Advancing the Science of Population Health and Aging through Interdisciplinary Research

Parminder Raina, PhD
Associate Professor, Department of Clinical Epidemiology and Biostatistics, Faculty of Health Sciences, McMaster University, Hamilton
Demographic Trends

- Canadians are living longer and older people are making up a larger share of the population.

- Between 1980 and 1999, the average Canadian’s life expectancy increased to 79 years from 75 years.

- By 2025, 1 out of every 5 Canadians (20%) will be 65 or older, compared to 1 in 8 (12%) in 2000.
Healthy Aging or Anti-Aging?
Healthy Aging or Anti-Aging?

The three basic rules of anti-aging medicine:

- Don’t get sick
- Don’t get old
- Don’t die

“Bridge the gap to Immortality” by taking good care of your physical and mental self, you will be around to avail yourself of the latest biotechnological advancements to further optimize your life and achieve that triple-digit lifespan.
Rectangularization of the survival curve

FURTHER INCREASE IN LIFE EXPECTANCY

Squaring the survival curve

JAMES F. FRIES, M.D., THE NEW ENGLAND JOURNAL OF MEDICINE, JULY 17, 1980,
Compression of morbidity

- Morbidity compressed into a short period prior to death
- Represented an important shift in thinking
- Departure from the medical model of aging, which assumed that death always occurred as a result of a disease process, and that older age was a period of inevitable decline

Figure: Mortality According to Age in the Absence of Premature Death
Compression of morbidity

Fries’ paradigm based on the premise that:

- The length of human life is fixed
  AND
- Chronic disease can be postponed

- Predicted that the increase in life expectancy would plateau in the coming decades, particularly life expectancy from age 65 which excludes early life mortality
Life expectancy
Fries potential scenarios

Present Morbidity

Life Extension

Shift to the Right

Compression of Morbidity

Morbidity

Death

55 y

76 y

55 y

80 y

60 y

81 y

65 y

78 y
Aging Process

A shift in focus from “cause of death” patterns to “functional status” patterns of survivors:

- Mortality
- Morbidity
- Longevity

- Function
- Ability/Disability
- Well being
Potential Determinants of Aging?

- Genes
- Biology
- Nutrition
- Lifestyle
- Environment
  - Physical
  - Social
  - Psychological
- Chance
Innovation

Environmental influences (e.g., rural, socio-economic, exercise, nutrition)

Chronic diseases (e.g., diabetes, cancer, dementia, arthritis, cardio)

Aging

Genetics (e.g., telomeres/oxidative stress, psychological & cognitive abilities, immune functions)

Health Services Utilization

Time (Longitudinal Study)
Our review identified around 70 longitudinal studies worldwide

- Majority of these studies were studying people over the age of 65
- Many of these 70 studies on aging collect lot of information on social factors or retirement but lack detailed information on health, especially clinical and biological measures or vice versa
Scientific Evidence

- Very few studies have looked at the aging process from a mid-life to old age perspective

- Very few population-based studies that capture the changing individual within a changing context and incorporate multiple levels of inquiry, the cell, the individual and society

- Very few studies have focused on how individuals cope or adapt to changing circumstances and how it impacts their well-being
Evidence

- Changing demographics #1 priority of Canadian Federal and Provincial Governments

- Healthy aging is important to the Canadian public and policy makers

- Canada differs from other countries in its:
  - health and social policy
  - health care delivery systems
  - climate, environment, geography, and
  - retirement policy and pension programs

- Seniors of tomorrow have different needs and expectations
  - major implications & challenges for the health care system and
  for social programs
The Canadian Longitudinal Study on Aging (CLSA)

A key component of the Canadian Lifelong Health Initiative, a strategic initiative of CIHR

- The Canadian National Birth Cohort
- The Canadian Longitudinal Study on Aging

More than 160 researchers - 26 institutions

Multidisciplinary - biology, genetics, medicine, psychology, sociology, demography, economics, epidemiology, nursing, nutrition, health services, biostatistics, population health
Overall Aims of the CLSA

- To examine aging as a dynamic process.
- To investigate the inter-relationship among intrinsic and extrinsic factors from mid life to older age.
- To capture the transitions, trajectories and profiles of aging: successful aging.
- To provide infrastructure and build capacity for sustained high quality research on aging in Canada.
Innovation - Cell to Society

- Mid life to old age
- Quantitative traits
  - Physical
  - Social
  - Psychological
- Gene-environment interactions
- Disease, disability, psychosocial consequences
- Adaptation
Priority Areas for CLSA

- Cardiovascular
- Brain
- Musculoskeletal
- Respiratory
- Metabolic

- Psychosocial and behavioral environment
- Health and social care environment
- Economic environment
Content Working Groups

- Policy
- Sociology
- HSR
- Psychology
- Clinical
- Biology/genetics
- Lifestyle/
<table>
<thead>
<tr>
<th>Focus of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Biomedical</strong></td>
</tr>
<tr>
<td>- Activities of daily living/disability/injuries</td>
</tr>
<tr>
<td>- Frailty/co-morbidities</td>
</tr>
<tr>
<td>- Chronic diseases</td>
</tr>
<tr>
<td>- Cognitive function</td>
</tr>
<tr>
<td>- Mental Health</td>
</tr>
<tr>
<td>- Oral health</td>
</tr>
<tr>
<td>- Vision, hearing</td>
</tr>
<tr>
<td>- Medications</td>
</tr>
<tr>
<td>- Health Care Use</td>
</tr>
<tr>
<td>- Institutional care</td>
</tr>
<tr>
<td>- Genetics/Biology</td>
</tr>
<tr>
<td>- Disease susceptibility/longevity genes</td>
</tr>
<tr>
<td>- DNA repair</td>
</tr>
<tr>
<td>- Antioxidant defence</td>
</tr>
<tr>
<td>- Apoptosis, programmed cell death</td>
</tr>
<tr>
<td>- Immunosenescence</td>
</tr>
<tr>
<td>- Telomere loss</td>
</tr>
<tr>
<td>- Nutrition</td>
</tr>
<tr>
<td><strong>Psychosocial</strong></td>
</tr>
<tr>
<td>- Lifestyle/behaviours</td>
</tr>
<tr>
<td>- Social networks and social support</td>
</tr>
<tr>
<td>- Values and meaning</td>
</tr>
<tr>
<td>- Everyday competence, adaptive functioning, coping</td>
</tr>
<tr>
<td>- Personality, emotion, psychopathology</td>
</tr>
<tr>
<td>- Work to retirement transitions</td>
</tr>
<tr>
<td>- Structural inequalities</td>
</tr>
<tr>
<td>- Built environments/physical environment</td>
</tr>
<tr>
<td>- Economics</td>
</tr>
<tr>
<td>- Healthy aging and well being</td>
</tr>
<tr>
<td>- Linkage to secondary data bases</td>
</tr>
<tr>
<td>- Health care use</td>
</tr>
<tr>
<td>- Disease registries</td>
</tr>
<tr>
<td>- Drugs</td>
</tr>
<tr>
<td>- Environmental</td>
</tr>
</tbody>
</table>
Interdisciplinary Research Agenda

- Methods
- Policy
- Sociology
- Psychology
- HSR
- Clinical
- Biology/genetics
- Lifestyle
Figure 1. Model of the CLSA’s research approach.
Example Research Questions: Cognition as a Quantitative Trait

Cognition as a precursor:

- Is decline in cognitive functioning (memory, executive function and psychomotor speed) in mid and later life associated with subsequent adverse health related (or biological) outcomes?

- Is decline in cognition (memory, executive function and psychomotor speed) in mid and later life associated with changes in social participation?
Example Research Questions: Cognition as a Quantitative Trait

- How do individuals with cognitive change adapt to maintain performance in everyday functioning?

- Are general lifestyle activities (e.g. physical activities, social activities, domestic activities, community service, etc) associated with cognitive functioning and/or change in cognition over time after adjustment for sensory impairment?
Example Research Questions:
Cognition as a Quantitative Trait

Cognition as a mediator
- How do cognitive functions mediate or moderate relations between biological/physical status and adaptive functioning and/or social participation?

Cognition as an outcome
- Are changes over time in cognition (memory, executive function and psychomotor speed) associated with specific biological states?
CLSA Architecture

Data collection on all 50,000 (at 10 sites)
Questionnaire, Database, Linkage

Follow-up over 20 years
Every 3 years age 40-79; Every year age 80+
Core Network of Facilities

National Coordinating Centre

Manage and Coordinate; Timelines; Develop Protocols, Procedures; Training & Documentation

Operations Data

Operations

Interim Follow Up

Operations Data / Measures / Analyses

Operations Data

Operations Data

CLSA ELCV
Partnerships

- Statistics Canada
- Health Canada
- HRSD
- Provincial Agencies
- Quebec (Fonds de la recherche en santé)
- McGill University
- University of Victoria
- University of Manitoba
- University of Toronto
- UBC
- Université de Montréal
- Université Laval
- Université de Sherbrooke
- University of Calgary
- Dalhousie University
- Memorial University of Newfoundland
- University of Alberta
- Western University
- University of New Brunswick
- University of Victoria
- British Columbia Canada
- Ontario Institute for Cancer Research
- CIHR IRSC
- CLSA ELCV
- CLSA
- 160 Investigators
- 200 Collaborators
- 10 Provinces

Private Sector
CLSA Management Structure

- Scientific Advisory Committee
- Board of Directors
- Financial Advisory Committee
- Executive Committee
- PI(s) and Scientific, Research & Infrastructure Management team
- Facility PI
- Facility Manager
- Infrastructure Committee
- Operations Committee
- User/Access Committee
- Scientific Advisory Committee
- Financial Advisory Committee
- Executive Committee
- PI(s) and Scientific, Research & Infrastructure Management team
- Facility PI
- Facility Manager
- Infrastructure Committee
- Operations Committee
- User/Access Committee
Ethical, Legal, Societal Issues (ELSI)

- Lawyers
- Ethicists
- Philosophers
- Geneticists
- Epidemiologists
- Social scientists
- Privacy commissioner
International Links

- Womens Health and Aging Study - USA
- Aging & Sexuality - USA
- HRS - USA
- British Birth Cohort - UK
- UK Biobank - UK
- ELSA - UK
- ALSPAC - UK
- Cohorte Constances - FRANCE
- LASA - Amsterdam
- ILSA - Italy
- InChianti - Italy
Canadian Cohort Network

Large cohorts in development stages - CIHR
- Canadian National Birth Cohort
- Asthma/Allergy Birth Cohort
- Cancer/chronic disease cohort
- Multi-generational cohort

Large population based research
- Canadian Multicentre Osteoporosis Study (CaMos)
- Prospective Urban and Rural Epidemiology Study (PURE)
- Epidream
- Panel Study of Lifecourse Dynamics (PSLD)
Improved Life-long Healthcare for Canadians

Common Research Platforms

Expertise in specific areas of child health, aging and chronic disease.

Population Genomics
National Coordinating Centre
Data Repository & Statistical Centre
BioBanking

CATI Centres
Data Collection Centres
Environmental and Remote Sensing Lab

FAMILY
Obesity

CHILD
Asthma/Allergy

CLSA
Healthy Aging and Function

PURE
Cardiovascular

OCIR
Cancer

Epidream
Metabolic Syndrome

Common infrastructure, enabling data collection, management and analysis.

Outcomes
Email: praina@mcmaster.ca
Website: www.CLSA-ELCV.ca