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Tsimane' Demography

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Chapter 5

Tsimane' Demography

Summary: In this chapter I describe the following demographic building blocks: *(a)* mistakes in reported age, *(b)* sample and composition of villages and age-sex composition of households, *(c)* age-sex population pyramids, *(d)* generational makeup of households, *(e)* pregnancy (14≤age≤50 years), *(f)* accuracy of self-reported pregnancy data, *(g)* female and male fertility by age and age cohorts (age≥14 years), *(h)* birth seasonality, *(i)* lactation (14≤age≤50 years), *(j)* marriage, post-marital residence, and mate selection, *(k)* migration (age≥16 years), and *(l)* mortality. I use two approaches to describe demographic changes: (1) comparing outcomes by survey year during 2002-10 and (2) by estimating how demographic outcomes varied by age-birth cohorts while controlling for age and other covariates (secular trend). *Measurement errors*: Data had random and systematic errors. People rounded answers around multiples of zero and five when reporting age and residence duration, and around multiples of six when reporting duration of lactation. We also see systematic measurement errors. Between two consecutive annual surveys, the reported age of older women and boys declined by more than one year compared with the measured elapsed time, while the age of older men and young girls rose by more than one year. The top of age-sex pyramids in later surveys were slightly fatter, probably from people overstating their age to gain early access to government pensions. Women under-reported pregnancies. *Findings from cross-sectional analysis*: Age-sex population pyramids show features found in other low-income, rural societies, namely a plinth of people at the bottom, narrowing gradually at the top. No imbalances in sex ratios jump out, though self-reported fertility shows that women gave birth to more boys (3.58) than girls (3.14) and that more boys (2.88) than girls (2.59) survived. A puzzle in the pyramids is the loss of girls between 10 and 14 years of age. Fertility rates are high, with post-menopausal women having a total of 8.93 births. Estimate from actual birth and deaths during the panel hint at population growth rate of 3%/year. Tsimane' follow positive assortative mating, but the practice bears no significant association with child stunting. *Secular trends*: We find an increase in the share of nuclear, patrilocal, and neolocal households, a drop in multi-generational and matrilocal households, and a rise in household dependency ratios, with some signs showing that working-age women might have to shoulder the burden of caring for young and old dependents. We see a decline in the age at first marriage, duration of breastfeeding, birth of daughters, peaks of births during the dry season, and inter-village migration. Together, these demographic changes point to a society moving away from the past.

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This chapter has two goals: to describe the building blocks of Tsimane' demography and to examine how the building blocks have changed over time. I can think of several well-rehearsed reasons for why the two goals matter. First, a tidy but weighty rendering of the demography of a rural society in the early stages of modernization can help us fathom the life cycle of people over a broad swath of human history. Demographic outcomes such as birth seasonality will likely change irrevocably with the moldering of traditional rural societies. Demographic changes over the nine years of the panel study are likely modest because of the short duration of the study, but through the modest corpus we can at least identify and describe the first signs of change, however small the changes might be. Second, we need to get demography right because it is the cellar on which the rest of the social dwelling stands. For instance, unless we have a firm handle on the age-sex compositions of households, we will blunder when using canonical measures of well-being, such as per capita income, asset wealth, or food consumption. For the same amount of household income, asset wealth, or food, a rural household with four adults is poorer than a household with two adults and two children, and poorer still if the four adults are men (Deaton, 2003; Rottke & Klos, 2016). Third, demography can tell us about vulnerabilities and about households' material impediments. Among the rural poor, seasons affect food consumption, work effort, the amount of energy for reproduction, and the timing of births and deaths. In industrial societies, pregnancies, births, health, and deaths also change with seasons (Jensen et al., 2015; La Rosa et al., 2014; Martinez-Bakker et al., 2014; Shwartz, 2011), but in low-income rural settings where people are less sheltered, seasons leave deeper footprints. Demography matters for one other reason. Reported demographic information is a window into psychological biases. As we shall see, when reporting answers Tsimane' have a proclivity to round numbers to agreeable last digits and to forget (or be unwilling to report) other events. By introducing measurement errors into foundational demographic variables (e.g., age), measurement errors spread into other outcomes that rely on these variables. Mis-measure demography and you mis-measure a great deal more.

In this chapter I scrutinize 12 building blocks of demography: *(a)* mistakes in reported age, *(b)* sample and composition of villages and age-sex composition of households, *(c)* age-sex population pyramids, *(d)* generational makeup of households, *(e)* pregnancy (14 years ≤age≤50 years), *(f)* accuracy of self-reported pregnancy data, *(g)* female and male fertility by age and age-cohorts (age≥14 years), *(h)* birth seasonality, *(i)* lactation (14 years≤age≤50 years), *(j)* marriage, post-marital residence, and mate selection, *(k)* migration (age≥16 years), and *(l)* mortality.

I use two approaches to describe and give a flavor of demographic changes. The first approach consists in comparing outcomes by survey year during the nine years of the panel. The second approach consists in estimating how demographic outcomes vary by age cohorts or birth cohorts while controlling for age and other covariates (e.g., sex). Comparing, say, the mean age at first marriage between people in their 40s with people in their 60s (while controlling for age) allows us to see if the age at first marriage has changed between generations. I use the term *secular trend* loosely to capture changes in demographic outcomes by age cohorts or birth cohorts, most often while conditioning for age.

I rely on raw and clean data for the descriptive analysis. As noted in Chapter 4, the clean panel data for the public leaves out Tsimane' who denied our requests for interviews, or who were disabled or too aged to be interviewed. Because these people had useful demographic information, I include them in some of the analysis. For instance, during annual surveys we coded for the age and sex of people who had formerly taken part in the surveys, but who later denied our requests for interviews, or who were too old to take the survey. Because they were in the village during the surveys and because we knew their sex and had estimates of their age from prior surveys, I include them in some of the analyses.

As we shall see, panel data is better for topics for which we collected information every year (e.g., pregnancy) than for topics for which we collected information sporadically (e.g., marriage). Besides the panel, I often turn to the randomized controlled trial (2008-2009) because it had more villages and people than the panel. Inadequate to reveal year-to-year changes because of its short duration, the sample from the trial is nonetheless ideal to asses secular trends using age cohorts.

Mistakes in reported age

Age is vital in describing the sample and in fashioning variables[i]. For this reason, I start by assessing mistakes in reported age as betrayed through rounding errors. Also known as digit preference or digit heaping, rounding errors happen when numerical answers get rounded up or down to a "pleasing" last digit, often multiples of five or ten, sometimes "combined with tendencies to avoid certain unpleasant numbers...(e.g., 13)" (Camarda, Eilers, & Gampe, 2008, p. 385)[ii]. For instance, a 14-year old and a 16-year old might both report being 15 years old when asked about their age. Age heaping happens from cognitive shortcuts people lean on when answering questions, from shortcuts surveyors use when recording information, or from both. A type of random measurement error, age heaping infuses mistakes into descriptive statistics of age, and weakens the confidence we can place in estimates of variables that use age.

The information on ages in Tables 5.1-5.3 covers nine years of annual surveys (2002-2010) and comes from self-reported answers by adults about their own age, or about the age of their dependents. We defined an adult as a person ≥16 years of age, or younger if they headed a household. Estimates of age for dependents younger than 16 years of age came from their caretaker, typically the mother. Tables 5.1-5.3 contain a yearly breakdown of the last digit of all reported ages.

Insert Tables 5.1-5.3

To begin examining digit predilection, I considered only ages reported in whole numbers (Table 5.1). The criterion excludes infants under one year of age and people with fractional ages (e.g., 1.5 years). In large samples without digit preference, the share of reported ages ending in each of the ten digits should be near 10%. For instance, about 10% of reported ages should end in 3, another 10% should end in 7, and so on. In Tables 5.1-5.2 I show in red the two most frequent digits, and I show in dark red the two least frequent digits. We asked people in the panel to report ages every year so Tables 5.1-5.2 concatenate answers over time rather than show independent, variegated, fresh yearly samples.

Table 5.1 shows that over the nine years of the panel study, ages ending in the digits zero or five accounted for most of the observations; each of these two digits accounted for 11.73-11.79% of the observations, above the benchmark of 10%. During the same period, ages ending in seven or nine accounted for the least observations (8.96% and 7.62%). However, Table 5.1 and Figure 5.1a also show variation in digit preferences. For instance, during 2002-2006 people preferred to report ages ending in zero (12.66-16.03%), but during 2007-2010 the leaning vanished; ages ending in zero account for about 10% of observations (Table 5.1) and in 2007 ages ending in zero were among the least likely to be reported (8.87%). During most years people liked reporting ages ending in multiples of five or ten, but not during 2008 and 2010. People shunned rounding digits to two, but during 2004, 2007 and 2009-2010 ages ending in two accounted for a high share of observations (11.36-12.10%). In Figure 5.1a we can also see less prominent summits at ages that do not end in multiples of five or ten, such as 7, 12, 18, 22, and 32 years.

Insert Figure 5.1a

Using information from Table 5.1, I estimated the annual gap between the digits accounting for the most and for the least observations. For example, in 2010 the last digit of age with the most observations was three (11.49%) while the last digit of age with the least observations was nine (8.26%), so the gap reached 3.23 percentage points (11.49 [most] - 8.26 [least] = 3.23 [gap]). Larger gaps imply greater overall rounding error. Over the nine years of the panel study, the error gap fell annually by 7.81%, but one cannot tell how much respondents and surveyors aided in the decline.

I next examine age heaping in the randomized controlled trial of 2008-2009. Like Figure 5.1a, Figure 5.1b shows age heaping at multiples of five and ten, particularly among people over 30 years of age, with less prominent peaks at ages 12 and 22 years. When we compare digit heaping between the two studies we see differences (Table 5.2). For instance, in 2008 respondents in TAPS liked reporting ages ending in three (11.04%) and eight (11.68%), but respondents in the randomized controlled trial liked reporting ages ending in two (11.95%) and five (11.51%). In 2009, TAPS respondents favored reporting ages ending in two (11.74%) and five (10.99%), but respondents in the randomized controlled trial leaned toward reporting ages ending in one (11.07%) and two (12.68%). Nevertheless, in both studies respondents avoided reporting ages ending in nine, which accounted for an average of 8.18% of observations in TAPS and 7.83% of observations in the randomized controlled trial, both below the 10% threshold.

Insert Figure 5.1b

As in other foraging societies (Hill & Hurtado, 1996; Howell, 2000; Marlowe, 2010), among the Tsimane' older people do not know their own or the dependents' ages (Godoy et al., 2008; Gurven et al., 2007). This happens because many older Tsimane' cannot read or write, and because in the past they did not need to know their birth date. The need to know one's birth date has grown in response to government demands. People need to know or estimate their age and birth date and those of their dependents to get birth certificates or national identification cards. Adults and children need these documents to enroll in school, join the army, access public medical care, and receive pensions (Zycherman, 2016). Whether true or false, the age and birth date in these documents get infixed in memory and serve as an anchor when one asks Tsimane' to report their age. The age and birth date in some documents are probably not accurate because Tsimane' have to proffer officials with any credible estimate of age or birth date to obtain gateway documents.

When asking participants about their age and birth date, we also asked them how confident they felt about their answers. Answers about self-reported confidence most likely reflect whether respondents had an official document showing their birth date, but because we did not verify whether respondents in fact had such a document, we cannot assess how well reported birth dates and ages match birth dates and ages from official documents. Nonetheless, answers about self-reported confidence allows us to split the sample between those who thought they knew and those who thought they did not know their own or their dependents' age and birthdate.

Table 5.3 shows that about the same share of answers in each study came from people who felt sure about the ages they reported (TAPS=89.05%; RCT=85.74%). Slightly more than ten percent (10.95%) of the age estimates in TAPS and 14.26% of the age estimates in the randomized controlled trial came from respondents who had a tincture of doubt about the age they gave. The information from TAPS suggests that, over time, people grew more confident in the ages they supplied. The number of people who felt sure about the ages they reported grew by 5.69%/year while the number of people who felt unsure about the ages they reported fell by 29.79%/year. These rates suggest that repeated dealings with surveyors increased respondents' confidence in their answers, though perhaps not respondents' accuracy. With only two years of observations, the randomized controlled trial was too short to assess trends in errors over time.

Because in every yearly survey we asked about age and wrote the interview date, we can assess whether people gave consistent answers through time, meaning whether the change in the age reported between surveys matched the age change estimated from the elapsed time between surveys. In Chapter 4 (Appendix C) I explained how we created a time-consistent estimate of age. When we compare the reported age with the consistent age we find that, on average, men over 16 years of age inflated their age by 0.02 years from one annual survey to the next. Over a decade, *ceteris paribus*, an average adult man in the sample would have reported being 0.20 years older than he would have been had he reported his age in a consistent way. Adult women deflated their age by the same amount (0.02 years from one annual survey to the next). Caregivers understated the ages of their dependents, with larger biases for boys than for girls. From one year to the next, caregivers lowered by 0.10 and 0.06 years the reported ages of their male and female dependents[iii].

Taken together, the two studies show digit heaping at ages ending in zero and five, and a digit trough at ages ending in nine. Except for some years, the inclination to report ages ending in zero or five was modest. In the TAPS surveys, we find extreme digit heaping in 2003 and 2006, when 16.03% and 15.27% of reported ages ended in zero. Favored digits varied by survey year and study. Over time, the size of random errors from digit heaping fell and respondents grew more confidence in the ages they reported. From one year to the next, the age of the average older woman and boy under 16 years of age rose by less than one year compared to the measured elapsed time between surveys, while the age of the average older man and girl under 16 years of age rose by more than one year, again, compared to the actual measured time between surveys.

Sample and composition of villages and age-sex composition of households

Villages (section A, Table 5.4). During an annual survey, a TAPS village had a median of 19.23 households (standard deviation≈6.06). On average, the number of households in a village grew by 1.19%/year. The mean number of households in the villages of the randomized controlled trial (range: 12.42-14.05) was smaller than the mean number of households in the TAPS sample (19.12).

Insert Table 5.4

Households (section B, Table 5.4). Each year the TAPS team surveyed a total of 252 households (median). Owing to in-migration and to the birth of new households, the sample of households surveyed grew by an annual rate of 1.06%. A household had a median of six people (standard deviation=2.71), with slightly fewer people (5.63-5.85) in the last years of the panel (2008-2010). The mean number of people in a household shrank by 0.78%/year. Within a household, the mean total number of people under 16 years of age was 3. 46 (girls: 1.66; boys: 1.80), larger than the mean total number of people ≥16 years of age (mean total = 2.45; women: 1.23; men: 1.22).

The sex ratio in a household was evenly split between females and males, with a slight bias in favor boys among children under age 16 and a slight bias in favor of women among adults 16 years of age and older. Households had slightly more boys than girls under age 16. A household in the TAPS sample had a median of 1.80 boys and 1.66 girls under 16 years of age, and a household in the randomized control trial had the same number of girls and boys (means: boys≈1.80; girls≈1.70). In the TAPS sample, the mean number of children under 16 years of age in a household declined annually by a larger rate among boys (-1.27%/year) than among girls (-0.68%/year). We also find the same number of adult women and men in a household. Over the nine years of TAPS, the median number of adult women in a household equaled the median number of adult men (women=1.23; men=1.22). In the early year of TAPS, we find barely more adult men than adult women, but starting in 2007 the pattern switches. The sample from the randomized controlled trial had slightly more adult women (1.22) than adult men (1.10) in a household.

In sum, we do not find a noticeable imbalance between the number of females and males in a household, whether among children or adults. A final point deserves attention. Recall that the average household size in the TAPS sample dwindled by -0.78%/year. The declined applied to girls, boys, and to adult men, but not to adult women. The fall was steeper for boys (-1.27%/year) than for girls (-0.68%/year), and steeper for adult men (-1.49%/year) than for adult women, the only group with a positive growth rate (+0.46%/year). If these growth rates persist, Tsimane' households will end up with more females than males.

People (section C, Table 5.4). I next describe the sample broken down by sex and by three age groups: age <16 years, 16 years ≤age <60 years, and age≥60 years. The age groups allow me to construct the dependency ratio of a household, discussed in the next section.

The TAPS annual samples show that until 2006 there were more males (~52%) than females (~48%), but starting in 2007 the share of females equaled the share of males (section C3). On average, children under 16 years of age accounted for the largest share of the annual sample (59%), followed by people 16 years ≤age <60 years (35%). People age ≥ 60 years accounted for 7% of the sample. Compared with the TAPS sample, the sample from the randomized controlled trial shows a slightly larger share of children (~61% versus 59%), the same share of people 16 years ≤age <60 years (~35%), and a lower share of people age ≥60 years (4% versus 7%).

Information from the two studies shows similar shares of females and males for each of the three age brackets. Among children under 16 years of age, females accounted for 28-29% of the sample compared with males who accounted for a barely larger share (30-32%). In the next oldest age group (16 years ≤age <60 years), females accounted for 18-19% of the sample compared with males who account for 17% of the sample. Among people age ≥60 years, the shares of women and men in the samples were similar (women=2-3%; men=2-4%).

TAPS data suggests that the number of people under 16 years of age and age ≥60 years has been growing annually by 0.07% and 8.78%, while the number of people of prime working age (16 years ≤age<60 years) has been falling by 0.65%/year. These growth rates suggest a rising dependency ratio, a topic discussed next.

Dependency ratio of households and households without workers (sections D-E, Table 5.4). Defined as the number of dependents in a household divided by the number of people of prime working age, the dependency ratio captures the work burden falling on people taking care of the aged and the young. I equate a dependent to a person who was either under 16 years of age or age ≥60 years, and I equate a person of prime working age to someone falling between these two age cut-offs (16 years ≤age<60 years). The age cut-offs are arbitrary. Sixteen years of age is a reasonable upper bound to define a dependent youth because Tsimane' set up independent households by that age (p. 23), and 60 years is a reasonable lower bound to define a dependent senior because older people begin receiving government old-age pensions by age 60. The dependency ratio gives a rough idea of the burden spawned by dependents on workers of prime working age -- rough because in rural societies children help in the household economy before marriage, and the aged likewise help in household chores after they start receiving old-age pensions. Furthermore, government transfers to the aged through pensions and conditional cash transfer programs for children to attend school ease the economic burden of dependents. These caveats aside, the dependency ratio is informative not so much when viewed as a snapshot, but when viewed over time.

Section D suggests that the dependency ratio for the sample of either TAPS or the randomized controlled trial was ~1.90, with the ratio rising yearly by 1.24% in the TAPS sample. The increase in the dependency ratio could be fictional if driven by older people over-stating their age to gain access to government pensions (p. 9). If, as noted, there is a trend of more and more adult women in a household and if -- in addition -- we also find more dependents in a household, then we might be witnessing the first signs of not only a society where females outnumber males, but also of a society in which women will shoulder the increasing double burden of having to care for the young and the old at the same time.

A neighboring concept of the household dependency ratio is the concept of a household empty of prime working-age people (16 years ≤age<60 years). Section E shows that in the TAPS annual samples, 5-10% of households (median = 9.00%) lacked workers of prime working age while in the randomized controlled trial 5.00% of households lacked such workers. Most households bereft of workers had two generations: young people under 16 years of age, and older people ≥60 years of age. A few households sans people of prime working age had only people below age 16 years of age, but 2-3% of households without prime workers had only people ≥60 years of age. In the TAPS sample, the number of households without premier workers grew annually by 8.05%. The trend of more households without prime working-age laborers could reflect the growing financial independence of older people from pensions (p. 9), neglect of the elderly by offspring of working age (p. 28), and greater financial independence of the young.

Age-sex population pyramids

So far, I have described levels and trends in the age-sex composition of the samples using roomy age brackets, such as sex ratios among people under or over 16 years of age. I next turn to age-sex population pyramids to examine sex ratios between thinner age brackets.

Figures 5.2a-5.2i and Figures 5.2j-5.2k contain annual age-sex population pyramids from the two studies (TAPS [Figures 5.2a-5.2i]; randomized controlled trial [Figures 5.2j-5.2k]). Besides showing the annual age-sex pyramids, I also pooled 2008 data from TAPS and from the randomized controlled trial into one pyramid (Figure 5.2l). As noted in Chapter 4, the randomized controlled trial changed aspect of village life (Undurraga et al., 2016), and affected out-migration from the village (Saidi et al., 2013). For this reason, in the pooled results of Figure 5.21 I only include data collected before we assigned the treatment (2008) in the trial. The pooled sample has the advantage of being large; done over a total of 53 villages, the total sample size has 4,821 people (randomized controlled trial = 3,327 (n); TAPS = 1,494 (n); Table 5.3). For transparency, I also show the age-sex pyramid from the 2009 survey of the randomized controlled trial. To remain loyal to the data, I do not smooth the pyramids' corners and edge and warbling contours. The pyramids point to three results, a puzzle, and a lesson.

Insert Figures 5.2a-5.2l

First, the pyramids display the textbookish shape of fast-growing populations in low-income nations, with a large bulging base and a long, thin and pinched apex. The shape hints at the idea that people of prime working age have a sheaf of children and aged kin they need to help, a point made earlier when discussing dependency ratios.

Second, we do not see any large, consistent swelling in favor of one sex, particularly during infancy or childhood. If we look at children under five years of age, we see about the same number of girls and boys. In the TAPS pyramids, we see roughly the same number of girls and boys in 2002, 2007, and 2009, slightly more girls than boys in 2003-2005 and 2008, and a slim margin in favor of boys in 2006 and 2010. Data from the randomized controlled trial shows more boys than girls in 2008, but the difference shrinks by 2009. When we combine the 2008 surveys of TAPS and the randomized controlled trial we find more boys than girls (Figure 5.2l), a result growing out of the fact that there were more boys than girls in the baseline (2008) survey of the randomized controlled trial (Figure 5.2j).

In the next age cohort (5 years ≤age<10 years) we still see about the same number of girls and boys. Except for the TAPS surveys of 2006-2007, the other TAPS surveys had more boys than girls. The 2008 survey from the randomized controlled trial had slightly more girls than boys, but the survey of 2009 had slightly more boys than girls. The combined 2008 surveys of TAPS and the randomized controlled trial show the same number of girls and boys in the cohort of 5 years ≤age<10 years. Thus, until about 10 years of age we see no large, patent, consistent imbalance in the number of girls compared to boys. However, at 10 years ≤age<14 years we see more boys than girls in all but two years (TAPS 2002 and 2009), but the pattern gets reversed in the cohort 15 years ≤age<25 years, which has more females than males. In 2007 we begin to see more females than males in the cohort 15 years ≤age<25 years, which likely reflects males leaving the village in search of employment. If we examine the age-sex pyramid for 2008 (Figure 5.2l), the year with the most observations, we see no large sex imbalance after 26 years of age. From all this admittedly descriptive and error-filled evidence I tentatively conclude that there does not seem to be any regnant numerical dominance of one sex over the life course.

The third result refers to the protrusion in the number of senior people over the age of 60 to 65 years in all survey except for the 2009 survey of the randomized controlled trial. At least in the TAPS surveys, the spread of public health services along the Maniqui River could explain the growth of the older population. Another reason for the swelling could be the retirement pensions established by the Bolivian government in 2002 (BONOSOL) for people over 65 years of age, and revamped and expanded in 2008 as Renta Dignidad for people as young as 60 years of age. Zycherman (2016, p. 164) found that the pensions made some Tsimane' fudge their age to get the payments.

The pyramids also show a puzzle: the loss in the number of girls between 10 and 14 years of age. In the TAPS surveys the loss gets bigger from 2002 until 2007 and then stabilizes. In the two annual surveys of the randomized controlled trial, the loss is large and persistent. I have no compelling explanation for the shrinkage other than noise from faulty measures. Girls 10-14 years of age do not move out of their villages to work. Virilocal marriage would also not explain the anomaly since girls typically do not marry so young, and - even if they did - the number of girls marrying out of a village to settle in the village of their spouses would be lave by the number of in-marrying girls from other villages. Also, after marriage females stay in the household compound and village of their parents while husbands move in (p. 24). Death of girls in this age cohort might explain the loss, but mortality records do not buttress the explanation. Table 4.5 suggests that, on average, only about seven people died each year in the TAPS sample. We shall have more to say about mortality later, but for now death as a reason for the loss seems questionable.

A final point. Anthropologists studying out-of-the-way rural populations often present age-sex pyramids for different historical periods to illustrate demographic changes (Hill & Hurtado, 1996; Howell, 2000). The description of the age-sex pyramids from TAPS bears out the pay-offs of the approach. In addition, the analysis presented shows the value of comparing age-sex pyramids for a society for the same time (2008), but with data from different samples. The comparison strengthens generalizations from only one sample. Findings from TAPS did not necessarily reappear with information from the randomized controlled trial.

Generational makeup of households

In Table 5.5 I draw on the samples from TAPS and from the randomized controlled trial to compute the number of generations in a household and create a typology of households. To estimate trends in household types I confine myself to TAPS since the randomized controlled trial included only two annual surveys. The TAPS sample is limited to 2005-2010 because we did not collect kinship data before 2005. Two findings stand out.

Insert Table 5.5

First, most Tsimane' live in nuclear household of 1-2 generations. In either study the median share of households made up of only a female and a male household head was 7.64%. During any one year, 75.05% of households had two generations, most often parents and children (74.86%), and, much less frequently, grandparents and offspring (0.27%). Together, households made up of a married couple without dependents (7.64%) and households made up of two generations (75.05%) accounted for 82.69% of all households in an annual survey. Households with three generations accounted for 17.03% of all households in an annual survey, and households with four generations were rare, accounting for merely 0.39% of the annual sample.

The second finding relates to time trends, and shows that the number of nuclear, two-generation households has been rising while the number of households with three or more generations has been falling. The number of households with one and two generations grew annually by 3.44% and 1.74%, while the number of households with three generations declined annually by 3.67%.

Most households had two heads (Table 5.6). Across the six years of the TAPS surveys for which we had kinship data and across the two years of data from the randomized controlled trial, we find that the median annual share of households with two heads was 86.00%, and that the median annual share of single-headed households was 10.80%. Polygynous households accounted for only 2.40% of the sample of households, lower than the estimates of 4.40-6.10% by Winking et al (2013), or 5-10% by Gurven et al. (2009, p. 160). Only 0.80% of households had no heads. A household coded as lacking a head does not mean that the household was, in fact, acephalous; rather, the statistic shows how we coded people during surveys. If during a survey the household heads were absent or did not want to participate in the survey, then we coded those present as living in a headless household.

Insert Table 5.6

Pregnancy: Women 14 years≤age≤50 years

I use clean data with consistent ages across surveys to describe pregnancy trends over the survey years and a woman's life cycle. The pooled data from TAPS and from the randomized controlled trial had 2,696 records showing if a female of childbearing age (14 years≤age≤50 years) reported being pregnant at the time of the interview. I chose 14 years of age as the lower age boundary to define childbearing because Tsimane' girls reach menarche at that age (Walker et al., 2006, p. 300) and because 10 girls of that age said they were pregnant. I chose 50 years as the upper age boundary of childbearing to facilitate comparisons with other studies, which often use 50 years of age as the end of the female reproductive cycle (Howell, 2000, pp. 141-143)[iv].

The information from TAPS and from the randomized controlled trial suggests that, on average, 15.76-16.62% of women reported being pregnant when we interviewed them, with TAPS surveys showing that the share rose at a yearly rate of 3.93 percentage points (Table 5.7). In the TAPS surveys, the median annual share of women who said they were pregnant (13.28%) was lower than the mean (15.76%).

Insert Table 5.7

To examine pregnancies by quinquennia, I pooled data from the two studies. Table 5.8 shows that the share of women who reported being pregnant during the surveys declined from the youngest age cohort (14 years ≤age<20 years) to the oldest (40 years ≤age≤50 years) cohorts. The share of women who were pregnant was highest (18.06%) among the youngest cohort, or women under 20 years of age. The share fell to 16.93% among women in their 20s, to 15.35% among women in their 30s, and dropped sharply to 9.51% among women ≥40 years of age. Among women of childbearing age, each additional year of age above the mean age in the sample (28.71 years) was associated with a 0.30% lower probability of becoming pregnant[v]. Figure 5.3 shows that women 17, 20, 22, 25, 27, 30, and 35 years of age were the most likely to report being pregnant.

Insert Table 5.8 and Figure 5.3

Accuracy of self-reported pregnancy data

In an annual panel study with limited attrition and additions, as with TAPS, the frequency of self-reported pregnancies each year should roughly match the frequency of annual births. After accounting for pre-natal and neonatal deaths, the number of self-reported annual pregnancies should be greater than or equal to the number of annual births. Since multiple births account for only 2% of all births in at least one of the largest international studies (Martin, Hamilton, & Osterman, 2012), having more annual births than self-reported pregnancies should be rare, and rarer still if the pattern persists year after year. In the TAPS surveys, we find large discrepancies between annual reported pregnancies and births[vi].

Recall from Table 5.7 that in the TAPS surveys, an average of 15.76% of women during an annual survey said they were pregnant (median=13.28%). At the time of the annual surveys, the TAPS team noted new additions to the household, such as infants who had been born since the last survey. The team assigned a new identification number to the infant, and noted the birth date, age, name, and sex of the infant, and measured the infant's weight and height. The information on babies born during each year of the panel is useful to assess many topics, such as fertility, birth seasonality, and the accuracy of self-reported pregnancy data, which is discussed next.

In Table 5.9 I show the number of infants added during each annual survey and the number of women who reported being pregnant during each annual survey. Under the column "Number of new births", I include babies who had a birth date, who were born after the panel started, and who were coded by the TAPS team as newborns or infants each year, beginning with the second year of the panel (2003). Infants recorded in a year captured new births since the last annual survey. We have no records of newborns in 2002 since surveyors started asking about new additions to the households in 2003, a year after the panel started. The estimates I am about to discuss are fragile because the annual sample of infants is small and there are clear oddities, such as the high number of new births in 2006. For this reason, I stress median values, do the analysis with and without 2006, and focus on totals.

Insert Table 5.9

Table 5.9 shows that the TAPS team recorded a total of 544 babies born from 2003 until 2010. If we compare the number of newborns with the number of women who reported being pregnant in a year, we find a consistent underreporting of pregnancies. For example, in 2004 we find 43 newborns in the sample, but only 28 women reported being pregnant. During the eight years that we surveyed women, we find an average of 44.86% fewer reported pregnancies than births. If we exclude 2006, there were 39.49% fewer reported pregnancies than births. The median values of the shortfall were 53.42% for the complete sample and 44.15% for the sample without data from 2006.

The shortfall could stem from two enlaced reasons. First, some women might have been in the early stages of pregnancy and not known that they were pregnant. If there is seasonality in births or conceptions, as I argue later (Figure 5.7d and p. 20), and if it takes 3-4 months for women to publicly acknowledge their pregnancy, then annual surveys, each spanning roughly four months (May-August), would have underestimated the total annual pregnancies by about 30%. Since our most conservative estimates suggest that there were 39.49% and 44.15% fewer reported pregnancies than births, this explanation is not enough. A complementary explanation centers on cultural norms about divulging information on pregnancy. The shortfall would emerge if women thought it improper to tell the survey team that they were pregnant[vii]. As noted in Chapter 4, each survey team was comprised of a university-trained Bolivian from the highlands and a Tsimane' translator, most often a man.

Female and male fertility by age and age cohorts: Age≥14 years, TAPS 2007

Caveats in the construction of fertility data. During the TAPS survey of 2007, we asked adult women and men about the total number of offspring (alive or dead) they had ever had, the sex of each offspring, and whether the offspring was alive at the time of the interview. We have no way of assessing omission bias, such as under-reporting of deaths, and whether respondents were more likely to forget the birth or death of girls over boys, or vice versa. From the self-reported age of adult respondents, I estimated their age quinquennium or their implicit birth quinquennium. Information on age allows one to approximate fertility over the life cycle, while information on age quinquennium allows one to estimate secular trends in fertility. Age cohorts (or birth period) matter because illness, nutrition, and body size during infancy and early childhood affect adult human biology (e.g., sperm count, height), which, in turn, affects adult fertility (Courtiol et al., 2013; Dama & Rajender, 2012; Ivell, 2007).

Table 5.10 contains information on fertility in two columns. In column A, I show the share of people who reported never having given birth or fathered an offspring. The sample for column A contains all adults who answered questions about fertility. In column B, I provide statistics on the total number of female and male offspring of respondents, and the number of those offspring alive at the time of the 2007 survey. I confine the samples of column B to people who reported having had at least one offspring, alive or dead.

Insert Table 5.10

In reporting fertility I had to decide what samples to use, with no ideal solution. For instance, in reporting the mean number of total offspring, should one include adult women who had never given birth or adult men who had never fathered an offspring? At first sight one might be tempted to include these adults, but if one wants to compare fertility with survival rates, as I do in Table 5.10, then including them would make it hard to carry out a meaningful comparison since the survival of offspring depends on first having had a child. Because I am interested in presenting data on fertility, survival, and, later (p. 28), on mortality I decided to restrict fertility statistics to people who had given birth to at least one daughter or to one son. The decision has shortcomings and advantages. To clarify tradeoffs, reduce misprision about samples, and add transparency to Table 5.10, I next discuss as an example the fertility of women 14 years ≤age<20 years. The example should make it easier to follow the discussion of results.

Table 5.10 shows that in 2007 we surveyed 57 women 14 years ≤age<20 years, of whom 42.11% said they had never given birth (column A), meaning that 33 women (57.89%; column B3) had given birth to at least one daughter or to one son at the time of the interview. In computing statistics for column B, I exclude the 24 women who had not given birth to daughters (column B1) or to sons (column B2). For example, the 17 women who had given birth to daughters gave birth to an average of 1.29 daughters; if a woman had given birth to a son, but not to a daughter, then I excluded her from column B1 for the total births of daughters, but I included her in column B2, and if she had given birth to both a daughter and a son, then I included her in both columns B1 and B2. The mean and standard deviation of the total number of offspring born reported in each cell thus refers to women who had given birth to at least one daughter (column B1) or to one son (column B2). Owing to the way I constructed the data for Table 5.10, we do not find a tight fit in the sample of women included in columns B1 and B2, and this has implications for the way I estimate and describe the total number of offspring. The way I treated the samples and computed the statistics explain why the total number of offspring born to a woman reported in column B3 (1.45) differs from the naive addition of the mean total number of daughters (1.29) plus the total number of sons (1.23), or 2.52. The total number of offspring born shown in column B3 corrects for the overlap or double counting in the samples of columns B1 and B2 and is thus accurate, whereas the summary statistics in columns B1-B2 are reliable on their own, but not when added. The advantage of having restricted the samples in this way arises when we consider the survival of offspring. To ease comparison with statistics on offspring born and to make the statistics meaningful, I restrict statistics under the column titled "# alive 2007" to women who had given birth to a daughter. We can see that among women 14 years ≤age<20 years, 17 women had given birth to an average of 1.29 daughters, and of these daughters, a mean of 1.29 daughters were still alive in 2007. Had we included in the column titled "Total born" women who had never given birth to a daughter, then there would have been a mismatch between statistics on the total number of offspring born with statistics on the total number of surviving offspring.

The data and analysis have at least two flaws that need addressing before discussing results. First, since adult fertility increases with age, relying on a one-time survey to estimate the concurrent associations between fertility and *(i)* the age of the adult and *(ii)* the age quinquennium of the adult is problematic because age and birth quinquennium move together. To overcome the limitation, we should have surveyed different people of the same age, but in different years (Godoy et al., 2007, p. 265). We did not. Had every yearly survey of the panel included questions about fertility, we would have been better placed to decouple the role of aging from the role of age quinquennium when estimating the association of each with fertility. The second flaw has to do with sample size. The sample size of each age cohort was small (Table 5.10, section A). On average, each age quinquennium of women had 43.85 people (median = 42.00) and each age quinquennium of men had 41.28 people (median = 37.00). The sample sizes were even smaller for sub-groups, such as women in an age quinquennium who gave birth to daughters. Owing to small samples, we should be chary when interpreting results.

Female fertility (section I, Table 5.10). Table 5.10 (column A) shows that the share of women who had never given birth dropped from a high of 42.11% among women under 20 years of age, to only 3.03% among women past their reproductive years (age ≥45 years). The share of nulliparous women at 25 years ≤age<30 years was 11.90%, above the rate for the Hadza (3%), but below the rate for the Dobe !Kung (14%)(Marlowe, 2010, pp. 182-183).

Column B3 shows that the mean number of all births (alive and dead) was highest among older women. The mean number of all births rose from 1.45 (SD=0.83) among women 14 years ≤age<20 years, to 3.20 (SD=1.67) among women in their 20s, to 7.04 (SD=3.11) among women in their 30s, and peaked at 8.79 (SD=3.24) among women ≥40 years of age. On average, a woman ≥45 years of age had a total of 8.93 births (median=9.00; SD=3.38), similar to the figure reported for the Ache of Paraguay (Hill & Hurtado, 1996, p. 271) . The overall sample shows that women gave birth to slightly more boys (mean=3.58; median= 3.00; SD=2.32; column B2) than girls (mean=3.14; median=3.00; SD=1.89; column B1). Women in most age cohorts gave birth to more boys than girls, particularly women ≥ 45 years of age; these women gave birth to an average of 5.11 boys (median=5.00; SD=2.41) and 4.33 girls (median=4.00; SD=1.77). Only among women in two age cohorts --14 years ≤age<20 years and 25 years ≤age<30 years -- do we find women giving birth to slightly more girls than boys, but the mean difference was trifling (~0.05).

Column B3 shows that the mean total number of living offspring rose from younger to older age cohorts, from a mean of 1.36 living offspring among women under 20 years of age (median=1.00; SD=0.78), to 2.77 (median=2.00; SD=1.47) among women in their 20s, to 6.00 (median=6.00; SD=2.63) among women in their 30s, peaking at 6.78 (median=7.00; SD=2.94) among women ≥40 years of age. If we examine the mean number of daughters and sons alive in 2007 by a mother's age cohort we find that sons outnumbered daughters, except among mothers under 25 years of age. The overall sample shows that in 2007 women had 2.88 sons (median=2.00; SD=1.98) but only 2.59 daughters still alive (median=2.00; SD=1.56) and among women ≥25 years of age there were, on average, 0.29 more living sons than living daughters. Excluding the two youngest age cohorts, the gap in the number of surviving sons versus surviving daughters increased among older women, and climaxed among women over 45 years of age, who had 0.58 more living sons than living daughters at the time of the 2007 survey. In the youngest age cohorts (<25 years) we see more living daughters than living sons.

In sum, two findings surface. First, a post-menopausal woman had experienced a mean total of 8.93 births, with 6.67 offspring alive by the time of the 2007 survey. The total number of births for post-menopausal women I computed (8.93) resembles the total fertility rate of Tsimane' women reported by McAllister et al. (9.10)(2012, p. 789) using a different sample of 213 mothers with accurate birth dates for their children, but higher than the completed fertility rate of women in 16 indigenous populations of lowland Latin America (7.46) compiled by McSweeney and Arps (2005, p. 15). Second, women reported giving birth to more sons than daughters, and having more surviving sons than daughter, but the bias in favor of sons dwindled among younger mothers.

Male fertility (section II, Table 5.10). Patterns of male fertility resemble but also differ from patterns of female fertility. For example, among men, as among women, the number of girls and boys ever born and living at the time of the interview rose from younger to older age cohorts. With reported fertility of men, as with reported fertility of women, the number of boys ever born or living was greater than the number of girls ever born or living, particularly among men over 25 years of age. But two differences appear when contrasting female with male fertility. First, compared with women, men reported having had fewer offspring or surviving offspring, whether daughters or sons. Only among men 40 years ≤age<45 years did men reported having had more offspring or having more surviving offspring than women. Second, until 30 years of age the share of men who reported never having fathered an offspring was generally higher than the share of nulliparous women. For example, among women 14 years ≤age<20 years or 20 years ≤age<25 years, 42.11% and 11.11% reported never having given birth, whereas among men of the same age brackets the shares who reported never having fathered an offspring reached 81.08% and 33.33%, suggesting that men begin reproducing at a later age than women. The result concurs with the results of a study by Walker et al. (2006, p. 300). During 2002-2003 they collected data from Tsimane' and found that women began reproducing at 18.60 years of age and men began reproducing later, at 23 years of age.

Aging and secular trend in female and male fertility. Table 5.11 shows the concurrent associations between *(i)* the total number of offspring ever born and surviving in 2007 and *(ii)* the age and birth quinquennium of the adult respondent.

Insert Table 5.11

[a] Aging (section 1, Table 5.11). After controlling for birth quinquennium, an increase in the age of a mother or of a father was associated with the birth of more boys among mothers and with more living sons among fathers. An additional year of age was associated with the birth of ~0.35 more boys among mothers, and with ~0.23 more living sons among fathers. Figure 5.4a shows in a transpicuous way that the relation between the total number of births and a women's age resembled an inverted U. However, among men, the relation between the number of living sons and a father's age resembled an upward-sloping straight line (Figure 5.4b). The age of a mother or a father bore no strong association with the number of girls ever born or the number of girls who survived.

Insert Figures 5.4a-5.4b

[b] Secular trend (section 2, Table 5.11). Among fathers we see a secular decline in the number of daughters born and the number of daughters who survived. For example, after controlling for age, and compared with younger men born during 1988-1992, older men born during 1968-1977 fathered an average of five more daughters and had 2.41-3.24 more surviving daughters (columns IIAi and IIBi). Among mothers, we see a less marked secular decline in fertility, but only with the total number of daughters born, not with the total number of surviving offspring. For instance, compared with mothers born during 1988-1992, older mothers born during 1983-1987, 1978-1982, or 1968-1972 gave birth to 1.14, 1.37, and 2.36 more daughters. Neither among mothers or among fathers do we find a noticeable secular trend in the number of boys born or surviving.

In sum, aging was associated with the birth of more sons among mothers and with the survival of more sons among fathers. We see a secular decline in the number of daughters fathered by men and in the number of these daughter who were still alive by the time of the 2007 survey. Secular trends were less marked among boys born to mothers or fathers, and among girls born to mothers.

Implicit length of inter-birth intervals during a woman's reproductive years (14 years ≤age≤45 years). Since we did not collect fertility histories from women, I had to estimate the mean and median number of years between births by subtracting 14 years from a women's age in 2007, and dividing the result by the total number of all births (alive or dead) reported by the woman. I changed the age of women over 45 years to 45 because I wanted the estimate of mean inter-birth interval to apply to a woman's reproductive years. Failure to top code age would have resulted in bloated inter-birth intervals for post-menopausal women. In defining the age boundaries of a woman's reproductive years, I chose 14 and 45 years as a lower and as an upper boundary to enhance comparison with other studies of Tsimane' fertility (Gurven 2012). My blunt method for estimating mean inter-birth interval is sensitive to the maternal age at the birth of the first child. For this reason, I also present results using 15 years as the maternal age at first birth. Owing to the small sample of women in each age cohort (mean=33.16; median=33.00), I stress median values to weaken the influence of outliers (Table 5.12).

Insert Table 5.12

Table 5.12 shows that women under 20 years of age gave birth every two to 2.5 years. From this base, the median inter-birth interval rose and stayed at three years for the rest of a woman's reproductive years, with a higher inter-birth interval if we use 14 years as the mean maternal age at first birth. Section A shows that women who completed reproduction (≥45 years of age) had given birth every 4.49 years (SD=4.16), or every 3.33 years if we use median values. If, instead, we use 14 years as the maternal age at first birth (section B), the mean and median values of the inter-birth interval rise to 4.64 and 3.44 years (SD=4.30). The median inter-birth intervals of 3.33 or 3.44 years for post-reproductive women resembles the estimate for the Dobe !Kung (Howell, 2000, p. 134) and the mean for hunter-gatherers with natural fertility (3.70)(Sellen, 2007, pp. 128-129), but is higher than the mean inter-birth interval (2.5 years) computed by McAllister et al. (2012, p. 789) for the Tsimane'[viii].

We end this section by commenting on the annual rate of population growth of the Tsimane'. Previous research suggests that the Tsimane' are experiencing an annual rate of population growth between 4.86% (Reyes-Garcia, 2001, p. 68) and 3% (McAllister et al., 2012, p. 795). I use the annual birth and death rates from the nine-years of the TAPS surveys to provide a blunt estimate of the rate of natural increase of the Tsimane' population (Table 4.5). Table 4.5 suggests that the Tsimane' are experiencing annual birth and dates rates of 5.32% and 2.23%. If accurate, *ceteris paribus*, these figures would point to an annual rate of natural increase of ~3%, and a doubling of the population every 25 years.

Birth seasonality: TAPS (2002-2010) and randomized controlled trial (2008) compared

In rural societies with meager resources, climate and seasons affect work, migration, illness, leisure, food consumption, and human biology, including fertility (Dorelien, 2016; Osei et al., 2016; Philibert et al., 2013; Torche & Corvalan, 2010; Yamauchi, 2012). Among the Tsimane', previous studies have shown that rainfall variability during the infancy and early childhood of females is associated with shorter height when these females reach adulthood (Godoy et al., 2008). Boys born during dry season growth faster between two and 11 years of age than boys born during the rest of the year (Zhang et al., 2016). Before discussing birth seasonality I briefly describe monthly rainfall and temperature in the area.

Figure 5.5a shows annual rainfall from 1943 until 2013 for the town of San Borja, the only place in the study area known to me with long-term weather records. Recall that the town of San Borja lies downriver from most of the villages in the panel study, so rainfall and temperature records for San Borja do not mirror faithfully weather conditions in villages farther up river, or of all the villages in the randomized controlled trial. Based on daily weather records from August 1999 until October 2000 collected *in situ* in the TAPS villages of Yaranda and San Antonio, Byron (2003, p. 150) found that during most of the year the village of Yaranda up the River Maniqui had more rainfall than the village of San Antonio, which lies farther downriver, near the town of San Borja. Bearing in mind caveats about how weather records from the town of San Borja might gloss over weather conditions in the entire sample of villages in the two studies, Figure 5.5a nonetheless shows a year divided between a dry season from about May until September, and a rainy season from about October until March, with April as a bridge between the two seasons. For comparison, in Figure 5.5b I show rainfall data for the town of

Rurrenabaque, department of Beni, at the edge of today's Tsimane homeland and near the northwestern villages from the randomized controlled trial (Figures 3.1 and 4.2). Both places had the least amount of rain during July-September, but -- for any given month -- Rurrenabaque had more rain than San Borja[ix].

Insert Figures 5.5a-5.5b

In Figures 5.5c-5.5d I show the mean minimum monthly temperature from the late 1950s and early 1960s until 2013 for the towns of San Borja and Rurrenabaque. Temperatures reached their lowest point at the height of the dry season (June-August). During these months, intense surges of frigorific weather from the south move north, causing temperatures to drop by as much as 10^{0}C within days, with adverse health consequences (Espinoza et al., 2012). Besides having the lowest temperatures of the year, the dry season is also when the larder is emptiest. On the positive side, the dry season might be the time when edible wild animals gain most weight (Luz, 2012, pp. 19, 103) and when Tsimane' hunt and fish more (Godoy et al., 2008). These counteracting pressures blur the net effects that seasons might have on human biology.

Insert Figures 5.5a-5.5b

Data quality. To assess birth seasonality, I used reported birth dates, from which I extracted the month and the year of birth. For the analysis, I used clean data from TAPS and from the baseline (2008) survey of the randomized controlled trial because the data sets had variables that correct for inconsistencies between years in age or birth date (Chapter 4). Since TAPS data had repeated measures for the same person, I used the earliest age. Because the food transfer of the randomized controlled trial could have affected food consumption and pregnancy, I only use data from the first year of the trial (2008), before the food transfers took place. All participants in the TAPS surveys and 72.73% (2,377 out of 3,268) of the people in the baseline survey of the randomized controlled trial had a birth date.

Earlier we saw that Tsimane’ guess when reporting ages (p. 3). The use of reported birthdates raises questions about the reliability of such information to analyze birth seasonality. I assess error in birthdates indirectly by analyzing the last digit of the day of the month and the year of the birthdate reported. Digit heaping for the day of the month and the year of birth would increase the chance that people guessed when reporting their own or their dependents’ birth month. Figures 5.6a-5.6b show the last digit of the birth month and birth year.

Insert Figures 5.6a-5.6b

Figure 5.6a shows that people in the two studies did not prefer the same last digit when reporting birth dates. In the TAPS surveys, we see a strong preference for days of the month ending in one, but in the randomized controlled trial of 2008 we see a mild preference for days of the month ending in multiples of five or 10. Figure 5.6b shows that people in the TAPS sample preferred reporting birth years ending in zero, but the sample from the randomized controlled trial showed a preference for reporting birth years ending in seven. These strands of evidence provide indirect evidence that information on birth month contains a modest amount of random measurement error from digit heaping.

Birth seasonality by study, sex, and birth decade (secular trend). Figure 5.7a.iii shows that for the two studies combined, most births happened between the start (May) and the end (August) of the dry season, with a nadir during November-December, and a smooth increase from November until May, a result echoed by a graphical analysis of Gurven (2012, p. 2497) of 1,758 births from 1950 until 2002 with known birth months. However, birth seasonality in TAPS and in the randomized controlled trial differ in at least one way. The TAPS sample shows a clear peak in the number of births in June and, to a lesser extent, in August, whereas the sample from the randomized controlled trial lacks striking peaks, though most birth took place between May and August. In Figure 5.7b I compare the number of females and males born by season. The number of births for females and males both peaked in June and August, but males had a sharper peak in June than females. The number of births for both sexes bottomed out in November-December, but males had another low point in the number of births in September. Across the months of the year, the number of females born did not vary as much as the number of males born. The histogram of female births by month had fewer of the sharp peaks or deep bottoms than the histogram of male births by month.

Insert Figure 5.7a-5.7b

Since birth seasonality reflects the vulnerability of rural populations to weather stresses, birth seasonality could show secular trends if Tsimane' gained more ways of buffering themselves against the stresses created by weather. For example, the availability of new employment opportunities, access to public health services, and government aid during floods could attenuate the effects of seasons on conception and births. To examine secular trends in birth seasonality I broke up the sample by birth decades. Owing to the small sample size for people born before 1950, I lumped people born before 1950 into one category, but grouped people born after 1950 into their birth decade (e.g., 1961-1970, inclusive). Figure 5.7c shows the results of birth month by birth decade.

Insert Figure 5.7c

Figure 5.7c shows that months with many or with few births were more common in the past, and were most prominent among people born before 1980. Starting in 1991, the number of births are more evenly spread out across all months. The marked peak in August births just noted reflects the influence of older people born before 1990. Births during the two most recent decades show no large peaks or dips; people born during 1991-2000 were more likely to be born in June and were least likely to be born in November, whereas people born during 2001-2010 were slightly more likely to be born in June and least likely to be born in September. The number and height of peaks shrink as we get closer to the present.

Quantitative analysis of birth period as a function of birth decade corroborates the results of the graphical analysis (Table 5.13). Females and males were equally likely to be born during the dry season, with males being only 0.5 percentage points more likely than females to have been born during the dry season. Nevertheless, people from TAPS villages were 6.39 percentage points more likely to have been born during the dry season than people from the randomized controlled trial. If birth seasonality picks up vulnerability to stresses from climate perturbations, then villagers from the TAPS sample, all living along the Maniqui River, were more vulnerable than people living elsewhere. Table 5.13 also shows that the propensity of births to take place during the dry season declined over time. For instance, people born during 1961-1970 were one percentage point less likely to be born during the dry season than people born before 1950; the probability fell to two percentage points less likely for people born during 1971-2000, and the probability fell to 3.93 percentage points less likely for people born in the most recent decade (2001-2010). The results of the analysis by quarter of birth complements the conclusion of a secular decline in birth seasonality. The results suggest a decline in the probability that births happened during the second and third quarters (dry season) and an increase in the probability that births happened during the rest of the year. For instance, compared with the cohort of people born before 1950, cohorts born during 1991-2010 were 3 to 0.8 percentage points less likely to have been born during the second and third quarters, and about 1 to 5 percentage points more likely to have been born during the first and fourth quarters.

Insert Table 5.13

<u>*Birth seasonality from TAPS data on newborns (2003-2010)*</u>. So far, the analysis of birth seasonality has relied on information from all participants with reported birth dates. An obvious shortcoming with such data is random measurement error of reported birth month from faulty recall. To redress the shortcoming, I next focus on a sub-sample of the TAPS population likely to have lower measurement error in reported birthdates: newborns recorded during the annual TAPS surveys. We have already referred to data on newborns when discussing errors in reported pregnancies in Table 5.9. Because they were newborns or additions to the panel since the last annual survey, their caretakers were more likely to remember their exact birthdates and perhaps even have a birth certificate for the infants. A shorter recall period should lower the chance that caretakers made mistake when reporting the birth date of their offspring. Unfortunately, we did not code for whether the caretaker had a birth certificate, so the information I am about to present most likely still contains measurement error from defective recall. Although these infants were included in the previous analysis of seasonality, I now pull them out of the previous samples and analyze them separately since their information is more likely to be truthful.

Figure 5.7d shows yearly histograms of birth months for 544 babies born during 2003-2010 as the panel study was taking place. Two findings stand out. First, we continue to find quirks likely to happen with small samples. Some of the more obvious anomalies include a spike in births during February 2005, no births during September-November 2004, and few births during May 2010. Second, when we pool the data we find modest peaks of birth during April and July, but no pronounced peak during June and (to a lesser extent) August, as we found with the entire sample from the panel (Figure 5.7a.ii).

Insert Figure 5.7d

To highlight the contrast in birth months between children born during 2003-2010 and older cohorts born ≤1980, I pooled the four oldest cohorts from Figure 5.7c and present them in Figure 5.7e. The older cohort had two unmistakable large peaks of births in June and in August whereas children born during 2003-2010 had two modest peaks, in April and July. Aside from the difference of when the peaks occurred, another difference has to do with the shape of the histogram. The older cohort shows a smooth increase in births from January until May, and a jagged declined after August. Births rise and fall across the months of the year, with a pinnacle during the dry season. In contrast, the distribution of birth months for babies born during 2003-2010 still looks like a bell-shaped curve, but a much flatter one, resembling a rectangle without peaks or troughs. Combined, all these fragments of evidence hint at the idea that climate might be exerting less influence on the timing of births, but leaves unanswered why this might be so.

Insert Figure 5.7e

Lactation (14 years≤age≤50 years): TAPS (2002-2004, 2006-2010) and randomized controlled trial (2008)

Lactation matters because it curbs fertility and affects infant, child, and maternal health. In this section I present statistics on lactation and discuss the links between lactation and fertility, leaving for a later chapter a discussion of the links between lactation and maternal and child health.

Data quality. In TAPS and in the randomized controlled trial we asked women in most years whether they were lactating and, if so, for how many months they had been lactating. During the 2005 TAPS survey, we asked women whether they were breastfeeding, but we did not ask them about the duration of breastfeeding. Because we asked the same questions in both studies, I combine and analyze the clean samples from the two studies. I limit the data from the randomized controlled trial to the baseline year because the food transfers of the trial could have changed nutrition and lactation. For simplicity, I rounded a few fractional answers about the duration of lactation into the next highest integer[x]. I restrict the analysis to women 14 years≤age≤50 years to make the age bracket comparable to the age brackets used in the pregnancy analysis, aware that some females could be lactating before or after these ages[xi].

Answers about the duration of lactation had random measurement errors. Figure 5.8 shows that women rounded their answers on how long they had been lactating to 12, 18, 24, and 36 months. The tendency to round answers to multiples of six appeared in the two studies[xii]. Table 5.14 (section A) shows that for the combined samples of the two studies, 59.20% of women were lactating at the time of the interview (TAPS=57.82%; RCT=68.04%), but 11.18% of lactating women had missing data on how long they had been lactating (TAPS=13.05%; RCT=0.93%), chiefly because in the 2005 TAPS survey we did not ask about the duration of lactation. Data on the duration of lactation had some unusual values (section C). In the randomized controlled trial we find low values among women 25 years≤age≤34 years (mean duration=7.61-9.03; median=5.50-8.00), most likely from outliers in the small samples for particular age cohorts (mean sample size of age cohort=30.42; median=33.00).

Insert Figure 5.8 and Table 5.14

Analysis. Table 5.14 (section A) shows that the youngest (14 years≤age≤19 years) and the oldest (45≤age≤50 years) women breastfed the least, with 52.59% and 35.63% of women in those age cohorts breastfeeding at the time of the annual interviews. The share of women 20 years≤age≤39 years who were lactating ranged from 63.16% to 67.38%. Section C of Table 5.14 shows that women breastfed, on average, for 11.10 months (median=10.00; SD=8.02), but we do not know at what age women introduced complementary foods[xiii]. Across all age cohorts, women in the TAPS sample breastfed 1.78 months longer than women in the randomized controlled trial (TAPS: mean=11.41 months, median=11.00; SD=8.13; RCT: mean=9.63 months, median=9.00; SD=7.33). In both studies, women in older age cohorts breastfed longer. Among women age ≥35 years, the median duration of current lactation in the TAPS sample was 12 months; in the randomized controlled trial, women of the same age had a median duration of lactation of 9.50-12 months. Figure 5.9 shows the duration of lactation and a women's age. The graph shows a modest, linear rise in the duration of lactation with age, equivalent to 1.41 more months of breastfeeding for each additional decade of age (Table 5.15, column B). To analyze secular trends in lactation I show the duration of lactation by survey year (Figure 5.10). The mean and median duration of breastfeeding fell from 12 to 10 months, before and after 2005. In Table 5.15 I present a statistical analysis of duration of current lactation as a function of age and survey year. The results in column B show that, compared with lactating women surveyed in 2002, lactating women surveyed during 2010 breastfed 3.45 fewer months[xiv]. Our result chimes with the results of a study by Veile et al. of 80 mother-infant dyads (2014, p. 154). They found that between 2003 and 2011, Tsimane' mothers introduced complementary foods at earlier ages. During 2003-2011, the mean age when a child was introduced to complementary foods fell by about one month[xv].

Insert Figures 5.9-5.10 and Table 5.15

To explore the association between breastfeeding and fertility we are confined to the 2007 survey because we only asked about reproductive histories in 2007. I begin by analyzing the association between the duration of lactation and inter-birth intervals (Figure 5.11). In Figure 5.11 I put the duration of lactation in months for women who were lactating in 2007 on the Y axis, and their mean inter-birth interval in years for all births (alive or dead) on the X axis. Figure 5.11 shows that a one-year increase in the mean interval between all births was associated with an increase in the duration of breastfeeding of 0.17 months. The same weak association re-appears when we examine the link between the current duration of breastfeeding and the total number of offspring born to a woman (Figure 5.12). Each additional birth was associated with 0.12 fewer months breastfeeding. In Figure 5.13 I show the relation between duration of lactation and the total number of living offspring among women surveyed during 2007. The relation was also negative, but stronger. Each additional live offspring was associated with 0.22 fewer months breastfeeding. In sum, the information hints at the idea that lower fertility is correlated with a decline in the duration of breastfeeding.

Insert Figure 5.11-5.13

Marriage, post-marital residence, and mate selection

Like other native Amazonian societies (Chagnon, 1977; Chernela, 1993, p. 55; Levi-Strauss, 1969), the Tsimane' have a prescriptive cultural ideal which says that people should marry their cross-cousin: a man should marry the daughter of his mother's brothers or of his father's sisters, and a woman should marry the son of these uncles. Failure to marry a cross cousin brings bad luck, such as a poor harvest. Tsimane' do not have a marriage ceremony. Couples, who have often known each other for years, set up a new household, sometimes after elopement, with abductions and forced marriages also happening (Gurven et al., 2009; Riester, 1978). As we shall see, newly-married couple live in the village of the wife, often in the compound of the wife's family.

Members of a household sleep under one roof, but cook in a separate structure. In 2002, the only year the TAPS team measured house types, we found that sleeping areas had 2.91 walls (standard deviation=1.50; median=4 walls) and 66.80% of households (163 out of 244 households) had a separate, covered kitchen. The lack of complete enclosure around houses makes it easier for neighbors to see what households own and do, and might explain why village economic inequalities affect individual well-being (Undurraga et al., 2016). Closely-related households, such as a newly married woman and her parents, cluster around a compound in a separate structure, but share a kitchen.

Ellis (1996) and Daillant (1994) have given us ethnographies of Tsimane' household formation and kinship, and more recent studies examine aspects of marriage, such as polygyny (Winking et al., 2013), assortative mating (Godoy et al., 2008; Gurven et al., 2009), and extra-marital affairs (Winking et al., 2007). In this section I complement these strings of research through quantitative analysis of household formation.

Data quality. The information for this section comes from two sources. First, I rely on the 2007 TAPS survey, already used for the analysis of fertility and breastfeeding. Because we found 10 women who said they married for the first time when they were 12 years old, we lower the minimum age from 14 years – the lowest age used to examine fertility and breastfeeding – to 12 years. Second, I draw on clean data from TAPS and from the randomized controlled trial to examine assortative mating -- the tendency to mate with people who complement or substitute for one's traits, above chance expectations.

Only during the 2007 survey did we ask about the marital history of adults, including how often they had been married, the age at the time of their first marriage, the age at the time of their current or last marriage, and their residence after their first marriage. As we have seen, the 2007 data has shortcomings, and for the topic at hand -- marriage -- we continue to find unusual values. *(i)* Only two people said they felt unsure about their age at the time of their first marriage, and only one person admitted being unsure about the age at the time of his current marriage. This is strange because, as we have seen in this chapter, Tsimane' do not keep accurate records of their age so one is surprised to find so few people admitting uncertainty. *(ii)* Two people said they never married, but nevertheless reported an age at the time of their first marriage or at the time of their current marriage. *(iii)* Three people who married more than once gave the age at the time of their first marriage, but did not say how old they were when they married their current spouse, which is counter-intuitive since one would expect better recall for more recent events. *(iv)* Last, four people said they were older at the time of their first marriage than at the time of their current marriage. I dropped (iv), recoded (i) (p. 4), and left ii-iii unchanged.

Figure 5.14 shows self-reported age at the time of first marriage for females and males. For both sexes, the graph shows rounding to ages ending in zero and five. However, among men and women we see many men reporting 18 years as the age at their first marriage, and many women reporting 16 years as the age at their first marriage. The preference of men to report 18 years of age as the age at their first marriage could reflect Bolivia's minimum age for military service, which elsewhere in rural Bolivia is one rite of passage into adulthood (Kohl, Farthing, & Muruchi, 2011, p. 48). In theory, military service is compulsory for women and men, but few Tsimane' enlist[xvi]. In Figure 5.15 I show the age at the time of their last or current marriage, but only for people who married more than once because Figure 5.14 already captures people married once. Among people who married more than once we again find a tendency to round the age at the time of their last marriage to numbers ending in zero or five.

Insert Figures 5.14-5.15

<u>Marriage: Number of times married and age at time of marriage</u>.

[a] *<u>Number of times married</u>*. Table 5.16 shows that 62.57% of women married once (section IA), but the figure misleads because it includes unmarried young girls who would eventually marry. If we narrow the summary statistics of section IA to women who had married at least once (n=292), we find that 81.85% married once, 17.12% married twice, and 1.03% married three or more times. Men also entered into lasting monogamous partnerships (section IB). Of the 256 men who had married at least once, 78.91% married once, 18.75% married twice, and 2.34% married three or more times. Thus, most conjugal unions (~80%) remained monogamous. What we cannot tell is whether multiple marriages eventuated from the death of a spouse, or from separation and remarriage.

Insert Table 5.16

In Table 5.17 I show secular trends in the probability that a person would marry many times. For ease of interpreting results, I use two approaches to estimate secular trends, and in both approaches I control for age and sex. The results evince a trend toward marrying once. For instance, compared with the cohort of people under 21 years of age, the cohort of older people between 36 and 45 years of age were 35-39% less likely to marry once. Expressed in percentage points, people in the cohort 36 years ≤age≤45 years were 8-10 percentage points less likely to marry once, again, compared with younger cohort of people under 21 years of age. Women and men were equally likely to marry once. Compared with women of the same age, men were only 0.8% (or 0.7 percentage points) less likely to marry once. The trend toward marrying once could reflect a secular erosion in polygynous unions.

Insert Table 5.17

[b] *<u>Age at the time of first and current marriage</u>*. Section IIA of Table 5.16 shows that among women who married for the first time, the mean and median age was about 16 years (SD=3.1). The median age at first marriage did not vary much across age cohorts (range: ~15.00 to 17.57 years). The mean and median age at which women married their current spouse was higher (mean=19.58 years; median=17.00; SD=9.22) than the age at which they married for the first time because the estimates for the age at the time of their marriage to their current spouse takes into account women who re-married. If we restrict the sample to women who married many times, we find that the mean and median ages at the time these women married their current spouse were 31.23 and 26 years (SD=16.09). The age at first marriage was one year lower (mean=15.96 years, median=15.00; SD=2.72) for women who married many times than for women who married once (mean=16.96 years, median=16.00, SD=3.17).

Men married at a later age than women. Section IIB (Table 5.16) shows that for the total sample of men, the mean and median ages at the time of their first marriage were 20.11 and 19.00 years (SD=4.04), higher than the age at first marriage for women (~16 years). Like women who married many times, men who married many times had a lower age at the time of their first marriage than their male peers who married once; the mean and median ages at the time of first marriage for men who married many times was about 18 years (SD=3.27), compared with a higher mean and median of about 20 years (SD=4.08) for men who married once. Among men who married many times, the mean and median ages at the time of their current marriage were 33.35 and 28.00 years (SD=16.35).

Figures 5.16a-5.16b shows some evidence of a decline in the age at the time of first marriage among younger cohorts, particularly among the cohort of people ≤25 years of age. Among cohorts of females ≤25 years of age (Figure 5.16a) we see a generally lower age at the time of their first union than among the cohort of females ≥26 years of age. The cohort of males ≤25 years of age had a lower age at the time of their first union than the cohort of males ≥26 years of age.

Insert Figures 5.16a-5.16b

Post-marital residence after first marriage. Most people (72.61%) settled in the household compound or in the village of the wife's family at their first marriage, with a smaller share (24.26%) settling in the household compound or in the village of the husband's family. Only 3.13% of newly-married couples moored outside the household compound or village of either spouse (Table 5.18)

Insert Table 5.18

Despite the omnipresence of uxorilocal post-marital residence, the descriptive statistics of Table 5.18 suggest that its importance has fallen. If we split the sample into two groups -- cohorts of people ≤25 years of age and cohorts of people over 25 years of age -- we find that the share of people who took up matrilocal post-marital residence after their first marriage fell from 74.94% among the cohort of people over 25 years of age to 66.21% among the cohort of people ≤25 years of age. The decline in matrilocal post-marital residence was accompanied by a rise in the share of virilocal post-marital residence. About a quarter (22.31%) of people over 25 years of age had taken up patrilocal residence at the time of their first marriage, compared with 29.66% among people ≤25 years of age. For people in these two broad age brackets – below and above 25 years of age -- we also see a rise in the share of neolocal post-marital residence. The share rose from a small base of 2.76% among the cohort of people over 25 years of age, to 4.14% among the cohort of people ≤25 years of age. The analysis in Table 5.19, which controls for age and sex, supports these findings. For example, people in the older age cohorts between 31 and 50 years of age were 28-30% (or 52-71 percentage points) less likely to have taken up patrilocal post-marital residence after their first marriage than their younger sex peers under 21 years of age. Note also that, after controlling for age cohort, each additional year of age above the mean age of the sample (37.51 years) was associated with about a 4% increase in the probability of taking up patrilocal residence, away from, mainly, matrilocal post-marital residence. This statistic supports the observation that post-marital residence shifts from matrilocal to other forms of residence as a married couple ages.

Insert Table 5.19

Self-reported value of cross-cousin marriage. As part of the module on marriage and fertility, during the 2007 survey we asked people ≥12 years of age to tell us how much they valued the traditional Tsimane' prescription of having to marry a cross-cousin. To elicit answers, we showed people a ladder with five steps (numbered 1 to 5) and asked them to pick a number or to point to the rung that best captured their valuation of cross-cousin marriage. In some ladders the bottom step was numbered as one and the top step was numbered as five, and sometimes the steps were numbered in reverse order, with five at the bottom and one at the top. We selected at random the ladder type for each respondent to avoid the bias that could arise if people thought that the top (or the bottom) rung was best because of its location, and we used a visual cue to make it easier to understand the task. We then read villagers the following vignette:

> *Among the elderly in the village of Jamanchi [a remote settlement well known for being traditional] people think it is important to marry their cross-cousin, but among the Tsimane' living in the town of San Borja, it is not so important to marry their cross-cousin. How important do you think is it to marry a cross-cousin? Where would you place yourself in the ladder?*

The surveyor read the numerical options in the ladder, which included: 1=not important, 2=somewhat unimportant, 3=neutral, 4=somewhat important, and 5=important. After the surveyor read the vignette, people pointed to a step in the ladder or said the number. To simplify the analysis, I collapsed answers into three categories: important, unimportant, and neutral.

Table 5.20 contains a summary of the answers and some blurry results[xvii]. Slightly more than half the sample (53.50%) felt that cross-cousin marriage was unimportant, 35.50% felt that it was important, and 11% felt indifferent. This much is unambiguous. A comparison of results between broad age cohorts is less clear. For example, we see a slight decline in the share of people who felt cross-cousin marriage was important from 36.30% among cohorts of older people ≥26 years of age to 33.85% among cohorts of younger people ≤25 years of age, but we also see a decline in the share of people who thought cross-cousin marriage was unimportant, from 55.31% of the sample among cohorts of older people ≥26 years of age to 49.74% among cohorts of younger people ≤25 years of age. Only among people who felt indifferent do we see a clear change between broad age cohorts, from a low of 8.40% among cohorts of older people ≥26 years of age to 16.41% among cohorts of younger people ≤25 years of age. We should not read too much into the growing insouciance toward prescriptive cross-cousin marriage owing to the small sample size of people who felt indifferent.

Insert Table 5.20

<u>*Assortative mating*</u>. When people marry, they tend to end up with partners who either resemble or complement them in traits such as age, education, body type, or personality. If tall, outgoing, and schooled women marry tall, outgoing, and schooled men, then their traits supplement each other in what is dubbed positive assortative mating (homogamy), but if these women were to marry short, wallflower, and unschooled men, then their traits would complement each other in what is known as negative assortative mating (heterogamy). Assortative mating has been studied in industrial societies (Fernandez & Rogerson, 2001; Goldstein & Harknett, 2006; Schwartz, 2013) and, to a lesser extent, in pre-industrial societies (Bailey et al., 2013; Sear & Marlowe, 2009), including the Tsimane' (Godoy et al., 2008; Gurven et al., 2009). Assortative mating matters because it might affect reproduction, child health, and community income inequality. For instance, couples who share values will be less likely to split and more likely to agree on how to care for their offspring. If the poor mate with the poor and the rich mate with the rich, socioeconomic inequalities will calcify across generations.

The study of assortative mating in pre-industrial societies faces two challenges. First, we do not know what traits people value consciously or unconsciously when selecting a partner. In autarkic societies, traits that bear directly on reproductive success, such as physical strength, matter most, but as these societies change from interactions with the market and the outside world, new traits, such as monetary income, school attainment, or fluency in the national language become desirable, perhaps overshadowing biological attributes. The bundle of valued traits change from those bearing directly on the biology of reproductive success to traits bearing on market outcomes, which perhaps only indirectly bear on reproductive success. The second challenge has to do with biases from the endogeneity of assortative mating, with biases arising from the fact that couples pick each other based on unobserved preferences. For instance, better child health could be associated with spousal resemblances in income or schooling because spouses who resemble each other in income and schooling are more likely to agree on decisions about their child's health. It would be incorrect to conclude that positive assortative mating in income or education improves child health because spousal resemblances in income or education pick up *inter alia* the effects of unseen spousal consensus on how to care for a child.

Bearing these caveats in mind, my purpose now is to use clean data from the randomized controlled trial and the panel to accomplish three aims: *(i)* describe and compare spousal differences in traits that matter in autarky (e.g., arm muscularity) and traits that matter in market economies (e.g., schooling), *(ii)* assess if these traits vary positively or negatively between the female and the male head of the household to find out the type of assortative mating Tsimane' follow, and *(iii)* estimate the associations between assortative mating and child stunting to find out if assortative mating improves child health.

Table 5.21 shows that -- compared with their male partners -- female household heads were 0.76 years younger, had 0.56 fewer completed grades of schooling, scored 0.42 points lower in a test of academic math skills (range: 0-4), and scored 0.32 points lower in Spanish-speaking fluency (range: 0-2). Compared with their male partners, female household heads were 4.53 cm shorter, but had 0.40 higher measures of age-sex standardized Z-score of arm muscle area, 3.00% more body fat, and 8.49 mm more skinfold. The last column shows that Tsimane' practice positive assortative mating for all the traits considered. The column contains the regression coefficients of the trait of the female household head (e.g., age) used as an outcome against the same trait for the male household head used as an explanatory variable. All coefficients were positive and significant at the 1% level, supporting the hypothesis that in connubium Tsimane' end up with partners who mirror each other.

Insert Table 5.21

I next assess whether positive assortative mating predicts better child health. I equate child health with stunting, or being two standard deviations below the median age-sex height Z-score (HAZ) for well-nourished, globally representative international populations (UNICEF, WHO, & WB, 2012), and confine the analysis to children under 13 years of age to avoid the complexities from pubertal growth (Leenstra, Petersen, & Kaiuki, 2005; Proos & Gustafson, 20112). Stunting is a vestigial biological footprint of disadvantages endured during early life, and is associated with poor cognitive skills, academic achievement, and heath during childhood, persisting into adulthood and even across generations (for a review see Zhang et al., 2016). In 2010, 30% of girls and 34% of boys below nine years of age were stunted (Zhang et al., 2016). In Table 5.22 I show the probability that a child becomes stunted when the difference in a trait between the female and the male head of the child's household increases by one unit above the mean female-male difference for household heads in the sample. A positive coefficient implies that as the difference increases, the probability that a child becomes stunted increases, buttressing the hypothesis that positive assortative mating is associated with better child health.

Insert Table 5.22

Table 5.22 shows three notable findings. First, most coefficients were negative, implying that negative assortative mating was associated with better child health. Second, only with completed grades of school and with fluency speaking Spanish do we see evidence that positive assortative mating predicted a lower probability that a child would be stunted, but even then the link was weak. For example, an increase of one year in the difference in school grades completed between the female and the male household heads above the sample mean of 1.19 grades was associated with only a 0.2% increase in the probability that a child would become stunted. Third, backing for the hypothesis that negative assortative mating was associated with better child health was also weak. True, most coefficients were negative, suggesting that as the gap in a trait between the female and the male household head increased, the probability of child stunting decreased, but the size of the negative coefficients was small and, most of the time, *de minimis*. For instance, if the height difference between the female and the male household head increased by 10 cm above the mean female-male difference in the sample (11.79 cm), the probability that a child would become stunted decreased by only 1%. In sum, we find slim backing for the hypothesis that assortative mating of any type bore a meaningful association with stunting, the brand of poor child health, but it could predict other indicators of child health or adult well-being.

Migration among people ≥16 years of age

Cultural anthropologist Rebecca Ellis (1996) spent two and a half years (December 1991-August 1994) doing ethnographic work among the Tsimane' and concluded that they had a "taste for movement" because they were constantly shifting between settlements, now in search for a spouse, now in search for fructuous farmlands, now in search for new hunting or fishing grounds, or simply to call on friends, kin, and affines. She wrote that the social organization of the Tsimane "is highly fluid. Household and settlement composition is subject to abrupt and frequent change as individuals and families move to live and work with different groups of kin and affines" (p. 4). Ellis noted that movement and knowledge entwine in Tsimane' ontology; they travelled to know about others, about natural resources, about jobs, missionaries, market towns, and about sacred places like the salt deposits in the headwaters of the Maniqui River (Chapter 3). Dotage and infirmity halted travel -- and learning (pp. 23-24). Traditionally, Tsimane' did not leave their homeland in the department of Beni, but recently they have slowly tarted to fan out throughout Bolivia and settle in towns[xviii].

In this section I use clean data from TAPS and from the baseline (2008) survey of the randomized controlled trial to delve into one aspect of mobility: residence change between villages. We have touched on changes in village of residence before. For example, in Chapter 4 (Table 4.5) we saw that each year newcomers and attriters made up 3.94% and 5.09% of the TAPS sample, and in this chapter we saw that at marriage, 72.61% of men and 24.26% of women moved to the village of their spouse (Table 5.18).

In this section I probe inter-village movement in two other ways. First, I assess if adults at the time of the survey resided in their birth village. Second, I examine how long people had lived in their current village of residence. With both ways, I assess if mobility has changed between age cohorts. The analyses of residential mobility matters because it could uncover a growing penchant for sedentary living, which has well-known health effects (Dounias et al., 2007; Larsen, 2003). As noted in Chapters 1 and 3, settled living could reflect more territorial fetters, exhaustion of natural resources, and the lure of public services (e.g., village schools).

Data quality. The TAPS sample allows us to assess whether people provided consistent answers when asked about their birthplace. Among the 932 participants ≥16 years of age who reported their birthplace during the different years of the panel, 14.81% mentioned more than one birthplace. I drop them from the analysis when comparing current village of residence with birth village. The baseline survey of the randomized controlled trial does not allow us to spot inconsistencies over time in self-reported answers about birthplace, so their answers about birthplace come with measurement error. Similar problems arise when we estimate how long people had lived in the village where we surveyed them. Panel data had too many inconsistencies about length of residence duration; from one annual survey to the next, people sometimes reported living in the village by more than the measured elapsed time between surveys. Because of excessive measurement error, I exclude TAPS data in the analysis of residence duration. Data from the 2008 baseline survey of the randomized controlled trial does not allow us to assess inconsistencies in residence duration over time, but it does allow us to identify rounding error in residence duration. Figure 5.17 shows that when reporting how many years they had lived in their current village of residence, people rounded answers to multiples of zero and five.

Insert Figure 5.17

Column 1 of Table 5.23 shows that at the time of the surveys, 41.34% of adults lived in their village of birth while 58.66% had moved to another village. These figures do not suggest excessive movement. The results further suggest that, after conditioning for age, younger cohorts of adults were more likely to live in their village of birth than older cohorts. Compared with people ≥45 years of age, people in their 30s or 20s were 15-16 and 19-22 percentage points more likely to live in their village of birth[xix]. Column 2 shows no significant change in residence duration between age cohorts. True, people 20 years≤ age≤35 years lived 6-7 more years in their village of current residence than people ≥45 years of age, but results were generally statistically insignificant[xx], probably from random measurement errors in estimates of residence duration.

In sum, we find fuzzy results. We see unmistakable evidence that cohorts of younger adults were more likely to live in their village of birth compared with cohorts of older adults, but we find weak evidence to suggest that younger cohorts were more likely to have lived longer in their current village of residence than older cohorts.

Insert Table 5.23

Mortality

Data on mortality is spotty because mortality never took a center stage in our studies. We have come across some fragmentary data on mortality before. For example, Table 5.10 shows that women ≥45 years of age reported having had 8.93 births, with 6.67 offspring alive by the time of the 2007 survey, implying that toward the end of her childbearing years a woman had lost an average of 2.26 offspring. Men ≥45 years of age had lost about the same number of offspring (2.21). Table 4.5 shows that deaths in the panel rose by an annual rate of 2.23%.

In 2005 in the panel study we started to ask about broad causes of death and age at death for people who had been in the panel in the previous year. The 52 records collected during the last six years of the panel study (2005-2010 inclusive) show the same number of deaths among females and males (Table 5.24), with a higher mean age at death among males (31.25; SD=31.23) than females (18.96; SD=27.42). Illness was the most common cause of death (75%), followed by accidents, violence, and suicide combined (13.46%).

Insert Table 5.24

Table 5.25 draws on the clean 2005 survey from the panel study to assess if adults knew the village of residence of their parents. We asked adults to tell us the village of current residence of their parents if the parent was alive, or the village of residence of their parents at the time of their death. We only wrote down answers if the parents were not part of the panel study. Two findings stand out. First, section A shows that 17-18% of adults did not know the whereabouts of their mothers or fathers. This seems like a high figure for an endogamic rural society, and could reflect parental permanent outmigration to distant places, numbness toward aging parents, or both. Section B shows that, after controlling for the age and the sex of the respondent, the probability that respondents knew the whereabouts of their parents did not vary by the age quinquennium of the respondent. Second, the probability that a mother or a father would be reported as being alive decreased by 9.21% and 19.59% for each five-year rise in the age cohort of the respondent.

Insert Table 5.25

Discussion and conclusion

I close the chapter by discussing three topics: (a) measurement errors, (c) findings from cross-sectional analysis, and (c) secular trends.

Measurement errors. Reported demographic data had random and systematic measurement errors. Random errors showed up in digit heaping. People rounded answers around multiples of zero and five when reporting the age and residence duration, and around multiples of six when reporting duration of breastfeeding. We also saw systematic measurement errors. Between the measured elapsed time of two consecutive annual surveys, the reported age of an average older woman and boy declined by more than one year while the age of an average older man and young girl rose by more than one year. Some of the age-sex population pyramids toward the end of the panel had systematic measurement errors. The top of those pyramids (e.g., Figures 5.2i, 5.2j, 5.21) were slightly fatter, most likely from people inflating their age to gain early access to government pensions. Another type of systematic measurement error had to do with the under-reporting of pregnancies. One can spot digit heaping with cross-sectional data, but one needed panel data to spot other types of measurement errors. Asking the same question year after year allowed us to estimate trends in measurement errors of age and in the confidence respondents felt about their answers.

The ubiquity of measurement errors has implications for methods of collecting reported data in pre-industrial societies. Much work has gone into developing methods to enhance the accuracy of reported age (Blurton-Jones, 2016; Gurven et al., 2007; Hill & Hurtado, 1996; Howell, 2000), but I find nothing similar for other reported demographic variables, such as residence duration or length of breastfeeding. For small samples, direct observations and in-depth interviews work well, but these labor-intensive approaches break down with large samples. What we need are statistical models built and tested with covariates for which we have truthful information -- models we can then use to help correct error-prone outcomes. Such models are already used to correct measurement errors in chronological age (e.g., Blurton-Jones, 2016), but need to be extended to correct errors in other outcomes, such as age at first marriage, age of school entrance, duration of breastfeeding and residence, and other outcomes that have nothing to do directly with demography (e.g., consumption).

Findings from cross-sectional analysis. The well-behaved age-sex population pyramids show most of the features found in other low-income, rural societies, namely a plinth of people at the bottom, narrowing gradually at the top. No imbalances in sex ratios jump out from the pyramids, though self-reported fertility suggests that the average woman gave birth to more boys (3.58) than girls (3.14) and that more boys (2.88) than girls (2.59) survived. Two uncommon traits of the pyramids include a slight protuberance at the top and the loss of girls between 10 and 14 years of age; the first oddity most likely reflects people mis-representing their ages to access government pensions, but the second oddity remains a puzzle. Self-reported fertility rates are high, with post-menopausal women having had a total of 8.93 births by the end of their reproductive lifecycle. My admittedly crude estimate from births and deaths that took place during the panel hint at an annual population growth rate of 3%.

The analysis of conjugal unions confirms previous studies showing that Tsimane' follow positive assortative mating. Nothing new there. Somewhat new is the finding that assortative mating bears no association with child stunting, a summary index of child poor health. The weak finding could reflect the consequences of measurement error with age when using age to compute height-for-age Z-scores, or the irrelevance of international standards to judge the growth of Tsimane' children (Blackwell et al., 2016). Perhaps. The trouble with this interpretation is that elsewhere we show that stunting -- however full of noise its measurement might be -- was associated with weaker child educational attainment and skills, including local ecological knowledge (Behrman et al., 2016). This raises the possibility that assortative mating in encapsulated (Blurton-Jones, 2016, p. 63), small-scale agrarian societies might reflect the spandrel of birds of a feather flying together owing to geographical proximity and to strong norms for in-breeding, rather than to a form of marriage conferring tangible benefits.

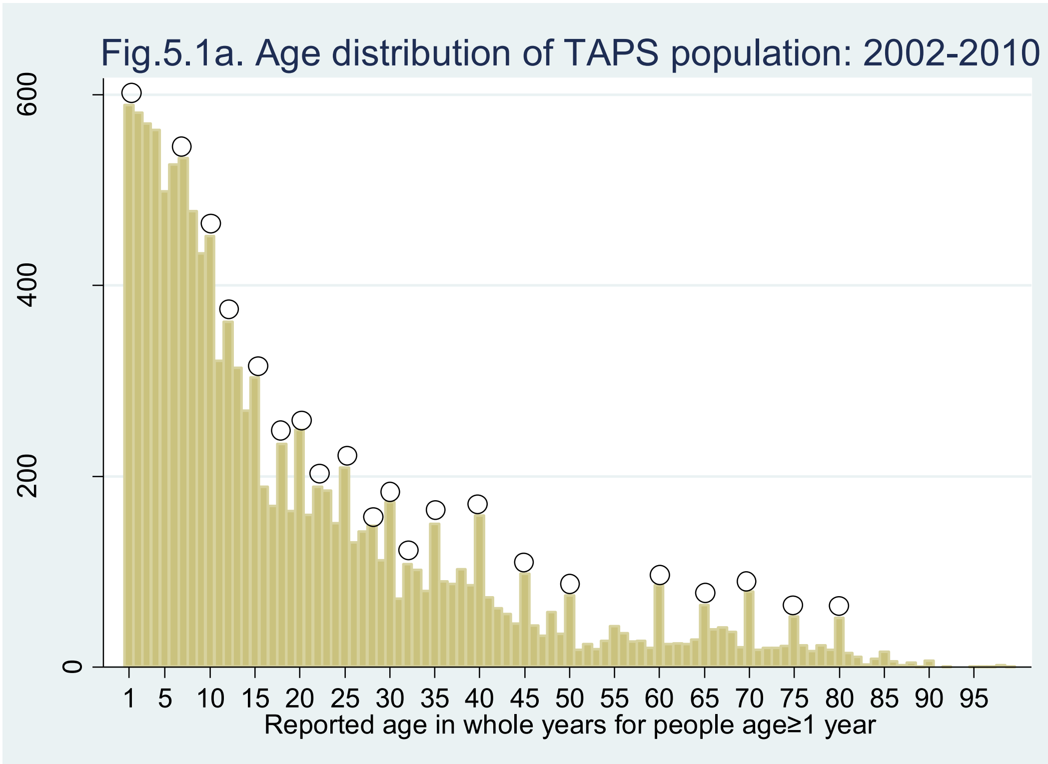
Secular trends. Recall from the introduction that I assess secular trends either by: (a) examining outcomes by survey year or (b) by using age cohorts or birth cohorts while controlling for age and sex. The approach is imperfect because it does not draw on multiple surveys, from multiple samples, from multiple times. Bearing the warning in mind, I nonetheless find hints of secular trends in: (i) household composition, (ii) marriage, fertility, and birth seasonality, and (iii) migration.

A comparison of household makeup across survey years shows an increase in the share of nuclear households and a decline in the share of multi-generational households. Along with this change we also see an increase in patrilocal and neo-local post-marital residence and a decline in matrilocal residence. More intriguingly, we see an increase in household dependency ratios, driven by the rise in the number of people under 16 and over 60 years of age, and a concomitant decline in the number of people -- mainly men -- of prime working age. *Ceteris paribus*, one could read the growth of dependency ratios, nuclear households, and patrilocal residence as the first symptoms of a pointillistic society in which women shoulder an increasing burden of caring for young and old dependents, perhaps without the social support of the past. This presumptive burden could get doled out to other kind, but we cannot address this point since we did not study alloparenting.

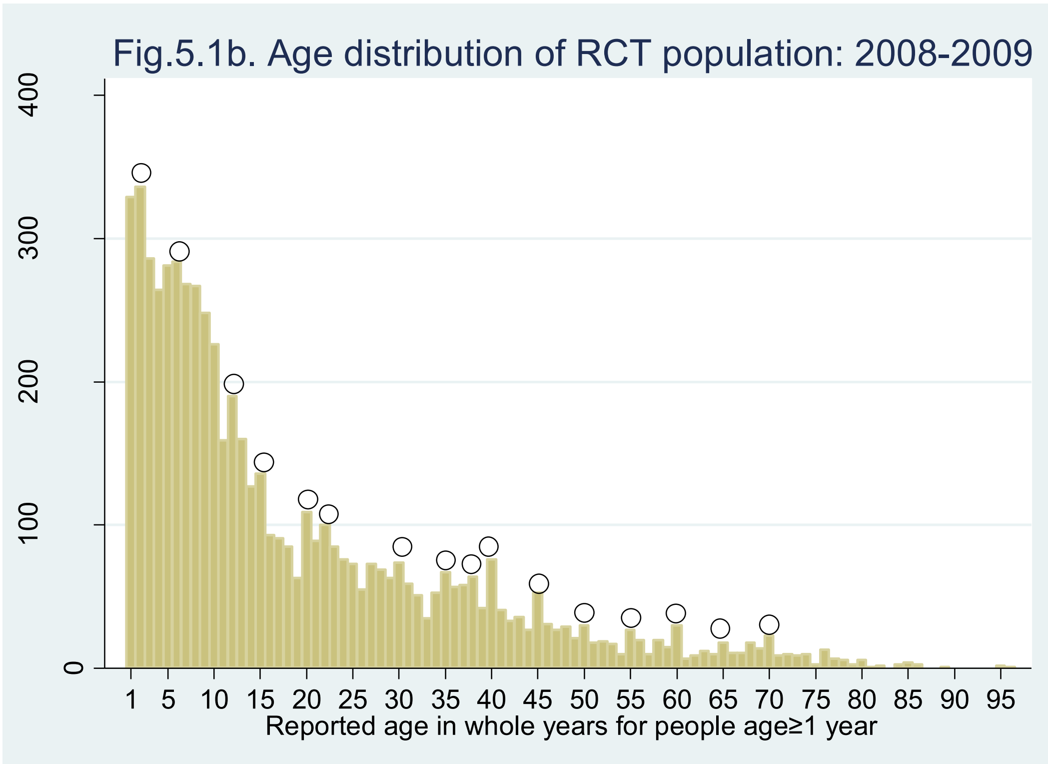
The 2007 survey suggests a secular decline in the age at first marriage, duration of breastfeeding, and reported number of daughters born, but we should not read too much into these findings because of the small samples. We are on surer footing when assessing birth seasonality. For the pooled sample, we see a spike in the number of births during the dry months (May-September), but the peak flattens among younger cohorts. Elsewhere we show that stunted boys (but not girls) were more likely to be born during the dry season (Zhang et al., 2016) and in work in progress we see that boys and girls born during the dry seasons of the panel study -- and for whom we had accurate birth records --- were shorter than boys and girls born during the rest of the year, but the adverse effects of birth season on height ebbed as children aged. From these scraps of evidence I gingerly conclude that the Tsimane' might have access to better ways of protecting themselves from the lean seasons of harm.

The last point worth stressing has to do with the decline in the amount of inter-village movement. By itself, a growing preference for sedentary living has no importance. Less shifting between villages only has weight as a portal into the diseases of modernization, or if it flags growing encroachment by outsiders, the internal draining of natural resources by Tsimane', or both. Whether people move less because they are pushed and actuated by circumscription and exhaustion of both wildlife and of the fertility of land, or whether they migrates less because they are pulled by the lure of public services we cannot tell (Godoy et al., 2005).

Together, these findings point to a society moving away from the past -- more patrilocal residence, more nuclear households, less migration, growing dependency ratios, less breastfeeding, and lower vulnerability to what the seasons bring.



Notes: Sample includes all people surveyed, so individuals reappear in the data with different reported ages.



Notes: Sample includes all people surveyed, so individuals reappear in the data with different reported ages.

Fig.5.2a. Age-sex pyramid for TAPS population, 2002

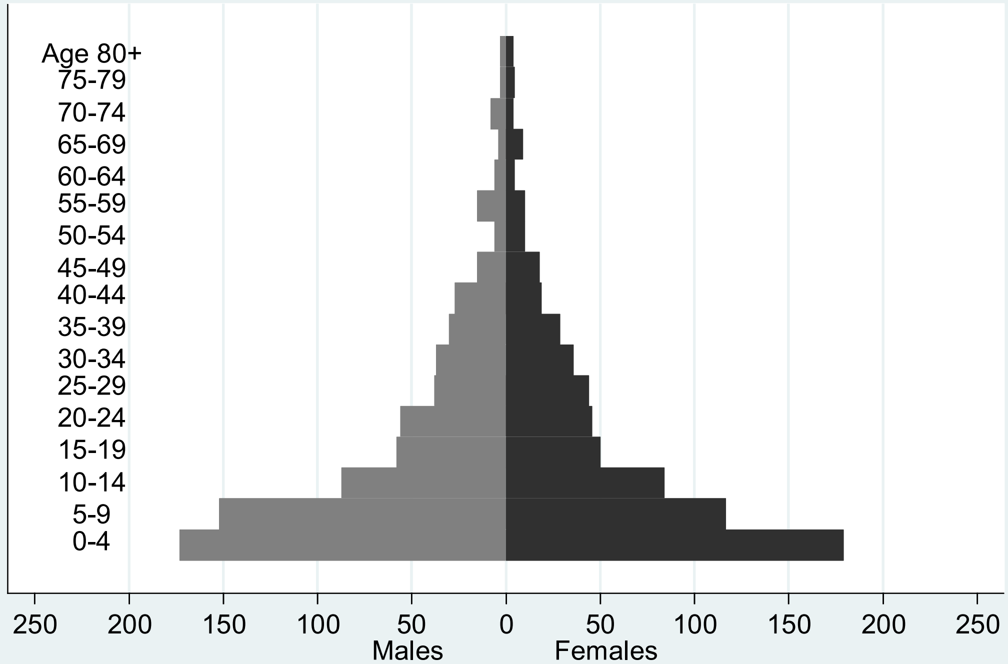


Fig.5.2b. Age-sex pyramid for TAPS population, 2003

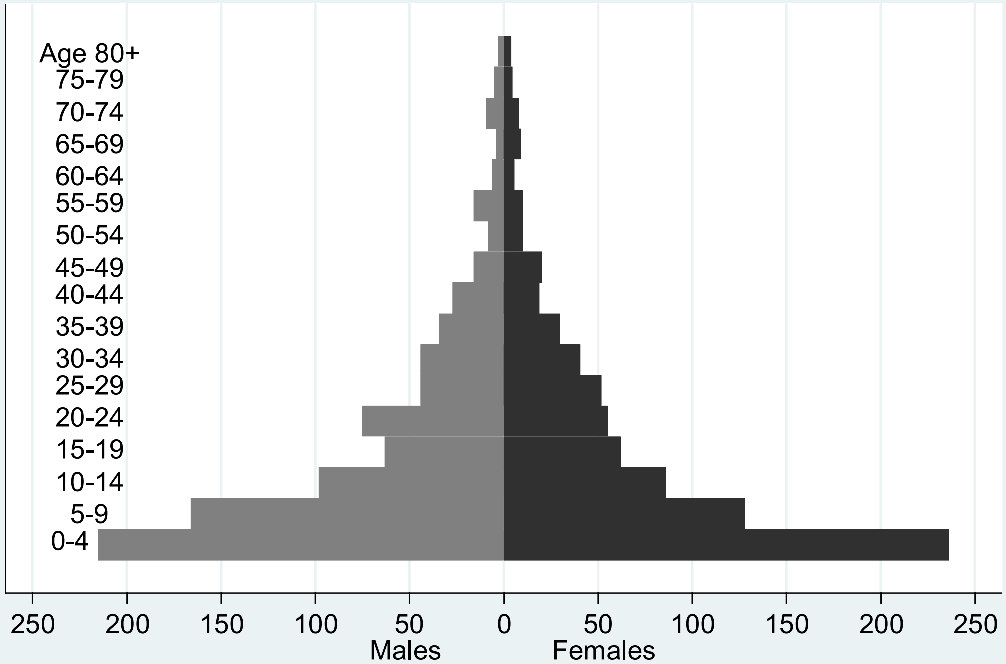


Fig.5.2c. Age-sex pyramid for TAPS population, 2004

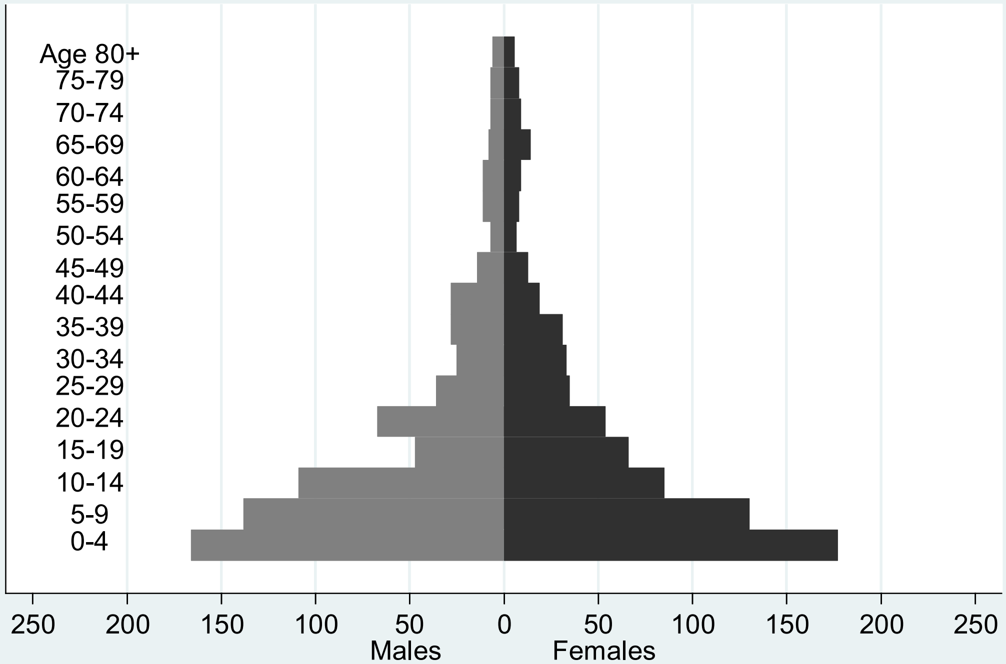


Fig.5.2d. Age-sex pyramid for TAPS population, 2005

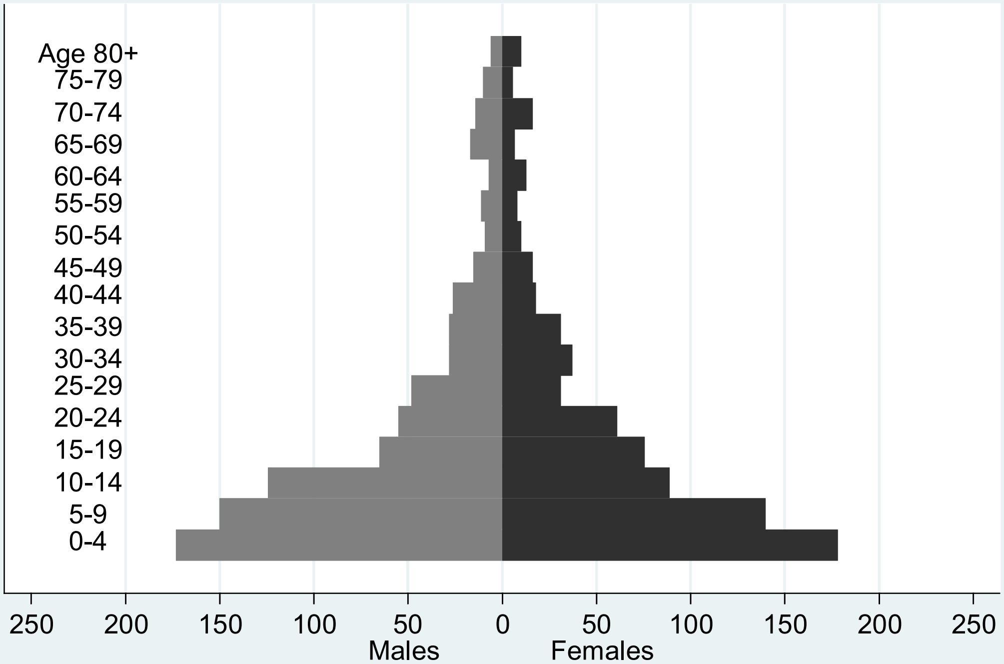


Fig.5.2e. Age-sex pyramid for TAPS population, 2006

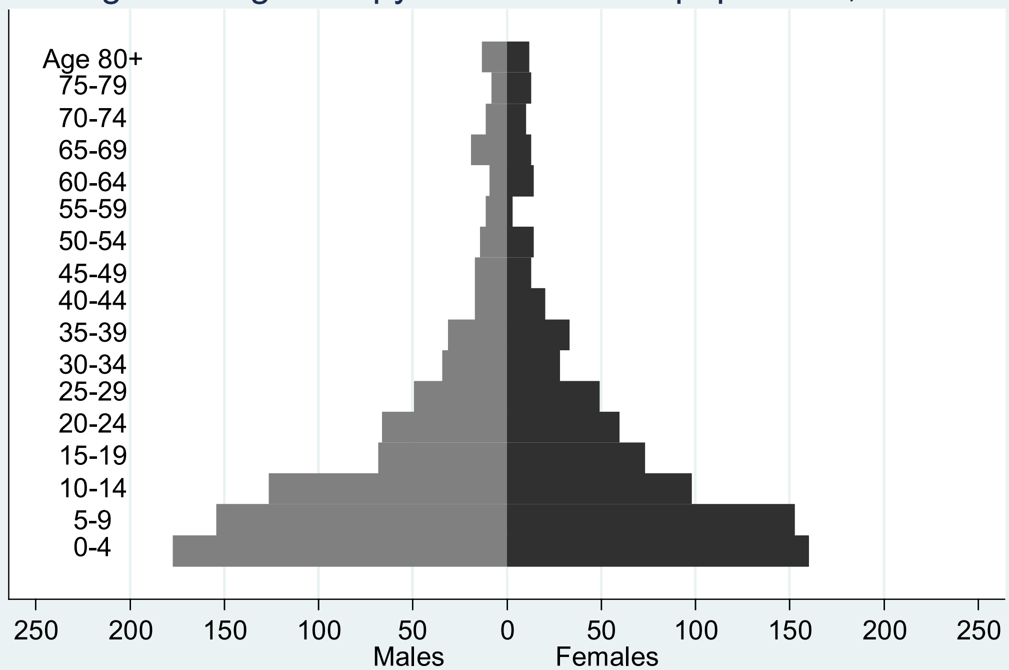


Fig.5.2f. Age-sex pyramid for TAPS population, 2007

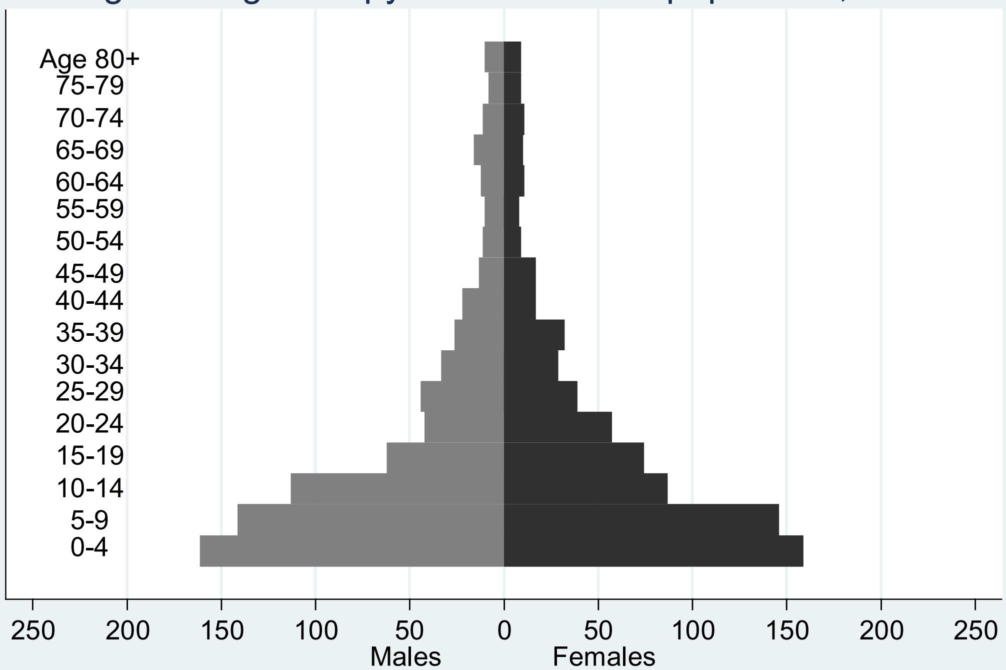


Fig.5.2g. Age-sex pyramid for TAPS population, 2008

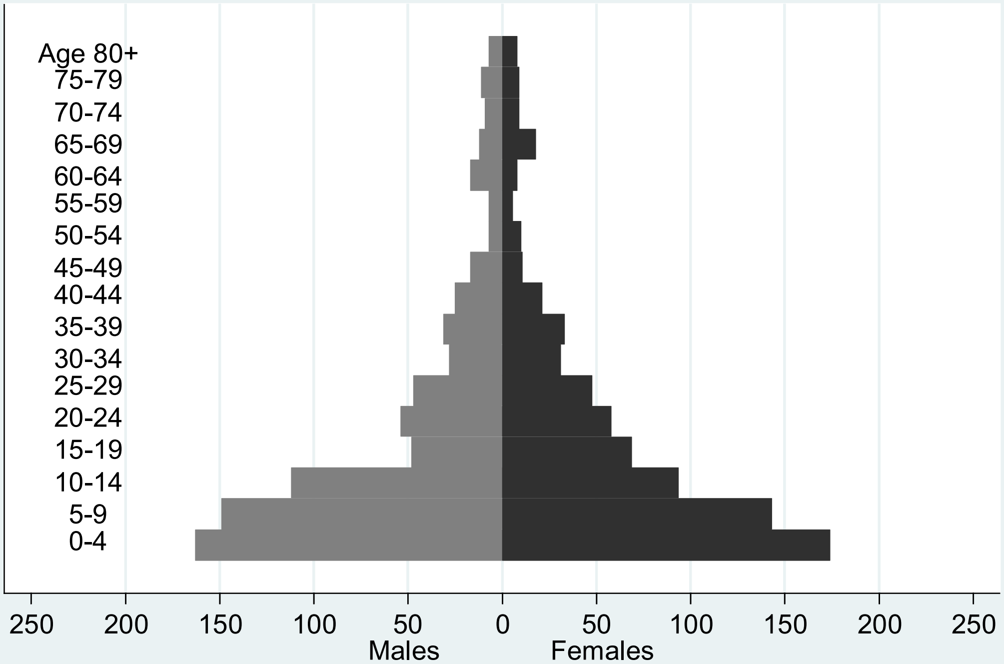


Fig.5.2h. Age-sex pyramid for TAPS population, 2009

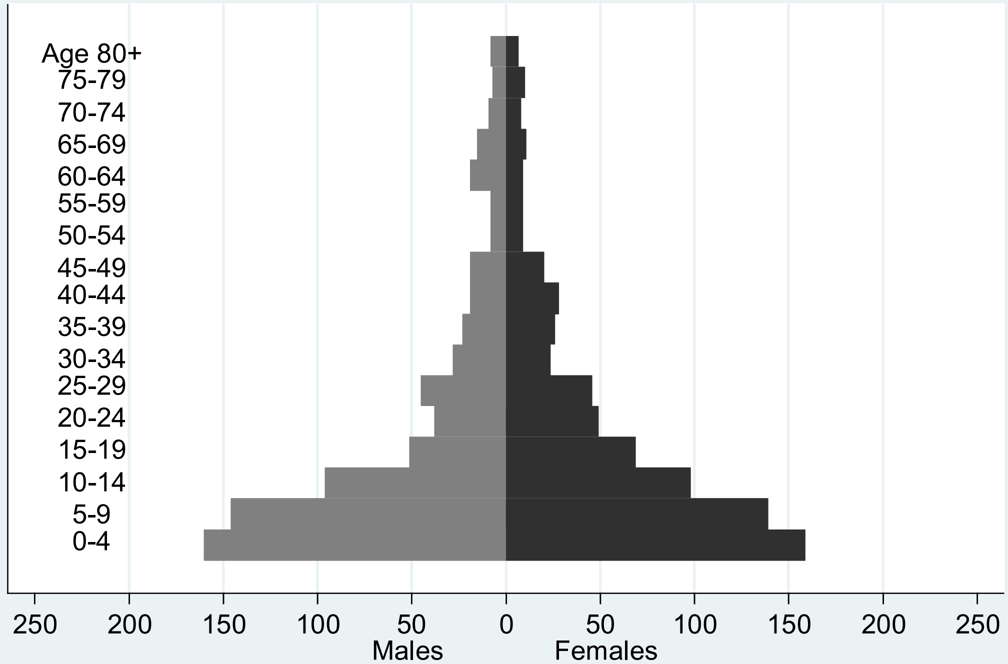
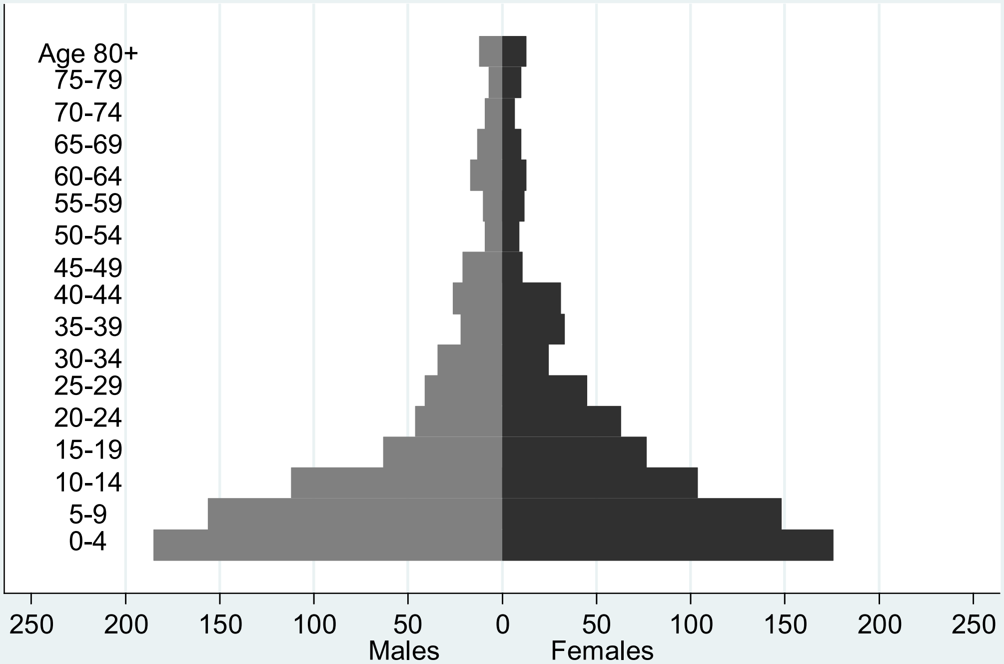


Fig.5.2i. Age-sex pyramid for TAPS population, 2010



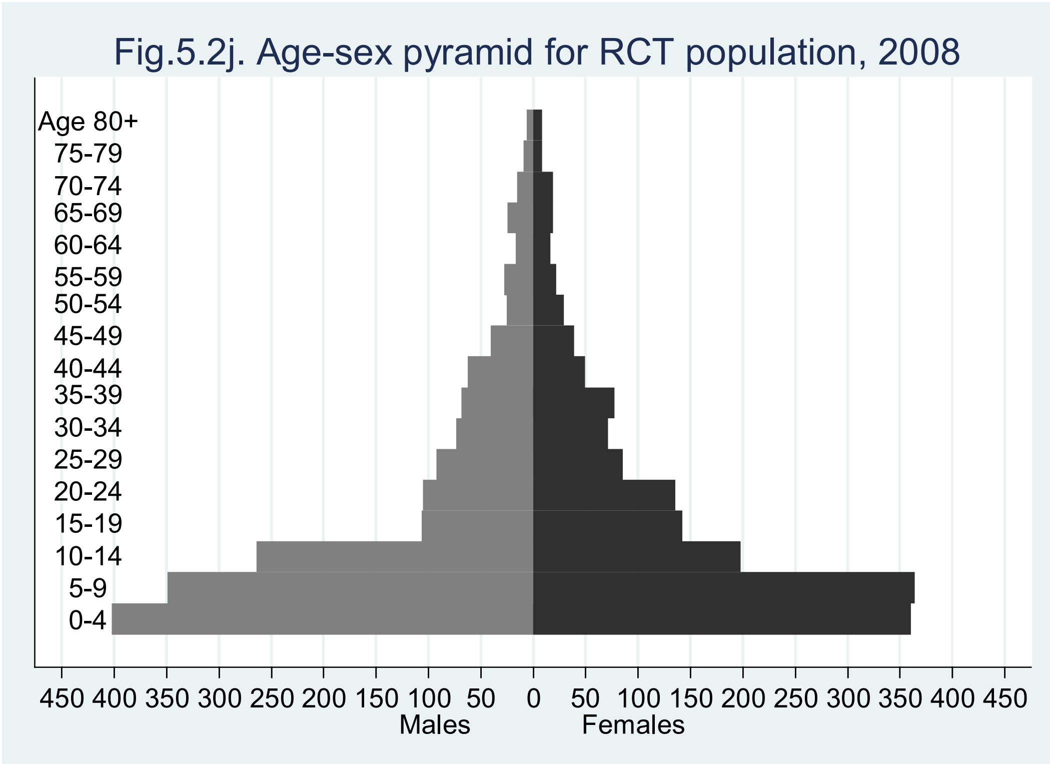


Fig.5.2j. Age-sex pyramid for RCT population, 2008
Age 80+
75-79
70-74
65-69
60-64
55-59
50-54
45-49
40-44
35-39
30-34
25-29
20-24
15-19
10-14
5-9
0-4
450 400 350 300 250 200 150 100 50 0 50 100 150 200 250 300 350 400 450
Males
Females

Fig.5.2k. Age-sex pyramid for RCT population, 2009

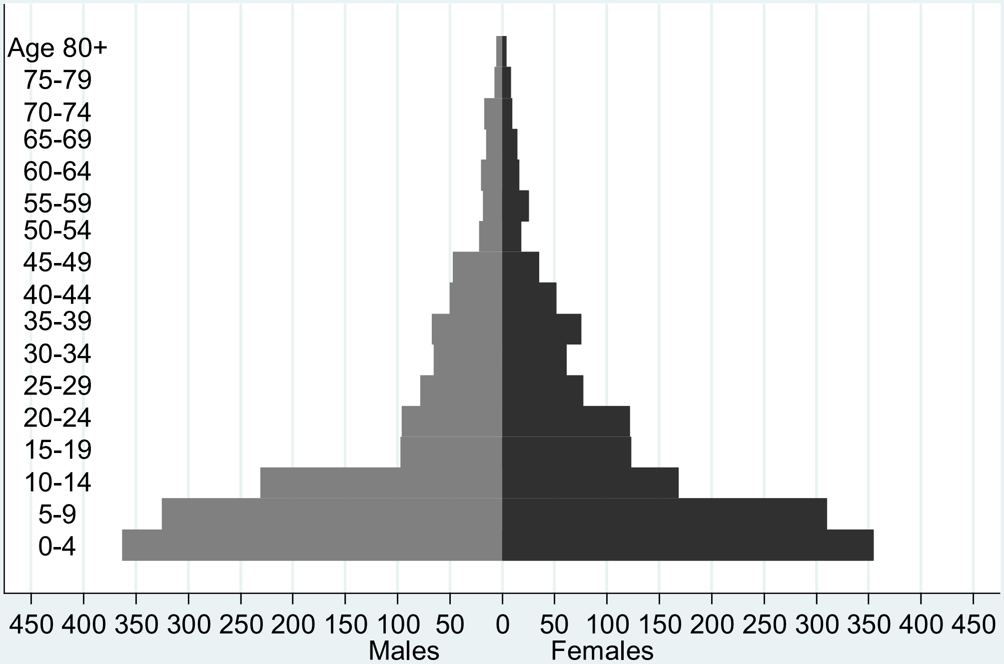
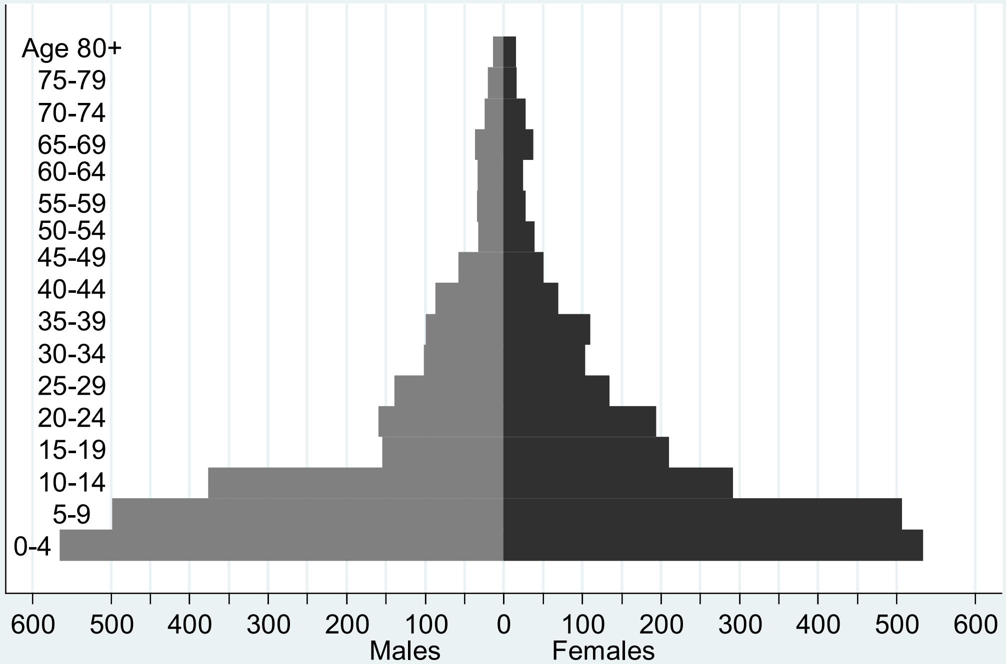


Fig.5.2l. Age-sex pyramid for TAPS & RCT populations, 2008



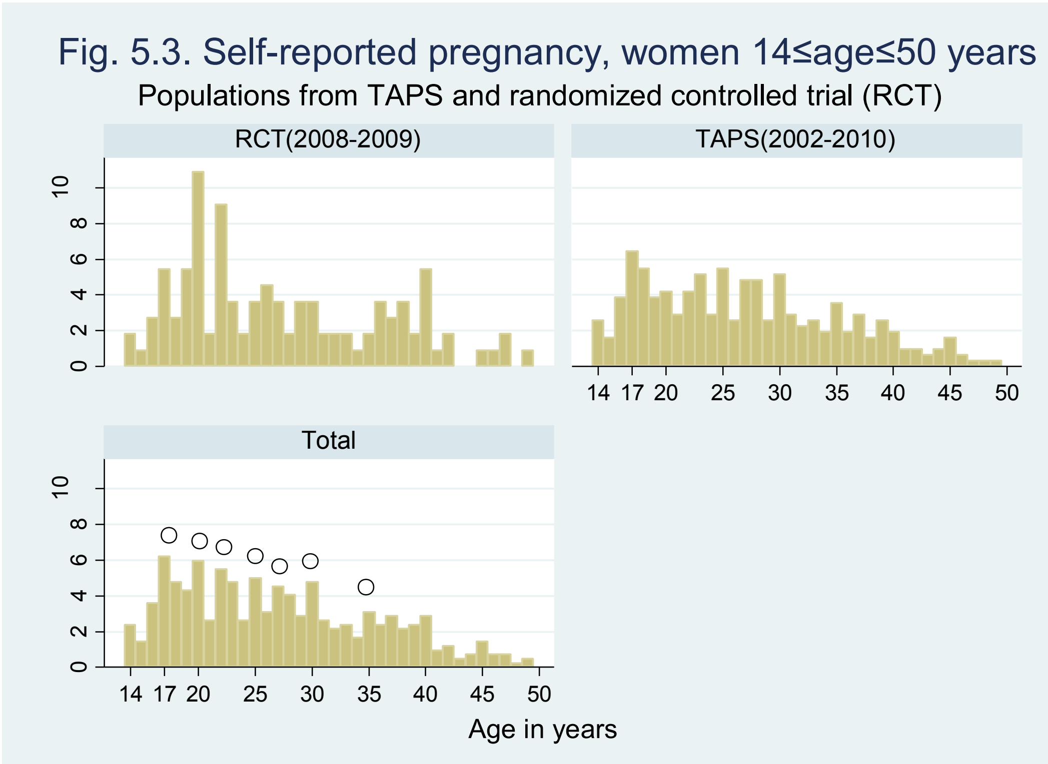


Fig. 5.3. Self-reported pregnancy, women 14≤age≤50 years
Populations from TAPS and randomized controlled trial (RCT)
RCT(2008-2009)
TAPS(2002-2010)
Total
0 2 4 6 8 10
14 17 20 25 30 35 40 45 50
Age in years

Fig. 5.4a. Total boys born to women≥14 years of age

TAPS 2007 survey

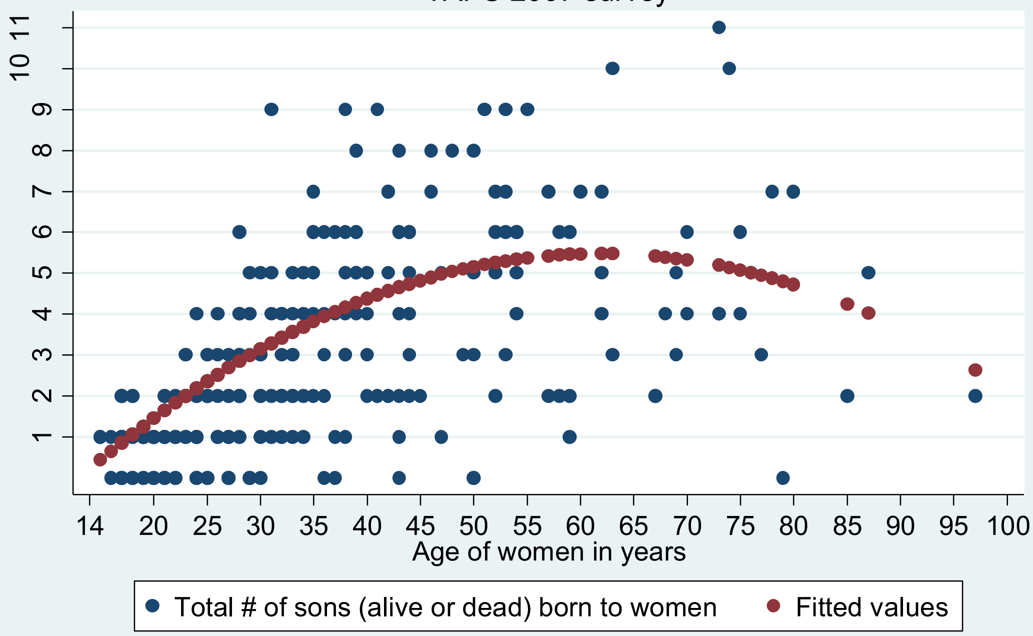


Fig. 5.4b. Total surviving sons of men≥14 years of age

TAPS 2007 survey

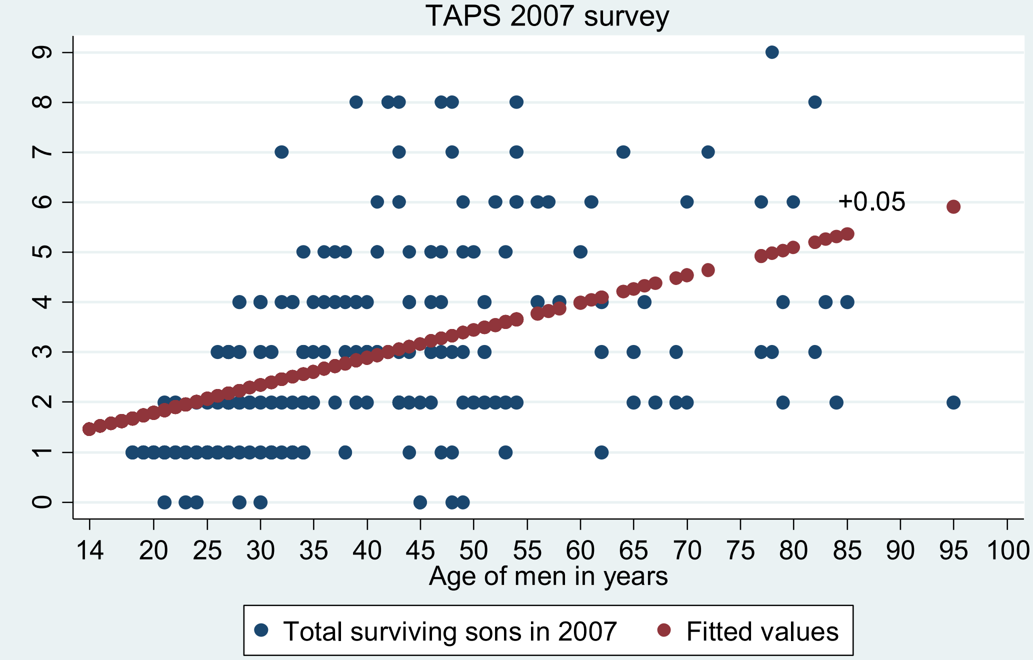


Figure 5.4a-5.4b - continued

Notes: The graphs show the outcome as a function of age and age squared (Figure 5.4a) and as a function of age (Figure 5.4b), with predicted values in red in both cases. Regressions are ordinary least squares with robust standard errors and clustering by village. The slopes for age and age^2 in Figure 5.4a are: age=0.28 (p=0.001) and age^2=-0.002 (p=0.001) (n=224). The coefficient for the slope in Figure 5.4b had a p value of 0.001 (n=205).

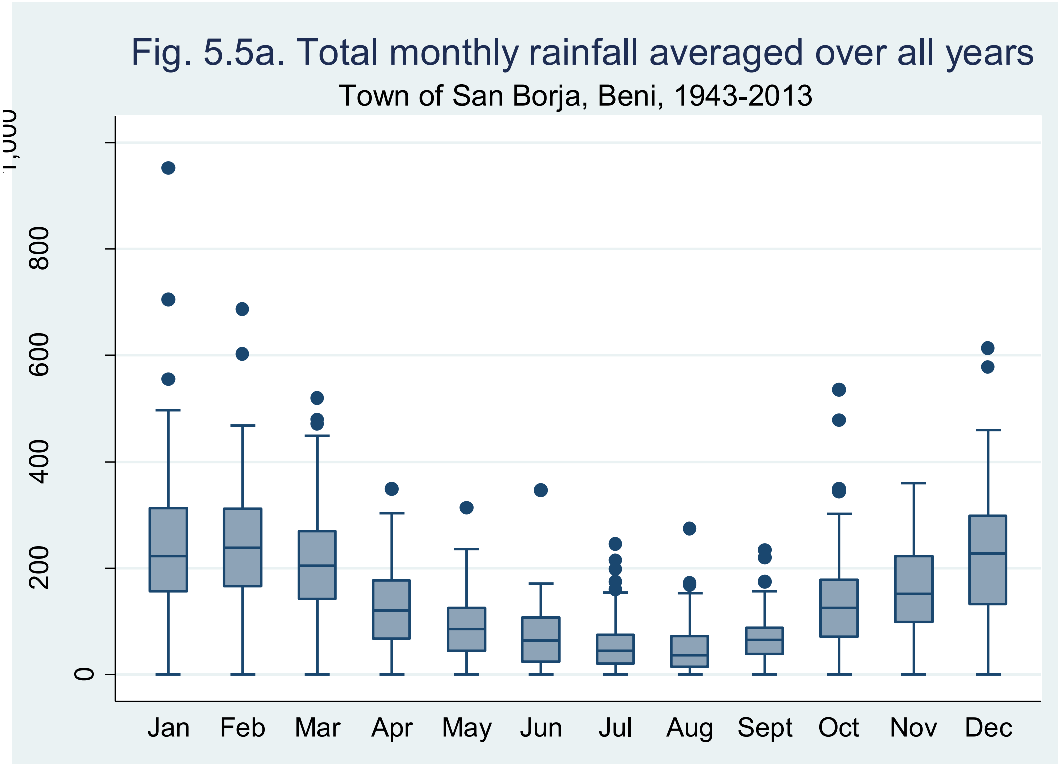


Fig. 5.5a. Total monthly rainfall averaged over all years
Town of San Borja, Beni, 1943-2013
1,000
800
600
400
200
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec

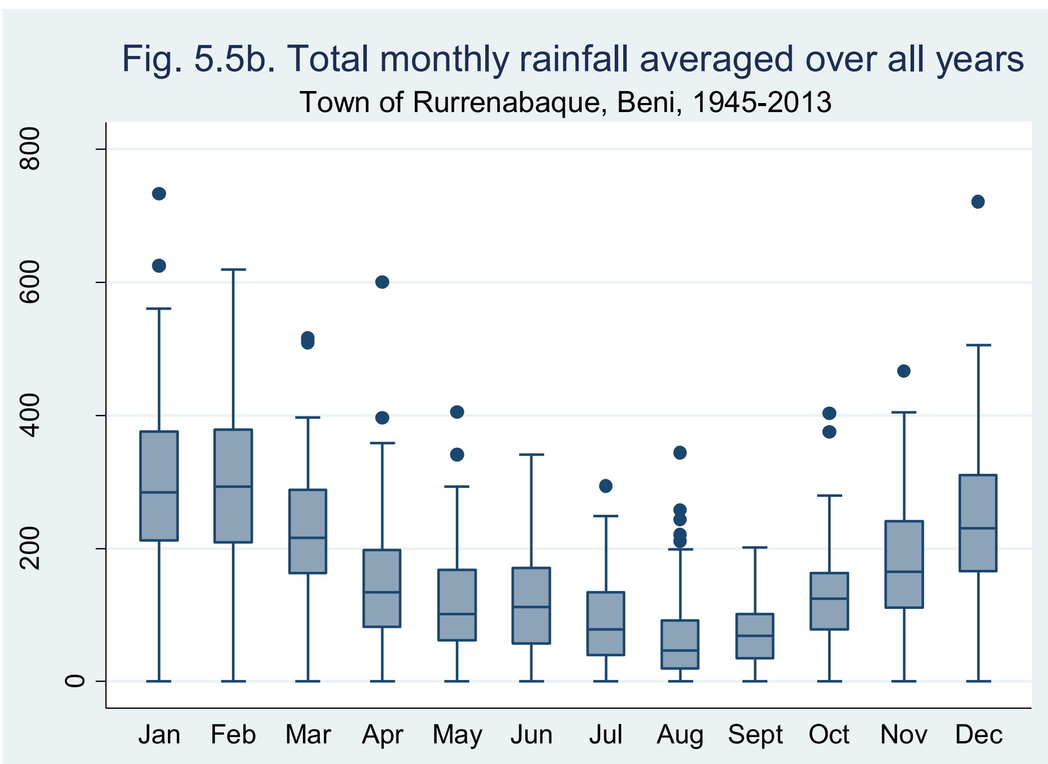


Fig. 5.5b. Total monthly rainfall averaged over all years
Town of Rurrenabaque, Beni, 1945-2013
800
600
400
200
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec

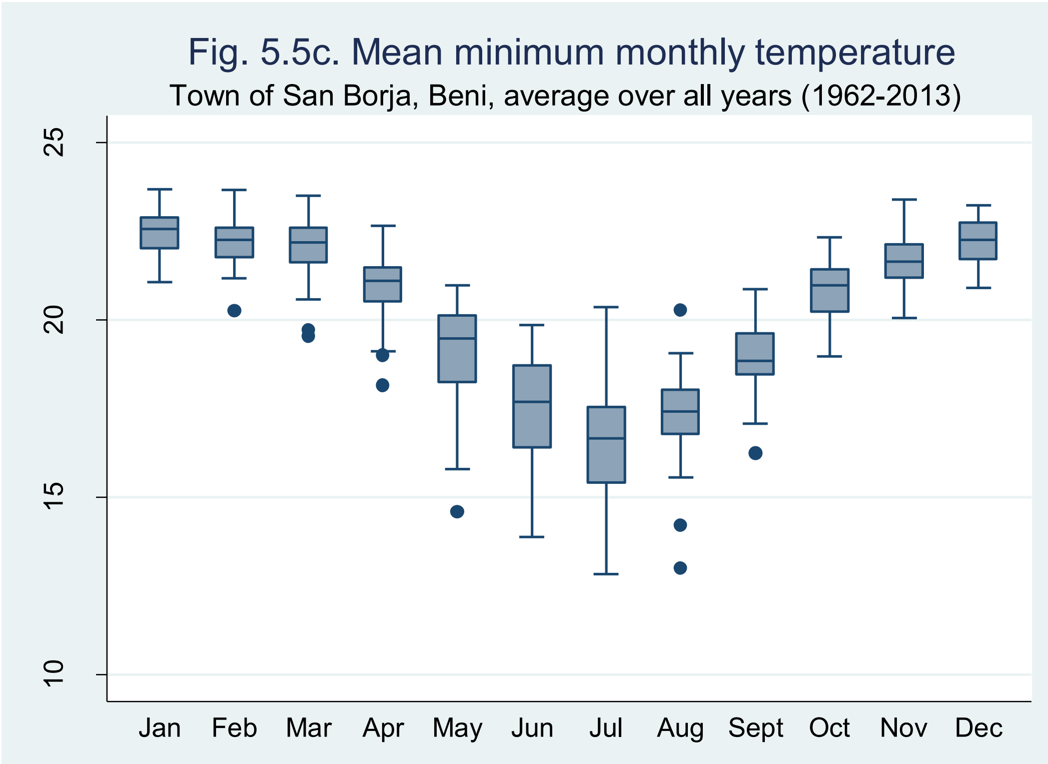


Fig. 5.5c. Mean minimum monthly temperature
Town of San Borja, Beni, average over all years (1962-2013)
25
20
15
10
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec

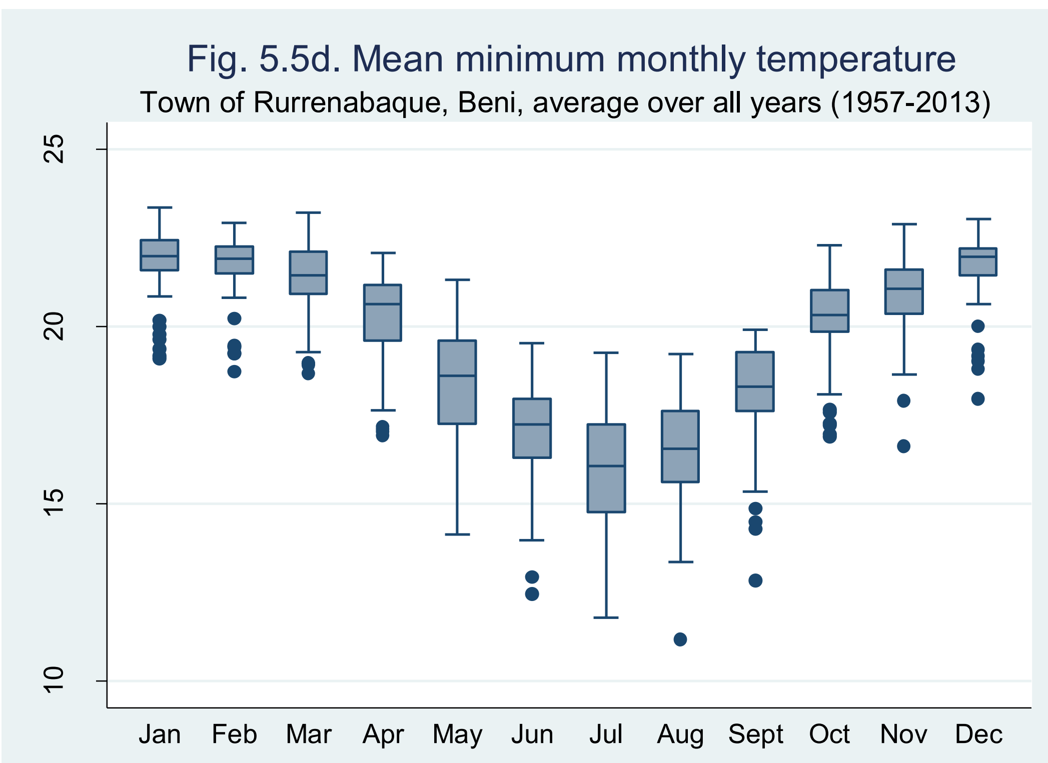


Fig. 5.5d. Mean minimum monthly temperature
Town of Rurrenabaque, Beni, average over all years (1957-2013)
25
20
15
10
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec

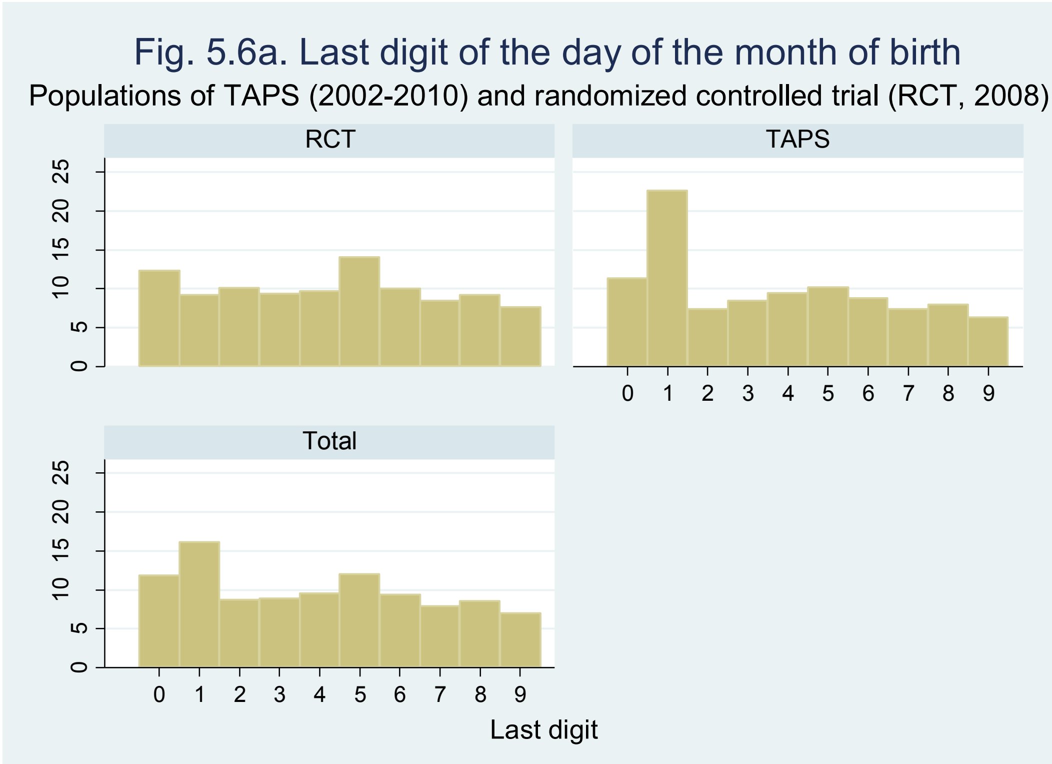


Fig. 5.6a. Last digit of the day of the month of birth
Populations of TAPS (2002-2010) and randomized controlled trial (RCT, 2008)
RCT
TAPS
Total
0 5 10 15 20 25
0 1 2 3 4 5 6 7 8 9
Last digit

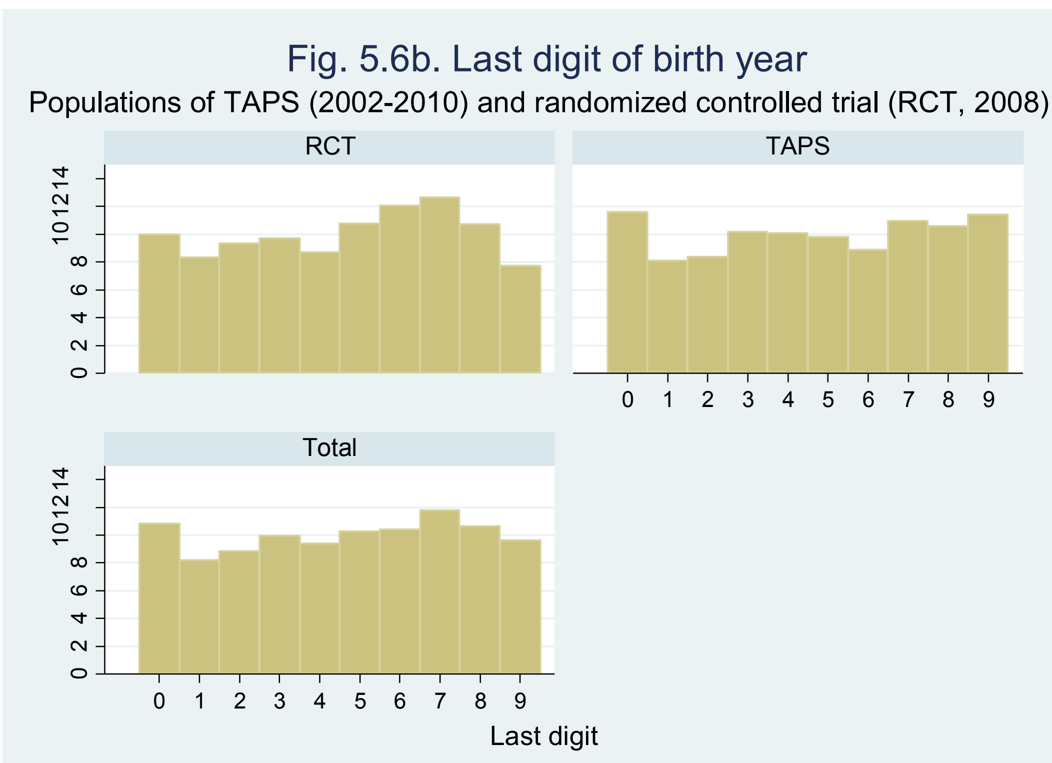
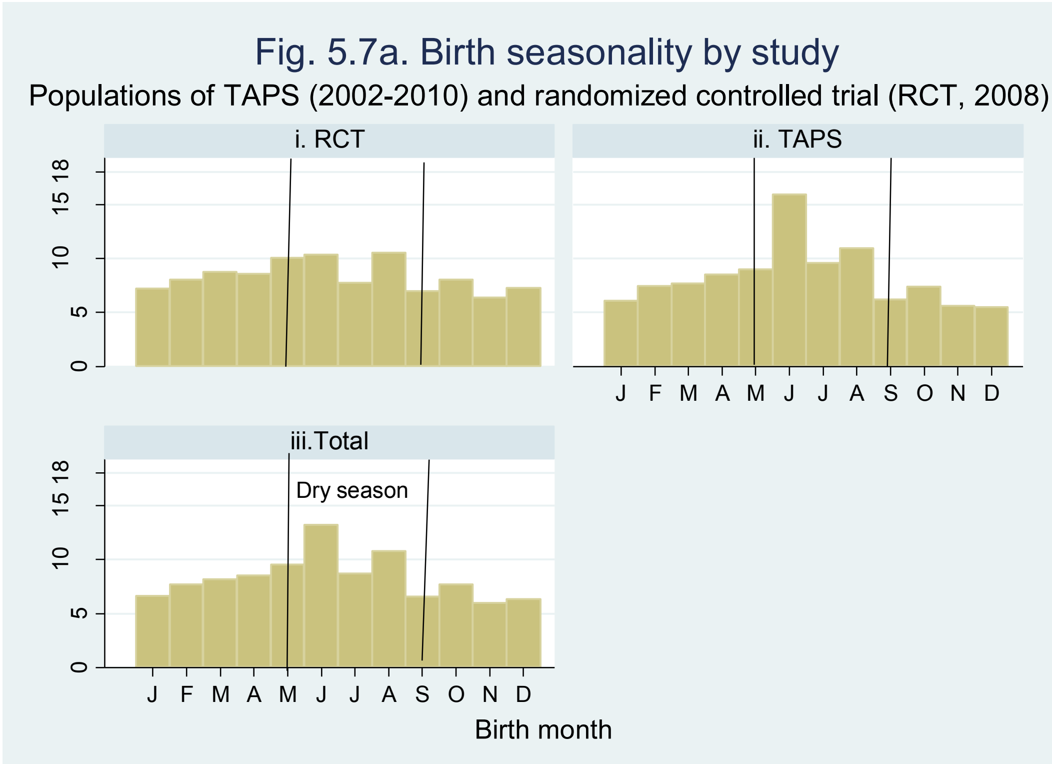
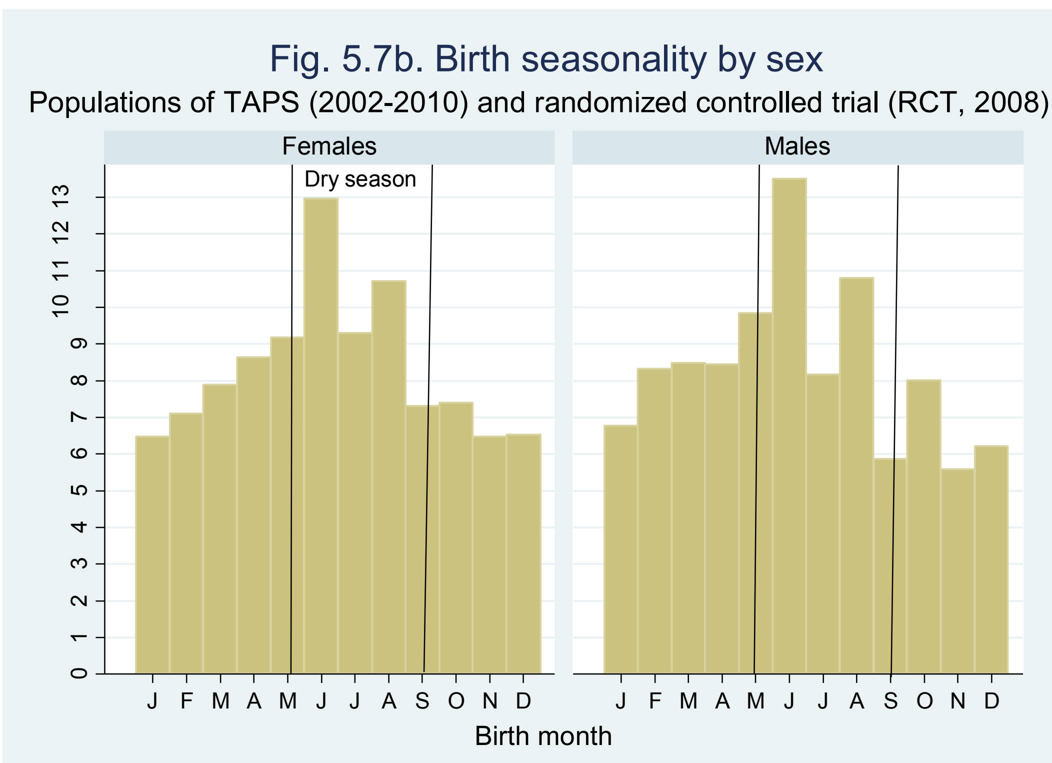
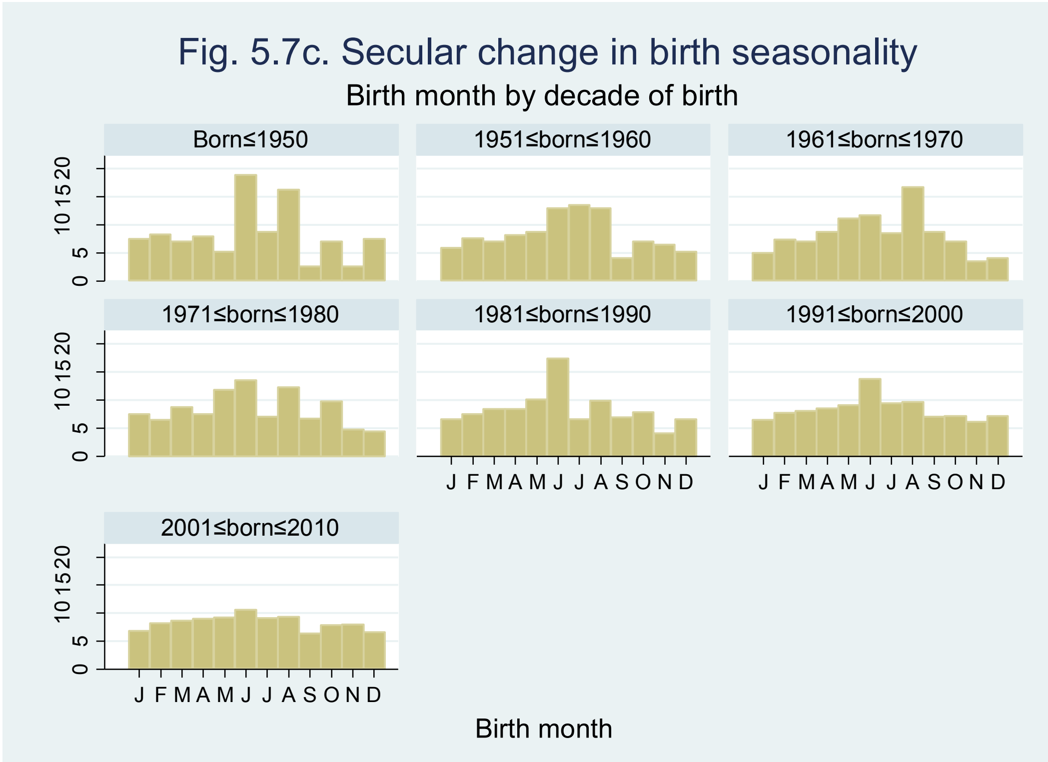


Fig. 5.6b. Last digit of birth year
Populations of TAPS (2002-2010) and randomized controlled trial (RCT, 2008)
RCT
TAPS
Total
0 2 4 6 8 101214
0 1 2 3 4 5 6 7 8 9
Last digit

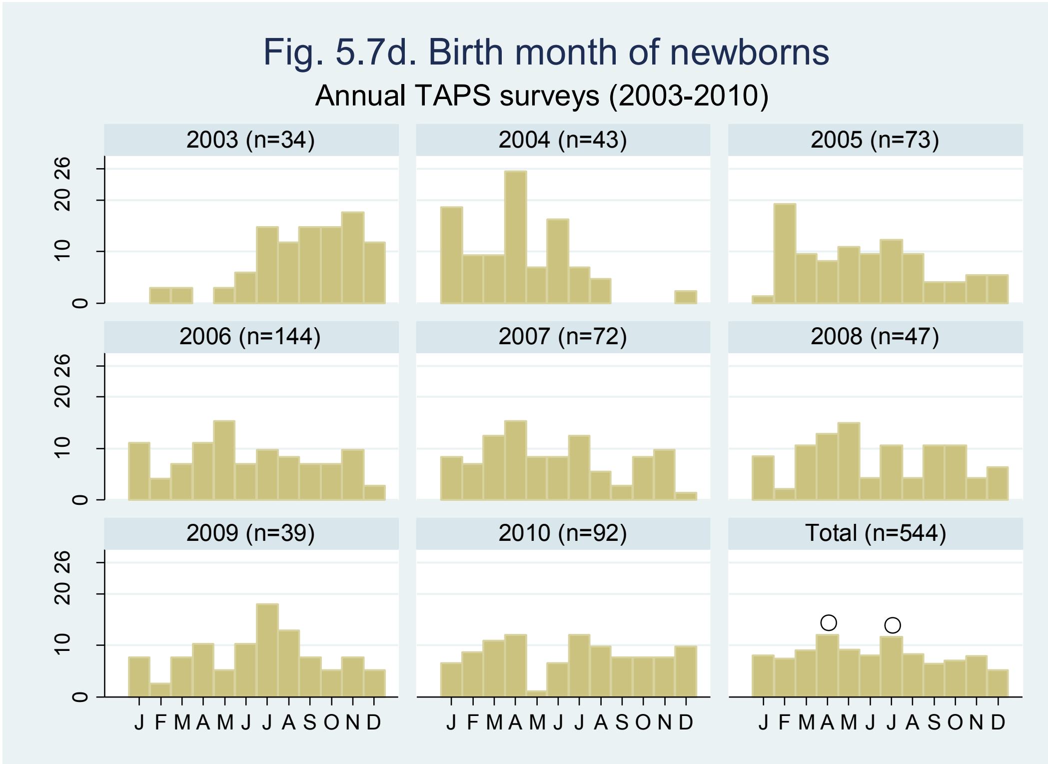




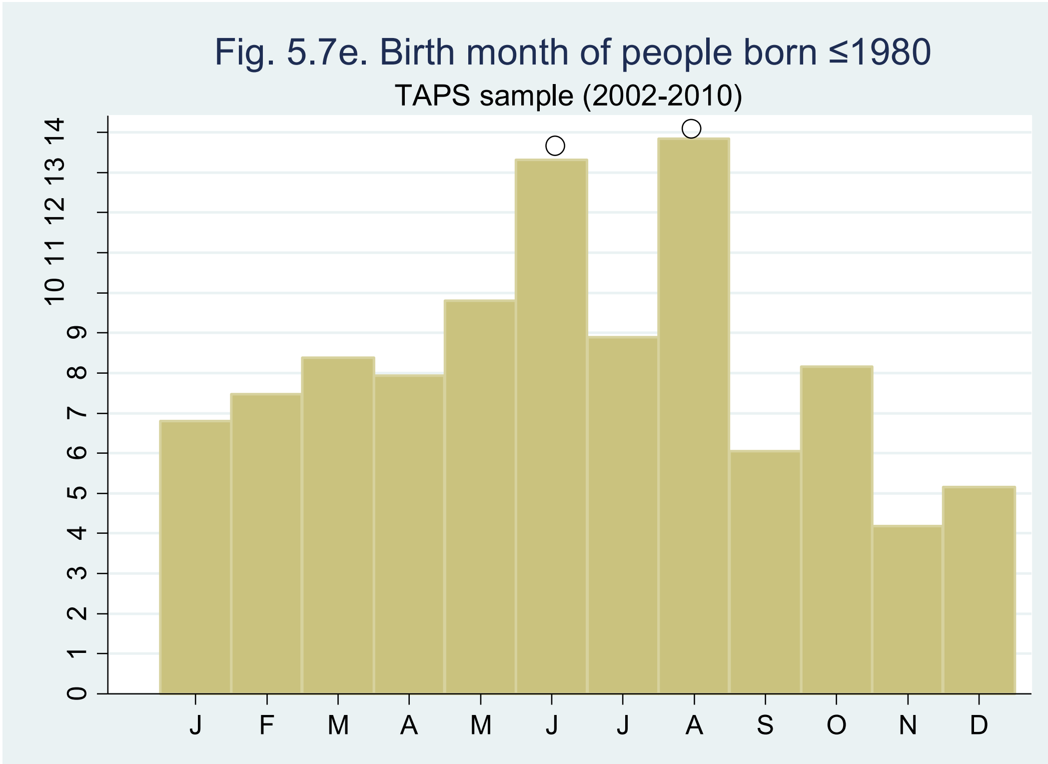
Note: Only one record for each person included. For TAPS sample, I included the earliest record of a person.



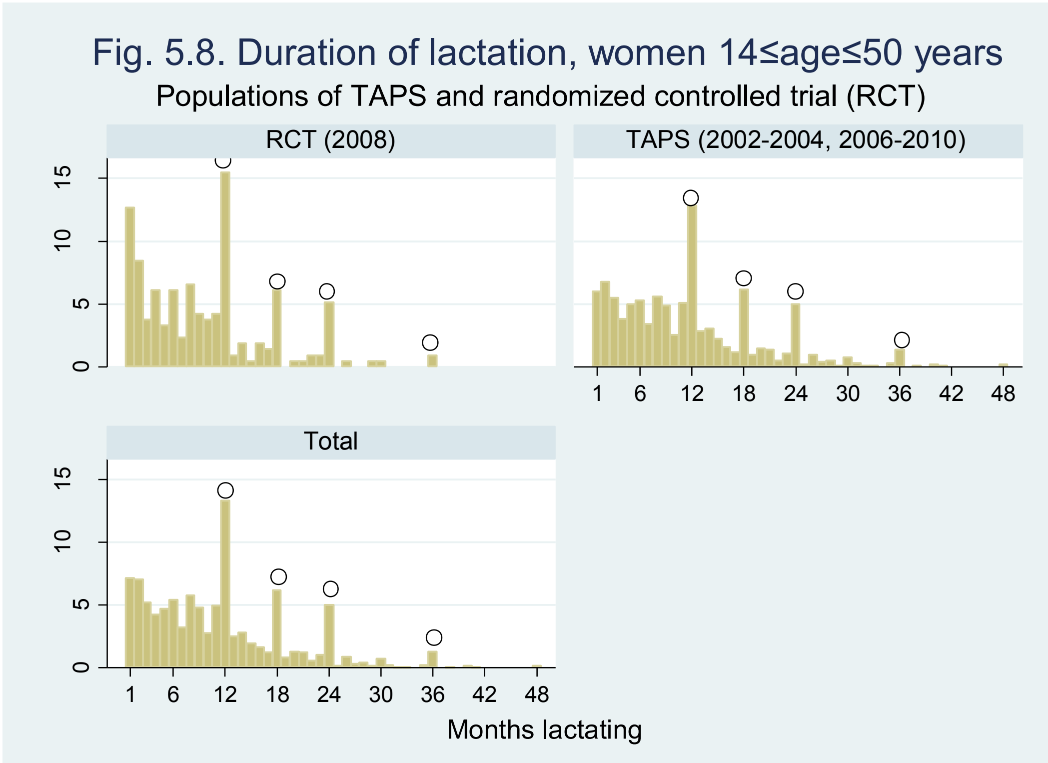
Note: Same as for Figures 5.7a-5.7b.



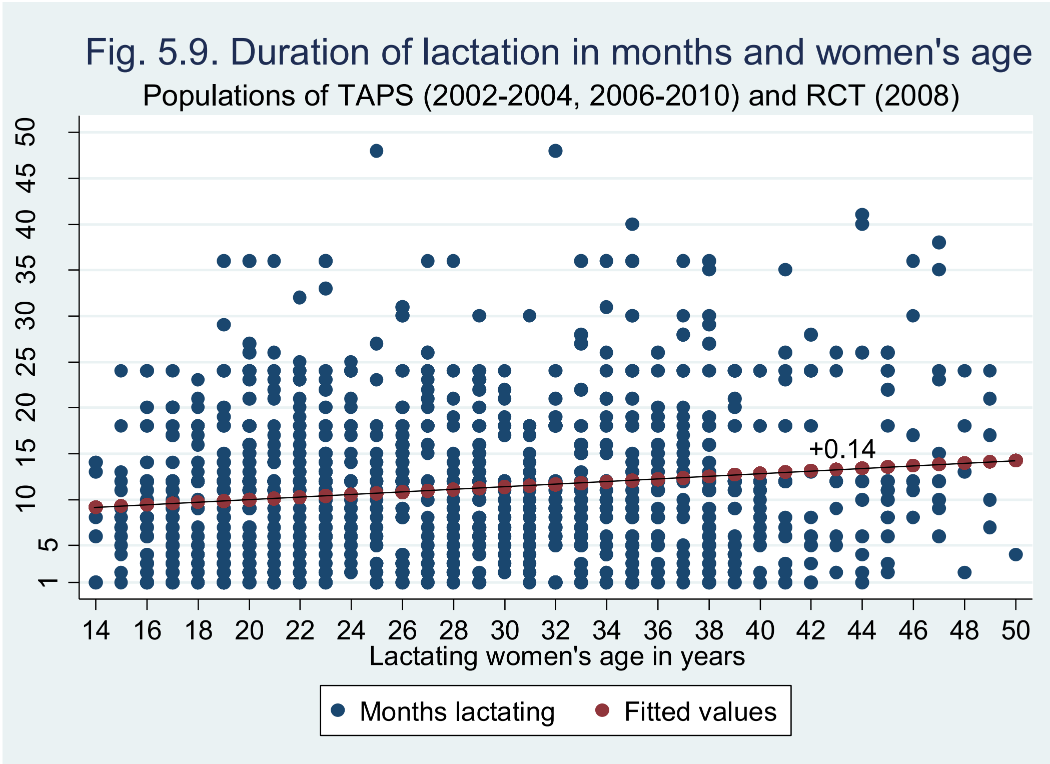
Note: The graph draws on new births reported by Tsimane' during annual TAPS surveys of 2003-2010.



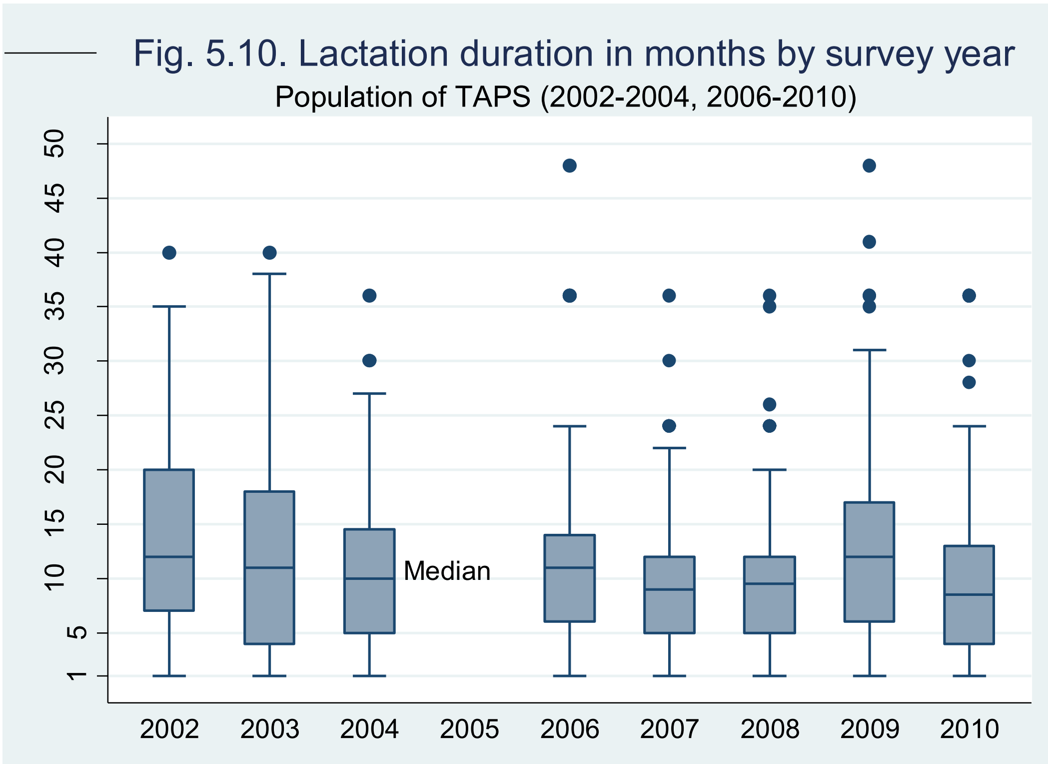
Note: The histogram combines the four oldest birth cohorts from Figure 5.7c.



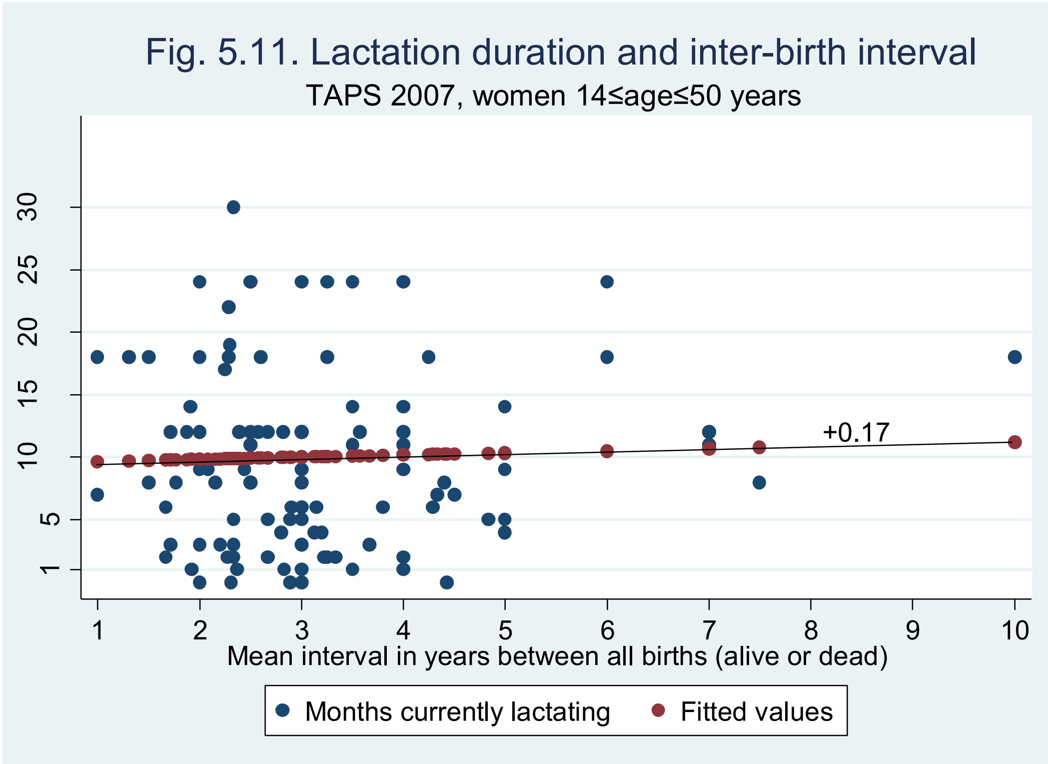
Note: TAPS sample lacks data for 2005.



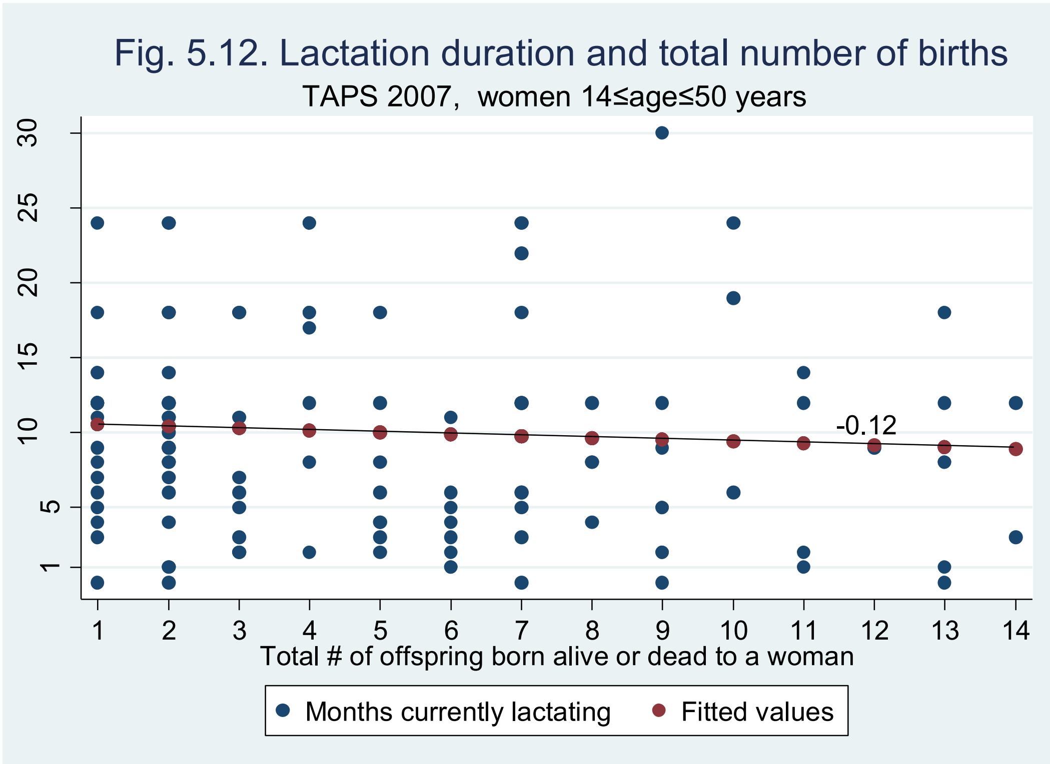
Note: TAPS 2005 survey did not include a question on the duration of lactation. Trend line is the predicted values of the duration of lactation in months as a function of a woman's reported age at the time of the survey. RCT = randomized controlled trial. Regression used to obtain trend line is ordinary least squares with robust standard errors clustered by participant. The slope of +0.14 had a p value of 0.001 (n=1,232). The slope of this graph (+0.14) differs slightly from the slope in Table 5.15, column [B], (+0.13), because in this graph I do not control for survey year so the two estimates are not strictly comparable. The sample includes women 14 years≤age≤50 years.



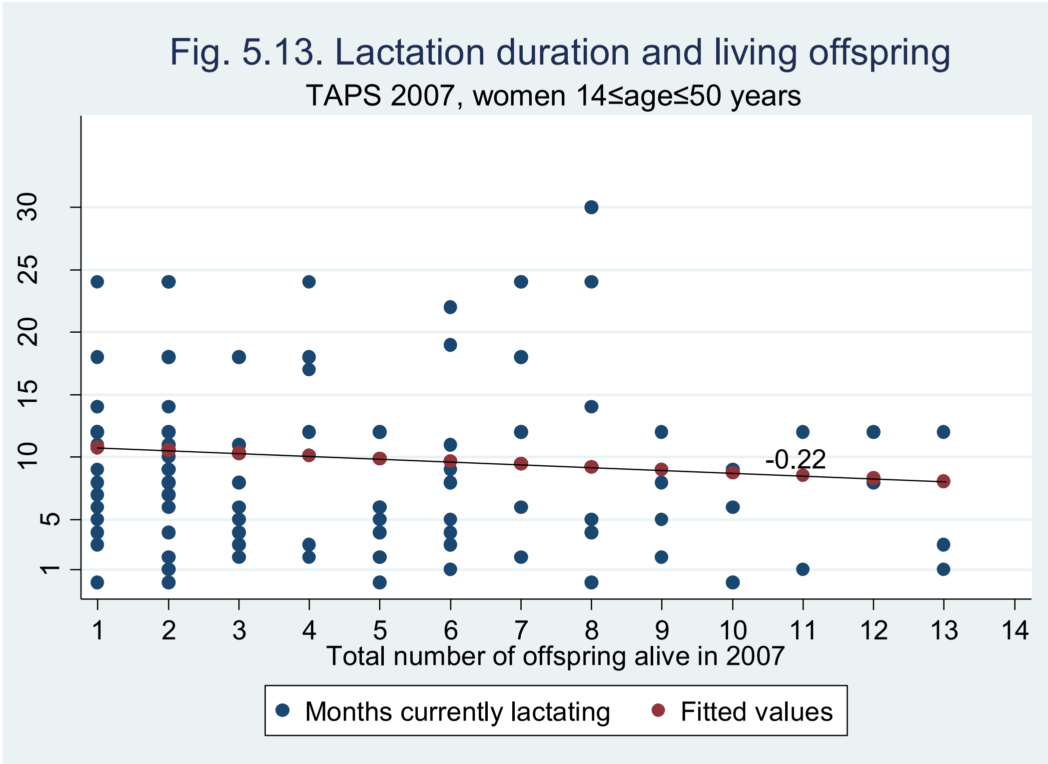
Note: The TAPS 2005 survey did not include a question about the duration of lactation. The vertical boxes capture the 25-75 percentile of observations, with the horizontal line in the middle of each box capturing the median duration of lactation during the survey year, and the line at 10 months of lactation capturing the median for the overall sample (Table 5.14). The vertical lines above and below the boxes capture adjacent values, and the dots capture outliers. See Table 5.15 for statistical analysis of the trend line. The sample includes women 14 years≤age≤50 years.



Note: The trend line is an estimate of predicted values for the duration of lactation (in months) as a function of mean inter-birth interval (in years) using an ordinary least squares regression with robust standard errors. Only women with positive, non-zero values for the duration of lactation are included in the analysis (n=111). Inter-birth interval uses 14 years as the start of a woman's reproductive life. The slope (+0.17) had a p value of 0.67.



Note: The trend line is an estimate of predicted values of the duration of lactation in months as a function of the total number of offspring born alive or dead to a woman. The trend line was estimated using an ordinary least squares regression with robust standard errors. Only women with positive, non-zero values for duration of lactation are included in the regression (n=111). The slope (-0.12) had a p value of 0.44.



Note: The trend line is an estimate of predicted values of the duration of lactation in months as a function of the total number of offspring alive in 2007. The trend line was estimated using an ordinary least squares regression with robust standard errors. Only women with positive, non-zero values for duration of lactation are included in the regression (n=111). The slope (-0.22) had a p value of 0.21.

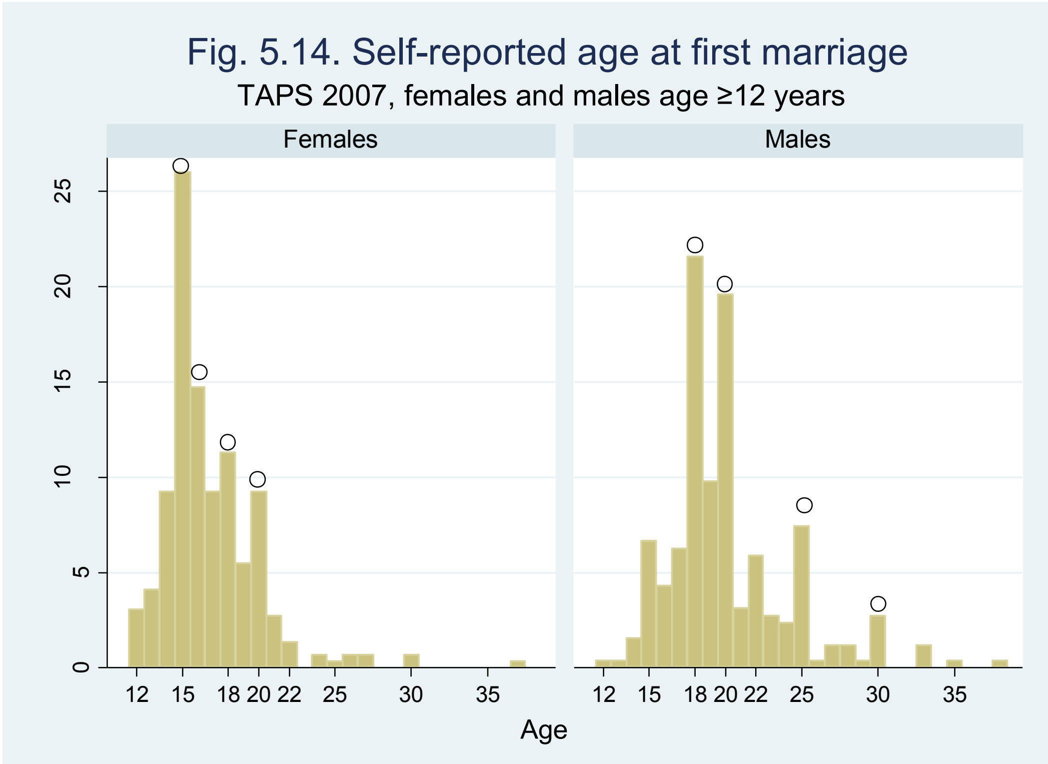
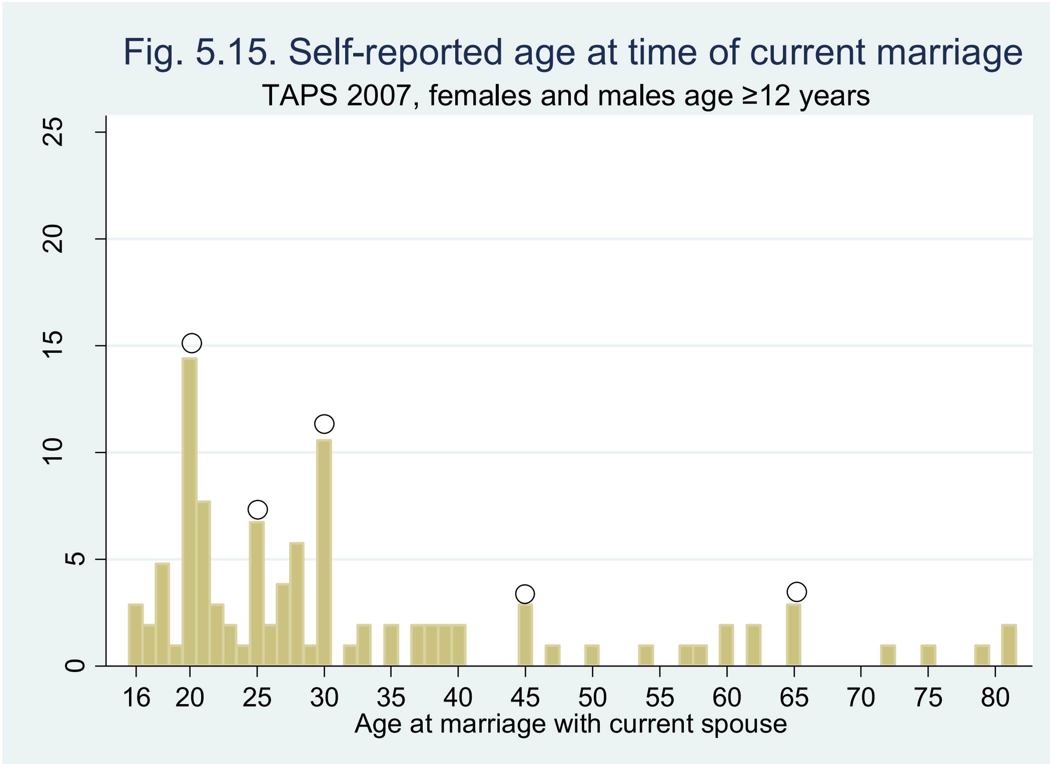
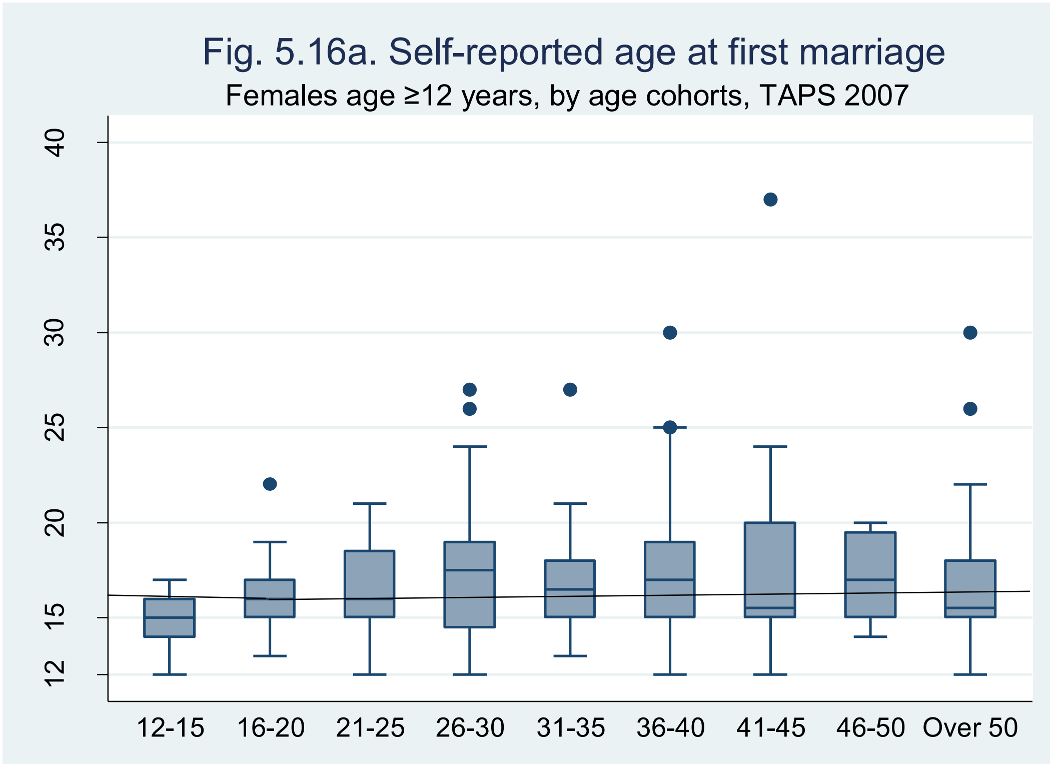
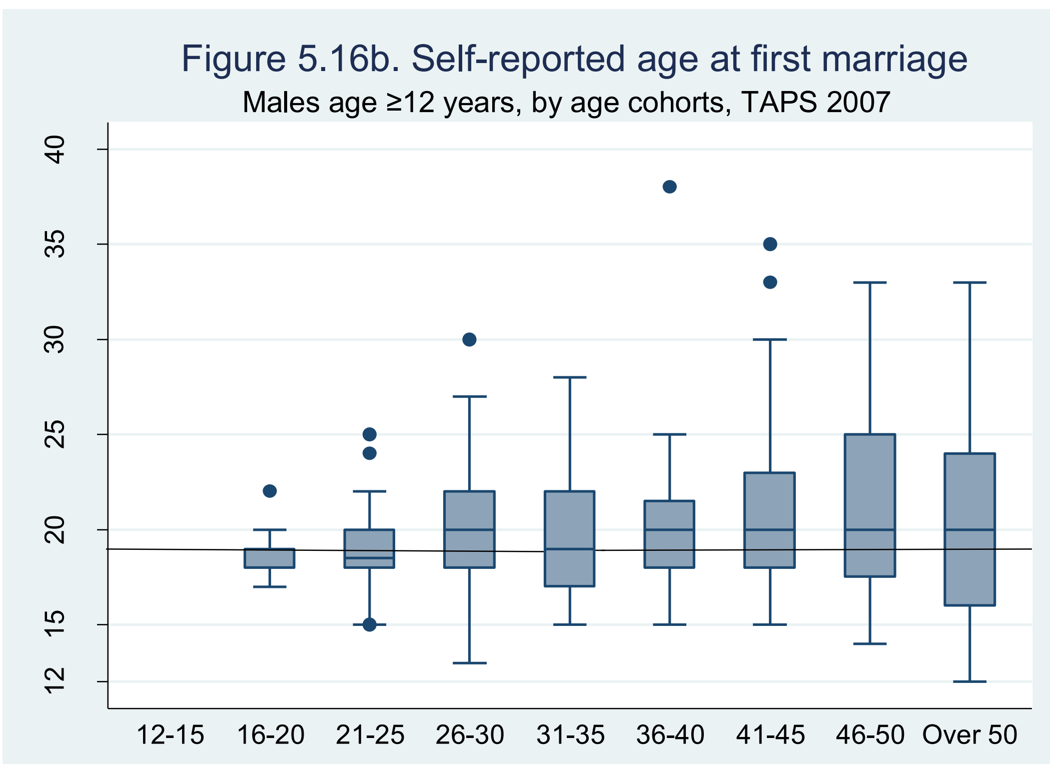


Fig. 5.14. Self-reported age at first marriage
TAPS 2007, females and males age ≥12 years
Females
Males
0
5
10
15
20
25
12
15
18
20
22
25
30
35
Age

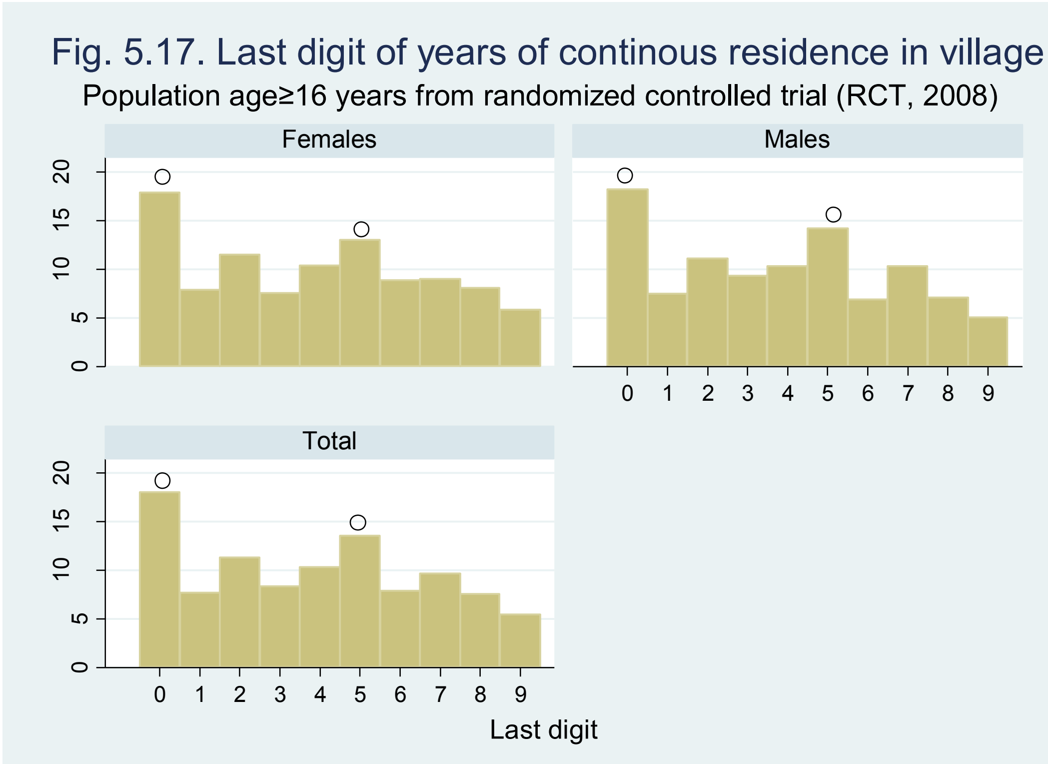


Notes: The histogram includes only people married more than once.





Note: Horizontal line across all age cohorts for each sex is the median age for the entire sample for females (16 years) or males (19 years).



Note: The sample includes adults who reported in whole numbers the years of continuous residence in the village where they were living at the time of the survey. We asked for continuous years living in the village without an absence of more than six months. Of the 1,042 people who answered the question (i) 1.64% answered in fractions (e.g., 1.5 years) and (ii) 2.20% admitted not knowing the exact number of years. (i-ii) are excluded from the graphs.

[i] For instance, we use age to estimate dependency ratios, birth periods, adult equivalents, or anthropometric Z scores standardized by age and sex. These variables play a cardinal role in demographic analysis, estimates of secular change, and in the analyses of anthropometric and socioeconomic outcomes.

[ii] Digit heaping surfaces not just when measuring age among living populations; it also surfaces when measuring other outcomes, such as blood pressure, expenditures, age at menopause, and time allocation (Holblook et al., 2014; Wang & Heitjan, 2008, p. 3791). Crockett and Crockett (2006) also find digit heaping in estimates of the size of religious congregations in historical records.

[iii] The estimates come from using the public TAPS panel in regressions of reported age (outcome variable) against the following explanatory variables: consistent age, number of times participants was surveyed, participant's completed grades of schooling, and a full set of dummy variables for villages and survey years.

[iv] For the seven girls under 14 years of age, there was one case each for girls 3, 9, 11, 12, and 13 years of age, and two cases of girls 10 years of age, all of whom reported being pregnant. Since there was a sharp drop in the number of pregnant girls below 14 years of age -- from 10 cases for girls 14 years of age to only one case in most ages below 14 years -- and there were obvious mistakes (e.g., pregnant girls 3 and 9-10 years of age), I dropped all records (n=7) for any girl ≤age 13 years who reported being pregnant. In the upper age bracket for women over 50 years of age, there were four women 52, 68, 76, and 97 years old who reported being pregnant; I dropped these women from the sample.

[v] The estimate comes from a probit regression with a discrete dummy variable for pregnancy as an outcome variable (1=pregnant; 0=not pregnant) and, as explanatory variables, age, a dummy variable for the study (TAPS=1; randomized controlled trial=0), and a dummy variable for each survey year, with clustering by individuals and robust standard errors. Probabilities are estimated as marginal changes over the sample mean of the explanatory variable.

[vi] In the panel study, surveyors coded if a woman currently had a baby born since the last survey. In the randomized controlled trial we did not code for new births, so I have to limit the analysis of the reliability of self-reported pregnancies to TAPS data.

[vii] Haws et al. (2010, p. 1770) found that women in rural Tanzania concealed their pregnancy and disclosed it "only to [their] partner and a few trusted females" for fear of having to explain pre-natal losses, and the gossip, stigma, and physical harm that the losses could engender.

[viii] The estimate of McAllister et al. (2012) is more accurate than my estimate because they used detailed fertility histories, but their results are hard to compare with the estimates using TAPS data because McAllister et al. do not specify the age brackets of their sample. If I use the mean inter-birth interval for reproductive women under 45 years of age (section A, Table 5.12), I obtain a mean inter-birth value of 2.87 years, close to the estimate of McAllister et al.

[ix] Thanks to Álvaro Fernández-Llamazares of the Ethnoecology Laboratory, Institut de Ciència i Tecnologia Ambientals, Universitat Autònoma de Barcelona, Spain, and the Servicio Nacional de Hidrología y Meteorología of Bolivia (SENAHMI) for providing climate data for Figures 5.5a-5.5d.

[x] For instance, I changed 0.5 months of lactation to one month. From a total of 1,232 observations on the duration of lactation, 24 observations had a fractional duration of less than one month, six observations had a fractional durations between one and two months, and three observations had a fractional durations between two and three months. Thus, my recoding affected only 2.67% of observations (33/1,232).

[xi] In the combined samples of TAPS (2002-2010) and the 2008 survey of the randomized controlled trial I found 13 cases of girls below the age of 14 years and 69 cases of women over 50 years of age who said they were breastfeeding. Since the complete sample of all females who said they were lactating -- though they might not have provided information on the duration of lactation -- reached 1,469 observations, the females I dropped because they were probably too young or too old accounted for 5.58% of the sample of lactating women. Owing to the measurement errors with age, we cannot tell whether the females I excluded should have been excluded because of the age bracket I considered, or whether they belonged in the age bracket I considered, but were miss-classified owing to their self-reported age.

[xii] My recoding of fractional answers about the duration of lactation did not affect the rounding errors around multiples of six because the few cases of recoding increased the sample size of observations ending in the digits one, two, and three, not in multiples of six (p. 62). However, my recoding did influence digit heaping at one month in the randomized controlled trial.

[xiii] In a sample of 183 breastfeeding Tsimane' mothers, Veile et al. (2014, p. 154) found that mothers introduced complementary foods when babies reached an average of 4.13 months (SD=2).

[xiv] In a separate ordinary least squares regression (not shown) with duration of lactation as an outcome variable, and a women's age and survey year as explanatory variables I found that the passage of each additional survey year was associated with a reduction of 0.27 months in breastfeeding ($p=0.003$; $n=1{,}019$). The regression included robust standard errors and clustering by participant.

[xv] Their analysis is presented in Figure 2 and discussed on p. 155. It is not clear from their discussion if the sample includes the same mothers interviewed in 2003 and 2011, or whether there were repeats in the later sample. In any case, from their Figure 2 it appears there were a total of 32 mother-infant dyads in 2003 and 48 mother-infant dyads in 2011. As they acknowledge, the null results could reflect a small sample size. That said, we see that in all three regions they considered -- near forests, rivers, and towns -- that complementary foods were introduced at an earlier age.

[xvi] In neither TAPS or in the randomized controlled trial did we ask about military service, but in 2012 and 2013 we did socioeconomic surveys of several ethnic groups in the Territorio Indígena Multiétnico, an area adjacent to the ones discussed in this chapter. In that survey we asked about military service and found that among the 188 adult Tsimane' men ≥18 years of age surveyed, only three had enlisted in the army. We did not ask women about military service because men are more likely to enlist.

[xvii] A chi-squared test of the five answers to the question on how much people valued cross-cousin marriage and a discrete binary variable for the type of ladder (1=traditional answer (1) at the bottom of the ladder, and non-traditional answer (5) at the top of the ladder; 0=traditional answer (1) at the top of the ladder and non-traditional answer (5) at the bottom of the ladder) produced a chi-squared statistics of 4.69 (p=0.32).

[xviii] For instance, the 1994 census of lowland indigenous peoples in Bolivia shows that 99% of Tsimane' lived in the department of Beni (Secretaria Nacional de Asuntos Étnicos Género y Generacionales, 1996, pp. 21-22). By 2001, the share had fallen to 92%, with 78.68% living in towns (Instituto Nacional de Estadística, 2003, pp. 82-83). The latest (2012) Bolivian census shows that the share of Tsimane' living outside of the department of Beni reached 90.82% (INE-Bolivia, 2016).

[xix] In analysis not shown I controlled for the person's school grades completed, and I got essentially the same results. Each additional school grade completed was associated with a 1.49 percentage-point increase in the probability of residing in one's birth village (n=4117; t=2.50; p=0.01).

[xx] Conditioning for the school grade completed did not change results; an additional school grade completed was associated with an additional 0.55 years of residence in the current village of residence (n=1016; t=3.58; p=0.001).

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Table 5.1. Last digit of own and dependents' age reported by adults, TAPS villages, 2002-2010[1]

Last digit	2002 N	2002 %	2003 N	2003 %	2004 N	2004 %	2005 N	2005 %	2006 N	2006 %
0	154	13.11[2]	220	16.03	142	11.09	176	12.66	184	12.49
1	119	10.13	134	9.77	149	11.63	122	8.78	126	8.55
2	125	10.64	150	10.93	155	12.10	145	10.43	160	10.86
3	122	10.38	137	9.99	135	10.54	142	10.22	147	9.98
4	111	9.45	124	9.04	121	9.45	157	11.29	146	9.91
5	136	11.57	154	11.22	152	11.87	173	12.45	225	15.27
6	99	8.43	115	8.38	110	8.59	128	9.21	151	10.25
7	113	9.62	118	8.60	112	8.74	109	7.84	111	7.54
8	102	8.68	114	8.31	108	8.43	133	9.57	125	8.49
9	94	8.00[2]	106	7.73	97	7.56	105	7.55	98	6.65
Total	1,175	100.00	1,372	100.00	1,281	100.00	1,390	100.00	1,473	100.00

Last digit	2007 N	2007 %	2008 N	2008 %	2009 N	2009 %	2010 N	2010 %	Total: 2002-2010 N	Total: 2002-2010 %
0	125	8.87	151	10.82	139	10.46	156	10.74	1,447	11.79
1	148	10.50	136	9.75	135	10.16	150	10.32	1,219	9.93
2	168	11.91	144	10.32	156	11.74	165	11.36	1,368	11.14
3	162	11.49	154	11.04	128	9.63	167	11.49	1,294	10.54
4	145	10.28	147	10.54	124	9.39	130	8.95	1,205	9.81
5	162	11.49	150	10.75	146	10.99	142	9.77	1,440	11.73
6	138	9.79	118	8.46	114	8.58	141	9.70	1,114	9.07
7	134	9.50	133	9.53	136	10.23	134	9.22	1,100	8.96
8	134	9.50	163	11.68	128	9.63	148	10.19	1,155	9.41
9	94	6.67	99	7.10	123	9.26	120	8.26	936	7.62
Total	1,410	100.00	1,395	100.00	1,329	100.00	1,453	100.00	12,273	100.00

Notes: [1]I elided fractional ages (e.g., 1.5) and only included ages reported in whole numbers. [2]For any year, numbers in red and in dark red are the two most common and the two least common last digits.

Table 5.2. Own and dependents' age reported by adults, TAPS and randomized control trial (RCT) study compared for two common years (2008-2009): Last digit of reported age

Last digit	Survey year							
	2008				2009			
	TAPS		RCT		TAPS		RCT	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
0	151	10.82	346	10.77	139	10.46	234	8.36
1	136	9.75	365	11.36	135	10.16	310	11.07
2	144	10.32	384	11.95	156	11.74	355	12.68
3	154	11.04	335	10.42	128	9.63	302	10.79
4	147	10.54	304	9.46	124	9.39	276	9.86
5	150	10.75	370	11.51	146	10.99	294	10.50
6	118	8.46	285	8.87	114	8.58	283	10.11
7	133	9.53	308	9.58	136	10.23	236	8.43
8	163	11.68	279	8.68	128	9.63	279	8.96
9	99	7.10	238	7.41	123	9.26	231	8.25
Total	1,395	100.00	3,214	100.00	1,329	100.00	2,800	100.00

Notes: Same as Table 5.1.

Table 5.3. Share of people reporting being sure and unsure about their own or their dependents' age[1] in TAPS (2002-2010) and in the RCT study (2008-2009)

Survey year	Sure		Unsure		Total	
	N	%	N	%	N	%
A. TAPS						
2002	910	73.03	336	26.97	1,246	100.00
2003	1,059	72.88	394	27.12	1,453	100.00
2004	1,074	81.00	252	19.00	1,326	100.00
2005[2]	1,392	90.80	141	9.20	1,533	100.00
2006[2]	1,495	94.03	95	5.97	1,590	100.00
2007	1,406	96.37	53	3.63	1,459	100.00
2008	1,429	95.65	65	4.35	1,494	100.00
2009	1,366	96.20	54	3.80	1,420	100.00
2010	1,527	97.26	43	2.74	1,570	100.00
Total	11,658	89.05[3]	1433	10.95[3]	13,091	100.00
Annual %Δ[4]	5.69		-29.79			
B. RCT						
2008	2,973	89.36	354	10.64	3,327	100.00
2009	2,451	81.73	548	18.27	2,999	100.00
Total	5,424	85.74[3]	902	14.26[3]	6326	100.00

Notes: [1]Totals for age in this table differ from totals in Tables 5.1-5.2 because in Tables 5.1-5.2 I only include ages in whole numbers whereas in Table 5.3 I include fractional ages. [2]2005-2006 includes attriters from the 13 villages of the panel study who moved to the village of Undumo (Chapter 4). [3]Share of total for all years of the panel. [4]Annual growth rate of column N, not of percentages.

Table 5.4. Composition of villages and age (years)-sex household composition in TAPS (2002-2010) and RCT (2008-2009) samples

Category	Statistic	A. TAPS											B. RCT	
		Survey year									Annual		Survey year	
		2002	2003	2004	2005	2006	2007	2008	2009	2010	Median	%Δ[4]	2008	2009
A. Villages	n	13	13	13	14	14	13	13	13	13	13	ne	40	40
Households/village	M	17.76	20.46	18.15	17.78	18.71	19.23	20.07	19.38	20.61	19.23	1.19	14.05	12.42
	SD	6.13	6.57	6.47	7.79	7.28	6.84	6.56	5.67	6.15	6.06	ne	6.27	6.12
B. Households	n	231	266	236	249	262	250	261	252	268	252	1.06	562	497
People/household	M	6.00	6.06	6.01	6.15	6.06	5.86	5.72	5.63	5.85	6.00	-0.78	5.91	6.03
	SD	2.84	2.96	2.71	2.85	2.81	2.69	2.55	2.41	2.61	2.71	ne	2.74	2.79
# girls <age 16 years/household	M	1.68	1.73	1.76	1.69	1.64	1.66	1.62	1.63	1.66	1.66	-0.68	1.69	1.74
# boys <age 16 years/household	M	1.85	1.86	1.80	1.86	1.84	1.77	1.69	1.66	1.74	1.80	-1.27	1.88	1.89
# women ≥age 16 years/household	M	1.21	1.19	1.21	1.30	1.28	1.23	1.25	1.22	1.27	1.23	0.46	1.22	1.22
# men ≥age 16 year/household	M	1.25	1.26	1.22	1.29	1.30	1.16	1.15	1.10	1.17	1.22	-1.49	1.10	1.16
C. Number of people	n[1]	1,387	1,614	1,419	1,533	1,590	1,459	1494	1,420	1,570	1,494	0.28	3,327	2,999
1. Females	(%)[2]	(48)	(48)	(50)	(49)	(48)	(50)	(50)	(51)	(50)	(50)	0.84	(49)	(49)
age<16 years	%	28	29	29	28	27	28	28	29	28	28	0.35	29	29
16≤age<60 years	%	18	18	17	18	17	18	18	19	18	18	0.80	19	19
age≥60 years	%	2	2	3	3	4	3	3	3	3	3	6.54	2	2
2. Males	(%)	(52)	(52)	(50)	(51)	(52)	(50)	(50)	(49)	(50)	(50)	-0.28	(51)	(51)
age <16 years	%	31	31	30	30	30	30	30	30	30	30	-0.20	32	31
16≤age <60 years	%	19	19	18	17	18	16	16	16	16	17	-2.17	17	17
age≥60 years	%	2	2	3	4	4	4	4	4	4	4	11.00	2	2
3. Total age <16 years	(%)	(59)	(59)	(59)	(58)	(57)	(59)	(58)	(59)	(58)	(59)	0.07	(61)	(60)
16≤age <60 years	(%)	(37)	(37)	(35)	(35)	(35)	34	(35)	34	(35)	(35)	-0.65	(35)	(36)
age≥60 years	(%)	(4)	(4)	(6)	(7)	(8)	(7)	(7)	(7)	(7)	(7)	8.78	(4)	(4)
D. Dependency ratio of household[3]	n	219	249	220	228	235	224	237	228	244	228	0.50	535	473
	M	1.74	1.75	1.97	1.94	1.85	1.98	1.85	2.01	1.94	1.94	1.24	1.94	1.89
	SD	1.11	1.12	1.34	1.35	1.30	1.40	1.23	1.41	1.22	ne	ne	1.38	1.28
E. Households without workers have only[5]:	%	5	6	7	8	10	10	9	10	9	9	8.05	5	5
People age≥60 years	%	3	2	3	2	3	4	3	4	5	3	10.45	2	2
People age<16 years	%	1	3	0	1	0	0	0	0	0	0	ne	0	0
People age≥60 & people age<16 years	%	2	2	4	6	7	6	7	5	4	5	13.29	3	2

Table 5.4. Composition of villages and age (years)-sex household composition in TAPS (2002-2010) and RCT (2008-2009) samples -- continued

Notes: n = number of observations. M = mean. SD = standard deviation. [1]Totals differ slightly from sample size in last row of Table 4.5 because Table 4.5 included some people without age and in this table we only included people for whom we had information on age. [2]Percent of line C; parenthesis indicates sub-total. Numbers might not add up due to rounding. [3]Dependency ratio = number of people in households (age <16 years+age≥60 years)/(16 years ≤age <60 years). [4]For sections C and E, growth rates computed from n (not shown) not from percentages. ne=not estimated because of small sample or little variation, or because it is not relevant. [5]Percent of line B.

Table 5.5. Generational composition of household samples in samples from TAPS and randomized controlled trial (RCT), 2005-2010

Number of generations	Kin relations across generations in the household[1]. Household includes:	A. TAPS						B. RCT		Annual[8]	
		Survey year									
		2005[2]	2006[3]	2007	2008	2009	2010	2008	2009	Median	%Δ
1	[a] Married couple alone (n)	16	20	20	20	19	21	46	29		3.44
	%	6.43	7.63	8.00	7.66	7.54	7.84	8.19	5.84	(7.64)	
2	[a] Parent-child[4](n)	185	186	173	196	192	200	425	381		1.74
	%	74.30	70.99	69.20	75.10	76.19	74.63	75.62	76.66	74.86	
	[b] Grandparent-offspring[5] (n)	1	1	1	0	0	1	1	0		ne[7]
	%	0.40	0.38	0.40	0.00	0.00	0.37	0.18	0.00	0.27	
	Sub-total: 2 generations (n)	186	187	174	196	192	201	426	381		1.67
	%	74.70	71.37	69.05	75.10	76.19	75.00	75.80	76.66	(75.05)	
3	[a] Parent-child-grandchild (n)	35	39	41	32	31	33	67	64		-3.51
	%	14.06	14.89	16.40	12.26	12.30	12.31	11.92	12.88	12.95	
	[b] Grandparent-grandchild[6] (n)	11	10	9	8	6	9	9	12		-7.58
	%	4.42	3.82	3.60	3.07	2.38	3.36	1.60	2.41	3.25	
	[c] Grandparent-offspring-grandchild (n)	1	6	5	4	3	4	8	8		ne[7]
	%	0.40	2.29	2.00	1.38	1.19	1.49	1.42	1.61	1.45	
	Sub-total: 3 generations (n)	47	55	55	44	40	46	84	84		-3.67
	%	18.88	20.99	22.00	16.86	15.87	17.16	14.95	16.90	(17.03)	
4	[a] Grandparent-offspring-grandchild & great grandchild[6] (n)	0	0	1	1	1	0	6	3		ne[7]
	%	0.00	0.00	0.40	0.38	0.40	0.00	1.07	0.60	(0.39)	
Total	N	249	262	250	261	252	268	562	497		
	%	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	(100.00)	

Notes: [1]Surveys included codes for wife, husband, father, mother, daughter, sons, daughter/son-in-law, grandchildren, brother/sister of ego, parents-in-law and siblings-in-law, step children, other kin (not specified), and non-kin. The table excludes unspecified kin and non-kin since one cannot place them in a generation, attriters, and impaired people. [2]2005 did not include parents-in-law, siblings-in-law, or step children. [3]Starting in 2006 we added parents-in-law and siblings-in-law. [4]Includes step children. [5]Includes parents-in-law. [6]Included in these rows are households with a total of three or four generations, even if the household had one or more missing generation in the middle. [7]ne=not estimated because of small sample. [8]Median includes both studies; %Δ refers to TAPS.

Table 5.6. Typology of households by number of heads present in samples of TAPS and randomized controlled trial (RCT)[1], 2005-2010

Survey year	Total number of household heads present during survey								Total	
	0[2]		1		2		3 (polygynous)			
	N	%	N	%	N	%	N	%	N	%
A. TAPS										
2005	4	1.61	20	8.03	219	87.95	6	2.41	249	100.00
2006	0	0	22	8.40	236	90.08	4	1.53	262	100.00
2007	2	0.80	27	10.80	215	86.00	6	2.40	250	100.00
2008	0	0.00	28	10.73	223	85.44	10	3.83	261	100.00
2009	5	1.98	35	13.89	203	80.56	9	3.57	252	100.00
2010	1	0.37	27	10.07	235	87.69	5	1.87	268	100.00
B. RCT										
2008	4	0.71	74	13.17	454	80.78	30	5.34	562	100.00
2009	8	1.61	63	12.68	401	80.68	25	5.03	497	100.00
Median for both studies		0.80		10.80		86.00		2.40		

Notes: [1]Excludes attriters and impaired people. [2]See page 10 for an explanation of why some households had no heads.

Table 5.7. Number (n) and share (%) of women 14 years ≤childbearing age≤50 years in total annual sample (N) who said they were pregnant at the time of the TAPS surveys (2002-2010) and of the randomized controlled trial (2008-2009), by survey year

Survey year	TAPS		Randomized controlled trial	
	n/N	%	n/N	%
2002	41/237	17.30		
2003	35/188	18.62		
2004	28/231	12.12		
2005	34/256	13.28		
2006	33/258	12.79		
2007	31/239	12.97		
2008	43/181	23.76	61/314	19.43
2009	32/163	19.63	49/348	14.08
2010	32/281	11.39		
Total	309/2034	Mean=15.76	110/662	16.62
		Median=13.28		
Percentage-point Δ/year[1]		3.93	ne[2]	ne[2]

Notes: [1]The growth rate refers to the shares not to the sample of pregnant women. [2]ne=not estimated because we only had two years of data.

Table 5.8. Number (n) and share (%) of women 14 years ≤childbearing age≤50 years in total sample (N) who said they were pregnant at the time of the surveys of TAPS (2002-2010) and of randomized controlled trial (2008-2009), by age cohort

Age cohort	n/N	%
14≤age<20	95/526	18.06
20≤age<25	90/553	16.27
25≤age<30	82/463	17.71
30≤age<35	57/369	15.45
35≤age<40	54/354	15.25
40≤age<45	26/248	10.48
45≤age≤50	15/183	8.20

Table 5.9. Accuracy of pregnancy data among women 14 years ≤childbearing age≤50 years, TAPS, 2003-2010

Survey year	Number of new births recorded in survey	Number of women who reported being pregnant[1]	Underreporting: Raw values (A-B)	Underreporting: In % ((A-B)/A)
	[A]	[B]	[C]	[D]
2003	34	35	-1	-2.94%
2004	43	28	15	+34.88%
2005	73	34	39	+53.42%
2006	144	33	111	+77.08%
2007	72	31	41	+56.94%
2008	47	43	4	+8.51%
2009	39	32	7	+17.95%
2010	92	32	60	+65.22%
Total	544	309	235	
Annual mean and median:				
Mean			Complete sample	44.86%
			Excluding 2006	39.49%
Median			Complete sample	53.42%
			Excluding 2006	44.15%

Notes: [1]From column "n/N", Table 5.7.

Table 5.10. Age-specific self-reported fertility among Tsimane' women and men ≥14 years of age, by age quinquennium (cohort) of respondent: Mean and standard deviation (SD) (TAPS 2007). Comparison of all births (alive or dead) and offspring alive in 2007

Age cohort (years)	A. No offspring[1]		B. Respondent gave birth or fathered at least one offspring (alive or dead). Offspring were:								
	N[2]	%	1. Females (daughters)			2. Males (sons)			3. Total (females + males)		
			N	Total born	# alive 2007	N	Total born	# alive 2007	N	Total born	# alive 2007
I. Women (mothers)											
14≤age<20	57	42.11	17	1.29/0.58	1.29/0.58	21	1.23/0.43	1.09/0.43	33	1.45/0.83	1.36/0.78
20≤age<25	45	11.11	35	1.45/0.61	1.31/0.58	28	1.53/0.79	1.28/0.93	40	2.35/1.02	2.05/0.87
25≤age<30	42	11.90	35	2.25/1.09	1.94/1.21	29	2.58/1.23	2.20/1.17	37	4.16/1.74	3.56/1.59
30≤age<35	34	14.71	28	2.53/1.03	2.32/0.90	28	3.03/1.77	2.50/1.23	29	5.37/2.47	4.65/1.79
35≤age<40	35	5.71	31	4.32/1.64	3.64/1.62	31	4.74/1.94	4.00/2.08	33	8.51/2.89	7.18/2.70
40≤age<45	28	3.57	26	4.34/2.13	3.61/1.74	26	4.42/2.21	3.69/2.36	27	8.44/3.06	7.03/3.01
45≤age	66	3.03	60	4.33/1.77	3.23/1.51	61	5.11/2.41	3.81/2.00	64	8.93/3.38	6.67/2.93
Total (≥14)	307	14.33	232	3.14/1.89	2.59/1.56	224	3.58/2.32	2.88/1.98	263	5.82/3.83	4.74/3.11
II. Men (fathers)											
14≤age<20	37	81.08	2	1.00/0	1.00/0	5	1.00/0	1.00/0	7	1.00/0	1.00/0
20≤age<25	39	33.33	18	1.33/0.48	1.33/0.48	20	1.20/0.41	1.00/0.56	26	1.84/0.67	1.69/0.67
25≤age<30	47	19.15	35	1.82/0.85	1.47/0.81	30	2.13/1.13	1.80/0.92	38	3.36/1.65	2.78/1.23
30≤age<35	37	10.81	30	2.76/1.25	2.56/1.22	29	2.86/1.94	2.37/1.56	33	5.03/2.70	4.42/2.09
35≤age<40	25	8.00	19	3.36/1.16	3.10/1.19	20	4.30/1.41	3.45/1.63	23	6.52/2.17	5.56/2.21
40≤age<45	29	0.00	29	4.44/1.99	3.63/1.83	29	4.89/2.22	4.00/2.01	29	9.34/2.88	7.68/2.55
45≤age	75	2.67	70	4.17/1.82	3.03/1.55	72	5.01/2.47	3.83/2.20	73	8.94/3.34	6.73/2.98
Total (≥14)	289	20.76	203	3.24/1.85	2.64/1.55	205	3.73/2.41	2.97/2.03	229	6.21/3.83	5.00/3.08

Notes: For columns "Total born" or "# alive 2007" number in cells show mean on top and SD in bottom, underneath "/". [1]No births ever. [2]N refers to the total of the sample for the age cohort, not to the number of people reporting never having had an offspring.

Table 5.11. Association between fertility outcomes and *(1)* age and *(2)* birth quinquennium (secular trend) among Tsimane' women and men ≥14 years of age, TAPS 2007, regression results[1]

Explanatory variables:	I. Women (mothers): A. Total born: i. Girls	I. Women: A. Total born: ii. Boys	I. Women: B. # offspring alive in 2007: i. Females	I. Women: B. # offspring alive in 2007: ii. Males	II. Men (fathers): A. Total born: i. Girls	II. Men: A. Total born: ii. Boys	II. Men: B. # offsprint alive in 2007: i. Females	II. Men: B. # offsprint alive in 2007: ii. Males
	1. Age							
Age	0.19	0.35***	0.04	0.07	-0.06	0.22	-0.09	0.23*
	(0.12)	(0.12)	(0.08)	(0.09)	(0.15)	(0.15)	(0.10)	(0.13)
Age quared	-0.001	-0.002***	-0.0004	-0.0007	0.0006	-0.001	0.0005	-0.001
	(0.0009)	(0.0008)	(0.0006)	(0.0007)	(0.001)	(0.001)	(0.0007)	(0.001)
	2. Birth quinquennium (reference group: parent born 1988-1992) - secular trend							
1983-1987	1.14**	0.02	-0.08	-0.04	2.96***	1.51	0.55*	-0.58
	(0.56)	(0.45)	(0.26)	(0.33)	(1.04)	(0.97)	(0.28)	(0.35)
1978-1982	1.37*	-0.02	0.44	0.67	4.43***	1.92	1.02*	-0.50
	(0.85)	(1.00)	(0.46)	(0.59)	(1.29)	(1.23)	(0.55)	(0.73)
1973-1977	1.03	-0.03	0.75	0.79	5.57***	2.37	2.41**	-0.62
	(1.10)	(1.54)	(0.74)	(0.84)	(1.67)	(1.72)	(0.87)	(1.11)
1968-1972	2.36*	0.88	2.02**	2.15	5.95***	2.96	3.24**	-0.16
	(1.37)	(1.92)	(0.88)	(1.25)	(2.05)	(2.16)	(1.09)	(1.40)
1963-1967	2.18	0.12	1.96	1.74	8.12***	4.12*	4.05***	-0.08
	(1.74)	(2.03)	(1.25)	(1.46)	(2.14)	(2.46)	(1.29)	(1.65)
≤1962	1.35	-0.25	1.78	1.97	7.41***	2.91	3.98**	-1.05
	(2.09)	(2.77)	(1.59)	(1.59)	(2.83)	(2.91)	(1.64)	(1.92)
Constant	-3.88*	-6.28***	0.68	-0.05	-2.13	-6.2***	2.56	-2.75
	(2.05)	(1.87)	(1.39)	(1.47)	(2.34)	(2.20)	(1.64)	(2.05)
R squared[2]	0.14	0.12	0.33	0.30	0.18	0.16	0.28	0.29
Total observations:	305	305	232	224	289	289	203	205
Left-censored	73	81	Not applicable		86	84	Not applicable	
Uncensored	232	224			203	205		
Joint significance test: Age & Age squared: F & (p>F)	1.22 (0.29)	7.48 (0.001)	1.36 (0.29)	1.12 (0.35)	0.40 (0.67)	2.07 (0.12)	1.22 (0.33)	2.14 (0.15)
Regression type	Tobit		OLS[3]		Tobit		OLS[3]	

Notes: [1]Regressions include robust standard errors (in parenthesis) and clustering by village. [2]For Tobit regressions, R squared is pseudo R squared. [3]OLS=ordinary least squares. *, **, and *** significant at ≤10%, ≤5%, and ≤1%.

Table 5.12. Implicit mean inter-birth interval[1] in years between all births (alive or dead) among women ≥14 or 15 years of age who reported at least one birth, by women's age cohort, TAPS 2007. Results of two estimation methods that differ in the mean age at first birth

Age cohort	N[2]	Length of inter-birth interval in years:		
		Mean	Median	SD[3]
	A. Mother is ***15*** years old at first birth			
15≤age<20	33[5]	1.91	2.00	1.20
20≤age<25	40	3.44	3.00	1.58
25≤age<30	37	3.71	3.00	2.54
30≤age<35	29	4.15	3.60	3.20
35≤age<40	33	3.50	2.55	3.85
40≤age<45	27	3.90	3.11	2.41
45≤age[4]	64	4.49	3.33	4.16
Total (≥14)	263	3.67	3.11	2.87
	B. Mother is ***14*** years old at first birth			
14≤age<20	33[5]	2.73	2.50	1.33
20≤age<25	40	3.95	3.33	1.80
25≤age<30	37	4.02	3.25	2.76
30≤age<35	29	4.39	3.80	3.38
35≤age<40	33	3.66	2.66	4.02
40≤age<45	27	4.04	3.22	2.50
45≤age[4]	64	4.64	3.44	4.30
Total (≥14)	263	4.00	3.00	3.21

[1]Inter-birth interval = [age - age at first birth]/[total offspring (alive or dead) born to a woman]. Age=woman's age in 2007, top coded to 45 for women over 45 years of age. Age at first birth can be either 15 years (section A) or 14 years (section B). [2]Sample size should be compared with samples in column IB3 of Table 5.10. [3]SD=standard deviation. [4]I changed the age of women over 45 years to 45. [5]The sample size of the youngest age cohorts <20 years are the same even though the age brackets in sections A and B differ because the 14 girls included in the sample had never had a child, so they were dropped when estimating mean inter-birth intervals.

Table 5.13. Secular trends in birth seasonality, data from TAPS (2002-2010) and from the 2008 survey of the randomized controlled trial combined, regression results[1] (n=4,917)

Explanatory variables:	Outcome variable is birth during:				
		Quarter:			
	Dry season[1]	First	Second	Third	Fourth
Birth cohort:	**Birth decade (reference group: parents born≤1950) – secular trend**				
1951≤born≤1960	0.02***	-0.02***	-0.01***	0.03***	0.01***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.0008)
1961≤born≤1970	-0.01***	-0.03***	-0.001	0.06***	-0.02***
	(0.001)	(0.0008)	(0.001)	(0.0009)	(0.0004)
1971≤born≤1980	-0.005***	-0.004***	0.006**	-0.01***	0.01***
	(0.0003)	(0.0003)	(0.004)	(0.0003)	(0.0001)
1981≤born≤1990	-0.009***	0.003***	0.03***	-0.04***	0.01***
	(0.003)	(0.0003)	(0.0005)	(0.0003)	(0.0001)
1991≤born≤2000	-0.007***	-0.007***	-0.008***	-0.01***	0.03***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.001)
2001≤born≤2010	-0.039***	0.006***	-0.03***	-0.02***	0.05***
	(0.0002)	(0.0002)	(0.0003)	(0.0002)	(0.0001)
Male[3]	0.005	0.02*	0.01	-0.02*	-0.005
	(0.009)	(0.01)	(0.01)	(0.01)	(0.007)
TAPS[3]	0.063***	-0.02*	0.04**	0.01	-0.03***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.008)
Constant	0.29***	0.23***	0.29***	0.29***	0.18***
	(0.008)	(0.007)	(0.006)	(0.006)	(0.004)
R squared	0.006	0.002	0.004	0.004	0.004

Notes: [1]Ordinary least squares regressions include robust standard errors (in parenthesis), clustered by birth decade. [2]Dry season=births during May-August, inclusive. [3]Male=1 if parent was a male, and zero if parent was female; TAPS=1 for people from TAPS villages, and TAPS=0 for people from the baseline (2008) survey of the randomized controlled trial. In all regressions, I use one record for each person; for the TAPS sample, I include the first time the person was surveyed in the panel. *, **, and *** significant at ≤10%, ≤5%, and ≤1%.

Table 5.14. Share of females 14 years≤age≤50 years who reported lactating at the time of the annual TAPS surveys (2002-2004, 2006-2010) and the 2008 baseline survey of the randomized controlled trial (RCT)

Item	Study:					
	TAPS		RCT		Both	
[A]. Women who said they were lactating [N=all women in age quinquennium; %=percentage of N who were lactating]						
Age quinquennium:	N	%	N	%	N	%
14≤age≤19	420	50.59	54	68.52	475	52.95
20≤age≤24	394	67.51	75	66.67	469	67.38
25≤age≤29	357	63.31	49	69.39	406	64.04
30≤age≤34	280	61.07	43	76.74	323	63.16
35≤age≤39	260	65.77	43	69.77	303	66.34
40≤age≤44	180	44.44	28	64.29	208	47.12
45≤age≤50	136	32.35	24	54.17	160	35.63
Total:	2,027	57.82	316	68.04	2,343	59.20
[B] Of lactating women, data on lactation duration is:						
Missing[1]	153	13.05	2	0.93	155	11.18
Complete	1,019	86.95	213	99.07	1,232	88.82
Total	1,172	100.00	215	100.00	1,387	100.00

Item	TAPS				RCT				Both			
[C] Duration of lactation in months by women's age quinquennium[2] [N=only for lactating women]												
Age quinquennium:	N	M	Me	SD	N	M	Me	SD	N	M	Me	SD
14≤age≤19	185	9.30	8.00	6.41	37	8.02	8.00	6.84	222	9.09	8.00	6.49
20≤age≤24	233	11.31	11.00	7.44	49	10.02	9.00	8.38	282	11.08	11.00	7.61
25≤age≤29	198	11.29	11.00	8.29	34	7.61	5.50	6.27	232	10.75	10.00	8.12
30≤age≤34	149	11.42	10.00	7.97	33	9.03	8.00	6.45	182	10.98	10.00	7.76
35≤age≤39	154	12.99	12.00	9.23	30	11.33	9.50	7.48	184	12.72	12.00	8.97
40≤age≤44	64	12.35	12.00	9.84	18	10.11	9.50	6.22	82	11.86	11.00	9.18
45≤age≤50	36	14.94	12.00	9.36	12	15.50	12.00	7.81	48	15.08	12.00	8.92
Total	1,019	11.41	11.00	8.13	213	9.63	9.00	7.33	1,232	11.10	10.00	8.02

Notes: [1]The 2005 TAPS survey did not include a question about the duration of lactation. [2]M=mean; Me=median; SD=standard deviation.

Table 5.15. Association between whether a woman was currently lactating or duration of current lactation (outcome variables) and *(1)* age and *(2)* survey year among Tsimane' women 14 years≤age≤50 years, regression results[1]

Explanatory variables:	Outcome variable is:	
	[A] Women lactating (1=yes; 0=no)	[B] Duration of current lactation (months)
	1. Age	
Age	0.05***	0.13***
	(0.008)	(0.02)
Age squared	-0.001***	^[2]
	(0.0001)	^
	2. Survey years [reference year: 2002]	
2003	-0.04	-1.74
	(0.03)	(1.14)
2004	0.008	-3.12***
	(0.03)	(0.95)
2005	-0.01	+[3]
	(0.04)	+
2006	-0.03	-2.35**
	(0.04)	(1.00)
2007	-0.08**	-3.63***
	(0.04)	(0.95)
2008	0.05	-3.94***
	(0.04)	(1.00)
2009	0.18***	-1.53
	(0.04)	(1.04)
2010	-0.06	-3.45***
	(0.04)	(0.98)
TAPS	-0.03	^[4]
	(0.04)	^
Constant	-0.17	9.96***
	(0.13)	(1.01)
R squared	0.06	0.04
Observations	2,343	1,019
Data included	TAPS 2002-2004, 2006-2010 and RCT 2008	TAPS 2002-2004, 2006-2010

Notes: [1]Regressions are ordinary least squares and include robust standard errors (in parenthesis) clustered by participant. ^ variable intentionally left out. [2]^Excluded because the quadratic term was not significant at p≤10% and because Figure 5.9 shows a straight line rather than a parabola. [3]+No data on duration of lactation in 2005 TAPS survey. [4]^Excluded because only TAPS data had surveys during many years; for the RCT we used only 2008 data for reasons discussed in the text. *, **, and *** significant at ≤10%, ≤5%, and ≤1%.

Table 5.16. Marital unions and age at the time of marriage for Tsimane' females and males≥12 years of age, TAPS 2007

Age cohort	N[1]	[I] Number of times married (% in age cohort)				[II] Age at the time of marriage:						
							First			Current or last		
		0	1	2	≥3	N/n[2]	Mean	Median	SD	Mean	Median	SD
	[A] Females											
12≤age≤15	80	87.50	12.50	0	0	10/10	14.90	15.00	1.44	14.90	15.00	1.44
16≤age≤20	59	25.42	72.88	1.69	0	45/42	15.22	16.00	1.70	15.92	16.00	1.85
21≤age≤25	42	4.76	80.95	14.29	0	40/38	16.75	16.00	2.27	17.44	17.00	2.80
26≤age≤30	43	4.65	88.37	4.65	2.33	40/39	17.22	17.50	3.52	17.58	18.00	3.77
31≤age≤35	31	3.23	80.65	16.13	0	30/29	17.03	16.50	2.96	18.51	18.00	4.02
36≤age≤40	33	0	78.79	21.21	0	33/33	17.57	17.00	3.43	19.48	18.00	5.39
41≤age≤45	26	0	73.08	23.08	3.85	26/26	17.46	15.50	4.79	20.84	20.00	8.17
46≤age≤50	12	0	83.33	16.67	0	12/12	17.16	17.00	2.24	18.58	18.00	4.07
50<age	56	0	60.71	37.50	1.79	56/52	16.57	15.50	3.30	26.73	20.00	17.55
Total	382	23.56	62.57	13.09	0.79	292/281	16.77	16.00	3.11	19.58	17.00	9.22
Married once	292	na[3]	81.85	17.12	1.03	238/230	16.96	16.00	3.17	16.99	16.00	3.22
Married many times	na[3]					53/51	15.96	15.00	2.72	31.23	26.00	16.09
	[B] Males											
12≤age≤15	97	100.00	0	0	0	0/0						
16≤age≤20	50	66.00	34.00	0	0	17/17	18.58	18.00	1.12	18.58	18.00	1.12
21≤age≤25	38	10.53	73.68	15.79	0	34/34	19.02	18.50	2.11	19.55	19.50	1.94
26≤age≤30	47	2.13	85.11	10.64	2.13	46/46	20.08	20.00	3.13	21.26	20.00	4.34
31≤age≤35	32	3.13	84.38	9.38	3.13	31/31	19.87	19.00	3.68	20.94	20.00	4.04
36≤age≤40	28	0	75.00	25.00	0	28/28	20.53	20.00	4.35	23.71	20.50	6.12
41≤age≤45	26	0	69.23	26.92	3.85	26/26	21.15	20.00	4.98	25.42	20.00	10.94
46≤age≤50	24	0	70.83	29.17	0	24/24	21.16	20.00	5.28	23.54	22.50	6.82
50<age	50	0	68.00	26.00	6.00	49/46	20.26	20.00	5.04	30.80	25.00	17.55
Total	392	34.69	51.53	12.24	1.53	255/252	20.11	19.00	4.04	23.47	20.00	9.85
Married once	256	na[3]	78.91	18.75	2.34	201/199	20.62	20.00	4.08	20.84	20.00	4.43
Married many times	na[3]					54/53	18.20	18.00	3.27	33.35	28.00	16.35

Notes: [1]Sample size for cohorts vary slightly by outcome because some respondents gave information on the number of times married, but not on the age at the time of marriage, or provided answers about the age at first marriage, but not about the age at the time of their current or last marriage. [2]The top number in the fraction refers to the sample size of answers about participants' age at the time of their first marriage, and the denominator refers to the sample size of answers about the age at which they married their current spouse. [3]Not applicable.

Table 5.17. Association between *(1)* the number of marriages contracted and *(2)* age, age-cohort, and sex among Tsimane' married adults≥12 years of age, TAPS 2007: Regression results (n=548)[1]

Explanatory variables:	Outcome variable: 1=married once; 0=married many times		
	[A] Ordinary least squares	[B] Probit[2]	
	Coefficient	Coefficient	Mean of explanatory variable
	1. Age		
Age[3]	-0.006***	-0.004***	37.59
	(0.001)	(0.0007)	
	2. Age cohort [reference age: people<21years]		
21≤age≤25	-0.11***	-0.35***	0.13
	(0.007)	(0.02)	
26≤age≤30	-0.02*	-0.22***	0.15
	(0.01)	(0.02)	
31≤age≤35	-0.03*	-0.27***	0.11
	(0.01)	(0.02)	
36≤age≤40	-0.08***	-0.35***	0.11
	(0.02)	(0.03)	
41≤age≤45	-0.10***	-0.39***	0.09
	(0.02)	(0.03)	
46≤age≤50	-0.03	-0.31***	0.06
	(0.03)	(0.04)	
50<age	-0.03	-0.29***	0.19
	(0.05)	(0.05)	
Male	-0.007	-0.008	
	(0.02)	(0.02)	
Constant	1.10***	na[5]	
	(0.01)		
R squared[4]	0.08	0.09	

Notes: [1]Sample includes only people married at least once. Regressions include robust standard errors (in parenthesis) and clustering by age cohort. [2]Coefficients for age cohorts or male variable are marginal probabilities for discrete changes in the binary variables from zero to 1; for age, the coefficient is the marginal probability when age increases by one year above the sample mean shown in the last column. [3]I only entered age in the regressions because I tested if age bore a non-linear relation, and found no significant results at the 10% level. [4]For probit regression, R squared refers to pseudo R squared. [5]Not applicable. *, **, and *** significant at ≤10%, ≤5%, and ≤1%.

Table 5.18. Post-marital residence after first marriage, Tsimane' females and males ≥12 years of age, TAPS 2007

Age cohort	Post-marital residence[1]						Total	
	Patrilocal		Matrilocal		Neolocal			
	N	%	N	%	N	%	N	%
12≤age≤15	4	40.00	5	50.00	1	10.00	10	100.00
16≤age≤20	17	27.87	42	68.85	2	3.28	61	100.00
21≤age≤25	22	29.73	49	66.22	3	4.05	74	100.00
(Sub-total≤25)	*(43)*	*(29.66)*	*(96)*	*(66.21)*	*(6)*	*(4.14)*	*(145)*	*(100.00)*
26≤age≤30	21	24.42	64	74.42	1	1.16	86	100.00
31≤age≤35	11	18.33	47	78.33	2	3.33	60	100.00
36≤age≤40	15	24.59	45	73.77	1	1.64	61	100.00
41≤age≤45	13	25.00	38	73.08	1	1.92	52	100.00
46≤age≤50	9	25.00	26	72.22	1	2.78	36	100.00
50<age	20	19.23	79	75.96	5	4.81	104	100.00
(Sub-total≥26)	*(89)*	*(22.31)*	*(299)*	*(74.94)*	*(11)*	*(2.76)*	*(399)*	*(100.00)*
Total	132	24.26	395	72.61	17	3.13	544	100.00

[1]Patrilocal [virilocal]=married couple resided in the household compound or village of the husband's family. Matrilocal [uxorilocal]=married couple resided in the household compound or village of the wife's family. Neolocal=married couple set up an independent household outside of the household compound or village of either the wife or the husband.

Table 5.19. Association between *(1)* the probability of patrilocal post-marital residence right after the first marriage (outcome) and *(2)* age, age cohort, and participant's sex among Tsimane' married adults≥12 years of age, TAPS 2007: Regression results (n=544)[1]

Explanatory variables:	Outcome variable: 1=patrilocal; 0=matrilocal or neolocal		
	[A] Ordinary least squares	[B] Probit[2]	
	Coefficient	Coefficient	Mean of explanatory variable
	1. Age		
Age[3]	0.04*	0.04*	37.51
	(0.02)	(0.02)	
Age squared	-0.0003*	-0.0003**	
	(0.0001)	(0.0001)	
	2. Age cohort [reference group: people<21 years of age]		
21≤age≤25	-0.15*	-0.14**	0.13
	(0.08)	(0.05)	
26≤age≤30	-0.33*	-0.24**	0.15
	(0.14)	(0.06)	
31≤age≤35	-0.52**	-0.29**	0.11
	(0.21)	(0.04)	
36≤age≤40	-0.57*	-0.30**	0.11
	(0.28)	(0.04)	
41≤age≤45	-0.64*	-0.30**	0.09
	(0.32)	(0.04)	
46≤age≤50	-0.71*	-0.28**	0.06
	(0.37)	(0.02)	
50<age	-0.84*	-0.42**	0.19
	(0.42)	(0.10)	
Male	-0.02	-0.02	0.46
	(0.03)	(0.03)	
Constant	-0.39	Na[4]	
	(0.39)		
Joint significance test: Age & Age squared[5]:			
F & (p>F)	73.76 (0.001)	83.31 (0.001)	
R squared[3]	0.01	0.01	

Notes: [1]Regressions include robust standard errors (in parenthesis) and clustering by age cohort. [2]Coefficients for age cohorts or male variable are marginal probabilities for discrete changes in the binary variables from zero to 1; for age, the coefficient is the marginal probability when age increases by one year above the sample mean shown in the last column. [3]For probit, R squared refers to pseudo R squared. [4]Not applicable. [5]For probit regression, test of joint significance refers to chi-squared test. *, **, and *** significant at ≤10%, ≤5%, and ≤1%.

Table 5.20. Self-reported value assigned to cross-cousin marriage among Tsimane' females and males ≥12 years of age, TAPS 2007

Age cohort	Valuation[1]						Total	
	Important		Neutral		Unimportant			
	N	%	N	%	N	%	N	%
12≤age≤15	4	22.22	3	16.67	11	61.11	18	100.00
16≤age≤20	37	38.14	15	15.46	45	46.39	97	100.00
21≤age≤25	25	31.25	14	17.50	41	51.25	80	100.00
(Sub-total≤25)	*(66)*	*(33.85)*	*(32)*	*(16.41)*	*(97)*	*(49.74)*	*(195)*	*(100.00)*
26≤age≤30	36	40.45	8	8.99	45	50.56	89	100.00
31≤age≤35	22	34.92	7	11.11	34	53.97	63	100.00
36≤age≤40	23	37.70	5	8.20	33	54.10	61	100.00
41≤age≤45	21	40.38	6	11.54	25	48.08	52	100.00
46≤age≤50	16	44.44	1	2.78	19	52.78	36	100.00
50<age	29	27.88	7	6.73	68	65.38	104	100.00
(Sub-total≥26)	*(147)*	*(36.30)*	*(34)*	*(8.40)*	*(224)*	*(55.31)*	*(405)*	*(100.00)*
Total	213	35.50	66	11.00	321	53.50	600	100.00

Notes: [1]For the question and possible answers, see the text on page 25. Answers included: 1=not important, 2=somewhat unimportant, 3=neutral, 4=somewhat important, 5=important. For Table 5.20 I recoded answers by combining answers 1-2 into unimportant, and answers 4-5 into important, but did not recode the answers of people who said they were neutral (3).

Table 5.21. Descriptive statistics for traits used in the analysis of assortative mating among Tsimane' household heads, TAPS (2002-2010) and randomized controlled trial (2008-2009)

Trait			Females		Males		Female-male difference		
Name	Definition	N[8]	Mean	SD	Mean	SD	Mean	SD	Coefficient[7]
A. Demographic and human-capital outcomes									
Age	Self-reported age in years	936	34.91	15.70	35.67	15.70	-0.76*	5.55	+0.93* (0.01)
Schooling	Completed grade of schooling	897	1.32	1.89	1.89	2.42	-0.56*	1.74	+0.54* (0.04)
Math	Score in math test[1]	875	0.51	1.07	0.94	1.46	-0.42*	1.17	+0.44* (0.03)
Spanish	Speaking fluency[2]	875	0.71	0.71	1.04	0.74	-0.32*	0.60	+0.63* (0.02)
B. Biological outcomes									
Height	Standing height[3]	875	150.71	4.66	155.25	7.40	-4.53*	6.90	+0.26* (0.02)
Arm	Mid-arm muscle area[4]	871	-0.09	0.78	-0.50	0.92	0.40*	0.84	+0.44* (0.03)
Fat	% body fat[5]	870	25.49	6.86	22.49	7.42	3.00*	5.98	+0.60* (0.03)
Skinfold	Sum of four skinfolds[6]	873	58.33	20.01	49.83	20.72	8.49*	16.73	+0.64* (0.02)

Notes: * significant at p≤1%. [1]Math: score in math test that asked people to add, subtract, multiply, and divide 1-2 digit numbers (Undurraga et al., 2013). [2]Spanish: Fluency speaking Spanish judged by surveyor as none (0), some (1), and fluent (2)(Godoy et al., 2007). [3]Height: Standing height following the protocol of Lohman et al. (1988). [4]Arm: Mid-arm muscle area estimated following Frisancho (2008). [5]Fat: Percent body fat measured with bioelectrical impedance. [6]Skinfold: sum of triceps, biceps, subscapular, and suprailiac; mm. [7]Coefficients from ordinary least square regressions of trait of female household head (outcome) against same trait from male household head (explanatory variable). Regressions include robust standard errors. [8]The sample is restricted to the first year female-male household heads appear in the sample of either TAPS or the randomized controlled trial.

Table 5.22. Probability of child ≤13 years of age being stunted (height-for-age Z score (HAZ)<-2), outcome variable, in relation to assortative mating of female and male household heads (female-male difference in a trait) used as explanatory variable: Results of probit regressions with clean annual data from TAPS (2002-2010) and from the randomized controlled trial (2008-2009) combined[1]

	Trait[2]	N[3]	Coefficient[4]	SE[5]	Mean[4]	R squared[6]
A. Assortative mating measured with demographic and human-capital variables						
[1]	Age	2201	-0.0005	0.001	-2.83	0.07
[2]	Schooling	2134	+0.002	0.004	-1.19	0.07
[3]	Math	2017	-0.014	0.008	-0.92	0.07
[4]	Spanish	2015	+0.02	0.02	-0.47	0.07
B. Assortative mating measured with biological variables						
[5]	Height	2096	-0.001	0.002	-11.79	0.07
[6]	Arm	2096	-0.02	0.01	+1.20	0.07
[7]	Fat	2093	-0.003**	0.001	+8.79	0.07
[8]	Skinfold	2091	-0.001*	0.0006	+24.60	0.07

Notes: [1]Probit regressions. The outcome variable is a discrete binary dummy variable for whether the child was stunted (1; HAZ<-2) or not stunted (0; HAZ≥-2). The main explanatory variable is the difference in a trait between the female and the male household head, a proxy for assortative mating. Other explanatory variables included but not shown in the table include a child's age and sex, and a full set of dummy variables for the study (TAPS=1; randomized controlled trial=0), villages, survey years, and interaction of village with year. [2]See Table 5.21 for definition of traits. [3]Number of child observations; because the data comes from panels, the same child can appear many times. [4]Coefficients are marginal probabilities that the child is stunted when the female-male difference in the trait increases by one unit above the sample mean of the trait. [5] Robust standard errors are clustered by child. [6]Pseudo R squared. * and ** significant at ≤10% and ≤5%.

Table 5.23. Associations of two outcome variables *(1)* the probability of living in the village of birth or *(2)* continuous years living in the current village of residence and the following explanatory variables: age, age cohort, sex, and study type. Tsimane' adults≥16 years of age, with data from TAPS 2002-2010 and randomized controlled trial (RCT) 2008: Ordinary least square regression results[1]

Explanatory variables:	Outcome variables: [1] Village of birth and residence Same (1); n=1722 [41.34%] Different (0); n=2443 [58.66%]	Outcome variables: [2] Years living continuously in current village
1. Age		
Age	0.002	0.69***
	(0.002)	(0.14)
2. Age cohort [reference group: people ≥45 years of age]		
16≤age<20	0.41***	10.49*
	(0.11)	(5.54)
20≤age<25	0.22**	7.83
	(0.10)	(4.87)
25≤age<30	0.19**	6.67
	(0.09)	(4.21)
30≤age<35	0.16**	7.10*
	(0.08)	(3.67)
35≤age<40	0.15**	3.19
	(0.07)	(3.11)
40≤age<45	0.11*	1.58
	(0.06)	(2.70)
3. Control variables		
Male	0.03	0.07
	(0.02)	(0.65)
TAPS	-0.11*	NA[2]
	(0.06)	
Constant	0.27	-9.96
	(0.18)	(7.96)
Year fixed effect[3]	YES	NA[2]
R squared	0.06	0.23
Observations	4165	1042
Data included	TAPS 2002-2009 and RCT 2008	RCT 2008

Notes: [1]Regressions include robust standard errors (in parenthesis) and clustering by subject for column 1 and clustering by household for column 2. The sample of column 1 contains repeated information for the same person because some people might have moved across villages over the duration of the panel. [2]Not applicable because sample comes from only the baseline year (2008) of one study, the randomized controlled trial. [3]Eight binary variables for each survey year (9 - 1=8) are included. *, **, and *** significant at ≤10%, ≤5%, and ≤1%.

Table 5.24. Causes of death and age at death in TAPS (2005-2010)(n=52)

	Females	Males	Total
Age:			
Mean	18.96	31.25	25.11
Median	5	20	6.50
Standard deviation	27.42	31.23	29.75
Cause of death:			
Illness	21	18	39
Old age	2	0	2
Accidents	3	1	4
Violence/suicide	0	3	3
Unknown	0	2	2
Other	0	2	2
Total	26	26	52

Notes: Causes of death and age at death came from reports of kin in the household. The data in this table comes from the raw annual surveys of the panel study.

Table 5.25. Knowledge of parental whereabouts by age cohort (quinquennium) of adult (age ≥16 years) respondent, TAPS 2005

Quinquennium		Mother (%)			Father (%)		
Age range	N	Alive	Deceased	Unknown	Alive	Deceased	Unknown
[A] Descriptive statistics							
16≤age<20	104	84.62	2.88	12.50	81.73	4.81	13.46
20≤age<25	100	68.00	14.00	18.00	71.00	12.00	17.00
25≤age<30	99	64.65	13.13	22.22	60.61	13.13	26.26
30≤age<35	70	52.86	20.00	27.14	51.43	24.29	24.29
35≤age<40	66	45.45	33.33	21.21	40.91	37.88	21.21
40≤age<45	61	40.98	39.34	19.67	21.31	59.02	19.67
45≤age<50	34	38.24	50.00	11.76	26.47	61.76	11.76
50≤age<55	28	17.86	78.57	3.57	7.14	82.14	10.71
55≤age<60	20	20.00	60.00	20.00	5.00	75.00	20.00
60≤age	75	8.00	80.00	12.00	6.67	78.67	14.67
Total (age≥16)	657	51.75	30.59	17.66	40.73	34.40	18.57
[B] Probability adults said parent (i) was alive or (ii) did not know if parent was alive or deceased, by age cohort (quinquennium) of respondent[1]							
Outcome variable		1=alive; 0= deceased		1=unknown; 0=alive or deceased	1=alive; 0= deceased		1=unknown; 0=alive or deceased
Probability		-9.21*		2.64	-19.59***		0.62
SE[2]		(0.04)		(0.02)	(0.04)		(0.02)
N		541		657	535		657

Notes: Answers from adults are only recorded if the parent of the adult was not part of the TAPS sample. [1]The results come from probit regressions with robust standard errors and one main explanatory variable, which captured the age cohort (quinquennium) of the respondent. The variable for age quinquennium had 10 values, corresponding to the 10 rows of section [A]. Control variables include the respondent's sex and age. [2]SE=standard error. Probabilities have been multiplied by 100 to facilitate their interpretation (e.g., 9.21% rather than 0.0921), but standard errors have been left with decimal notation. * , **, and *** significant at ≤10%, ≤5%, and ≤1%.

Appendix A

Guide to tables and figures for Chapter 5

Table	*Figure*	*Discussion in end notes or text*	*1st line: Folder* *2nd line: Stata do file*	*Comment; in most cases search for table or figure # in Stata do file*
5.1			AgePyramid: Do_Demography_10_age_pyramid	Do search throughout this do file for "Table 5.1" - it will bring you to the values for each year. Total 2002-2010 done in Excel file "Tables Chapter 5"
		TAPS annual Δ in rounding error gap		Excel file "Tables Chapter 5"
5.2			AgePyramid: Do_Demography_10_age_pyramid	Search for "Table 5.2". For TAPS, figures are copied from Table 5.1, but for RCT search for Table 5.2 in this do file
5.3			AgePyramid: Do_Demography_10_age_pyramid	Do search throughout this do file for "Table 5.3" - it will bring you to the values for each year. Row of totals & %Δ/year done in Excel file "Tables Chapter 5"
	5.1a		Prefered_age: Do_demography_7_prefered_age	Search for "Figure 5.1a"
	5.1b		Prefered_age: Do_demography_7_prefered_age	Search for "Figure 5.1b"
		Gap between reported and consistent age	Age_inconsistency: Age_inconsitency_V3_July_21_2016	The relevant explanatory variable is called "Consistent_age". Deviations from 1 capture over or under-estimation relative to the consistent estimate.
5.4			Village_HH_Dependency_Ratio Do_Village_HH_Dependency_Ratio_V2	Do search for "Table 5.4" in this Do file. Percentages for sections C and E are in Excel file "Tables Chapter 5"
	5.2.a-l		AgePyramid Do_Demography_10_age_pyramid	Search for /*Population pyramid for ****/ where **** is year. All the age-sex pyramids are produced in this do file
5.5-5.6			HouseholdTypes Do_Demography_1_house_types_V5	Both tables are in this do file -- search for "Table 5.5" or "Table 5.6"
5.7-5.8			Pregnancy DO_Demography_Pregnancy_V33	Search for "Table 5.7". Median and percentage growth rates in share of pregnant women in TAPS are in Excel file.
		Probability of becoming pregnant	Pregnancy DO_Demography_Pregnancy_V33	Probability estimated as a function of age, survey year, and study.
5.9			Seasonality_from_actual_births Do_Seasonality_from_actual_births_survey_2004_2010_V4	Annual births (column A) from this file
5.10-5.12			Pregnancy DO_Demography_Pregnancy_V33	Search for Table 5.10-5.12, but needs to be done twice, once for women and once for men
	5.3-5.4a-b		Pregnancy DO_Demography_Pregnancy_V33	Search for Figure #
	5.5a-5.5d		Rainfall & minimum temperature DO_RainFall_V2	Search for Figure #
	5.6a-5.6b		Pregnancy DO_Demography_Pregnancy_V33	Search for Figure #
5.13			Pregnancy DO_Demography_Pregnancy_V33	Search for Table 5.13
	5.7a-c		Pregnancy DO_Demography_Pregnancy_V33	Search for Figure #
	5.7d		Seasonality_from_Actual_births Do_Sesonality_from_actual_births_surveys_2004-2010_V4	Search for Figure #
	5.7e		Pregnancy DO_Demography_Pregnancy_V33	Search for Figure #

	5.8		Pregnancy DO_Demography_Pregnancy_V33	Search for Figure #
5.14- 20			Pregnancy DO_Demography_Pregnancy_V33	Search for Table #
	5.9-5.10		Pregnancy DO_Demography_Pregnancy_V33	Search for Figure #
	5.11- 5.15		Pregnancy DO_Demography_Pregnancy_V33	Search for Figure #
		House and kitchen enclosure	HouseStructure_Walls_Kitchen DO_House_Structure_Walls_Kitchen	
5.21- 22			Assortative_Mating DO file: Assortative_Mating_V4	Search for Table #
5.23			OnTheMove DO file: OnTheMoveV2	Search for Table #
		Inter-village mobility controlling for school grade	OnTheMove DO file: OnTheMoveV2	
5.24- 25			Mortality DO file: Mortality_V2	Search for Table #
	5.16a- 5.16b		Pregnancy DO_Demography_Pregnancy_V33	Search for Figure #
	5.17		OnTheMove DO file: OnTheMoveV2	Search for Figure #