Transforming Everyday Life into Extraordinary Ideas
Advancing the Science of Population Health and Aging through Interdisciplinary Research: Canadian Longitudinal Study on Aging

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The Canadian Association of Population Therapeutics, Toronto, Ontario
November 18th, 2013
DEMOGRAPHY AND AGING

“Population aging is unquestionably the most important demographic force of the first half of the twenty-first century”.

(Schoeni FR, Ofstedal MB. “Key Themes in research on the Demography aging” Demography, 47, 2010: S5-S15)
THE DEMOGRAPHIC TRANSITION

THE DEMOGRAPHIC TRANSITION MODEL

STAGE ONE
(Pre-Modern)

STAGE TWO
(Urbanizing/Industrializing)

STAGE THREE
(Mature Industrial)

STAGE FOUR
(Post Industrial)

YEAR

CBR, CDR RATE PER 1000

TOTAL POPULATION

CISR, CIR, Total Population

(www.marathon.uwc.edu)
The world population is rapidly growing:

Source: U.S. Census Bureau, International Data Base, June 2010 Update.
• World population is especially growing older:

  ➔ the share of the population aged 65+ is expected to double between 2010 and 2040, from 7.8% to 14.7%

  ➔ the number of older people will increase from 530 million in 2010, to 1.3 billion by 2040.

(U.S. Census Bureau, International Data Base)
Another aspect of world population aging is the aging of the older population; the share of the older at ages 80+ (the “oldest-old”) is growing more rapidly than the older population itself.

This growth will translate into a large increase of oldest-old within the world’s older population, from 16% in 2000 to 24% in 2040.

(U.S. Census Bureau, International Data Base)
Gender and Aging

- NUMBERS
- MORBIDITY
- POVERTY
Trends in Global Aging

Percent of Population Aged 65 & Over: History and UN Projection

Source: UN (2005)
Number of Years for Percent of Population Age 65 or Older to Rise from 7% to 14%

<table>
<thead>
<tr>
<th>More developed countries</th>
<th>Less developed countries</th>
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<tbody>
<tr>
<td><strong>France</strong> 1865-1980</td>
<td><strong>Azerbaijan</strong> 2000-2041</td>
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<tr>
<td><strong>Sweden</strong> 1890-1975</td>
<td><strong>Chile</strong> 1998-2025</td>
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<td><strong>Australia</strong> 1938-2011</td>
<td><strong>China</strong> 2000-2026</td>
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<tr>
<td><strong>United States</strong> 1944-2013</td>
<td><strong>Jamaica</strong> 2008-2033</td>
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<td><strong>Canada</strong> 1944-2009</td>
<td><strong>Tunisia</strong> 2008-2032</td>
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<td><strong>Hungary</strong> 1941-1994</td>
<td><strong>Sri Lanka</strong> 2004-2027</td>
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<td><strong>Poland</strong> 1966-2013</td>
<td><strong>Thailand</strong> 2003-2025</td>
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<td><strong>United Kingdom</strong> 1930-1975</td>
<td><strong>Brazil</strong> 2011-2032</td>
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<td><strong>Spain</strong> 1947-1995</td>
<td><strong>Colombia</strong> 2017-2037</td>
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<td><strong>Japan</strong> 1970-1996</td>
<td><strong>Singapore</strong> 2000-2019</td>
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<tr>
<td></td>
<td></td>
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<tr>
<td><strong>Speed of Population Aging in Selected Countries</strong></td>
<td></td>
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</table>

* Dates show the span of years when percent of population age 65 or older rose (or is projected to rise) from 7 percent to 14 percent.

### Population Totals in Canada by Age Group and Year

<table>
<thead>
<tr>
<th>AGE</th>
<th>MALES</th>
<th>BOTH SEXES</th>
<th>FEMALES</th>
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<td>670192</td>
<td>440294</td>
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1991 TOTALS: 13938100, 28117600, 14179500

Canadian Longitudinal Study on Aging
Etude longitudinale canadienne sur le vieillissement
Population aging
65+ representing a larger proportion of population and growing

Proportion of population aged 65 years and over, Canada, 1971 to 2061

Population aging
80+ representing larger proportion of seniors and also growing

Observed (1971 to 2011) and projected (2016 to 2061) number of people aged 65 to 79 years and 80 years and over, Canada

Source: Population estimates and Population projections (medium growth scenario) programs, Demography Division, Statistics Canada.
EPIDEMIOLOGY OF AGING: DISEASES

- The leading *cause of death among elderly*:
  - heart disease
  - cancer
  - stroke
  - chronic lower respiratory tract disease
  - Alzheimer’s disease

EPIDEMIOLOGY OF AGING: DISEASES

The leading Causes of Morbidity:

- Hypertension
- Osteoprosis
- Osteoarthritis
- Vision/Hearing Problems
- Falls and Fractures

- Disease in older population is the norm
  - And many have multiple morbidities: Need more research in this area
- Use of multiple medications
RESEARCH ON AGING

• The **demographic causes of aging** of the population, in terms of fertility rates and mortality rates, are generally predictable. A variety of population projections are available, prepared by UN, EU and National Statistic Institutes.

• What is **less predictable** is the interaction of these forces with social context, health status, economic changes, cultural influences and hence international migrations.
Risk factors for Disease, Disability and Longevity

- **Risk factors**
  - Many factors contribute
  - Gender difference remains unexplained
  - Loss of prediction
  - Paradoxes in prediction

- **New opportunities**
  - Larger number of very old people
  - Longer term follow-up
  - Longitudinal data – identify optimal trajectory
  - Common risk factors
RESEARCH ON AGING

• For this reason further research on biodemography, dynamic of health, epidemiology, economics, psychology, social sciences and aging are needed.

• Longitudinal data are essential in order to sort causal relationships among demographic, biological, psychosocial and economic factors, and health.

• Cross-national comparison are important, considering variability across societies, in terms of status and well-being of older persons, experiences of health and mortality, family and social support.
The Canadian Longitudinal Study on Aging (CLSA)

- A key strategic initiative of CIHR
- 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
Canadian Longitudinal Study on Aging (CLSA)

A research platform – infrastructure to enable state-of-the-art, interdisciplinary population-based research and evidenced-based decision-making that will lead to better health and quality of life for Canadians.
Innovation - Cell to Society

- Mid life to old age
- Quantitative traits
  - Physical
  - Social
  - Psychological
- Gene-environment interactions
- Disease, disability, psychosocial consequences
- Adaptation
Overall Aims of the CLSA

• The progression of **health** from middle-age to early old age to older old age
• The determinants of **well-being and quality of life**
• Risk Factors (including genetics and epigenetics) of **Chronic diseases**
• Multi-morbidity and its consequences
• Medication and pharmacogenomics
• **Cognitive functioning and mental health**
• **Disability** and the compression of morbidity
• Biomarkers of Healthy Aging, Frailty, and Longevity
• The examination of socioeconomic and health **inequalities** in an aging population
• **Social participation, social relationships and care giving** in an aging population
• Veteran’s Health and Aging
• **Retirement** and **post retirement** labor market activity
Study Overview

50,000 women and men aged 45 - 85 at baseline

n=20,000
Randomly selected within Provinces

n=30,000
Randomly selected within 25-50 km of 11 sites

Questionnaire
• By telephone (CATI)

Questionnaire
• In person, in home (CAPI)

Clinical/physical tests
Blood, urine (consent)
• At Data Collection Site

Interim contact, Follow up every 3 years

Data Linkage (consent)
National Scope

Vancouver
Victoria
Burnaby
Calgary
Winnipeg
Hamilton
Ottawa
Montreal
Sherbrooke
Halifax
St Johns

Data collection Sites
Representative sample frame

- Statistics Canada: Canadian Community Health Survey Cycle 4.2 Healthy Aging
- Ministries of Health: Provincial health billing records
- Random Digit Dialing
Standardized, Centralized Process

Potential Participants Sent Study Information

Participants Consent to Participate in CLSA

Participants Provide Questionnaire Data (n=50,000)

Biological Data
- Blood
- Urine

DATA COLLECTION SITE VISIT
Physical/Psychological Data
- Neuropsychological Battery
- Performance Testing
- Anthropometric Measures
- Bone Density, Body Composition
- Aortic Calcification
- ECG, BP
- Carotid Intimal-Medial Thickness
- Pulmonary Function
- Vision and Hearing

Stored at Biorepository and Bioanalysis Centre (BBC)

Stored at (NCC/SAC)

Home Interview

n=30,000 Telephone Interview

n=20,000

n=20,000

Linkage to Admin Data

Questionnaire Data Processed
CLSA Software Architecture, IT Integration Systems for Paperless Data Collection

**Mastodon** - manages interactions with participants and securely stores identifying information

**Sabretooth & Limesurvey** – CATI software manages participant data collection, Interview scheduling and tracks the status of the interviews through to completion

**Beartooth & Onyx** – CAPI software used by the Data Collection Sites to coordinate the collection of questionnaire responses, physical measurements and biospecimens from participants

**Opal** – Central Data Repository – or databank – stores and manages all non-identifying data collected using Sabretooth, Beartooth and Onyx
CLSA Infrastructure

- National Coordinating Centre (McMaster)
- Biorepository and Bioanalysis Centre (McMaster)
- Statistical Analysis Centre (McGill)
- Genetics and Epigenetics Centre (UBC)
- 4 Computer-Assisted Telephone Interview Sites
  - Victoria, Winnipeg, Sherbrooke and Halifax
- 11 Data Collection Sites
  - Victoria, Vancouver, Surrey, Calgary, Winnipeg, Hamilton/Toronto, Ottawa, Montreal, Sherbrooke, Halifax and St John’s
Questionnaire Modules

- Demographics
- Veteran ID
- Height, Weight
- Smoking
- Alcohol
- Physical Activity
- Nutritional risk/Nutrition
- General health
- Women’s health
- Vision, Hearing
- Oral Health

- Chronic conditions
- Injuries
- Pain, discomfort
- Health care utilization
- Medication/Supplement use
- Functional status
- ADL, IADL
- Cognition (Rey, MAT, AN)
- Parkinsonism module
- Depression
- PTSD
Questionnaire Modules

- Satisfaction with life
- Psychological distress
- Personality traits
- Social networks
- Social support
- Social participation
- Online social networking
- Social inequality
- Care receiving
- Care giving

- Labour force participation
- Retirement planning
- Transportation
- Mobility, Migration
- Built environments
- Income, Wealth
- Home ownership
At the Data Collection Site

**Measurement Room 1**
- Hip Waist ratio
- Height/Weight (BMI)
- Heart rate & BP
- ECG
- c-IMT/Plaque sweep
- Spirometry

**Measurement Room 2**
- DEXA (BMD, body composition, aortic calcification)

**Measurement Room 3**
- Event PMT
- Audiometer
- Stroop & COWAT (F,A,S)
- Choice Reaction
- Social Network Q

**Measurement Room 4**
- Standing balance
- Chair rise
- Visual acuity
- Fundus photograph
- Occular pressure
- Grip strength

**Measurement Room 5**
- Timed PMT
- Disease Symptoms Q

**Hallway**
- 4m walk
- Timed Up and Go

**Biospecimen Room**
- 50 ml blood draw
- Sample processing

**Washroom**
- Urine Sample

**Check out**
- Review of results
- Snack
- Honorarium

**TOTAL TIME**
2.5 – 3 HRS
Biospecimen Room
Collection, processing, analysis

- 5 – 6 participants per day
- 50 mL blood
- Urine sample
- Hematology tests
- Collection to storage time
  2 hour

AcT DIFF, Beckman Coulter
Biospecimen processing:
42 aliquots per participant

Legend:
- Citrate
- Serum
- Heparin
- EDTA
- ACD
- CPT
- Urine

Hematology testing at DCS

First Centrifugation

Second Centrifugation

Whole Blood

Addition of 20% DMSO in RPMI

Restuspension in PBS

Cells

Peripheral Blood Mononuclear Cells

GenPlate

Urine
Disease Ascertainment Algorithms

• Diseases will not diagnosed by clinicians
• DAAs developed by CLSA Clinical Working Group
• Validated by pilot studies\textsuperscript{1,2}

- Osteoarthritis-knee, hip, hand
- Parkinsonism
- CAO
- Diabetes
- Hypo- and Hyperthyroidism
- Ischemic heart disease
- HBP
- Stroke/Cerebrovascular event
- Osteoporosis
- Depression
- Dementia

Proposed Data Linkages

• Regular linkage with mortality databases between waves of data collection
  • Decedent Questionnaire implemented for first follow-up
• Air pollution data (in collaboration with Health Canada)
• Environmental Biomarker and Aging (INSPQ)
• Administrative data linkage health services & drugs & other administrative databases for participant who provide consent
Proposed Sub Studies

- Neuroimaging (collaboration with CCNA)
- Genetic analysis (NeuroXChip)
- Mobility and Aging (funded through CIHR)
- Environmental Biomarker and Aging (INSPQ)
- Veterans Health and Aging (Veteran’s Affairs Canada)
- Falls and Consumer Products (PHAC)
- Neurological disorders of Aging (PHAC)
CLSA Recruitment: Where are we now?

Telephone-Administered Questionnaires

- Goal: Completion of all 20,000 baseline interviews by early 2014
- As of last week:
  - 20,376 completed 60-minute baseline interview
  - 885 completed maintaining contact interview (mid wave)

In-home Interviews and DCS Visits

- Goal: complete first 30,000 baseline DCS visits by March 2015
- As of last week:
  - 15,298 In home interviews completed
  - 12,777 DCS visits completed

Preparing for the next wave that begins in April 2015
What is required to create a centralized platform like CLSA?

- Good governance
- Coordinated ongoing ethics approval process
- Transparent Data and Sample Access Policies
- Transparent Data Ownership and IP Policies
- Integrated and secure IT infrastructure
Data and Sample Access

• Data and samples available to the research community

• Fundamental tenets:
  • The rights, privacy and consent of participants must be protected and respected at all times
  • The confidentiality and security of data and biological samples must be safeguarded at all times
  • CLSA data and biological samples are resources that will be used optimally to support research to benefit all Canadians.
What is the process to access data?

• 20,000 CATI Interviews: anticipate data to be available mid-2014
• Application process via CLSA website portal
• Review: Administrative, Data and Sample Access Committee recommendation
• Approval, data/sample sharing agreements
• Raw data and/or samples to investigator
• Return of derived variables to CLSA dataset
Harmonization and Global Observatory on Aging

• International collaboration and CLSA
  • EU FP7 funded Project: Creating a network of about 30 cohorts across Canada, Europe, Israel, China, and USA
  • CHANCES: Healthy Aging (already funded by EU): 10 Cohorts
  • Frailty Consortium (submitted to EU)
  • NIH funded harmonization consortium of cognitive aging

• Individual level pooled analysis and cross-national comparison

• Technical and methods development for harmonization
# CLSA CORE TEAM

<table>
<thead>
<tr>
<th>Role</th>
<th>Members</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead PI</td>
<td>Parminder Raina <em>(McMaster)</em></td>
</tr>
<tr>
<td>CO-PI</td>
<td>Christina Wolfson <em>(McGill)</em> and Susan Kirkland <em>(Dalhousie)</em></td>
</tr>
<tr>
<td>Key Senior Co-Investigators</td>
<td>Gerry Mugford, Patrick Parfrey <em>(Memorial)</em>, Helene Payette <em>(Sherbrooke)</em>, Ron Postuma <em>(McGill)</em>, Vanessa Taler, Larry Chambers <em>(Ottawa)</em>, Harry Shannon, Cynthia Balion, Christopher Patterson, Lauren Griffith and Mark Oremus <em>(McMaster)</em>, Mary Thompson and Chang Bo <em>(Waterloo)</em>, Debra Sheets, Lynne Young, Holly Tuokko, <em>(Victoria)</em>, Verena Menec <em>(Manitoba)</em>, David Hogan and Marc Poulin <em>(Calgary)</em>, Max Cynader, Michael Hayden and Michael Kobor <em>(UBC)</em> and Andrew Wister, Scott Lear <em>(SFU)</em></td>
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<tr>
<td>Scientific Working Group</td>
<td>See our website – <a href="http://www.clsa-elcv.ca">www.clsa-elcv.ca</a></td>
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</table>
Our Mission
Transforming everyday life into extraordinary ideas

The Canadian Longitudinal Study on Aging (CLSA) is a large, national, long-term study that will follow approximately 50,000 men and women between the ages of 45 and 85 for at least 20 years. The study will collect information on the changing biological, medical, psychological, social, lifestyle and economic aspects of people's lives. These factors will be studied in order to understand how, individually and in combination, they have an impact on both maintaining health and in the development of disease and disability as people age. The CLSA will be one of the most comprehensive studies of its kind undertaken to date, not only in Canada but around the world.

Dr. Parminder Raina (McMaster University, Hamilton) is the lead principal investigator of the CLSA. Dr. Christina Wolitski (McGill University, Montreal) and Dr. Susan Kirkland (Dalhousie University, Halifax) are co-principal investigators of the CLSA. Drs. Raina, Wolitski and Kirkland, along with a team of more than 160 investigators and collaborators from several Canadian universities, have participated in the development of this innovative, interdisciplinary study.

For more information, please contact us at info@clsa-elcv.ca.

News

Montreal site reaches 1,000 visits
Oct 8th
The Canadian Longitudinal Study on Aging (CLSA) achieved a milestone at the Montreal Data Collection Site this week when the site welcomed its 1,000th participant.

Living Longer, Living Better: Is there a secret to longevity?
Oct 1st

Winnipeg: A thousand participants and counting
Sep 26th
By sharing his experience as he ages, Alex Waywood is committed to helping Canadians age better in the future.

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Provincial & Institutional Partners

Funders
Supported by the Government of Canada through the Canadian Institutes of Health Research and the Canada Foundation for Innovation.
Transforming Everyday Life into Extraordinary Ideas

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www.clsa-elcv.ca

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