UNIVERSIDAD DE COSTA RICA

CRELES Pre-1945

Costa Rican Longevity and Healthy Aging Study Methods, Wave 3

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The Costa Rican Longevity and Healthy Aging Study (CRELES, or *Costa Rica Estudio de Longevidad y Envejecimiento Saludable*) is a nationally representative longitudinal survey of health and life-course experiences of 2,827 Costa Ricans ages 60 and over in 2005. Baseline household interviews—the wave 1 survey—were conducted between November 2004 and September 2006, with 2-year follow-up interviews. The first follow-up, or wave 2, took place from October 2006 to July 2008, rendering 2,364 elderly people interviewed plus 269 interviews of family members of deceased participants. Loss of follow up between waves 1 and 2 thus represented 7%. The wave 3 interviews took place from February 2009 to January 2010 with 1855 complete interviews plus 255 interviews of family members of deceased participants. Loss of follow up between waves 2 and 3 thus represented 9% of the baseline sample.

The study was conducted by the University of Costa Rica's *Centro Centroamericano de Población* (CCP) in collaboration with the *Instituto de Investigaciones en Salud*, with the support of the Wellcome Trust (grant 072406). The Principal Investigator is Luis Rosero-Bixby, with Co-Principal Investigators Xinia Fernández (University of Costa Rica) and William H. Dow (University of California, Berkeley).

The baseline sample was drawn from Costa Rican residents in the 2000 population census who were born in 1945 or before. It was stratified by 5-year age groups in order to have similar sample sizes in each age group, which implies over sampling of older people. All centenarians were included in the sample. The main study objective was to determine the length and quality of life, and its contributing factors in the elderly of Costa Rica. Vital statistics indicate that Costa Rica has an unusually high life expectancy for a middle-income country, even higher than that of the United States, but CRELES is the first nationally representative survey to investigate adult health levels in Costa Rica. CRELES public use data files contain information on a broad range of topics including self-reported physical health, psychological health, living conditions, health behaviors, health care utilization, social support, and socioeconomic status. Objective health indicators include anthropometrics, observed mobility, and biomarkers from fasting blood (such as cholesterol, glycosylated hemoglobin, and C-reactive protein). The third wave did not collected blood, however. Mortality events are tracked and conditions surrounding death are measured in surviving family interviews in waves 2 and 3.

Note: the data files for waves 2 and 3 do not include characteristics that are fixed over time, such as education, children ever born, and childhood conditions. These characteristics were not surveyed in the re-interviews. The information about these characteristics is available in the baseline (wave 1) data files.

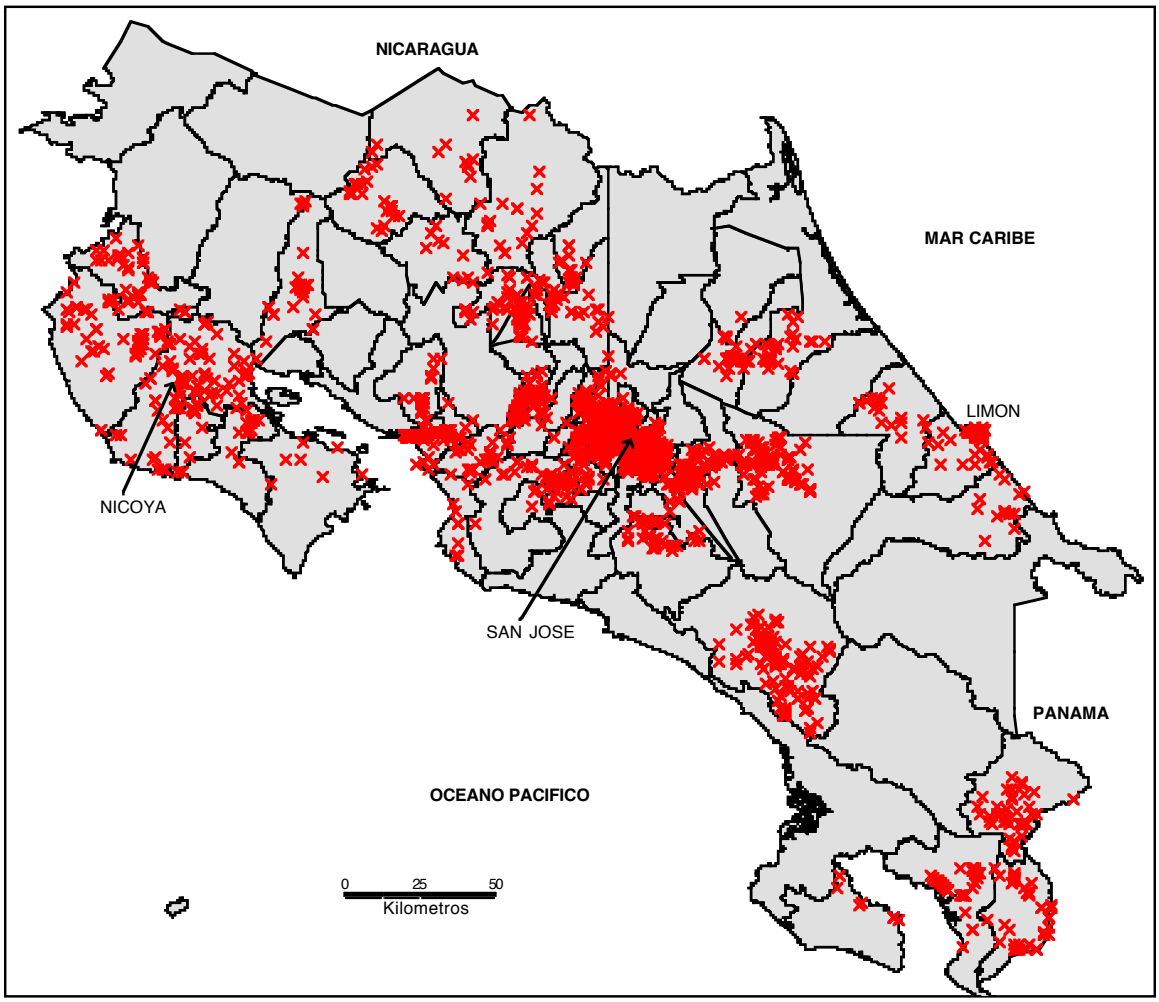
Design of the baseline sample

In the first stage of the design model, a random selection was made from the database of the Census of Population of the year 2000, totaling 9,600 individuals 55 years of age or older, after a stratification by five-year age groups that assures a sufficiently large number of observations for advanced ages. The sampling fraction in this selection varies between 1% for the ones born in 1941-1945 and 100% for the ones born before 1905. For the detailed longitudinal follow-up, including the baseline CRELES survey to which the present report refers, a sub-sample was selected consisting of 60 "Areas of Health" (from a total of 102 in the whole country) aggregated into sub-regions. The sample covers 59% of the national territory. The map in figure 1 shows the zones in the country included in CRELES and the location of the participants.

The sub-sampling for the longitudinal study originally included nearly 5,000 individuals from the census of 2000; of those, it was possible to locate and to interview 2,827. The non-interview rates are comprised of: 19% deceased by date of contact, 18% were not located in the field (due mainly to the lack of accurate addresses), 2% had changed residence, 2% declined to be interviewed and 2% of interviews were pending after several

visits (that in fact are veiled rejections). The 20% non-interviewed due to change of residence or non-located was concentrated among the younger ages and it varies by urban and social condition. To correct this distortion and to take into account the different sample fractions by age, non-response weights (variable named "ponderador") were determined by age, sex, urban residence and two education groups (schooling less than 6 years and schooling 6 years or more). These weights reproduce the structure by sex, age, residence and education of the whole 2005 population of Costa Rica born in 1945 or before. The weights were normalized so they reproduce the sample size of 2,827. These weights varied from a minimum of 0.07, for men 95 years of age and older with low education, to a maximum of 3.85 for rural men age 60-64 with high education.

Figure 1. Map of the health areas of Costa Rica and the interviewees in CRELES



The sample in wave 3

The final sample size of completed interviews for the third wave totals 1,855 surviving participants plus 255 interviews of family member of deceased participants. The number of participants lost between wave 2 and 3 was 241 (an additional 13 had died but no interview was conducted with their family), which represents an 8.5% attrition rate of the baseline sample or 10% attrition of the wave 2 sample. Interviews at wave 3 did not attempt to re-contact those who had been lost between waves 1 and 2. Sampling weights were established for wave 3 following an analogous procedure as for the baseline sampling; i. e. forcing the weighted sample to reproduce the Costa Rican population in 2009 by 5-year age groups, sex, two educational groups, and residence in the great metropolitan area of San Jose (GAM). The weights were normalized so they also reproduce the sample size of 1,855. These weights varied from a minimum of 0.06, for participants aged 95 years or more

with low education and residence out of the GAM, to a maximum of 3.5 for participants aged 64-69 with secondary education and residence in the GAM.

The sampling weights specific for each wave (variables "ponde_r2" and "ponde_r3") must be used when computing population estimates for 2007 with wave 2 or 2009 with wave 3 data. In prospective longitudinal analyses, however, is advisable to use the sampling weights provided for the baseline or wave 1 survey. The sampling weights are available in the tracking data file named "trackCRELES-public".

Table 1 compares selected CRELES data (weighted) from the baseline or first wave of interviews with the July 2005 Costa Rican Household Survey for Multiple Purposes (EHPM), an annual research effort conducted by the Costa Rican Institute of Statistics and Census (INEC) in a national sample representing more than 12,000 homes. The table also compares the weighted results of wave 3 with the EHPM of 2009 and the 2011 census. An acceptable degree of concordance exists in most variables. The exceptions are significantly higher proportions of household heads, married and working participants in the CRELES-wave 3 sample. These differences might be true differences or just artifacts of the different data collection instruments used. For example, the higher proportion of household heads in CRELES (66% compared to 60% or 61% in the other databases) may be because in CRELES the informant is the elderly person who may perceive themselves as household head, while in EHPM and census it can be another person with a different perception of who is the head of the household.

Table 1: Comparison between CRELES and the EHPM
(Population born before mid-1945)

	CRELES Wave 1	EHPM 2005	CRELES Wave 3	EHPM 2009	Census 2011
(N)	(2,827)	(3,834)	(1,855)	(3,215)	(311,717)
Age range	60+	60+	65+	65+	65+
Male/female ratio	90.3	88.3	90.5	85.1	86.8
Average age	70.4	70.9	73.8	74.8	74.2
% secondary education or +	21.8	23.1	23.8	21.7	25.8
% in urban area	62.6	62.2	63.2	66.4	…
% in households <3 members	38.5	39.6	42.7	44.2	44.7
% head of household	65.7	60.4	65.7	61.6	61.7
% married	60.3	57.2	57.4	52.2	53.4
% widowers	21.4	22.6	24.9	26.1	24.6
% in the labor force	29.4	26.2	22.8	15.1	13.4

EHPM = Costa Rican Household Survey for Multiple Purposes, source database in Internet.
Both EHPM and CRELES corrected for sampling weights

Field Work

All the data (and specimens in previous waves) were gathered in the homes of the participants. In the first wave of visits participants granted their informed consent by means of their signature and in a form approved by the Bio-ethics Committee of the University of Costa Rica. The main questionnaire took about 90 minutes to administer in the first wave and about 60 minutes in the third wave. Participants also answered a short (about 10 minute) frequency of food consumption questionnaire for 30 tracer foods. Blood pressure was measured twice during the main interview. A separate form collected the data on anthropometric measurements were taken and mobility and grip strength tests.

At the beginning of the main interview a cognitive evaluation was included, which, together with the interviewer's criteria, established whether or not a "Proxy" informant for the participant was needed to help respond to the survey. Of the interviews, 26% were conducted with the help of a Proxy in wave 3.

All the data from the fieldwork were recorded using handheld Palm computers or "Personal Digital Assistants" (PDAs), with a software application developed at the *Centro Centroamericano de Población* for this study. This included the main questionnaire which featured complex skip patterns and linkages. During CRELES pilot work the questionnaire answers were recorded in the PDA and on paper simultaneously by two interviewers, yielding an high level of concordance (Hidalgo et al. 2007). The PDA shows on the screen the text of each question that the interviewer should read and, when needed, it also provides instructions. The answers are usually registered in the PDA by pressing on the screen ("tapping") on the selected option from a list, but also it can be registered by entering numbers or text directly in "graffiti" or, if so choosing, into a virtual keyboard. The PDA controls the flow of the interview; that is to say, it skips questions and employs filters based on previous questions. It also executes verifications of consistency programmed ahead of time, and it automatically generates certain variables such as the date and time. The palm computer does not allow recording inconsistent or out-of-range responses, nor does it allow skips in the sequence of questions. The PDAs also contained preloaded data on the location and identification of each sampled participant, thus reducing transcription and identification errors. Data were backup daily in the field and uploaded regularly to allow real-time data quality monitoring during fieldwork.

Also registered in the field were the data of the geographical coordinates of the place of each participant's residence, using GPS devices.

The fieldwork to gather the information of the first round was conducted from November 2004 to September 2006; that is to say, during a period of 22 months. A team of 5 interviewers with a supervisor located the subjects in the sample, completed the informed consent protocol and conducted the interviews and examinations. In waves 1 and 2, a parallel team comprised of two phlebotomists and an interviewer from the first team obtained the fasting blood samples, gathered the overnight urine sample, took the anthropometric measurements, and conducted physical functioning tests. There was no second team in wave 3 since no specimens were drawn. The entire data collection was carried out in the home of the participants.

The questionnaire in the third wave is the same as in the second wave (variable names are kept unchanged), except for the addition in the third wave of a module to measure physical activity and a few other minor additions.

Physical, anthropometric, and mobility and flexibility tests

The following describes materials, equipment and methods used in the physical measurements: blood pressure, anthropometric measurements, flexibility and mobility tests and grip strength. More detail of the tests is available in the interviewer's manuals on the project website: (http://ccp.ucr.ac.cr/creles/index.htm).

Blood pressure
It was measured on two occasions during the main interview, with an average interval time of 20 minutes between each; the measurement was taken using OMRON brand digital monitors with automatic inflating, model HEM-711AC, DuPont (precision: ± 3mmHg) that were calibrated periodically. The bracelet was adjusted to the thickness of the adult's arm.

Anthropometric measurements
These were taken by the interviewers who were trained and certified for this purpose, with updated training after a year of fieldwork. The measurements taken and the equipment used are the following:

- *Body weight*: The scale used was the Life Source brand, M&D medical, model UC-321p; it was placed on even floor and without carpets, the measurement was carried out without shoes, nor objects of weight in the pockets of those participants with clothes.

- *Height:* A Seca brand stadiometer was used to measure the height of the senior adults. The measurement was not taken if the person had major deformations of the spine.

- *Knee height*: The measurement was carried out in the right leg whenever the interviewee did not have present a lesion on it. For this measurement an inclinometer was used to indicate the angle of 90 degrees, and then height was measured with a stadiometer manufactured by Shorr Productions (USES Knee-Height Caliper).

- *Abdominal measurement and Hip circumference*: These measurements were made with the participants standing, in a semi-anatomical position (with the feet separated and the palm of the hands resting on the lateral thigh). The metric tapes used were the Dry and the Quick Medical brand tapes.

- *Calf circumference*: The person was seated, with the right leg exposed.

- *Arm circumference*: With the person seated or standing, the circumference was measured in the half point between the acromion (or posterior bone of the shoulder) and the olecranon or protruding bone of the elbow.

- *Tricipital and sub-scapular skin folds*: The interviewer carried out the measurements using his or her thumbs and index fingers in order to make sure to only take the fatty tissue and not muscles or nerves. For this, a Lange Skinfold caliper, from Beta Technology Incorporated, was used.

- *Grip strength*: Two measurements of hand strength were taken (the highest value is used in the analysis) with the interviewee standing with the dominant arm extended beside their body. A Creative Health Products Inc. dynamometer of was used, model T -18.

- *Flexibility and mobility*: The flexibility and mobility tests were carried out with the purpose of measuring (1) equilibrium and balance, (2) agility and (3) walking speed. The exercises that were carried out were the following:

- *Equilibrium and balance*: To measure equilibrium and balance two tests conducted, (1) to remain standing with feet together for 10 seconds and (2) to stand up five times from a sitting position, with arms crossed on the chest.

- *Agility*: The agility was measured beginning with the senior's ability to bend over, to pick up a pencil and to straighten out. If the interviewee could not do it in less than 30 seconds the test was not continued. The test was also not conducted if the senior had a cataract operation or another retinal procedure in the six weeks previous to the test.

- *Walking speed*: To measure the senior's ability to rise off of a chair and walk, the interviewee was asked to rise from a chair and walk a distance of 3 meters in the manner that he normally does it; neither slower nor faster. The test was registered with a chronometer, noting the time in seconds that it took to carry out the test.

Laboratory procedures

There was no specimen collection in the third wave

Nutrients in the diet

Data on the diet of the participants were gathered with an abbreviated food frequency questionnaire (FFQ) developed specifically to evaluate the ingestion of macronutrients in the adult population in Costa Rica. It was developed and validated from a Costa Rican coronary health study that contained a full FFQ (Ek-Sohemy, Baylin et al 2001; Kabagambe, Baylin et al 2001; Kabagambe, Baylin et al 2005).

The original full FFQ in the coronary health study contained 147 foods in the Costa Rican diet, and it required approximately 45 minutes of interview time (Kabagambe, Baylin et al 2005). That study collected information on about 2000 residents in the Central Valley of Costa Rica, ages 60 and older who were the population control group in a case-control study of myocardial heart attack patients (the heart attack patients were not used in the FFQ validation study). The FFQ asked for the average consumption during the year prior to the survey, providing 9 possible answers to categorize the consumption frequency, which range from "never or less than once a month" to "6 or more times a day." The frequencies were converted by computer to a daily number of servings to estimate the quantity consumed. The FFQ also asked for the consumption of vitamins and nutritional supplements, the brands of cooking shortening, oil margarine used, and certain kinds of food preparation.

The coronary health study estimated for each individual the energy ingestion of several dozens of nutrients by multiplying the frequency of consumption of each food by the nutritional content of the respective portion using values of composition of the foods from the database of the Department of Agriculture of the US, in addition to data from producers and published reports as well as specific data for Costa Rica regarding the nutritional content of foods and local food preparation practices.

Using stepwise regression to optimize the goodness-of-fit and the parsimony of the model that explains the nutrient with the foods, CRELES researchers reduced the original FFQ to a 10 minute interview by identifying the minimum number of foods that maximizes the variance explained in a selection of macronutrients of interest to CRELES. In this way 27 tracer foods were identified for the abbreviated CRELES FFQ, which together with the brand of oil or shortening and the food preparation practice, explain 85% or more of the variance in seven macronutrients and 75% or more in a total of 17 macronutrients (Table 2). The abbreviated FFQ of CRELES was defined with these purposes: (1) to have valid estimates at the individual level of the consumption of key nutrients of interest and (2) to minimize the interview time.

The ingestion of these 17 macronutrients by the CRELES participants is estimated based on the abbreviated questionnaire of tracer foods in combination with the regression equations estimated from the detailed coronary health study data. The tracer foods defined in this way are sometimes counterintuitive or go against previous knowledge. For example, although rice is an important determinant of the consumption of calories in Costa Rica, this food is not a good tracer because its consumption is practically universal in the country. After consolidating all the tracer foods of the different nutrients, the result was the list of 27 foods of the abbreviated FFQ. The correlation coefficients among the 18 nutrients estimated in this way and the originals in the coronary study are on the average of 0.90, with range from a minimum of 0.84 for iron to 0.94 for cholesterol and 0.99 for alcohol.

Table 2: Goodness-of-fit (R2) of ingestion of selected macronutrients with an abbreviated questionnaire of 27 tracer foods.

Nutrient	R^2
Total energy, kcal/d	0.81
Proteins, g/d	0.80
Carbohydrates, g/d	0.76
Glycemic Load, g/d	0.78
Total fats, g/d	0.85
Saturated fats, g/d	0.84
Monounsaturated fats, g/d	0.88
Polyunsaturated fats, g/d	0.82
Omega-6 fatty acid, g/d	0.81
Omega-3 fatty acid, g/d	0.85
Trans fats, g/d	0.85
Cholesterol, mg/d	0.94
Fiber, g/d	0.76
Alpha-Tocopherol, mg/d	0.78
Gamma-Tocopherol, mg/d	0.86
Calcium, mg/d	0.84
Alcohol, g/d	0.99

N = 2,200 (decreased slightly in some nutrients due to missing values)
Source: database of the Costa Rican Study of Coronary Health

Research Ethics

The study was approved by the Bio-Ethical Science Committee of the University of Costa Rica in the March 17, 2004 session (reference: VI-763-CEC-23 -04), research project number 828-A2 -825. All the databases of the study have been made anonymous (the name and other identifiers were removed) to avoid risks to the privacy of the participants. Written informed consent was signed during the first wave of interviews, in which it was explained the occurrence of follow up visits after two years.

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