

SUPPORTING INFORMATION

Food security for an ageing and heavier population

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Dataset S1. Tables with adult population, and average food energy requirements, weight, height and age at the global and national levels. (as Excel file)

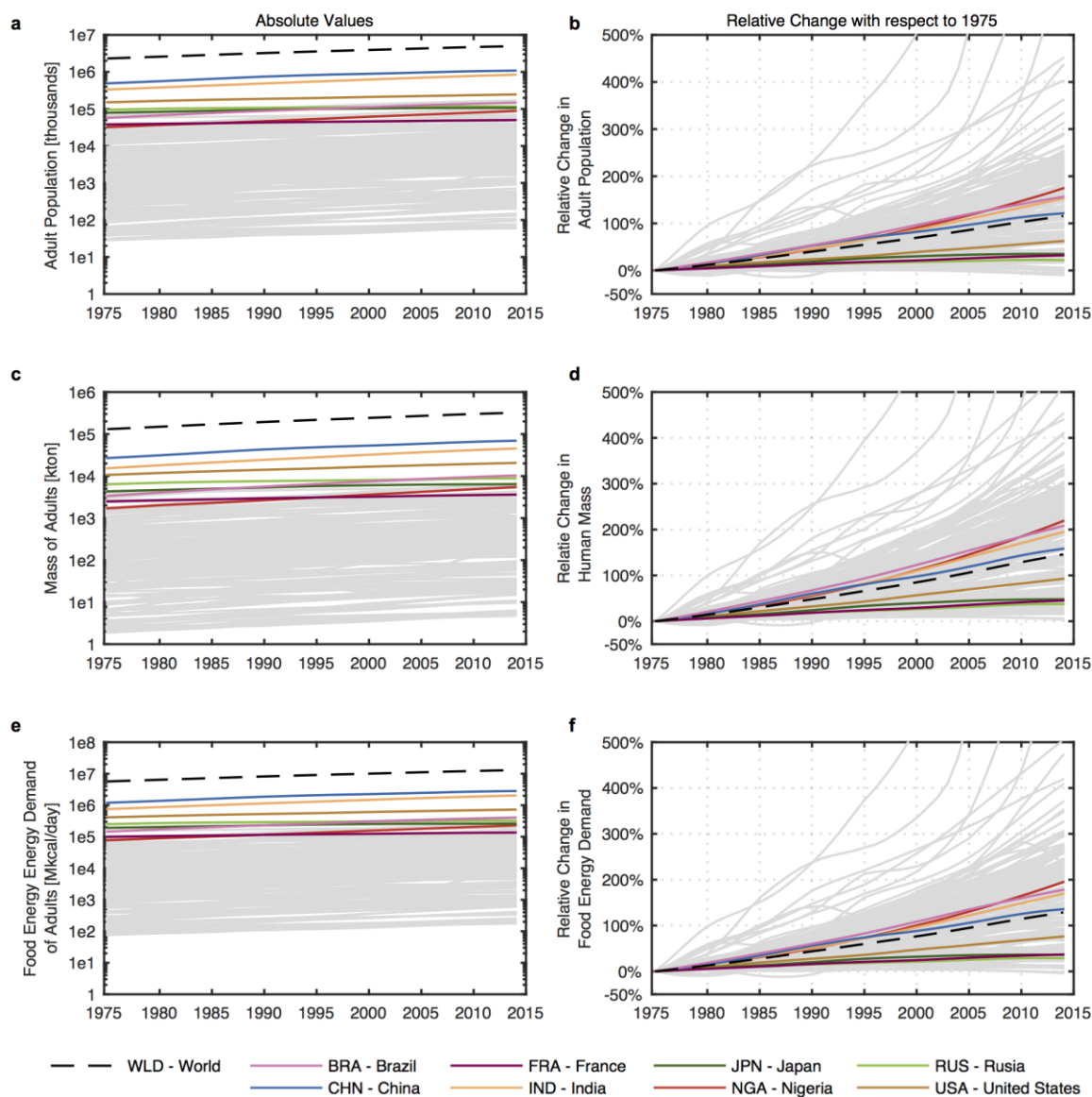


Figure S1. Absolute values (left - a,c,e) and relative changes (right - b,d,f) in total adults' population (a,b), mass (c,d) and food energy demand (e,f).

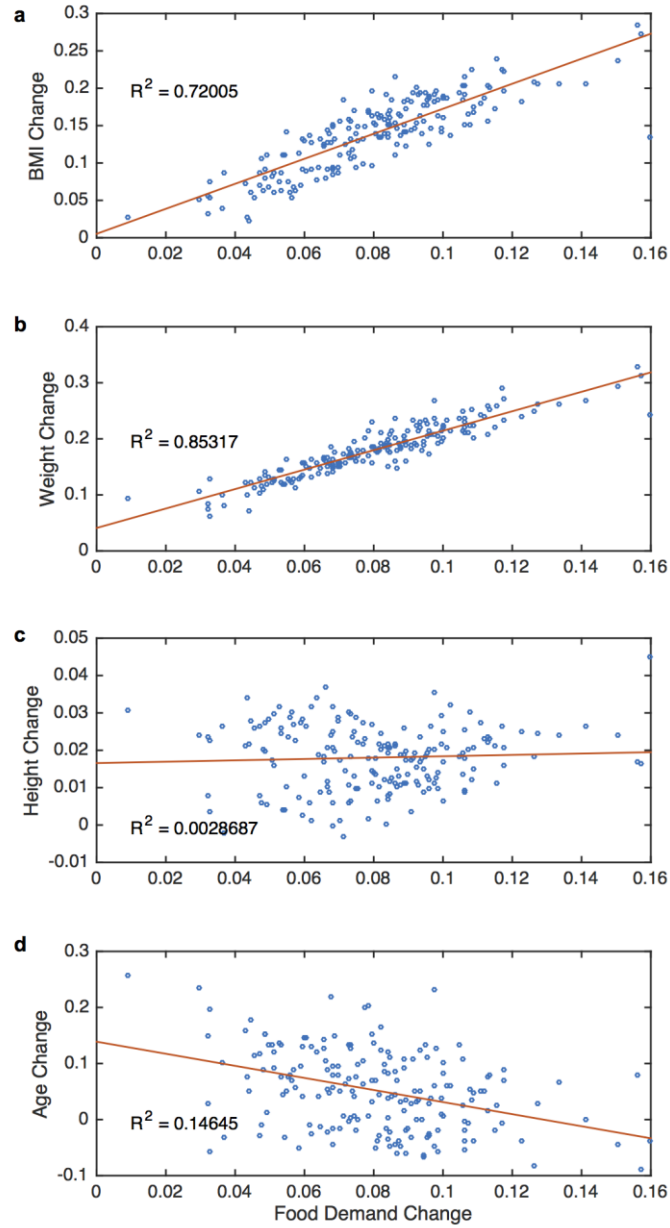


Figure S2. Linear correlation analysis between relative changes in body mass index (a), weight (b), height (c), and age (d) and relative changes in food energy demand. Changes in 2014 with respect to 1975 are studied. Each circle (blue) represents one country. The orange line is the linear fit with the R-squared displayed in the plot.

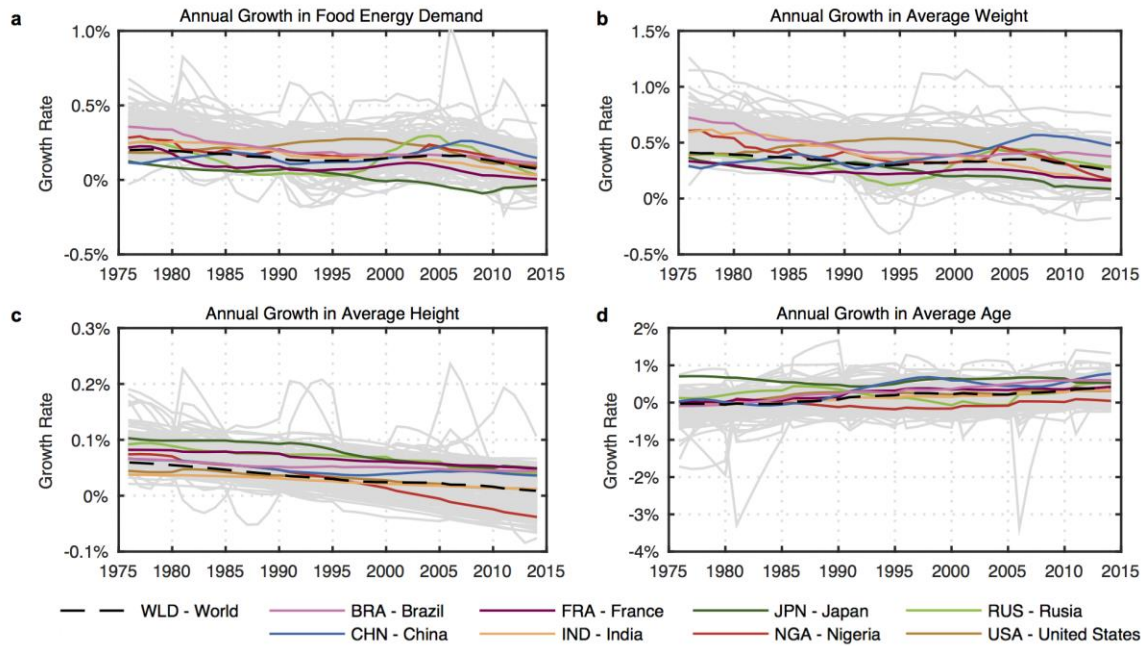


Figure S3. Growth rates in food energy demand (a), average weight (b), average height (c), and average age (d) of adults.

Demographic Modelling

Figure S4 presents a system definition for the study of the population stock and flows in given region. Six variables are considered: the Population Stock (P), the Population Stock Change (ΔP), Births (B), Deaths (D), Immigration (I) and Emigration (E).

The equations that explain each of the variables or the relationship among them are a generalization synthesized from different approaches found in literature ¹⁻⁵. Accordingly, this method does not intend to provide a complete description of all demographic phenomena, but instead to communicate the essentials of demographic modelling and to illustrate the use of a common mathematical language with socioeconomic metabolism modelling. Similarly, the terminology and notation greatly vary between authors in the field ⁴, and thus here the most general terms have been selected.

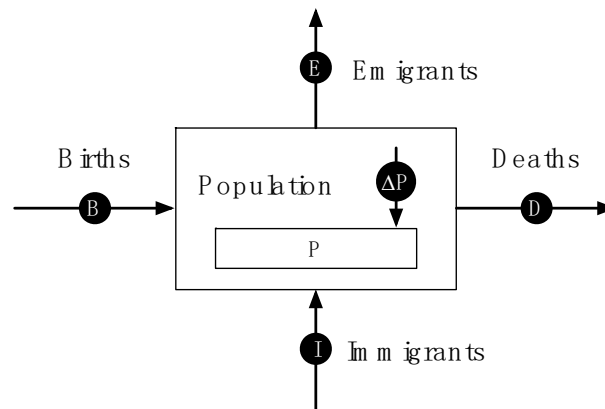


Figure S4 Classic demographic system definition. P and ΔP represent the population stock and its stock change respectively.

Balance Equation

In a region, the population (P) at the end of a given year “t” is the result of balancing the births (B), deaths (D), immigrants (I) and emigrants (E) of that year with population of the previous year, using the so-called demographic or population balancing equation ^{2,3,6} (Eq. 1).

$$P_t = P_{t-1} + B_t - D_t + I_t - E_t \quad (\text{Eq. 1})$$

Intrinsic Equations

Because the population is composed of individual of different sex “i” from different cohorts “c”, it is also true that the population of a year “t” is the sum of the population of different sexes and cohorts (Eq. 2), and likewise the population change (Eq. 3).

$$P_t = \sum_i \sum_c P_{i,c,t} \quad (\text{Eq. 2})$$

$$\Delta P_t = \sum_i \sum_c \Delta P_{i,c,t} = \sum_i \sum_c (P_{i,c,t} - P_{i,c,t-1}) \quad (\text{Eq. 3})$$

Model Approach Equations

The total number of births in a year depends on the number of women “i=women” of each age and their age-specific fertility rate (FR) ⁴ (Eq. 4). This rate represents a woman’s probability to have children, which vary along their life, and can be different across women of different cohorts.

$$B_t = \sum_c P_{i=women,c,t} \cdot FR_{c,t} \quad (\text{Eq. 4})$$

The probability of dying is also a function of the age of a person and can vary across cohorts along with changes in the life expectancy ^{2,4}. Therefore, deaths are estimated using a death or mortality rate (DR) (Eq. 5)

$$D_t = \sum_i \sum_c P_{i,c,t} \cdot DR_{i,c,t} \quad (\text{Eq. 5})$$

Finally, immigration and emigration can also be estimated from migration rates ¹, in a similar fashion as for births and deaths.

Glossary

Definitions based on the Food and Agriculture Organization^{7,8}

Anthropometry. Use of human body measurements to obtain information about nutritional status.

Body mass index (BMI). The ratio of weight-for-height measured as the weight in kilograms divided by the square of height in meters.

Birth cohort: A group of people born during a particular year

Bio-demography: is a new branch of human (classical) demography concerned with understanding the complementary biological and demographic determinants of and interactions between the birth and death processes that shape individuals, cohorts and populations.

Dietary energy requirement (DER). The amount of dietary energy required by an individual to maintain body functions, health and normal activity. .

Basal Metabolic Rate. Human energy requirements are computed by multiplying normative requirements for basic metabolic rate (BMR, expressed per kilogram of body mass) by the weight of a person given height, age and sex and then multiplied by a coefficient of physical activity level.

Kilocalorie (kcal). A unit of measurement of energy. One kilocalorie equals 1 000 calories. In the International System of Units (SI), the universal unit of energy is the joule (J). One kilocalorie = 4.184 kilojoules (kJ).

Food insecurity. A situation that exists when people lack secure access to sufficient amounts of safe and nutritious food for normal growth and development and an active and healthy life. It may be caused by the unavailability of food, insufficient purchasing power, inappropriate distribution or inadequate use of food at the household level. Food insecurity, poor conditions of health and sanitation and inappropriate care and feeding practices are the major causes of poor nutritional status. Food insecurity may be chronic, seasonal or transitory.

Food security. A situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life. Based on this definition, four food security dimensions can be identified: food availability, economic and physical access to food, food utilization and stability over time.

References

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