

Chapter 2

A Half-Century Portrait: Health Transition in the Xavante Indians from Central Brazil

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Abstract This chapter discusses some of the most recent studies that have been conducted among the indigenous Xavante people in Central Brazil by members of the research group Health, Epidemiology and Anthropology of Indigenous Peoples, coordinated by Ricardo Ventura Santos and Carlos E. A. Coimbra Jr., from the Oswaldo Cruz Foundation, Rio de Janeiro. Members of this research group first studied the Xavante in 1990 and have since published on such diverse topics such as nutrition, subsistence, demography, epidemiology of infectious and parasitic diseases, and social organization. Recently, the group has focused on the relationship between health profiles and emergent forms of socioeconomic differentiation internal to specific Xavante communities. Additionally, they have begun publishing the results of longitudinal studies that document phenomena that had not yet been evident in cross-sectional approaches. In this chapter, they illustrate these new directions with examples of recent research on dental health, demography, and nutrition transition. These examples demonstrate the interrelatedness of health and various ecological, political, economic, and sociocultural transformations of different temporal scales.

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2.1 Introduction

The first visit by members of our research group to the Xavante Indians, more specifically to Pimentel Barbosa village, also known as Etênhiritipá, was in July 1990. In Central Brazil, the months in the middle of the year are dry and nights are cold. It is a season with few clouds, making it possible to visually appreciate the vast and varied landscape. At the time we first visited, the Xavante were involved in many ritual activities related to youth initiation rites. That first visit made such an impression on us that we have returned many times. Although at the time we may not have anticipated the trajectory of our relationship with the Xavante of Pimentel Barbosa, our mutual involvement has deepened and diversified profoundly over the years.

That visit marked the beginning of a research program in the areas of health, human ecology, and biological anthropology that has continued to the present. The research team at that initial moment was coordinated by Nancy M. Flowers, Carlos E.A. Coimbra Jr., and Ricardo Ventura Santos. Nancy had conducted her doctoral dissertation research on subsistence, nutrition, and demography for 14 months in 1976–1977 in that same community and under the supervision of Daniel R. Gross at City University of New York (CUNY). At the time, Carlos and Ricardo were novices in studies regarding the Gê peoples of Central Brazil, though both had field experience in other regions of Brazilian Amazonia. Carlos was then a visiting researcher at the National School of Public Health (ENSP) of Fundação Oswaldo Cruz, in Rio de Janeiro, and had concluded his doctorate in anthropology at Indiana University under the supervision of Emilio F. Moran (with a dissertation in 1989 on medical anthropology about the Suruí of Rondônia, Brazil). In 1990, Ricardo was a doctoral student in biological anthropology (under the supervision of Paul L. Jamison and with Moran on his committee, he would defend his dissertation on the Tupi-Mondé of Rondônia in 1991).

In the following decades, many other researchers, the majority of which were master and doctoral students at ENSP, were affiliated with our group on health and indigenous peoples and conducted research at Pimentel Barbosa. Numerous articles, chapters, and books related to our research have been published on topics such as nutrition, subsistence, demography, epidemiology of infectious and parasitic diseases, and social organization, among others (see Coimbra et al. 2002). In 2002, we published a monograph titled “The Xavante in Transition: Health, Ecology and Bioanthropology in Central Brazil” (as part of a series at University of Michigan Press edited by Emilio F. Moran) that synthesized the studies that we and our colleagues had completed by that time. One of the people who joined our research group more recently was anthropologist James R. Welch, who conducted his doctoral dissertation on social organization and life cycles among the Xavante, defending his dissertation at Tulane University under the supervision of William Balée. James is currently a researcher at ENSP and an active participant in the research group on health and indigenous peoples.

Since the beginning of our research with the Xavante, our theoretical interest centered on processes of change and their interfaces with health. As we point out in the introduction of our book *The Xavante in Transition*,

Our principal aim, in collecting and analyzing demographic, biological, epidemiological, and ecological data, has been to produce a diachronic view of the long and complex interaction between the Xavante people, especially those of the Pimentel Barbosa community, and the surrounding Brazilian national society. On a broader scale, our research may be seen as an attempt to understand how local systems interact with larger social, economic, and political institutions and processes (Coimbra et al. 2002: 1).

Today, we not only continue conducting health research with the Xavante but do so in a dynamic and collaborative manner that has led us to become involved in other research endeavors of interest to the community, including land issues and cultural heritage conservation.

Our objective in this chapter is to reflect upon the most recent studies that have been conducted among the Xavante by our research group. We are especially interested in highlighting theoretical questions and methods that were not emphasized in the first decade of our research (1990–2000) but became prominent in later years. Increasingly, our research addressed questions related to the influence of emergent forms of socioeconomic differentiation, especially on health profiles. Along these lines, our recent research tends to emphasize differentiation in health profiles internal to specific communities in addition to making broader generalizations about the Xavante population as a whole. We consider this an important aspect of our evolving research agenda, since elucidating generalizations may be made through an understanding of local particularities. This is especially true for ethnic segments of national societies, for which assumptions of uniformity often mask important underlying complexities. Additionally, we have begun publishing the results of longitudinal studies that document phenomena that had not yet been evident in cross-sectional approaches. In this chapter, we illustrate these new directions with examples of recent research on dental health, demography, and nutrition transition.

2.2 The Xavante: Ecology, Territory, and History

Xavante territory is located in the central region of Brazil, characterized by tropical scrub vegetation known as *cerrado*. At present, the Xavante number approximately 14,500 distributed among nine separate indigenous reserves (Fig. 2.1). In 2004, the villages in these territories totaled 160. Most of them (about 80%) had populations under 100.

According to contemporary elders at Pimentel Barbosa, the Xavante were previously highly mobile, once residents of the Atlantic coast, and more recently occupants of the wide expanse of the Central Brazilian Plateau to the east of the Araguaia River. They explain that the increasing presence of nonindigenous colonists forced them to migrate to their present territory relatively recently, an

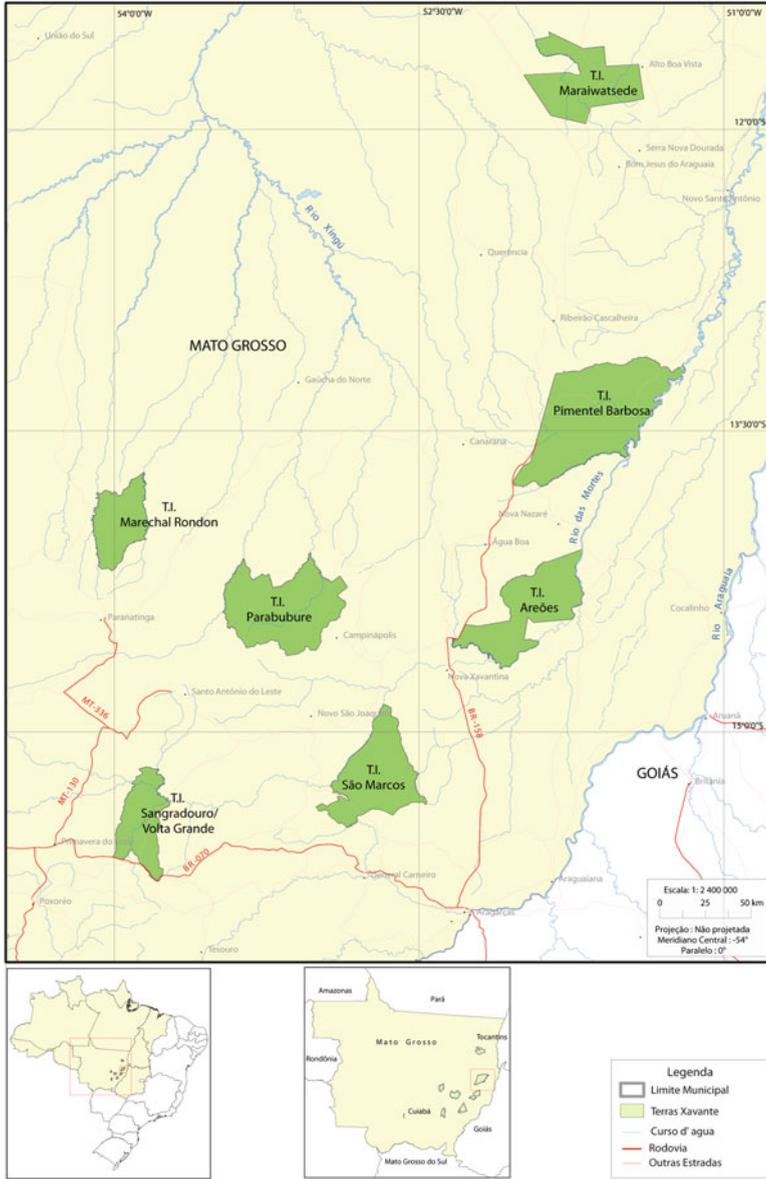


Fig. 2.1 Locations of Xavante indigenous reserves, Mato Grosso

event scholars estimate occurred in the mid-nineteenth century. These Xavante oral historians identify the banks of the Rio das Mortes in Mato Grosso as the location of the first permanent village, which differed from previous settlements because it was maintained for multiple years in succession (Coimbra et al. 2002).

According to historical documents, in the recent precontact era (pre-1940s), the Xavante were seminomadic, occupying vast territories in eastern and central Mato Grosso (Lopes da Silva 1992). Relatively large villages numbering hundreds of individuals were built near gallery forests along rivers, where a handful of crops (including maize, beans, and squash) were cultivated in modest quantities with slash-and-burn horticulture. These villages dispersed periodically into smaller trekking groups that subsisted for weeks to months by hunting and gathering. Foraging provided a significantly greater portion of dietary resources than horticulture at all times of the year, including periods of residence in permanent villages (Coimbra et al. 2002; Maybury-Lewis 1967; Santos et al. 1997).

In 1941, one year after a Brazilian Air Force airplane carrying Getulio Vargas, the president of Brazil, flew over the region to observe Xavante villages, an Indian Protection Service team entered the territory by land with the intent of “pacifying” them (Coimbra et al. 2002; Garfield 2001). At this time, the Brazilian government was engaged in the effort to occupy its central region, seen as “wilderness,” and open it to settlement and economic integration with the rest of the country. Direct state intervention consisted in large part of road building and carrying out the enormous enterprise of building the new national capital Brasilia. As a result of the thrust of settlement and development during the 1950s and 1960s, a number of Xavante groups were dislocated from their lands. By the end of the 1950s, they were reduced to ten small patches of population (Maybury-Lewis 1967). In the words of Lopes da Silva (1992: 369), “pressure on their land and their villages had increased so much that, defeated by the indirect contact that decimated them, they saw no alternative than to deliberately seek peaceful coexistence with the whites.”

During the same decades, the Xavante suffered from epidemic diseases that severely reduced their population. The large number of deaths resulted in constant movement of villages, forcing enemy factions to live in close proximity, which led to intense internal conflict. According to Lopes da Silva (1992: 372), “it was a period of great epidemics; it was also the time when people came in daily contact with the catechizing of the missions and with industrial goods. The fission and fusion of political factions and villages led to migration, but from this time it was only within a limited area, disputed piece by piece with non-Indians.”

After being confined to reservations, the Xavante became increasingly sedentary and increased their dependence on agriculture. Trekking was gradually discontinued and is now rare. At this time, when the Xavante population was in steep decline from epidemic diseases and persecution, the military government of Brazil promoted a number of programs specifically aimed at the occupation and economic development of the Amazon region, emphasizing mechanized agriculture and cattle-raising. Migration from the south of the country to Mato Grosso intensified. As a consequence, the population of Mato Grosso increased rapidly, transforming its economy and its urban structure (Coimbra et al. 2002).

Toward the end of the 1970s, the National Indian Foundation (FUNAI), a government agency, introduced a project aimed at turning the Xavante into large-scale rice producers (Coimbra et al. 2002). The expectation was that the project would integrate them into the local market economy as sedentary and economically

self-sufficient farmers. The scheme failed, but it left a trail of dependence on rice monoculture and changes in food habits. Rice is now the indispensable staple of Xavante diet, and at times, it is the only food available. In 1996, the Brazilian government, as part of a social project known as “United Communities” began to distribute a ration of basic foods on the reservations. This led to a decline in agriculture, an increase in village divisions, and greater external economic dependence.

Also in the 1970s, the Xavante began to reassert their land claims with vigor, seeking to recover possession of at least a portion of their historical territory. When their reservations were finally officially recognized, mainly in the 1980s and 1990s, the boundaries failed to include much of the land they considered their own. That struggle continues today, and the authors of this chapter have recently completed a land demarcation study for FUNAI at the request of the Xavante communities of the Pimentel Barbosa Reserve. Xavante lives continue to be conditioned by interaction with Brazilian society and political and economic events that occur beyond reservation boundaries (Lopes da Silva 1992).

During the 1990s, the question of how to provide health care for indigenous groups in Brazil came under intense discussion in the national political arena. As a result, the Indigenous Health Care Subsystem was instituted in 1999. At that time, the responsibility of providing indigenous health care was transferred from FUNAI to the National Health Foundation (FUNASA), which provides services under the Ministry of Health (Santos et al. 2008). A special health service for indigenous peoples was instituted and structured according to geographical districts called Special Indigenous Health Districts, or DSEI, which are linked to the Unified Health System (SUS). The headquarters of the Xavante district, one of the 34 DSEIs in Brazil, is located in Barra das Garças, Mato Grosso.

At present, salaries earned through remunerated public service positions (e.g., FUNAI employees, municipal school teachers, healthcare assistants), coupled with government retirement pensions and freelance work, constitute the major sources of income that are largely used by Xavante families to buy commercially available consumer goods, including food, at stores in neighboring towns outside the reservation. Those economic changes directly affect the quality of the food system. Today, rice accounts for most of the caloric bulk of the diet. Sugar, coffee, salt, pasta, soda drinks, crackers, and cooking oil are now regular items in Xavante meals (Coimbra et al. 2002; Gugelmin and Santos 2001; Welch et al. 2009). According to our observations, these and other foods circulate within and between households according to a strong morality of sharing and complex norms of kinship-based reciprocity, such that the nutritional impacts of food shortages and excesses may potentially be buffered. As we will see in this chapter, these dietary changes are closely associated with the ongoing health transition taking place among the Xavante.

It is important to mention that the Xavante people are among the most studied indigenous groups in Brazil, as evidenced in a variety of publications on diverse themes such as ecology, health, demography, ethnohistory, and social structure and organization (for a review, see Coimbra et al. 2002). The Xavante have

factored importantly in public discourse since the mid-twentieth century for, among other things, being pioneers in the field of Brazilian indigenous politics (Garfield 2001) and being pivotal in the development of anthropological structuralism (see Maybury-Lewis 1979).

2.3 Health Transition and the Xavante

We now present a series of three case studies in health transition from our recent research among the Xavante. The first, focusing on demography, addresses the entire Xavante population resident on officially recognized reserves. The other two, addressing dental health and nutritional status of adults, focus on the population at Pimentel Barbosa, among which we have worked since the 1990s.

2.3.1 *Recent Demographic Change*

In this first section we present an overview of Xavante demography according to recent research, including a doctoral dissertation defended by Luciene Souza in 2008 at ENSP (Souza 2008; Souza et al. 2011). Whereas previous demographic studies focused on individual Xavante communities, this study addressed the population of all nine Xavante reserves. Demographic data covered the period from 1999 to 2004. They derived from household censuses and records of vital statistics collected by FUNASA local health teams, which were systematized and analyzed by Souza.

One of the difficulties of doing demographic research among indigenous peoples in Brazil is obtaining reliable and complete data. Populations are often small in number and geographically dispersed. It is therefore not surprising that many studies of anthropological demography carried out in Amazonia are based on data from specific communities, seldom considering whether they are representative of the entire ethnic group. Among the few exceptions are a study by Early and Peters (1990) of the Yanomama of Mucajai in the state of Roraima and a recent participatory sociodemographic investigation among the Sateré-Mawé of the state of Amazonas (Teixeira and Brasil 2005). These studies analyzed the demographic dynamics of relatively large and geographically dispersed populations. The Xavante study we present here is similar to these in scope.

A first aspect that deserves attention is that the Xavante population is not evenly distributed among the reservations. Pimentel Barbosa, with more than 300,000 ha, is the largest reservation and has the lowest population density, with 0.44 persons per square kilometer. Parabubure and São Marcos reserves, among others, have higher densities with 2.14 and 1.6 persons per square kilometer, respectively.

The overall results show that from 1999 to 2004 the mean annual growth of the Xavante population was 4.4%. The highest annual growth rate was at Pimentel

Barbosa (5.2%) and the smallest at São Marcos and Sangradouro-Volta Grande (3.9%). The high population growth rate of the Xavante is similar to those reported for a number of other indigenous peoples in Brazil (Pagliaro et al. 2005) and elsewhere in Latin America (McSweeney and Arps 2005).

As Azevedo and Ricardo (2002) note, at present, one of the great challenges for demography of indigenous peoples in Brazil is to identify the factors that may explain this increase. In the Xavante case, the figures clearly indicate that natural increase, i.e., the difference between births and deaths, is the principal factor responsible for the striking increase in population. Migration is an irrelevant component. Fertility analysis indicates a total fertility rate of 8.2 children per woman, from 1999 to 2004. In a society where marriage and maternity are practically universal, women's reproductive years start in their early teens, peaking at the ages of 20–29. As a result, the population is very young, with 54% under 15 years of age. Xavante population structure and their specific demographic indices are quite similar to those reported for other indigenous peoples in Brazil with high population growth (Pagliaro et al. 2005).

A very important aspect of the Xavante population in both demographic and epidemiological terms is that along with the high growth rate, death rates remain high. The crude death rate from 1999 to 2004 was 12.1 per 1,000. Infant mortality was 96.7 per 1,000 live births. In comparison, the infant mortality rate for all Brazil in 2000 was 29.6 per 1,000, and for the Central-West (Centro-Oeste) region, it was 21.2 per 1,000 (Simões 2002), pointing to major health disparities.

Demographic analyses of the entire Xavante population also demonstrated considerable variation in epidemiological and demographic indicators between Xavante groups. Notable differences are evident in practically all measurements analyzed. The total fertility rate varied from 6.7 at Marechal Rondon to 10.9 at Pimentel Barbosa; the infant mortality rate varied from 74.4 per 1,000 live births at Sangradouro-Volta Grande to 129.5 at São Marcos. Some differences between Xavante groups have been described in the ethnological literature. For example, Lopes da Silva (1986) divided Xavante groups into three major blocks according to the following criteria: (1) intensity and characteristics of contact between villages, (2) whether or not the group still occupied its traditional territory, and (3) whether agents of contact were representatives of the state or of the church. According to this model, the three blocks consist of (1) Pimentel Barbosa and Areões; (2) Batovi (Marechal Rondon), Culuene (Parabubure), and part of Couto Magalhães (Parabubure); and (3) Sangradouro-Volta Grande, São Marcos, and most of Couto Magalhães. Our demographic results do not permit in-depth analysis of the demographic characteristics of different Xavante groups according to an interpretive system such as that which Lopes da Silva (1986) suggested. However, recognizing their different historical trajectories is important in order to avoid unjustified generalizations about the Xavante as a whole.

The demographic data reveal some relevant trends when comparisons are made between the first half of the study period (1999–2001) and the second half (2002–2004). Despite being a relatively short period of time, by taking into consideration all the reservations, we can observe important changes from the first 3-year period

to the second: a decline in crude birth rate from 61.2 to 57.3 per 1,000, a decline in total fertility rate from 8.5 to 7.1 children per woman, a decline in crude death rate from 12.7 to 11.5 per 1,000, and a marked decline in infant mortality rate from 103.3 to 89.8 per 1,000 live births. Similar patterns are observed for all seven individual reserves, although there is variation among them, probably due in part to fluctuation in small numbers.

Even though death rates are still high among the Xavante, there has been some decline since the implementation of the Indigenous Health Care Subsystem and the beginning of the demographic study period (both in 1999). There are indications that the system, while suffering from major deficiencies, has nevertheless afforded indigenous peoples greater access to health services than they had before 1999.¹ In an analysis of the first 3 years of the subsystem, Garnelo et al. (2003: 77) note that national health coverage provided by FUNASA to indigenous peoples became more inclusive and more health professionals entered the system to provide basic care. Lunardi et al. (2007) found that there was an increase in the use of hospital services by the Xavante population after 1999. They observed that rates of hospitalization increased for all four Xavante reserves analyzed. Including all reserves, the number of hospitalizations per 100 inhabitants almost doubled, from 5.1 to 9.5. It is important to emphasize that, despite increased access to hospital services, the major causes of hospitalization in Xavante children were diarrhea and acute respiratory infections, indicating major deficiencies in primary health care in villages (Lunardi et al. 2007).

While the reduction in Xavante mortality might be associated with greater investments made in indigenous health at the national level, the relationship between better health care and the observed decline in natality and fertility is neither obvious nor direct. A possible cause for this reduction might be more access to contraceptive technologies, although in the Xavante case this is probably not the explanation, since FUNASA did not provide routinely family planning or contraception services. There are no specific studies available on this politically delicate topic in Brazil, although the public position of some activists in the indigenous movement is opposition to contraceptives (Coimbra and Garnelo 2004).

Perhaps the most important finding that emerges from our demographic analysis of the Xavante population is that the decline in fertility is not the result of directed family planning but appears to be rather a consequence of the reduction in infant mortality through better health services. In other words, it may be due to mortality-fertility interaction. According to Wood (1990), fertility levels may be affected more by mortality than by reproduction itself, especially in populations with high mortality. As he explains, “when a nursing child dies, lactation is terminated and the mother resumes ovulating sooner than she otherwise would

¹As we write this chapter, responsibility for indigenous health in Brazil has once again undergone a major reorganization, being transferred in late 2010 from FUNASA to the newly created Special Secretariat of Indigenous Health. The implications of this most recent change will not become apparent for some years to come.

have” (Wood 1990: 233). Therefore, paradoxically, elevated infant mortality may result in increased total fertility of a group of women. Since ovulation resumes when the death of an infant interrupts lactation, the interval between births is reduced, a phenomenon Wood calls “reproductive compensation.” Alternatively, decreased infant mortality, as observed in the Xavante, may result in lower total fertility. This argument parallels the discussion of the “proximate determinants” of fertility by Bongaarts and Potter (1983), which cites the duration of lactation as an important factor in regulating fertility.

Survival analysis of Xavante interbirth intervals showed them to be consistent with the idea that the reduction of fertility from 1999–2001 to 2002–2004 could be due to fertility-mortality interaction. In the first place, there was an increase in average length of time between births of around 6%. Moreover, the results suggest a close relationship between the survival of infants and longer interbirth intervals. It is also notable that the decline in fertility was spread across all age cohorts, which suggests that the process was general and unfocused. If it were only in the older age brackets, we might suspect the use of contraceptives for family limitation. In the short length of time analyzed, it is improbable that fertility decline among the Xavante was due to extensive sociocultural change leading to new normative values regarding family size.

To conclude this section, it is appropriate to mention a major recent transformation in the demographic outlook for Brazil’s indigenous population. During almost all of the twentieth century, it was believed that indigenous peoples were undergoing biological and cultural extinction and would not survive as socioculturally distinct populations in the twenty-first century. Only very recently, in the 1980s and 1990s, did it become evident that these populations were not only coming to occupy important political spaces (especially through the indigenous and indigenist movements in the aftermath of the 1988 constitutional revision), but also their population growth rates indicated rapid demographic recovery and growth. The demographic data from the Xavante point to an additional factor, whereby improved health services not only decrease mortality but also indirectly influence the indigenous population’s fertility levels. These findings suggest that recent public health policies regarding indigenous peoples may have unintended effects, a subject that deserves research attention at the national level.

2.3.2 The Case of Oral Health

Research regarding health transition among the Xavante of Pimentel Barbosa benefits from an exceptional element, the existence of a detailed genetic and medical study conducted in the same population in 1962 by James V. Neel and Francisco M. Salzano. One aspect of their published analyses (Neel et al. 1964) addressed dental health conditions, especially the occurrence of caries. They observed a low prevalence of caries, which they explained as the result of a diet based on hunting and collecting, with limited dependence on agricultural products.

As in several other parts of the world (Grim et al. 1994; Jamieson et al. 2006; Niendorff and Jones 2000), the oral health of indigenous peoples in Brazil, exemplified by several cases showing a trend toward increased rates of caries and other pathological conditions, attests the interplay of dietary changes, insufficient access to preventive resources, and inadequate availability of health care. Notwithstanding those limited data, all too little is known about the human biological and epidemiological conditions of indigenous peoples related to changes in oral health conditions in Brazil (Arantes 2003; Arantes et al. 2001, 2010).

Very few studies have focused on the dental health of indigenous peoples in Brazil (Arantes et al. 2010). Those that were conducted were cross-sectional; none were prospective. It is especially productive to follow the trajectories of changing dental health conditions in indigenous peoples because the epidemiological transition may take different tracks, depending on ethnic group and socioeconomic and environmental contexts.

While national surveys have documented general tendencies toward reduction in the prevalence of dental caries in the Brazilian schoolchildren population (Narvai et al. 2006), studies in specific indigenous communities have noted an increase, which may be explained by dietary changes and limited access to health services (see review in Arantes et al. 2010). However, the notion that these peoples formerly had low prevalences of dental disease and are uniformly moving to higher rates should be examined with care. Some case studies fail to corroborate this tendency, indicating that consumption of sugar and length of contact are not the only determining factors of caries epidemiology in indigenous peoples (Arantes 2003).

We recently published the results of the first longitudinal study on oral health carried out in an indigenous group in Brazil (Arantes et al. 2009). The research was based on data collected in two surveys (1999 and 2004) and was carried out as part of a doctoral research project by Rui Arantes at ENSP. Following WHO methodology (WHO 1997), the study included 128 individuals, 63 (49.2%) males and 65 (50.8%) females, divided into four age groups (6–12, 13–19, 20–34, 35–60 years of age). The decayed, missing, and filled teeth index and incidences (difference between 1999 and 2004) were calculated for each individual.

Arantes et al. (2009) observed that exposure to risk of developing caries varied significantly according to age group and gender. Higher incidence of caries was found in females compared to males and in adults over 20 years of age compared to the 6–12 and the 13–19 age groups. Our interpretation is that these risk differentials may be related to a protective factor active in the younger age group and to a vulnerability factor that intensifies the incidence of caries in adults over 20 years of age. The protective factor may involve improved access to preventive measures, which were implemented at Pimentel Barbosa by Arantes in the mid-1990s and continued until 2009. These measures included regular monitoring of caries lesions, use of fluoride topical application and varnishes, supervised tooth brushing, and distribution of dental hygiene materials (toothbrushes, toothpaste, and dental floss).

We also observed that the high incidence of caries among women observed in the Xavante community at Pimentel Barbosa was an important factor in raising the

incidence of caries in adults over 20 years of age. Men in the 20–34 age bracket showed an increase of only 1.08 teeth with caries, while women showed an increase of 4.37 teeth with caries. The mean increment in women was four times greater than that in men, thereby raising the increment of the age bracket as a whole.

Our interpretation is that certain socioeconomic and cultural factors may determine different oral health profiles between Xavante males and females, such as those that emerge from gendered production and consumption patterns and differential access to information, health services, and education. In a comparative study of the health determinants of indigenous women of the Americas based on data from seven countries (Canada, Ecuador, Guatemala, Mexico, Nicaragua, Peru, and the United States), researchers called attention to the centrality of gender to the understanding of health differences in indigenous communities (PAHO 2004; see also Verbrugge 1985). That study found that indigenous females show higher rates of dropping out of school and lower education levels, lower rates of bilingualism, and limited access to health services. It seems that a similar pattern may be present among the Xavante, whereby men and women have different roles in society, causing unequal exposure to factors responsible for the development of dental decay. For example, males and females not only have different reproductive roles but may also have unequal access to education and health preventive measures.

As we mentioned above, demographic data show that many of Brazil's indigenous populations experienced population recoveries after initial reductions caused by epidemics and sociocultural upheaval following contact with non-Indians. In the Xavante case, conditions improved somewhat in the 1960s, and, in the late 1970s, the population at Pimentel Barbosa began a process of recovery and demographic growth through an increase in women's fertility and a decline in infant mortality (Coimbra et al. 2002). The analyses carried out by Coimbra et al. (2002) showed that in the period from 1970 to 1990, the fertility rate of Xavante women increased relative to earlier periods. The rate for women between the ages of 15 and 40 was 7.9 births, with the highest age-specific fertility being that of women between the ages of 20 and 30. As we showed in the previous section, the total fertility rate at Pimentel Barbosa reached the impressively high rate of 10.2 in the period 1999–2004.

Clinical studies have shown that oral tissues may be affected by pregnancy (Laine 2002). Hormonal changes during pregnancy increase the susceptibility of gum tissues to local irritating factors and inflammatory processes. An increased concentration of estrogen in the saliva produces more epithelial shedding, creating an environment propitious to bacterial growth. Levels of the bacteria *Streptococcus mutans* and *Lactobacillus* spp. rise in the buccal milieu, and while there is no significant change in the flow of saliva, the saliva has a lowered pH and buffering capacity. The concentration of calcium and phosphate is slightly lowered during pregnancy, which may affect the remineralization of initial caries lesions. It appears that the effects of pregnancy are more closely related to the buccal milieu than to teeth themselves. These changes alter unfavorably the organism's capacity to resist the various risk factors for caries and gingivitis (Laine 2002; Lukas and Largaespada 2006).

Due to their high fertility, Xavante women spend most of their reproductive years pregnant or lactating, on average experiencing eight pregnancies. Consequently,

alterations in the buccal environment due to pregnancy may be both frequent and long-lasting. This situation, related to the high value attributed by Xavante society to large families (Coimbra et al. 2002; Maybury-Lewis 1967), may make women more susceptible than men to mouth diseases like caries and gingivitis.

The Xavante economy was historically based on seasonal cycles of wild food procurement and horticulture, with marked gender roles in productive activities. In recent decades, reservation life has led to profound changes in the group's economy and the emergence of new configurations of gender roles. In the past, Xavante families spent much of the year engaged in hunting and gathering activities during treks throughout a large territory (Maybury-Lewis 1967). At that time, women provided the caloric basis of the dietary through gathering activities and men concentrated their attentions on hunting. Despite their distinct work activities, both women and men were very mobile. At present, Xavante women and men retain primary responsibility for gathering and hunting, respectively, although both now invest a great deal more effort in gardening. Furthermore, women and men have undergone other contrastive transformations in their modes of economic production. Today, women spend the greater proportion of their time in the village or at their gardens, where they attend to child care, handcraft production, and food preparation. Men, on the other hand, now tend to be more involved in economic activities that require interactions beyond the village. At Pimentel Barbosa, nearly all salaried jobs associated with the village school and the health post are occupied by men. Men are also more mobile than women, tending to visit neighboring towns with greater frequency than women. Due to this combination of factors, Xavante women have limited fluency in Portuguese as compared to men, have fewer years of schooling, and therefore may be less exposed to new habits that might impact oral health, including brushing and dental flossing.

The arguments we have outlined here suggest that changing sociocultural, economic, and dietary circumstances have caused Xavante women to face greater exposure to caries than men. The influence of gender upon oral health operates at several levels in this population. The social expectations for large families, perhaps the result of regional demographic changes and federal policies regarding indigenous settlement, cause female adulthood to be closely associated with pregnancy and breast-feeding, thereby causing specific adverse alterations in the buccal environment. At the same time, additional socioeconomic determinants of oral health, highly influenced by gender roles, place women at a disadvantage in accessing public health measures that may prevent caries.

2.3.3 Nutrition Transition and Socioeconomic Differentiation

The records of early visitors to Xavante communities often mention witnessing impressive physiques. A journalist who visited the Xavante village of São Domingos in the 1940s wrote, "Although they are not really giants, as was rumored at first, the Xavante physical presence is admirable. Bronzed, of medium height, among them

we can find some individuals who are tall, others who are short. However, what seems to be most characteristic of the tribe are their fine, at times even Olympian, physical proportions. They are strong, vigorous, athletic” (Souza 1953: 99).

Fit Xavante bodies impressed not only journalists and visitors but also physicians and biologists who did research among them. When reporting on health conditions among the Xavante in 1954, Amaury Sadock de Freitas-Filho (1955: 155) referred to their good health and “fine physical appearance.” The doctor even suggested that the Xavante physique represented “the physical standard that should be the Brazilian ideal” (Freitas-Filho 1955: 165). In the early 1960s, when James Neel, Francisco Salzano, and their collaborators made a detailed biomedical study of the Xavante at São Domingos, almost 20 years after first contact, they were hardly less emphatic. They wrote, “The general impression of the men was of exuberant health and vitality. They were erect in carriage, deep-chested, and very well muscled, with a notable absence of adiposity” (Neel et al. 1964: 110).

Subsequent reports began to depict a very different scenario. They suggest that the Xavante, especially those belonging to certain communities, are experiencing an accelerated nutritional and epidemiological transition. Endocrinologist João Paulo Botelho Vieira-Filho, from the Escola Paulista de Medicina, wrote, based on his many years of experience in providing medical care in the Xavante reservations of Sangradouro and São Marcos:

The Xavante, who were slim before contact . . . have become overweight or obese (some weighing more than 100 kg) because of dietary changes that came with the government rice-growing project . . . [and] high consumption of rapidly absorbed carbohydrates. Their consumption of vegetable fiber is drastically reduced. Every time I visit the western Xavante I see more cases of diabetes. Twenty years ago there was no diabetes among them. (Vieira-Filho 2000: 2)

As it is widely recognized, excess weight is a major health concern throughout the world, both in industrialized countries and in developing regions undergoing rapid urbanization (Popkin 2001, 2006; WHO 1998). Some authors refer to obesity as a worldwide epidemic and emphasize its greater prevalence in low socioeconomic status populations in developing countries (Caballero 2007). High-fat and low-fiber diets, combined with low levels of physical activity, play an important role in the increase of overweight and obesity. Obesity may have a number of different impacts on health: it is associated with diabetes, cardiovascular disease, cancer, hypertension, gallbladder disease, and dyslipidemia (Popkin 2001, 2006; WHO 1998).

Recent case studies carried out among indigenous peoples in Brazil show an emerging pattern of high prevalence rates of overweight and obesity in adults (see review in Coimbra and Santos 2004). Several of those studies were carried out in the Amazon region. Comorbidities associated with obesity (e.g., hypertension and non-insulin-dependent diabetes mellitus) also emerged recently as important health challenges to indigenous peoples in the region. These changes are related to swift and profound shifts in nutritional profiles, associated with modifications in dietary intake and nutrient expenditure patterns, indicative of an ongoing nutrition transition.

The adoption of Western diets (i.e., high in saturated fats, salt, and sugar), reduced levels of physical activity, and increased use of alcohol are considered important aspects of the nutrition transition in developing regions (Batista-Filho and Rissin 2003; Kain et al. 2003; Popkin 2001, 2006). In Amazonia, such transition takes place in contexts of rapid sociocultural and environmental transformations accompanying increased involvement in the market economy. Recent studies show that this process can be internally heterogeneous, with intracommunity variation in socioeconomic status correlating with body composition measures. One study carried out among the Suruí Indians from the southwestern Brazilian Amazon showed that both adult males and females in wealthier households, as reflected in household infrastructure and presence of consumer durable goods, had significantly higher mean values of weight, body mass index (BMI), and skinfold thickness (Santos and Coimbra 1996). More recently, Dangour (2003) demonstrated that greater BMI among the Wapishana from Guyana was strongly associated with differential wealth between households, approximated by the value of household consumer durables. Godoy et al. (2005a, b) found among the Tsimane from lowland Bolivia a stronger correlation between nutritional status and wealth, defined in terms of physical assets, than between nutritional status and income. Lourenço et al. (2008) restudied the Suruí Indians previously investigated by Santos and Coimbra (1996) and characterized the nutritional transition taking place in the population in relation to socioeconomic and gender issues. Together, these studies demonstrate that nutrition transition among indigenous Amazonian populations varies within societies and point to household wealth measured in terms of durable goods as a useful proxy for internal socioeconomic differentiation as it relates to health discrepancies.

In our 2002 book *The Xavante in Transition*, we analyzed in detail the epidemiological transition that the Xavante have been experiencing. We argued that although infectious and parasitic diseases were still the leading causes of sickness and death, it was clear that chronic noncontagious diseases, including hypertension and diabetes, were becoming increasingly important. Among the Xavante, changes that have taken place in settlement patterns, levels of physical activity, and diet are affecting health conditions. We compared anthropometric and other health-related data collected in the 1990s with data collected in the 1960s. The trend was toward changes in body composition (weight gain) and emergence of hypertension. We argued that in order to understand the trend toward weight gain at Pimentel Barbosa, altered patterns of physical activity might be of even greater importance than nutritional shifts.

We recently concluded a study that aimed to readdress the issue of nutritional transition among the Xavante (Welch et al. 2009). In this investigation, our first goal was to compare contemporary data with historical information collected in 1962 and 1990 in the same community, permitting a diachronic perspective of anthropometric changes associated with ecological and socioeconomic transformations. With a time depth of 45 years, this diachronic view has no parallel in human ecological and bioanthropological studies in the Brazilian Amazon. Our second objective was to compare two sets of original field data collected in 2006, one that assessed

household socioeconomic status and a second that recorded anthropometric measurements of individual participants. Those two data sets were compared statistically to ascertain how internal socioeconomic differentiation may be associated with differences in body morphology.

In order to assess within-community socioeconomic variation, we identified two apparent and measurable socioeconomic variables (monetary income and industrial durable consumer goods) to serve as proxies for household socioeconomic status. We opted to work with household monetary income and industrial goods for several reasons. First, because we sought to assess aspects of socioeconomic differentiation related to recent nutritional change, we emphasized types of income and wealth that reflected market integration. This strategy differs from studies that include subsistence production in income calculations and locally produced goods in wealth calculations (e.g., Godoy et al. 2005a, b). Second, the particulars of the Xavante situation facilitated our assessment of both monetary income and wealth, two commonly used indices of socioeconomic differentiation. Some other studies of socioeconomic differentiation and anthropometric variation in Amazonian societies assessed wealth but not monetary income due to income unpredictability or participants' reluctance to disclose incomes (e.g., Dangour 2003; Lourenço et al. 2008). In contrast, at Pimentel Barbosa, we found monetary income to be relatively predictable and income sources to be willingly disclosed.

Income was assessed by tabulating the quantity and type of routine personal income sources for all members of each household. Quantification of consumer goods owned by members of each household was based on a comprehensive list of privately owned durable industrial consumer goods present in the community at the time of the study. The items were motorcycles, satellite dishes, televisions, VCR players, DVD players, audio recorders, portable stereos, cellular telephones, film and digital cameras, gas stoves, sewing machines, firearms, handguns, bicycles, and fishing nets. Local market value of each consumer item included in the sample was later estimated by informal survey of local sources and consumers.

In comparing our results with data from studies undertaken in the Pimentel Barbosa population at earlier points in time, we observed that the adult Xavante population has experienced rapid and substantial increase in adiposity, as indicated by significant differences in mean values for weight and BMI between 1962 and 2006, while, at the same time, stature remained stable. A dramatic finding is that, on average, adult Xavante men and women are 8.9 and 13.8 kg heavier, respectively, than in 1962 when Neel and his collaborators conducted their original study (see Table 3 in Welch et al. 2009).

As is the case among other recently studied indigenous Amazonian peoples (Lourenço et al. 2008), the substantial weight gains observed through time among Xavante adults, which reached a frequency of overweight or obesity of 68.6% for individuals ≥ 20 years of age, resulting from a combination of changes in diet and physical activity. Recent research conducted in other indigenous communities in Brazil has also found very high prevalence of overweight or obesity in adults, surpassing 70% in many cases (see review in Coimbra and Santos 2004).

The few studies that have also analyzed the anthropometric profile of the same indigenous population at different moments have confirmed the rapid pace and pervasiveness of the ongoing nutrition transition among Brazilian indigenous peoples (see, for instance, the studies carried out by Lourenço et al. (2008) and Santos and Coimbra (1996) among the Suruí from Rondônia and Sampei et al. (2007) among the Kamayurá of Mato Grosso). As in the Xavante case, those studies emphasize the association between the emergence of overweight and obesity with the commoditization of indigenous economies, bringing about the Westernization of indigenous diets and the reduction of physical activity levels. Not surprisingly, chronic metabolic disorders and cardiovascular disease are also rapidly becoming part of the health-disease profile of indigenous peoples in Brazil (Coimbra and Santos 2004).

As we have mentioned, in recent years, there has been an increase in the number of studies pointing to associations between body composition measures and socioeconomic conditions in indigenous peoples in Lowland South America. Common to those studies is the finding that the processes of socioeconomic change, including increased market involvement, create internal differences within communities that come to be expressed in health differentiation. Our findings show that socioeconomic differentiation is associated with anthropometric measurements in the study population. Notably, the direction of the relationship is the opposite of that often observed in developing countries. Whereas increased weight is often associated with poverty (Caballero 2007), in Xavante society, it is more prevalent among adults from households with greater socioeconomic status. Although our cross-sectional data preclude direct assessment of the historical relationship between socioeconomic change and changes in the nutritional profile, they suggest that socioeconomic status is a factor in the internal contours of the nutrition transition that is taking place among the Xavante. The results also suggest that the process of differentiation and its relation to anthropometric variables is a recent one, as we did not observe differences in stature among adults, which reflects long-term linear growth.

It is relevant to recall that in the Xavante case we are dealing with a society that, in the recent past, did not show significant internal economic differentiation, given that the mode of production was largely identical for all households. Furthermore, even today the Xavante maintain a strong morality of equality and sharing. Pervasive social-leveling mechanisms, such as kinship-based reciprocity, multiple intersecting social affiliations that structure sharing, and the social expectation that those with greater resources should give freely to those with less, may serve to minimize the dietary effects of household income and wealth disparities among male and female individuals. Accordingly, sharing behaviors may mitigate the health effects of socioeconomic differentiation among members of higher-income households and perhaps transfer and dilute them as those benefits are passed to others. Yet our data corroborate the findings of other studies which show that despite reciprocity and other sharing practices, a clear relationship remains between socioeconomic status and adiposity (e.g., Godoy et al. 2005a, b).

Among the most striking findings of our recent study is the very clear role of gender in internal adiposity differentiation. Socioeconomic indicators were strongly associated with adiposity measures for females, considered separately, but not for males. That pattern has been documented elsewhere in the Amazon region, such as the case reported by Lourenço et al. (2008). As in that case, our ethnographic data suggest that the gender discrepancy observed in the relationships between adiposity and income and wealth measures may be explained by gender roles and food sharing.

Among the Xavante, females and males may have different access to food resources, such that female diets reflect more closely the income and wealth characteristics of their households. At Pimentel Barbosa, males tend to eat away from home and share food resources more frequently and according to more diverse social configurations than females. This occurs for several reasons. Males tend to go to town more often than females and during those trips eat in groups in restaurants and purchase food in supermarkets. Males also eat from their yields during hunting and fishing excursions before taking them back to their households. Participation in those subsistence activities was not limited by income-related factors, since 75% of incomes were retirement pensions and only 11 men had employment obligations that partially reduced their availability to hunt or fish. According to our observations, men with high personal and household incomes were among the most avid hunters in the community. Furthermore, males often share food resources according to male-only principles involving extended kinship ties, relative age, and ceremonial group affiliations (other sharing principles apply to women and to both sexes). For example, male members of younger age sets often furnish food to male members of older allied age sets. Also, sons-in-law are generally permitted to eat freely at their natal households throughout life, whereas females frequently do not have an analogous alternative venue within the village. Taken together, these male food consumption and sharing practices may mitigate against residence-based income and wealth disparities manifesting in fatness differentials among men.

Besides the epidemiological component of nutrition transition in our recent research at Pimentel Barbosa, we have also sought to address in greater depth aspects related to Xavante perceptions of the transition in process. Important in this respect have been sociocultural analyses carried out by James R. Welch. As we will see below (and detailed in Welch et al. 2009), these analyses show that Xavante perspectives of health and body weight are highly compatible with, if not in technical agreement with, our finding of an association between socioeconomic indicators and adiposity measures. Taking those compatibilities as a point of departure, we have sought new avenues for interchange between Xavante perspectives and our research in order to stimulate critical and productive attention within the Xavante community to the problem of nutrition transition.

Xavante adults unanimously agree that contemporary life at Pimentel Barbosa is characterized by poorer diets and greatly reduced levels of physical activity than in the past, and that those changes are important factors (among others) in what they

perceive to be an overall deterioration in health and nutritional status throughout the population. However, they also frame those changes in terms of a distinction between “strengthening” foods and behaviors (*danhíptetezé*), which promote health, and “weakening” ones (*danhíp’uwazé*), which diminish it. Although opinions vary, important strengthening foods include wild tubers, traditional maize, wild game meat, and other collected, gathered, and traditional horticultural foods. Examples of weakening foods are cooking oil, salt, pasta, candy, alcoholic beverages, and other introduced and industrial foods. Certain lifestyle and behavioral habits are similarly believed to promote strength and health. For example, traveling in the forest by foot rather than by vehicle is considered to strengthen the body. Also, for men, participating in spiritual rituals and other demanding ceremonial rites is also thought to be a vital source of strength, whereas abandoning them is thought to cause weakness. A theme common to each of these distinctions is an association between foods and activities perceived to be traditional and healthiness. Importantly, according to the Xavante point of view, excess fatness (*dahöi’pi*—“fat skin”) is a common result of nontraditional diets and lifestyles.

Those Xavante interpretations of nutritional transition and adiposity are compatible with epidemiological explanations even if they are not in absolute technical agreement. Specifically, Xavante individuals tend to attribute excessive weight gain not only to specific foods (“weakening” foods) and types of behaviors (avoidance of resistance-building activities) but also more generally to a lack of traditionalist values. Furthermore, many Xavante see money as a potentially corrupting influence that can diminish cultural continuity and compromise traditionalist values. Although we do not make such value judgments, our finding that adiposity is positively associated with income is compatible with the Xavante perspective. More generally, we perceive an emergent awareness at Pimentel Barbosa of the broad deleterious health effects of weight gain, many of which are not accounted for by Xavante ethnomedicine, and a strong disposition toward reducing its prevalence through reconsideration of dietary practices. There is also keen awareness of the practical difficulties in motivating and sustaining behavioral changes to the effect that community leaders explicitly seek solutions that are congruent with contemporary lifestyles and values.

A product of conversations between members of our research group and the community at Pimentel Barbosa regarding diet and health is an ongoing collaborative initiative sponsored by the Museu do Índio, Rio de Janeiro, in which Xavante youth, trained in audiovisual documentation, record traditional subsistence techniques and foodways from their own culture. One of our shared goals for this endeavor is to stimulate interest in traditional foodways among youth and provide tools that facilitate intergenerational communication. It is their hope, and ours, that these new efforts may improve youth appreciation of traditional Xavante dietary culture and thereby better equip young people to make lifestyle choices that implicate good health (Welch 2010).

2.4 Final Considerations

In *Disease and Social Diversity: The European Impact on the Health of Non-Europeans*, Stephen Kunitz (1994) makes a comparative analysis of what he calls the “changing epidemiological regimes” of indigenous peoples in different parts of the world, drawing his examples from North America, Australia, New Zealand, and Polynesia. Kunitz emphasizes the ways in which processes of health and disease overlap with colonial policies, with political institutions, and with indigenous cultures and patterns of social organization, in order to demonstrate that “diseases rarely act as independent forces but instead are shaped by the different contexts in which they occur” (1994: 5).

Stressing the importance of recognizing diversity and giving attention to local contexts, Kunitz argues that although it is possible to find parallels in the situations of indigenous peoples in different parts of the world—when placed in national context invariably they have lower life expectancies, higher morbidity and mortality, and higher rates of violent death compared to nonindigenous peoples—this inequality is produced and reproduced in multiple and diverse forms (see also Stephens et al. 2009). Kunitz does not believe that a few explanatory schemes can be made to render, in any satisfactory way, the complexities faced by human groups living in different historical, social, economic, and political situations. This is even truer of indigenous peoples, who have such diverse histories of interaction with Western expansion and colonialism:

At our present stage of knowledge and in the wake of the recent collapse of many old certainties, it is more useful to understand in detail the myriad ways in which different causes of morbidity and mortality in populations are affected by social processes, rather than strive to build grand theories. (Kunitz 1994: 4–5)

In our research on the Xavante, we have tried to adhere to an analytic focus that recognizes the influence of local history, or, as Kunitz writes, adopt a “particularistic approach to the study of diseases in populations” (1994: 4). This approach is especially pertinent to our discussion of the changing health and disease patterns of the Xavante. The subject of gender, mentioned in the introduction of this chapter, is an important example. In the case of demography, certain female social and biological processes, such as fertility, are shown to be closely linked to changing national health policies. Similarly, oral health data demonstrate a link between gendered health disparities and Xavante sociocultural values that favor large families, which may in turn be associated with historical political processes at regional and national levels. Nutrition data also point to a relationship between a more elevated weight gain among women, as compared to men, and emergent socioeconomic differentiation accompanying the sociopolitical process of increasing market integration. When considering the various forms that the “epidemiological transition” may assume, we find that they are made up of elements that include political history, demography, human ecology, and epidemiology—in short, the themes we have been addressing in our research over the years.

A benefit of reflecting on one's past research is that it offers an opportunity to recognize patterns that are not otherwise obvious. An important pattern that emerges from the three studies we have highlighted in this chapter is the interrelatedness of health and various ecological, political, economic, and sociocultural transformations of different temporal scales. In the Xavante case, this dynamic may be framed as involving interaction between both biology and culture and internal and external sociocultural factors. For example, although gender was not a primary focus of our research, each of the three studies we discuss in this chapter reveals gender to be an important component of health. Gender, considered in relation to biology, demography, social behavior, and political policy, proves to be an important factor in diverse aspects of health transition among the Xavante. Such interconnections are central to our ongoing research and motivate us to pay special attention to relationships between health and environmental context, which we consider in both its physical/biological and sociopolitical dimensions.

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