Original Article

Fertility patterns in the Toba, an Argentine indigenous population in transition

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Introduction

Indigenous populations all over the world are experiencing dramatic lifestyle changes that have serious consequences for their population structure. Evidence is accumulating, particularly in small-scale societies living in tropical regions, that points to synergistic interactions among socio-economic, historical, and cultural agents and their effect on the demographic, nutritional, and epidemiological composition of a group, which in turn feeds back to demographic patterns to portrait a dynamic picture of population change (Benefice et al. 2007; Coimbra and Santos 2004; Lourenco et al. 2008; Malina et al. 2008; Mc Sweeney 2004a; 2004b). Most of these native communities are adopting "western" lifestyles as the inevitable product of the contact with industrialized, market-economy hegemonic cultures (Santos and Coimbra 1998). This process of "Westernization" is characterized by the abandonment of traditional ways of life, including a shift in subsistence practices from hunting and gathering to purchasing goods in local markets, an increase in urbanization and secularization, and an increase in individualism, marked by an increased emphasis on education.

Argentina's indigenous population is not the exception to this worldwide trend. Lowland indigenous groups in Argentina can now be found along an acculturation gradient, ranging from a rural, more traditional lifestyle that is relatively dependent foraging, to an urban, sedentary lifestyle that relies on wage labor and store-bought goods for sustenance (Martinez Sarasola 1992). Virtually no studies have been conducted that focus on the effect that these dramatic changes in their environment (both physical and social) are exerting on the demography of Argentine native populations. The aim of this work is to present an analysis of fertility patterns in a Toba population, one of several indigenous groups currently living in the Gran Chaco region in northern Argentina. We will discuss possible proximate mechanisms underlying the observed patterns and suggest useful approaches for future

research and issues that deserve closer attention.

Methods

The Toba

The Toba are one of several indigenous groups that currently live in the Gran Chaco region in northern Argentina. Traditionally, the Toba were nomadic or semi-nomadic hunter-gatherers with rudimentary agriculture (Arenas 2003; Braunstein and Miller 1999). Although historical documents suggest that the first contact with Spanish colonizers occurred around the 1550's, the Gran Chaco people successfully resisted colonization and "civilization" attempts by the nation-state. It was not actually until the beginning of the 20th century that major changes in their traditional lifestyle began to occur (Martinez Sarasola 1992). The restrictions on access to large tracts of land, their partial integration in the labor market, and the arrival of missionaries from various Christian denominations have been major determinants in the settlement process for these communities (Braunstein and Miller 1999; Gordillo 1995, 2002; Mendoza 2002; Mendoza and Wright 1989). Depending on their location, different communities have been exposed to varying degrees of these forces. As a result, Toba settlements can be found in a variety of social and ecological conditions, ranging from a rural, more traditional lifestyle that is relatively dependent foraging, to an urban, sedentary lifestyle that relies on wage labor and store-bought goods for sustenance.

Study populations

This study was conducted in the Toba communities of Sombrero Negro (SN). The SN communities are found to the west of the province of Formosa, in northern Argentina (61º-62º W and 23º-24º S, Figure 1). The communities own 35,000 hectares of land, which are considered communal property. The approximate 1,600 inhabitants in this area still rely heavily on traditional forms of economic activity including hunting and fishing, rudimentary agriculture, and gathering of seasonal fruits (Arenas 2003; Gordillo 1995; Mendoza 2002; Mendoza and Wright 1989). Their first language is the indigenous one (which belongs to the Guaycuruan family), although most men and some women also speak Spanish. Access to western medical care is limited in these communities and the use of contraceptives is rare.

Research Ethics

The research design and data collection for this study followed the informed consent process. We discussed the research plan with community leaders, and then explained the purpose and the design of the study to everyone during community meetings. As the meetings developed, local health agents translated discussions and agreements to the Toba local languages as necessary. Verbal consent was obtained from all the participants; only two people decline to participate. Reports of study results are being prepared to present at a future

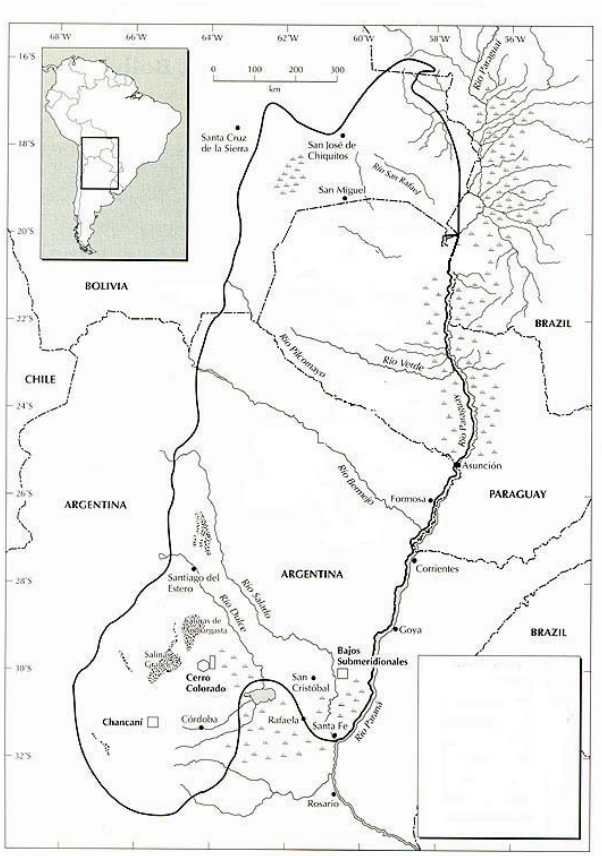

Figure 1. Map of the Gran Chaco region with the approximate location of the study Toba population

community meeting. The research protocol was reviewed and approved by the University of Pennsylvania Institutional Review Board, protocol # 804880.

Sources of demographic data

A pilot study conducted in 2001 collected information about possible sources of demographic data for this population. Several population censuses, conducted by various parties were identified and assessed for their completeness and reliability.

Although there are some demographic data starting around the 1930's, it was not until the 1980's when it was deemed that reliable information could be gathered. Thus, we are presenting an analysis of fertility changes from 1980 through 2002, the year of the last overall population census.

In addition, as part of an ongoing long-term reproductive ecology project, we collected complete reproductive histories which were used to supplement the census data and provide a cross-validation source. A total of 435 reproductive histories were collected from villagers 12 years old and older. When the interviewee was not fluent in Spanish, we used the help of local translator (all of them young women of the same community as the interviewee).

Participants were visited in their homes and data was collected in semi-private conditions (children were always present) using a structured interview.

Data from censuses and reproductive histories were cross-checked with other sources such as national identification documents, health records kept at the local health center, and birth records provided by Toba health agents.

Data analysis

The data obtained as described above allowed us to conduct a cross-sectional demographic analysis of this Toba population between 1980 and 2002. In order to evaluate possible changes across time, we organized the data in five time periods 1980-1984, 1985-1989,

1990-1994, 1995-1999, 2000-2002. For each of these periods, we estimated the following fertility parameters: the *Crude Birth Rate* (CBR) as the number of live births per 1000 of population; the *General Fertility Rate* (GFR) as the number of live births per 1000 women between the ages of 15 and 49 years; and the *Total Fertility Rate* (TFR) as the average number of children a woman would bear during her lifetime, based on age-specific fertility rates of women between 15 and 49 years old (Welti et al. 1997). We used reproductive histories to evaluate temporal trends in mean age at first birth and in mean interbirth interval, which were calculated using survival analysis and Cox regressions. We used the Population Analysis System software (www. classes.entom.wsu.edu/pas/) to perform demographic analyses and SPSS 15.0 for all statistical analyses.

Results and Discussion

Fertility among the Toba women of the SN communities is considerably high. All the fertility parameters analyzed indicated an upwards trend across the study time periods (Table 1). The CBR varied between 37.4 ‰ and 50.6 ‰, while the GFR varied between 186 and 246 ‰. TFR values ranged between 6.4 and 8.0 births. The lower TFR value agrees well with the mean number of live births for women over 49 years, which equaled 6.4 (□ 4.1). Seven women over 49 years of age reported not having had any pregnancies in their lifetime (11% primary infertility).

These values are strikingly similar to the ones found in a different Toba population located in the Eastern region of the Gran Chaco (Valeggia and Ellison 2004) and are also in the upper range of what has been reported for other South American lowland indigenous groups such as the Hupd´äh (Machado et al. 2006) and the Bororo (Souza et al. 2005) of the Brazilian Amazon. Given the high fertility values of Amerindian populations in general, we can not rule out the possibility of a global increase in fertility for the region. Mortality values for our study population are still being computed, but preliminary results would indicated that both crude death rates and age specific mortality rates are declining (Lanza et al. 2007). This pattern of high fertility values accompanied by decreasing mortality values would fit the typical profile of populations in the early stages of the demographic transition (Caldwell et al. 2006). According to the Demographic Transition Model, pre-industrialized societies are characterized by a high birth rate which is approximately balanced by a high mortality rate, largely due to infectious diseases experienced during the first few years of life, so that the population stays in approximate equilibrium. As populations move into the second stage of the demographic transition and experience improvements in sanitation and health care that more effectively prevent, diagnose, and treat infectious diseases, mortality rates decrease sharply and life expectancy increases slightly-to-moderately. However, the rapid decrease in mortality does not show a corresponding drop in fertility, which leads to a high rate of population growth.

A more detailed analysis of reproductive patterns allowed us to highlight some of the possible proximate mechanisms by which the above mentioned population explosion may be taking place among the western Toba. Age at first birth has been declining

TABLE 1.
Population size (in number of people), Crude Birth Rates (CBR), General Fertility Rates (GFR), Total Fertility Rates (TFR), and mean age at first birth (in years, ± standard deviation, SD) across five time periods between 1980 and 2002 in a Toba population of northern Argentina.

Period	Population size	CBR (‰)	GFR (‰)	TFR	Mean age at first birth ((± SD)
1980 - 1984	848	37.4	189	6.6	20.1 (± 6.4)
1985 - 1989	894	38.1	186	6.4	19.7 (± 5.1)
1990 - 1994	1346	42.8	214	7.2	17.1 (± 3.8)
1995 - 1999	1464	50.6	246	8.0	18.5 (± 4.3)
2000 - 2002	1544	48.3	225	7.4	17.9 (± 3.5)

steadily during the last decades (Cox regression analysis, $B = 0.02$, $p < 0.001$). A survival analysis of birth cohorts indicated that the mean age at first birth declined from 27.1 (± 7.6) years for women born before 1940 to 17.2 (± 2.8) years for women born in the 1980's (Fig. 2). This decline of the age at first birth was also apparent when we analyzed the data focusing on women who had their first born in each of the study periods previously described (Table 1).

A possible proximate explanation for a reduction in age at first birth is a secular decline in age at menarche (Ellison 2001). Unfortunately, we do not have any records of age at menarche for Toba women in the past. Interestingly, recalled age at menarche, with all the reliability caveats this datum merits, does not suggest a reduction in the last few decades. Women born in the 1950's and 60's ($n = 55$) reported a mean age at menarche of 12. 7 ± 1.4 years; while that of those born in the 1980's and 1970's ($n = 113$) was 12.5 ± 1.3 years (n.s., $p > 0.05$).

In addition to biological variables, it is equally important to look at the possible social mechanisms behind the reduction in age at first birth. We were able to collect qualitative information using participant observation and semi-structured interviews of key informants in the community that may shed some light on the causes of the decline in age at first birth. Elders reported that in the past (they were talking about the generation of their parents and of theirs, i.e. between the early 1900's and the 1940's) women married at an older age and had children considerably later than nowadays. Some of the reasons they cited for this difference included the need to marry a very competent and experienced woman because life was harsher in the past and they mentioned the lack of mating opportunities given the nomadic lifestyle they carried. In addition, they mentioned that when a very young woman, or an unmarried one, got pregnant, many times women resorted to abortion or infanticide.

These fertility control practices have been also mentioned in ethnographic and historical studies of Chacoan indigenous populations (Vitar 1999). Another emergent theme in the Toba discourse about fertility changes included the current attendance to co-educational public schools in adolescent boys and girls. A 55 year-old man said, regarding this issue that "boys and girls have now more opportunities to meet each

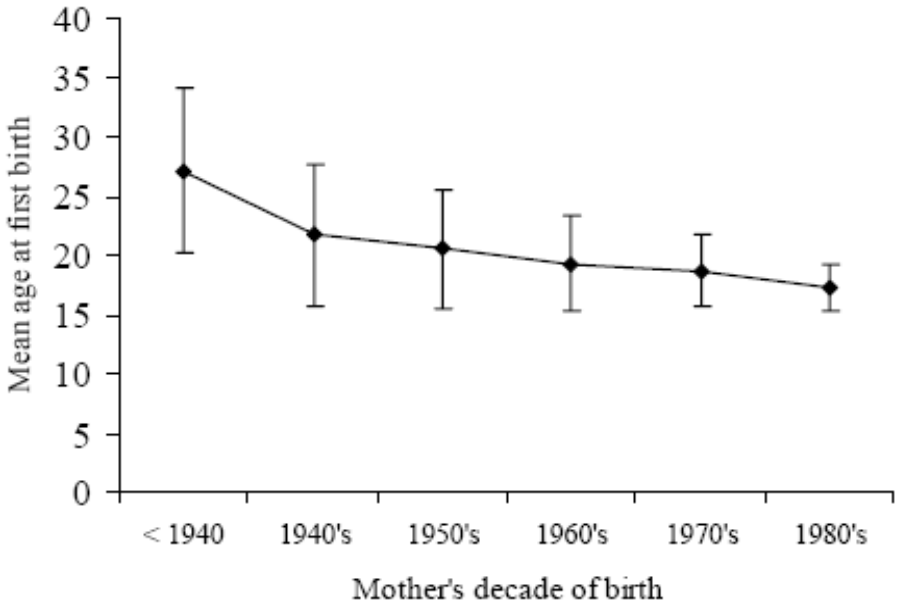

Figure 2. Mean age (in years, ± SD) at first birth for women born in different decades from before the 1940's to the 1980's

other". Another 60 year-old man explained that it is easier for girls to assess candidates because they meet them at school. Further research is needed to explore these sociocultural issues and their impact on age at first birth.

The length of the interbirth interval is another crucial component to consider for explaining changes in women's fertility. We analyzed a total of 1234 births, for which the median interbirth interval (IBI) was 28.5 months (mean = 33.2 ± 16.0, n = 1336 closed intervals from 339 women). There was no association between age of the mother and the duration of the IBI's ($R^2_{(1333)} = 0.13$, $p = 0.7$). However, this population has been experiencing a decline in the length of IBI's ($F_{(4)} = 9.5$, $p < 0.005$, Fig. 3).

The estimated duration of IBI's in this population is very similar to the one found for the Eastern Toba (median 29.2 months; mean = 35.6 ± 21.2 months, (Valeggia and Ellison 2004)). The reduction in the duration of the IBI's in the last few decades deserves further discussion. It has been well established now that breastfeeding is one of the

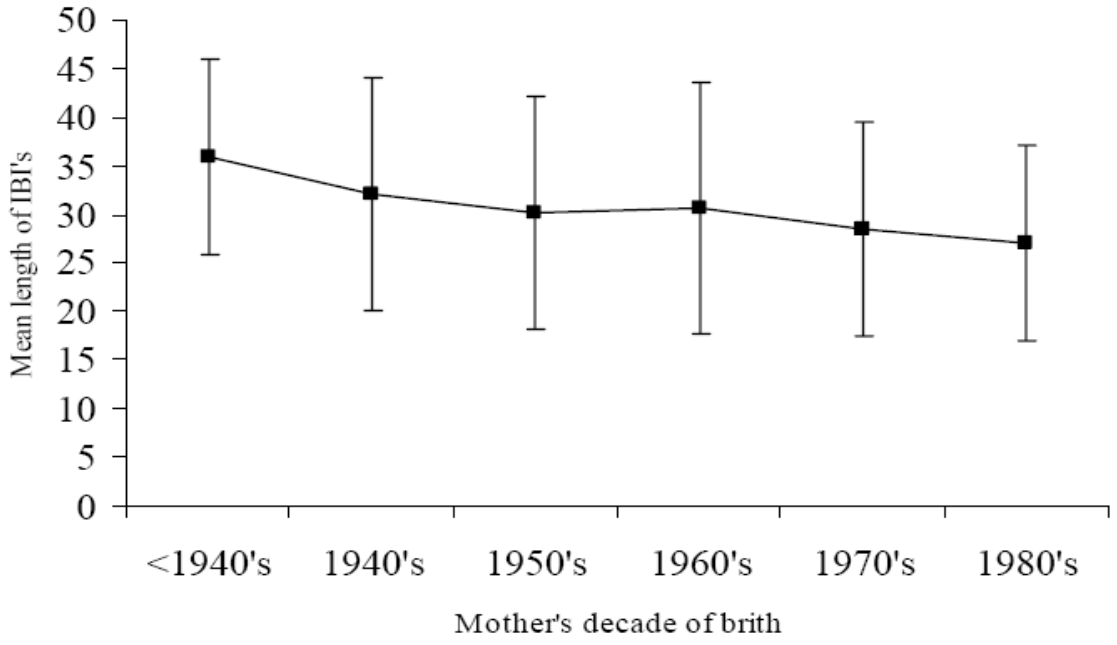

Figure 3. Mean length of interbirth intervals (in months ± SD) for women born in different decades from before the 1940's to the 1980's

major determinants of the interbirth interval (Wood 1994). The proximate causes of the contraceptive effect of lactation, however, are still a matter of productive debate. It has been postulated that energy balance plays a major role in determining the duration of lactational amenorrhea (Ellison and Valeggia 2003, Valeggia and Ellison 2004). According to this view, the return to postpartum fertility depends on the metabolic budget of the breastfeeding mother. The metabolic cost of lactation being equal, better nourished women would have shorter periods of lactational amenorrhea and, in the absence of contraception, shorter IBI's. Toba women still practice on demand, exclusive breastfeeding for an extended period of time. This practice has not changed in the last few decades. However, the process of westernization brought changes in dietary patterns which may have had an impact on the energy balance of these women (Valeggia and Ellison 2003; 2005). It is not unreasonable to suggest that Toba women in transitional populations are responding with shorter periods of lactational amenorrhea, which, in turn, result in shorter IBI's.

Further research on the consequences of rapid lifestyle changes is needed for this and other Argentine indigenous populations. A particularly useful perspective is the one offered by biocultural models (Dettwyler 1992; Dufour 2006; Goodman and Leatherman 1998). Although there is a considerable body of ethnographic work about the Toba of Western Formosa (Arenas 2003;

Gordillo 1995, 2001, 2002; Mendoza 1999, 2002; Mendoza and Wright 1989), it has not yet been combined with ongoing demographic and human biology studies. A mixed-methods approach, which evaluates detailed, historically informed, qualitative data in conjunction with quantitative (demographic, epidemiological, nutritional) data, would produce a more nuanced understanding of the predicaments that the Toba are facing as they encounter rapid changes in the social, cultural, and physical environment.

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