

# Delayed Fertility Transition Among Indigenous Women In the Ecuadorian Amazon

**CONTEXT:** Communities indigenous to the Amazon are among the few remaining worldwide still practicing near-natural fertility, without the use of modern contraceptives. Given the large proportion of women desiring no more births, information on the challenges women there face in limiting fertility would be useful.

**METHODS:** Samples of women of reproductive age from five indigenous ethnic groups in the Northern Ecuadorian Amazon were surveyed in 2001 and 2012. Cross-sectional and longitudinal analyses examined married women's desire for another child at both times and modern contraceptive use in 2012, as well as determinants of a change in women's desire to have more children and of the number of children born during the study period.

**RESULTS:** In 2001, 48% of married women desired another child, 2% used a modern contraceptive and 50% had an unmet need for limiting; in 2012, the proportions were 40%, 19% and 47%, respectively. The total fertility rate was 7.9 births per woman in 2001 and 7.0 births per woman in 2012. Characteristics associated with wanting another child in 2001 and 2012 included parity (odds ratios, 0.6 and 0.4, respectively) and experience of a child death (2.0 each); characteristics associated with contraceptive use in 2012 included desire for another child, experience of a child death and presence of a community health worker (0.3–0.5). Number of children born was positively associated, and the square of the term negatively associated, with no longer wanting more children in 2012 among women who wanted more in 2001 (2.1 and 0.9, respectively).

**CONCLUSIONS:** Indigenous women in the Northern Ecuadorian Amazon appear to be making the transition to lower fertility. Insufficient access to credible information about the safety and efficacy of modern contraceptives, however, may slow the transition.

*International Perspectives on Sexual and Reproductive Health, 2015, 41(1):1–10, doi: 10.1363/4100115*

By Jason Davis,  
Richard Bilsborrow  
and Clark Gray

Jason Davis is postdoctoral scholar, Richard Bilsborrow is faculty fellow and research professor, and Clark Gray is faculty fellow and assistant professor, all with the Carolina Population Center, University of North Carolina, Chapel Hill, NC, USA.

Much of the fertility research in recent decades has focused on below-replacement fertility<sup>1–4</sup> and associated concerns with dependency ratios and social cohesion.<sup>5,6</sup> Few populations in the developing world have not begun the transition to lower fertility. Indigenous populations in the Ecuadorian Amazon are among these increasingly rare cases. Factors such as isolation from and lack of integration into the globalized world have limited the speed at which these populations have moved into and through fertility transition. This study takes advantage of longitudinal data on indigenous households in the Ecuadorian Amazon to describe the setting and the challenges women there face in limiting their fertility.

## BACKGROUND

Ecuador is well into its demographic transition. As elsewhere in the region, the country first experienced a gradual, long-term decline in overall mortality beginning in the early 20th century, which was followed by a decline in fertility.<sup>7</sup> Ecuador's total fertility rate (TFR) decreased from 7.0 births per woman as late as 1969 to 3.3 in 2004, but has stalled since then.<sup>8</sup> The fertility decline experienced nationally extended even to some populations in the Amazonian frontier: Observed fertility levels among nonindig-

enous Amazonian colonists dropped from around seven births per woman in 1990 to around five in 1999.<sup>9</sup>

However, in contrast to the downward trend in fertility rates for Ecuador overall and for nonindigenous Amazonian colonists in particular, the fertility rates of indigenous groups throughout the Amazon have remained high. According to a meta-analysis of fertility rates in more than 50 South American lowland indigenous groups between 1980 and 2000, the average TFR was 7.2.<sup>10</sup> Within the Northeastern Ecuadorian Amazon, the area for this study, the TFR for all indigenous populations combined was 7.9 in 2001, although it varied by ethnic group.<sup>11,12</sup> According to a study that used a series of statistical methods to detect intraethnic fertility differences among the Tsimane, who are indigenous to Bolivia, levels of acculturation (as proxied by distance to urban areas) were tied to lower ideal family sizes.<sup>13</sup>

The Northern Ecuadorian Amazon region includes five distinct self-identified ethnic groups—Kichwa (previously referred to as Quechua), Shuar, Waorani (previously Huaorani), Cofán and Secoya. These ethnic groups live in separate communities, and intermarriage among them or with nonindigenous individuals is uncommon.<sup>14</sup> The groups also differ in their integration into and remoteness

from Ecuador's nonindigenous society.<sup>15,16</sup> For example, the Kichwa and Secoya have had contact with European groups since the Spanish conquest, whereas the Waorani were first approached by missionaries in 1958.<sup>17</sup>

The population sizes of most of the ethnic groups in the Northern Ecuadorian Amazon are small: For example, the Cofán and Secoya each have fewer than 1,000 individuals, the Waorani about 2,000, and the Shuar about 3,000 (although several thousand more live elsewhere). The Kichwa, in contrast, have the largest presence in the region—about 60,000.<sup>11</sup>

The mating patterns of the five indigenous groups are similar, with the exception of the Waorani and to a lesser extent the Shuar. Monogamy is strictly practiced in Cofán, Kichwa and Secoya communities,<sup>18</sup> and it is the norm among the Shuar, although they occasionally practice polygamy as well;<sup>19</sup> polygamous, polyandrous and monogamous mating schemes are all acceptable among the Waorani.<sup>14</sup> In general, the groups rely on subsistence farming supplemented by hunting and fishing to meet their nutritional needs.<sup>20</sup> The tradeoff between subsistence crops and wild game varies by the remoteness of communities; however, the hunting and fishing components of these groups' livelihood strategies have declined in recent years.<sup>21</sup>

As contact with nonindigenous groups has increased in recent decades, the lifestyles of Ecuadorian Amerindians have changed in many ways. Assimilation of indigenous peoples into Ecuador's economy has increased as they have entered external labor markets, such as employment with petroleum companies, in ecotourism and in other types of wage labor following migration to towns and cities in the Amazon region.<sup>14,20</sup> Indigenous peoples have also become more integrated into commodity markets through increased sale of agricultural crops and natural resources to local markets.<sup>16,22,23</sup> Furthermore, school enrollment has increased greatly among indigenous children,<sup>24</sup> and most ethnic groups have abandoned their nomadic lifestyles,<sup>15</sup> instead settling in villages with a primary school and communal titles to land.<sup>25</sup>

Integration of indigenous groups into Ecuador's health system is still a work in progress. Many such communities have government-run health clinics (*puestos de salud*); however, not all such clinics are regularly staffed or stocked with a full range of medicines and contraceptive methods.<sup>26</sup> Thus, isolated indigenous women must travel long distances and at great expense to access health and family planning services.<sup>11</sup> Community health workers (*promotoras* or *promotores*) provide other public health services to rural Ecuadorian communities. These individuals—who must meet minimal literacy, age and residency requirements—are chosen (primarily by community leaders) to participate in two months of health training administered by the Minis-

try of Health,<sup>27</sup> after which their primary charges include health education, detection of pregnancy complications, promotion of immunizations and hygiene, and treatment of common illnesses. In addition, community health workers act as a bridge to the formal health care system.<sup>27</sup> Despite such attempts to improve access to health services for Ecuadorian Amazonian indigenous groups, fertility and family planning access may still be lagging behind other areas, such as in employment and education.

## METHODS

### Sample and Data

The study uses primary longitudinal data collected from 32 Northern Ecuadorian Amazonian indigenous communities in 2001 and 2012. A thorough description of the original sampling procedures can be found elsewhere.<sup>28</sup>

Briefly, in 2001, survey communities representing the Kichwa, Shuar, Waorani, Cofán and Secoya ethnic groups were selected to capture a diverse range of characteristics, including ethnicity, population size, and proximity to major roads and small cities in the region and near to and within the region's two large national parks and protected areas (the Cuyabeno Nature Reserve and the Yasuni National Park). Greater numbers of Kichwa and Shuar communities were selected because of their larger populations; the three smaller ethnic groups were oversampled to have sample sizes permitting valid interethnic comparisons to the extent possible. The selection of households within sample communities was dictated by community size. For small communities (i.e., with 22 households or fewer), all households were sampled; for larger communities, 22 occupied households were randomly selected.

Overall, 541 households in 36 communities were interviewed in 2001. The same communities were revisited in 2012, but it was possible to resurvey only 32;\* thus, four communities were excluded from the 2001 sample. Efforts were made to include all households surveyed in 2001, plus new households that had split off from them—mostly because of children growing up and forming their own families, but also occasionally because of separations and divorces. Of the households surveyed in 2001, 399 were resurveyed in 2012, representing a response rate of 89% in resurveyed communities. In addition, 200 new households were surveyed in 2012, for a total of 599. Of the households interviewed in 2001 and 2012, 334 and 515, respectively, contained a married woman of reproductive age (15–49), the study population for this research; women in formal marriages and those in consensual unions were both considered married for the purposes of this study.

The interviews in 2001 and 2012 used essentially the same questionnaire. In 2001, private interviews were held with the female head of household or the wife of the household head; however, in 2012, the procedure was expanded to include interviews with each woman of reproductive age—married or single—in the household. Of the 515 married women interviewed in 2012, 15 were not the head of household or married to the household head.

\*Two Waorani communities were excluded because another investigator was conducting an intensive ethnographic study in them, one Waorani community disappeared because the last three families had moved to live closer to a road and one Shuar community refused to participate because of internal conflict.

**TABLE 1. Selected characteristics of indigenous women aged 15–49, by ethnicity and year, Northern Ecuadorian Amazon, 2001 and 2012**

Characteristic	All		Kichwa		Shuar		Cofán		Secoya		Woorani	
	2001	2012	2001	2012	2001	2012	2001	2012	2001	2012	2001	2012
<b>ALL WOMEN</b>	(N=590)	(N=711)	(N=297)	(N=419)	(N=109)	(N=107)	(N=62)	(N=79)	(N=36)	(N=39)	(N=86)	(N=80)
Mean age	27.4	26.8	27.6	26.7	27.6	27.5	26.6	28.2	29.1	25.8	27.4	26.0
Mean parity	4.2	3.4	4.2	3.5	4.5	3.7	6.5	3.3	2.9	2.6	3.2	2.9
Education (%)												
None	12.9	5.0	8.1	2.1	9.3	4.7	25.8	13.9	11.1	0.0	28.2	12.8
Complete primary	65.1	52.5	66.7	53.9	67.6	54.2	66.1	58.2	63.9	46.2	51.8	43.6
Complete secondary	22.0	42.5	25.3	43.9	23.1	41.1	8.1	27.8	25.0	53.8	20.0	43.6
Speaks Spanish (%)												
Yes	88.9	96.1	96.0	98.6	97.2	100	62.9	91.1	97.2	100	66.3	80.0
No	10.9	3.9	4.0	3.4	2.8	0	37.1	8.9	2.8	0	33.7	20.0
<b>MARRIED WOMEN</b>	(N=334)	(N=515)	(N=167)	(N=314)	(N=63)	(N=75)	(N=38)	(N=54)	(N=20)	(N=23)	(N=46)	(N=49)
Desires another child (%)												
Yes	48.1	39.7	48.4	41.2	25.0	31.6	65.9	30.9	40.9	30.4	68.1	51.0
No	51.9	60.3	51.6	58.8	75.0	68.4	34.1	69.1	59.1	69.6	31.9	49.0
Modern contraceptive use (%)												
Yes	2.1	18.8	2.4	29.5	4.6	32.8	0	11.8	2.8	18.2	1.2	2.2
No	87.9	81.2	97.6	60.5	95.4	67.2	100	88.2	97.2	81.8	98.8	97.8
Unmet need for limiting (%)												
Yes	49.6	47.3	52.0	45.8	59.8	43.4	32.7	57.1	65.0	58.3	32.6	47.1
No	50.4	52.7	48.0	54.2	40.2	56.6	67.3	42.9	35.0	41.7	67.4	52.9

† Married women only. Note: The 2001 survey wave interviewed female household heads and wives of household heads, while the 2012 wave interviewed all reproductive-age women in the household.

The interview asked women about their fertility history (total numbers of births and surviving children, by sex, and date of last birth), their current desire for more children and their current contraceptive use. Specific questions asked to derive desire for more children—including ideal family size—and modern contraceptive use include “Do you desire another child?”, “Are you currently using a contraceptive method to avoid pregnancy?” and “Which method are you currently using?”

Independent variables consisted of standard control variables included in many fertility studies, such as the respondent’s age and ethnicity, whether she and her husband had completed secondary education, and whether any of her children had died. However, we also included less common variables, such as an asset index, travel time in minutes to the nearest town and to the nearest source of family planning services, whether the respondent’s last living child had been born in a hospital, and whether a community health worker and oil industry employment were available in the community. We created the asset index variable by employing principal components analysis to assign each household a wealth value between 0 and 10 on the basis of its physical infrastructure and household assets, per a previously described methodology.<sup>29,30</sup> Specifically, 31 variables representing size and main construction materials of the dwelling, source of water, type of cooking fuel and ownership of selected household goods (e.g., table, cook stove, refrigerator) were used to create the index. The travel time variables were included to capture potential urban influences and the degree of effort needed to procure family planning services.\* Hospital birth of the last child, oil industry presence and community health worker variables are included to control for the possibility that women may have been exposed to family planning

information and modern ideas about family size through the presence of these health-information resources in the community;† the former two variables, as well as the asset index, may also capture the relative degree of household wealth. Quadratic (squared) terms for both number of children born and age were also included; when significant, solving the quadratic equation shows the point at which the linear association between term and the respective dependent variable begin to diverge.

In addition, we included a measure of unmet need for limitation of births,‡ defined as the proportion of married women of reproductive age who desired no more children, but were not currently using a modern contraceptive; survey questions did not identify unmet need for birth spacing. Parity was calculated on the basis of several questions about pregnancies, live births and child deaths; all live births were captured whether they occurred within or outside of marriage. A list of all the independent variables can be found in Appendix Table 1 (page 9).

### Statistical Analyses

To examine factors associated with women’s childbearing desire, modern contraceptive use and parity, we conducted cross-sectional and longitudinal multivariate logit anal-

\*Substituting travel distance or cost for time in our models did not alter the final results.

†Oil companies often have their own clinics for employees and their families.

‡Unmet need for contraception to limit childbearing includes women actively using modern contraceptives for birthspacing, as well as breastfeeding women who previously used modern contraceptives (in the denominator only). However, because the survey did not ask whether a woman was pregnant, (not) sexually active or menopausal, 11 of 526 women in 2012 who had previously used a modern contraceptive were not using one at the time of the survey, which could slightly inflate the estimate of unmet need.

**TABLE 2. Among married indigenous women, percentages who desired another child and who were currently using a modern contraceptive method; and mean parity—all by year, according to five-year age-group**

Age-group	% desires another child		% contraceptive use		Mean parity	
	2001	2012	2001	2012	2001	2012
15–19	80.5	46.5	1.4	9.8	1.15	1.10
20–24	63.6	36.7	4.5	29.5	2.46	2.36
25–29	52.0	34.6	1.3	12.9	4.19	3.85
30–34	37.0	24.2	0.0	20.8	6.10	4.83
35–39	24.5	18.6	1.8	15.2	8.37	6.79
40–44	13.0	12.5	6.0	11.1	8.74	6.78
45–49	9.1	0.0	2.3	7.1	8.43	8.54

Note: The 2001 survey wave interviewed female household heads and wives of household heads, while the 2012 wave interviewed all reproductive-age women in the household.

yses, as well as longitudinal Poisson regression analysis. The cross-sectional logit models were used to investigate desire to have another birth in 2001 and 2012, and modern contraceptive use in 2012; modern contraceptive use was not modeled in 2001 because only 2% of women in the sample reported having ever used a modern contraceptive at that wave. A longitudinal logit model was used to identify predictors of women changing from wanting another child in 2001 to not wanting another child in 2012.

Finally, to better understand 2001 conditions leading to higher birth counts in 2012 at the individual level, we used a Poisson regression model. Specifically, we conducted a regression on the number of births that occurred between 2001 and 2012 with several predictors measured in 2001,

including previous births and child deaths; woman's age, secondary education and ethnicity; household assets; and urban travel time; along with change in household wealth between 2001 and 2012, and the presence of the oil industry in either 2001 or 2012.

The longitudinal models included only the 191 women who were at least 15 years of age in 2001, no more than 49 years of age in 2012 and married at both points.\* A series of diagnostic and robustness checks were performed for each model: Per recommendations specified by Chen et al.<sup>31</sup> and by Rabe-Hesketh and Skrondal,<sup>32</sup> we tested for independence and normality, overdispersion, specification errors, goodness of fit, multicollinearity and distorting effects of outliers.

## RESULTS

### Descriptive Findings

Overall, women in the 2001 sample had a mean age of 27.4 years and a mean parity of 4.2 children; in 2012, the mean age and parity were 26.8 and 3.4, respectively (Table 1, page 3). Twenty-two percent of women in 2001 reported having completed their secondary education, and 89% spoke Spanish, compared with 43% and 96%, respectively, in 2012. Among married women in 2001, 48% desired another child, 2% were currently using a modern contraceptive and 50% had an unmet need for limiting; in 2012, those figures were 40%, 19% and 47%. Of the 72 women surveyed in 2001 who desired more children, 54 no longer wanted another child in 2012 (not shown). The TFR in the sample of indigenous women was 7.0 in 2012, nearly one child fewer than in 2001 (7.9).

In general, age and parity seemed to decrease in each ethnic group between the two times. The overall decline in parity across ethnic groups is at least partly due to a sharp decrease among Cofán women (from 6.5 in 2001 to 3.3 in 2012). The Cofán also experienced substantial increases in secondary education (from 8% to 28%) and modern contraceptive use (from 0% to 12%), and a substantial decrease in childbearing desires (from 66% to 31%), which together may be related to a jump in unmet need (from 33% to 57%).

Among the Waorani, the most isolated of the five ethnic groups,<sup>14</sup> the proportion of women with complete secondary education more than doubled between 2001 and 2012 (from 20% to 44%); among married Waorani women, the proportion who desired another child went from 68% to 51%, the proportion using a modern contraceptive from 1.2% to 2.2%, and unmet need from 33% to 47%. In contrast, unmet need decreased among married Kichwa, Shuar and Secoya women, reflecting an increase in contraceptive use, and a decrease in desire for another child (among Kichwa and Secoya only).

In analyses that looked at outcome measures in 2001 and 2012 among all married women by five-year age-group

\*For these analyses, one Waorani and one Shuar community were excluded because of a lack of interviewed married women of reproductive age.

**TABLE 3. Odds ratios (and standard errors) from logit models examining the likelihood of married indigenous women's desire for another child, by year, and modern contraceptive use**

Characteristic	Desires another child		Contraceptive use
	2001	2012	2012
Desires another child	na	na	0.51 (0.17)*
No. of children born	0.58 (0.12)**	0.41 (0.06)***	0.79 (0.15)
No. of children born—squared	1.02 (0.02)	1.06 (0.01)***	1.02 (0.02)
Had a child die	2.01 (0.70)*	2.03 (0.61)*	0.39 (0.18)*
Age	1.09 (0.16)	1.41 (0.16)**	1.49 (0.23)**
Age-squared	1.00 (0.00)	0.99 (0.00)***	0.99 (0.00)**
Secondary education			
Respondent	0.33 (0.29)	0.72 (0.26)	2.41 (0.98)*
Husband	1.25 (0.74)	0.71 (0.19)	0.93 (0.32)
Ethnicity (ref=Kichwa)			
Shuar	0.47 (0.29)	0.61 (0.21)	0.92 (0.38)
Cofán	2.32 (1.07)†	0.58 (0.22)	1.33 (0.72)
Secoya	0.33 (0.13)**	0.59 (0.23)	0.68 (0.45)
Waorani	3.75 (1.88)**	1.86 (0.70)†	0.07 (0.80)**
Asset index	0.93 (0.09)	1.08 (0.06)	1.21 (0.09)*
Oil industry presence	1.30 (0.38)	1.06 (0.28)	2.38 (0.81)*
Travel time			
To urban area	1.00 (0.00)	1.00 (0.00)	na
To family planning	na	na	1.00 (0.00)
Last birth in hospital	na	na	1.87 (0.58)*
Presence of health promoter	na	na	0.33 (0.12)**
Constant	5.590 (11.20)	0.050 (0.08)*	0.001 (0.00)**

\*p<.05. \*\*p<.01. \*\*\*p<.001. †p<.10. Notes: na=not applicable. ref=reference group. The 2001 survey wave interviewed female household heads and wives of household heads, while the 2012 wave interviewed all reproductive-age women in the household.

(Table 2), women's desire for more children appeared to decrease for all age-groups. In 2001, 81% of the youngest age-group (15–19) and 64% of the next youngest (20–24) wanted another child; in 2012, those proportions were 47% and 37%, respectively. When we assessed childbearing desires and children born to date, however, many of these young women seemed to have reached an ideal family size of about two children (not shown). In 2012, contraceptive use was lowest among 15–19-year-olds and 45–49-year-olds (the oldest age-group) and highest among 20–24-year-olds. Regarding the methods used by the 96 women who reported in 2012 using a modern contraceptive (not shown), the one-month injectable (58%) and oral contraceptives (28%) were the most common; the condom, the IUD and female sterilization were each used by fewer than 10% of women. Mean parity decreased for all but one age-group between 2001 and 2012; the largest decreases (of about 1.5–2.0 children) occurred among women in the age-groups from 30 to 44.

### Cross-Sectional Models

Cross-sectional results for predictors of married women's desire to have another child in 2001 and 2012 show modest differences (Table 3). In 2001, parity was negatively associated with childbearing desire (odds ratio, 0.6). In 2012, parity remained negatively associated with desire for another birth (0.4), but the odds ratio of the squared measure was positive and significant (1.1). This U-shaped pattern, in which the desire for another birth is high initially, drops with more children, but rises again for women with more than eight births, suggests the existence of two populations: one that is older and pretransition—always wanting more children—and another that is younger and wants to control its fertility. Experience of a child death was positively associated with childbearing desire in both 2001 and 2012 (2.0 each).

In contrast to parity, the pattern of the association between women's age and their childbearing desire in 2012 is bell-shaped: As women age, their desires for more children increase until about age 29, when they wane and start to move downward, as noted by the negative aged-squared term. Regarding ethnic differences, in 2001, Waorani were more likely than Kichwa, and Secoya were less likely than Kichwa, to desire another child (3.8 and 0.3, respectively); no differences by ethnicity were found in 2012.

In analyses of predictors of modern contraceptive use in 2012, desire for another birth and the loss of a child were both negatively associated with the outcome (0.5 and 0.4, respectively). Similar to the 2012 childbearing desire outcome measure, respondent's age and age-squared conform to a bell-shaped pattern in which contraceptive use increases to age 28 and then falls. Measures of affluence and exposure to family planning information (respondent's education, asset index, last birth in a hospital and availability of petroleum industry employment) were positively correlated with modern contraceptive use (1.2–2.4). Waorani was the only ethnicity found to be significantly

**TABLE 4. Odds ratios (and standard errors) from longitudinal logit analyses of the likelihood of women changing from desiring another child to not doing so between 2001 and 2012; and incidence rate ratios (and robust standard errors) from longitudinal Poisson analyses of the predictors of women's number of children born between 2001 and 2012**

Characteristic	No longer wants more children	No. of children born 2001–2012
No. of children born by 2001	2.10 (0.66)*	1.06 (0.06)
No. of children born–squared	0.91 (0.04)*	1.00 (0.01)
Had a child die	2.16 (1.02)	1.54 (0.12)***
Age	1.08 (0.38)	1.10 (0.10)
Age-squared	1.00 (0.00)	1.00 (0.00)
Secondary education	3.85 (4.30)	0.62 (0.21)
Ethnicity		
Kichwa (ref)	1.00	1.00
Shuar	0.53 (0.34)	0.80 (0.08)*
Cofán	1.93 (1.05)	0.74 (0.09)*
Secoya	0.33 (0.40)	0.66 (0.15)†
Waorani	3.84 (2.57)*	1.06 (0.14)
Asset index	0.87 (0.11)	0.92 (0.02)***
Change in wealth, 2001–2012	0.91 (0.10)	0.97 (0.02)
Travel time to urban area	1.00 (0.00)	1.00 (0.00)
Oil industry presence, 2001 or 2012	0.56 (0.23)	1.03 (0.07)
Constant	0.11 (0.23)	1.47 (2.12)

\*p<.05. \*\*\*p<.001. †p<.10. Notes: ref=reference group. Only the 191 married women of reproductive age who were household heads or married to the household head and interviewed at both survey waves were included. All variables are for 2001, unless noted.

different from Kichwa in terms of modern contraceptive use (0.1). The presence of community health workers was negatively associated with contraceptive use (0.3).

### Longitudinal Models

In the logit model of change in women's childbearing desire from wanting more children in 2001 to not wanting more in 2012 (Table 4), number of children born was positively associated, and the square of the term was negatively associated, with the outcome (odds ratios, 2.1 and 0.9, respectively). In addition, Waorani women were more likely than Kichwa women to no longer want additional children (3.8).

These data suggest that women with high parity have likely reached their desired parity by 2012. Furthermore, the child-squared term indicates that the association with a change in desire to have more children is attenuated as women have more children. In other words, the positive association between women changing their desire from wanting to not wanting to have more children is not as strong for women who had more than 3.8 children initially, in 2001. The child-squared term provides evidence that some women, independent of age, have adopted modern notions of small family size while others have not.

In our Poisson model predicting children born between 2001 and 2012, women who had lost a child before 2001 had 50% more children between 2001 and 2012 than women who had not (incidence rate ratio, 1.5). In addition, a one-unit increase in a woman's asset index score was associated with an 8% reduction in her number of

children born between 2001 and 2012 (0.9). Some ethnic differences were also found: Compared with Kichwa women, Shuar and Cofán women had 20–26% fewer children (0.7–0.8).

## DISCUSSION

During the first decade of the 21st century, indigenous populations in the Northern Ecuadorian Amazon increased their levels of development and integration into Ecuador's society of mixed European and indigenous ancestry.<sup>14,20,22</sup> Between 2001 and 2012, the proportion of indigenous women in our sample who spoke Spanish increased, and the proportion with secondary education almost doubled. Other indicators of development include household wealth, hospital delivery and the availability of oil industry jobs—all linked with modern contraceptive use in our multivariate analyses. Furthermore, the proportion of indigenous married women who reported not wanting to continue childbearing rose from five in 10 to six in 10 between 2001 and 2012. All these factors strongly suggest that indigenous women in the region are entering a fertility transition. We predict that as indigenous peoples increasingly interact with a nonindigenous culture in which family sizes are typically smaller and family planning knowledge and technology are more prevalent, their TFR—which was 7.0 for our sample in 2012—will fall substantially.

Given the remoteness of the study's indigenous populations, it is not surprising that their fertility remains high; however, the levels of desire to cease childbearing create an interesting quandary. During the 11-year study period, the proportion of indigenous women reporting no desire for further childbearing rose by eight points to 60% overall, and modern contraceptive use rose substantially, from 2% to 19%; however, unmet need to limit childbearing declined only slightly, from 50% to 47%. In comparison, for Latin America as a whole, the proportion of women wanting no more children was greater than 60% in the 1980s, and two-thirds were using modern contraceptives at that time.<sup>33</sup> Furthermore, the only other examples of such high rates of unmet need for modern contraception (albeit for both spacing and limiting) occur in subnational groups of very poor countries, principally among women with very little or no education and in the lowest economic quintiles:<sup>34</sup> noneducated women in Lesotho (50%, 2004–2005); primary school-educated women in Bolivia (51%, 2003); and women in the bottom fifth of the economies of Armenia (58%, 2000), Bolivia (57%, 2003), Comoros (54%, 1996) and Togo (52%, 1998).

Women may express their desire to cease childbearing, but their ability to act on that desire may be limited. This disconnect between wanting to control reproductive decisions and actually doing so may be partly due to lack of access—either to credible information about the safety and efficacy of modern contraceptives, or to effective contraceptive methods themselves. Although the latter—physical barriers to contraceptives—might seem to be the more likely explanation, our results do not bear this out.

We found no correlations between travel time to family planning centers and contraceptive use. This leads one to wonder if the key could be lack of family planning information, or perhaps family planning misinformation. In fact, community health workers could be a source of such misinformation, given that we found a negative association between them and modern contraceptive use. A qualitative study of indigenous communities in Guatemala's Western Highlands reports a similar dynamic.<sup>35</sup> The *promotoras* in Guatemala are similar to those of rural Ecuador in that they are trained to inform community members about women's health issues, including contraception; however, promoting modern contraceptives is not a primary charge in either context.<sup>27</sup> Furthermore, they are selected on the basis of their status as older, respected members of their communities. Their ability to disseminate accurate information on modern family planning technologies is often limited by low education, traditional values supporting large family size and the fact that they may have completed their reproductive lives prior to the introduction of modern contraceptives to their community.<sup>27,35</sup> In the case of Ecuador, roughly half of community health workers in Amazonian indigenous communities are men.<sup>36</sup> Thus, in their role as information distributors and facilitators of family planning use, male and older women community health workers are likely to have less knowledge than others of modern contraceptives—their use, effectiveness and potential side effects—and are not likely to be strong advocates for smaller families.

Of the five ethnic groups included in this study, the Waorani stand out in terms of fertility dynamics. The Waorani—who are the most isolated of these groups and have interacted with nonindigenous cultures for less than 60 years<sup>17</sup>—had a low level of modern contraceptive use, which suggests a lack of acculturation into the modern world. Although Waorani women were more likely than women from the other four ethnic groups to want more children, their mean parity was toward the low end of the range. This is not surprising, given the higher spousal separation and potential nutritional deficits (from high energy expenditure and low food security) associated with the Waorani's traditional hunter-gatherer lifestyle.<sup>37</sup> As the Waorani become more accustomed to sedentary lifestyles, one might expect that their relatively high desire for children would translate into a short-term increase in parity; however, the classic demographic transition may not occur among them should modern notions of smaller family size and opportunities to act on desires to limit childbearing spread through their communities before transitory habits are abandoned.

## Limitations

All field surveys have limitations, and ours is no exception. Our calculations of unmet need to limit childbearing were likely slightly inflated because we did not have data on current pregnancies, sexual activity or women starting menopause. Comparisons between the 2001 and 2012 cross-sectional data on women's desire for more children

might have been biased by the fact that the 2012 sample of women included all women of reproductive age living in the household, whereas the 2001 sample included only married women of reproductive age who were household heads or married to the male household head. Last, the longitudinal sample used in the statistical analysis was truncated to include only married women of reproductive age in both survey years (15–38 in 2001 and 26–49 in 2012); as a consequence, the longitudinal models were hampered by small sample sizes.

## CONCLUSIONS AND POLICY IMPLICATIONS

Studying indigenous fertility dynamics in environments rich in natural resources creates ethical challenges. What types of family planning policy improvements are appropriate under these circumstances? Given that some of the indigenous populations studied have very small populations (e.g., the Cofán and Secoya have 500 and 700, respectively<sup>11</sup>), is it ethical to provide family planning recommendations that could limit their ability to reach a more sustainable size? In contrast, what about women's autonomy and their right to act to achieve their desired family size?

The dissemination of family planning information and recommendations, in and of itself, is not population planning, nor a covert means of population control. At the individual level, birth spacing through contraception allows sufficient time for a woman's body to recover from pregnancy and birth; as a result, she may be able to have more and healthier children over her lifetime. According to studies in rural western Africa, where couples often seek to maximize family size, it is not uncommon for women to use contraceptives to allow for reproductive recuperation after a miscarriage or a particularly taxing birth and to improve the prospects of a subsequent birth.<sup>38</sup> Given the high fertility and desire to limit childbearing among the indigenous women studied here, expanded family planning information and access is needed in the Northern Ecuadorian Amazon. We, therefore, offer some recommendations to lessen the high levels of unmet need.

Female sterilization is the most commonly used contraceptive method in Ecuador: In 2004, one in three married women of reproductive age practicing contraception relied on the method.<sup>8</sup> Given the proportion of indigenous women who desire to cease childbearing and the logistic barriers in the region to regular access to supplies of short-acting contraceptives (the pill and the injectable, the two methods most used by contraceptive users in this study), female sterilization—which requires only a one-time procedure—would seem the most promising and cost-effective method to meet a majority of women's reproductive needs. Promotion of the method, however, is problematic because indigenous groups—some with small populations—have suffered from a long history of repression and continued discrimination. It is further complicated by continuing conflicts between petroleum interests and indigenous rights in historic indigenous areas; promotion of sterilization by the government may be seen as a way to reduce in-

igenous populations to make it easier to appropriate land for mineral extraction. Thus, strongly advocating for the use of this family planning method would likely meet with strong resistance, and might do more harm than good to women's reproductive rights.

Also germane is Bongaarts' recommendation to provide a selection of modern contraceptive methods.<sup>39</sup> Diversity and improved availability of contraceptives allows women with differing reproductive desires to better meet their needs. The mix should include long-acting methods, such as the IUD and the three-year implant. Such methods diminish women's need to travel long distances for repeat injections or contraceptive supplies. They also obviate problems with user compliance, such as remembering to take the pill each day. Although long-acting methods have greater upfront costs, they are more cost-effective for women in remote, developing world settings who wish to control their fertility.<sup>40,41</sup> The IUD has the dual benefits of preventing pregnancy for long periods (12 years for Copper T IUDs<sup>42</sup>), but can be removed earlier should the woman choose, thus providing a safe and effective alternative to sterilization. Furthermore, a selection of short-acting methods should be available for women who desire to space births.

The community health worker model can be a powerful mechanism for disseminating health information and even some methods within indigenous communities;<sup>43,44</sup> however, it seems to fail when applied to family planning promotion in Ecuadorian indigenous communities. Thus, further research is called for to examine, for example, if all *promotoras* are adequately trained about family planning. Furthermore, a review of the methodologies for selecting community health workers—particularly those that favor older women or men who have limited direct knowledge of family planning technologies—should be made. Results from such a review may allow policymakers to rethink how *promotoras* are selected, thus ensuring that all aspects of women's health, including family planning, are properly advocated by these first-line women's health advisers.

The community health worker model holds great promise for improving women's health in rural settings. As respected members of the community, *promotoras* should be effective in presenting local women with information about available family planning methods and where they can be obtained. In addition, *promotoras* could improve contraceptive access if, for example, they were empowered not only to provide family planning information, but also to administer modern contraceptives such as injections. Determining how the model can be improved in Ecuador would go a long way toward reducing the high levels of unmet need that exist in indigenous communities and promote the transition to lower fertility that indigenous women clearly desire.

## REFERENCES

1. Kohler HP, Billari FC and Ortega JA, The emergence of lowest-low fertility in Europe during the 1990s, *Population and Development Review*, 2002, 28(4):641–680.

2. Morgan SP, Is low fertility a twenty-first-century demographic crisis? *Demography*, 2003, 40(4):589–603.
3. Morgan SP and Taylor MG, Low fertility at the turn of the twenty-first century, *Annual Review of Sociology*, 2006, 32(1):375–399.
4. Livi Bacci M, Low fertility in historical perspective, *Population and Development Review*, 2013, 38(Suppl. 1):72–82.
5. Lutz W, O'Neill BC and Scherbov S, Demographics. Europe's population at a turning point, *Science*, 2003, 299(5615):1991–1992.
6. Lutz W and Skirbekk V, Policies addressing the tempo effect in low-fertility countries, *Population and Development Review*, 2005, 31(4):699–720.
7. Arriaga EE, *New Life Tables for Latin American Populations in the Nineteenth and Twentieth Centuries*, Westport, CT, USA: Greenwood Press, 1976.
8. Ishida K, Stupp P and Sotomayor JO, Stalled decline in fertility in Ecuador, *International Perspectives on Sexual and Reproductive Health*, 2009, 35(4):203–206.
9. Bilsborrow RE, Barbieri AF and Pan W, Changes in population and land use over time in the Ecuadorian Amazon, *Acta Amazonica*, 2004, 34(4):635–647.
10. McSweeney K and Arps S, A “demographic turnaround”: the rapid growth of the indigenous populations in Lowland Latin America, *Latin American Research Review*, 2005, 40(1):3–29.
11. Bremner J et al., Fertility beyond the frontier: indigenous women, fertility, and reproductive practices in the Ecuadorian Amazon, *Population and Environment*, 2009, 30(3):93–113.
12. Bilsborrow RE et al., *El Comportamiento Reproductivo de las Poblaciones Indígenas: Un Estudio a La Amazonia Ecuatoriana*, Quito, Ecuador: Center for Studies of Population and Social Development (CEPAR) and United Nations Population Fund (UNFPA), 2007.
13. McAllister L et al., Why do women have more children than they want? Understanding differences in women's ideal and actual family size in a natural fertility population, *American Journal of Human Biology*, 2012, 24(6):786–799.
14. Lu FE, Bilsborrow RE and Oña AI, *Modos de Vivir y Sobrevivir: Un Estudio Transcultural de Cinco Etnias en la Amazonia Ecuatoriana*, Quito, Ecuador: Abya Yala/Universidad Politécnica Salesiana, 2012.
15. Lu FE, The common property regime of the Huaorani Indians of Ecuador: implications and challenges to conservation, *Human Ecology*, 2001, 29(4):425–447.
16. Gray CL et al., Indigenous land use in the Ecuadorian Amazon: a cross-cultural and multilevel analysis, *Human Ecology*, 2008, 36(1):97–109.
17. Lu F and Bilsborrow RE, A cross-cultural analysis of human impacts on the rainforest environment in Ecuador, in: Cincotta RP and Gorenflo LJ, eds., *Human Population, Its Influences on Biological Diversity*, Heidelberg, Germany: Springer-Verlag, 2011.
18. Fugler CM and Swanson WL, Biological and ethnoecological observations of the Cofan, Secoya, and Awishiri Indians of eastern tropical Ecuador, *Proceedings of the Oklahoma Academy of Sciences*, 1971, 51(1):106–119.
19. Pillsworth EG, Mate preferences among the Shuar of Ecuador: trait rankings and peer evaluations, *Evolution and Human Behavior*, 2008, 29(4):256–267.
20. Holt FL, Bilsborrow RE and Oña AI, Demography, household economics, and land and resource use of five indigenous populations in the Northern Ecuadorian Amazon: a summary of ethnographic research, *Occasional Paper*, Chapel Hill, NC, USA: University of North Carolina, 2004.
21. Gray C, Bozigar M and Bilsborrow R, Declining use of wild resources by indigenous peoples of the Ecuadorian Amazon, paper presented at the annual meeting of the Population Association of America, Boston, MA, USA, May 1–3, 2014.
22. Lu F, Integration into the market among indigenous peoples: a cross-cultural perspective from the Ecuadorian Amazon, *Current Anthropology*, 2007, 48(4):593–602.
23. Suárez E et al., Oil industry, wild meat trade and roads: indirect effects of oil extraction activities in a protected area in northeastern Ecuador, *Animal Conservation*, 2009, 12(4):364–373.
24. Rival L, *Trekking Through History: The Huaorani of the Amazonian Ecuador*, New York: Columbia University Press, 2002.
25. Bremner J and Lu F, Common property among indigenous peoples of the Ecuadorian Amazon, *Conservation & Society*, 2006, 4(4):499–521.
26. DeRoeck D et al., *Rural Health Services at Seguridad Social Compesino Facilities: Analysis of Facility and Household Surveys*, Washington, DC: USAID, 1996, <[http://pdf.usaid.gov/pdf\\_docs/Pnabw876.pdf](http://pdf.usaid.gov/pdf_docs/Pnabw876.pdf)>, accessed Dec. 28, 2014.
27. Mangelsdorf KR, The selection and training of primary health care workers in Ecuador: issues and alternatives for public policy, *International Journal of Health Services*, 1988, 18(3):471–493.
28. Bremner J et al., Fertility beyond the frontier: indigenous women, fertility, and reproductive practices in the Ecuadorian Amazon, *Population and Environment*, 2009, 30(3):93–113.
29. Filmer D and Scott K, Assessing asset indices, *Demography*, 2012, 49(1):359–392.
30. Kolenikov S and Angeles G, Socioeconomic status measurement with discrete proxy variables: is principal component analysis a reliable answer? *Review of Income and Wealth*, 2009, 55(1):128–165.
31. Chen X et al., *Regression with STATA*, Los Angeles: Institute for Digital Research and Education, University of California Los Angeles, <<http://www.ats.ucla.edu/Stat/stata/webbooks/reg/default.htm>>, accessed Mar. 20, 2008.
32. Rabe-Hesketh S and Skrondal A, *Multilevel and Longitudinal Modeling Using Stata*, College Station, TX, USA: STATA Press, 2008.
33. Bongaarts J, The KAP-gap and the unmet need for contraception, *Population and Development Review*, 1991, 17(2):293–313.
34. Westoff CF, New estimates of unmet need and the demand for family planning, *DHS Comparative Reports*, Calverton, MD, USA: Macro International, 2006, No. 14.
35. Davis J and Lopez-Carr D, The effects of migrant remittances on population-environment dynamics in migrant origin areas: international migration, fertility, and consumption in highland Guatemala, *Population and Environment*, 2010, 32(2–3):216–237.
36. Gray CL and Bilsborrow R, Carolina Population Center, University of North Carolina, Chapel Hill, NC, USA, unpublished data, 2012.
37. Bentley GR, Hunter-gatherer energetic and fertility: a reassessment of the! Kung San, *Human Ecology*, 1985, 13(1):79–109.
38. Bledsoe C, Banja F and Hill AG, Reproductive mishaps and Western contraception: an African challenge to fertility theory, *Population and Development Review*, 1998, 24(1):15–57.
39. Bongaarts J, Trends in unwanted childbearing in the developing world, *Studies in Family Planning*, 1997, 28(4):267–277.
40. Neukom J et al., Dedicated providers of long-acting reversible contraception: new approach in Zambia, *Contraception*, 2011, 83(5):447–452.
41. Hubacher D et al., Contraceptive implants in Kenya: current status and future prospects, *Contraception*, 2007, 75(6):468–473.
42. Grimes DA, Intrauterine devices (IUDs), in: Hatcher RA et al., eds., *Contraceptive Technology*, 19th ed., New York: Ardent Media, 2007.
43. Brown A et al., On the front line of primary health care: the profile of community health workers in rural Quechua communities in Peru, *Human Resources for Health*, 2006, 4(11):1–6.
44. Lewin S et al., Lay health workers in primary and community health care, *Cochrane Database of Systematic Reviews*, 2005, Issue 1, Art. No. CD004015.



**APPENDIX TABLE 1: Independent variables of indigenous women aged 15–49, Northern Ecuadorian Amazon**

Variable	Mean	Definition
Desire another birth, 2012	0.36	Respondent wants another child
No. of children born, 2001	4.2	Children born by 2001
No. of children born–squared, 2001	30.1	Children born by 2001 squared
No. of children born, 2012	3.4	Children born by 2012
No. of children born–squared, 2012	22.3	Children born by 2012 squared
Had a child die, 2001	0.37	Respondent has had at least one child die by 2001
Had a child die, 2012	0.21	Respondent has had at least one child die by 2012
Age, 2001	29.9	Respondent's age in years 2001
Age–squared, 2001	986.7	Respondent's age in years 2001 squared
Age, 2012	29.1	Respondent's age in years in 2012
Age–squared, 2012	933.5	Respondent's age in years in 2012 squared
Secondary education, 2001	0.03	Respondent completed secondary education in 2001
Secondary education, 2012	0.10	Respondent completed secondary education in 2012
Husband's secondary education, 2001	0.06	Husband completed secondary education in 2001
Husband's secondary education, 2012	0.21	Husband completed secondary education in 2012
Ethnicity	2.88	Kichwa, Shuar, Cofán, Secoya, Waorani
Asset index, 2001	2.90	See Methods section
Asset index, 2012	4.81	See Methods section
Change in wealth 2001–2012	1.91	Difference between 2012 and 2001 relative wealth indices
Travel time to urban area, 2001	202.1	Number of minutes to nearest town in 2001
Travel time to urban area, 2012	166.5	Number of minutes to nearest town in 2012
Travel time to family planning, 2012	112.9	Number of minutes to nearest source of family planning in 2012
Last birth in hospital, 2012	0.20	Last child was born in a hospital
Presence of health promoter 2012	0.79	Promotor(a) works in the community
Oil industry presence, 2012	0.44	Oil company employment available in community in 2012
Oil industry presence, 2001 or 2012	0.66	Oil company employment available in either 2001 or 2012

Notes: In 2001, N=590; in 2012, N=711. All dichotomous variables were coded no=0 and yes=1. Coding for ethnicity was Kichwa=0, Shuar=1, Cofán=2, Secoya=3 and Waorani=4.

## RESUMEN

**Contexto:** Las comunidades indígenas de la Amazonia son unas de las pocas comunidades en el mundo que todavía practican casi en su totalidad la fecundidad natural, sin el uso de anticonceptivos modernos. Dada la gran proporción de mujeres que no desean más embarazos, sería útil contar con la información sobre los retos que las mujeres enfrentan en esa región para limitar su fecundidad.

**Métodos:** En los años 2001 y 2012, se encuestaron muestras de mujeres en edad reproductiva de cinco grupos étnicos indígenas en el norte de la Amazonia ecuatoriana. Por medio de análisis transversales y longitudinales se examinó el deseo de las mujeres casadas de tener otro hijo en ambos años y el uso de anticonceptivos modernos en 2012, así como los determinantes del cambio en el deseo de las mujeres de tener más hijos y el número de hijos nacidos durante el período de estudio.

**Resultados:** En 2001, el 48% de las mujeres casadas deseaba tener otro hijo, el 2% usaba un anticonceptivo moderno y el 50% tenía una necesidad insatisfecha de anticoncepción para limitar sus embarazos; en 2012, las proporciones fueron 40%, 19% y 47%, respectivamente. La tasa global de fecundidad fue de 7.9 en 2001 y de 7.0 en 2012. Las características asociadas con el hecho de desear otro hijo en 2001 y 2012 incluyeron la paridad (razón de probabilidades, 0.6 y 0.4, respectivamente) y la experiencia de la muerte de un hijo (2.0 cada una); las características asociadas con el uso de anticonceptivos en 2012 incluyeron el deseo de tener otro hijo, la experiencia de la muerte de un hijo y la presencia de un trabajador sanitario de la comunidad (0.3–0.5). El número de hijos nacidos se asoció positivamente y el cuadrado del período se asoció negativamente con el hecho de ya no desear más hijos en 2012 entre las mujeres que deseaban más hijos en 2001 (razón de

probabilidades, 2.1 y 0.9, respectivamente).

**Conclusiones:** Las mujeres indígenas en el norte de la Amazonia ecuatoriana parecen estar experimentando una transición hacia una fecundidad más baja. Sin embargo, el acceso insuficiente a información creíble acerca de la seguridad y la eficacia de los anticonceptivos modernos puede hacer más lenta la transición.

## RÉSUMÉ

**Contexte:** Les communautés autochtones d'Amazonie sont parmi les rares populations restantes au monde qui observent toujours une fécondité quasi-naturelle, sans recours à la contraception moderne. Étant donné la vaste proportion de femmes désireuses de ne plus avoir d'enfants, il serait utile de documenter les difficultés auxquelles celles de ces communautés se trouvent confrontées à cet égard.

**Méthodes:** Des échantillons de femmes en âge de procréer issues de cinq groupes ethniques autochtones du nord de l'Amazonie équatorienne ont fait l'objet d'enquêtes en 2001 et en 2012. Le désir des femmes mariées d'avoir encore un enfant au moment des deux enquêtes et la pratique contraceptive moderne en 2012 ont été examinés par analyses transversales et longitudinales, ainsi que les déterminants du changement du désir des femmes d'avoir encore des enfants et du nombre d'enfants nés pendant la période de l'étude.

**Résultats:** En 2001, 48% des femmes mariées désiraient avoir encore un enfant, 2% pratiquaient une méthode contraceptive moderne et 50% présentaient un besoin de limitation non satisfait. En 2012, ces proportions étaient, respectivement, de 40%, 19% et 47%. L'indice synthétique de fécondité était de 7,9 en 2001 et de 7,0 en 2012. Les caractéristiques associées au désir d'avoir encore un enfant en 2001 et 2012 sont la parité

(rapports de probabilité de 0,6 et 0,4, respectivement) et l'expérience du décès d'un enfant (2,0 chacun); celles associées à la pratique contraceptive en 2012 sont le désir d'avoir encore un enfant, l'expérience du décès d'un enfant et la présence d'un agent de santé communautaire (0,3–0,5). Le nombre d'enfants nés est associé positivement, et le carré du terme l'est négativement, au fait de ne plus désirer avoir d'enfants en 2012 parmi les femmes qui en désiraient encore en 2001 (2,1 et 0,9, respectivement).

**Conclusions:** Les femmes autochtones du nord de l'Amazonie équatorienne semblent être en transition vers une moindre fécondité. L'accès insuffisant à une information fiable sur l'innocuité et l'efficacité de la contraception moderne ralentit cependant peut-être la transition.

#### **Acknowledgments**

The authors thank Jessica Morse for her invaluable comments regarding family planning recommendations in developing world settings. The authors also thank their Ecuadorian partners, CEPAR (Centro de Estudios de Población y Desarrollo Social), Victoria Salinas and the field staff for survey coordination and data collection. This research was supported by grants R01 HD3877701 and R00 HD061752 from the National Institutes of Health. Jason Davis's work was supported by Population Research Training grant T32 HD007168 and Population Research Infrastructure Program grant R24 HD050924, awarded to the Carolina Population Center by the Eunice Kennedy Shriver National Institute of Child Health and Human Development. Richard Bilborrow's work was supported by a project to UNC-Universidad San Francisco de Quito funded by USAID via Higher Education for Development. This research is part of the family of Ecuador Projects at the Carolina Population Center <<http://www.cpc.unc.edu/projects/ecuador>>.

**Author contact:** [jdavis36@live.unc.edu](mailto:jdavis36@live.unc.edu)