



Advancing the Science of Population Health and Aging through Interdisciplinary Research

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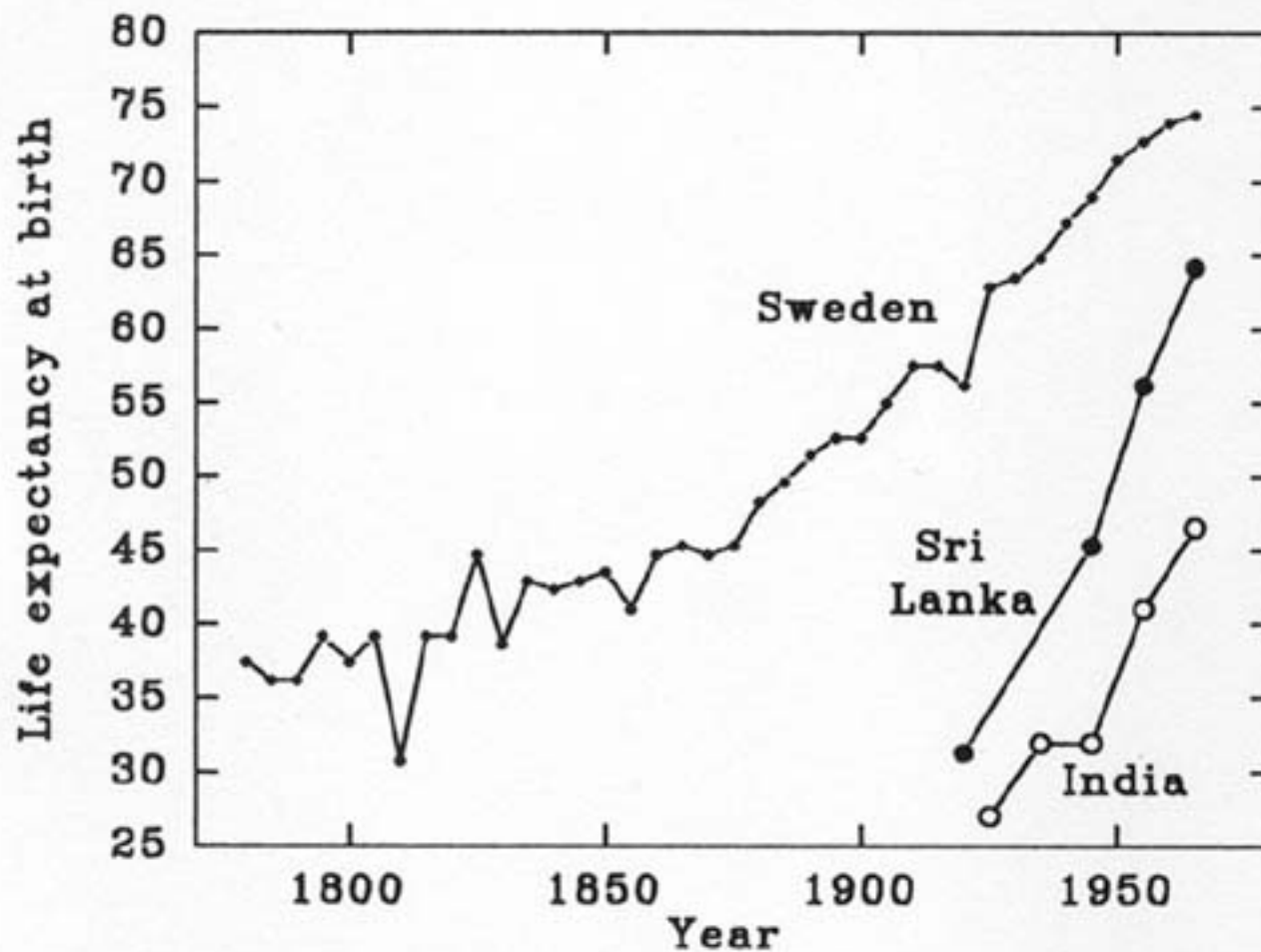
The Aging Revolution

- The rapid and continuing increase in human survival.
- New scientific understanding of the ageing process.
- The changing nature of old age and its determinants.
- Expectations, adjustments and policy.

Population Totals in Canada by Age Group and Year

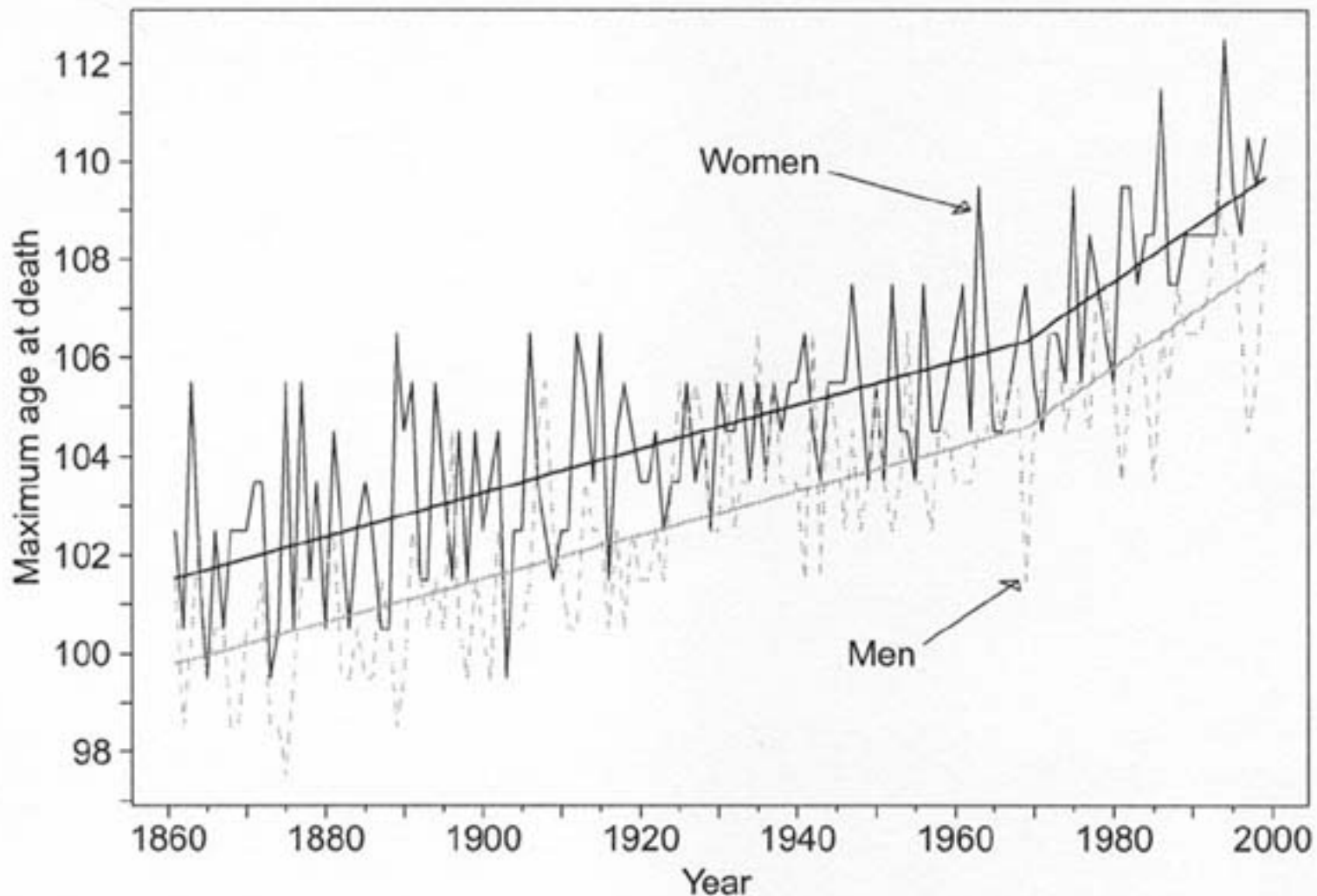
AGE	MALES	BOTH SEXES	FEMALES
80+	229898	670192	440294
75-79	255599	622194	366595
70-74	364298	833991	469693
65-69	497996	1084588	586592
60-64	578596	1190087	611491
55-59	618096	1238387	620291
50-54	673295	1339986	666691
45-49	844194	1674182	829988
40-44	1076892	2138777	1061885
35-39	1173491	2344675	1171184
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

Trends in Life Expectancy



Source: J Cairns, *Matters of Life and Death*, 1997

Maximum Lifespan in Sweden, 1861-1999



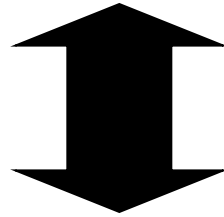
Source: Wilmoth JR et al, *Science*, 2000

Demographic Futures

- Upward trend in life expectancy continue, cease, or reverse?
 - + Effective interventions against age-related diseases
 - + Improved environment for ageing
 - + Life-cycle deceleration (delayed reproduction)

 - Adverse effects of excess nutrition
 - Adverse effects of alcohol and drug abuse
 - Adverse effects of increasingly sedentary lifestyles
 - Life-cycle acceleration (early maturation)

Why ageing occurs



How ageing is caused

- We are not programmed to die.
- We are programmed for survival but in our ancestral environment investments in reproduction were a higher priority than long-term survival.
- Ageing is caused by the build-up of faults.

What is the Relationship between Ageing and Disease?

- What is 'normal' ageing?
- Why is the aged cell (or organ) more vulnerable to pathology?

Ageing or Disease?

- Osteoporosis
- Osteoarthritis
- Dementia

What Accounts for the Individuality of Human Ageing?

Genetic Heritability of Human Lifespan

Cournil & Kirkwood *Trends in Genetics* 2001

Twin Studies

- McGue et al (1993) 0.22
- Herskind et al (1996) 0.25
- Ljungquist et al (1998) <0.33

Traditional Family Studies

- Philippe (1978) 0-0.24
- Bocquet-Appel & Jakobi (1990) 0.10-0.30
- Mayer (1990) 0.10-0.33
- Gavrilova et al (1998) 0.18-0.58
- Cournil et al (2000) 0.27

Genes account for 25% of what determines longevity



The Aging Process

Kirkwood, 2005

Functional Impairments in Organs and Tissues leading to Age-related Frailty, Disability, and Disease

Inflammation

Anti-Inflamm

**Good
lifestyl
e**

**Good
Food**

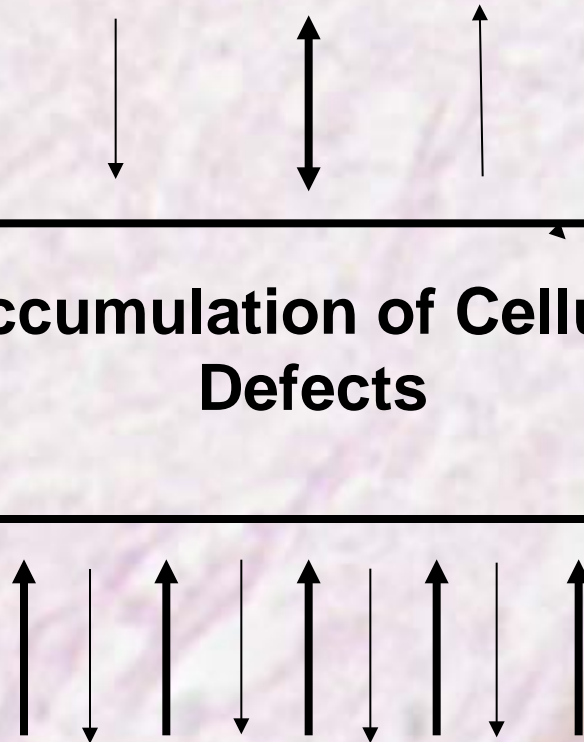
**Accumulation of Cellular
Defects**

Random Molecular Damage

**Stres
s**

Environment

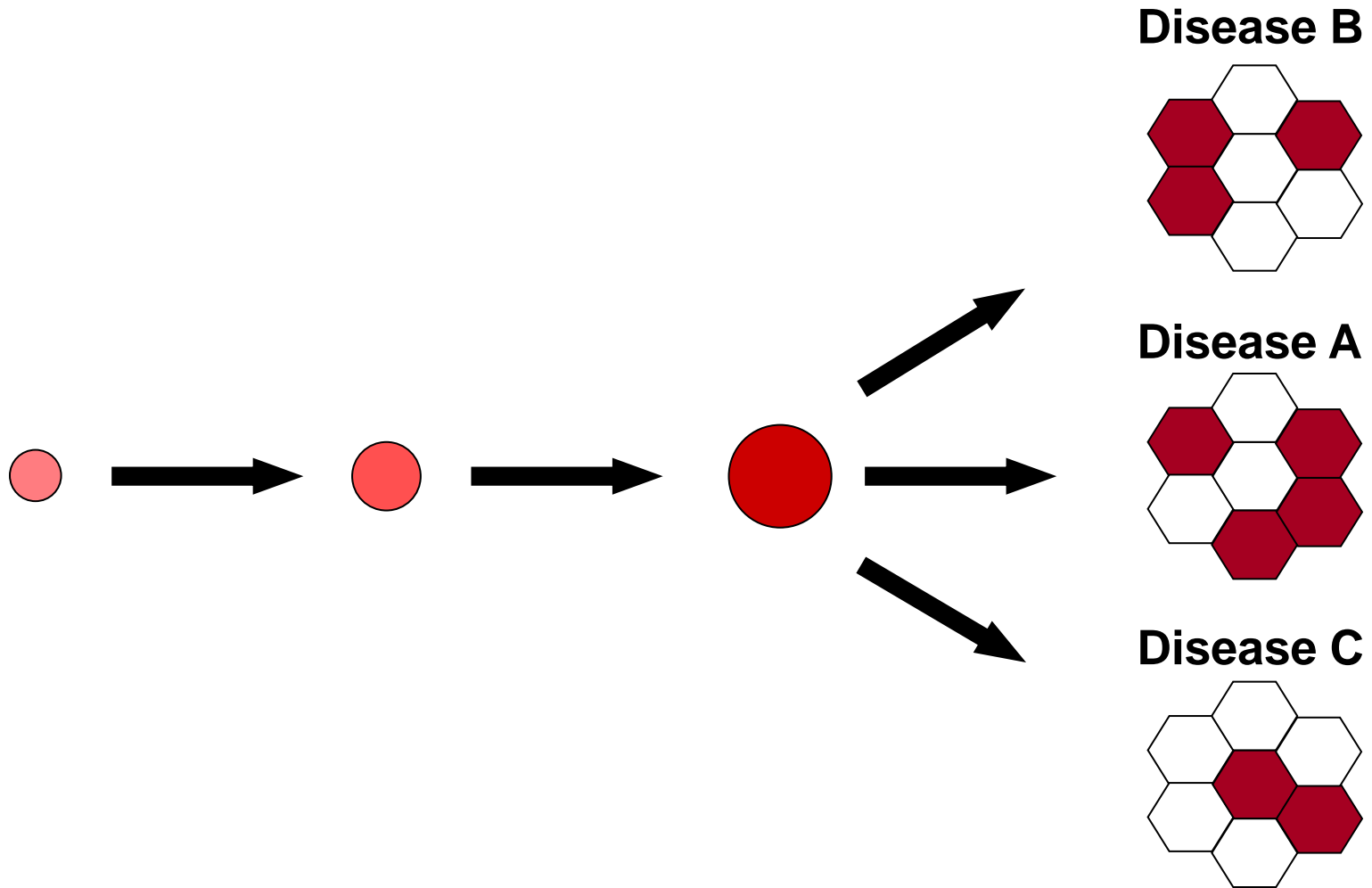
**Bad
Food**



Factors Influencing Longevity and Health

- Genes
- Nutrition
- Lifestyle
- Environment

Multi-Stage Progression of Age-Related Disease



'Upstream'



'Downstream'

Scientific Evidence

- 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

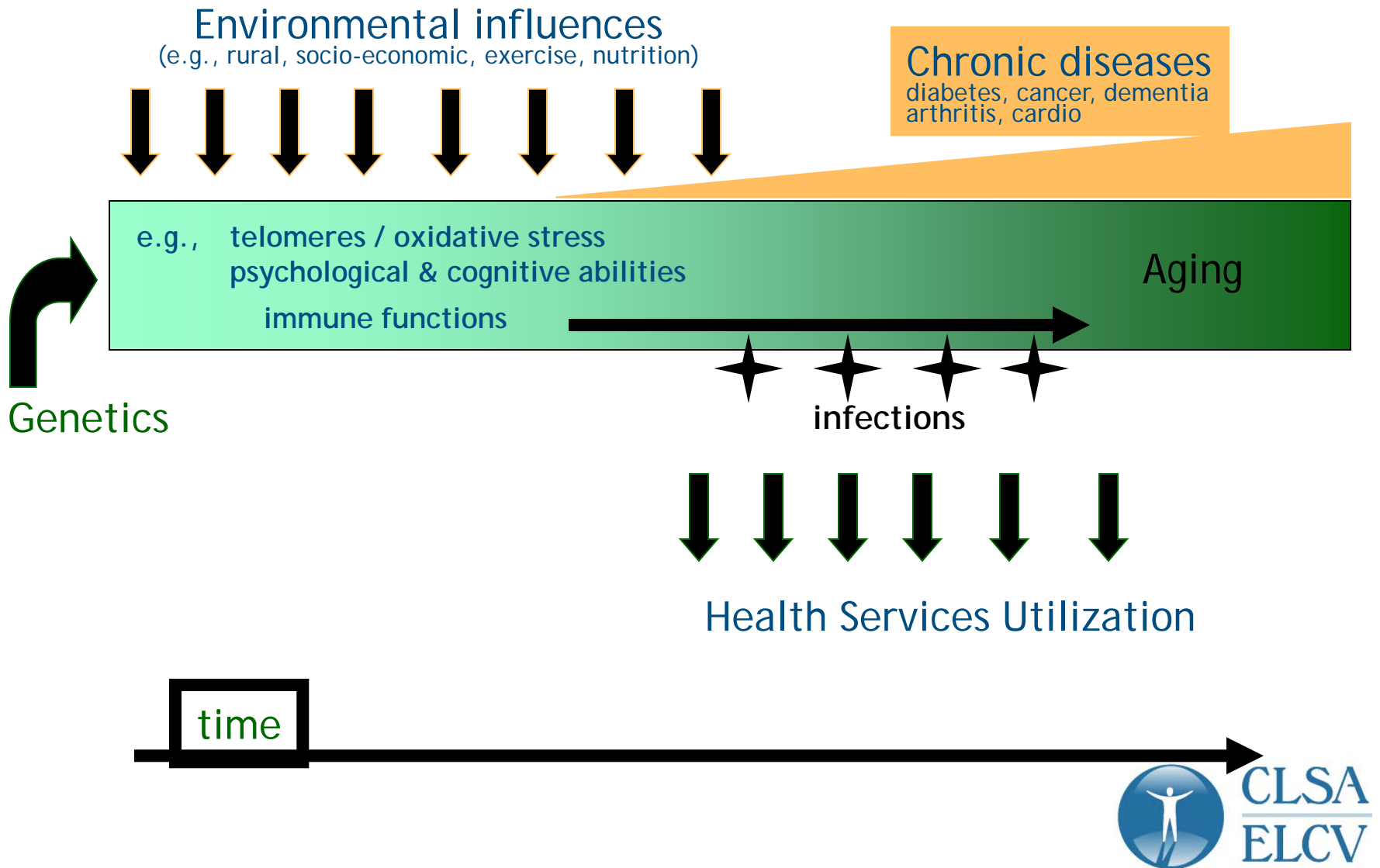
Scientific Evidence

- 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

Policy Needs

- ▶ 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

Future of Research in Aging in Post-Genomic Era



Future of Research in Post-Genomic Era

- Age-related changes---”complexity”
 - INDIVIDUAL LEVEL
 - SOCIETAL AND CONTEXTUAL LEVEL
- Innovative study design that advance science of aging and health as well as inform health and social policy
- Need for interdisciplinary long-term longitudinal studies

Methodological Challenges

Conceptual frameworks, theoretical models and analytical approaches that:

- ❑ distinguish independent, cumulative, interactive, and contextual effects, and critical and sensitive periods
- ❑ Make parsimonious models from mountains of data (modeling ageing outcome and risk factor trajectories)
- ❑ handle repeat observations and missing data, hierarchical data, measurement error, latent variables.

BUT THERE ARE DANGERS OF OVER COMPLICATED METHODOLOGY!

Need clear and transparent approach

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

Principal Investigator Triumvirate

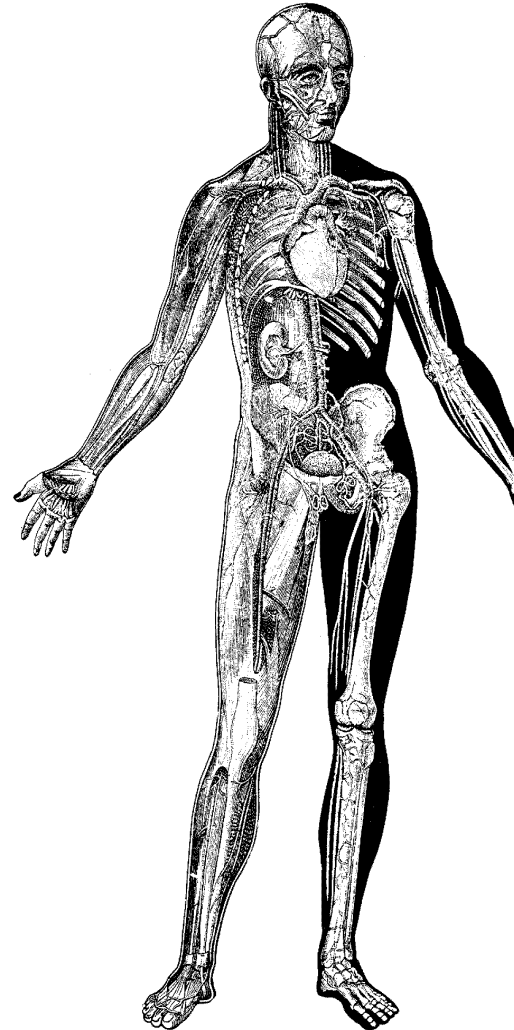
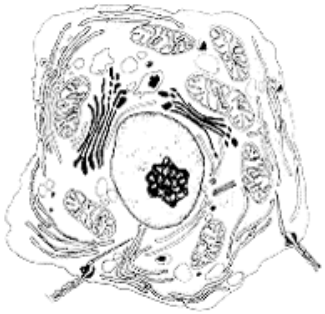
Susan Kirkland - Dalhousie University

Parminder Raina - McMaster University

Christina Wolfson - McGill University



Innovation - Cell to Society



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

CLSA Mandate

1. To develop a Canadian multi-centre study that could determine:
 - genetic, immunologic and molecular determinants of aging
 - effect of physical exercise, nutrition and other habits
 - evolution of physical, psychological, and cognitive abilities
 - role of psychological determinants of health
 - role of social and cultural determinants of health
 - health services utilization of this population
2. To identify preventive strategies and health services that would promote healthy aging
3. To translate the findings into clinical practices, health services and policy

CIHR-IA RFP

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.

Examples of Few Research questions in CLSA

- ❖ What is the relative importance of mid-life and later life risk factors on changes in neuromuscular, neuroendocrine, inflammation and immune functions that underlie aging and age-related diseases?
- ❖ Do exposures early in mid-life influence the development of social inequalities in older adults and how these social inequalities relate to disease, disability or psychosocial outcomes?
- ❖ Are there common risk factors and processes that promote the development and maintenance of cognitive and physical capability across the life course, reduce chronic disease risk and improve longevity?

Focus of Measurement

Biomedical

- Activities of daily living/disability/injuries
- Frailty/co-morbidities
- Chronic diseases
- Cognitive function
- Mental Health
- Oral health
- Vision, hearing
- Medications
- Health Care Use
- Institutional care
- Genetics/Biology
 - Disease susceptibility/longevity genes
 - DNA repair
 - Antioxidant defence
 - Apoptosis, programmed cell death
 - Immunosenescence
 - Telomere loss
- Nutrition

Psychosocial

- Lifestyle/behaviours
- Social networks and social support
- Values and meaning
- Everyday competence, adaptive functioning, coping
- Personality, emotion, psychopathology
- Work to retirement transitions
- Structural inequalities
- Built environments/physical environment
- Economics
- Healthy aging and well being
- Linkage to secondary data bases
 - Health care use
 - Disease registries
 - Drugs
 - Environmental

CLSA Architecture



Population of 50,000 (at 10 sites)

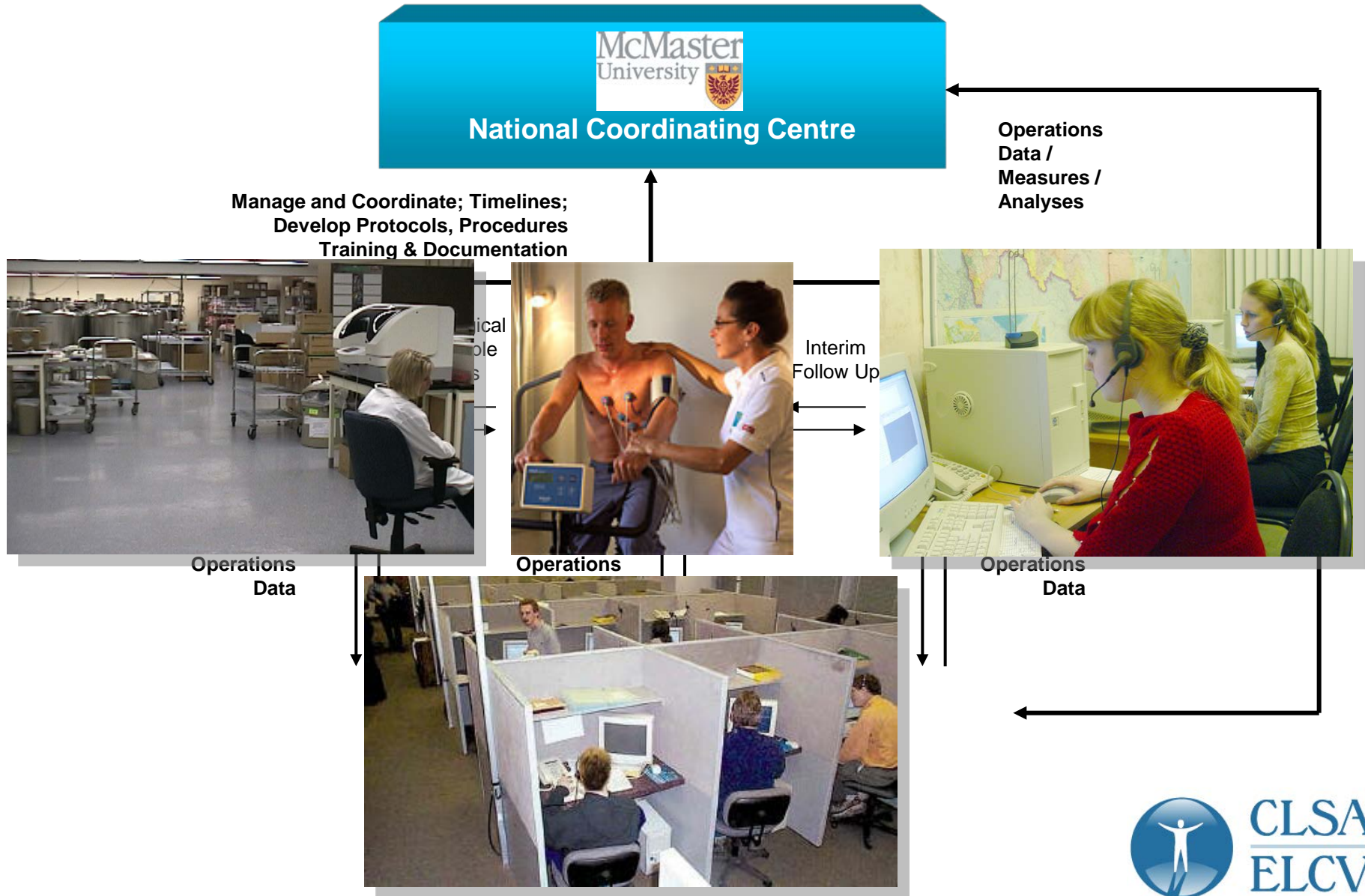
Genetic, Biological, and Physical Data

Follow-up over 20 years

Every 3 years age 45-84



Core National Network of Facilities





CLSA

ELCV

Website: www.CLSA-ELCV.ca

