792926  203049  65216 | 91,2%  6,6%  2,2% |
| Hospitalization due to any cause during 2016 | No hospitalizations  1-2 hospitalizations  ≥ 3 hospitalizations | 2941249  97268  22674 | 96,1%  3,2%  0,7% |

**How often have they been followed up?**

The follow up period is 1987-2021 with the possibility for extension. Currently the data are available for nearly 35 years and over 30 million person-years. Most of the data are available based on when the event (e.g., prescription or diagnosis) had occurred. Some data are available as a monthly or yearly indication of the status change (e.g., starting to receive care upon disability or certain age) or frequency (e.g. services per month, year).

**What has been measured?**

For each participant we are able to link their data from TPR, NPR, and National Cause of [Death Register](http://www.socialstyrelsen.se/register/dodsorsaksregistret) (NCDR) since 1987 and the [Real Estate Property Register](https://www.lantmateriet.se/sv/Fastigheter/Fastighetsinformation/Fastighetsregistret/) (REPR) and Longitudinal integrated database for health insurance and labour market studies (LISA) since 1990. Even more data can be linked from the National Prescribed [Drug Register](http://www.socialstyrelsen.se/register/halsodataregister/lakemedelsregistret) (NPDR), National Register of Care and Social Services for the Elderly and Persons with Impairments (NRCSS) and National Register of Interventions in Municipal Health Care (NRIM), and the [Apartment Register](https://www.lantmateriet.se/sv/Fastigheter/Fastighetsinformation/Lagenhetsregistret/) (AR) after 2005, 2007 and 2012, respectively. To be able to account for the consequences of the COVID-19 pandemic and to compare to the influenza epidemics and pandemics, we linked data from the Swedish Intensive Care Register (SIR) and Swedish internet-based surveillance system for communicable diseases (SmiNet) with COVID-19 and influenza surveillance and clinical outcomes.

The linkage of the abovementioned registers is based on [personal identification numbers](https://link.springer.com/article/10.1007/s10654-016-0117-y) (PINs) and property numbers and is implemented by Statistics Sweden. For a detailed registers and data overview, please see Table 2. Additionally, the participants living in Scania, which is one of the most populated counties in Sweden, can be linked to the newly developed Scania Outdoor Environment Database (ScOut) on area-level, which allows to account for the close outdoor living environment effects (Gefenaite et al., **under revision**). In addition, other environmental data can be linked to Register RELOC-AGE upon further needs.

Table 1. Overview of the data from the registers available for the Register RELOC-AGE cohort.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Register (start year) | Starting year for inclusion in Register RELOC-AGE | | | | | | |
| 1987 | 1988 | 1990 | 1994 | 2005 | 2007 | 2011 onwards |
| Total Population Register (TPR) (1968) | Sex; birth date; civil status (duration, dates, changes); address (dates, changes); income; country of origin; citizenship; in-/emigration (dates); n of people in the dwelling; housing tenure; socioeconomic indicators of the neighbourhoods (on postal code, municipal levels) | | | | | | |
| National Patient Register (NPR) (1987) | Hospitalization outcomes: total no. of hospitalizations/month; in-patient health outcomes based on ICD-10 chapters (e.g., for falls, fractures, stroke etc.) | | | | | | |
| Real Estate Property Register (REPR) (1908) | Objective housing characteristics for each dwelling: type of dwelling; price of dwelling; type of tenure; size; presence of stairs/elevator; floor; building and construction year; characteristics of the neighbourhood: communal facilities (e.g., roads), green areas; date of each relocation | | | | | | |
| Geographical database (GD) (1952) | DESO (demographical statistical unit); coordinates of the housing and address etc. | | | | | | |
| Death Cause Register (DR) (1952) | Death cause and date | | | | | | |
| Longitudinal integrated database for health insurance and labour market studies (LISA) (1990) |  | | Education level, income, social insurance | | | | |
| Drug Prescription Register (DPR) (2005) |  | | | | Drug prescriptions for chronic illnesses (ATC code, dose and date): endocrine; cardiovascular; hepatic; renal or neurological/ neuromuscular | | |
| Swedish Intensive Care Register (SIR) (2001) |  | | | | Intensive care for laboratory-confirmed influenza and (since 2020) COVID-19. | | |
| Swedish internet-based surveillance system for communicable diseases (SmiNet) (1997; 2004) |  | | | | Laboratory-confirmed influenza and (since 2020) COVID-19 | | |
| Municipal Health Care Register (MHCR) (2007) |  | | | | | Care received and date | |
| Interventions for Elderly and People with Disabilities Register (IEPDR) (2007) |  | | | | | Home help and service type and no of hours/month/year: escorting, replace the relative, personal care, meal delivery, security alarm, daytime activities; short-term vs long-term | |
| Apartment Register (AR) (2011) |  | | | | | | Dwelling type; number of rooms; dwelling unit size; kitchen type |
| Scania Outdoor Environment Database (ScOut) |  | | | | | | 24 outdoor environement characteristics 2008-2019 |

**What has it found?**

Need to have the first study submitted for this.

describe the most important findings and publications generated by the cohort (provide a web address if there is a complete list of publications online);

describe what has been found rather than what has been examined; and

illustrate one or two of the main findings with a table or figure.

**What are the main strengths and weaknesses?**

While the challenge to study housing choices and decisions is that data on individual perceptions should be collected from the individual participants through surveys or interviews directly,17 objectively measured living environment characteristics obtained through population-based registers is a yet underused alternative to learn about the actual links between housing, relocation and active and healthy ageing (trajectories). For this reason, a number of population-based registers have been linked to provide a hitherto never used opportunity to investigate housing and health associations in older age, with a possibility to also study the effects of COVID-19 and influenza A(H1N1)pdm09 pandemics on these associations. Addressing the need of prospective data based on detailed surveys as well as in-depth qualitative studies with individuals aged 55+, Register RELOC-AGE is one part of the large RELOC-AGE Project, which is based on a mixed-methods design. That is, with the Prospective RELOC-AGE 17 and Register RELOC-AGE we are in a strong position to generate novel knowledge in this research field.

To our knowledge, the Register RELOC-AGE data infrastructure is inter/nationally unique in terms of the size and type of study population, follow-up length and information detail. Including the study participants already at age 55+ allows us to capture the dynamics at target from an earlier phase in life than done before. To be able to address the social context in which the 55+ participants age, including demographic, socioeconomic and health data about their spouses/reg. partners (irrespective of their age) is a notable strength.

Linked TPR, NPR, DR, LISA, SmiNet and SIR provide data of high quality. While data in REPR are detailed and generally of high quality, one known limitation is that the relocations to special accommodation are not well captured as older persons tend to not deregister from their previous independent living accommodation. The remaining registries pose some challenges due to shorter follow up and/or data quality, to be taken into careful consideration during the design and analysis phases, as well as when interpreting and reporting the results. Linking to AR adds more detailed information about the dwellings since 2011, and DPR data will make it possible to use more detailed information on health conditions and primary health care use since 2005. Additional measures to decrease the risk of bias (e.g., limiting the analysis to fewer years or municipalities) will be considered due to lower data quality in MHCR and IEDPR, for the latter especially in some years. Nevertheless, municipal health care and care of people with disabilities is an essential indicator of active and healthy ageing and these registries will be used as complementary data sources, which will contribute to identifying their (yet unknown) limitations and strengths.

The project is situated at the Centre for Ageing and Supportive Environments (CASE), bridging research at four faculties and collaborating with Lund University Population Research Platform (LUPOP), providing the needed subject expertise and collaborations in an excellent research environment.

**Can I get hold of the data? Where can I find out more?**

Proposals for possible collaboration should be sent to the Lund University Population Research Platform (LUPOP; lupop@ed.lu.se) or directly to the responsible researchers assoc. prof. Giedre Gefenaite [giedre.gefenaite@med.lu.se] or prof. Susanne Iwarsson [susanne.iwarsson@med.lu.se]. Each case will be considered in terms of research scope, meeting applicable ethical regulations the by the Swedish Ethical Review Board (EPM) and the General Data Protection Regulation (GDPR), aiming to facilitate research with local and international partners.

**Ethics approval**

Register RELOC-AGE project was approved by the EPM (Dnr. 2020-01369, Dnr. 2021-01124), allowing to obtain the additional data until 2024-03-31 or extended upon further request. Further EPM amendments can be sought to allow the research questions not currently covered.

**Author contributions**

GG, JB and SI conceived and designed the study, and acquired the data. GG analysed the data, with JB and SI contributing to the interpretation. GG drafted the article, JB and SI revised it critically for important intellectual content. All authors approved the final version and agree to be accountable for all aspects of the work.

**Supplementary data**

None.

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**Acknowledgements**

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**Conflict of interest**

GG none

JB ?

SI ?

Zotero Reference list

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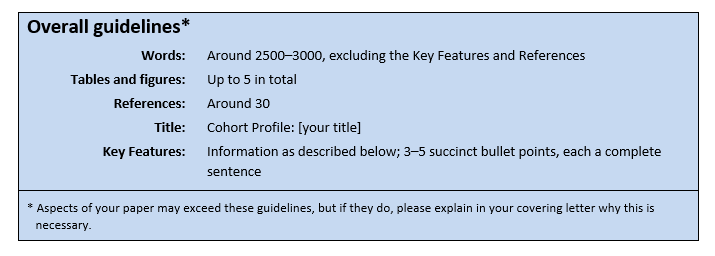
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