THE NEED FOR GOOD DATA :

COHORT STUDIES OF AGEING

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Faculty/Presenter Disclosure

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Mitigating Potential Bias

Not applicable.

OBJECTIVES

- To review the need for consistent, reliable data from multiple populations
- To review basic epidemiological methods
- To review ongoing cohort studies

KEY POINTS

- Data are important
- Data need to be understood in the correct context
- The epidemiology of ageing is complicated
 - Sampling a highly heterogeneous population
 - Multiple interacting risk factors
 - Long time horizons
 - Fluctuations over time
 - Multiple competing outcomes
 - Loss to follow-up
 - Bidirectional causation

QUESTIONS

- How many nursing home beds do we need?
- How much home care do we need?
- What should home care services look like?
- How many hospitals do we need?
- What should those hospitals look like?
- What will happen to my mum? Me? My kids?

We need to understand

- The natural history of growing old
- The effects of time on individuals, populations, and societies
- What factors influence health across the life course
- We need to understand how health changes over time

COHORT STUDIES

- Help answer some of these questions
- Should be interpreted in the context of other data

Why are French data in an American textbook?

TABLE 2.1

	Life Expectancy at Birth (Years)	Infant Mortality Rate (per 1000 Live Births)
Prehistoric	20-35	200-300
Sweden, 1750s	37	210
India, 1880s	25	230
United States, 1	900 48	133
France, 1950	66	52
Japan, 1996	80	4
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Life Expectancy and Infant Mortality Throughout



- Text on ageing De Senectute
- "I find four reasons why old age appears to be unhappy: first, that it withdraws us from active pursuits; second, that it makes the body weaker; third, that it deprives us of almost all physical pleasures; and, fourth, that it is not far removed from death. Let us, if you please, examine each of these reasons separately and see how much truth they contain."
- Cicero then addresses each of these in order

 I do not now feel the need of the strength of youth any more than when a young man I felt the need of the strength of the bull or of the elephant. Such strength as a man has he should use, and whatever he does should be done in proportion to his strength

- Multimorbidity recognized in Byzantine texts c300-400 ACE
- Disability recognized as an issue for older people throughout medical history
 - Incurables
 - Workhouses

COMMUNITY SURVEYS

Physical Findings

Our most striking observation was the frequency of multiple disabilities. Men had a mean of 3.26 disabilities, of which 1.87 were unknown to the family doctor; women a mean of 3.42 disabilities, with 2.03 unknown

Aging Studies

- Wolverhampton Inquiry, 1948
 - Loneliness
 - Functional status
 - High heterogeneity
 - "Indomitability"

VISUAL REPRESENTATIONS OF AGING









AGE 18-24

- Shared taste in music, books and films is more important
- Needs to pass the 'friends test'
- AGE 25-34
- The importance of physical attraction is at its peak
- Ambition is a key trait
- AGE 35-44
- Manners maketh the man; less than 1% will date men with bad manners
 - Most willing to date a younger man

AGE 45-54

- A high income is now more important than ever
- Women are least picky about who they date

AGE 55+

- Intelligence, shared values and humour are more important
- Women at 55 and over are the pickiest





Irony ends in pathos in Saul Steinberg's 'Untitled, 1954', a version of the traditional diagram of the Ages of Man. The successful man rises from infant, through boy scout, academic, business man, tycoon to... playboy on a beach in Florida, retired, relaxed, happy but – useless.

Four life stages of a dog





Stugging to balance, Circling, Head till, Flicking eye movements, Vomiting - stroke

Definitions

- Life Span: is the species-specific longest duration of life, excluding premature death
- Life Expectancy: The average number of additional years of life that is expected for a member of a population
 - increasing quite dramatically as premature morbidity is reduced.



Figure 1: A life-course perspective for maintenance of the highest possible level of functional capacity



*changes in external environment can lower disability threshold

Early life interventions to ensure the highest possible functional capacity



Adult life interventions aimed at slowing down the decline



For those in older age above the disability threshold, revisiting previous interventions



For those in older age below the disability threshold, interventions are aimed at improv interventions ing the quality of life



Fried, 2001

Fig. 2.2. Three hypothetical trajectories of physical capacity



- A. Optimal trajectory, intrinsic capacity remains high until the end of life.
- B. Interrupted trajectory, an event causes a decrease in capacity with some recovery.
- C. Declining trajectory, capacity declines steadily until death. The dashed lines represent alternative trajectories.

WHO Report on Aging, 2016



Figure 5: A public health framework for healthy ageing

COMPRESSION OF MORBIDITY

814

James F. Fries



TYPES OF EPIDEMIOLOGICAL STUDIES

- National Data Collection / Vital Statistics / Admin Data
- Observational
 - Descriptive
 - Survey
 - Analytic
 - Case Control
 - Cohort
- Experimental
 - RCT
- Other
 - Qualitative
 - Case Series
 - I saw a guy

Threats to Validity

- Bias
 - Selection
 - Information
- Confounding
- Mismeasurement

Dealing with Confounding

- Restriction
- Stratification
- Matching
- Statistical modelling
- Random Allocation

Case Control

- People with the disease of interest (the cases) and people without this disease (the controls or comparison group) are sampled from either the general population or a special population
- Exposures among the cases are compared with exposures among non-diseased persons.

Advantages and Disadvantages

- Multiple exposures can be evaluated
- Small sample size
- Can study rare outcomes
- Inexpensive
- Fast answer

- Higher risk of bias
- Higher risk of misclassification
- Cannot study change
- Cannot study life course
- Cannot determine incidence or prevalence
- Only one outcome

COHORT STUDY

- A cohort study is simply a set of individuals who share some characteristic and who are followed up over time.
- In terms of cohort studies of ageing this is generally birth year (or years), but it might be another shared characteristic such as occupation or geography.
- Can use existing data collected for other reasons ("Historical cohort")

Kingston, Age and Ageing 2018

Reasons for Doing Them

- To determine whether there is a relationship between a cause or exposure, and an effect or outcome
- The exposure must happen before the outcome to infer cause and effect.
- Hence, the natural starting point is with the exposure either observe outcome(s) that result from a given exposure (observational cohort study) or control the exposure and record the outcome(s) (RCT).

A. Kingston and C. Jagger



Figure 1. Design of RCT and observational cohort study.

Advantages and Disadvantages

- Timing can be established
- Limit recall bias*
- Can determine incidence and prevalence*
- Multiple outcomes (if common)*
- Change over time (both risk factor and outcome)
- Lifecourse study is possible*
- Age, period cohort can be established****

- Large numbers*
- Long time frames*
- High cost*
- Loss to follow-up*
- Sampling frame*
- Change in measurements with time*
- Analyses can be complicated*
- Answer may come too late*

WHAT ARE THE CHALLENGES?

Intellectual

- Measures to be included need to balance burden and adherence with information
- Analysis can be complicated
 - Time to event
 - Change over time
- Accounting for attrition
- Accounting for bias and confounding

Practical

- Infrastructure and tradition
- Expensive long and *consistent* funding commitment
- Hard to maintain interest
 - Participants
 - Investigators
 - Funders
- Academic reward system



Things to think about

- What is the initial sampling frame and age?
- How frequent are the measures?
 - Outcomes
 - Predictors
- How long a time frame?

Examples of Cohort Studies

- Aging in Manitoba (1971 to 2006)
- Manitoba Follow-Up Study (1948 to present)
- CHSA
- Quebec Longitudinal Study on Nutrition and Aging (NuAge)
- CLSA



Aging in Manitoba



Originator: Betty Havens Pls: Payne, Chipperfield



≈ 9,000 participants

Strengths of AIM

Representative (Stratified randomized sampling)

Length of follow up: 35 years

Minimal loss to follow up (intensive follow up)

Interview data links to Manitoba Health Claims Data

Breadth of measures



CSHA Study Centres



Prevalence of Dementia Canada 1991-92

Rate per 1,000



Source: Can Med Assoc J 1994;150:899-913

Risk Factors for Alzheimer's Disease (CSHA-1 Case-Control Study)

OR 95% CI 2.6 1.5 - 4.5 One or more relatives with AD 2.5 - 6.4 0-6 yrs education 4.0 Occupational exposure to glues 2.2 1.3 - 3.7 Head injury 1.7 0.97 - 2.8 Arthritis 0.5 0.4 - 0.8 Use of NSAID drugs 0.6 0.4 - 0.8

Profile of Canadian Caregivers (Baseline Data from CSHA-1)

- 75% of caregivers were women; 70% were married
- 29% were also employed
- 23% of caregivers were the person's wife
- 12% were the husband
- 37% were children: 28% daughters, 9% sons
- 23% were other friends or relatives
- 5% were paid caregivers.

Source: Can J Aging 1994;13:470-487

Manitoba Follow-Up Study

- Initiated by Dr. FAL Mathewson during WWII
- Physical examination of aircrew recruits during war years
- Survivors contacted between 1946 and 1948
- Housed since 1948 at University of Manitoba
- Participants across Canada and the world

MFUS Cohort Spans 70 Years

In 1948:

- 3,983 male air recruits
- Mean age 30y
- □ 90% were 20-39y
- All across Canada
- Free of heart disease

In 2014:

- 368 alive (9%)
- Mean age 93y
- 90% are 90y+
- 91% in Canada
- 36% developed IHD

Data Collected

Annual Contact

181,234 person-years of observation

Medical Examinations

- 74,104 Electrocardiograms
- 99,321 Blood pressure/weight
- 93,890 Clinical entries

Questionnaires

- Smoking, activity, war time stress
- ~10,500 Successful Aging
- ~2,500 Nutritional Risk

Chronology of Research Reporting

- 1950s Early case series reports, annual reporting
- 1960s First analyses of morbidity and mortality
- 1970s Natural history of EKG abnormalities
- 1980s Relationship of body build and blood pressure to cardiovascular disease and stroke
- 1990s Longitudinal analysis and patterns of chronic disease risk factors
- 2000s Successful Aging, nutritional risk
- 2010s Successful Aging, psychological control, liver disease, biostatistical methods, frailty and functional trajectories

1. Do you feel the time, effort and support you have provided to MFUS have been worthwhile?

Yes, very worthwhile
Yes, somewhat
No, not very
No, not at all
No opinion



2. Do you feel the results of MFUS have contributed to society's better understanding of human health?



3. Do you feel that participating in this study has had an impact on YOUR OWN HEALTH?

Yes, definitely
Yes, probably
No, probably not
No, definitely not
No opinion



Canadian Longitudinal Study on Aging

- The Canadian Longitudinal Study on Aging (CLSA) is a large, national, long-term study of more than 50,000 men and women who were between the ages of 45 and 85 when recruited.
- These participants will be followed until 2033 or death.
- The aim of the CLSA is to find ways to help us live long and live well, and understand why some people age in healthy fashion while others do not.

- CATI sites are responsible for data collection for more than 20,000 study participants who consented to take part in extensive telephone interviews throughout the course of the 20-year study.
- The CATI sites are located at Simon Fraser University, University of Manitoba, Université de Sherbrooke and Dalhousie University, and their work is coordinated by the National Coordinating Centre at McMaster University.

Comprehensive Cohort

- Of the 51,338 participants taking part in the CLSA, more than 30,000 individuals have undergone in-depth data collection at our DCSs.
- The DCSs are located in 11 cities across Canada.
- Each DCS has specially trained CLSA staff including research assistants, medical lab assistants, a phlebotomist, research coordinators and interviewers.

Messiness of Late Life Epidemiology

- Inadequate research / Age exclusions
- Sampling frame and population
- Long time frames
- Attrition not missing at random
- Competing outcomes
- Complex causal models
- Bidirectional associations
- Selective citation
- Overinterpreting results
- Not interpreting results

IN SPITE OF THESE LIMITATIONS

- We need good data which are population based
- We need multiple sources of data
- This requires consistent attention, funding, and interest from investigators, funders, and participants

