September 20, 2013

Exceeding Ideal Family Size and Child Growth Outcomes in the Tsimane Amerindians of Bolivia

[RESEARCH IN PROGRESS, DO NOT CITE]

Abstract

This paper assesses the causes and consequences of exceeding maternal and paternal ideal family size (IFS) in a high fertility population, the Tsimane of lowland Bolivia. Analyzing IFS in this population offers an opportunity to better understand the transition of a high fertility population in real time. Relationships between sociobiological factors and IFS are estimated using linear regression; probabilities of exceeding IFS by these factors are estimated using logistic regression. Effects of sociobiological factors and exceeding IFS on child growth outcomes are estimated. The preliminary results indicate little effect of literacy, Spanish proficiency, and proximity to town on IFS or exceeding IFS. Exceeding IFS does not affect child growth outcomes as strongly as biological effects such as maternal BMI. These results imply that child growth outcomes are not sensitive to exceeding either parents' IFS, promoting the discussion of what "ideal family size" means in high fertility settings.

Keywords: Tsimane, ideal family size, child growth, HAZ, BMIZ, high fertility, transition

Acknowledgements: I am grateful for insightful discussions with Michael Gurven, Benjamin Trumble, and Lisa McAllister.

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Introduction

The fertility transition from high to replacement fertility is complete in many high-income settings and well underway in most remaining countries (Hirschman 1994). Few populations exist where initial stages of the fertility transition can be observed. Studying the Tsimane of the Bolivian lowlands presents an opportunity to analyze the transition of a high fertility population in real time with modern data collection tools. Because the Tsimane face environmental stressors including high parasite and pathogen burdens that are similar to those faced throughout human evolution, working with the Tsimane to assess fertility preference allows an understanding of demographic transition processes in a manner not possible with historical or archaeological data. Survey research with extant transitioning populations like the Tsimane help expand our understanding of individual-level interests at play including ideal family size during the demographic transition.

This paper examines the determinants of ideal family size (IFS) and consequences of exceeding IFS for the Tsimane, a high fertility population of forager-horticulturalists in the early stages of demographic transition using data from the Tsimane Health and Life History Project. First, the determinants of ideal family size for parents of children under five years of age are examined in relation to a previous analysis predicting ideal family size and probability of birth in the three years following measurement of IFS (Mcallister, Gurven et al. 2012). Ideal family size in this stage of transition may be affected by many factors; parents living in more remote areas may have higher ideals related to the increased utility and relatively low cost of each additional child (Mace 2008). Alternately, parents living in less remote locations may opt for different investment strategies, motivating a quality/quantity tradeoff due to increased accessibility to schools and perceived future access to markets (Montgomery and Casterline 1996). Further, parents residing in less remote locations will have increased access to markets and town centers. Is exposure to Bolivian nationals, including their language, culture, and markets, associated with lower ideals as diffusion theories of fertility transition might predict? In the

early stages of fertility transition, which parental characteristics distinguish higher or lower ideal family size?

Second, factors associated with the odds of exceeding ideal family size are examined using logistic regression. Diffusion theories of fertility decline suggest social learning and social influence affect the amount and type of information an individual has to make decisions and can render some decisions too costly to make (Montgomery and Casterline 1996). Do individuals who speak both Spanish and Tsimane exceed their ideals less often because of increased access to information on limiting and spacing births? Or do individuals who live in locations closer to town centers face fewer social constraints on limiting births than their remote counterparts? These motivating questions are used to address potential effects of Spanish literacy and fluency and proximity to town on exceeding ideal family size.

Third, the effect of exceeding IFS on the growth of children using height-for-age and BMI-for-age z-scores is estimated controlling for socio-economic status, maternal condition, and partner IFS using multivariate regression. Understanding whether children in resource-sparse, early-transition settings pay a growth penalty for being in excess of parental ideals help us to understand the strength of preferences in this setting. In a case where ideals are consistently exceeded, do families adapt as the number of children increases? Or does being unwanted imply unequal distribution of resources among wanted and unwanted children, thus strengthening arguments for increased accessibility to family planning programs?

Study Population: The Tsimane

The Tsimane Health and Life History Project is a joint effort between the University of California, Santa Barbara and the University of New Mexico to collect health and anthropology data continuously from 2001 to present in a population of Bolivian Amerindians called the Tsimane (Beheim 2011). Broad aims of this project include improving the understanding of the impact of environment and evolution on

the life course, focusing on health, aging, economics, and biodemography in forager-horticulturalists practicing a traditional lifestyle thought to approximate the conditions faced throughout most of human evolution. The Tsimane are a population approximately 12,000 in size spread among 88 small villages and the larger town of San Borja (n ≈ 24,000, mostly non-Tsimane). Villages consist of extended family groups ranging from 50-150 people with varying access to the Maniqui River, seasonal logging roads, and market goods. No villages currently have running water or electricity, however, approximately 30 villages contain schools teaching both Tsimane and Spanish, though staffing is sporadic (Beheim 2011). Households consist of one to four nuclear families and serve as the unit of resource distribution. Approximately 2/3 of foodstuffs consist of horticultural goods from small-scale cultivation, including corn, plantains, manioc, and rice, which are supplemented by fishing and hunting (Mcallister, Gurven et al. 2012). The nuclear family forms the household unit, where grandparents, parents, aunts, uncles, and children typically live in the same household or village. Market integration is limited; cash crops, sporadic wage labor, and trade with merchants comprise the primary market activities, though low-income wage labor is available primarily to men, and only in communities near the market town of San Borja (Mcallister, Gurven et al. 2012).

Marriage is not a formal process; a couple is married when they live under the same roof for longer than a brief period of time. Mean mage at marriage is 21 years old for men and 16.5 years old for women (Winking 2005). These unions are fairly stable, with fewer than 20% of unions ending in dissolution within the first years of marriage; after the birth of a couple's second child, union dissolution is negligible (Winking 2005). Polygyny is rare, with approximately 6% of the male population engaging in polygyny, most of which involve two sisters married to the same man (Winking 2005). Parental time spent childrearing is disproportionally female; women contribute on average 39.4% of their time to parental care compared to 8.6% of time spent by men, whose contributions to direct childcare are mostly in the form of play (Winking, Gurven et al. 2009).

In addition to a mostly traditional lifestyle, fertility and mortality rates resemble those observed in pre-transition societies. Fertility and infant mortality are high, with a total fertility rate (TFR) of 9.1 and infant mortality rate of 13%, though this varies with proximity to San Borja (Gurven, Kaplan et al. 2007). Women living furthest from San Borja experience slightly lower fertility rates (TFR= 8.0) and higher infant mortality (IMR≈25%) (Mcallister, Gurven et al. 2012). Closer to San Borja, fertility is higher (TFR=9.5) and infant mortality is lower (IMR≈10%) (Mcallister, Gurven et al. 2012). Natural fertility is often defined as fertility without parity-specific control, however, variation between populations is introduced through non-specific parity controls such as duration and intensity of breastfeeding, post-partum abstinence, and social taboos regarding oldest acceptable age to give birth (Henry 1961). Mean number of children per completed family of women married at age 20 as calculated by Henry 1961 ranged from 6.2 in women living in Guinea in the 1950s to 10.9 in Hutterite women married from 1921-1930 (Henry 1961). The observed TFR in Tsimane women in communities both remote and proximate to San Borja fit well within this range. Little evidence of modern contraception is found in this population, though coverage of traditional and modern contraceptive use has been added as a measurement objective in the most recent waves of household surveys.

Ideal Family Size

Fertility intentions and ideals have long been measured in both high and low-income settings. While there is generally a strong relationship between ideals and actual fertility, discord between intentions, ideals, and realized fertility is common in many populations (Hin, Gauthier et al. 2011). In controlled fertility settings, intentions and ideals are one of many determinants of reproduction (Blake 1966). However, the association between ideal family size (IFS) and fertility behaviors in uncontrolled fertility settings is less clear. For example, in Nepal, stated ideals are thought to mask son preference and tend to vary with regard to number of sons already born (Stash 1996). In Demographic and Health Surveys from Ghana and Nigeria, non-numeric responses to IFS questions further complicate

associations between IFS and fertility behavior, with responses such as “up to God” associated with higher family sizes and disapproval of family planning (Olaleye 1993). In high-income, high fertility control settings such as the United States and much of Western Europe, ideals tend to exceed realized period fertility in part due to competing interests (Hagewen and Morgan 2005). The amendment of ideals over time will affect whether disparities between observed period fertility and ideals may be classified as unmet demand for children (high-control settings) or unmet need for contraceptives (low-control settings) (Hin, Gauthier et al. 2011). Thus understanding the predictors and consequences of exceeding IFS in high fertility populations is essential to understand the relationship between ideals, child outcomes, and fertility.

Ideal or desired family size is denoted as fundamentally different from intentions in the fertility literature; ideals are unconstrained, a number provided by an individual which is not necessarily tied to resource limitations. Intentions, however, are thought to include realistic parameters such as socio-economic considerations and partner’s intentions (Iacovou and Tavares 2011). Survey questions measuring intentions ask specifically about the next birth, and are thought to predict fertility behavior when factors predicting behavior and intentions are the same (Schoen, Astone et al. 1999). Survey questions focusing on ideals ask more abstract questions about an ideal number of children for any given individual to have, or for the number of children the respondent would prefer if they were to begin their reproductive career anew. Though ideals may shift over the life course, they are informative in the long-term when considering directionality of trends in ideals and actual family size.

Ideal Family Size in the Tsimane

A previous study examining the determinants of Tsimane ideal family size undertaken by McAllister and colleagues sought to better understand why Tsimane women consistently over-achieve their ideal family sizes. Potential mechanisms responsible for excess family size include limited reproductive autonomy, improved maternal condition, and low return on embodied capital, or that

women prefer somatic expressions of wealth (larger family sizes) rather than material expressions of wealth (Mcallister, Gurven et al. 2012).

When looking at births in the three years following measurement of ideals, there was no evidence suggesting a lack of reproductive autonomy; indeed, when husbands desired more children but wives did not, no fertility difference was observed compared to couples in which both parents did not want the next child. The authors also propose that women in better maternal condition as measured by body mass index (BMI) and percentage body fat are better able to support a larger family size and will thus list higher ideals. Though women in better condition had higher parity and were more likely to have a birth in the three years following interview, they tended to state smaller IFS.

The authors' hypothesis that larger family sizes are favored over smaller ones as an expression of wealth status was supported. When women were asked which women were most "influential" or a "model" in their village, respondents chose women with larger families, and when asked why, 81% listed traditional attributes such as being a good mother, good at gathering food, and having many children (Mcallister, Gurven et al. 2012). In the context of the local economy, this quality-quantity tradeoff makes economic sense; a study of 257 households in 13 villages found that Spanish speaking ability was not associated with wages and that there is a strong perceived lack of economic advantages of sending children to school (Godoy, Reyes-García et al. 2007). When traditional skills are ranked more highly than mainstream skills that would allow an individual to engage in the greater Bolivian market economy, and when children can contribute to the household (or gain traditional skills which will allow them to do so at a later date) the incentive to have more children is apparent. Indeed, it has been noted that "if somatic wealth remains the most important component of status, the motivation to deliberately control fertility will be low and fertility will remain high," (Mcallister, Gurven et al. 2012). Though ideal family sizes are declining by birth cohort in this population, the economy and low level of market integration encourage high ideals.

McAllister *et al* introduce several frameworks for considering factors associated with ideal family size and exceeding ideal family size for women in this population. However, the sample is limited to women who give birth in the three years following demographic interview. In a population in which the mean inter-birth interval is 2.55 ±.88 years, this choice of cutoff may not be optimal because some of the IFS interviews are excluded. Women with longer than average inter-birth intervals may be systematically different from those with a shorter inter-birth interval. In addition to this cutoff, the analysis by McAllister and colleagues does not apply the same framework for maternal IFS to paternal IFS; paternal IFS is included as a predictor and not considered as a dependent variable. Factors influencing paternal IFS are important if we believe it is associated with maternal IFS. Failing to look at the reverse relationship precludes the possibility that maternal IFS might influence paternal IFS. Most importantly, the analysis undertaken by McAllister and colleagues does not address whether exceeding IFS has a lasting effect on children. Determinants of ideals and probabilities of following births are discussed, but their analysis ends at the birth of the next child. Including child growth in the analysis will yield information on what IFS might mean as a measure in a high fertility population, and whether maternal or paternal ideals are more predictive of child health.

Hypotheses

The analyses undertaken here build on previous work by expanding the unit of analysis to all women who had a child aged 0-5 during the period, including paternal IFS and exceeding paternal IFS as dependent variables, and examining whether exceeding ideal family size negatively affects child health outcomes from birth to age five.

First, the effects of socioeconomic and demographic indicators on ideal family size are examined. It is hypothesized that both the respondent and partners' Spanish proficiency and literacy will have a strong negative association with IFS for both sexes. Partner's IFS and maternal BMI are hypothesized to have strong, positive associations with IFS. This hypothesis stems from previous

assessments of fertility decline; Spanish speaking and literacy in this population may be linked to exchange of ideas with Bolivian nationals, a population with a TFR of 3.3 births per woman in 2010 (UNICEF 2010). If social interaction accelerates ideational change, then opportunities for interaction with other parents with small IFS may increase for parents with Spanish-speaking networks, where ideas about smaller family sizes can be communicated through social contacts or exposure to Bolivian media (Bongaarts and Watkins 1996). If diffusion is operating along these channels, we expect Spanish speaking, literacy, and proximity to town to negatively affect IFS.

Mothers' BMI is expected to be positively associated with IFS; in a setting in which wealth is measured in body fat as opposed to material possessions, it is hypothesized that individuals with more 'wealth' will be able to 'afford' more children than women with a lower BMI and will thus state higher ideals. Controlling for literacy, Spanish proficiency, distance to San Borja, maternal BMI, maternal age, and presence of sons in the household, it is predicted that parity at time of interview will be positively associated with IFS. This stems from post-rationalization, where the more children a woman has the higher IFS she is likely to state.

Partner's ideals are hypothesized to have a strong effect on IFS for several reasons; the first as proposed by McAllister and colleagues concerns a lack of reproductive autonomy. Due to the presence of her husband at the time of interview, a woman may be pressured to list an ideal family size consistent with her partner. Additionally, she may have no control over her own reproduction through gender-unequal dynamics in the household. There was no evidence of a lack of autonomy in previous analyses, but the reproductive autonomy hypothesis is considered again for this expanded sample. Paternal IFS was not previously considered as a dependent variable, and the bidirectional predictive power of partner IFS may reflect a convergence of ideals, indicating either assortative mating or post-socialization. These two phenomena reflect slightly different strategies. Assortative mating indicates partner selection based upon common ideals, while post-socialization involves modification of ideals

following marriage to improve the quality of the match (Oppenheimer 1988). In this case, a positive bidirectional relationship is predicted with the expectation that matches are made among like-minded individuals.

Similar to the fertility declines observed in France prior to widespread availability of modern contraception, it is hypothesized Tsimane who speak Spanish will not only have lower ideal family sizes, but better knowledge of how to avoid births and will thus exceed their ideals less often than those who do not speak Spanish. Though access to modern contraception in villages is negligible and not yet adequately measured in this population, it is proposed that those who speak Spanish, can read, and live closer to San Borja have access to information on how to avoid pregnancy albeit with less effective traditional methods such as prolonged breastfeeding, coitus interruptus, the rhythm method, and abstinence.

Lastly, the hypothesis that exceeding parental IFS is associated with negative child growth outcomes as measured by height-for-age and BMI-for-age z-scores is tested. In a high fertility setting in which children represent wealth, it is hypothesized that exceeding ideals will have no effect on child growth outcomes. In this case, somatic indicators of wealth such as maternal BMI will be more predictive of child growth outcomes than exceeding IFS. According to this hypothesis, shifting ideals still represent changing preferences and perhaps future directions of fertility, but when IFS is routinely exceeded and children comprise an expression of wealth, exceeding IFS will have little effect on the growth of 'excess' children. Alternately, if stated ideals are strongly tied to limited underlying household resources, then children exceeding stated ideals will experience worse growth outcomes.

Data

Three datasets were combined to examine the proposed hypotheses: initial demographic interviews asking each mother and father their ideal family size and reproductive history, a subsequent census file to update family size from the observed size at initial demographic interview, and finally

anthropometry data were added for each child under five and their mother. A GPS dataset was used to add proximity to San Borja (km) at time of initial interview. These datasets are as yet unstandardized and are not yet publicly available. To more completely address the hypotheses listed above, economic data on short- and long- term economic crises should be included in the analysis to test plasticity of ideals relative to economic uncertainty. Additionally, contribution of alloparents should be assessed in relation to both ideals and child outcomes. Prevalence of traditional and modern forms of contraception should also be included to better understand the relationship between use of modern contraception and ideals in this setting. Due to limited access to data and ongoing collection of some of the indicators of interest including contraception and wealth inventories, preliminary analyses will examine the relationship among available variables, including mother and fathers' demographic quantities and socioeconomic status measured by literacy and Spanish proficiency, proximity to San Borja, and child health outcomes.

Demographic interviews with mothers and fathers took place from 2002-2006. In-home interviews were conducted in the presence of partners, gathering demographic information, reproductive histories, and ideal family size at time of interview. A total of 305 partner pairs were asked about ideal family size. The ideal family size question specifically asked "What number of children do you think is the best number of children for you to have so that you can live well? Think about your experience, life, and wishes. There are no correct or incorrect answers to this question" (Mcallister, Gurven et al. 2012). Reproductive histories were collected including all children living and dead, though only living children are used in this analysis.

The 2012 census collected basic demographic information on all individuals in a household, including relationships between household members. These data were used to add children born from the time of initial interview to present so that all children from a parents' initial interview to the 2012 census were included in the dataset. Anthropometric data were collected yearly on all members present

at household at time of survey, resulting in a varying number of measurements per child. The census-updated list of children was used to merge on all anthropometric measures taken from 2002- January 2013 for each child. Child anthropometric data were reshaped so that each observation in the dataset represented a child-measurement under age five. The resultant dataset included all under-five child-measurements from the date of parental interview to January 2013. Parental information, such as maternal and paternal ideals as well as proximity of parental residence to San Borja was attached to each child-observation.

A total of 1,586 child-measurements belonging to 646 children aged 0-5 were linked to 211 parent pairs. Missing information on literacy and Spanish-speaking in parents reduced the final sample size to 206 parents and 635 children, resulting in 1,562 child-measurements (a loss of 1.5% of measurements). Hypotheses predicting IFS and exceeding IFS were tested on a dataset containing 206 parents. Hypotheses predicting height-for-age z-score (HAZ) and body mass index for age z-score (BMIZ) were tested on the child dataset containing 1,562 child measurements.

Methods

Ideal family size was examined for men and women separately using linear regression. Independent variables included BMI of mother, a dummy variable indicating presence of one or more live sons, age at interview, parity at interview, mother and father literacy, mother and father Spanish proficiency, partner's IFS, and distance to San Borja. Mothers' and fathers' literacy and Spanish proficiency are dichotomous variables, and remain separate in this analysis. Odds of exceeding ideal family size were estimated for men and women separately using logistic regression. The same control variables were included in both linear and logistic regressions, though IFS of both partners and exceeding partner IFS were added to the logistic model.

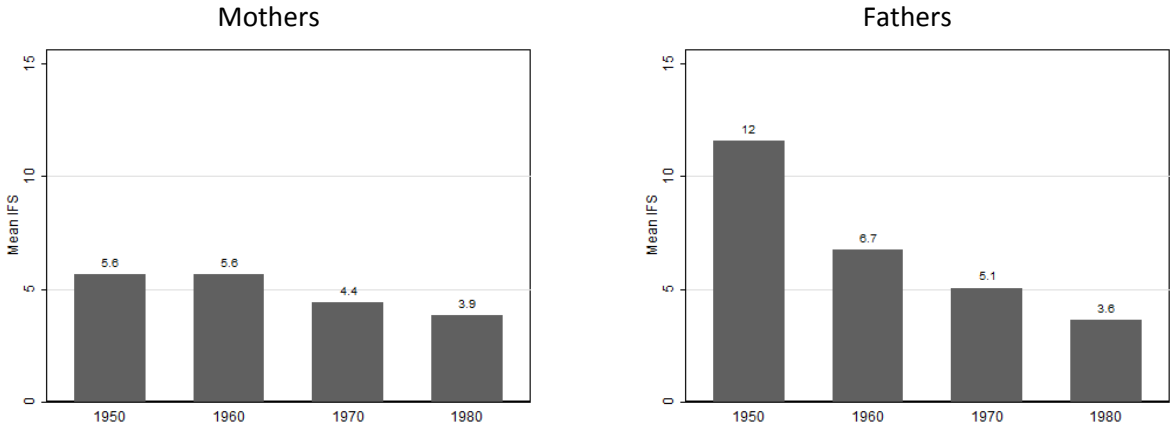
To test the effect of exceeding ideals on WAZ and BMIZ, z-scores were calculated for children aged 0-5 using the z-score STATA module *zscore06*, which calculates anthropometric z-scores using

World Health Organization 2006 growth curves. Using linear regression, the effect of mothers' BMI, having at least one son, maternal age at child's birth, number of surviving children aged 0-5, mother and fathers' IFS, literacy, Spanish speaking, exceeding IFS, and distance to San Borja on child growth outcomes were estimated. To obtain corrected standard errors, child-observations were clustered by child ID. All analyses were performed using STATA 12.1.

Preliminary Results

Of the 211 partner pairs interviewed, 48.8% of mothers and 93.7% of fathers speak at least some Spanish, and 32.9% of mothers and 60.8% of fathers are literate. By the 2012 census, 55.7% of mothers and 45.28% of fathers exceeded their ideal family sizes. Ideal family size declined by decade of birth, with those in the most recent cohort stating lowest IFS. Women born from 1980-1990 had mean IFS of 3.9, whereas men born in the same period had mean IFS of 3.6 (Figure 2).

Figure 2. Mean IFS by birth cohort, mothers and fathers



Factors hypothesized to affect IFS include literacy, Spanish proficiency, maternal BMI, and partner IFS. Holding all other variables in the model constant, maternal literacy was associated with a positive effect on IFS while maternal proficiency in Spanish was associated with a negative effect. However, these results were non-significant at the α-0.05 level. The effects of paternal literacy and Spanish speaking were mixed and non-significant, offering no statistical evidence of a consistent

association between increased Spanish proficiency and reduced IFS for men or women (Table 1). Maternal BMI was not strongly associated with IFS for men or women. Partner IFS was strongly associated with respondent's IFS for both men and women ($p<0.01$). Parity at time of interview and partners' IFS were associated with increased IFS in both men and women though the effect is larger in magnitude for men, while women's Spanish proficiency has a significant negative effect on men's IFS only ($\beta=1.07$, $p=0.04$, Table 1). Controlling for all other variables in the model, men who live farther from San Borja tend to have higher IFS, though the magnitude of the effect is small ($\beta=0.0067$, $p<0.001$).

Table 1. Estimated effect of selected indicators on maternal and paternal IFS

	IFS			
	Maternal		Paternal	
	β	S.E.	β	S.E.
Mother Literate	0.469	0.384	0.61	0.528
Mother Speaks Spanish	-0.086	0.381	-1.079*	0.510
Father Literate	-0.632	0.335	0.247	0.462
Father Speaks Spanish	0.798	0.497	-0.126	0.676
Distance to San Borja at interview	0.007	0.007	0.031***	0.009
Maternal BMI	0.001	0.044	-0.019	0.060
Age at Interview	-0.002	0.033	-0.057	0.034
At least one son	1.362	0.826	0.785	1.121
Parity at Interview	0.195*	0.084	0.557***	0.082
Partner IFS	0.192***	0.045	0.317***	0.093
* p≤0.05, **p≤0.01, ***p≤0.001	Adj R^2=0.25		Adj R^2=0.44	

Odds of exceeding IFS were predicted to decline with parental proficiency in Spanish and literacy. Spanish proficiency and literacy have differential results depending on which parent's IFS is estimated, however, all effects on odds ratios are non-significant (Table 2). Factors associated with exceeding IFS are more difficult to interpret, warranting more detailed analyses; results presented here indicate higher odds of exceeding ideals with each one unit increase in partner IFS for both men and women (Table 2). While increases in respondents' IFS is associated with lower odds of exceeding their own IFS, an increase in partner's IFS is associated with increased odds of exceeding respondents' IFS for both sexes. This result would be consistent with the reproductive autonomy argument if it was

unidirectional, but results presented here suggest the relationship persists for exceeding both maternal and paternal ideal family sizes, indicating that having a partner with higher ideals increases the odds of exceeding ideals for respondents of either sex.

Table 2. Estimated effect of selected indicators on the odds of exceeding IFS

	Exceeding IFS			
	Maternal		Paternal	
	OR	S.E.	OR	S.E.
Mother Literate	2.11	1.362	0.61	0.490
Mother Speaks Spanish	0.71	0.458	1.05	0.797
Father Literate	1.27	0.720	0.98	0.645
Father Speaks Spanish	0.73	0.620	4.55	4.831
Distance to San Borja at interview	1.01	0.011	1.01	0.014
Maternal BMI	1.12	0.084	1.04	0.082
Age at Interview	0.97	0.051	1.07	0.064
At least one son	0.09	0.157	4.78	6.881
Parity at Interview	1.55**	0.239	1.42	0.277
Father IFS	1.37**	0.138	0.13***	0.044
Mother IFS	0.3***	0.068	3.18***	0.747
Exceeded Partner IFS	54.83***	34.198	326.02***	300.991
* p≤0.05, **p≤0.01, ***p≤0.001	Pseudo R^2=0.51		Pseudo R^2=0.68	

The effect of IFS variables were predicted to have little association with child growth outcomes after controlling for socioeconomic and demographic characteristics. Mothers' mean BMI from interview date to 2012 has a strong positive association with child BMI z-score (BMIZ) after controlling for socioeconomic, demographic, and IFS variables (Table 3). Each one-unit increase in maternal BMI is associated with a 0.05 increase in child BMIZ ($p<0.001$, Table 3). Presence of at least one son at time of interview had no statistically significant effect on child BMIZ. Mothers' IFS was positively associated with child BMIZ, however, this relationship does not retain the same sign for height-for-age z-score (HAZ). Maternal Spanish proficiency is associated with a 0.26 increase in BMIZ, controlling for socioeconomic and demographic variables in the model (Table 3). Higher paternal IFS is strongly associated with a decrease in BMIZ, however, the effect is small (β=-0.0083, $p<0.001$).

Results differ slightly between BMIZ and HAZ; maternal BMI has a positive but non-significant effect on child height for age (β=0.014, p=0.408). Parent age at child's birth is strongly associated with an increase in HAZ, however this relationship does not retain the same direction for child BMI (Table 4). The presence of more children living in the household aged 0-5 has a negative effect on both BMI and height z-scores, however, the effect is statistically significant for height only. Father's IFS has an opposite effect on height than BMI; that is, higher father's IFS is associated with an increase in height for age, though the effect is very small (β=0.007, p=0.042).

Table 3. Estimated effect of selected indicators on height-for-age z-score (HAZ) and body mass index for-age z-score (BMIZ)

	BMI Z		HAZ	
	β	Robust S.E.	β	Robust S.E.
Mother Literate	-0.042	0.116	0.111	0.134
Mother Speaks Spanish	0.263*	0.108	-0.024	0.138
Father Literate	-0.142	0.099	-0.196	0.116
Father Speaks Spanish	0.062	0.132	0.32	0.208
Distance to San Borja at interview	-0.003	0.002	0.0003	0.003
Maternal BMI	0.056***	0.014	0.014	0.017
Mother age at birth	-0.005	0.007	0.023*	0.009
At least one son	0.416	0.233	-0.654	0.356
Number of children age 0-5	-0.026	0.025	-0.084*	0.036
Father IFS	-0.008***	0.002	0.007*	0.004
Mother IFS	0.05*	0.023	-0.006	0.033
Exceeded Father IFS	0.024	0.097	0.131	0.112
Exceeded Mother IFS	0.136	0.115	0.019	0.155
* p≤0.05, **p≤0.01, ***p≤0.001		R^2=0.037		R^2=0.029

Discussion and Limitations

The hypotheses that parental Spanish proficiency and literacy are associated with decreased IFS and maternal BMI is associated with increased IFS are not supported. However, there is statistical evidence of both a significant effect of partner IFS and parity at time of interview on IFS for both men and women. This suggests measurement of IFS may be influenced by post-rationalization, where men and women provide higher ideals when they have higher realized fertility. The bi-directional effect of

partner ideals does not support the reproductive autonomy hypothesis, rather, the relationship might suggest assortative mating or post-socialization where individuals with similar ideals and values are partnered.

Hypothesized relationships between parental literacy, Spanish proficiency, and exceeding ideals are not supported. Instead, exceeding partner ideals is strongly associated with exceeding one's own, providing additional support for assortative mating or post-socialization in this population. However, higher partner ideals have a strong positive association with increased odds of exceeding respondents' ideal family size for both men and women. This result is puzzling in light of the result from the first hypothesis that partner IFS has a strong positive correlation with respondent IFS. This particular finding might be influenced by individual economic contributions to the household of partners; if, for example, one partner contributes more than the other, their ideals may win out over the partner who contributes less. More detailed data on specific economic contributions of partners to the household may shed light on ideals and within-household dynamics.

Stated ideals have little effect on child growth outcomes. In this population, factors such as maternal BMI, maternal age at birth, and parity have a stronger effect on child growth z-scores. Though ideals have declined over the last several birth cohorts for both men and women, there is little evidence that period fertility is catching up. Children in excess of parents' ideals do not pay a growth penalty for being undesired. The lag between period fertility and ideals is likely a product of the current structure of household economies. The importance of more immediate factors such as maternal BMI instead of IFS indicates that the cost of raising undesired children has not yet reached a level that causes economic strain in households (Davis and Blake 1956). Further, women's tendency to value traditional skills and hold women with large family sizes in high regard is consistent with previous observations that wealth correlates with family size in small, homogenous populations (Mace 2008, Mcallister, Gurven et al.

2012). Indeed in the Tsimane context where children are an expression of wealth and the cost of raising each additional child is marginal, exceeding ideals of either parent is not detrimental to child health.

The lack of observed negative consequences on child growth does not invalidate IFS as a measure of fertility desires in the Tsimane, rather, it draws attention to the result that even in more resource sparse settings, undesired children do not suffer in terms of growth. Further studies are required to determine whether the lack of observed negative consequences are due to low childrearing costs, low market integration, or large kin networks enabling use of alloparents. Two central factors thought to affect fertility and child growth require further exploration in this population; contraceptive coverage and household economic information. Though these data were not available at the time of analysis, further work will incorporate contraceptive use and wealth indices to clarify our understanding of child growth outcomes in transitioning populations.

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