

Lifespan Extension in Human Evolution: Intelligence, Intergenerational Transfers and Health in Old Age



Hillard Kaplan, Univ. of New Mexico

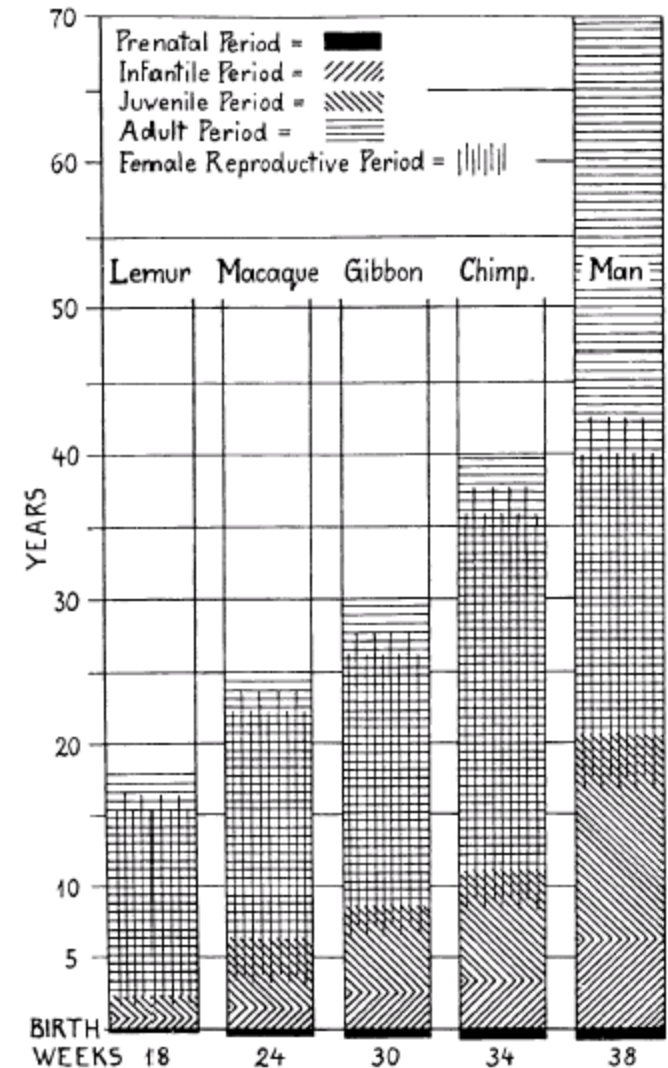


Figure 1. Adolf H. Schultz's rendition of primate life histories in comparative perspective.¹⁴ This figure has been used repeatedly to demonstrate the prolonged period of human ontogeny.

World's Oldest Woman and Man

Christian Mortensen, 115

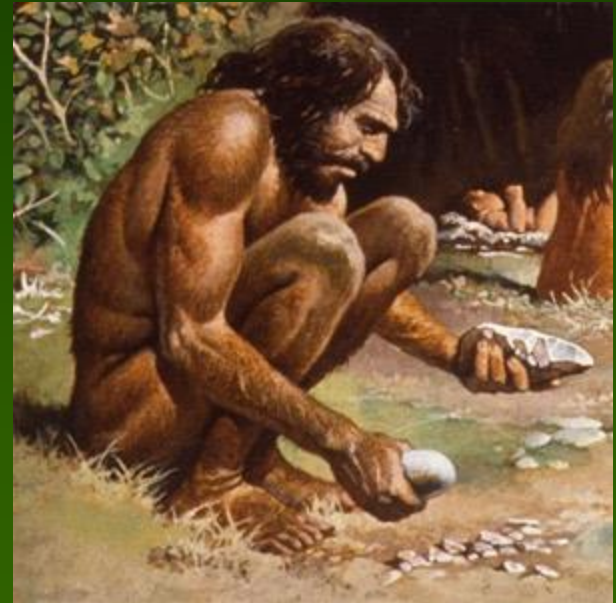
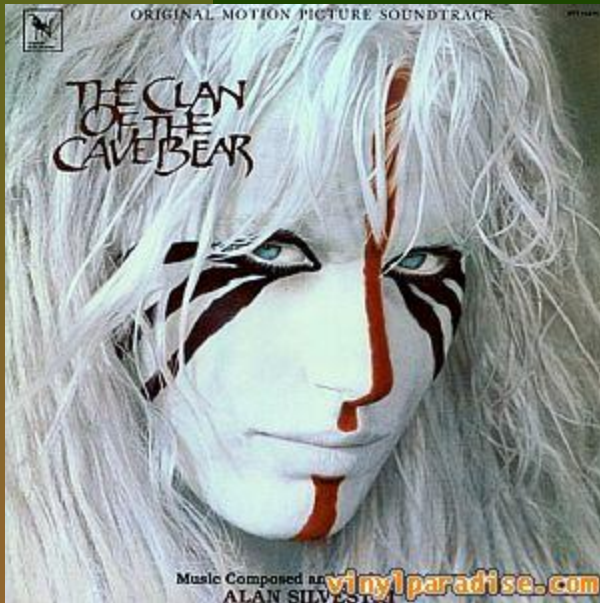


"I've never had but one wrinkle,
and I'm sitting on it."

Jeanne Calment, 122 years old



Hunter-gatherer life as “nasty, brutish and short”?

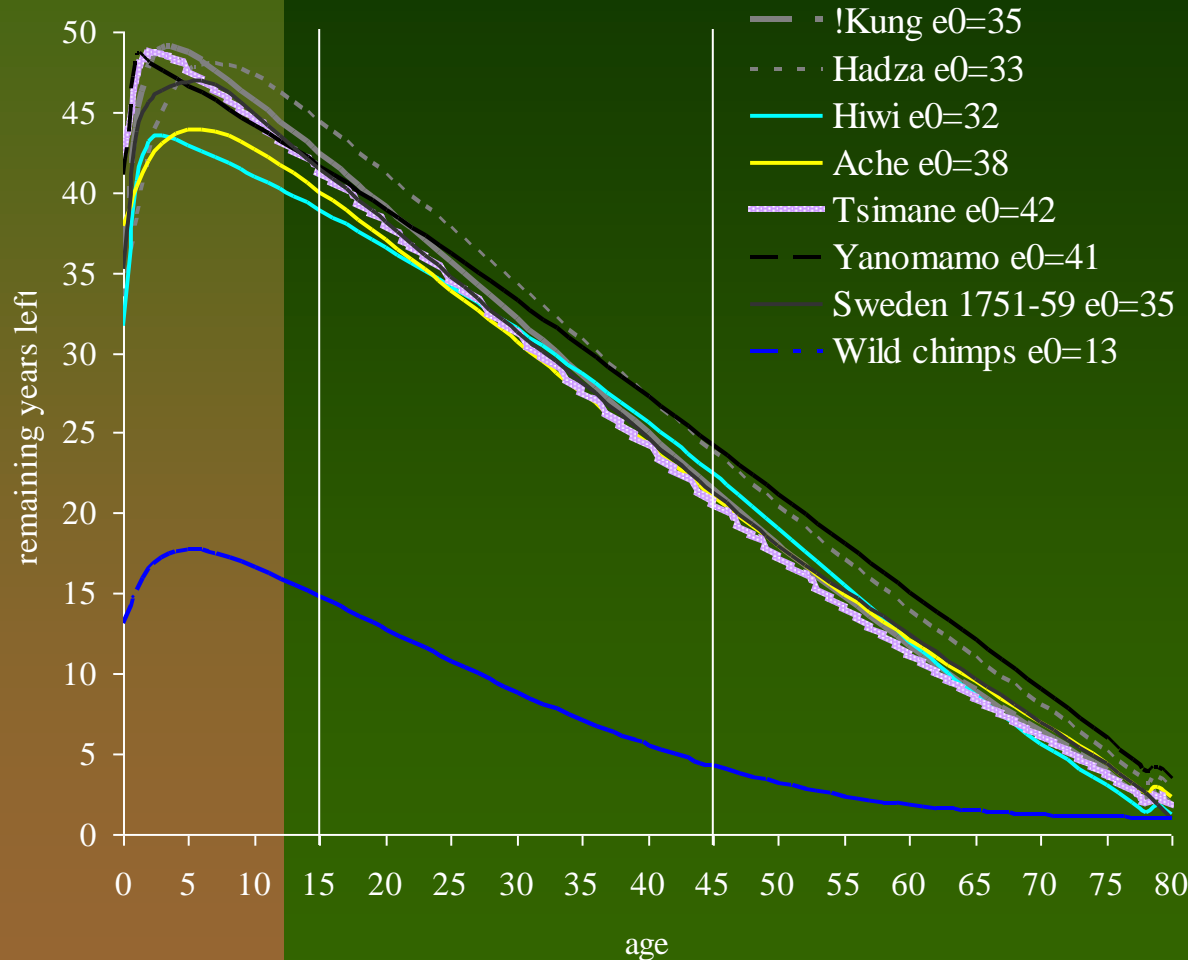


Hunter-Gatherers: How long did people live during our ancestral past?

- >99% of hominid evolution occurred among hunting and gathering populations; Agriculture, western medicine, public health initiatives, immunizations all extremely recent.
- The lifeway of extant hunter-gatherers and forager-farmers shares many features with our evolutionary past: a) high pathogen burden; b) low energy balance; c) natural fertility; d) minimal healthcare
- Lens on the evolved biology of intelligence, aging and life expectancy in our species.
- Comparisons with modern societies shed light on
 - ❖ The interaction of genes, environments and lifestyles on health and longevity
 - ❖ Modern health conditions
 - ❖ The future

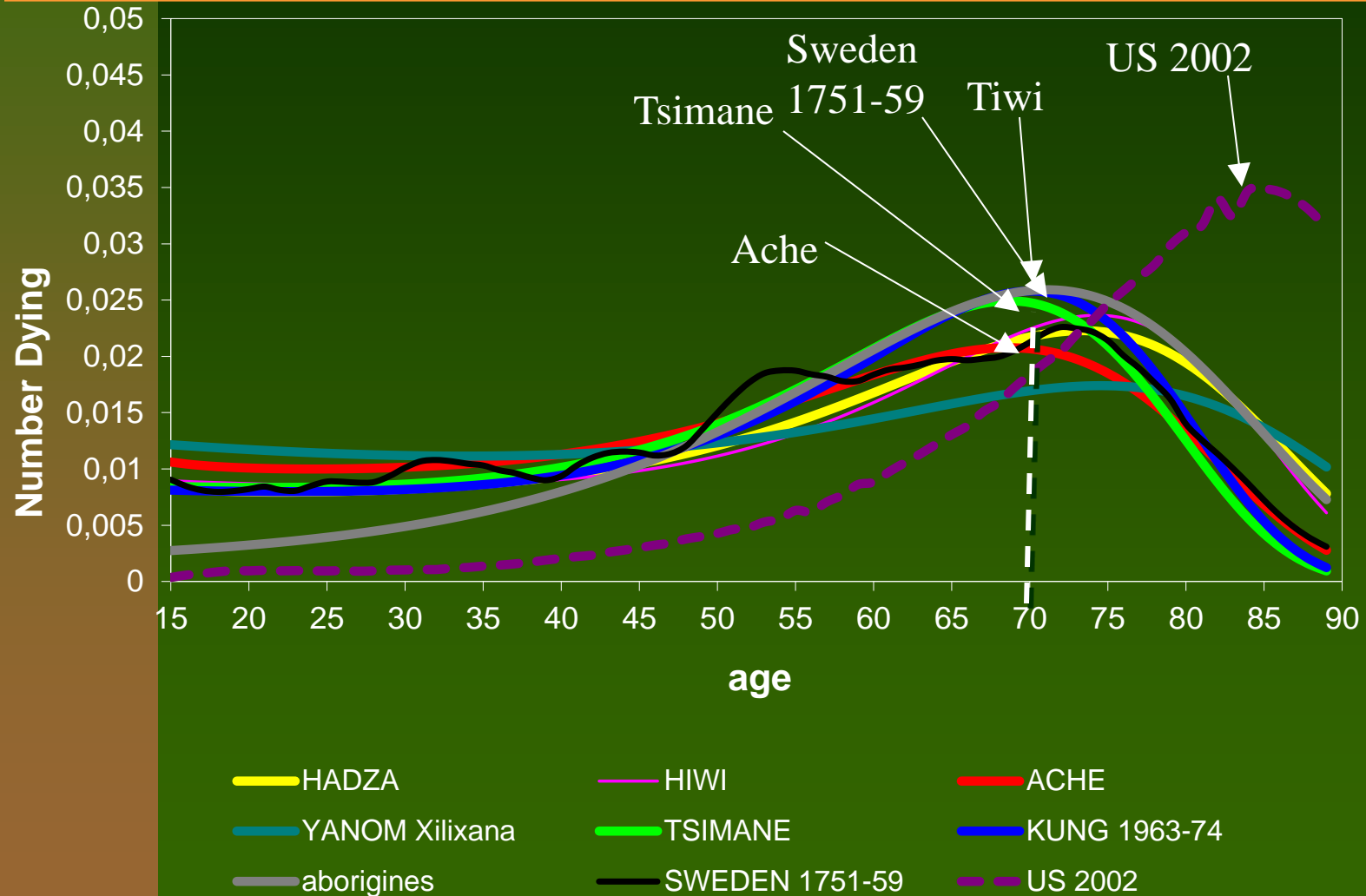
How long do foragers live?

Age-specific remaining life expectancy



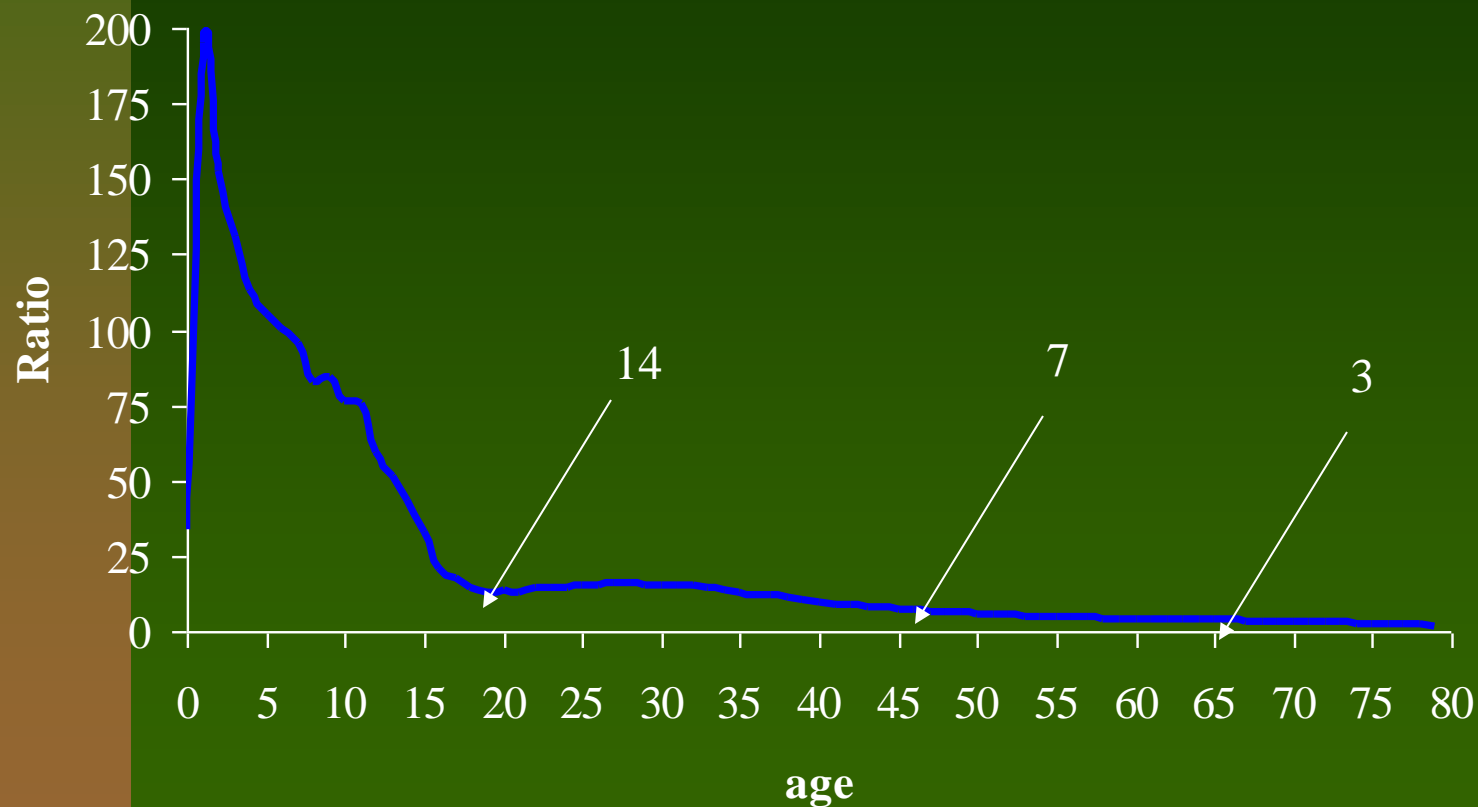
Why do humans live so long and why do they not live longer?

Modal Ages at Death for Foraging, Horticultural populations: *Adaptive lifespan of seven decades?*



(Gurven and Kaplan 2007. *PDR*)

Ratio of Hunter-Gatherer to US 2002 h_x



(Gurven and Kaplan 2007. *PDR*)

What forces drove the evolution of human aging?



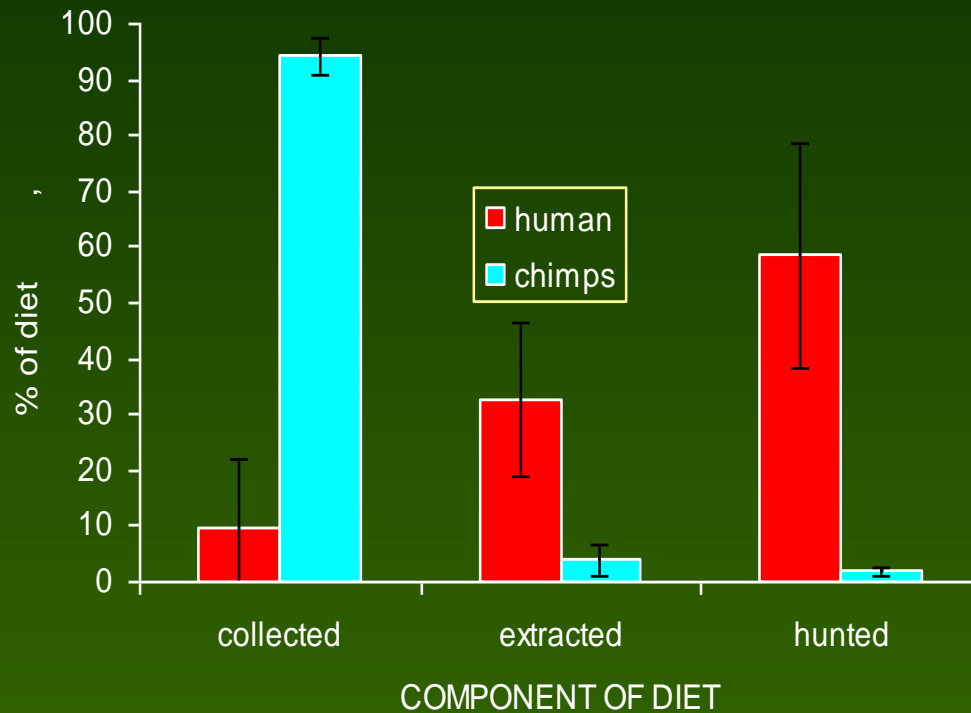
Flo just before her death in 1972.
(H. van Lawick)



MR. WORZLE (H. van Lawick)



Diets of Human Foragers and Chimpanzees



DIFFICULTY

low



high

PACKAGE SIZE

small



large

sharing













Homo Sapiens is an Outlier Among Primates

2. Brain Size

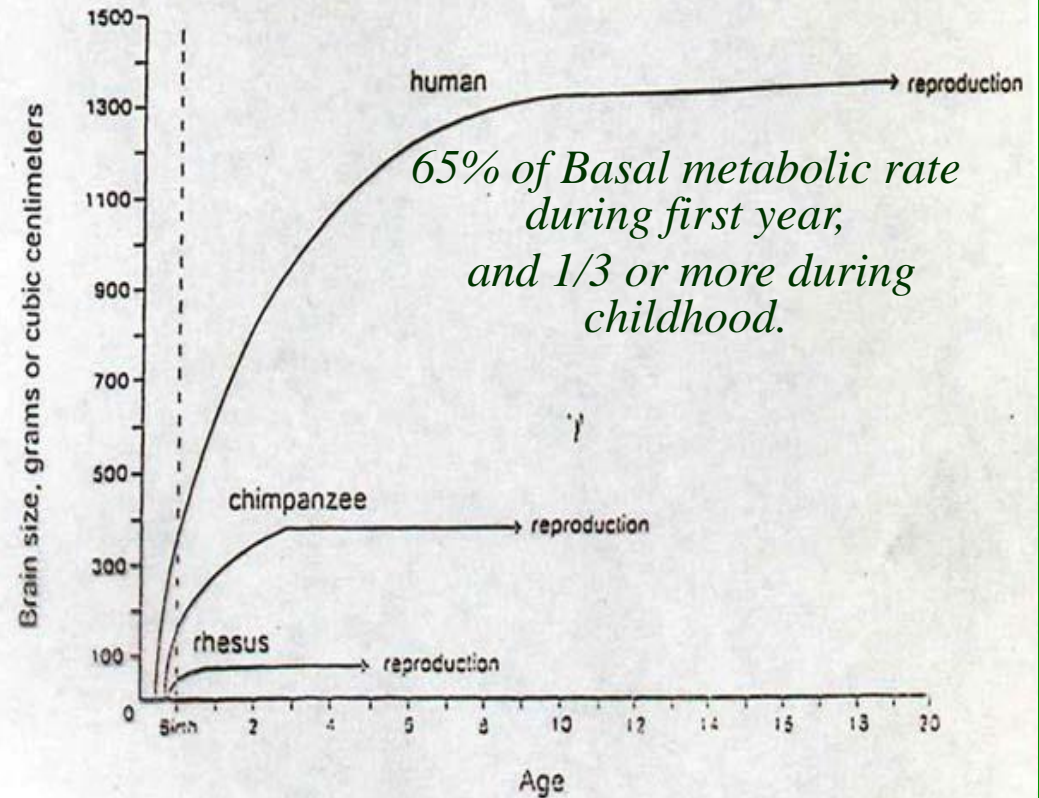


FIGURE7 . Brain growth in rhesus monkeys, chimpanzees, and humans
SOURCE: After Lancaster, 1986.

Hunting Return Rates and Upper Body Strength

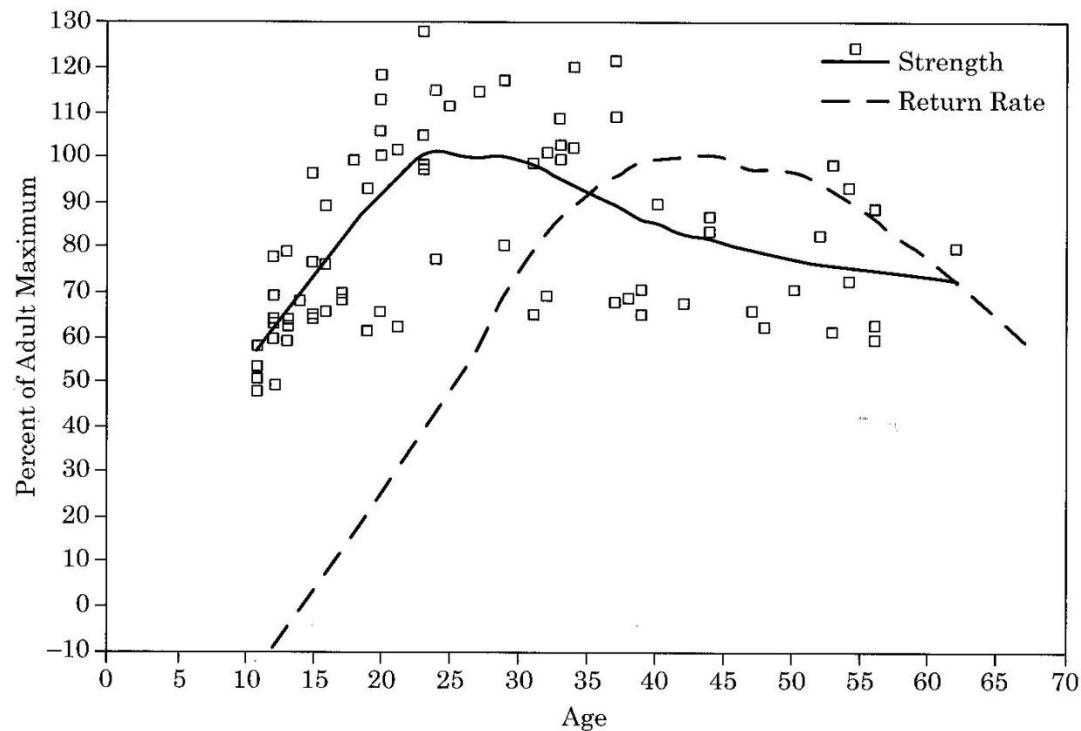
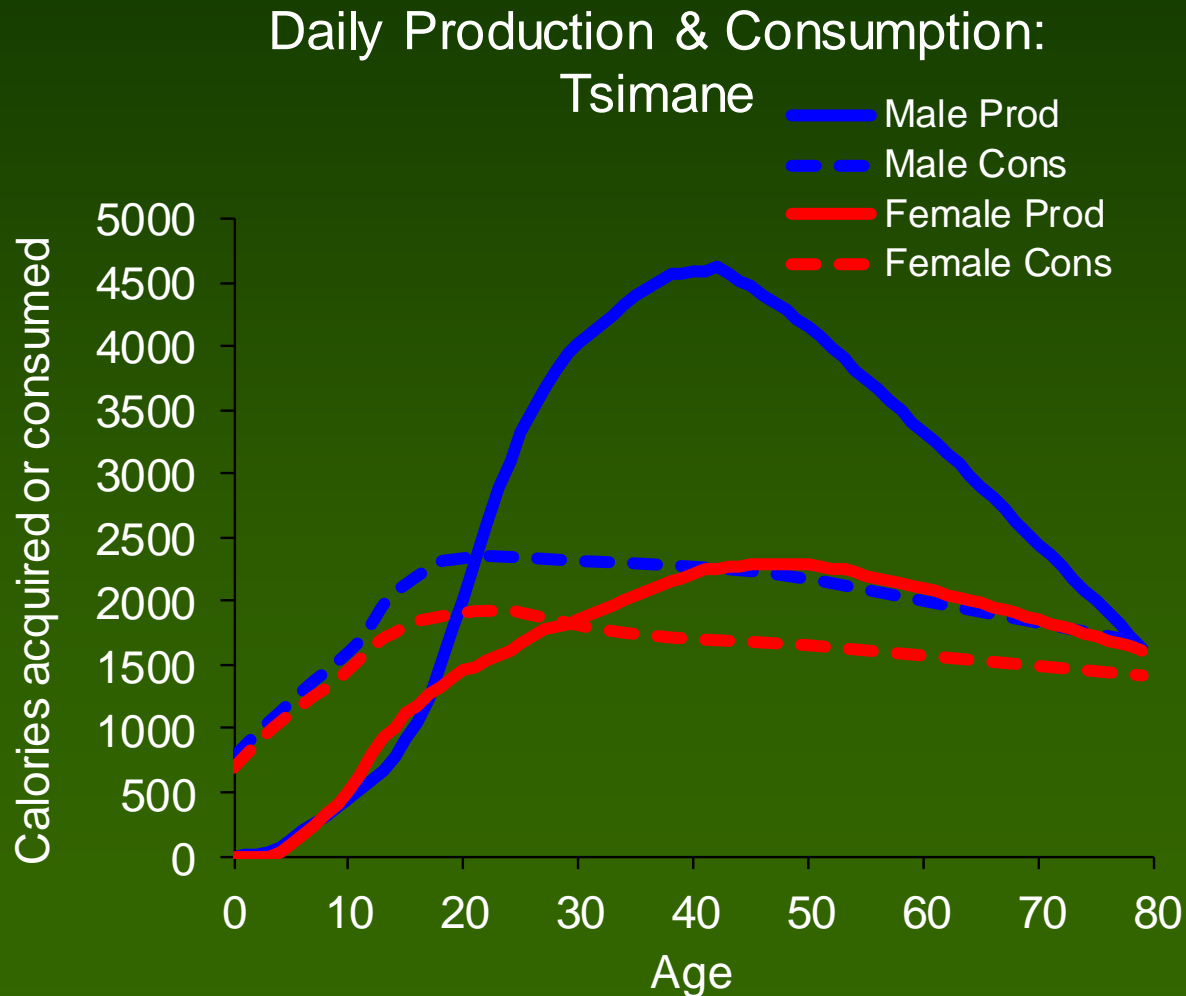
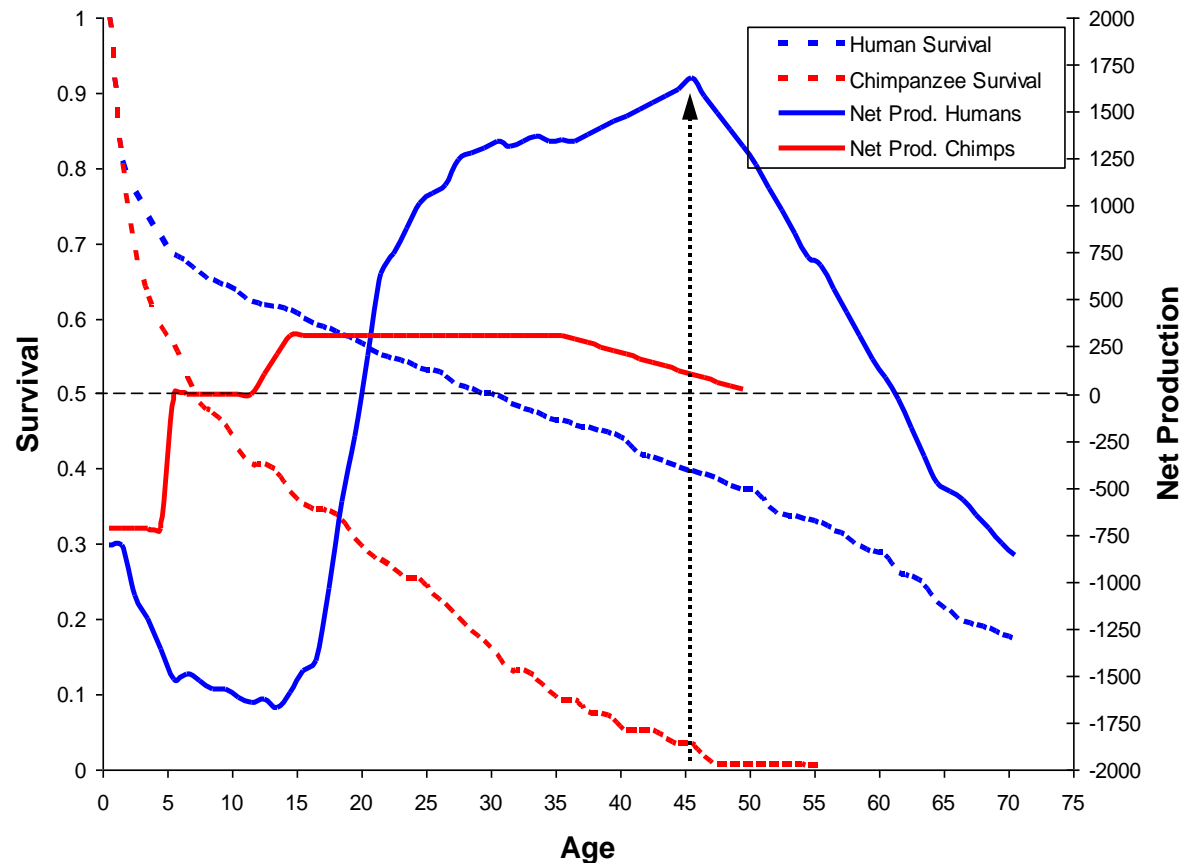


Figure 5. Comparison between hunting return rate and strength, an equally weighted composite measure of weight, grip strength, arm diameter, 50-m dash speed, push-ups, pull-ups, and chin-ups for 71 men. Both return rate and strength are on the scale of percent of adult maximum. Recall that sample sizes for hunting return rate at later ages are small.

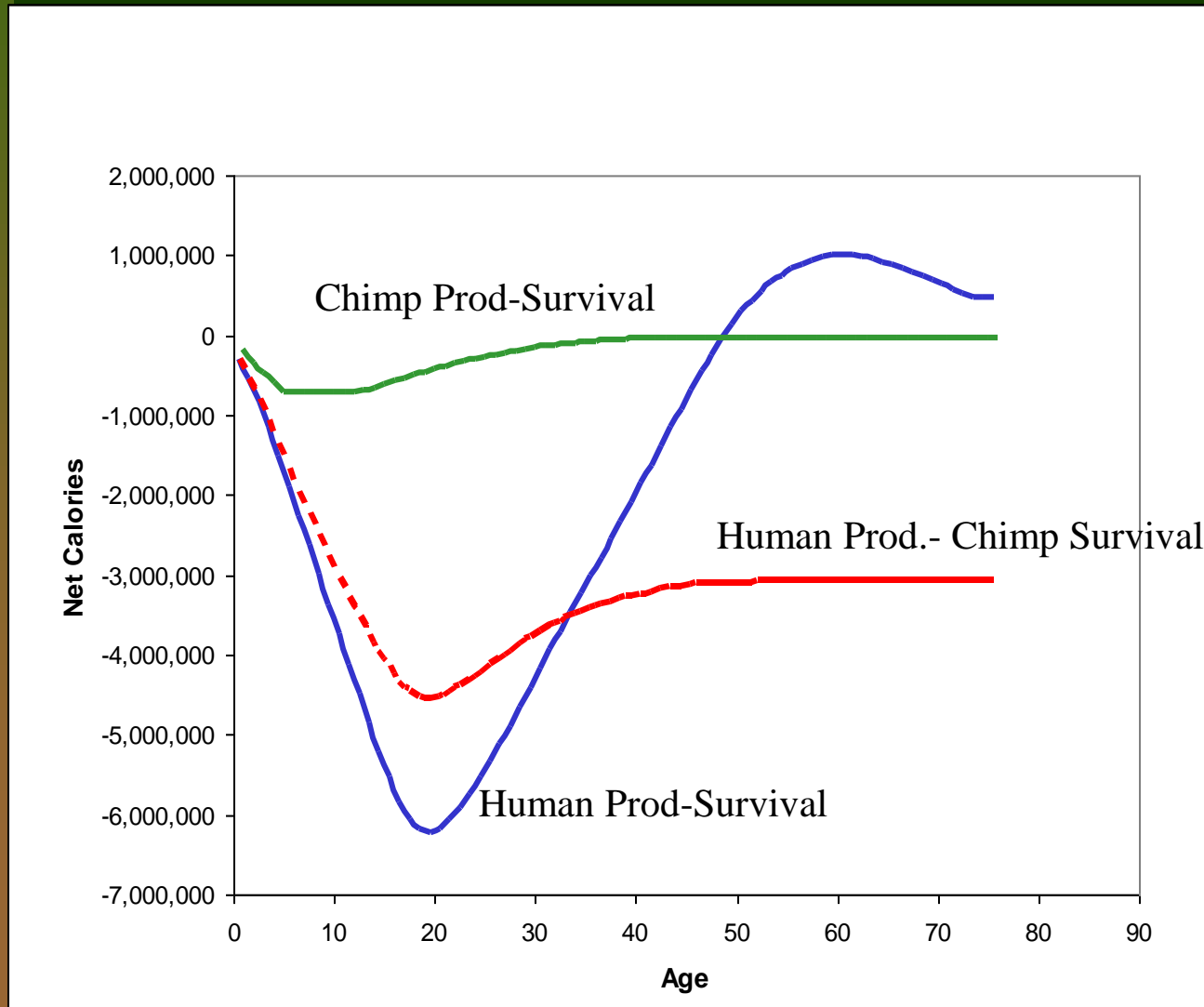
Production and Consumption over the Life Course



Net Food Production and Survival: Human Foragers and Chimpanzees



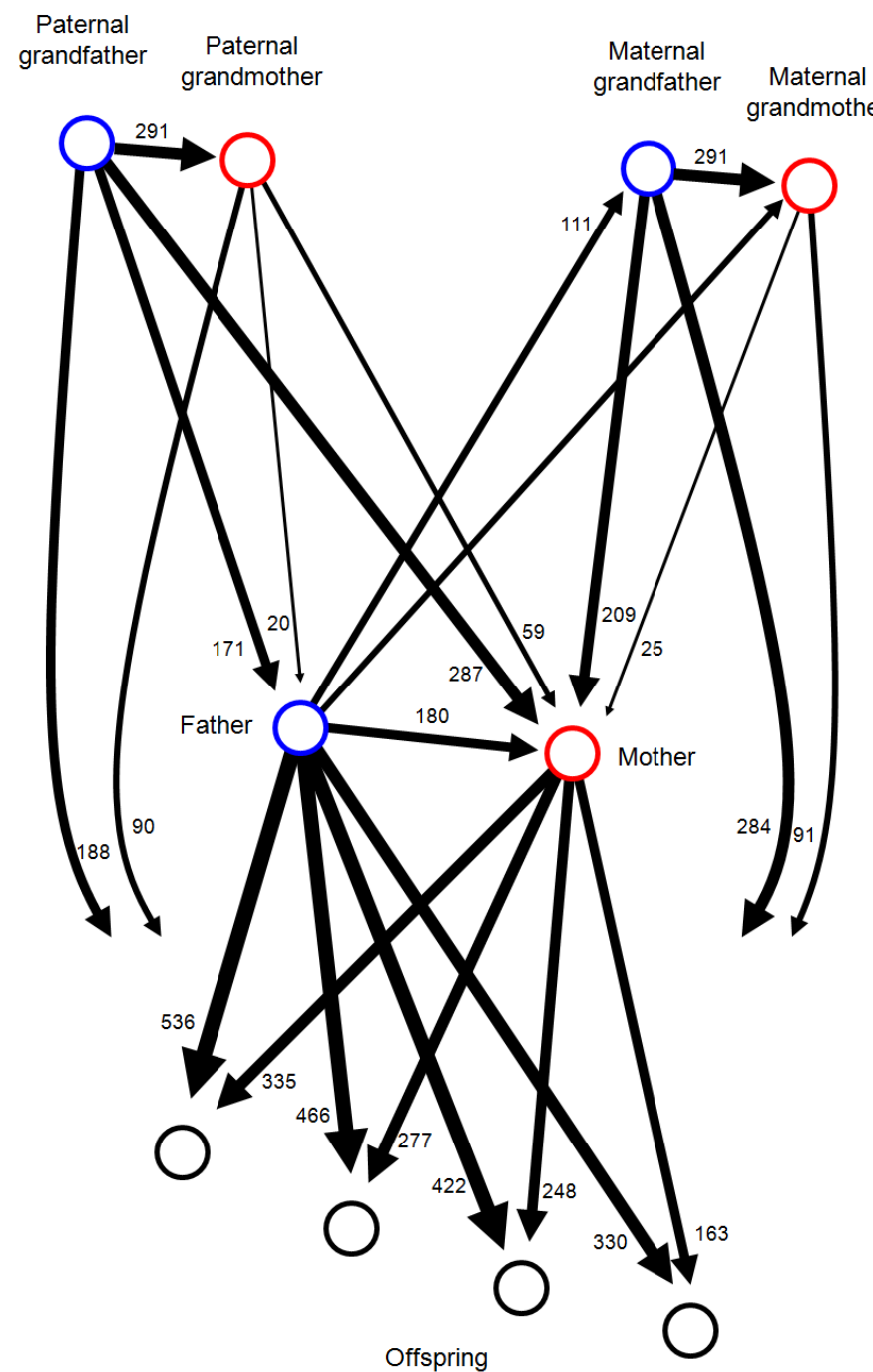
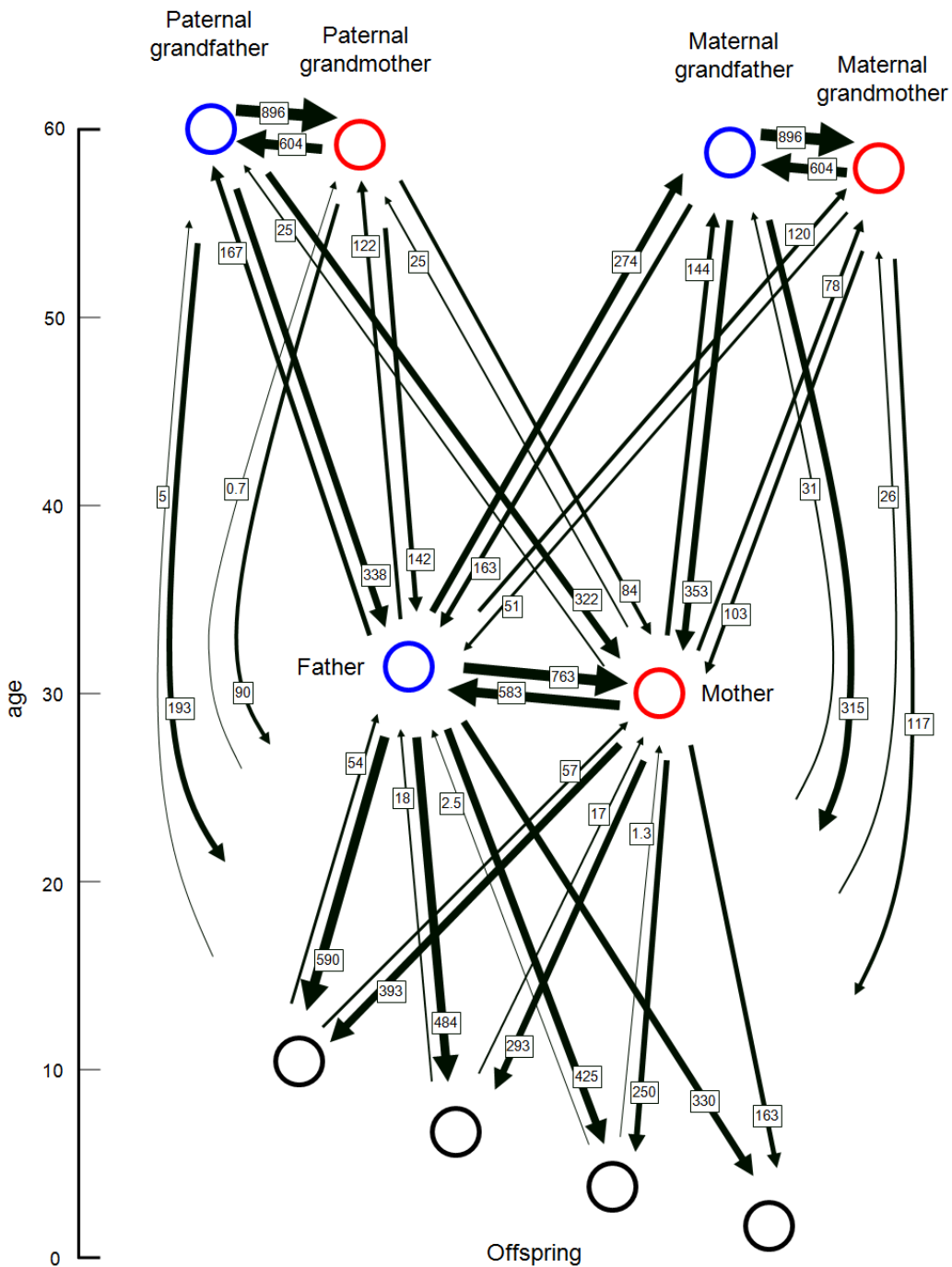
Cumulative Expected Net Caloric Production by Age: Humans and Chimpanzees



Percent Food Contributions by Sex among Forager Adults: 10 Societies

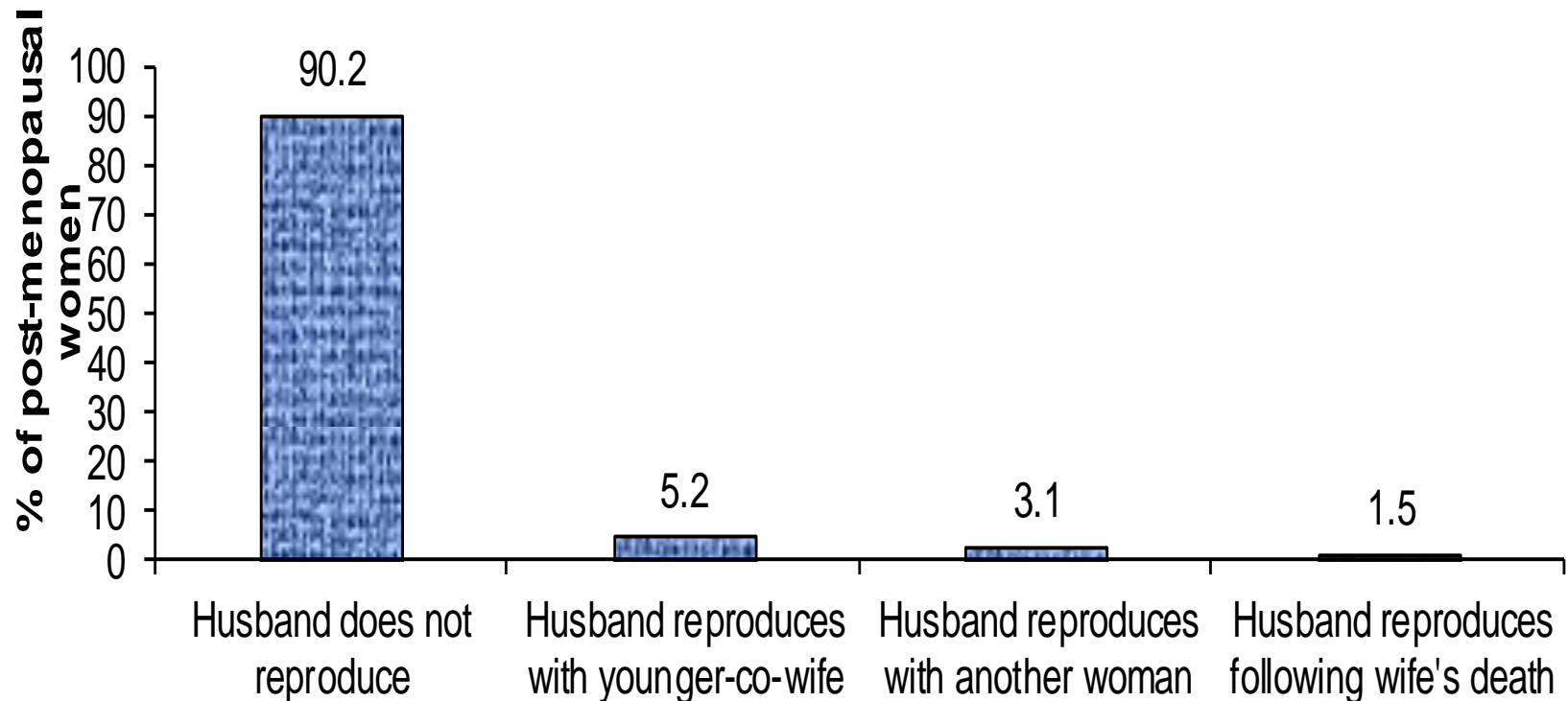
Food	Males	Females
Calories	68	32
Protein	88	12
Calories For Offspring	97	3
Protein for Offspring	100	0

Ache women spend more than 90% of time in tactile contact with infants



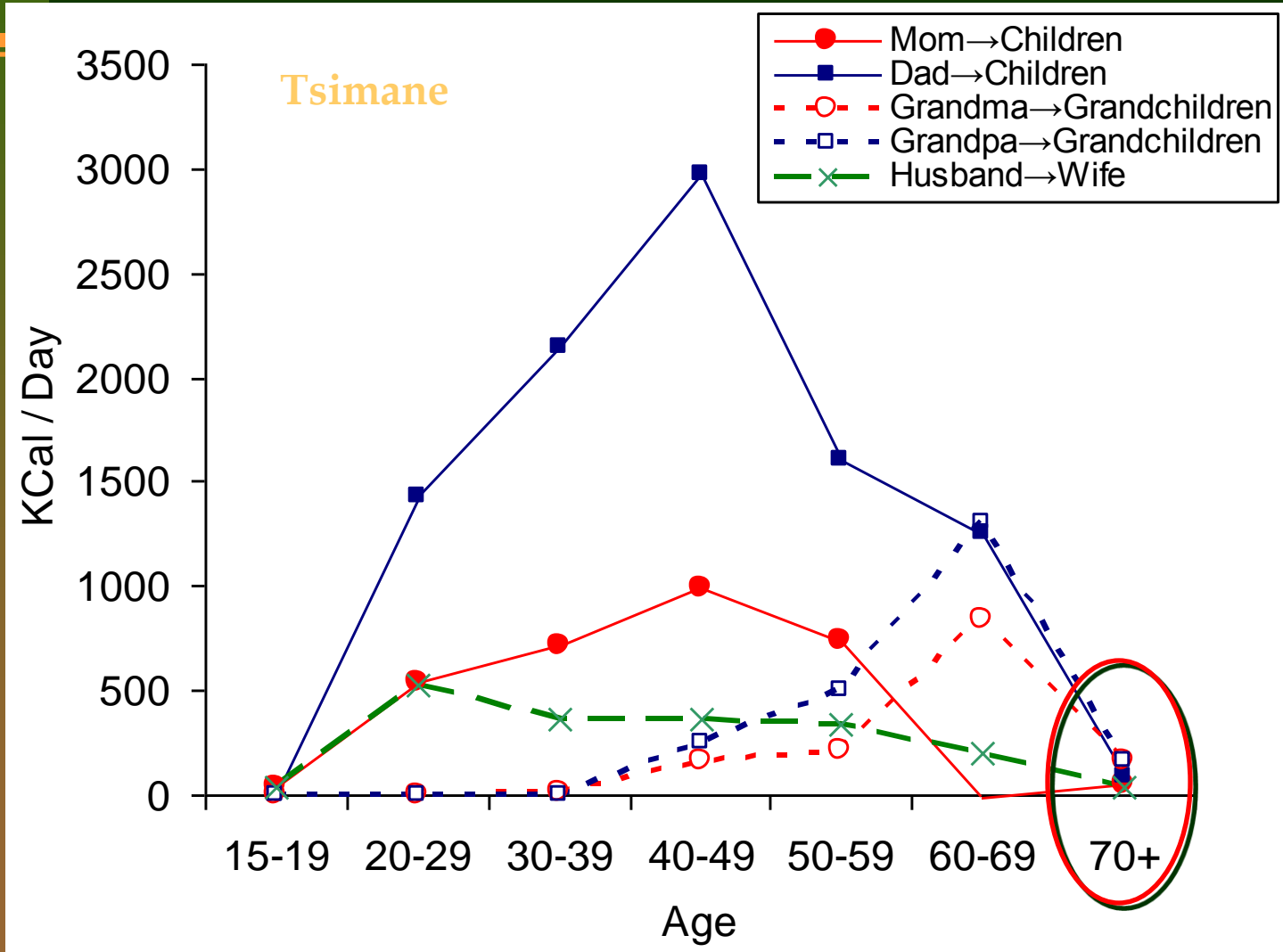
Male Reproductive Cessation: Tsimane

Men's reproductive behavior following wife's menopause (n=194 women)

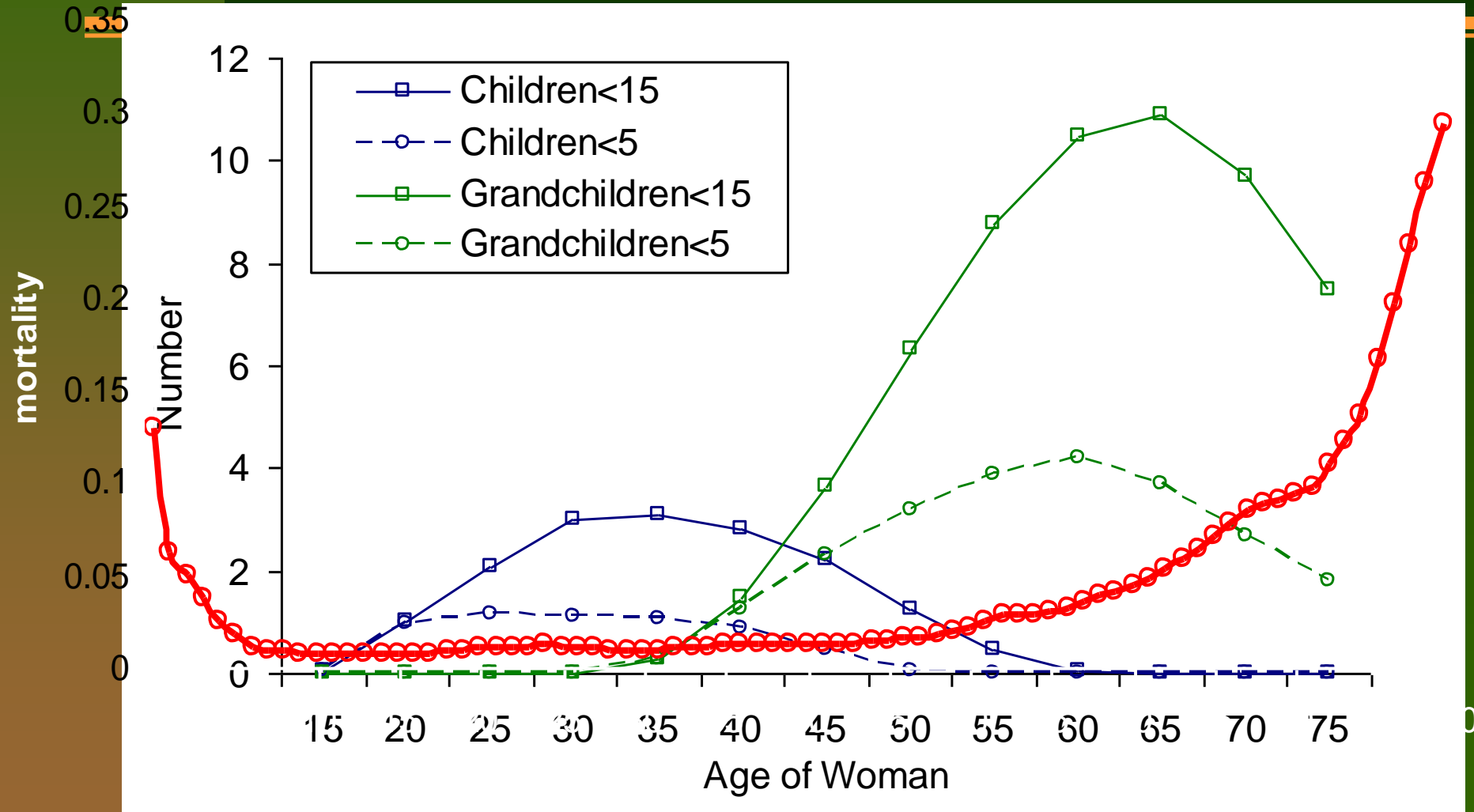


Without menopause, there would not be enough food to support children

Intergenerational Resource Transfers



Expected Number of Descendents: The Benefit Side



(Gurven and Kaplan 2007, *PDR*)

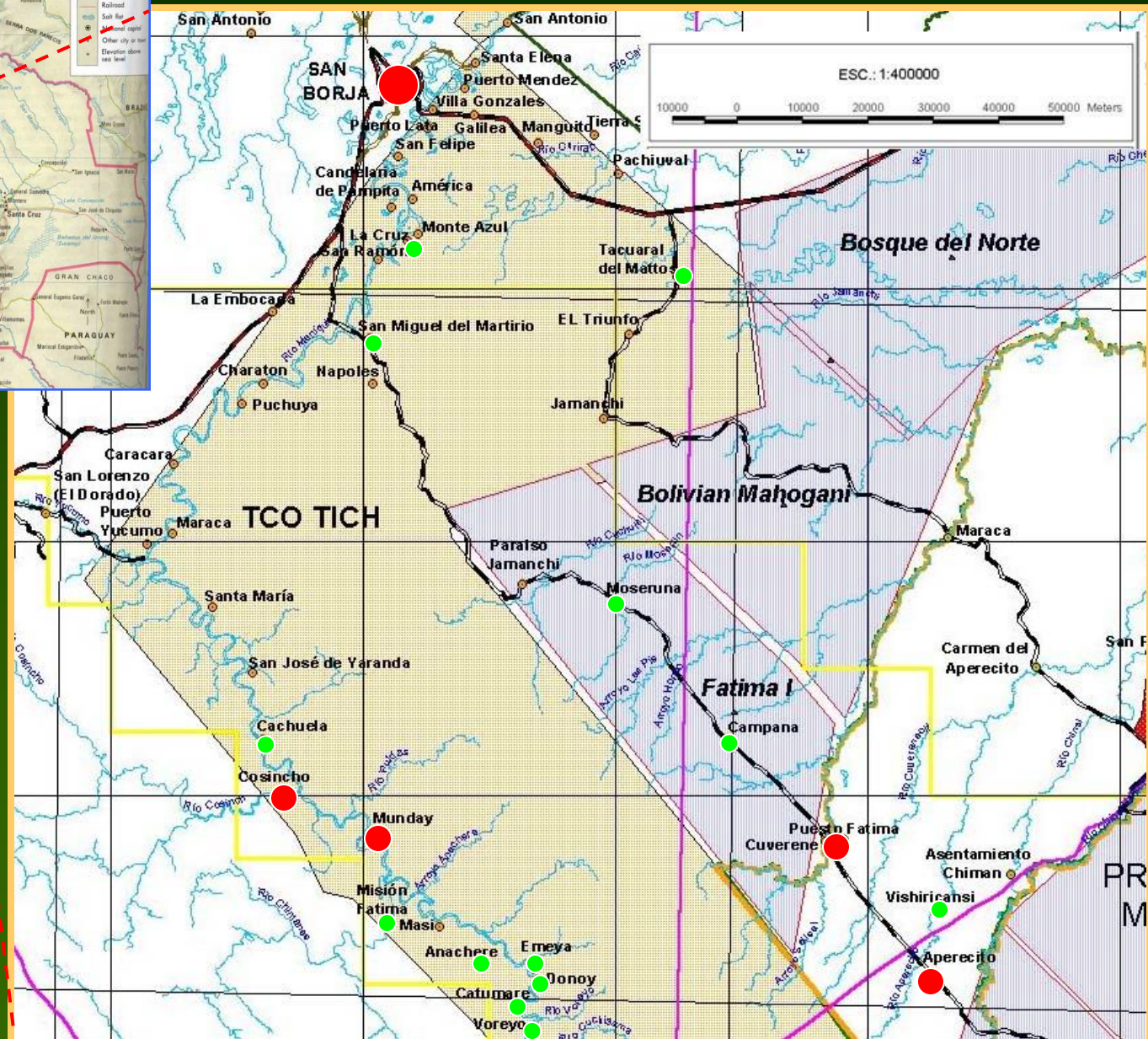
Aging, intergenerational transfers and the 70 year lifespan

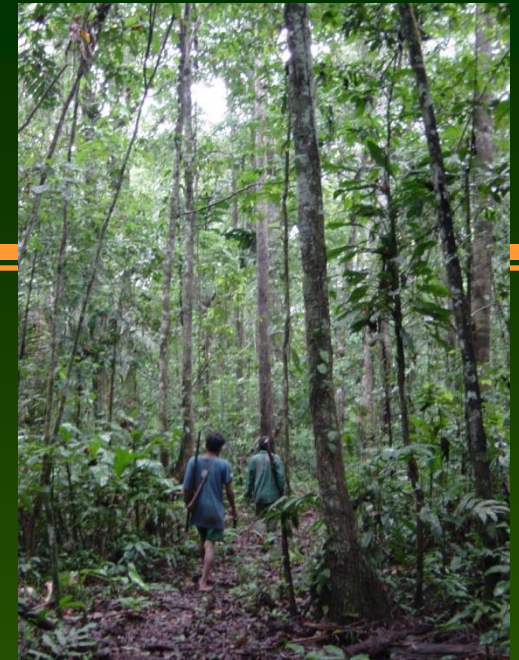
- Both men and women engage in reproductive cessation
- Reproductive cessation is necessary for maintaining economic viability of human life history.
- Older adults are net producers to about age 70
- Reduction in production results from physical decline
- There are net downward transfers in three generations
- Downward transfers terminate at age 70
- Number of dependent grandchildren declines dramatically after age 65, just when mortality rates climb sharply.

What Causes Death among the Aged

- What are the relative roles of infectious and chronic diseases in causing death among traditional subsistence populations
- Cardiovascular diseases represents 30% of all deaths worldwide (15 million deaths/year) and the majority of Westerners 60+ have fully developed atherosclerosis
- If people survived the infectious diseases of childhood, would they have experienced heart disease and cancer in the past ?

A map of South America with a red box highlighting the central region, including Peru, Ecuador, and northern Brazil. The map shows major cities, rivers, and geographical features. A dashed red line runs diagonally across the map, separating the highlighted region from the rest of South America.











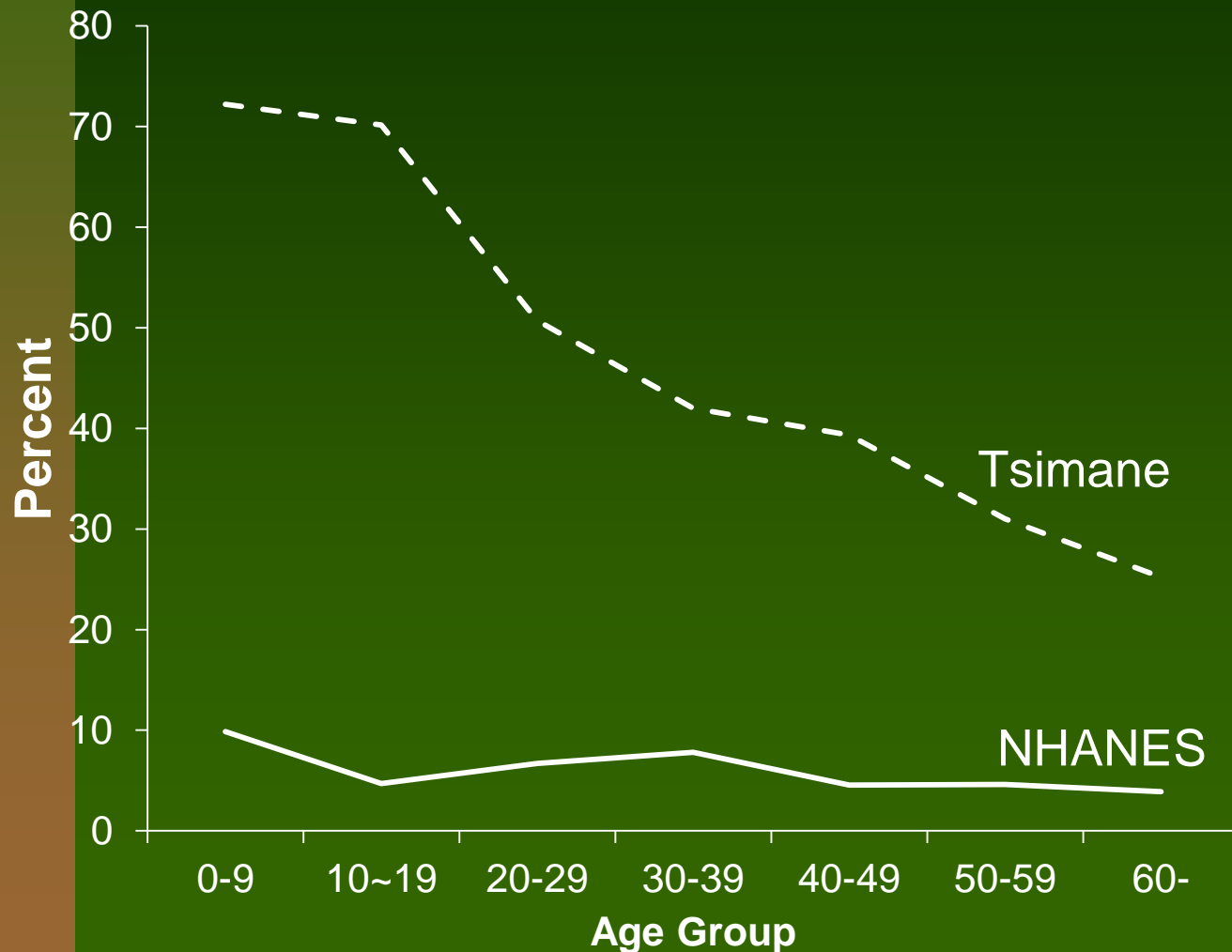




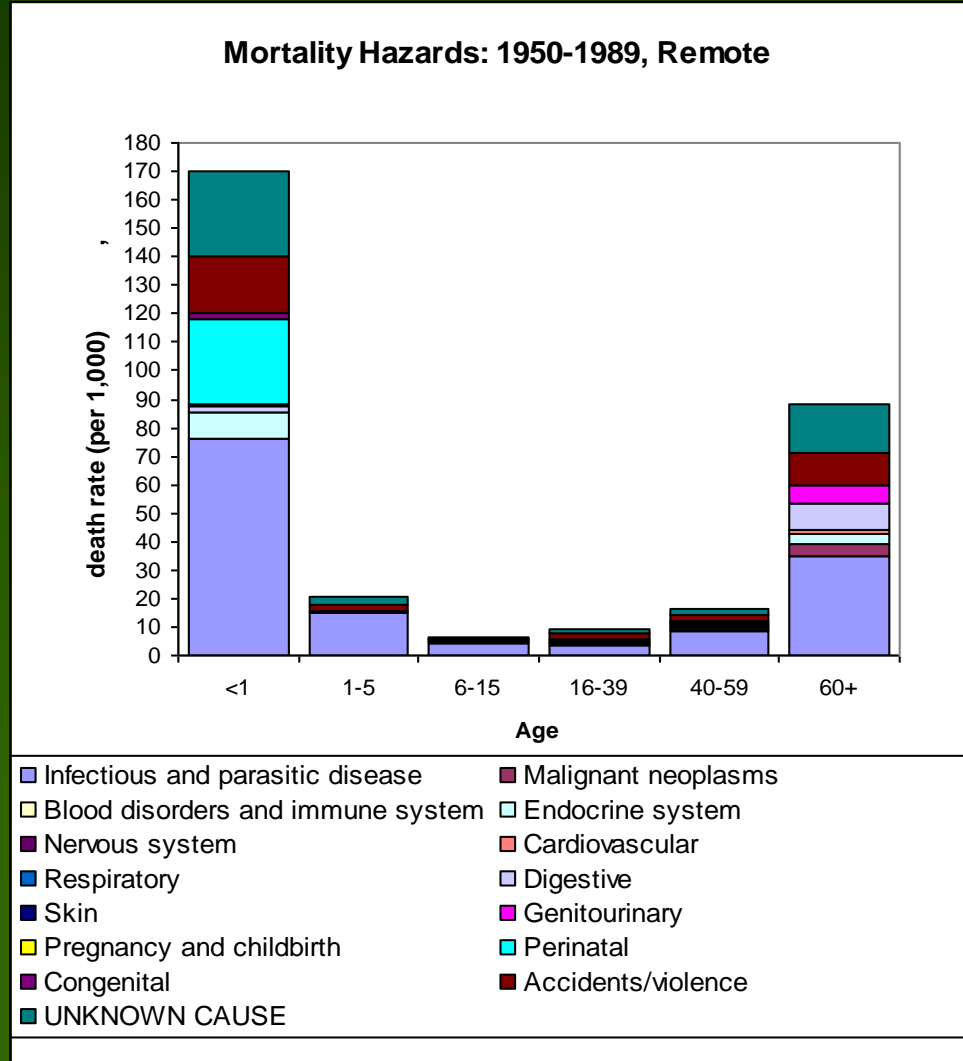




Percentage of Individuals with elevated ($>10,800$ cells/ μ l) white blood cells: Tsimane vs NHANES

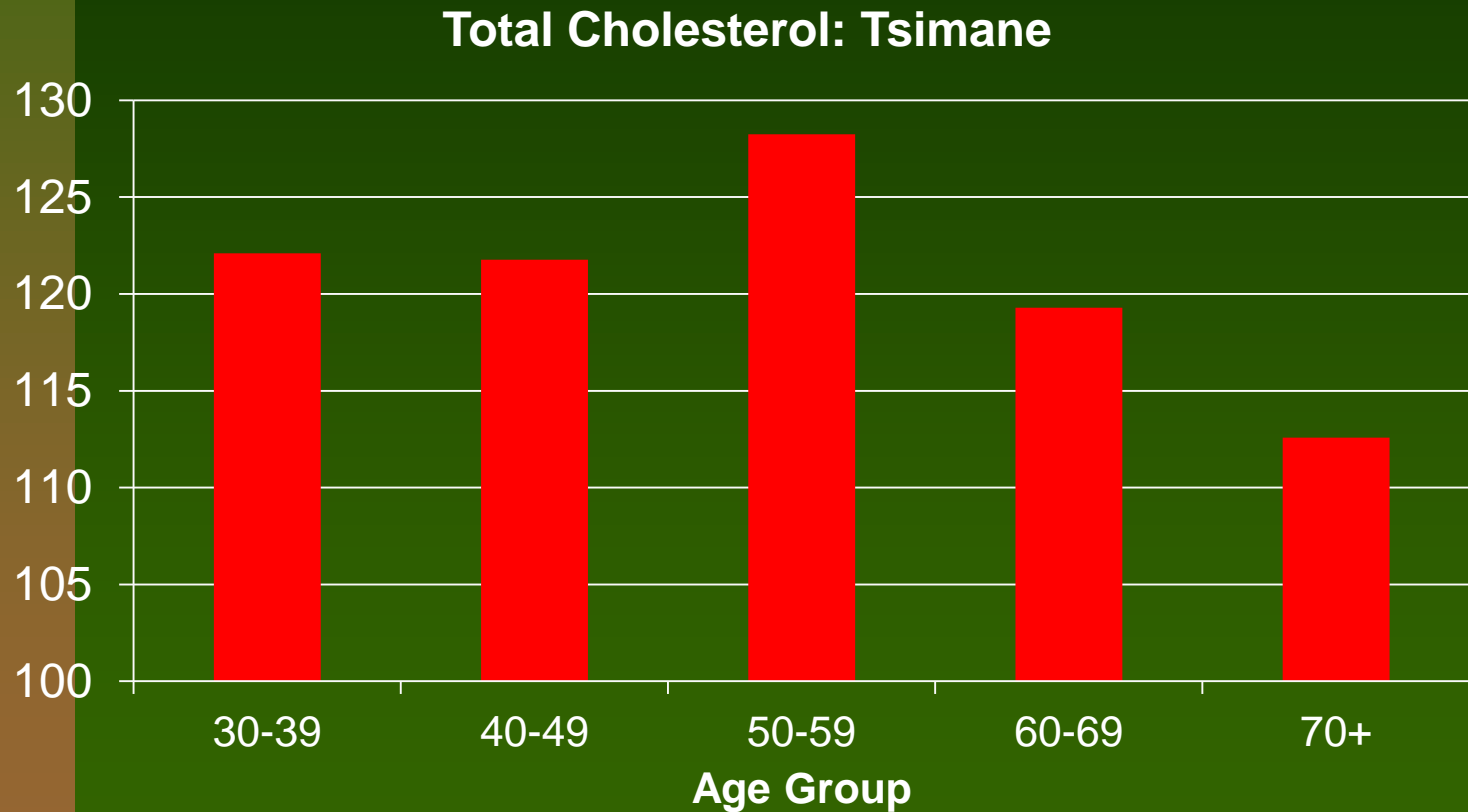


Mortality Hazards from Specific Causes: 1950-1989



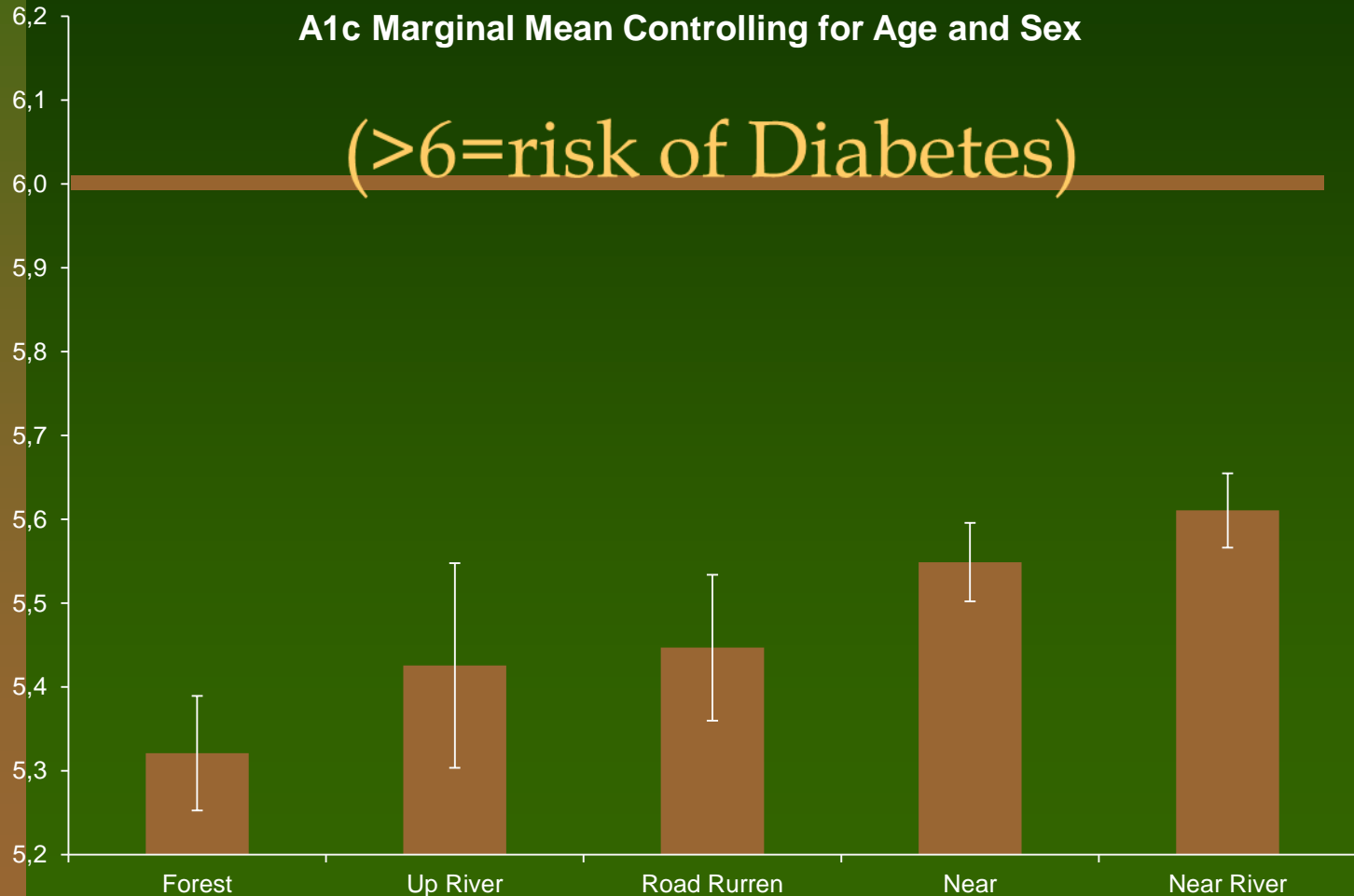
Infectious disease is the major cause of death, affecting infants and elderly most

Low Rates of Obesity and Cholesterol



[illegible]

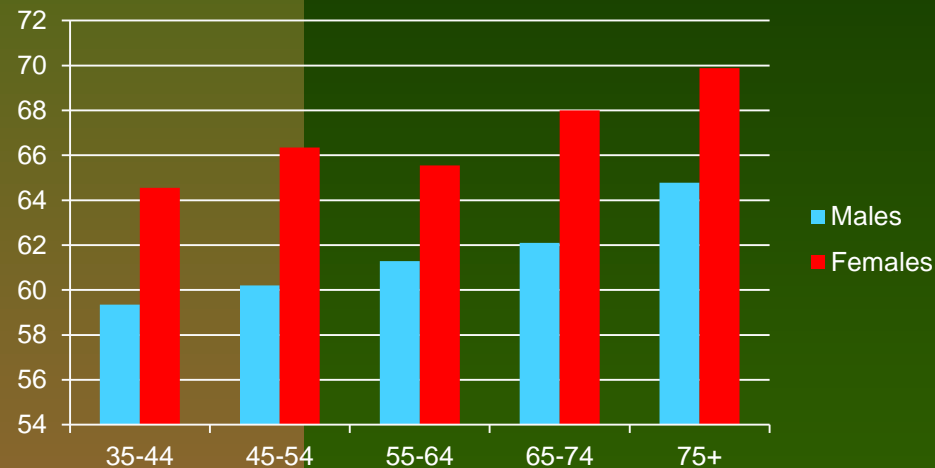
Blood Sugar (Glycated Hemoglobin) by Region



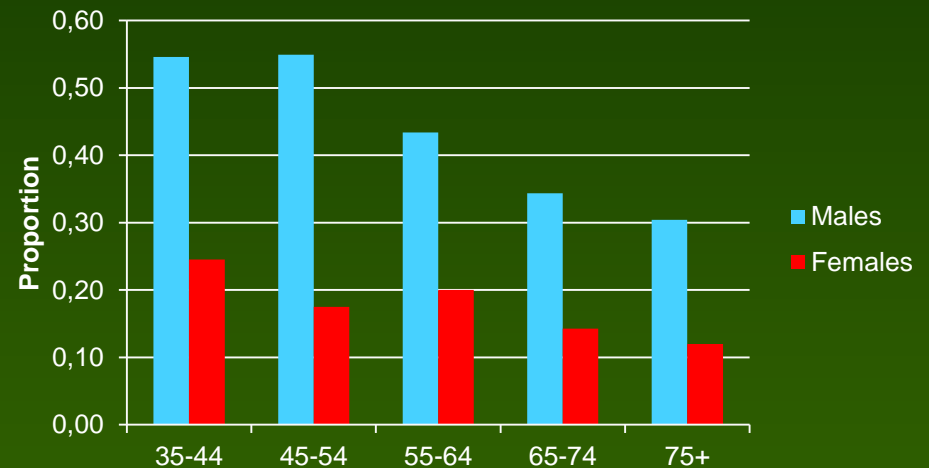
Closeness to Town: Acculturation Gradient

Bradycardia: Heart Rate < 60

Resting Heart Rate (N=972)



Resting Heart Rate < 60



Highlights: Infectious and Cardiovascular disease among Traditional Peoples

- Infectious disease is the major cause of death, with the highest risks of mortality for infants, children and the elderly; the immune system ages more quickly than in westerners.
- However, hearts are healthy and cardiovascular aging is slower
 - Low levels of obesity and cholesterol .
 - Hypertension and diabetes are rare.
 - Aerobic fitness is high and heart rate is low
 - Heart attacks are almost absent
 - Systolic function (ejection of blood) is well preserved
 - Diastolic function (Filling stage) reveals heart aging, but 65 year old Tsimane is comparable to 45 year old Londoner
- Many people survive to old age without heart disease.

The Future and Achieving the “Health Sweet Spot”

- Human development and aging follow a clear species-specific pattern, but health and mortality causes differ significantly between pre-modern and modern societies
 - Is there a health sweet spot in which cardiovascular, immune, muscular, osteological and nervous function is maintained at the highest rate and ages at the slowest rate?
 - What is the optimal level of stress for each system?
 - What factors will determine people's lifestyle choices and how they trade off today's satisfaction against tomorrow's health?
 - Interdisciplinary research is necessary to answer these questions.

Grazie!
