COHORT PROFILE

Cohort Profile: the Jerusalem longitudinal cohort study

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How did the study come about?

Whilst it has been suggested that about 25% of the variability in human longevity is attributed to genetic influences, the remaining 75% is consequent upon a complex interplay of biological, environmental, social and culturally determined factors. In rising to the challenge of understanding the complexities of human ageing, a valuable tool to emerge in ageing research has been the longitudinal study, and early pioneering works in North America and Europe were instrumental in defining the emergence of modern geriatrics and gerontology. Undertaking such studies among diverse populations in different cultures is of value in furthering the understanding of universal ageing processes. Furthermore in many societies the oldest old are among the fastest growing sector of the population, and the need for basic definitions and descriptions of their patterns of need is a matter of pressing urgency for health care planners, ageing researchers and policy makers alike.

After fruitful collaboration in the late 1980s with Alvar Svanborg, the leader of the Gottenberg Longitudinal Study of 70 year olds, we decided to initiate a long-term longitudinal study of ageing among Jerusalem residents, who are a uniquely heterogeneous elderly population, including immigrants from the America, Europe, Africa and Asia. The study, which was designed to follow a birth cohort from age 70 at baseline as they advanced with age, still remains the only such study of its kind both in scope and magnitude in the geographical region. Funding was provided in part by the Ministry of Health, the Ministry of Labor and Social Affairs, the National Insurance Institute (the Israeli Social Security administration), Eshel—the Association for the Planning and Development of Services for the Aged in Israel, as well as several private and charitable funds. Following a pilot feasibility study in 1989, with subsequent refinement of the study protocols and questionnaires, the Jerusalem Longitudinal Cohort study was established in 1990, with follow-up continuing up until the present time.

Who is in the study sample?

The sample frame throughout the duration of the research has been the birth cohort born 1920–21 who were resident in Jerusalem. All subjects were identified from the national electoral register and the study sample, which formed approximately one-third of the total sample frame, was randomly selected according to their 8-digit identification number. Subjects were aged 70–71 at baseline in 1990–91, and at subsequent study phases in 1997–98 and 2005–06, the sample frame was augmented with newly recruited subjects aged 77–78 and 85–86, respectively, again randomly chosen from the updated electoral register. The cohort was highly heterogeneous in origin reflecting the historical and social forces of the last century which have been formative of Israeli society. Only 16% were native born at baseline, the remainder was born in 40 different countries. From 1990–98 1.2 million new immigrants from the former Soviet Union arrived in Israel, and by 1998 10.7% of >65 year olds in Israel were new immigrants. The study cohort was proven to be representative of the West Jerusalem 70-year-old population. Table 1 describes the basic characteristics of the cohort, and illustrates the shifting in certain measures as the cohort advances with age.
What does it cover?

The study aims at the outset were broad and included:

(i) the provision of a comprehensive survey over time defining the medical, social, and functional status and needs of ageing adults in Jerusalem;

(ii) the creation of a longitudinal database spanning numerous domains, enabling the evaluation of trends in normal patterns of ageing and the epidemiology of disease;

(iii) an identification and understanding of the complex interaction between numerous potential risk factors on longevity and successful ageing; and

(iv) a comparison of gender differences in ageing over time and cross cultural comparison.

What has been measured?

Subjects underwent two separate structured interviews and assessment, each one lasting 1.5 h and performed in the subjects home by a trained study researcher. One interview included mainly social information gathered by a trained occupational therapist and a second interview was performed by a trained study physician. Over 700 items were covered in the baseline questionnaire, and only slight differences existed in the questionnaire used at different phases, with great emphasis placed upon continuity of study measures (Table 2). The social interview included socio-demographic and autobiographical information, living arrangements and social networks,
leisure activities, self-reported levels of functional status and health utilization data. In addition to self-reported data, activities of daily living and instrumental activities of daily living were directly observed. An assessment of self-rated health, mood, depression and psychological screening was performed. The medical interview included physician based assessment of medical diagnoses, medication usage, a structured systems review, physical examination, cognitive assessment (including the Mini Mental State Examination), anthropomorphic measures, repeated blood pressure and assessment of gait. Blood was taken for laboratory tests and frozen serum was saved for future analysis. Portable echocardiography was performed at home at the third study phase.

Annual mortality data has been collected from the Ministry of Interior throughout the period of follow-up and surveillance is considered to be 100% complete for all subjects remaining in Israel. Health service utilization, hospitalization rate, hospital based morbidity and mortality rates were assessed for subjects enrolled in the study and compared with those of subjects who refused to enroll as well as subjects from the sample frame who were not approached. Near identical rates were found for all measures, thus supporting the representative nature of the study sample.

How often have they been followed up?
Assessment was performed at age 70 (Phase I: 1990–91), age 78 (Phase II: 1997–98), and again at age 85 (Phase III: 2005–06). The number of subjects who underwent assessment at phase I was 605. In order to compensate for the naturally high mortality rate of this age group, the study sample was augmented with 644 new recruits at age 78 and 612 new recruits at age 85, all of whom were randomly enrolled from the same birth cohort. Thus the total number of subjects who underwent assessment at phases II and III was 1021 and 1222, respectively (Figure 1).

What was the attrition like?
The primary reason for attrition has been mortality throughout the 18 years of follow-up. From among the total of 1861 subjects who have been enrolled, 462 (24.8%) have died during follow-up, 101 (5.4%) of enrollees declined to continue to a subsequent phase, 56 (3%) left the Jerusalem area and therefore dropped out, and a further 20 (1.1%) were lost to follow-up due to lack of updated contact information. Efforts were made to maintain contact with all subjects, and where necessary proxy informants, with consent from legal guardians, were used in the case of extremely frail or demented subjects.

What has the study found?
The study has provided comprehensive descriptive data concerning demographic, psychosocial, functional and medical status,1–10 as well as health care utilization.11,12 The influence of place of origin and ethnicity within our highly heterogeneous sample was found to play a very minor role in ageing patterns after adjustment for associated economic and educational status,13,14 and similarly cross cultural comparison revealed that the similarities across cultures in ageing patterns and health needs are far greater than the differences.15 Financial status was to emerge as a strong predictor of health measures within the cohort,16 and social networks17 and reported loneliness18 were linked to quality of life and health measures. Gender differences were to play a significant role in numerous outcomes measured, perhaps most obviously seen in the gender specific mortality rates.19

The breadth of medical data over time have given rise to a diverse number of in depth studies of clinically relevant entities, including nutritional status,20,21 recurrent falls,22 vision23 and hearing loss,24 chronic pain,25,26 sleep,27 siesta,28,29 fatigue,30 nocturia,31 hypertension,32 resting heart rate,33 gastrointestinal complaints,34 renal,35,36 and liver37 function. The evolving pattern of drug usage within the cohort was examined38 and, specific effects of certain chronic drug usage were investigated.39,40 Laboratory findings have demonstrated the need for age adjusted norms,41 and a preliminary genetic study described the role of a number of candidate genes associated with ageing and life expectancy.42 The range and depth of functional assessment has enabled the subtle measurements of functional difficulty as well as functional dependence to be defined, and the relationship with mortality has been investigated.43,44 Risk factors for functional decline have been identified, and physical activity has emerged as a strong predictor of function.45 Strategies for successful longevity have been identified.19 In particular the importance of maintaining an active lifestyle has been repeatedly described. Not only physical activity, which throughout follow up to age 88 has been shown to improve both survival and function,46,47 but also non-strenuous socially oriented activities such as volunteering,48 leaving the house daily49 and cognitive activity such as reading50 have all been found to improve longevity.

The opportunity to examine the influence of distant catastrophic life events in later life arose among Holocaust survivors, who formed a significant part of the cohort.51 Similarly, the effect of recent social upheaval in old age upon health and well-being was examined among the wave of new immigrants from the former Soviet Union.52 Current work is directed at analysing successful ageing among the oldest old, as measured by functional, cognitive, psychological and biological parameters. In keeping with dementia incidence,
the number of demented subjects at ages 70 and 78 was small and thus insufficient to permit statistical analysis. At age 85 the cohort included sufficient numbers of demented subjects, and current work will examine dementia from a number of perspectives.

**What are the main strengths?**

The study sample has consistently enrolled one-third of the total birth cohort, and was proven to be truly representative. Both response and follow-up rate have been high, and only a few subjects left the Jerusalem area. The comprehensive nature of the data set, repeated in its entirety at three points in time, has allowed for numerous avenues of investigation of health and ageing trajectories. Similarly, the wealth of data has enabled meaningful adjustment for multi-disciplinary confounding variables. By repeatedly augmenting the sample size with new recruits from the same birth cohort at each subsequent study phase, the sample size has been maintained despite inherent mortality within the study population.

**What are the main weaknesses?**

The large number of items collected, whilst itself a strength, has meant that on occasion the range of questions asked for any one specific area of enquiry has been limited. The natural mortality among the study sample has limited the number of subjects seen
at all three stages of the study. Although funding has been secured throughout the duration of the study, the budget has nonetheless been modest, and laboratory and biological tests have been limited to those tests deemed to be most important. Limitations in time spent with each subject prevented a full battery of neurocognitive testing, which would have permitted an assessment of cognitive ageing and preclinical dementia within the cohort.

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

All collected source data are maintained and stored at the study research office, in the Department of Geriatrics and Rehabilitation, at the Hadassah Hebrew University Medical Center, Mount Scopus, Jerusalem. External collaboration is welcomed, and we would encourage interested parties to make contact with the Leader and Chief Investigator of the study, Prof. Jochanan Stessman at jochanans@ekmd.huji.ac.il.

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References
