



From the Roman Empire to the New Millennium. Data access and sharing from healthy ageing cohorts

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ARTICLE INFO

Keywords:

Cohort
Healthy ageing
Preventive initiative
Open data and data sharing

ABSTRACT

Cohort studies are the best way to analyze the incidence and natural history of a disorder, permitting to assess associations between multiple exposures and multiple outcomes. A well-designed cohort may be particularly relevant regarding the study of the ageing processes of adult populations, allowing the study of processes and dynamics of the individual life course and the study of the effects of earlier exposures and characteristics on later outcomes. Moreover, cohort studies seem the best instrument to analyze the factors favoring active and healthy ageing, and to increase knowledge about the most appropriate interventions to enhance older population's wellness. Nonetheless, the number of cohorts on ageing is limited, because they are very expensive to develop, establish, and maintain, requiring long-term investment to be efficiently performed to obtain all the data needed to address the longitudinal research questions. Open data and data sharing should be encouraged to ensure verifiable, reproducible and transparent results, and to allow the generation of new knowledge in the context of earlier discoveries. Making cohort studies "open" can foster the efforts of the scientific community committed in the study of ageing and give a real contribution to the well-being of the ageing population.

KEY-MESSAGE:

- Cohort studies are the best way to analyze the incidence and natural history of a disorder, the factors favoring active and healthy ageing, and to increase knowledge about the most appropriate interventions to enhance older population's wellness.
- Making cohort studies "open" can foster the efforts of the scientific community committed in the study of ageing and give a real contribution to the well-being of the ageing population.

The cohort was the equivalent of a modern military battalion and was the standard tactical military unit of the Roman army, who conquered a great part of the ancient world. W.H. Frost was the first who used the word "cohort" in 1935 and the word "cohort" has been subsequently adopted in the field of epidemiology to define a set of people followed over a period of time (Doll, 2001). The current epidemiological definition of a cohort is a "group of people with defined characteristics who are followed up to determine the incidence of, or mortality from, some specific disease, all causes of death, or some other outcome" (Song and Chung, 2010). Cohort or longitudinal studies are the best way to ascertain both the incidence and natural history of a disorder and represent a suitable study design to assess associations between multiple exposures on the one hand and multiple outcomes on the other. The potential to provide the strongest scientific evidence of cohort studies depends on the fact that exposure to an event of interest is identified in a disease-free sample before the outcome of interest or

disease occurs, guaranteeing a temporal framework to assess causality (Karlsson, 2005). A well-designed cohort study can thus provide powerful results, which may be particularly relevant regarding the study of the ageing processes of adult populations.

The population is ageing rapidly worldwide, and it is estimated that in the next four decades, the proportion of people aged over 60 years old will represent nearly the 22 per cent of the world total population (Bloom et al., 2015). This will lead to an increased demand for primary health care and long-term care and relevant social consequences (Organisation, xxxx). For these reasons, ageing, ageing trajectories and healthy ageing are hot topics deserving attention from the scientific community, whose role is essential in promoting interventions that can improve the natural process of ageing through the analysis of contributory factors (Lunenfeld and Stratton, 2013), and in offering stakeholders (i.e. public institutions and community welfare organizations) the necessary scientific background to inform effective policies/

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<https://doi.org/10.1016/j.pmedr.2020.101186>

Received 3 July 2020; Received in revised form 31 July 2020; Accepted 14 August 2020

Available online 25 August 2020

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actions.

Understanding differences within the older populations which drive ageing trajectories is vital for the development of health and social care policies to guarantee the possibility of long, active lives and appropriate care for those who become frail and dependent (European Commission, 2018). In the last years, some review articles focused on the topics of ageing and healthy ageing (European Commission, 2018; Peel et al., 2005; Jenkin et al., 2017; Cha et al., 2012; Hornby-Turner et al., 2017). Successful aging was found to be significantly affected by gender, self-esteem and the support received during older age (Cha et al., 2012).

Modifiable risk factors among the behavioural and lifestyle determinants for a healthy aging include smoking, physical activity, body mass index, diet, alcohol use, and health practices (Peel et al., 2005). The role of sport and physical activity has been recently analyzed and discussed also by Jenkin and coworkers (Jenkin et al., 2017).

A recent review (Hornby-Turner et al., 2017) including twenty-three publications for a total of 78 422 participants from more than 13 different countries, showed that higher scores of self-rated health, psychological well-being and life satisfaction were associated with better health in older age. Important support mechanisms were a social network, contact with family and friends, engagement in leisure and social activities, education and financial resources.

The reviews mentioned above point to the need for developing knowledge to promote the population's healthy and active ageing while paying attention to the relationship between ageing and disease (Pitt et al., 2015). Studying the interindividual heterogeneity of ageing in large samples of community-dwelling older adults, researchers could identify the characteristics associated with what has been called "successful ageing" and "positive ageing phenotype" (Crowther et al., 2002).

Since cohorts are the only means allowing the study of processes and dynamics of the individual life course and the study of the effects of earlier exposures and characteristics on later outcomes, cohort studies seem the best instrument to analyze the process of ageing, the factors favoring an active and healthy aging, and to increase knowledge about the most appropriate interventions to enhance older population's wellness (Martin et al., 2006; Jones et al., 2014). In particular, baseline self-reported measures used by longitudinal cohort study seem to be effective in predicting health outcomes among community-dwelling older people. Self-rated measures, concerning future health, functional decline, disability, and mortality, have a predictive validity in older populations (van Dalen et al., 2014; Jylhä et al., 2001). In fact, self-assessment of physical capacity, habitual physical activity and depressive symptoms has a potential for change through public health interventions (Bond et al., 2006), favoring early preventive initiatives started before the symptom onset, which in turn could reduce the social-economic burden of the society.

Nonetheless, the number of cohorts on ageing is limited. One possible reason is that longitudinal studies are very expensive to develop, establish, and maintain (Bond et al., 2006); they require long-term investment to be efficiently performed to obtain all the data needed to address the longitudinal research questions (Martin et al., 2006). While methodological problems are shared by all longitudinal studies, they become particularly relevant in ageing cohort studies due to the nature of the population, and its wide heterogeneity in functional status, health perceptions, satisfaction with health and emotional well-being (Caruana et al., 2015; Ferrucci et al., 2008).

To overcome some of the critical issues in this field of research, open data and data sharing (making all raw data fully and openly available to any researcher) should be encouraged to ensure verifiable, reproducible and transparent results, and to allow the generation of new knowledge in the context of earlier discoveries (Poscia et al., 2017).

One of the most important existing cohorts is the UK Biobank, involving over 500,000 participants aged 40–69 years when recruited in 2006–2010. The longitudinal follow-up study has collected and is collecting extensive phenotypic and genotypic details about participants

(i.e. data from questionnaires, physical measures, sample assays, accelerometry, multimodal imaging, genome-wide genotyping) to study a wide range of health-related outcomes (Adibuzzaman et al., 2017). To avoid that the use of data remained available mainly for UK-based scientists, applications from outside the UK were encouraged through communication strategies to increase awareness about this resource and its accessibility worldwide to all bona fide researchers for all types of health-related research, according to what established by the UK Biobank Access Procedures and the Ethics & Governance Framework.

In 2017, the National Institute of Health (NIH) announced the All of Us initiative, previously known as the Precision Medicine Cohort Program, aimed at collecting data (such as Electronic Health Records (EHR), genomic, imaging, socio-behavioural, and environmental data) from one million or more patients living in the United States, over the next few years, to boost research and improve health (Sudlow et al., 2015). By taking into account individual differences in lifestyle, environment, and biology, researchers will uncover paths toward delivering precision medicine.

Further critical issues of cohort studies may include publication bias (Jones et al., 2014) and the fact that replication of findings in new samples is often done by the same researcher who made the original claim; this may lead to allegiance biases, reduce generalizability and perpetuate the same errors as the original work (Sankar and Parker, 2017). External validation by independent teams and analysis of the proper conduct of the trial is essential to guarantee research quality and to avoid or correct possible biases (Patil et al., 2016).

Summarizing, it appears necessary to foster the availability of information (including functional autonomy, perception of health status, fragility, social isolation, lifestyles, services use, access to dedicated programs) which could be relevant for the improvement and maintenance of the good quality of life in people over 65 years. Only by understanding the peculiarity of the ageing process, it may eventually be possible to acknowledge the importance of the contribution older people can bring to society.

Besides a clear scientific focus and sound methodology, cohort studies require also streamlined governance, effective networking between academic and management disciplines, centralised infrastructure with industrial approaches to collection and processing of data and samples. Moreover, a close partnership with major funders, a wide network of scientific advisors, high-quality, pragmatic legal and ethical advice, and widespread public support are indispensable components in the management of a longitudinal study. Many existing cohorts seem to be good candidates to study the ageing process. Making them "open" can foster the efforts of the scientific community committed in the study of ageing and give a real contribution to the well-being of the ageing population.

Funding

This research had the financial support of the Università del Piemonte Orientale.

CRediT authorship contribution statement

Gambaro Eleonora: Data curation, Writing - original draft.
Gramaglia Carla: Conceptualization.
Faggiano Fabrizio: Supervision.
Zeppegno Patrizia: Writing - review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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