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REVIEW

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Population-based cohorts of the 50s and over: a summary of worldwide previous and ongoing studies for research on health in ageing

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Abstract As most countries face the ageing of their population, understanding successful and pathologic ageing is a research priority. Longitudinal studies examining the ageing process from middle-age are required to establish causal and valid relationships. This systematic review of the literature aimed at identifying large community-based longitudinal studies either including exclusively elderly people or following people from middle-age (50+ years at enrolment) to death, and resulted in a selection of 72 cohort studies. Design features of selected studies show that most were conducted in North America or Northern Europe, most included both genders, and follow-up period was often less than 10 years. Many cohorts focused on cardiovascular health, cognitive decline or osteoporosis. Usually collected variables comprise of self-reported data on socio-demographics, chronic diseases and functional status, as well as measures of cognition, anthropometrics and physical performances. Biological samples were taken in about 60% of the studies, and a third also undertook genetic analyses. This review summarises information on design and content of large population-based cohorts of older persons, and represents a valuable background from which additional data may be retrieved.

Keywords Cohort study · Longitudinal study · Aged · Ageing · Review

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Introduction

Parallel to the ageing of populations, the number of dependent older persons has increased considerably, as well as the need for costly long-term care services. In this context, geriatric research has been interested in the determinants of health in later life, and, more recently, the concept of frailty has emerged as a key issue (Rockwood et al. 1994). There is still much debate around the nature and measurement of frailty (Hogan et al. 2003), and further results from population-based longitudinal studies are needed to investigate the determinants of successful ageing and frailty (Fried et al. 2001; Peel et al. 2005). Numerous cohort projects have already been undertaken, or are still ongoing, focusing on the different populations and different health domains. An insight into the existing studies might be useful for the researcher before undertaking a new project and for the clinician interested in a particular health domain. Overviews of the design and content of the previous projects are not so easily available, even though most large cohort studies did publish articles on methodology or have a website providing this type of information. Summary information allowing to compare similar cohort projects is particularly difficult to find. This review aimed at identifying large population-based cohort studies including either middle-aged adults (aged 50 and over) or focusing on older persons. A literature search did not retrieve any comparable work: previous reviews focused on the disease-related morbidity (Pryer et al. 1995; Bosworth and Siegler 2002), or on a specific theme such as functional decline (Stuck et al. 2002). A similar, yet less systematic work, was undertaken in Canada. Its selection of cohorts was slightly different and results may be considered as complementary (Health Canada, Review of longitudinal studies on ageing, available on the Internet).

Our review provides a summary of design characteristics and domains of investigation of selected studies examining age-related health events in older adults and

represents a useful source of references for research on health in ageing.

Methods

Selection criteria

Inclusion criteria for selecting cohort studies were a lower age limit at enrolment set at 50 years or more and a minimal sample size of 500 subjects at baseline.

By setting this arbitrary lower sample size limit, we intended to select cohort studies large enough to provide sufficient statistical power given attrition over time. Then, to select cohorts representative of the general population, the search was limited to the population-based studies.

Search strategy

We first identified keywords or MesH terms used in several publications related to cohort studies of elderly people. The search strategy combined the terms ''ageing'' or ''aged'' with terms related to the study design: ''cohort study or studies'' or ''longitudinal study or studies'' and ''population-based''. The research was then limited to middle-aged (45–65 years) or aged subjects (65 years or older) and to publications in English, French or German. Medline (Ovid 1966–2002), PsycInfo (1967–2002) and SocioFile (1974–2002) were searched on 31.10.2002, and 1,500, 24 and 1 publications, respectively, were retrieved. The same search strategy was rerun periodically from November 2002 to July 2004 with an extension to the publications of the years 2003 and 2004.

Other data sources

The Cochrane database was searched from October 2002 to January 2003, as well as in November 2003, and in July 2004 and did not yield any further references.

During October to November 2002, a search was conducted on the Web, using the words ''cohort'' or ''longitudinal study'', combined with ''elderly'' and ''health'' and identified known or additional cohorts by their Internet site. Internet sites of geriatrics societies were consulted, as well as those of centres and institutes of ageing. Finally, bibliographies of relevant articles or handbooks were hand-searched.

Exclusion criteria

Retrospective or historical cohorts were not considered for inclusion. Studies not focusing on health (e.g. psychological studies) and those focusing on a narrow clinical theme were excluded, as well as studies in which data were collected from administrative or medical databases only, without contacting the participants either face-to-face or by questionnaire. Finally, studies among twins, among very specific ethnics, among people who had been exposed to nuclear irradiation, and studies selecting subjects with a specific disease at inclusion were not selected.

Study selection and data extraction

First, titles and abstracts of all 1,525 publications were screened by the first author, using the exclusion criteria. Abstracts of the 732 remaining publications were reviewed independently by the two authors. In case of disagreement, more information was searched on the study, and inclusion of the study was discussed.

To gather maximum information on each cohort, abstracts of publications related to the same cohort study were then searched in Medline using the entire name or acronym of the cohort as keyword. Whenever this strategy did not identify any publication, or only a few, we retrieved the publications of the principal investigators and identified articles related to the cohort study by reading the abstracts.

The following data were extracted from abstracts and articles: name/acronym of the study, number of subjects, age at inclusion, gender of participants, year of beginning and duration of follow-up, setting (country/town), domains assessed, number of publications in Medline and availability on the Internet. For each cohort, abstracted data were sent to one of the original investigators for review. We also requested information on the data we could not find in the publications. Finally, the investigators were asked for references of publications describing the study methodology and its main findings.

As our aim was not to evaluate the validity of the outcomes but to examine populations and themes under study, we did not assess the methodological quality of the selected studies.

Results

Review of the 732 abstracts by two authors resulted in the selection of 67 cohorts. Then, reading the articles led to an exclusion of 28 studies because age or number of subjects at baseline did not match our inclusion criteria. Nineteen cohorts were retrieved from the Internet search, among which 7 were excluded and 28 were retrieved from other sources, among which 7 were excluded, leaving a sample of 72 cohort studies corresponding to our criteria (Fig. 1).

Table 1 shows the selected studies by world region in alphabetical order and summaries their design: gender, age and number of subjects at inclusion, country, year of baseline assessment, duration of follow-up and major themes under study are displayed. It also indicates how

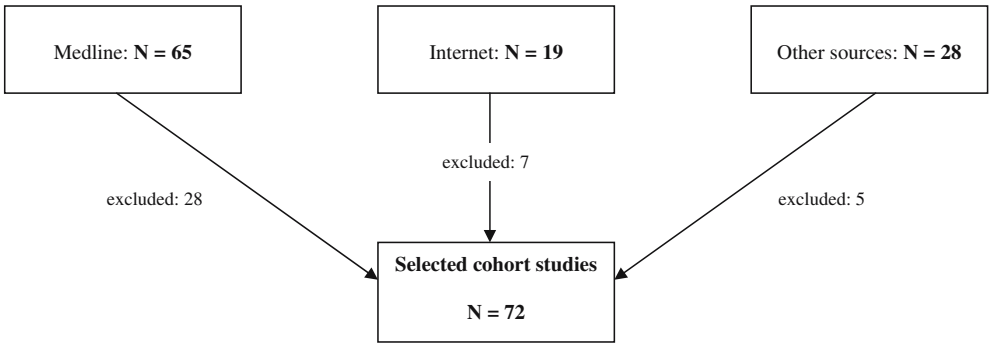

Fig. 1 Flow-chart: source of identification and selection of cohort studies

many publications were retrieved using the name or acronym of the cohort as keyword in Medline 1966–2003 and whether the data abstracted from publications were validated by the investigators of the study (about 30% of original investigators did not respond to that request, and data for those studies are displayed as found in publications).

Finally, one reference per cohort study was chosen upon the indication of the investigators. Three studies had no indexed publications retrieved in our review process, so that their website is cited as a source of information.

Longitudinal studies of older people have been undertaken in all continents, including South America and Asia. In Europe, half of the selected cohorts originated from the United Kingdom, the Netherlands, Sweden and Germany. Most cohorts were strictly community-based, only seven projects also included participants living in institutions and one was conducted in convents.

Many studies include men and women, except for certain themes, such as osteoporosis, breast cancer and prostate cancer. Longitudinal studies focusing on cardiovascular diseases initially enrolled mainly men, and similar studies were later undertaken in women.

Age at inclusion varies with the disease under study; studies on cardiovascular events tend to recruit people in their 50s, while most studies on dementia recruit people aged 70 years or older. Studies including only younger elderly people were quite rare, as those recruiting persons older than 80 years at baseline.

If we look at cohorts focusing on specific health problems, we observe that cardiovascular disease and dementia have been the objects of many studies. On the other hand, there are only five longitudinal studies focusing on cancer. Our domain of interest, age-related fragilisation, has been examined in 28 studies, among which 23 were interested in the functional decline, while 5 focused on successful ageing.

Duration of follow-up is highly variable, from 2 years to more than 30 years. However, the majority of selected studies followed their participants for less than 10 years.

Table 2 shows a summary of variables collected in each study: although a high proportion of data are self-reported, most studies also collected data derived from observation (measure of physical or mental performances, clinical assessment), at least in a subsample of participants. Besides socio-demographic data, current health status, chronic conditions and medical history, a majority of studies did assess mental health using standardised tests such as Folstein's mini-mental evaluation, Geriatric Depression Scale or Centre for Epidemiological Studies–Depression Scale. Evaluation of cognitive impairment was more frequent if the study included people aged 60 years or more at baseline. Other risk factors for functional decline such as visual and auditive impairments, incontinence, and falls were not routinely collected. These characteristics were more frequently assessed in studies of successful ageing, while neglected in studies focusing on a specific disease. A few studies described health care services utilisation.

A third of the cohorts undertook DNA sampling and analyses. Contrary to our hypothesis, DNA sampling was not undertaken more frequently in the recent studies. In fact, some longitudinal projects, that began before genetic testing was easily available, did collect and store blood samples and are now undertaking these analyses. Other studies collected genetic material during a recent follow-up wave.

While comparing data collected and publication themes, we observed that many cohorts tend to underuse information (data not shown): most papers report results on cardiovascular diseases and dementia, while data on functional status, physical performances or health care utilisation tend to be less frequently reported.

Discussion

Even though we focused on large cohort studies of older persons, the number of studies retrieved was large and populations studied were heterogeneous. The number of publications related to each study was also highly variable and seemed independent of design features. In particular, larger projects did not always lead to a higher number of scientific publications.

It is interesting to observe that some investigators have taken the unique opportunity of longitudinal design in order to collect additional data during follow-up, such as new assessment tools or new technologies

Table 1 Design characteristics of community-based longitudinal studies on elderly people (listed to alphabetical order and by world region)

Study name and acronym (Reference)	Sample size	Gender	Age	Country	Beginning	Follow-up (years)	Domains assessed	Population	Website	Publications[a]	Validation[b]
Europe											
Berlin Ageing Study (BASE) (Borchelt and Horgas 1994)	516	W/M	70+	Germany	1990–1993	Ongoing	Cognitive + functional decline, depression, social network	Community	Yes	34	No
British Women's Heart and Health Study (Lawlor et al. 2003)	4,286	W	60–79	United Kingdom	1999–2001	Ongoing	Cardiovascular health	Community	Yes	6	Yes
Cambridge project for later life, follow-up of Hughes Hall project (CC75C) (Brayne et al. 1992)	2,609	W/M	75+	United Kingdom	1985	13	Cognitive decline	Community + institutions	Yes	>40	Yes
Cardiovascular study in the Elderly (CASTEL) (Casiglia et al. 1991)	2,254	W/M	65+	Italy	1984	7	Cardiovascular health	Community	No	8	No
Doorlopend Onderzoek Morbiditeit en Mortaliteit (DOM) (de Waard et al. 1984)	14,697	W	50–65	Netherlands	1975	2 (ongoing: random subset)	Cancer reproductive health	Community	No	>15	Yes
Edinburgh Artery Study (Donnan et al. 1993)	1,600	W/M	55–74	United Kingdom	1987	5	Cardiovascular health	Community	Yes	45	No
English Longitudinal Study of Ageing (ELSA) (Nazroo 2001)	12,000	W/M	50+	United Kingdom	2001	Ongoing	Medical, social and economic data	Community	Yes	1	Yes
EPIDOS (Dargent-Molina et al. 1996)	7,575	W	75+	France	1992	4	Osteoporosis	Community	No	22	Yes
Etude du Vieillissement Artériel (EVA) (Dufouil et al. 1997)	1,389	W/M	59–71	France	1991–1992	4	Cognitive decline	Community	No	>40	Yes
EURONUT-SENECA: Survey Europe on Nutrition in Elderly: Concerted Action (Van'thof et al. 1991)	2,586	W/M	70–75	12 Countries	1988	10	Nutrition, health status, social data	Community	Yes	>40	Yes
European Vertebral Osteoporosis Study (EVOS), followed by European Prospective Osteoporosis Study (EPOS) (O'Neill et al. 1995)	13,400	W/M	50+	19 Countries	1990	3–4	Osteoporosis	Community	Yes: EPOS	EVOS: 31, EPOS: 9	Yes
FINE study (Menotti et al. 2001)	2,226	M	65–84	3 Countries	1984–1985	15	Cognitive + functional decline, cardiovascular health	Community	No	8	Yes
Gospel Oak Project (Livingston et al. 1990)	889	W/M	65+	United Kingdom	1994	1	Depression, dementia	Community	No	7	No
Gothenburg H-70 Study (Maxson et al. 1996)	508	W/M	70	Sweden	1971	20	Medical and social data	Community	No	8	No

Table 1 (Contd.)

Study name and acronym (Reference)	Sample size	Gender	Age	Country	Beginning	Follow-up (years)	Domains assessed	Population	Website	Publications[a]	Validation[b]
Groningen Longitudinal Ageing Study (Ormel et al. 1998)	5,279	W/M	56+	Netherlands	1993	Ongoing	Cognitive decline, psychological status	Community	No	5	Yes
Helsinki Ageing Study (Tilvis et al. 1996)	795	W/M	75+	Finland	1990	5	Cognitive decline, dental problems	Community	No	>50	Yes
Hoorn Study (Mooy et al. 1995)	2,484	W/M	50–75	Netherlands	1989	Ongoing	Diabetes and glucose intolerance	Community	Yes	42	Yes
Italian Longitudinal Study on Ageing (ILSA) (Maggi et al. 1994)	5,493	W/M	65–84	Italy	1992	Ongoing	Cognitive decline, depression	Community + institutions	No	17	Yes
Kungsholmen Project (Fratiglioni et al. 1991)	1,810	W/M	75+	Sweden	1987	12	Cognitive decline	Community	Yes	27	Yes
Lausanne Cohort 65+ (LC65+) (information available from : http://www.iumsp.ch)	1,567	W/M	65–69	Switzerland	2004	Ongoing	Frailty	Community	No	0	Yes
Leiden 85-plus study I/II (Westendorp 2002)	I: 977, II: 599	W/M	85+	Netherlands	1987/1997	15/5	Cognitive + functional decline, depression	Community	No	>10	Yes
LEILA 75+ (Busse et al. 2002)	1,500	W/M	75+	Germany	1997	1.5	Cognitive decline, vision	Community + institutions	No	3	No
Longitudinal Ageing Study Amsterdam (LASA) (Deeg et al. 2002)	3,107	W/M	55–85	Netherlands	1992	10	Cognitive + affective status, functional status	Community + institutions	Yes	>35	Yes
Longitudinal Survey of Ageing (information available from: http://www.agenet.ac.uk)	1,500	W/M	65+	United Kingdom	1987	3	Health status, health services use	Community	Yes	0	No
Medical Research Council-Cognitive Function in Ageing Study (MRC-CFAS), including Resource Implication Study (Saunders et al. 1993)	>10,000	W/M	65–75	United Kingdom	1991	5	Cognitive decline, cardiovascular health, depression, health services use and costs	Community	No	12	No
Melton Osteoporotic Fracture (McGrother et al. 2002)	1,289	W	70+	United Kingdom	1989	5–6	Osteoporosis	Community	No	2	Yes
Million Women Study (Million Women Study Collaborative Group 1999)	1,400,000	W	50–64	United Kingdom	1996–2001	Ongoing	Hormone replacement therapy, breast cancer	Community	No	3	Yes
Netherlands cohort study on diet and cancer (Dorant et al. 1994)	120,852	W/M	55–69	Netherlands	1986	7–8	Nutrition, cancer	Community	No	16	No
Nordic Research on Ageing (NORA) (Kauppinen et al. 2002)	3×400	W/M	75+	3 Countries	1990	5	Normal Ageing, functional decline	Community	Yes	9 via web	No
North London Eye Study (Reidy et al. 2002)	1,318	W/M	65+	United Kingdom	1997	4	Ophthalmology	Community	No	1	No

Table 1 (Contd.)

Study name and acronym (Reference)	Sample size	Gender	Age	Country	Beginning	Follow-up (years)	Domains assessed	Population	Website	Publications[a]	Validation[b]
Nottingham Longitudinal Study of Activity and Ageing (Morgan 1998)	1,042	W/M	65+	United Kingdom	1985	12	Physical activity, functional decline	Community	No	3	No
Odense Study (Nielsen et al. 1999)	2,500	W/M	65–85	Denmark	1997?	2	Cognitive decline, depression	Community	No	6	No
Personnes âgées QUID? PAQUID (Dartigues et al. 1991)	3,777	W/M	65+	France	1988	Ongoing	Cognitive + functional decline	Community	Yes	71 + report on website	Yes
Rotterdam Study (Meijer et al. 2000)	7,983	W/M	55	Netherlands	1990–1993	Ongoing	Cardiovascular health, cognitive + functional decline, depression, ophthalmology	Community + institutions	Forth-coming	>210	Yes
Study of men born in 1913/study of men born in 1914 (Janzon et al. 1986)	792/703	M	55	Sweden	1963/1968	32/ongoing	Cardiovascular health	Community	No	72/>80	Yes
Survey of Health, Ageing and Retirement in Europe (SHARE) (2004) (information available from: http://www.share-project.org)	1,500 per country (target)	W/M	50+	11 Countries	2004	Not yet	Health, functional status, retirement, economics	Community	Yes	0	Yes
Swiss Evaluation of the methods of Measurement of Osteoporotic Fracture risk (SEMOF) (Krieg et al. 2002)	7,496	W	70–80	Switzerland	1998	3	Osteoporosis	Community	No	1	Yes
Tampere Longitudinal Study of Ageing (TamELSA) (Jylha 1994)	1,059	W/M	60–89	Finland	1979	20	Medical and functional data, incontinence	Community	No	3	Yes
Zutphen Elderly Study (Hertog et al. 1993)	939	M	65–84	Netherlands	1985	8	Cognitive + functional decline, nutrition	Community	No	34	Yes
United States (USA) and Canada (CA)											
Asset and Health Dynamics among the Oldest Old (AHEAD), with HRS from 1998 (Soldo et al. 1997)	8,124	W/M	70+	USA	1993	5	Health status, functional decline	Community	No	35	Yes (referred to website)
Atherosclerosis Risk in Communities Study (ARIC) (The ARIC investigators 1989)	15,784	W/M	51–72	USA	1987–1989	10	Cardiovascular health	Community	Yes	77	Yes
Buck Centre for Research in Ageing (BCRA), Health and Function cohort (Reed et al. 1995)	2,025	W/M	55+	USA	1989–1991	4	Health status, functional decline	Community	No	2	Yes
Canadian Study of Health and Ageing (CSHA), Etude Santé et Vieillissement au Canada (McDowell et al. 2001)	10,263	W/M	65+	CA	1991–1993	10	Cognitive decline	Community + institutions	Yes	117	Yes

Table 1 (Contd.)

Study name and acronym (Reference)	Sample size	Gender	Age	Country	Beginning	Follow-up (years)	Domains assessed	Population	Website	Publications[a]	Validation[b]
Cardiovascular Health Study (CHS) (Fitzpatrick et al. 2004)	5,201	W/M	65+	USA	1989	7	Cardiovascular health	Community	Yes	216	Yes
Established Populations for Epidemiologic Studies of the Elderly (EPESE) (Blazer et al. 1991)	4,162	W/M	65+	USA	1986–1988	10	Health status, functional decline, health services use	Community	Yes	119	Yes
Etude Longitudinale Québécoise sur le Vieillissement (Québec Longitudinal Study on Ageing) (Lefrancois et al. 2000)	782	W/M	60–85	CA	1997	5	Functional decline, quality of life, retirement	Community	Yes	2	Yes
Health Ageing and Body Composition (ABC) Study (Mehta et al. 2003)	3,075	W/M	70–79	USA	1997–1998	Ongoing	Body composition	Community	Yes	15	Yes
Health and Retirement Study (HRS) and Ageing, Demographics and Memory Study (ADAMS), combined with AHEAD (Choi and Schlichting-Ray 2001)	12,654	W/M	50–60	USA	1992	Ongoing	Medical, social and economic data	Community	Yes	59	Yes
Iowa Women's Health Study (Folsom et al. 2000)	41,836	W	55–69	USA	1986	Ongoing	Cancers	Community	No	165	Yes
Longitudinal Study of Ageing (LSOA) I/II (Dunlop et al. 2002)	7,527/9,447	W/M	70+	USA	1984/1994	6	Functional decline, health care use	Community	No	18/429	Yes
MacArthur Studies of Successful Ageing (sub-cohort of EPESE) (Berkman et al. 1993)	1,189	W/M	70–79	USA	1988	8	Health status, functional+ cognitive decline	Community	No	36	Yes
Manitoba Study of Health and Ageing (Hawranik 1998)	1,751	W/M	65	CA	1991	5	Cognitive decline, health services use	Community	Yes	3	Yes
Massachusetts Health Care Panel Study (MHCPS) (Jette et al. 1990)	1,625	W/M	65+	USA	1974	11	Health services use, functional decline, nutrition	Community	No	15	No
Monongahela Valley Independent Elders Study (MoVIES) (Ganguli et al. 1993)	1,681	W/M	65+	USA	1987	15	Cognitive decline	Community	Yes	45	Yes
Nun Study (Greiner et al. 1996)	978	W	≥75	USA	1991	15	Dementia	Convents	Yes	>40	Yes
Salisbury Eye Evaluation (SEE) (West et al. 1997)	2,886	W/M	65–84	USA	1993	2	Ophthalmology, health status	Community	No	21	No
San Antonio Longitudinal Study of Ageing (SALSA) (Espino et al. 2001)	833	W/M	65–79	USA	1992–96	3–4	Health status, functional+ cognitive decline	Mexican Americans	No	8	No

Table 1 (Contd.)

Study name and acronym (Reference)	Sample size	Gender	Age	Country	Beginning	Follow-up (years)	Domains assessed	Population	Website	Publications[a]	Validation[b]
Saunders County Bone Quality Study (Davies et al. 1996)	1,401	W/M	50+	USA	1990	4	Osteoporosis	Community	No	4	No
Study of Osteoporotic Fractures (Black et al. 2001)	9,704	W	65+	USA		9	Osteoporosis, breast cancer	Community	No	153	Yes
Victoria Longitudinal Study (Small et al. 1999)	3×500	W/M	75+	CA	1990	6	Psychological status	Community	Yes	6	No
Washington Heights-Inwood Columbia Ageing Project (WHICAP) (Tang et al. 1996)	1,238	W/M	65+	USA	1991	7	Cognitive decline, neurological status	Community	No	>20	No
Women's Health and Ageing Study (Simonsick et al. 2001)	1,002	W	>65	USA	1992–1995	3	Health status, functional+cognitive decline, health services use	Community and institutions (women with functional impairment)	Yes	49+monography on website	Yes
Asia and South America											
Australian Longitudinal Study of Ageing (Anstey et al. 2003)	2,087	W/M	70+	Australia	1992	Ongoing	Cognitive decline, vision, hearing	Community	Yes	12	Yes
Bambui Health and Ageing Study (Costa et al. 2000)	1,495	W/M	60+	Brazil	1996	6	Health status, functional+cognitive decline, health services use	Community	No	4	No
Canberra Longitudinal Study (Korten et al. 1999)	897	W/M	70+	Australia	1991	10	Cognitive decline, psychology	Community	No	21	No
Dubbo Osteoporosis Epidemiology Study (Jones et al. 1994)	1,762	W/M	60–100	Australia	1989	7	Osteoporosis	Community	No	15	No
Epidemiologia do Idoso (EPIDOSO) (Ramos et al. 1998)	1,667	W/M	65+	Brazil	1991	22	Health status, functional+cognitive decline, health services use	Community	No	4	No
Hong Kong old–old Survey (Ho et al. 1997)	2,032	W/M	70+	Hong Kong	1991	3	Cardiovascular health, functional+cognitive decline	Community	No	>25	Yes
Japanese Longitudinal Studies (Japanese Longitudinal Studies 2004)	4,464	W/M	65+	Japan	1999	4	Frailty, functional decline	Community	No	0 (abstracts only)	No
Maracaibo Ageing Study (Maestre et al. 2002)	3,657	W/M	55+	Venezuela	1998	Ongoing	Cognitive decline, nutrition	Community	No	3	Yes
Shanghai Survey of Dementia (Hill et al. 1993)	3,558	W/M	65+	China	1957	10	Cognitive decline	Community	No	15	Yes
Tokyo Metropolitan Institute Of Gerontol–Longitudinal Interdisciplinary Study on Ageing (TMIG–LISA) (Suzuki et al. 1999)	1,562	W/M	65+	Japan	1992	9	Health status, functional decline	Community	No	>20	Yes

W women, *M* men

[a]Number of publications retrieved on Medline 1966–2003 using the name or acronym of the cohort as keywords

[b]Indicates whether the data were validated by a principal investigator of the cohort

Table 2 Data collected in community-based cohorts enrolling older people (listed to alphabetical order and by world region)

Study name	Socio-demographics	Chronic conditions	Functional status (reported)	Mental health	Vision, hearing	Biochemicals	Genetics	Miscellaneous
Europe								
Berlin Ageing Study (BASE)	+	+	+	+		+		Physical examination, Dental status
British Women's Heart and Health Study	+	+	+	+	+	Blood count, lipids, insulin, biochemistry, clotting	Exploratory scanning for cardiovascular disease-related genes	Blood pressure, BMI, W/H ratio, ECG, Physical activity, Dietary assessment, current and early life socio-economic environment
Cambridge project for later life, follow-up of Hughes Hall project (CC75C)	+	+	+	MMSE, CAMDEX, CAMCOG		No detailed data	Apoe, preselinilin, α1-antichemotrypsin, acetylcholinesterase	Lifestyle (alcohol, smoking), social network, Brain donation program
Cardiovascular study in the Elderly (CASTEL)	+	+				Lipids, liver enzymes, thyroid hormones, uric acid, proteinuria		Blood pressure, Lung function, ECG, echocardiography
Doorlopend Onderzoek Morbiditeit en Mortaliteit (DOM)	+	+					Sampling of urine and toenail clipping	BMI, Blood pressure, W/H ratio, Physical examination, Reproductive history, Mammography
Edinburgh Artery Study	+	+		+ (Bedford-Foulds personality deviance scale)		Viscosity, clotting, lipids, Lp(a), uric acid, sex hormones, glucose intolerance	MTHFR (homocystein), fibrinogen, polymorphism	Ankle-brachial pressure index, reactive hyperaemia test
English Longitudinal Study of Ageing (ELSA)	+	+	+	+	+	Yes	Yes	Data on financial and social status, use of health services, Physical performance
EPIDOS	+	+	+	Cognitive assessment	+	Sex hormones, alkaline phosphatase, vitamin D, osteocalcine, deoxypyridinoline, urin/serum C-telopeptide		BMI, BMD (DXA + US), Physical performance: balance, hand grip, gait
Etude du Vieillissement Artériel (EVA)	+	+		MMSE, Digit Symbol, substitution, Trail making test		Biochemicals including vitamins, selenium	Apoe	Cerebral MRI and US carotid arteries at wave 3
EURONUT-SENECA: Survey Europe on Nutrition in Elderly: Concerted Action	+	+	+	MMSE, GDS	+	Haematology, lipids, glucose, insulin, albumin, vitamins		BMI, body composition (W/H ratio, skinfold thickness), Physical performance, Dietary assessment
European Vertebral Osteoporosis Study (EVOS), followed by European Prospective Osteoporosis Study (EPOS) (EVOS)	+	+	+			Creatinine, calcium, phosphate, liver enzymes, markers of bone metabolism	Growth factor polymorphism (TGF-B1)	BMI, Physical activity and dietary assessment, Gynaecologic history, medication use, BMD (DXA and US)

Table 2 (Contd.)

Study name	Socio-demographics	Chronic conditions	Functional status (reported)	Mental health	Vision, hearing	Biochemicals	Genetics	Miscellaneous
FINE study	+	+	+	MMSE, Dementia Rating Scale, Clock, Drawing		Lipids		BMI, Blood pressure, ECG, Hand grip
Gospel Oak Project	+	+	+	+				
Gothenburg H-70 Study	+	+	+	+ neuropsychological assessment in sub-sample	+ complete ophthalmological examination	+	–	Physical examination, BMI, Blood pressure, Social contacts, Physical activity, smoking, Medication use
Groningen Longitudinal Ageing Study	+	+	Groningen activity restriction scale	MMSE Anxiety Depression Neuroticism	+			
Helsinki Ageing Study	+	+	+	MMSE, CDR		No detailed data		Blood pressure, Dental status
Hoorn Study	+	+			Ophthalmological examination, fundoscopy	Lipids, glucose, leptin, CRP, homocystein, Von Willebrand f, micro-albunmin, adhesion molecule		Blood pressure, BMI, W/H ratio, Physical examination, Glucose tolerance test Ankle-brachial pressure index, US carotid arteries
Italian Longitudinal Study on Ageing (ILSA)	+	+		MMSE, Digit cancellation, Babcock, Hamilton scale for depression		Lp(a)		ECG Clinical examination
Kungsholmen Project	+	+	+	MMSE, neuropsychological tests, life satisfaction		Blood count, albumin, iron, vitamin B12 + folic acid, thyroid hormones	Apoe	Blood pressure, BMI, Clinical examination, including psychiatric and neurological tests, Medication use, dietary assessment, lifestyle habits, dental status
Lausanne Cohort 65 + (LC65 +)	+	+	+	+	+			Physical examination and performance
Leiden 85-plus study I/II	+	+	ADL + Groningen Activity Restriction Scale	MMSE, neuropsychological tests, GDS		Lipids, Lp(a), hba1c, IL-10, CRP	TNF-a, mutation of hemochromatosis gene	Physical performance: walk test
LEILA 75 +	+	+	+	MMSE + SIDAM (with blind version testing), Neuropsychological assessment)	+	Haematocrit		
Longitudinal Ageing Study Amsterdam (LASA)	+	+	+	MMSE, Auditory verbal learning test, alphabet coding task, self-report + diagnostic interview for depression, mastery, self-efficacy, self-esteem	+	Bone markers: osteocalcin, deoxypyridinoline	Apoe	BMD, Physical performance: mobility, walk, stand up, hand grip, Fall calendar
Longitudinal Survey of Ageing	+	+	+	+				Available information is minimal
Medical Research Council-Cognitive Function in Ageing Study (MRC-CFAS), including Resource Implication Study	+	+	+	Geriatric Mental State, Minimum Data Set, GHQ-30			Apoe	Medication use (antidepressants, BZD), Postmortem brain examination

Table 2 (Contd.)

Study name	Socio-demographics	Chronic conditions	Functional status (reported)	Mental health	Vision, hearing	Biochemicals	Genetics	Miscellaneous
Melton Osteoporotic Fracture	+	+	+	Clifton Assessment Procedure for the Elderly (cognition)	Snellen test (visual acuity)			BMI, Dietary assessment, physical activity, medication, Fall history, fractures, Physical performance: mobility, balance, 10 min walk, stand up from chair, handgrip US of the calcaneus
Million Women Study	+	+					Yes, no details	Reproductive history, HRT and OC use, familial history of cancer, lifestyle habits (diet, alcohol, tobacco), Early life events, Mammography
Netherlands cohort study on diet and cancer	+	+					Toenail clipping	Dietary assessment, medication use, Family history of cancer, smoking
Nordic Research on Ageing (NORA)	Interview	+	+	CES-D				Physical performance: muscle strength, stair-mounting test
North London Eye Study	+	Diabetes						Ophthalmological evaluation
Nottingham Longitudinal Study of Activity and Ageing	+	+	+					Physical activity and performance: grip strength, mobility, Lifestyle habits
Odense Study (EURODEM)	+	+		CAMCOG, CAMDEX, neuropsychological tests (trail making, Symbol Digit, Benton Boston and Token tests). CDR				
Personnes âgées QUID? PAQUID	+	+		CES-D, MMSE, neuropsychological tests (Benton, Wechsler)	+	Lipids, hormones	Apoe (sub-sample)	BMI, Dietary assessment, medication use, Home visits
Rotterdam Study	+	+	+	MMSE, CES-D, GMS-organic, battery of other tests	Vision	Lipids, markers of inflammation (CRP, IL-6), hormones, Thyroid antibodies, Clotting, Homocystein, Vitamins, ferritin, caerulopasmin, and other (some in subset only)	Apoe, Polymorphism of hormones receptors, Myocilin mutation, Factor V Leiden, and other (some in subset only)	Blood pressure, BMI, W/H ratio, ECG, US of carotid arteries, cerebral MRI, Bone density, RX of knee, Ophthalmological examination, Dietary assessment

Table 2 (Contd.)

Study name	Socio-demographics	Chronic conditions	Functional status (reported)	Mental health	Vision, hearing	Biochemicals	Genetics	Miscellaneous
Study of men born in 1913/ study of men born in 1914	+	+	+	Neuropsychological tests (Men born in 1914)	Hearing	Blood count, lipids, chemistry, PSA, sex hormones, insulin, coagulation factors	Activated C protein resistance	Blood pressure, BMI, ECG, RX of chest, Physical examination, 24-h ECG, echocardiography, US of carotid and peripheral arteries, Lung function, Test of audition
Survey of Health, Ageing and Retirement in Europe (SHARE) (2004)	+	+	+	+				Professional occupation and retirement, economics, social situation, intergenerational relationships, health services utilisation
Swiss Evaluation of the methods of Measurement of the Osteoporotic Fracture risk (SEMOF)	+	+	+	+		Markers of bone metabolism in serum and urine		BMD (DXA and US)
Tampere Longitudinal Study of Ageing (TamELSA)	+	+	+	+				Medication use, Incontinence
Zutphen Elderly Study	+	+	+	MMSE Courtald Emotional Control Scale		Lipids, hematocrit, insulin, C-peptide, albumin, creatinine		Blood pressure, BMI, Detailed dietary assessment (vitamins, glycemic index...), Functional performance measured in some individuals (validation of self-report instrument)
United States (USA) and Canada (CA)								
Asset and Health Dynamics among the Oldest Old (AHEAD), with HRS from 1998	+	+	+		+			BMI
Atherosclerosis Risk in Communities Study (ARIC)	+	+				Blood count, coagulation factors, lipids, chemistry, renal function	No details	Blood pressure, BMI, W/H ratio, ECG, echocardiogram
Buck Centre for Research in Ageing (BCRA), Health and Function cohort	+	+	+	Short Portable Mental Status CES-D	+	No detailed data		Blood pressure, Physical performance: balance, stand up from chair, Extensive visual examination in a subset
Canadian Study of Health and Ageing (CSHA), Etude Santé et Vieillissement au Canada	+	+	+	MMSE, CES-D, Zarit's Burden Scale, Ryff's wellbeing measure		Folate, vitamin B12	Apoe	BMI, Neuropsychological examination

Table 2 (Contd.)

Study name	Socio-demographics	Chronic conditions	Functional status (reported)	Mental health	Vision, hearing	Biochemicals	Genetics	Miscellaneous
Cardiovascular Health Study (CHS)	+	+	+		+	Lipids, IL-6, CRP, coagulation, fructosamine	+	Blood pressure, ankle blood pressure, BMI, Lung function, ECG, echocardiography, Physical performance: 6 min walk
Established Populations for Epidemiologic Studies of the Elderly (EPESE)	+	+	+	CES-D + MMSE		Blood count, albumin, IL-6, at year 6	Apoe	BMI, Physical performance: walking speed, balance, stand up from chair, Data on past hospital admissions
Etude Longitudinale Québécoise sur le Vieillissement (Québec Longitudinal Study on Ageing)	+	+	+					
Health Ageing and Body Composition (ABC) Study	+	+	+	CES-D, MMSE, assessment of anxiety	Self-report of physician diagnosed impairment	Blood count, chemistry (glucose, hormones, inflammation markers), Urine collection		Blood pressure, BMI, W/H ratio, DXA, CT of thigh, Physical performance : 6 min walk, stand up from chair, knee extension, grip strength, Physical activity, Medication use, Lung function
Health and Retirement Study (HRS) and Ageing, Demographics and Memory Study (ADAMS), combined with AHEAD	+	+	+	CES-D	Self-rated vision and hearing			BMI, Physical activity, Physical performance: strength, Leisure activity
Iowa Women?s Health Study	+	+				Sex hormones, insulin in a small subset	Candidate genes for breast cancer	BMI, W/H ratio, Dietary assessment Reproductive history, HRT, Cancer (total and cause-specific mortality, incidence)
Longitudinal Study of Ageing I/II (LSOA I/II)	+	+	ADL	+				No performance or physical measure
MacArthur Studies of Successful Ageing (sub-cohort of EPESE)	+	+	ADL	Short Portable, Mental Status, Boston Naming, Task and other cognitive performance measures		IL-6, uric acid, CRP, albumin, cholesterol, cortisol/ACTH, Urinary cortisol and catecholamins	Apoe (other future analyses not yet determined)	Blood pressure, Physical performance: stand on one leg, walking speed, Lung function

Table 2 (Contd.)

Study name	Socio-demographics	Chronic conditions	Functional status (reported)	Mental health	Vision, hearing	Biochemicals	Genetics	Miscellaneous
Manitoba Study of Health and Ageing	+	+		CES-D, Self-reported memory loss + modified MMSE				Lifestyle habits, Inhome help services use
Massachusetts Health Care Panel Study (MHCPS)	+	+	+		+			Physical performance: test of strength and function, Dietary assessment, Health and dental care services use, Blood pressure, Physical performance: balance, stand up from chair, Extensive visual examination in a subset
Monongahela Valley Independent Elders Study (MoVIES)	+	+	+	MMSE, CES-D, Neuropsychological tests: Story and word recall, Boston naming, Verbal fluency, Praxis, Clock drawing	+	No detailed data	Apoe	Medication use, Use of health care services
Nun Study	+	+	+	+		Biochemicals	Apoe	Autopsy (brain)
Salisbury Eye Evaluation (SEE)	+	+	ADL	MMSE	Visual acuity			Opthalmoscopy, Visual performance, Clinical evaluation, BMI, Physical performance: hand grip, Dietary evaluation
San Antonio Longitudinal Study of Ageing(SALSA)	+	+		MMSE, GDS				Physical performance: mobility of articulations, walking speed, Mcgill pain map
Saunders County Bone Quality Study	+	+						BMI, grip strength, Bone quality assessment (RX + US), Dietary assessment, Use of HRT
Study of Osteoporotic Fractures	+	+	+	GDS, modified MMSE	Visual acuity	Serum: sex hormones, osteocalcin, alkaline phosphatase, Urin: telopeptides, pyridinolines	Tumour growth factor, vitamin D receptor, apoe	Blood pressure, ankle-brachial pressure index, BMI, Physical performance: hand grip, gait, balance, Medication use, Physical activity, Dietary assessment, Fall calendar, Bone quality assessment (DXA, US)
Victoria Longitudinal Study	+	+	+	Memory Compensation Questionnaire, Bradburn Affect Balance scale				Psychological testing

Table 2 (Contd.)

Study name	Socio-demographics	Chronic conditions	Functional status (reported)	Mental health	Vision, hearing	Biochemicals	Genetics	Miscellaneous
Washington Heights-Inwood Columbia Ageing Project (WHICAP)	+	+	+	MMSE, Hamilton rating scale for depression, neuropsychological assessment (10 tests)		Lipids Amyloid-beta peptide	Apoe	Blood pressure, Dietary intake (vitamin, antioxydant), Neurologic examination in subset of subjects
Women?s Health and Ageing Study	+	+	ADL	GDS, SF-36, Anxiety/mastery evaluation, Emotional vitality	Self-report + tests	Blood count, chemistry, albumin, lipids, thyroid hormones, IL-6	Candidates genes for decline	Physical performance: balance, 4 min walk, functional reach, stand up from chair, hand grip, Physical and clinical examination, Hospital use
Asia and South America								
Australian Longitudinal Study of Ageing	+	+	+	MMSE, CES-D, well-being evaluation	Measures of vision + hearing			BMI, W/H ratio, Physical performance: Corrected Arm Muscle Area, grip strength, Physical activity assessment, Numerous cognitive tests, History of falls
Bambui Health and Ageing Study	+	+	+	Depression and cognitive evaluation		Blood count, Chemistry, Lipids, Chagas disease serology	No details	Blood pressure, ECG, BMI, W/H ratio, triceps skinfold, Health services utilisation (including hospitalization)
Canberra Longitudinal Study	+	+	+	Psychiatric evaluation, cognitive performances	+	–	–	Blood pressure, Smoking, Social support, Physical performance: grip strength, reaction time
Dubbo Osteoporosis Epidemiology Study	+	+			Vision		Vitamine D receptor	BMI, Dietary + physical activity assessment, Reproductive history, Physical performance: strength + balance, History of falls, Bone density (DXA), radiological assessment
Epidemiologia do Idoso (EPIDOSO)	+	+	ADL	Dysthymia, MMSE				Physical activity, Health services utilisation
Hong Kong old–old Survey	+	+	Barthel index	GDS, Clifton Assessment Procedure for the Elderly	+	Blood sample in a small subgroup (no details)	Gene polymorphism related to longevity	Blood pressure, BMI, W/H ratio, skinfold thickness, Functional + physical performance: walking test

Table 2 (Contd.)

Study name	Socio-demographics	Chronic conditions	Functional status (reported)	Mental health	Vision, hearing	Biochemicals	Genetics	Miscellaneous
Japanese Longitudinal Studies	+	+	+	+				
Maracaibo Ageing Study	+	+	+	CDR, MMSE		Hematology, Chemistry, vitamin B12, folic acid, homocystein	Apoe, folate metabolism, presenilinin	Blood pressure, ECG, Holter test, Physical performance treadmill, Dietary evaluation, Anthropometrical measures, Neuropsychiatric evaluation
Shanghai Survey of Dementia	+	+	ADL, Pfeffer, Outpatient, Disability Scale	Chinese MMSE, CES-D	+	No detailed data	Apoe	Neuropsychological tests, The questionnaire of TMIG–LISA was used in this study
Tokyo Metropolitan Institute of Gerontol–Longitudinal Interdisciplinary Study on Ageing (TMIG–LISA)	+	+	ADL, TMIG, index of competence (evaluation of higher level of functional capacity)	GDS, index of life satisfaction, self-rated health	+ self-report	Blood count, Chemistry, Lipids, Liver enzymes, B2 micro-globulin, sex hormones, Hba1c Urinalysis	Markers of osteoporosis	BMI, skinfold thickness, Physical performance: grip strength, tapping rate, one-leg standing, speed walk, Dental examination, ECG, Dietary assessment, RX of chest, BMD (lumbar)

The symbol "+" indicates that the study collected data in this domain, but details are not reported here, either because no detailed information was found, or because the amount of information was difficult to summarise. *ADL* activity of daily living, *BMD* bone mineral density, *BMI* body mass index, *CAMCOG* Cambridge cognitive examination, *CAMDEX* Cambridge examination for mental disorders of the elderly, *CDR* clinical dementia rating scale, *CES-D* Centre for Epidemiological Studies Depression Scale, *CT* computer tomography, *DXA* dual-energy X-ray absorptiometry, *ECG* echocardiogram, *GDS* geriatric depression scale, *GHQ* general health questionnaire, *GMS* geriatric mental state, *HbA1c* glycosylated haemoglobin A1c, *IL* interleukin, *Lp(a)* lipoprotein a, *MMSE* mini-mental state examination, *MRI* magnetic resonance imaging, *RX* roentgenogram, *SF-36* short form-36 quality of life questionnaire, *SIDAM* structured interview for the diagnosis of Alzheimer disease, multi-infarct dementia and dementias of other etiology, *US* ultrasound, *W/H ratio* waist to hip ratio

like DNA sampling that were often not part of the baseline study protocol.

On the other hand, most studies do collect a great deal of information that is underused in further analyses and publications. Ideally, reasons for assessment of a variable and further use in analytic planning should be decided before the study begins and have valid justification. However, data collection is also influenced by the legitimate concern of collecting data that might be useful later, according to scientific developments and also to compete with other studies (Deeg and Van der Zanden 1991). The gap between variables collected and those used in published analyses might also result from the inability to answer research questions due to insufficient statistical power. Most studies did not recruit participants in a homogeneous age category, but only set a lower age limit at baseline, despite the fact that the health picture is very different at the age of 60 and 80. Studying age-related events might be difficult if the sample size of each age category is small, in particular when attrition over time is taken into consideration. Following a large and homogeneous sample during many years seems necessary to come to valid results.

Finally, there may be insufficient resources available for data analysis, which requests a high level of scientific competence. Underuse of available databases is a very frequent problem in medical studies and more attention should be given to solutions that may overcome this. In particular, allocating time and resources for data analysis and paper redaction is a necessity that might be underestimated by funding sources. Part of the solution is in collaboration and sharing of data among researchers, respecting the huge investment consented by researchers to collect cohort data and to find financial resources.

This work also illustrates the difficulty of retrieving accurate and comprehensive information on this type of study. Depending on the cohort, our initial search strategy retrieved only 30–60% of publications identified by the name or acronym of the cohort on Medline 1966–2003, thus indicating low sensitivity of that initial strategy. We urge researchers to choose a name or acronym at the beginning of the study, to mention it in each related publication, and to create a website, in order to facilitate access to the information.

Then, we had to contact the principal investigators to get accurate and comprehensive results, because information on study design is not always available in published material. For instance, the number of people included at baseline tends to vary from one publication to another, particularly when some assessments were undertaken in a sub-sample only. We therefore recommend that each publication contains a brief but accurate description of the original study design, including more details on participation rates and characteristics of non-participants, or refers to publications describing study design. It would also enable the reader to estimate the representativeness of the population sample under study.

This work of course has some limitations. First, we limited our search to cohorts of subjects that were middle-aged or aged at enrolment. As cohorts recruiting subjects under 50 years were less likely to include a follow-up long enough to observe problems specific to ageing subjects, we decided to exclude such studies from our search. We are, however, conscious that ageing is a continuum, and that any lower limit of age is arbitrary and therefore limits the extent of the results.

Secondly, we excluded studies in developing countries, although ageing of the population will soon be a prevalent problem in these countries also. However, lifestyle, socio-economic circumstances and health care systems are very different in these countries and we believe that many results of these studies would not be applicable to our developed setting and should be studied separately.

Finally, despite our systematic search combined with manual searching, it is of course possible that we overlooked some important projects in the field. Our search on the Internet retrieved other lists of cohort studies, such as the ones from Health Canada (2004), review of longitudinal studies on ageing and from the National Institute on Ageing (2005). When compared to our results, we found that several studies retrieved in our review were not included in these works. Furthermore, our review encompasses a larger number of cohorts, although these databases included studies recruiting young adults as well. Therefore, we think that our review constitutes a valuable resource for researchers involved in geriatric studies, not only as a background for communication and exchanges, but also to foster the use of available resources, to learn from others' experiences and to help set priorities for future research in ageing communities.

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