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CRELES-RC

Costa Rican Longevity and Healthy Aging Study, Retirement Cohort
Methods, Wave 2

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DATA AND METHODS

CRELES-RC Overview

The Costa Rican Longevity and Healthy Aging Study (CRELES, or Costa Rica Estudio de Longevidad y Envejecimiento Saludable) is a set of nationally representative longitudinal surveys of health and lifecourse experiences among older Costa Ricans. CRELES is part of the growing set of Health and Retirement Surveys being conducted around the world. Costa Rica is of particular interest to study given its high longevity: life expectancy is greater than that of the United States, despite being a middle income country with about one-fifth the per capita income and one-tenth the per capita health spending.

CRELES is now composed of multiple waves of data from two cohorts: the original CRELES pre-1945 birth cohort is a nationally representative sample of nearly 3000 Costa Rica residents born in 1945 or before, first interviewed in 2005. An additional CRELES Retirement Cohort (CRELES-RC) sampled individuals born 1945-1955, with baseline interviews starting in 2010 (with interviews occurring through 2011, but for simplicity referred to as the 2010 wave). This document describes data and methods for the second wave of CRELES-RC, a 2-year follow-up starting in 2012 (with interviews completed in early 2014, but for simplicity referred to as the 2012 wave). The sample for the first wave of CRELES-RC included 2798 baseline long-form interviews with targeted age-eligible individuals plus 1338 interviews with their spouses (regardless of age). The second wave of CRELES-RC (described herein) attempted to re-interview all of the baseline long-form target interviewees, yielding 2428 wave 2 target re-interviews plus interviews about 49 deceased targets. CRELES-RC also attempted interviews for current or deceased spouses of all wave 2 target interviewees, yielding 1097 wave 2 spouse re-interviews, 12 new spouse interviews, and interviews about 29 deceased spouses.

The first wave of CRELES-RC included a supplemental sample of short-form interviews conducted between January 2012 and January 2013, with 491 initially non-responding target individuals so as to study response-rate patterns which may be especially systematic in working age populations. These 491 respondents were not followed for interview at the second wave.

Due to the study's longitudinal design, CRELES data are well-suited for studying longevity determinants, relationships between socioeconomic status and health, stress and health, patterns of health behaviors, and the effects of Costa Rica's rapid 1960s fertility decline. The 2005 wave of the original CRELES pre-1945 cohort included fasting blood and overnight urine collection, with blood collection repeated in 2007. The 2010 CRELES-RC drew (non-fasting) venous blood to measure cholesterol, C-reactive protein, and HbA1c. DNA has been extracted for both cohorts, and leukocyte telomere length measures are available for a subset of recipients (contact the Principal Investigators for further details). Biomarkers were not measured in the second wave of CRELES-RC.

Other objective health indicators measured in all waves include anthropometrics and observed mobility. The CRELES surveys are also distinguished by linkages with the Costa Rican National Death Index, which has allowed on-going monitoring and follow-up of mortality events, which are also studied through a surviving family interview. 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, work, and socioeconomic status.

CRELES-RC was conducted by the University of California-Berkeley and the University of Costa Rica's *Centro Centroamericano de Población* (CCP) with funding from the United States National Institute on Aging (NIH grant R01 AG031716). The Principal Investigator is William H. Dow (University of California, Berkeley), with Co-Principal Investigators Luis Rosero-Bixby and Gilbert Brenes (University of Costa Rica).

CRELES-RC Wave 2 Sampling Design and Response Rates[1]

In drawing the baseline sample the study employed a multi-stage probabilistic sampling design with four stages. In the first stage, a simple random sample of 60 Health Areas was selected out of 102 Health Areas into which Costa Rica is divided. In the second stage, 222 pseudo-census tracts (each composed of two or more actual census tracts contiguous to each other in order to have at least 15 houses with age-eligible individuals in each pseudo-census tract) were drawn from a sampling frame based on a corrected version of the 2000 Census. In every pseudo-census tract, all residences with at least one age-eligible individual were selected with complete certainty (probability one) in the third stage. Finally, in the fourth stage, among all people born between 1945 and 1955 in each of these residences, we selected randomly only one person as the main "target" informant; the target respondent's spouse was interviewed if the target individual was married (or in a marriage-like cohabitation).

The non-response rates for the second wave differ between target individuals and spouses. The total response rate for targets was 89% (Table 1).

Table 1. Response rates for target respondents in wave 2 ("2012 wave") of CRELES-RC.

Response	Absolute freq	Relative freq
Accepted	**2,479**	**88.6**
-Alive	2,430	86.8
-Deceased	49	1.8
Non-response	**319**	**11.4**
-Refusal	77	2.8
-Not found	238	8.5
-Not visited	4	0.1
Total	**2,798**	**100.0**

The non-response was mainly due to subjects "not found" during the fieldwork (8.5%), which includes some who were known to be residents of the household still but could not be available for an interview. The explicit refusal rate was close to 3%. Additionally, 4 subjects were not visited because they live in places that became too dangerous or distant for feasible interview.

Among spouses the percent re-interviewed was lower, but this was primarily due to the fact that spouse interviews were not attempted if the target respondent was not successfully re-interviewed. Table 2 describes non-response for the total sample of spouses, and the subsample with target re-interviews.

The overall non-response rate for spouses was 14%. Most of this non-response is due to spouses of targets who were not found (9%). When excluding spouses of targets who were not found or refused to be interviewed, the non-response rate among eligible spouses was 4.3%.

If a marriage was dissolved between the first and the second wave, there was no attempt to re-interview the former spouse. There are 31 such cases that are excluded from the response rate denominator because they are not eligible.

[1] A detailed description of the wave 2 sampling design isincluded in the Appendix. The baseline sampling design and response rates are included in the wave 1 methods documentation at creles.berkeley.edu.

Table 2. Response rates for spouse respondents in wave 2 ("2012 wave") of CRELES-RC, by target re-interview status.

Response	Whole sample		Excluding targets who did not respond	
	Absolute freq	Relative freq	Absolute freq	Relative freq
Accepted	**1,138**	**86.1**	**1,138**	**95.7**
-Alive	1,097	83.0	1,097	92.3
-Deceased	29	2.2	29	2.4
-New spouse	12	0.9	12	1.0
Non-response	**183**	**13.9**	**51**	**4.3**
-Refusal	61	4.6	22	1.9
-Not found	120	9.1	29	2.4
-Not visited	2	0.2	0	0.0
Denominator for response rate	**1,321**	**100.0**	**1,189**	**100.0**
Dissolved union (divorce or separation)	31		31	
Targets did not respond			130	
Total	**1,352**		**1,352**	

During the first wave, the fieldwork team interviewed 51 spouses whose target individuals could not be interviewed because of late refusals or problems in contacting them. There is a separate wave 1 dataset with these 51 spouses. During the second wave the fieldwork team approached 30 of these spouses. There is a separate file with these 30 interviews; they are not included in the above response rate tables.

During the second wave anthropometric measurements were performed for 99% of the total target sample. Among spouses, 92% have anthropometric measurements; this higher non-response rate is due to 6% of interviews (72 cases) that were performed by telephone only, hence anthropometry was not possible. Only 3 out of the 75 spouses interviewed by phone have anthropometric measurements because the fieldwork personnel made special appointments for performing the measurements after the interview was completed earlier.

Not including the Deceased interviews, among the rest of respondents only 2.2% of target respondents and 1.2% of spouses 1.8% needed another person to respond on his/her behalf ("proxy respondent").

For analyzing the first wave of data three sets of sampling weights were computed. The first sampling weight variable, named *factor_cort*, corresponds to the long-form target sample and the short-form supplemental target sample analyzed together (appended one to the other). The second sampling weight variable, *factor_princ*, was computed in order to make inferences about the population based on the long-form target sample only. Finally, the third sampling weight variable, *factor_cony*, corresponds to the spouse sample; this last sampling weight can be used to make inferences about the population of spouses and to perform couples analysis.

For wave 2 analysis two new sets of sampling weights were computed. The first sampling weight variable, *factorprinc2wave*, is only for individuals who answered the long-form questionnaire in the first wave and were

interviewed during the second wave. The second sampling weight variable, *factorcony2wave*, is for spouses interviewed in wave 2 in order to perform couple analysis. Both sampling weights sets correct for differential non-response in the second wave. Both should be used for the second wave data if doing longitudinal analysis.

Table 3 compares the distributions of certain variables using the sampling weights for the the first wave and the sampling weights for the second wave. The age variable refers to age at first wave.

Table 3. Comparison of relative frequency distributions of CRELES 1945-1955 Retirement Cohort for the subsample of persons interviewed during second wave, weighted by the two sets of sampling weights.

Characteristics	Targets			Spouses	
	First-wave Long-form sampling weights	Second-wave sampling weights		First-wave Long-form sampling weights	Second-wave sampling weights
Age at first wave[1/] (Total)	**100.0**	**100.0**		**100.0**	**100.0**
55-58	42.8	43.1		54.1	53.2
59-62	34.2	34.4		16.5	16.5
63-65 (or older)	23.0	22.6		29.4	30.2
Marital status (Total)	**100.0**	**100.0**		**100.0**	**100.0**
Cohabiting	10.6	10.6		15.4	15.6
Married	60.4	60.5		84.6	84.4
Separated/Divorced	15.6	15.4		-	-
Widowed	7.0	7.0		-	-
Not married	6.5	6.5		-	-
Education	**100.0**	**100.0**		**100.0**	**100.0**
No school/elementary school	57.3	56.8		61.9	62.6
Academic secondary school	21.4	21.5		22.3	21.9
Post-secondary & technical	21.2	21.5		15.4	15.2
DK/NR	0.1	0.1		0.3	0.3
Working	**100.0**	**100.0**		**100.0**	**100.0**
Yes	42.6	44.1		39.0	39.2
No	57.4	55.9		61.0	60.8

Field Work

The study, being longitudinal, consists of baseline household data collection and a two-year household follow-up survey. This report presents the results of the second wave which gathered information between 2012 and 2014. It included a structured interview, anthropometric measurements, and physical functioning tests; as explained before, unlike during the first wave, there was no draw of blood samples during the second wave. The questionnaire was comprised of questions about marital history, children's characteristics (both alive and deceased children), health and health behaviors, income from wages and entrepreneurial activities, perceived

SES (socio-economic status), housing characteristics, intergenerational transfers, and social support. There were special batteries of questions about perceived stress, physical activity (the IPAQ scale), cognitive status, depression symptoms (a short version of the Geriatric Depression Scale), and friendship.

A shorter version of the questionnaire, centered mainly on health and social support questions, is used to interview the main respondent's spouse, when there is one. In order to improve response rates, 71 spouse interviews were performed by telephone instead of face-to-face. There was a special informed consent form for these telephone interviews. The fieldworkers make appointments with some of the spouses interviewed by phone in order to collect anthropometric measurements and mobility tests, but most of the phone interviews lack this information.

There is also an "exit questionnaire" for target subjects and spouses who were interviewed during the first wave but died before they were interviewed at second wave. Interviewers had to interview a proxy respondent who must have been close to the deceased subject and who had enough information about the subject's last days. The "exit questionnaire" is also a short-form version of the long-form questionnaire. It has additional questions about limitations in daily activities (ADL) before death, general causes of death, hospital and assisted-facility stays, and bequests.

During the first wave, the fieldwork team gathered data on the geographical coordinates of the place of each participant's residence, using GPS devices. This task was not performed during the second wave because most people have not change residence. All the data were gathered at the participants' homes, generally in a single visit. Participants granted their informed consent by means of their signature at both interviews. The interview was around 90 minutes long; during this time blood pressure was measured twice. At the end of the interview, the anthropometric measurements were taken, and the physical functionality tests were performed.

At the beginning of the main interview a cognitive evaluation was included that, together with the interviewer's criteria, established whether or not a "Proxy" informant for the participant was needed to help respond to the survey. Only 66 interviews (1.85% of total non-exit interviews) were conducted with the help of a Proxy.

All the data from the fieldwork were recorded using handheld Pocketbooks, a type of "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. The same technology and procedure was used for the cohorts born before 1945 and interviewed between 2004 and 2009. During pilot fieldwork for that study, the questionnaire answers were recorded in the PDA and on paper simultaneously by two interviewers, yielding an extremely high level of concordance (Hidalgo-Cespedes, Rosero-Bixby 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 into a virtual keyboard, if the interviewer chooses to. The PDA controls the flow of the interview; 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 PDA does not allow recording of inconsistent data or dates that are outside of the range, nor does it allow skips in the sequence of questions. Data were backed-up daily in the field and uploaded regularly to allow real-time data quality monitoring during fieldwork. For the CRELES-RC cohort, the model of the PDAs used for fieldwork is HP-IPAQ-111 Pocketbook.

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, hand strength and peak breathing flow. 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-711 (precision: ± 3mmHg) that were calibrated periodically. The bracelet was adjusted to the thickness of the adult's arm. Given that the spouse's interview was shorter, the interval between the two measurements was sometimes shorter, too.

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, A&D medical, model UC-321; it was placed on even floor and without carpets, the measurement was carried out without shoes, and objects of weight were removed from the pockets of those participants with clothes.

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 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 take only the fatty tissue and not muscles or nerves. For this, a Lange Skinfold caliper, from Beta Technology Incorporated, was used.

Hand 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.

Measurements of height and knee height were performed only during first wave because researchers assume that, at these ages, there is little change during a two-year interval. Therefore, there is no information about height and knee height in the second wave datasets. The procedure to measure these anthropometric measurements during the first wave was the following:

> *Height:* A Seca brand stadiometer was used to measure the height of the senior adults during first wave. 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 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).

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.

Research Ethics

The study was approved in April 2009 by the Committee for Protection of Human Subjects (CPHS II) at the University of California at Berkeley. The study and procedures for fieldwork and informed consent were also approved by the Ethical Science Committee of the University of Costa Rica in the sessions held in April 24, 2009, August 10, 2009, February 23, 2011, and April 18, 2012 (references: VI-2878-2009, VI-5308-2009, VI-1313-2012, and VI-2403-2012), as part of the 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. During the first wave, some of the subjects in the supplementary sample (the "short interviews") were interviewed by phone; during the second wave, some of the spouses were interviewed by phone, too; these participants' consent to be interviewed is registered in a special "Informed Consent Form for Phone Interviews" approved by the Ethical Science Committee of the University of Costa Rica in the April 18, 2012 session (reference: VI-2403-2012).

References

Hidalgo-Cespedes, J., L. Rosero-Bixby, et al (2007). "Improvement in the quality and decrease of costs and surveys using hand (PDA) computers. An application in Costa Rica." Population and Health in Mesoamerica. 5(1).

APPENDIX I

Sampling Design for Baseline and Second Wave
CRELES 1945-1955 Retirement Cohort (2010 CRELES-RC)

Study Population:

First wave: Persons born between 1945 and 1955 and living in Costa Rica between 2010 and 2011, and their co-resident spouses (regardless of their year of birth).

Second wave: Persons born between 1945 and 1955 and living in Costa Rica between January 2012 and February 2014, and their co-resident spouses (regardless of their year of birth). People who moved to other countries are not pursued for the second wave.

Planned Sample Size: 3330 target individuals. The study assumed a non-response rate of 10%.

Final sample size:

First wave: Long-form interviews were completed with 2798 target individuals ("main interviews") and 1338 spouses ("spouse interviews"). To investigate non-response patterns in long-form interviews, an additional 491 short-form interviews were conducted, yielding a total sample of 3289 target interviews.

Second wave: Interviews were completed with 2472 target individuals who were alive and 1142 spouses ("spouse interviews"). Of the 2472 target interviews, 50 correspond to exit interviews for deceased subjects. Thirty exit interviews were achieved for deceased spouses. Additionally, in the second wave, 13 persons who entered into a union with target subjects were interviewed for the first time during the second wave.

Sampling design: The study employed a multi-stage probabilistic sampling design with four stages:

(a) Primary Sampling Units (PSUs): Health Areas. A simple random sample of 60 Health Areas was drawn out of 102 Health Areas that cover the Costa Rican territory. These PSUs were originally selected for the CRELES-2004 cohort (the cohort born before 1946). Fifty-five percent of the elderly population in 2002-2004 and 62% of the population born in 1945-1955 (ages 54 to 65 at baseline) live in these Health Areas. The study decided to keep the same PSUs for the new cohort in order to facilitate the planning of the fieldwork and to use administrative information gathered in 2009 about the health services in those areas.

(b) Secondary Sampling Units (SSUs): Pseudo-census tracts, constructed from clusters of the 2000 Census Tracts. Census tracts from the 2000 Population Census were clustered in order to have at least 15 houses with persons born between 1945 and 1955 in a geographically continuous territory. These clusters are called pseudo-census tracts. Most of these clusters are comprised of 2 census tracts; however, in certain cases (mostly in very rural areas), the clusters had 3 or 4 census tracts. The study selected 222 SSUs wih Probability Proportional to Size (PPS), using a systematic procedure in order to cover the whole region defined by the 60 Health Areas.

(c) Tertiary Sampling Units (TSUs): Residences. The study selected all houses within the pseudo-census tract (the SSUs).

(d) Fourth-stage Sampling Units (4SUs): Persons. Among all the persons born between 1945 and 1955 and living in each house, one person is selected randomly as the main informant.

Sampling Frame: The sampling frame is the main dataset of the 2000 Costa Rican Population Census. To correct for outdated information, we estimated survival ratios using the electoral list of 1998 and 2006. The electoral list ("padron") has a record for every Costa Rican citizen; estimates computed at Centro

Centroamericano de Poblacion suggest that, within the 55-65 age range, the population in the electoral list represents 97% of the total population. We divided the population aged 51 to 61 in 2006 by the population aged 43 to 53 in 1998, for each electoral district. Given that this is an eight-year period, we powered the ratio by 1.25 for estimating a 10-year ratio (which corresponded to 2010, the year in which the fieldwork started). The population in each census tract was multiplied by this ratio. This procedure has two assumptions:

a) The ratio in each electoral district correctly represents the mortality and internal migration patterns of the cohorts in the census tracts located in the electoral district.
b) Mortality and internal migration patterns of Costa Rican citizens (who are listed in the electoral lists) are similar to the non-citizens patterns.

After correcting the population in the sampling frame, the data was grouped in the pseudo-census tracts described before.

Fieldwork procedure:

First wave: The interviewers went to each pseudo-census tract divided in two groups of 3 interviewers and one driver (one of whom was the fieldwork supervisor). They visited each residence in the pseudo-census tract to determine which house had residents born between 1945 and 1955. Information on non-responding households was gathered from neighbors where possible; remaining non-responders were assigned an estimated probability of having a qualifying resident, for weighting purposes. In each house, one person was selected randomly as the target interviewee using a random number generator algorithm programmed into the handheld computer used for data entry. If the target interviewee was married or cohabiting, this coresident partner was selected with certainty (conditional on completed target interview) for a spouse interview. Some spouses were interviewed without having the target information, because the target respondent refused to be interviewed or could not be contacted after the spouse was interviewed; there are 50 spouses without information about the target individual.

Second wave: The fieldwork chief organized the fieldwork in order to have the most number of potential interviews within a previously determined area. He also organized it in order to have at least 18 months between the baseline and follow-up interview. The team was reduced to a single group of only 3 interviewers and 1 supervisor/driver. Information of non-responding households was gathered from neighbors or from contact informants whose information was written in each physical household interview log during the first wave. Interviewers searched the name and identification number of each respondent in the PDA in order to keep the same id information to link records of the second wave to the records of the first wave. If the target interviewee was newly-wed during the second wave, the record of the new spouse was introduced to the PDA electronic dataset. Some spouses who were interviewed during the first wave without having the target information were interviewed again during the second wave. There are 29 spouses in the second wave dataset without information about the target individual. There are no sampling weights computed for these spouses who do not have information about the target individual.

Selection probability:

First wave[2]: The sampling weight is equal to the inverse of the selection probability. Each respondent has a different selection probability. Therefore, the sample is not self-weighted. There are three sets of selection probabilities; hence, there are three sets of sampling weights: (1) For all main respondents including the supplemental sample of short-form interviewees; (2) for main respondents of the long-form questionnaire, only; and (3) for spouses (which can be used also when analyzing couples).

[2] We describe the formula for the selection probability applied only to the long-form respondents in wave 1 because, during the second wave, we interviewed respondents that were interviewed using only the long-form questionnaire during the first wave.

The planned selection probability without corrections would be:

$$P(X) = P(PSU) * P(SSU) * P(TSU) * P(4SU)$$

$$P(X) = \frac{60}{102} * \frac{Mt_{\alpha}}{984.89} * 1 * \frac{1}{\text{Number of age} - \text{eligible persons in household}}$$

The effective selection probability includes four correction factors included due to limitations in the fieldwork.

(a) **factor1=0.99.** Eight pseudo-census tracts (equivalent to 16 census tracts) were completely excluded. Four of these SSUs are located in extremely dangerous neighborhoods, so they were excluded to avoid any harm to the fieldworkers. There were no target individuals at all in three SSUs, and another pseudo-census tract could not be visited because there was no easy vehicular access. Additionally, 11 SSUs were covered only partially; in 4 of them, one of the census tract was visited and the other was located in a dangerous neighborhood, therefore, only half of the pseudo-census tract was visited; in each of 7 SSUs, one of the census tracts had informants, and in the other, no informants were found. The total number of residences with expected informants in these areas with no information was equivalent to 1% of the total expected houses in the whole sample.

(b) **factor2= (Houses effectively visited in SSU X / Total number of expected houses with information in SSU X).** There were important differences across pseudo-census tracts in the number of houses found to have target individuals compared to the expected number of houses according to the sampling frame. The average ratio per SSU was 0.42, but the minimum was 0.03 and the maximum was 1.6 (in 6 SSUs, the fieldwork team found more houses with target individuals than expected). This inconsistency might be due to:
   - **i)** Outdated sampling frame
   - **ii)** A high percentage of houses with target individuals that could not be found (or defined as such).
   - **iii)** Refusals.

(c) **factor3:** A differential response rate across sex, age, and education. Based on the 2011 Population Census, we found that the weighted sample weighted by factor1 and factor2 overestimates women over men, older persons over younger ones, and less educated over more educated people. We computed correction factors for 30 different groups defined by sex (males, females), age groups (54-56, 57-58, 59-60, 61-62, 63-65) and years of schooling (only primary school, at least one year of academic secondary school, at least one year of technical school or post-secondary school).

(d) **factor 4:** The probability of responding the long-form questionnaire instead of the short-form questionnaire. Of the total target interviews, 2798 (85%) responded the long-form questionnaire and 491 answered the short-form interview. We used two logistic regression models –one for men and one for women– to compute the differential probabilities of responding the long-form questionnaire, controlling by several covariates. The models were simplified with a stepwise backward selection procedure, using an exit probability of 0.20 (we decided to use a relatively high significance in order to give priority to classification rather than explanation of the event). Among men, more educated people and subjects living outside Cartago were more likely to answer the long-form. Among females, older women, those who reported worse health, not married women, and working women

were more likely to answer the long-form; additionally, females living in Cartago, Puntarenas, or Alajuela were less likely to answer this type of questionnaire[3].

The final formula for the selection probability is:

$$P(X) = P(PSU) * P(SSU) * P(TSU) * P(4SU) * factor1 * factor2 * factor3 * factor4$$

$$P(X) = \frac{60}{102} * \frac{Mt_{\alpha}}{984.89} * 1 * \frac{1}{\text{Number of age} - \text{eligible persons in household}} * factor1 * factor2 * factor3 * factor4$$

Second wave: The sampling weight for the second wave corrects the first wave sampling weights for differential non-response during the new stage of interviews. Therefore, we can summarize the sampling weight as the inverse of the product of the selection probability during the first wave, times the probability of responding in the second wave.

$$P(X.2\ wave) =$$

$$P(PSU) * P(SSU) * P(TSU) * P(4SU)$$

$$* factor1 * factor2 * factor3 * factor4$$

$$* P(second\ wave)$$

$$P(X.2\ wave) =$$

$$\frac{60}{102} * \frac{Mt_{\alpha}}{984.89} * 1 * \frac{1}{\text{Number of age} - \text{eligible persons in household}}$$

$$* factor1 * factor2 * factor3 * factor4$$

$$* P(second\ wave)$$

The probability of responding in the second wave is estimated using a logistic model for each gender group (males and females) where the binary dependent variable is equal to one if respondent did not answer the second wave questionnaire, and covarites are drawn from the first-wave dataset. Table 4 describes the estimated model. In both groups, residing in the Metropolitan Area and being an immigrant increases the odds of not responding during the second wave. These factors were observed during fieldwork. It was harder to complete interviews in the Metropolitan Area, where the capital San José is; this was a problem of schedules and other characteristics of urban life, rather than geographical

[3] To see the model, check the Sampling and Methods Document that corresponds to the first wave.

accessibility problems. People born abroad were harder to find during the second wave because some of them moved again to another country temporarily or permanently; 2% of targets change their address, some of them abroad, therefore the fieldworkers were not able to interview them. Retired men were more likely to respond the interview, while working women were harder to find during the second wave. Additionally, males that reported having at least one functional limitation were less likely to be interviewed.

Table 4. CRELES-RC. Logistic regression models for estimating the probability of not responding in the second wave, given that subjects responded the long-form questionnaire during the first wave, by sex.

Covariates	Coefficient	Standard error	p-value
Males			
Residing in Metropolitan Area	0.926	0.184	0.000
Retired	-0.783	0.242	0.001
With functional limitations	0.630	0.211	0.003
Foreign-born	0.596	0.318	0.061
Intercept	-2.313	0.159	0.000
Females			
Residing in Metropolitan Area	0.602	0.175	0.001
Working	0.476	0.176	0.007
Foreign-born	0.659	0.271	0.015
Intercept	-2.787	0.153	0.000

Selection probability for spouses (or couple analysis):

First wave: Spouses were only interviewed, if the main respondent accepted the long-form interview (except for 51 spouses that were interviewed before the main target individuals failed to be interviewed). Among the long-form questionnaire respondents, 24% of eligible spouses were not interviewed because of refusal or fieldwork difficulties. Therefore, there is a separate calculation of selection probabilities for spouses. These spousal weights can also be used when analyzing the subsample composed only of couples who both completed interviews. The spouse's selection probability is equal to the selection probability of main informants, multiplied by the response rate of spouses. The differential probabilities of responding the spouse questionnaire controlling by several covariates were computed using another logistic model[4], simplified with a stepwise procedure, using an entry probability of 0.05. Spouses with lower response rates are those who work, those with more education, cohabiters, and those living in Cartago province, and female spouses. Probabilities of being interviewed were computed based on this equation. The selection probability for spouses is then calculated as the selection probability of the main informant multiplied by this probability of spousal interview:

$$P(X.sp) = P(spouse|X\ married\ and\ long-form)$$

[4] To see the model, check the Sampling and Methods Document that corresponds to the first wave.

$$P(X.sp) = P(X\ with\ long-form) * P(spouse\ interviewed|target\ interviewed)$$

$$P(X.sp) =$$

$$\frac{60}{102}$$

$$* \frac{Mt_{\alpha}}{984.89}$$

$$* 1$$

$$* \frac{1}{\text{Number of age} - \text{eligible persons in household}}$$

$$* factor1 * factor2 * factor3 * factor4$$

$$* P(spouse\ interviewed|target\ interviewed)$$

Second wave: In the second wave, all spouses must be interviewed, except when the union was terminated. As mentioned before, the spouses' non-response rate spouses amounts to 14%. Therefore, the sampling weight for spouses is then as the inverse of the product of the spouses' selection probability in wave 1 times the probability of being interviewed in wave 2. The formula of the selection probability of spouses can be expressed as:

$$P(X.sp.2\ wave) = P(spouse|X\ married\ and\ longform) * P(spouse\ resp\ 2nd\ wave)$$

$$P(X.sp.2\ wave) = P(X.sp) * P(spouse\ resp\ 2nd\ wave)$$

$$P(X.sp.2\ wave) =$$

$$\frac{60}{102}$$

$$* \frac{Mt_{\alpha}}{984.89}$$

$$* 1$$

$$* \frac{1}{\text{Number of age} - \text{eligible persons in household}}$$

$$* factor1 * factor2 * factor3 * factor4$$

$$* P(spouse\ interviewed|target\ interviewed)$$

$$* P(spouse\ resp\ 2nd\ wave)$$

The probability that a spouse responds in the second wave varies across groups. To identify the most important sources of variation in the probability that a spouse responds in a second wave, we use a

logistic regression for each gender group to estimate the set of probabilities. We use a stepwise procedure to estimate a parsimonious model with only the most relevant variables. Then, we estimate the probabilities of response using the logistic model, and multiply the inverse of these probabilities times the first-wave sampling weights to compute the spouses' sampling weights for wave 2. In order to get more information, the covariates chosen for the model are variables from the target dataset, which has more variables. Besides, this decision takes into account that most of the non-response among spouses is due to targets' non-response.

For men, residing in urban areas and in the Metropolitan Area increases the odds of non-response; additionally, if the target respondent has bad health, the target's spouse is more likely of not responding the survey. Among women, residing in the Metropolitan Area increases the odds of non-response. If the target is working, the spouse is more likely of not responding. The spouse is also more likely of not responding if the target respondent has functional limitations, but is more likely of responding if the target reports to have bad health.

Table 5. CRELES-RC. Logistic regression model for estimating the probability that a spouse interviewed in the first wave did not respond during the second wave.

Characteristics of targets	Coefficient	Standard error	p-value
Males			
Residing in urban areas	0.634	0.306	0.038
Residing in Metropolitan Area	0.582	0.296	0.049
Target has bad health	0.707	0.267	0.008
Intercept	-3.137	0.320	0.000
Females			
Residing in Metropolitan Area	0.677	0.219	0.002
Target has functional limitations	0.828	0.272	0.002
Target is working	0.584	0.261	0.025
Target has bad health	-0.451	0.236	0.055
Intercept	-2.461	0.297	0.000

APPENDIX II

Description of the tracking file Track_ RC_V1.dta.

The tracking file Track_RC_V1.dta contains basic information about each of the individuals interviewed during CRELES-RC fieldwork. The file can be used to know which interviewees have longitudinal data.

Variable	**Description**
idquest	Type of interview. Target respondents with the long-form questionnaire, spouses, and target respondents with the short-form questionnaire.
idsujeto	Number Of Elder: Id number of each of the respondents
hhid	Household id
idlote	Primary Sampling Unit
nwaves	Number of waves with data. Short-form respondents were interviewed in only one wave.
sex	Sex
track_w1	Status by wave 1: 1 "Interviewed" 6 "Not yet spouse" 8 "Interviewed-Spouse wo/target" Respondents categorized as “Not yet spouses” are spouses of target individuals who started their union after the first wave, but before the second wave. Respondents categorized as “Interviewed-Spouse wo/target” are spouses who were interviewed but their corresponding target individual was not interviewed. The fieldworkers did not intend to interview them, but some were interviewed because of inconsistencies during the fieldwork.
track_w2	Status by wave 2: "Interviewed" 2 "Death by wave date" 3 "Lost between waves 1 & 2" 4 "No follow-up-Short form" 7 "No longer a spouse" 8 "Interviewed-Spouse wo/target" 10 "Lost-Sp.wo/target" The fieldwork did not follow up the short-form interviewees. Some of the spouse without targets were lost to be followed up in wave 2.
fentr1	Date of interview--Wave1

fentr2	Date of interview--Wave2
dwave1	Median date Primary Sampling Unit was visited for wave 1
dwave2	Median date Primary Sampling Unit was visited for wave 2
agew1	Age at wave 1
agew2	Age at wave 2
proxyw1	Flag variable that indicates whether the interview needed a proxy respondent on behalf of the main informant in wave 1
proxyw2	Flag variable that indicates whether the interview needed a proxy respondent on behalf of the main informant in wave 2
rantrow1	Flag variable that indicates whether respondent has anthropometric measurement data in wave 1
rantrow2	Flag variable that indicates whether respondent has anthropometric measurement data in wave 1
phonew1	Flag variable that indicates whether the interview was made by telephone in wave 1. Only some short-form and some spouses' interviews were performed by phone in wave 1.
phonew2	Flag variable that indicates whether the interview was made by telephone in wave 2. Only some spouses' interviews were performed by phone in wave 2.
biomarkers	Flag variable that indicates whether the respondent has biomarker information.
sp_wo_target	Flag variable that indicates whether the respondent is a spouse whose corresponding target individual was not interviewed.
ponderador	Sampling weight for wave 1
ponde_r2	Sampling weight for wave 2
ponde_shortlong	Sampling weight for target individuals if respondents of both short and long-form interviews are pooled.
gam	Flag variable that indicates whether the respondent lives in the Greater Metropolitan Area.