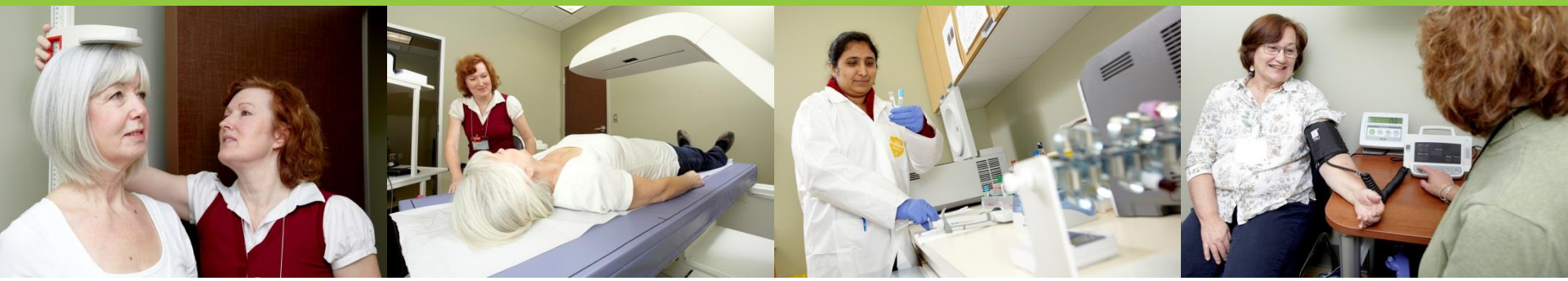




Transforming Everyday Life into Extraordinary Ideas



Canadian Longitudinal Study on Aging as a Platform for Research on Healthy Aging

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Seoul, South Korea, November 9th, 2016

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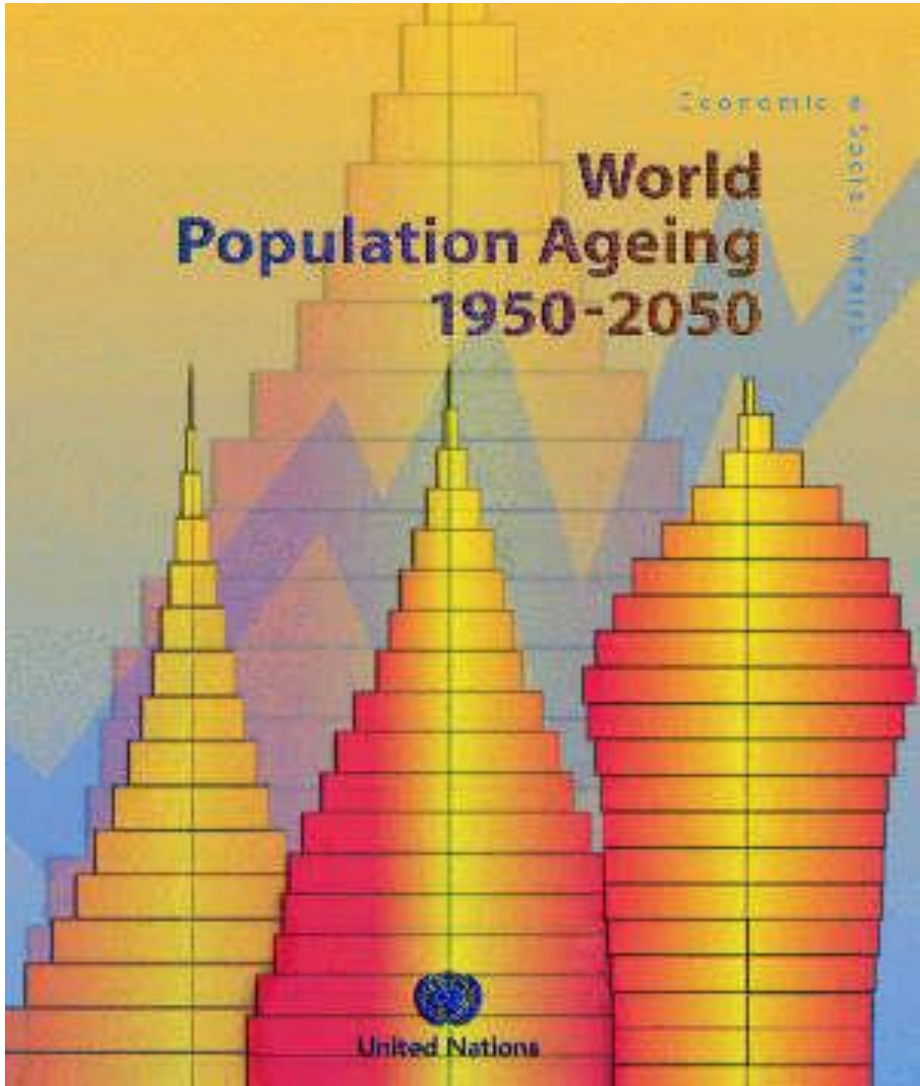
Canadian Longitudinal Study on Aging
Étude longitudinale canadienne sur le vieillissement

Talk Outline

- Canadian Longitudinal Study on Aging (CLSA) as platform for research on aging
- Why do we need Large Comprehensive Longitudinal Studies?
  - Multi-Morbidity
    - Data harmonization
  - Heterogeneity of the Aging Population
- CLSA Data and Sample Access

Population aging

- Due to declining fertility and increasing longevity (demographic transition)
- Unprecedented, accelerating, shifts will be permanent
- Profound implications for human life, including health



Gender and Aging

- NUMBERS
- MORBIDITY
- POVERTY

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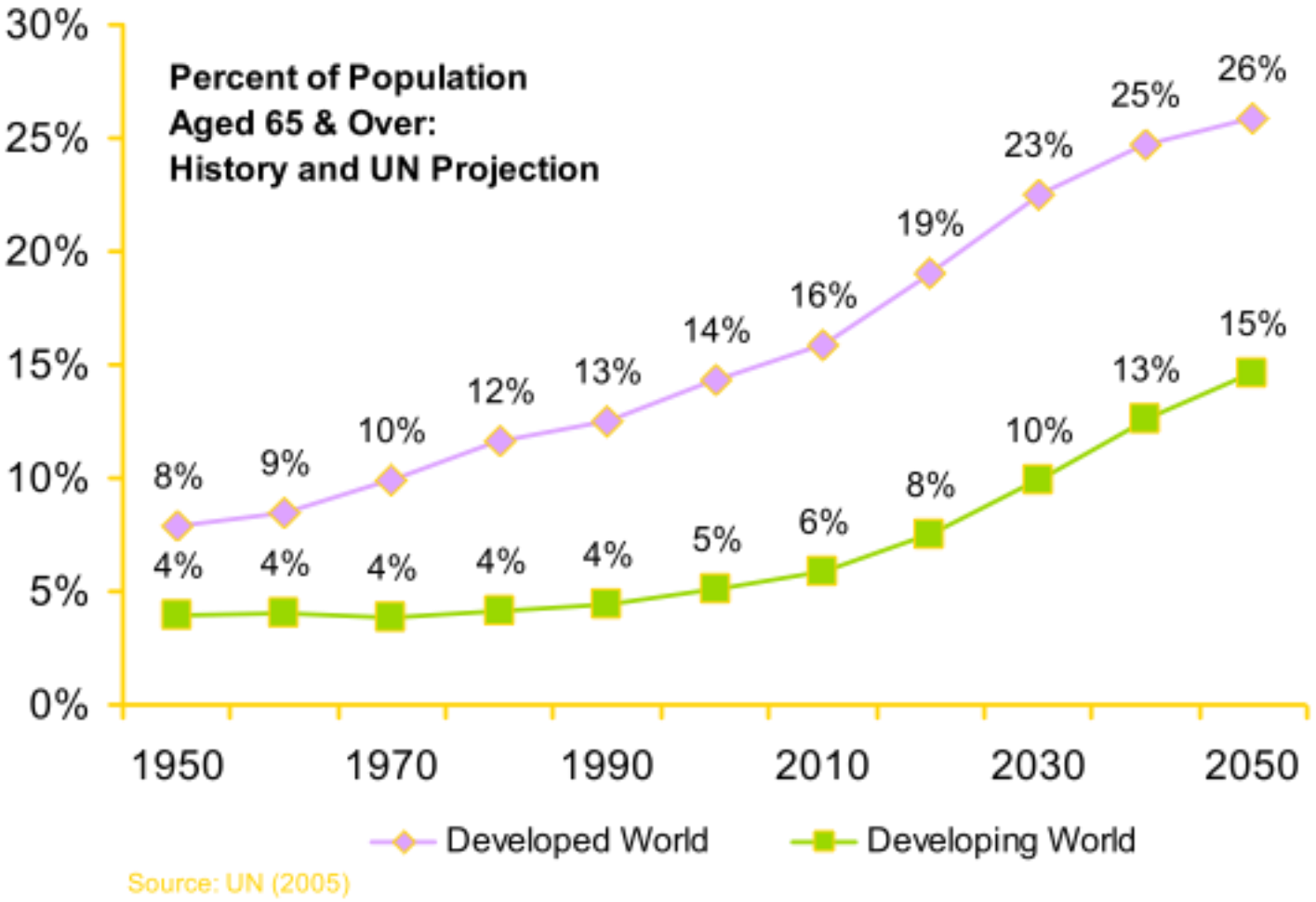
Trends in Global Aging



Source: UN (2005)

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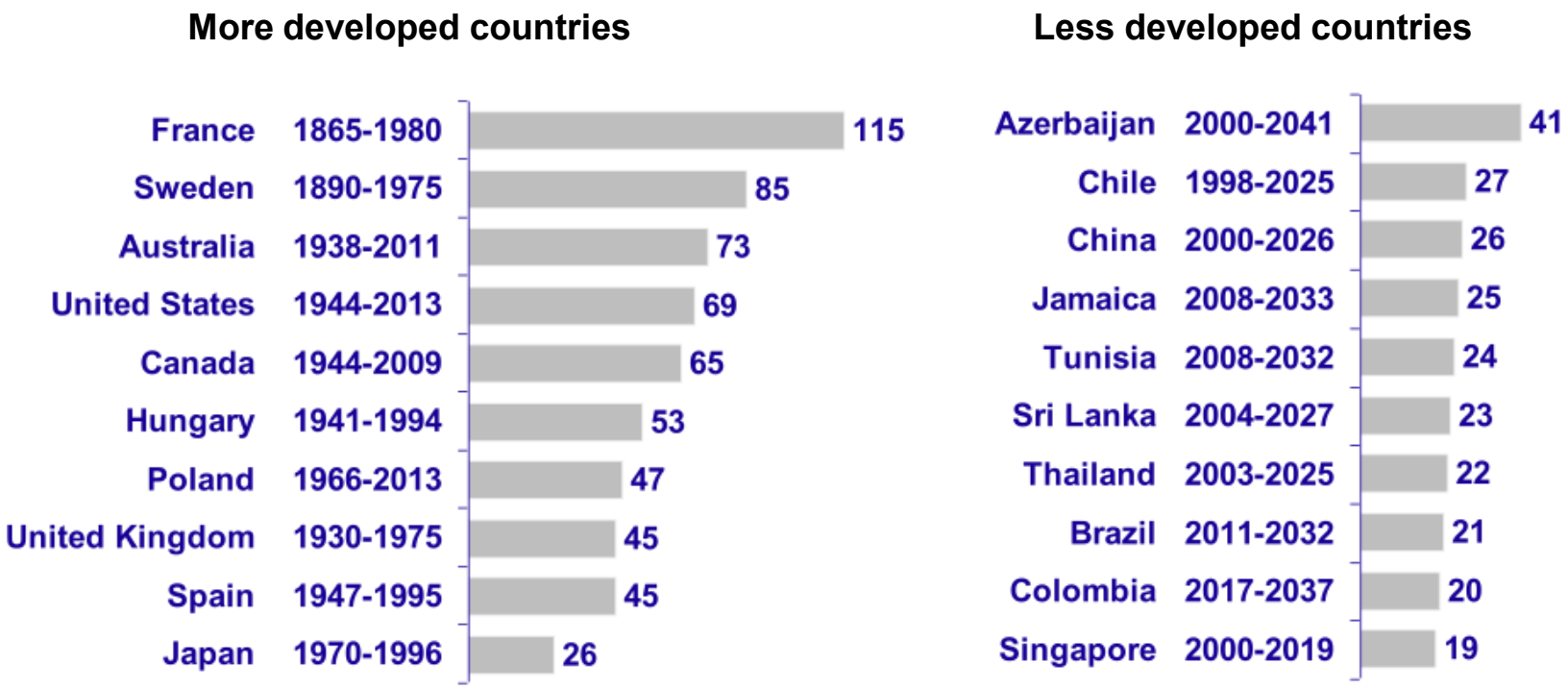
Number of Years for Percent of Population Age 65 or Older to Rise from 7% to 14%



*** 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.**
Source: K. Kinsella and Y.J. Gist, *Older Workers, Retirement, and Pensions: A Comparative International Chartbook* (1995) and K. Kinsella and D. Phillips, "The Challenge of Global Aging," *Population Bulletin* 60, no. 1 (2005).

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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)

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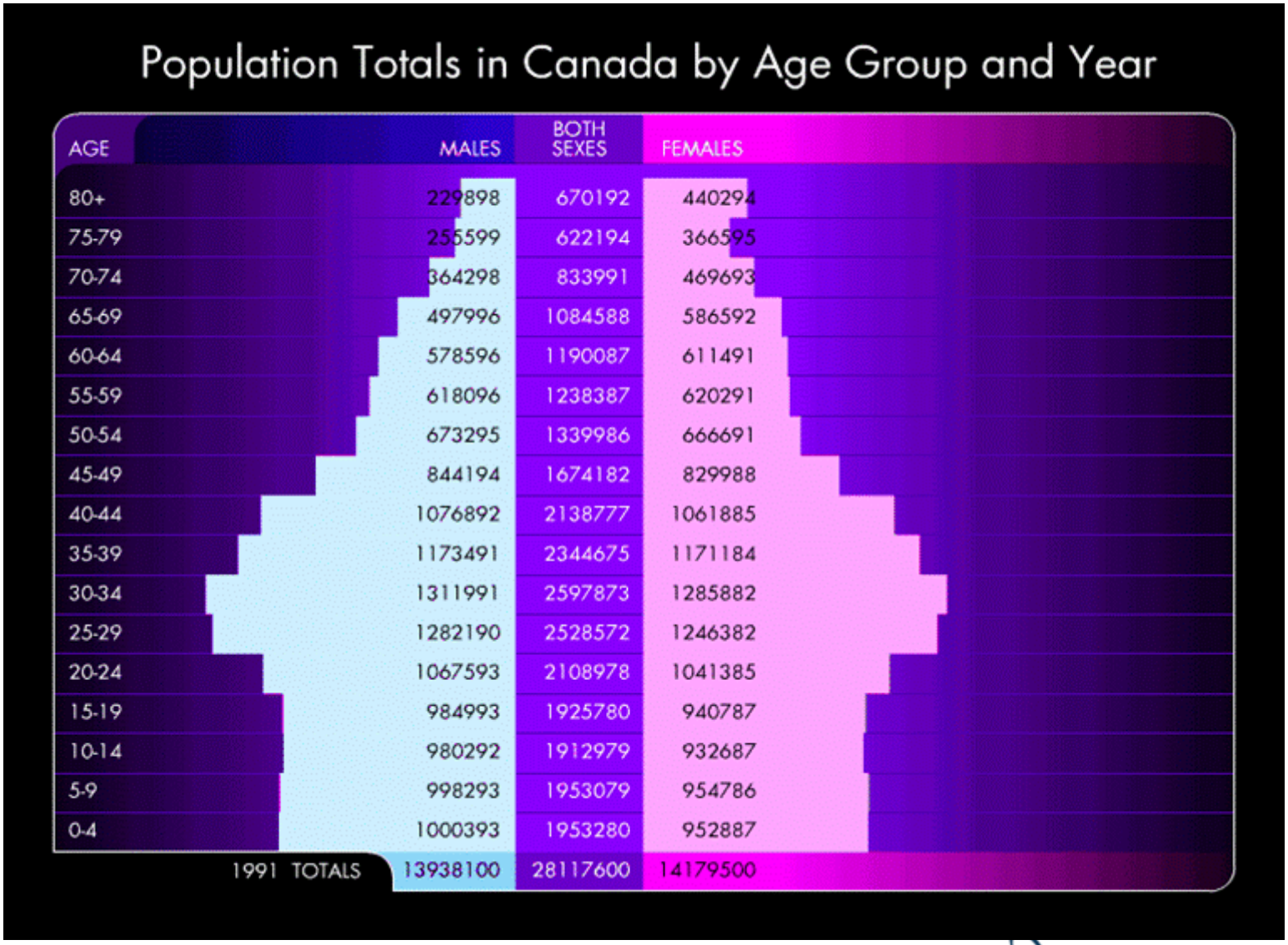
Population Totals in Canada by Age Group and Year



AGE	MALES	BOTH SEXES	FEMALES
80+	229898	670192	440294
75-79	255599	622194	366595
70-74	364298	833991	469693
65-69	497996	1084588	586592
60-64	578596	1190087	611491
55-59	618096	1238387	620291
50-54	673295	1339986	666691
45-49	844194	1674182	829988
40-44	1076892	2138777	1061885
35-39	1173491	2344675	1171184
30-34	1311991	2597873	1285882
25-29	1282190	2528572	1246382
20-24	1067593	2108978	1041385
15-19	984993	1925780	940787
10-14	980292	1912979	932687
5-9	998293	1953079	954786
0-4	1000393	1953280	952887
1991 TOTALS	13938100	28117600	14179500

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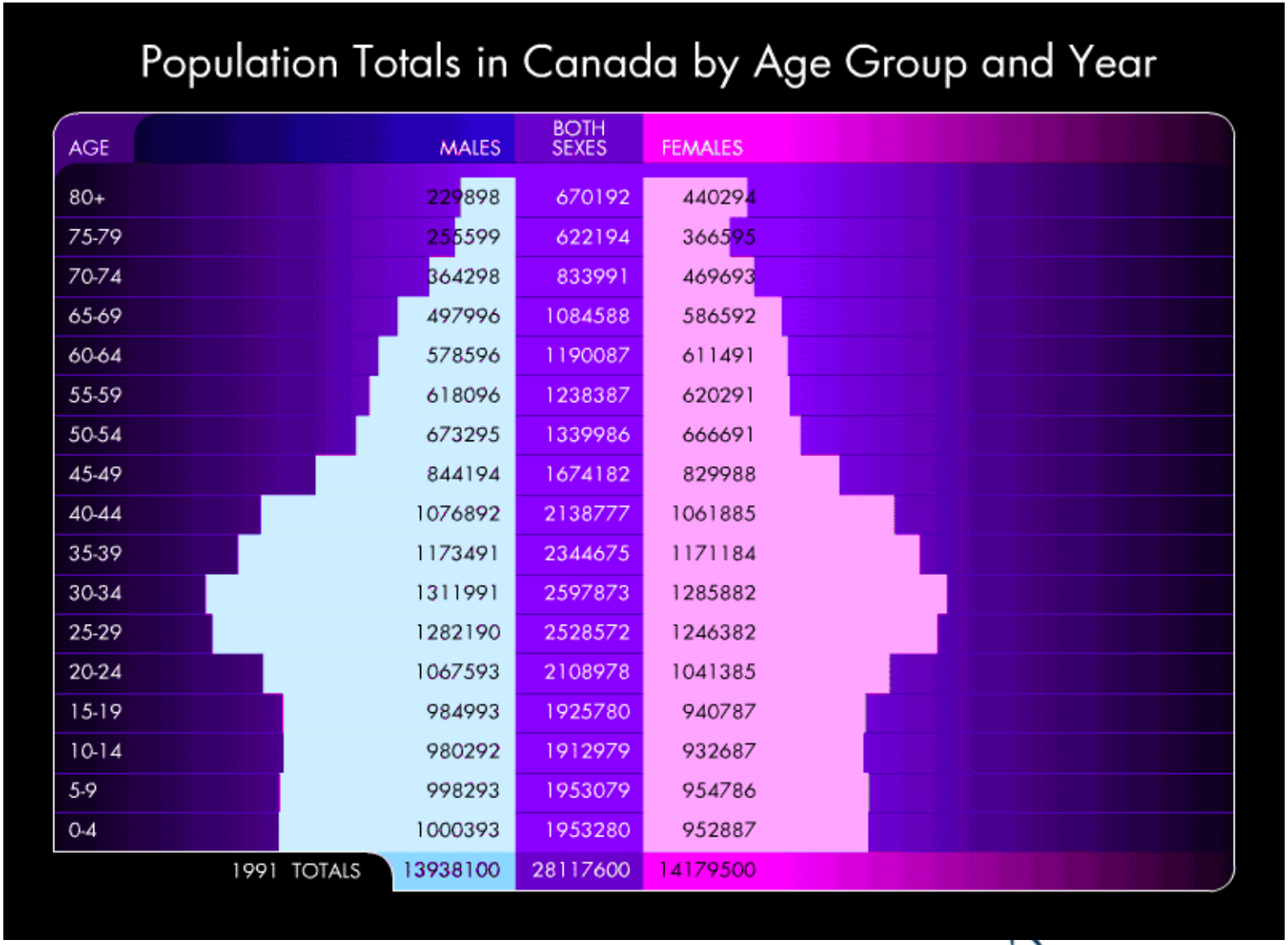

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Population aging

THE GLOBE AND MAIL

Canada shows its age as seniors outnumber children for first time

ERIC ANDREW-GEE

The Globe and Mail

Published Tuesday, Sep. 29, 2015 9:50PM EDT

Last updated Wednesday, Sep. 30, 2015 8:07AM EDT

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CLSA Leads

Lead Principal Investigator
Parminder Raina (McMaster)

Co-principal Investigator
Christina Wolfson (McGill)

Co-principal Investigator
Susan Kirkland (Dalhousie)

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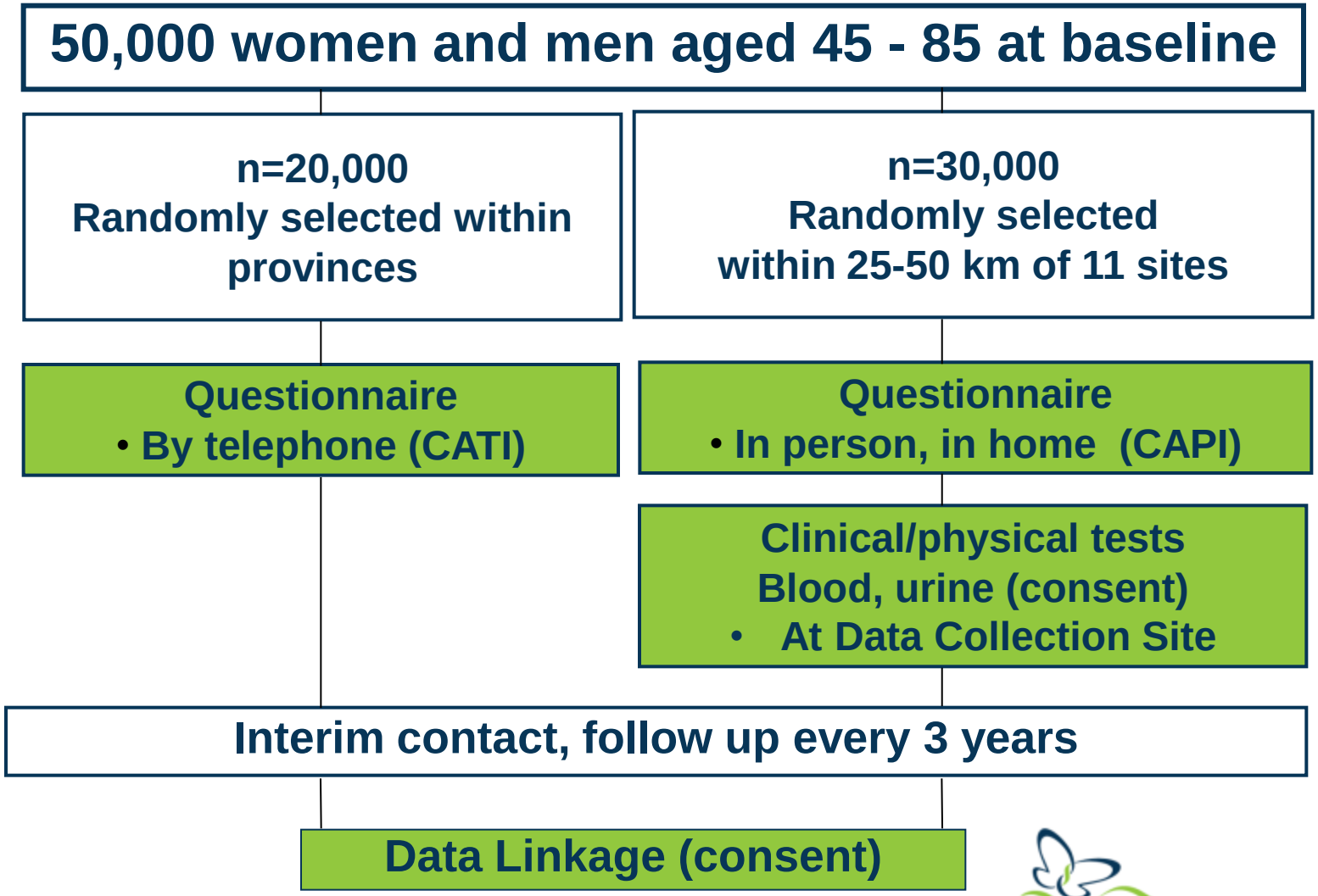
What is the Canadian Longitudinal Study on Aging (CLSA)?

"The Canadian Longitudinal Study on Aging is the largest most comprehensive research platform and infrastructure available for aging research with longitudinal data that will span 20 years from over 50,000 Canadians over the age of 45"

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

Study Overview



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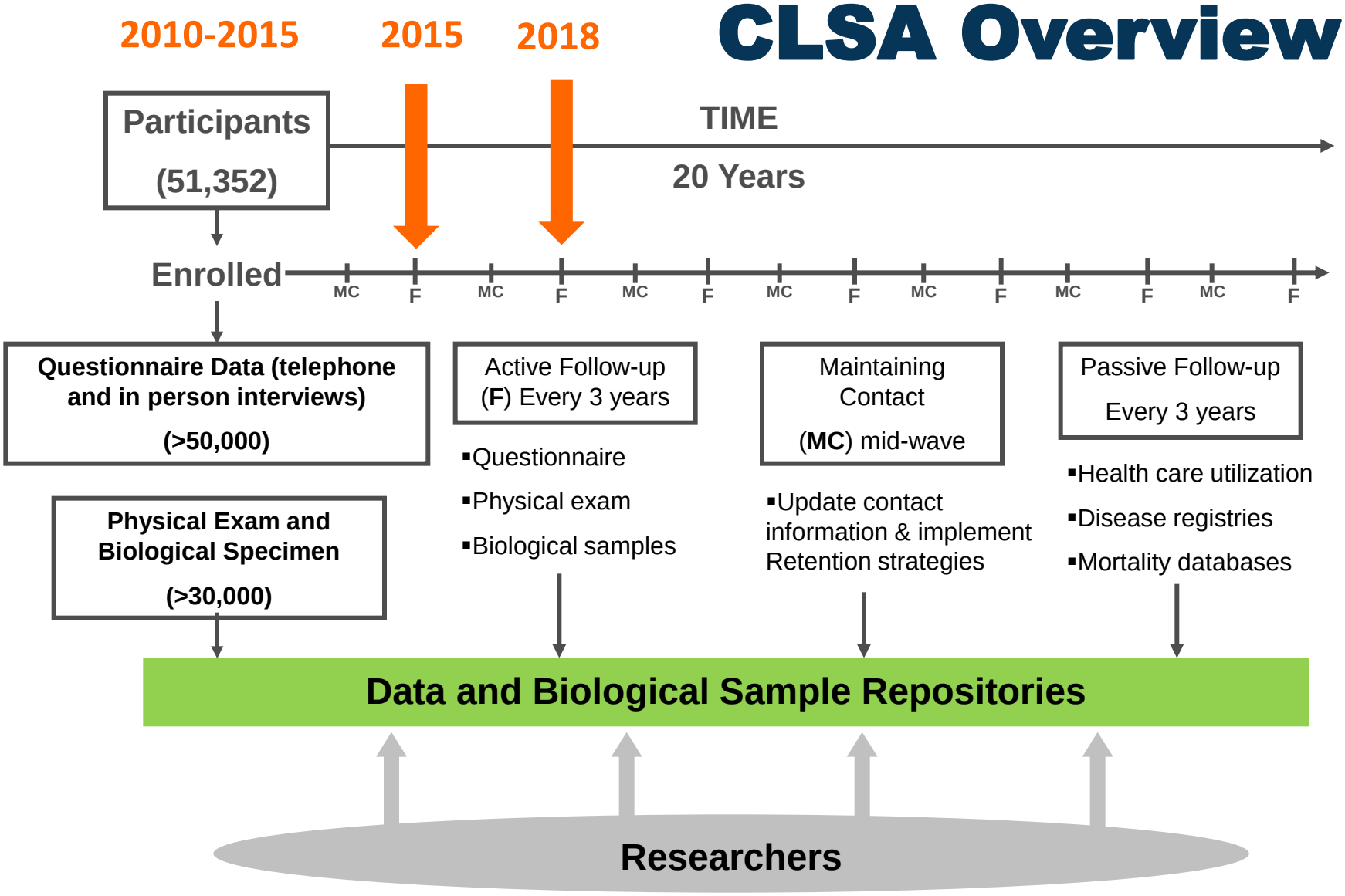
CLSA Overview



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Depth and Breadth of Baseline CLSA

PHYSICAL & COGNITIVE MEASUREMENTS

- Height & weight
- Waist and hip measurements
- Blood Pressure
- Grip strength, timed up-and-go, chair raise, 4-m walk
  Standing balance
- Vision (retinal imaging, Tonometer & visual acuity)
- Hearing (audiometer)
- Spirometry
- Body composition (DEXA)
- Bone density (DEXA)
- Aortic calcification (DEXA)
- ECG
- Carotid intima-media thickness (ultrasound)
- Cognitive assessment (30 min. battery)
- Brain imaging (New)

HEALTH INFORMATION

- Chronic disease symptoms **(disease algorithm)**
- Medication and supplements intake
- Women's health
- Self-reported health service use
- Oral health
- Preventative health
- **Administrative data linkage health services & drugs & other administrative databases**

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PSYCHOSOCIAL

- Social participation
- Social networks and support
- Caregiving and care receiving
- Mood, psychological distress
- Veteran's Identifier & PTSD
- Coping, adaptation
- Injuries and consumer products
- Work-to-retirement transitions & Workability (New)
- Retirement planning
- Social inequalities
- Mobility-life space
- Transportation
- Built environments & Contextual Factors
- Air Pollution
- Income, Wealth and Assets
- Child Maltreatment & Elder abuse (New)

LIFESTYLE & SOCIODEMOGRAPHIC

- Smoking
- Alcohol consumption
- Physical activity (PASE)
- Nutrition (nutritional risk and food frequency)
- Birth location
- Ethnicity/race/gender
- Marital status
- Education

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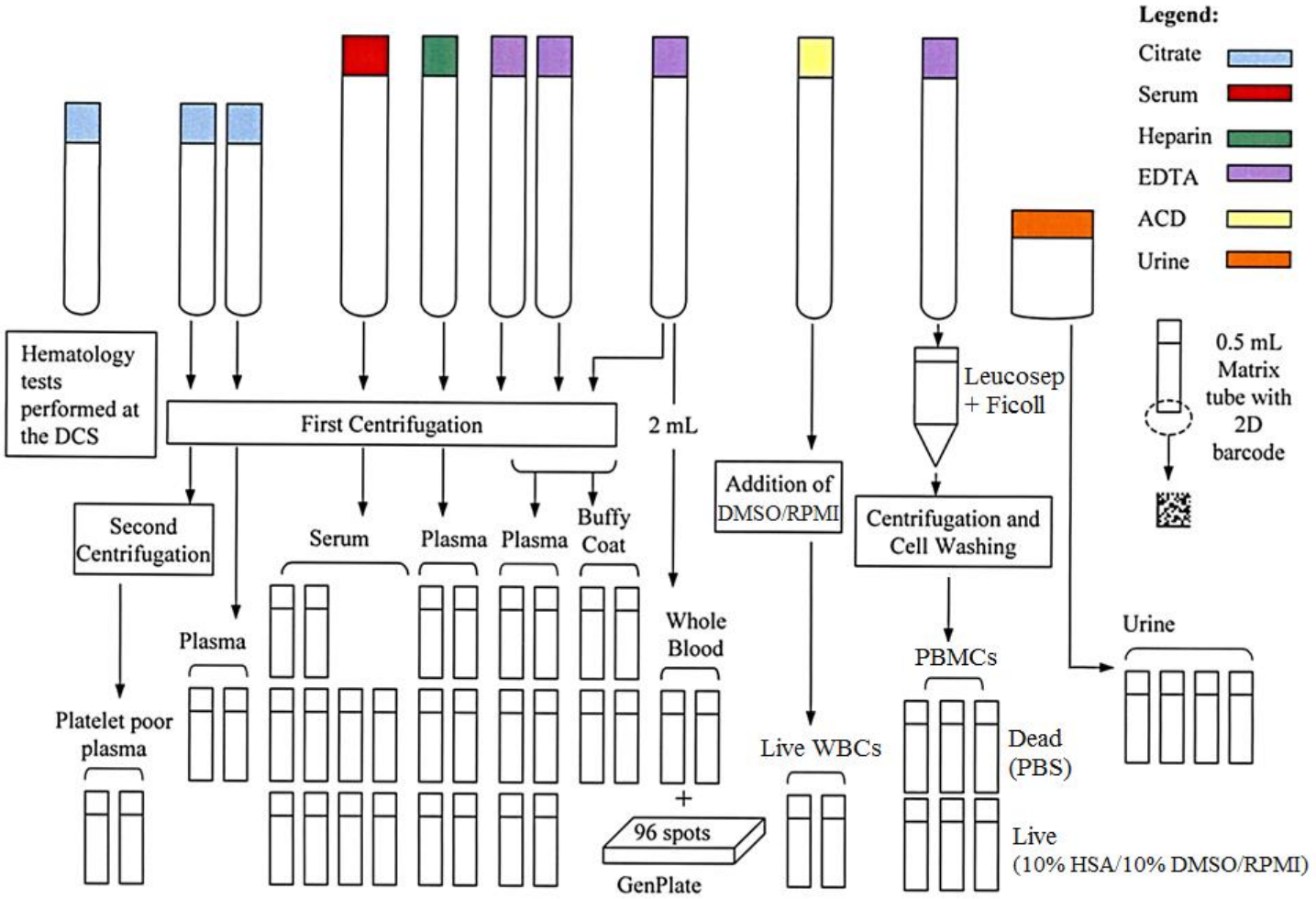
CLSA biospecimens



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Biomarker data

Comprehensive Cohort (n=30,000)

~2,000 participants with matching soluble, genetic, epigenetic and metabolomic marker data

Soluble Markers
Calgary Laboratory Services
(n=30,000)

- Albumin
- Alanine Aminotransferase
- C-Reactive Protein, High Sensitivity
- Creatinine, serum
- Total Cholesterol, HDL Cholesterol, Calculated LDL Cholesterol, Triglycerides
- Ferritin
- Free T4
- Hemoglobin A1c
- Thyroid Stimulating Hormone
- Total 25-Hydroxyvitamin D

Genome-wide Genotyping
McGill University and Génome Québec Innovation Centre
(n=10,000)

- Buffy coat DNA extracted on all 30,000
- Genotyping by the ~820K UK Biobank Axiom Array (Affymetrix)
- Imputation (~6 million SNPs) performed by Brent Richards (McGill University)

Metabolomics (n=3,000)

- Performed on participant serum in Japan using a mass spectrometry approach

DNA Methylation Profiling
UBC Genetics and Epigenetics Centre
(n=2,000)

- Performed in the laboratory of Dr. Michael Kobor, UBC
- PBMCs used for DNA extraction
- Profiling by 850K Infinium MethylationEPIC BeadChip (Illumina)

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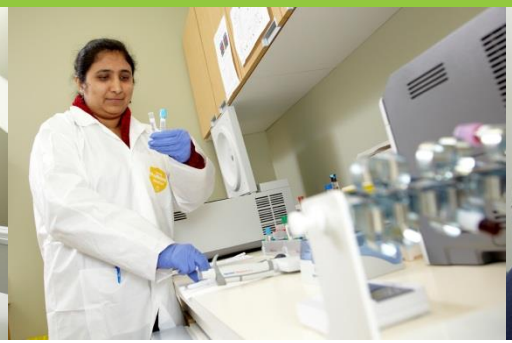
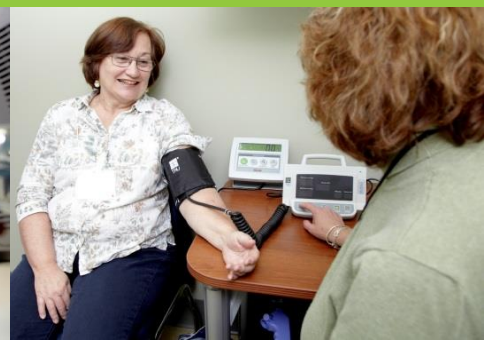

Some Observations from CLSA data

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Social Participation and Loneliness by Age & Gender

Variable	Total % (age 45-85)	Age 65+ %	Males Age 65+ %	Females Age 65+ %
Desire to participate in more activities **(Yes)**	41.7	31.7	29.7	33.5
How often participant feels lonely **(Sometimes or more)**	22.7	23.7	19.1	28.5

Community-related Activities by Age & Gender

Frequency of any community-related activity participation	Total % (age 45-85)	Age 65+ %	Males Age 65+ %	Females Age 65+ %
At least once per day (daily)	15.5	16.1	16.3	16.0
At least once per week (weekly)	66.6	67.8	65.6	69.7
At least once per month or less (monthly or less)	17.9	16.3	18.2	14.3

Social Participation Types by Age & Gender

Frequency of participation in past 12 months	Total % (age 45-85)	Age 65+ %	Males Age 65+ %	Females Age 65+ %
Sports or physical activities with others	50.3	47.9	47.3	48.5
Family/friends activities outside household	50.2	46.2	47.0	52.9
Religious activities	22.4	32.3	28.2	35.9
Volunteer or charity work	16.9	22.1	18.1	25.7
Educational or cultural activities	10.3	11.6	10.1	12.9
Neighbourhood, community or social association activities	8.3	10.9	8.5	12.7
Service clubs or fraternal organization activities	5.2	7.2	7.5	6.8

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Perceived Barriers to Social Participation, by Age & Gender

Reason(s) preventing more participation	Total % (age 45-85)	Age 65+ %	Males Age 65+ %	Females Age 65+ %
Too busy	51.7	31.4	33.3	28.3
Health condition/limitation	15.9	23.2	20.4	25.3
Personal responsibilities	15.8	14.1	10.8	16.7
Going alone	10.2	12.2	12.0	12.5
Cost	8.7	7.4	7.9	7.0
Lack of activities in area	7.8	9.0	8.5	9.5
Transportation problems	3.5	5.3	2.3	7.5
Location accessibility	1.4	1.8	1.2	2.4
Language reasons	0.4	0.6	0.7	0.5

Retirement Status

Retirement Status	45-64		65-85	
	Male	Female	Male	Female
Completely Retired	19.6%	25.3%	76.4%	84.5%
Partly Retired	10.5%	9.4%	15.1%	8.3%
Not Retired	69.9%	65.3%	8.2%	7.2%

	45-64		65-85	
	Male	Female	Male	Female
Retired and Returned to Work	9.6%	8.1%	26.7%	16.6%

Of those retired:	
Voluntary Retirement	n = 9,633 (78.7%)
Health/Disability/Stress contributed to decision to retire	n = 2,922 (23.5%)

Need for Large Studies?

Few Examples

Multimorbidity

- Older adults are also at higher risk for multi-morbidity (MM)

- MM is associated with increased disability and premature mortality, and health services utilization and costs

[1]St John, Can Fam Physician (2014)

[2]Lehnert, Med Care Res Rev (2011)

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Definition and Burden of Multimorbidity (MM)

- Definition: the co-existence of two or more chronic conditions where one is not necessarily more central than the others
- MM represents a **new** and **increasing** challenge for the countries and their health and social care system.
- MM often has significant impact on: quality of life, increased functional disability and premature mortality.
- Currently no clear consensus on how to operationalize MM
  - Simple disease counts (# and type of CCs vary across studies)
  - Depending on definition prevalence of multimorbidity ranges from 13.1% to 71.8% in population-based studies

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THE IMPACT OF MM ON MORTALITY RATE ADVANCEMENT PERIODS IN OLDER ADULTS

Canadian data were harmonized with several cohorts from Europe to maximize the sample size

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METHODOLOGY

INCLUDED STUDIES:

- Canadian Study on Health and Aging (1991) n= 9008
- CHANCES consortium on Health and Aging n=18207 (EPIC Elderly (1992) n=10079; ESTHER study (2000) n=3842; Tromso study (1994) n=4286
- **EXPOSURE:**
- Baseline information available for the following **5 prevalent, costly and preventable causes of death** in high income countries:
- **Cancer, Stroke , Hypertension, Myocardial infarction, Diabetes**
- Categorized into **mutually exclusive** groups of disease combinations
- **OUTCOME:**
- All-cause mortality; Mean of 10y FU
- **ANALYSES:**
- Cox proportional hazard models
    - adjusted for age, sex, tobacco smoking and education
    - Hazard (t, exposure) = $b_1 \times$ exposure + $b_2 \times$ age + covariates
- **Rate advancement period**
    - RAP=b_1/b_2
    - specifies the loss of years in terms of mortality risk

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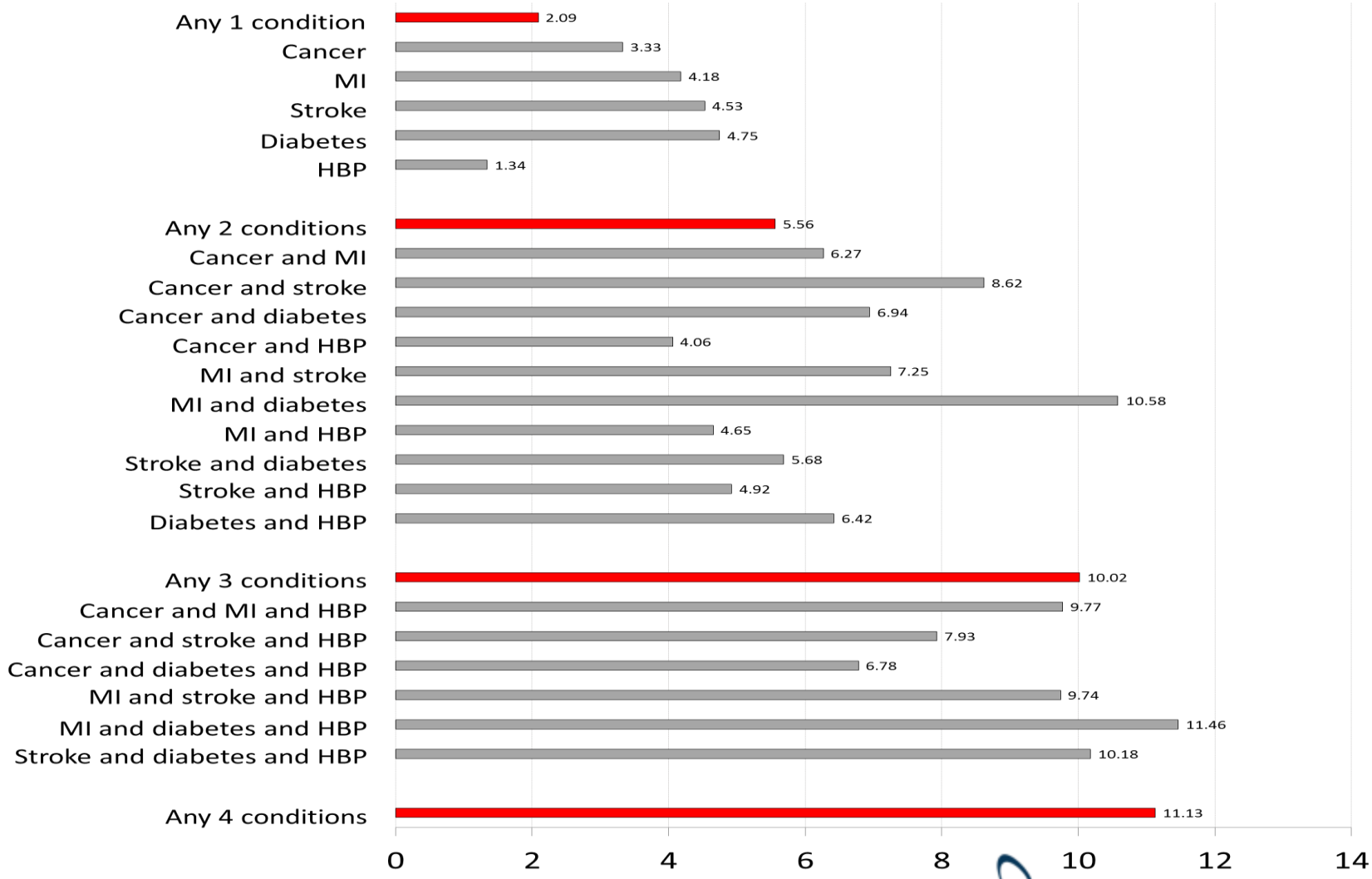
Estimates of rate advancement period (RAP) for overall Mortality associated with cluster of chronic diseases



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RESULTS

- At baseline, >65% of participants reported having one or more chronic conditions hypertension being the most prevalent condition.
- The period by which the rate of death was advanced increased with each additional chronic condition.
- Compared with individuals without any of the five chronic conditions, the rate of death was advanced by 2.09, 5.56, 10.02, and 11.13 years for participants with 1, 2, 3, or ≥4 conditions, respectively.
- Among combinations with the same number of conditions, there was substantial variability in RAPs.
- Some disease combinations (e.g. cancer and stroke; RAP: 8.62, 95%CI: 4.79-12.49) had a significantly greater impact on the period by which the rate of death was advanced than others (e.g. cancer and hypertension; RAP: 4.06, 95%CI: 2.88-5.25).

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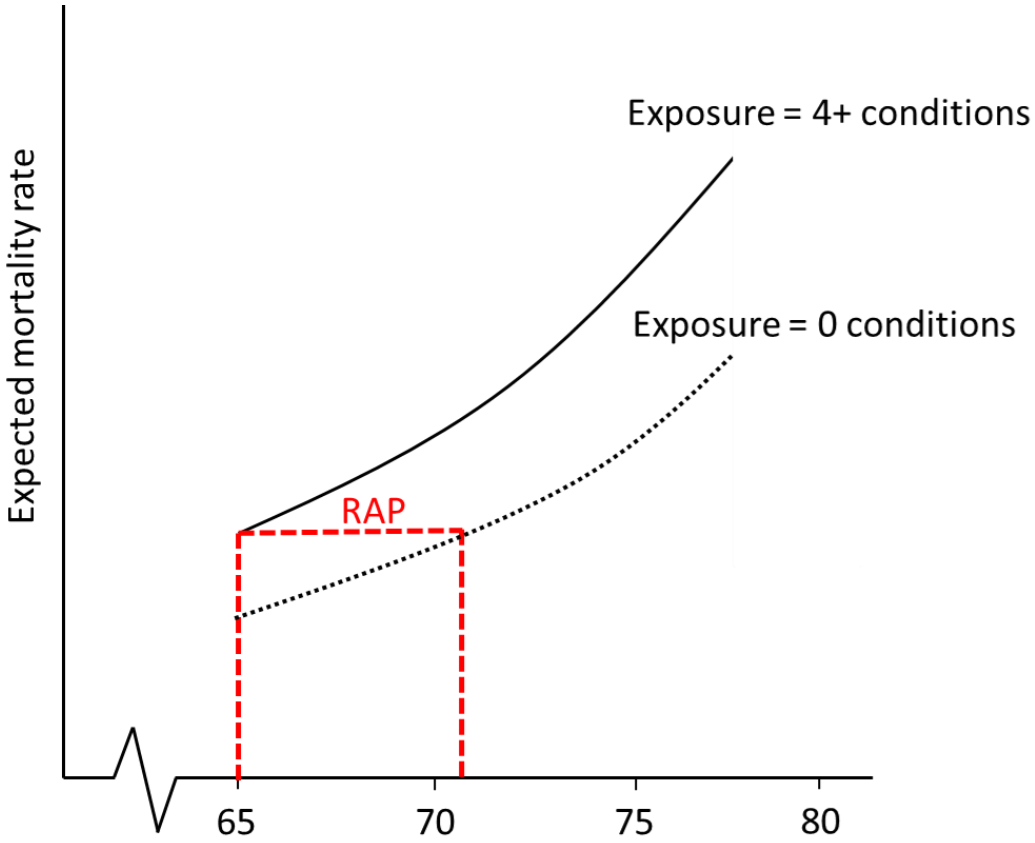

Rate Advancement Period

Specifies by which period the rate of death is advanced among people with a specific multi-morbidity relative to their disease free counterparts. For example, a 65 year old individual with 4+ chronic conditions has the same mortality risk as a 77 year old individual who has none of the five chronic conditions.

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RESEARCH ON MULTIMORBIDITYAND COMPLEX PROCESSESSOF AGING

- Large Population-based Studies that follow people over time are essential in order to sort causal relationships among demographic, biological, psychosocial and economic factors, and health (multimorbidity).

- Harmonization of data sets and 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, and health care systems.

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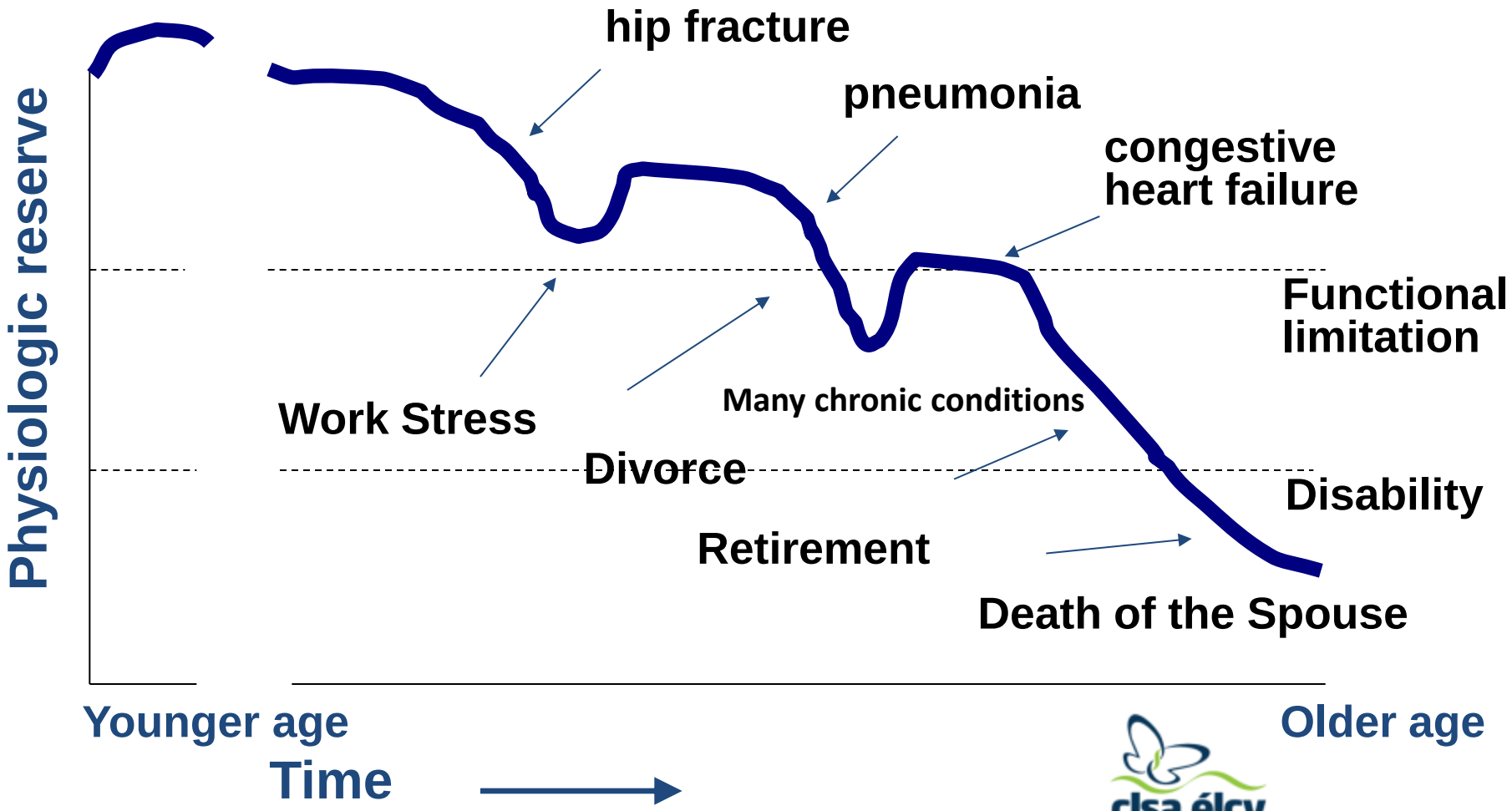
Heterogeneity of the Aging population

Physiologic and Psychosocial Reserve - Hypothetical Trajectory to Fraility, Functional Limitation & Disability



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Frailty as an Indicator of Heterogeneity of Aging Population: Preliminary Analysis of the Canadian Longitudinal Study on Aging (CLSA)

David Kanters, M.Sc. & Lauren Griffith, PhD, 2016

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What is Frailty?

- Frailty is a state in which there is an increase in an individual's vulnerability for developing increased dependency and/or mortality when exposed to a stressor.
- It describes the heterogeneity among older populations

Morley JE, Vellas B, Abellan van Kan G, Anker SD, Bauer JM, Bernabel R et al. Frailty consensus: a call to action. J Am Med Dir Assoc. 2013. 14(6): 392-7

Challenges

Operational definition of frailty should further our understanding between frailty and healthy status, its biological basis, impairments and longitudinal changes and trajectories in physical function as well as the contribution of social determinants, environmental and behavioural factors (Bergman et al., J Gerontol A Biol Med Sci 2007;62:731-737)

- Need for longitudinal, population-based data with great breadth and depth

→ Canadian Longitudinal Study on Aging (CLSA)

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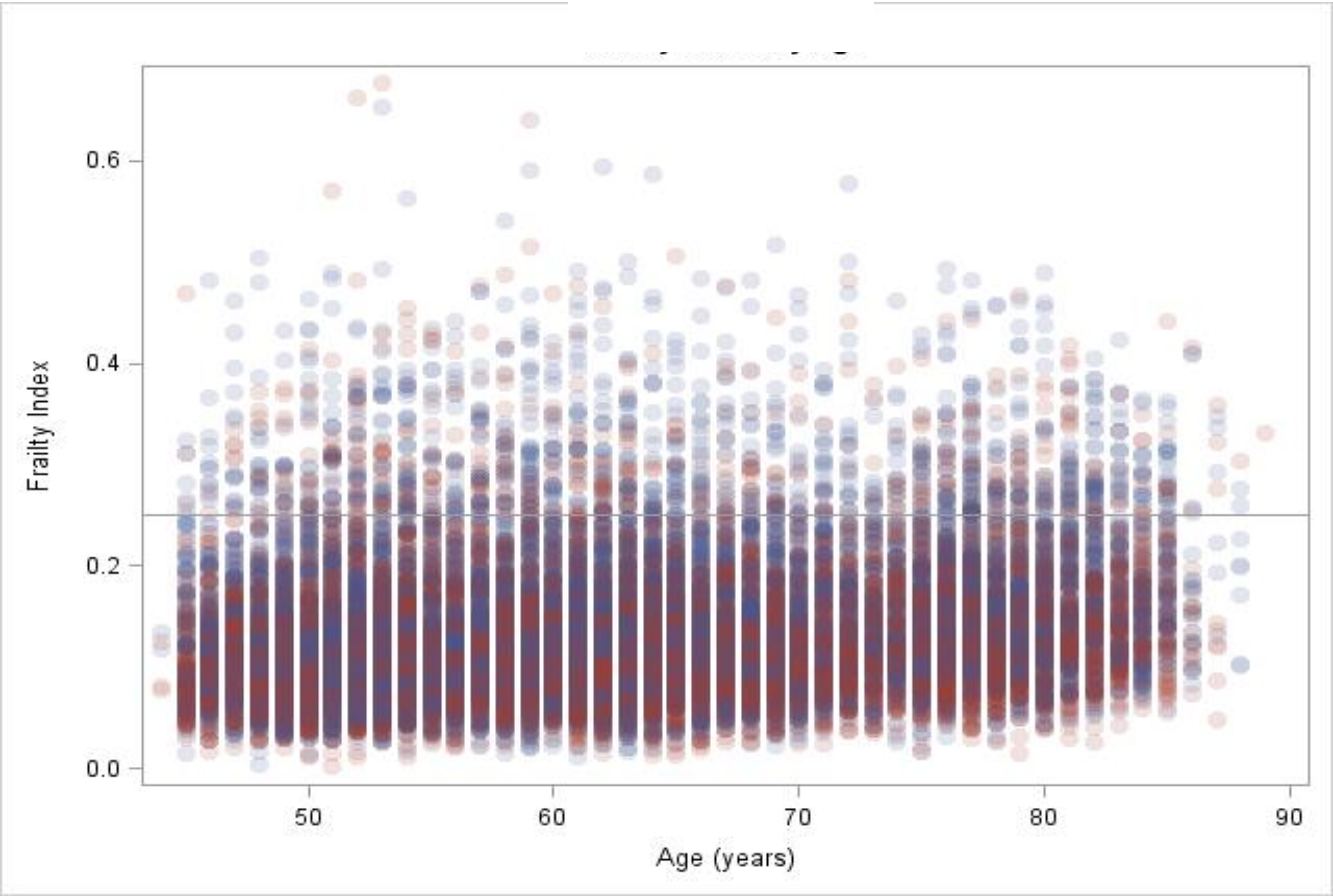
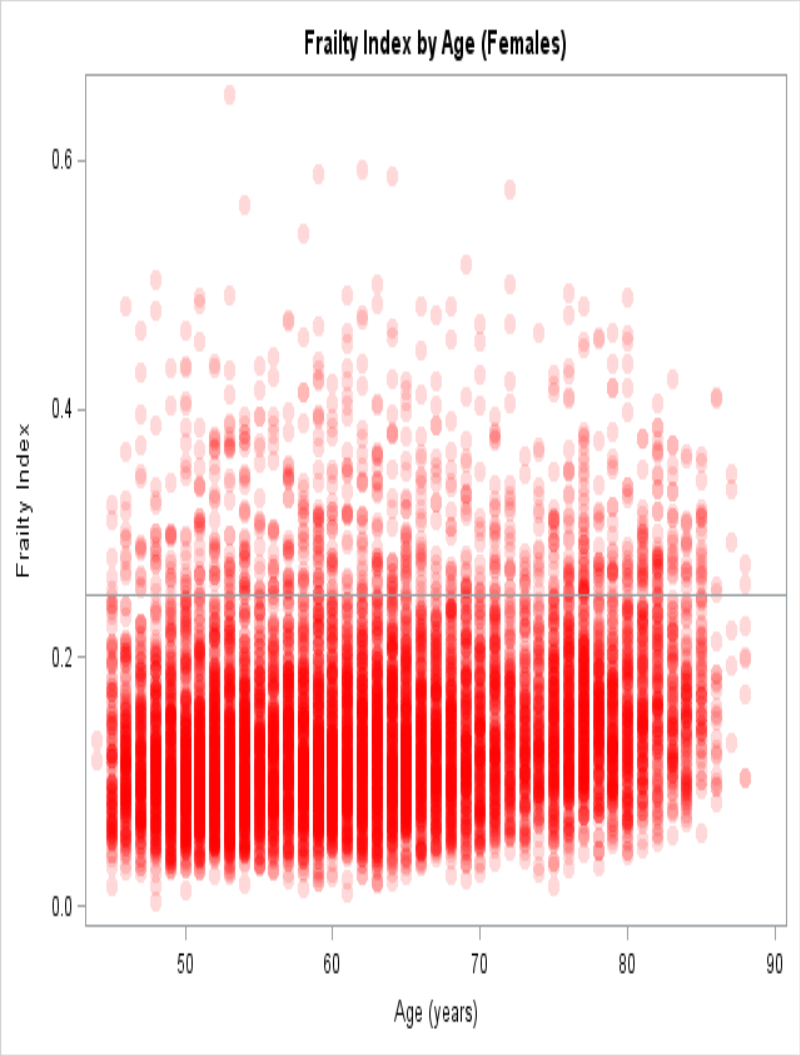
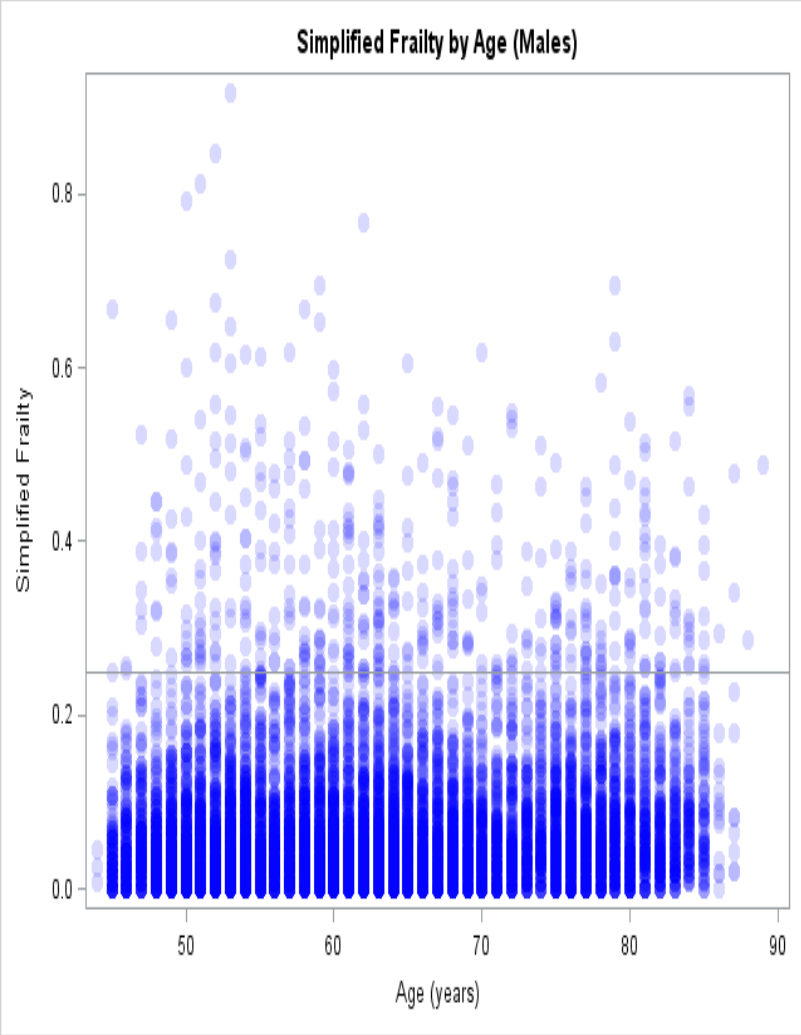
Heat Map for Frailty by Age in CLSA

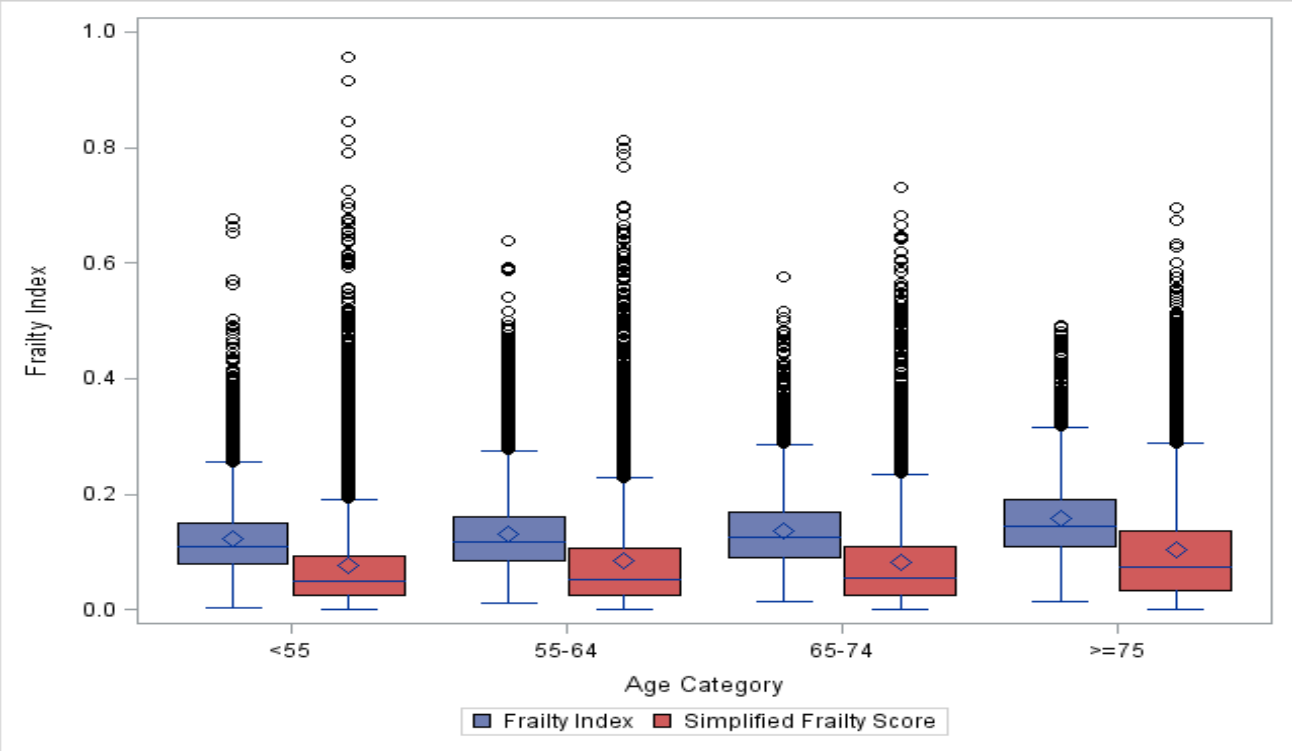


Heat Map for Frailty by Age & Sex in CLSA





Frailty Indices by Age Group



Profile of Frailty by Key Factors

	Age	Sex (M)	Income	Education	Injury from Fall	Serious Injuries	Informal Home care	Formal Home Care
Frailty Index	0.170	-0.119	-0.339	-0.174	0.122	0.122	0.324	0.300
Simplified Frailty	0.097	-0.118	-0.259	-0.155	0.107	0.123	0.329	0.315

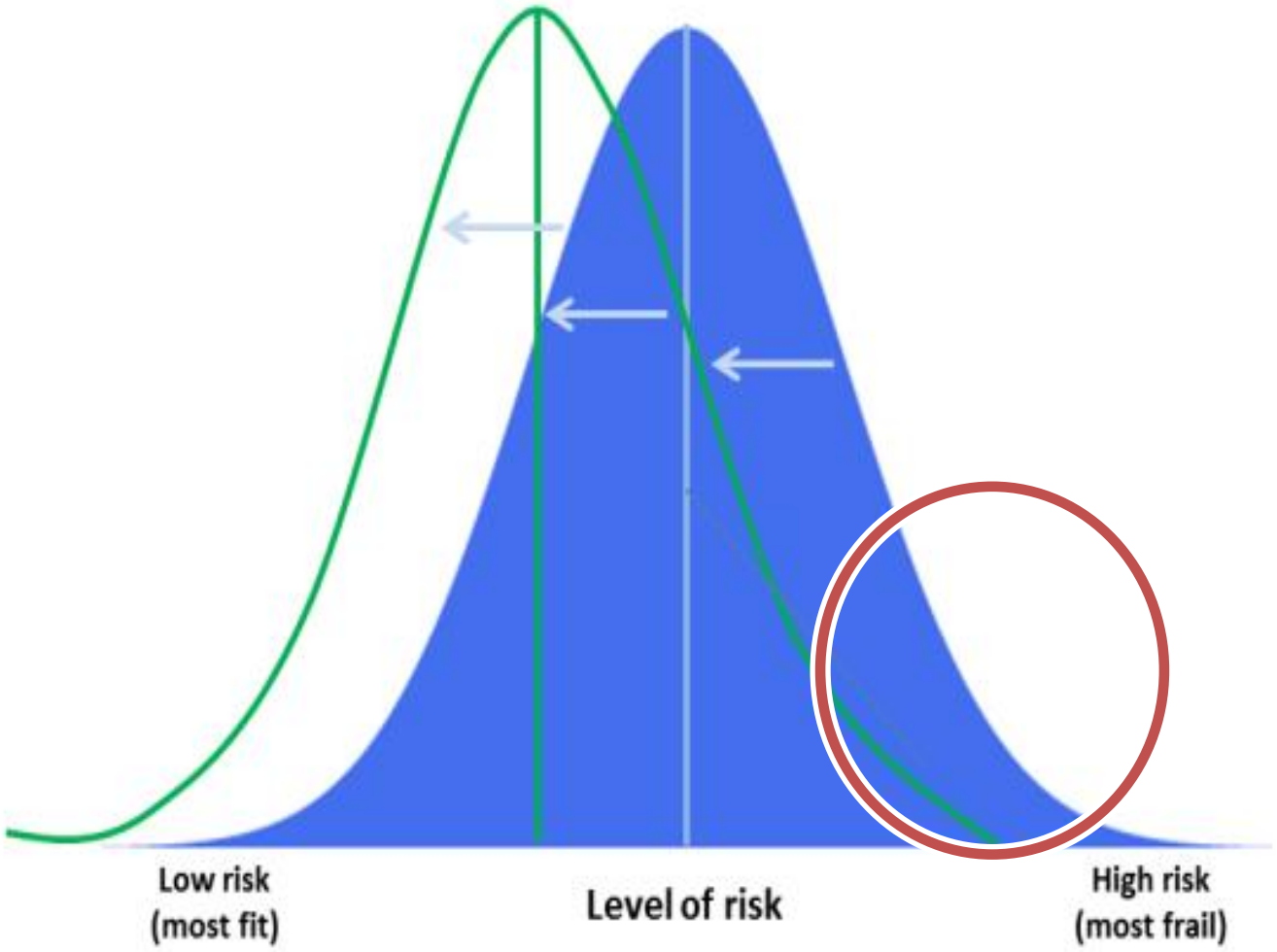


Fig 1. Shifting the level of population risk

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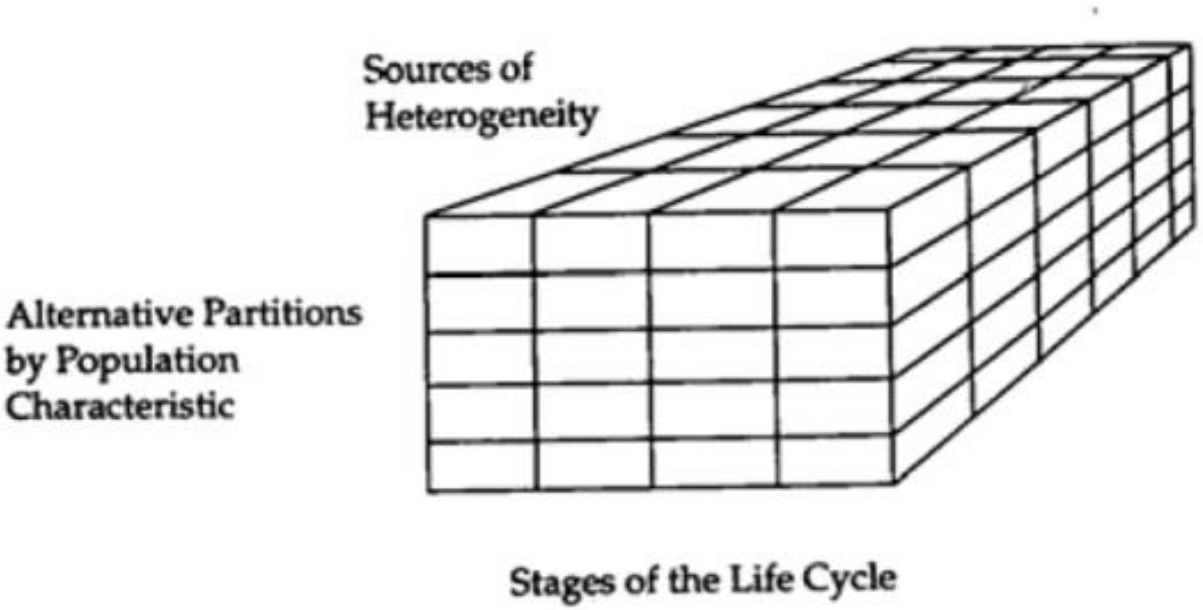


Stages of the Adult Life Cycle	*Characteristics*	*Sources of Heterogeneity*
1. Chronic disease 45-74 yrs	1. Socioeconomic status	1. Individual lifestyle
2. Senescence: 75+ yrs	2. Ethnicity/migration	2. Physical environment
	3. Geograpahic	3. Social environment
	4. Female/Male	4. Biology
	5. Special Popluations	

Fig. 1. Model for investigation of heterogeneities in population health status
Adapted from: C. Hertzman, J. Frank, and R. G. Evans, Heterogeneities in Health Status[6]

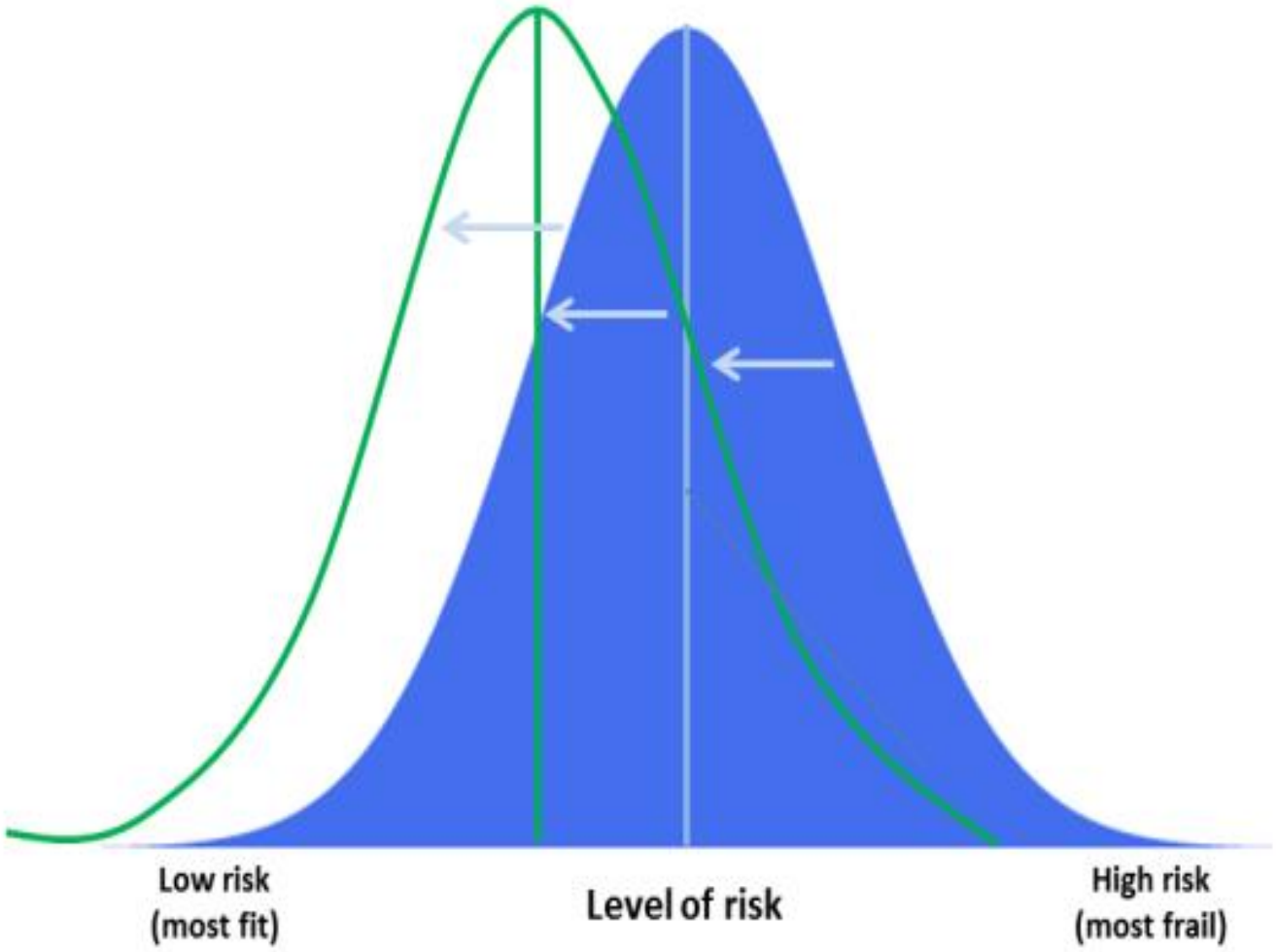
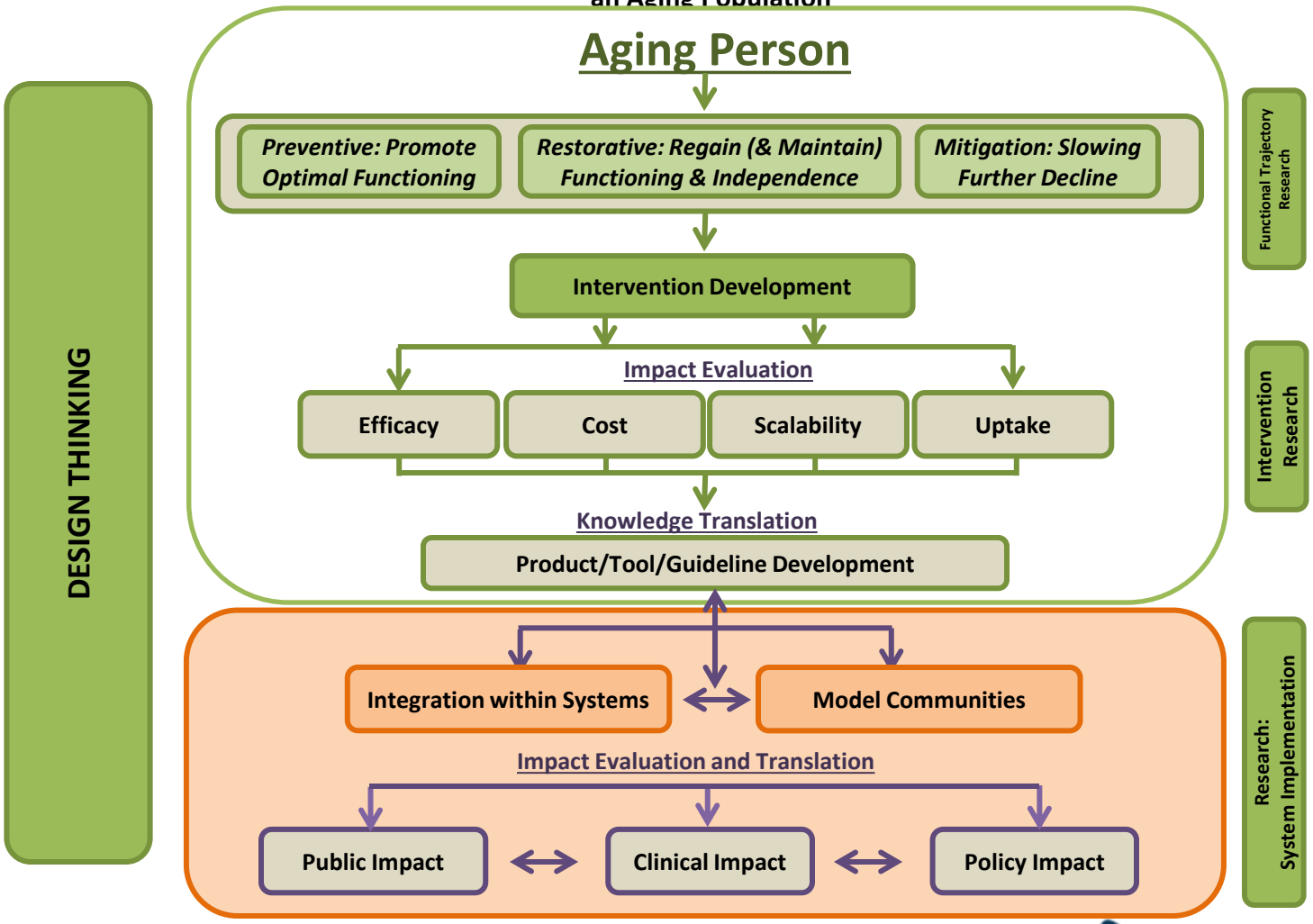


Fig 1. Shifting the level of population risk

What else are we doing at McMaster University to complete the picture?

RESEARCH ON AGING IS THE FOCUS!

Proposed Focus of the MIGS: Cross-Disciplinary Research in Plasticity of Function in an Aging Population



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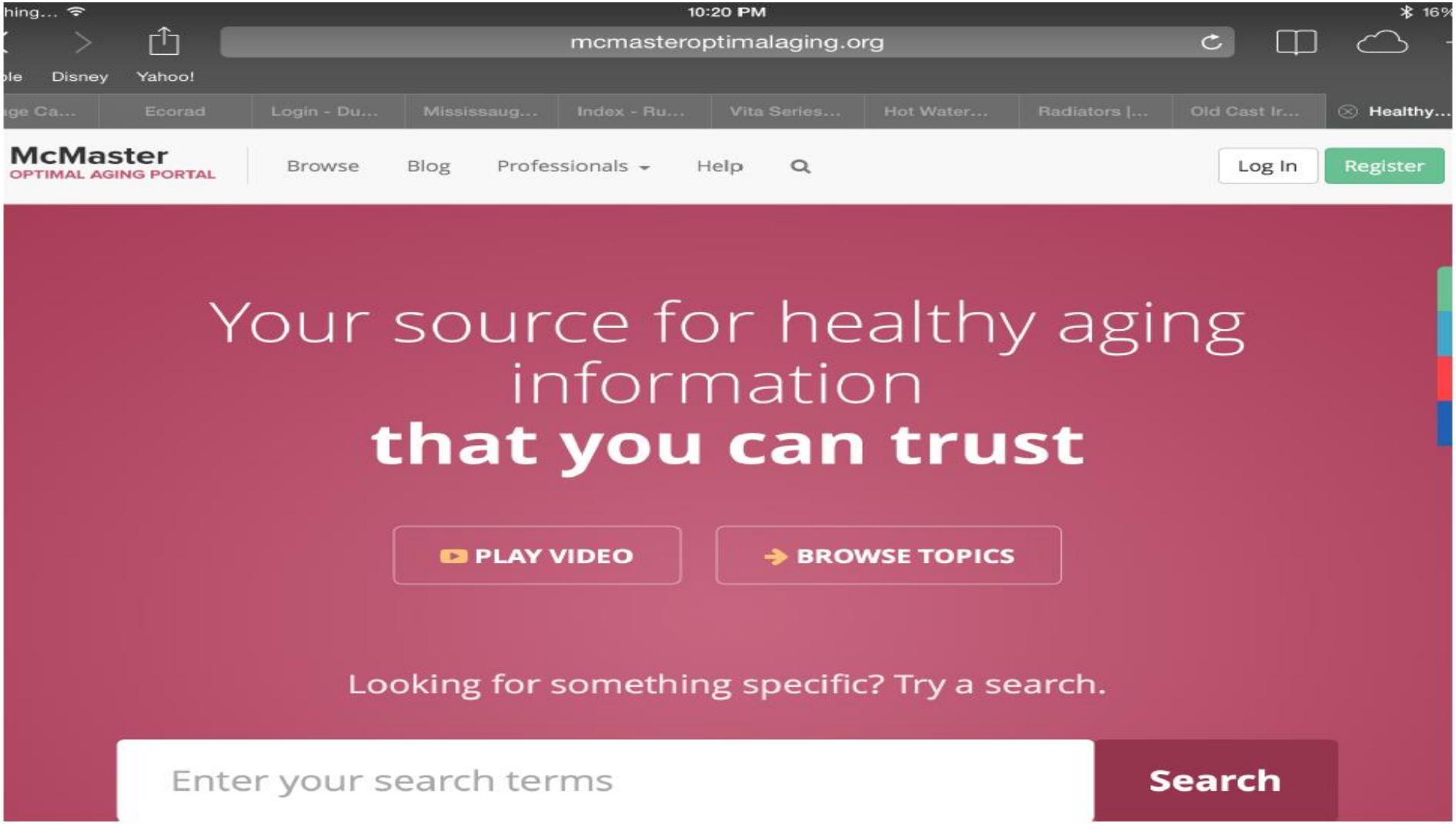

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McMaster Optimal Aging Portal

Support for the Portal is largely provided by the Labarge Optimal Aging Initiative. Help us to continue to provide direct and easy access to evidence-based information on how to manage our health conditions and to stay healthy, active and engaged as we grow older. Donate Today.

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May 25, 2016

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Full story

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Accessing CLSA data

Data and Biospecimen Access

- **Fundamental tenets:**
  - The rights, privacy and consent of *participants* must be protected and respected at all times
  - The confidentiality and security of *data and biospecimens* must be safeguarded at all times
  - CLSA data and biospecimens are resources that will be used optimally to support research to benefit all Canadians
  - No preferential or exclusive access

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CLSA as Platform for Interdisciplinary Research through collaborations: Examples

- Falls and Consumer Products (PHAC)
- Elder abuse and Child Maltreatment (PHAC)
- Air pollution and chronic diseases (funded through CARA: Health Canada)
- Veteran's Health and PTSD (Veterans Affairs)
- Transportation, Mobility and Migration (Ontario Ministry of Transportation)
- Biomarkers and mobility (CIHR)
- MINDMAP-Urbanization and Mental Health (EU-Horizon2020)
- Epigenetic Clock and Healthy Aging
- Genetics and Chronic Disease
- Metabolomics and diabetes sub-study
- Hearing and Cognition
- Volunteerism, social engagement and baby boomers
- CLSA-Brain sub-study

CIHR IRSC
Canadian Institutes of Health Research
Instituts de recherche en santé du Canada

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CLSA funded by the Government of Canada through CIHR and CFI, and provincial governments and universities

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