Medical Anthropology Quarterly

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Individual Wealth Rank, Community Wealth Inequality, and Self-Reported Adult Poor Health:

A Test of Hypotheses with Panel Data (2002–2006) from Native Amazonians, Bolivia

Growing evidence suggests that economic inequality in a community harms the health of a person. Using panel data from a small-scale, preindustrial rural society, we test whether individual wealth rank and village wealth inequality affects self-reported poor health in a foraging–farming native Amazonian society. A person's wealth rank was negatively but weakly associated with self-reported morbidity. Each step up/year in the village wealth hierarchy reduced total self-reported days

MEDICAL ANTHROPOLOGY QUARTERLY, Vol. 24, Issue 4, pp. 522–548, ISSN 0745-5194, online ISSN 1548-1387. © 2010 by the American Anthropological Association. All rights reserved. DOI: 10.1111/j.1548-1387.2010.01121.x

ill by 0.4 percent. The Gini coefficient of village wealth inequality bore a positive association with self-reported poor health that was large in size, but not statistically significant. We found small village wealth inequality, and evidence that individual economic rank did not change. The modest effects may have to do with having used subjective rather than objective measures of health, having small village wealth inequality, and with the possibly true modest effect of a person's wealth rank on health in a small-scale, kin-based society. Finally, we also found that an increase in mean individual wealth by village was related to worse self-reported health. As the Tsimane' integrate into the market economy, their possibilities of wealth accumulation rise, which may affect their well-being. Our work contributes to recent efforts in biocultural anthropology to link the study of social inequalities, human biology, and human-environment interactions.

Keywords: [Tsimane', economic rank, inequality, self-rated health, social gradient of health, socioeconomic status]

The relation between economic inequality and human biology has been a growing concern of biocultural anthropologists in recent years, as a way of understanding how broader social structures are embodied in individuals (Dressler 2001, 2005; Dressler et al. 1998; Leatherman 1996, 2005). Growing evidence worldwide suggests that economic inequality in a community harms the health of a person even after conditioning for resources of the individual, household, and community (Leatherman 2005; Wilkinson and Pickett 2006; 2009; World Health Organization [WHO] 2008). Nevertheless, the issue still stirs controversy, and some authors remain skeptical about the relation (Gravelle 1998; Lynch et al. 2004a, 2004b). More than 200 studies and several reviews (Lynch et al. 2004a, 2004b; Macinko et al. 2003; Subramanian and Kawachi 2004; Wilkinson and Pickett 2006, 2009) have been published in the last decade, with little indication of closure over the topic.

Most researchers have taken two broad but complementary approaches to study the topic from a social perspective. The first approach stresses the causal chain going from (1) the growth of community economic inequality to the (2) erosion of social capital, (3) to the weakening of social trust and to the increasing frequency of negative emotions, stress, and stress-related behaviors (e.g., drinking, violence, depression) (Gallo and Matthews 2003; Gallo et al. 2006; Ichida et al. 2009; Kawachi 2000; Ryff and Singer 2003; Wilkinson and Picket 2009), and—through paths (2) and (3)—to the breakdown of selected indicators of self-reported and objective health (Cohen et al. 1999; Smith et al. 2004).

The second approach stresses the positive association between a person's socioeconomic rank and a person's good health through processes of social comparison or access to differential resources (Adler and Ostrove 1993; Leatherman 1996; Link and Phelan 1995; Macinko et al. 2003). All else held constant, people higher up relative to others in the social or economic hierarchy of a community enjoy better health than their peers lower down the hierarchy in gradient fashion (Marmot 2004; Sapolsky 2004). Higher social or economic rank contributes to better health through several linked paths, including biological mechanisms (e.g., reduced allostatic load), psychological responses (e.g., negative emotions, stress), exposure to harmful environments (e.g., pathogens, workplace), social capital, and stress-related behaviors

(Adler and Snibbe 2003). To explain the relation between individual health and community economic inequality some researchers have stressed other paths besides the ones just noted (e.g., Gravelle 1998; Leatherman 1996; Macinko et al. 2003). For example, Leatherman (1996) notes that pervasive illness affects work and production and contributes to poverty. However, these alternative approaches are beyond the scope of this article.

Advocates of the two main approaches agree on several points. First, they agree on the health outcomes most likely affected by community economic inequality. These health outcomes respond to negative emotions and include but are not limited to cardiovascular disease, diabetes, obesity, chronic respiratory diseases, substance abuse, and psychiatric disorders (Adler and Snibbe 2003; Cohen et al. 1991; Kaplan and Keil 1993; Siegrist and Marmot 2004). Second, they agree on the main paths mediating the relation between socioeconomic rank and health. The paths include psychosocial factors, social capital, and attributes of the workplace and community. Third, proponents of the two approaches agree that inferences about the effects of economic inequality on health must control for resources at the individual, household, and community levels that protect health (e.g., education; see Macinko et al. 2003; Muntaner and Lynch 1999; Subramanian and Kawachi 2004). Nevertheless, proponents of the two approaches differ in the underlying determinant they stress, with proponents of the first approach emphasizing the role of community economic inequality and proponents of the second approach emphasizing a person's relative standing in the social or in the economic hierarchy of a community (Lynch et al. 2004a, 2004b).

Both approaches leave open the level at which one defines a community (e.g., state, nation), the economic resource (e.g., income, wealth), or social resource (e.g., status) whose inequality presumably affects individual health, and the way one measures economic inequality or a person's individual socioeconomic rank (e.g., self-perceived vs. objective status; Goodman et al. 2007). In this article, we use the term *community economic inequality* or simply *economic inequality* to refer to the economic inequality measured at the village level each year (e.g., Gini wealth inequality of a village), and we use the term *individual economic rank* to refer to a person's objective relative standing in the economic hierarchy of a community during a year (i.e., 1 = least wealthy person, 2 = slightly more wealthy than 1, etc.). Among socioeconomic indicators we focus on wealth rather than on other economic resources (e.g., income) or on social resources (e.g., status) because wealth is a canonical indicator of many indicators of well-being (e.g., consumption, vulnerability) and because it is relatively simple to measure with accuracy in rural settings of developing nations (Davies et al. 2008; Filmer and Pritchett 2001).

Our approach to evaluating the social gradient of health is novel in two regards: (1) here we test the two approaches to the study of community economic inequality and individual health simultaneously and (2) by using a panel dataset we are able to explore the longitudinal dimension of the status gradient in small-scale rural communities, and we can do so while controlling for individual and community fixed effects. In all cases we condition for both community economic inequality and for a person's economic rank in the community. We test the following three hypotheses.

First, we expect that a person's wealth rank will bear a negative association with her or his self-reported poor health (i.e., the higher the wealth rank of a person, the lower her or his self-reported poor health; H_1).

Second, we expect that community wealth inequality will bear a positive association with a person's self-reported poor health (i.e., the larger the wealth inequality in the community, the more likely a person will report suffering from poor health; H_2).

Third, because the two approaches identify social capital and negative emotions as salient mediating path variables, we expect that neither a person's wealth rank in a community nor community wealth inequality will bear a significant association with a person's self-reported poor health once we condition for these mediating pathways (H_3).

To our knowledge both approaches have never been tested simultaneously. A moment's reflection suggests that they should, as it is theoretically and empirically possible that the effect of wealth rank on individual health will vary in relation to the wealth inequality of a community. Individual wealth rank might only affect a person's self-reported health when community wealth inequality is large. When the wealth inequality in a community is small, then the difference in wealth separating one person from the person just above them or just below them in the hierarchy will also be small and unlikely to affect individual health. Furthermore, large community wealth inequality might be associated with permanency in individual wealth rank, and it is possible that duration in a rung of the wealth hierarchy might affect individual health more than the mere position in the hierarchy. If a person's rank in the wealth hierarchy of a community is fluid and if people continuously slip in and out of neighboring ranks, then individual wealth rank will be unlikely to affect individual health because the benefits or the burdens that rank imposes on the person will be transitory—unless the unpredictability of shifting ranks is enough to impact stress and stress-related behaviors. One might hypothesize that a person's economic rank in a community will most likely affect a person's health when people get locked into a rung of the wealth hierarchy of a community, or when it is costly and time consuming to change one's relative position in the wealth ladder of a community.

Most studies of the effects of socioeconomic status (SES) or rank on a person's health come from industrial societies (see Reyes-García et al. 2008 for a recent review), and few have considered its longitudinal dimension. While the SES and health gradient has been verified in almost every industrialized nation in which it has been tested, the existence of a similar gradient of health inequalities in small-scale societies has yet to be explored. To address these gaps in the literature, we draw on an unusual panel dataset, the Tsimane' Amazonian Panel Study, TAPS, a public-use microdataset that includes five annual surveys from a foraging and farming society of native Amazonians in Bolivia, the Tsimane'

Testing the two approaches with data from a small-scale, preindustrial rural society has several advantages, but also some disadvantages. First, unlike industrial societies, economic rank is easy to compute in small-scale societies such as the Tsimane' where population size is low and there is a narrow range of goods that contribute to material wealth. In contrast, the large population and geographical size, ethnic and racial heterogeneity, and large range of physical goods in which people keep their wealth make it difficult to accurately identify a person's wealth rank in industrial societies. Besides posing difficulties in the selection of items to measure wealth, industrial societies make it difficult to identify the appropriate reference community. For instance, a woman might score low in the wealth rank

of the entire society but score high in the wealth rank of her neighborhood or ethnic group. For wealth rank to affect a person's health, the measure of a person's wealth rank should rest on a geographically and culturally informed reference group (Subramanian and Kawachi 2004), and we think this task is far easier in a small-scale, preindustrial rural society than in an industrial society.

A second advantage of working in a small-scale, preindustrial rural society has to do with the ease of controlling for confounders that plague empirical estimates in industrial societies. For example, in industrial societies the link between a person's health and community income inequality has been hard to estimate accurately because community income inequality also picks up the effects of race and ethnicity (Deaton and Lubotsky 2002) and overlaps with characteristics of neighborhoods (Ackerson et al. 2008) and the workplace (Siegrist and Marmot 2006). Fortunately, in small settlements where there is little occupational division of labor beyond the lines of sex or age, one can conveniently remove the role of these confounders by the simple choice of research location.

Nevertheless, the kin-based fabric of these small-scale, preindustrial societies might produce unexpected findings. In industrial societies people are unlikely to be tied by bonds of blood or marriage to those above or below them in the economic hierarchy of a community. It follows that the distance in economic resources separating people from those above or below them in the socioeconomic hierarchy of a community might cause distress and harm health in part because people do not have claims on the resources of anonymous people above or below them. Now contrast this with the social tapestry of a small-scale, preindustrial rural society in which bonds of blood and marriage link people across households in a community. Then, even if community economic inequality is large or growing, even if the difference in economic resources separating people along each rung of the economic ladder is large, and even if people get locked into a rung of the hierarchy, a person's rank in a community might not harm health because those above or those below one are likely to be kin, and one is less likely to feel resentment at economic inequalities within a tight kin group than within a group composed of anonymous strangers.

This study responds to a growing interest among anthropologists to develop new theoretical perspectives and methods on biocultural research. There have been important efforts to link the study of social inequalities, human biology, and human–environment interactions, to understand the relation between individuals and broader social structures, particularly as they refer to inequality and health (Dressler 2001, 2005; Dressler et al. 1998; Leatherman 1996, 2005). This task also requires diversifying inquiry methodologies, such as developing culture-specific indicators through ethnographic work and the use of quantitative methods for hypothesis testing (Dressler 2005).

Background and Study Site

The Tsimane' are a horticultural and foraging society in the rain forests at the eastern foothills of the Bolivian Andes in the department of Beni. They number ~8000 people and live in ~100 villages, mostly along the Maniqui and the Apere rivers (see Figure 1). Tsimane' have low income and are highly autarkic. Their subsistence and economy centers on hunting, fishing, plant foraging, and slash-and-burn farming,

with the sale of thatch palm and cash cropping of rice increasingly becoming the most important economic activities of households (Reyes-García et al. 2008; Vadez et al. 2004). Other sources of monetary income include the sale of various crops, such as maize, manioc, and fruit, sale of domesticated animals and animal products such as eggs, sale of forest products such as timber and firewood, wage labor in logging camps, cattle ranches, and in the homestead of highland colonist farmers and salaried work in local institutions (e.g., schools). Several historical and ethnographic studies of the Tsimane' have been published (Huanca 2006; Martínez-Rodríguez 2009; Reyes-García 2001), and in previous studies we have also analyzed Tsimane' forms of subsistence and incorporation to the market economy (Godoy et al. 2005a, 2006a, 2009; Reyes-García et al. 2008).

Tsimane' society is relatively egalitarian in many ways. As in other lowland native Amazonian groups, there are various norms of sharing and reciprocity. These are partly explained by a preferential system of cross-cousin marriage, common migration between villages (Ellis 1996), and frequent visiting, which creates a thick and wide network of relatives relations. Tsimane' borrow each other's assets constantly, often without asking the owner. They also share food and beverages such as game and locally made fermented beverages *(chicha),* and they participate in community work, especially in the smaller villages (Godoy et al. 2004). Furthermore,

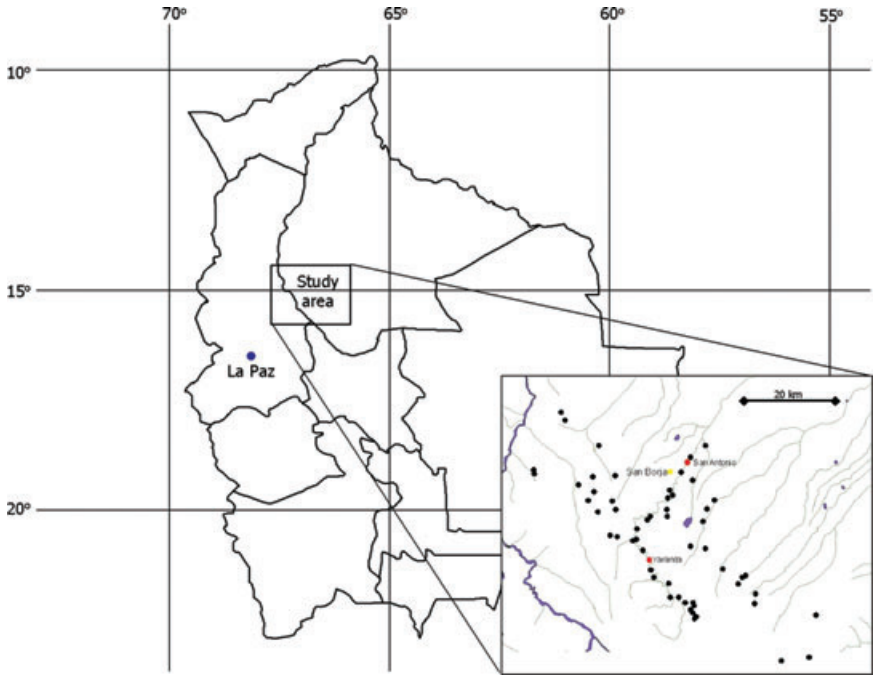

Figure 1 Tsimane' Amazonian Panel Study area and the distribution of Tsimane' villages in the department of Beni, Bolivia.

their myths describe how humans stole crops from supernatural beings who had refused to share their crops (Godoy et al. 2007).

Nevertheless, we have observed considerable differences in their attitude toward traditional and modern assets, as traditional assets are more readily available to everyone in the village. For example, people can borrow a mortar lying in an open courtyard, but they cannot use a firearm or an outboard motor without the explicit consent of the owner. The possibilities of wealth accumulation have risen as Tsimane' have become more sedentary. In fact, some houses even have locks on the doors to guard possessions, usually in those villages nearer to market towns (Godoy et al. 2004). Even in remote villages, one finds a strong ethos of economic independence among households, especially regarding farm and forest goods produced by each household.

Materials and Variables

The data presented in this article come from five waves (2002–06, inclusive) of an ongoing panel study in the Bolivian Amazon, the Tsimane' Amazonian Panel Study (TAPS). The objective of TAPS is to document the effects that a rapid integration into the national and international market economy is having among the Tsimane'. Every year, between June and August, we measure a broad range of indicators of well-being, including economic measures (e.g., income, food consumption, expenditures, wealth), social capital (e.g., expressions of prosocial behavior within the community and with outsiders), biological and health indicators (e.g., anthropometric indicators of nutritional status), psychological states and social indicators (e.g., sadness, fear), and human capital (e.g., ethnobotanical knowledge, school attainment, academic skills such as math or reading). The study was preceded by seven years of pilot research (1995–2001), which included a broad range of data-collection methods, from ethnographic studies to cross-sectional pilot surveys. During that first stage, we identified communities, built trust with the villagers, trained local researchers, built infrastructure, and refined methods of data collection.

The population of adults totals 433 women and 455 men from 332 households (Leonard and Godoy 2008). We selected 13 villages along the Maniqui River to capture geographic variation in proximity to the market town of San Borja (mean = 25.96 km; SD = 16.70), which also serves as a proxy for variation in market exposure and degree of community income inequality. The complete data and its documentation, along with publications from the project, are available for public use at the following address: www.tsimane.org.

The sample used in this article contains only people over the age of 16 (or younger if they headed a household) because we excluded children and young adults when measuring economic indicators, social capital, and negative emotions.[1,2] Because we surveyed the entire population of the 13 villages and the villages were not selected at random from the total population of about 100 Tsimane' villages, we must exercise caution when interpreting many standard statistics. Griliches (1986) and others (McCloskey and Ziliak 1996) have noted that when one deals with an entire population rather than a random sample, then the meaning of many statistics (e.g., standard errors of regressions) are far from obvious, and in such cases tests

of statistical significance likely tell one more about the adequacy of the model than about the likelihood of finding the results.[3]

Materials

For this article, we use a panel dataset with individual-level information on the following outcome, underlying, and path variables to test the two approaches: (1) self-reported poor health *(outcome),* (2) physical assets used to construct the *underlying variables* of each of the two approaches (i.e., a person's wealth rank in the community and community wealth inequality), and (3) social capital and negative emotions *(path variables)*. Because we have repeated observations of the same people, we can remove the confounding role of attributes of the person that remain stable during the study period (hereafter, "individual fixed effects").

Variables

Table 1 contains definition of the variables used in the regressions. Details of how we measured the variables are in earlier publications (Godoy et al. 2005a, 2005b, 2006b). We discuss below how we measured the variables relevant to the two approaches, which include: (1) self-reported poor health (outcome), (2) a person's wealth rank, (3) village wealth inequality, (4) social capital, and (5) negative emotions as a proxy for psychosocial factors.

Self-reported poor health. We equate poor health with the number of self-reported bed-ridden days because of illnesses during the 14 days before the day of the interview. We do not know whether the variable for poor health contains random measurement error, but we know the variable contains forward telescoping bias, omission bias, or both. To obtain data on morbidity, we broke up the recall period and asked about bed-ridden days during the 1–7 days before the interview, and we then asked about illnesses during the 8–14 days before the interview. We limited the recall period to two weeks before the day of the interview because we found that sickness recalls beyond that period produced unreliable information. A shorter recall period (e.g., one day) might have produced more accuracy but would have also produced lower variance. Assessment of health status using self-reported measures has been used in a variety of health studies (DeSalvo et al. 2005; Idler and Benyamini 1997), including well-known anthropological studies, such as Leatherman's (1996) study in Nuñoa, Peru (e.g., number of symptoms, number of days of work lost). From an anthropological perspective, assessments of self-reported health might give more information to the researcher than an objective health measure because health is a function of "the burden of pathology and the individual's social and cultural context" (Murray and Chen 1992). As defined by WHO (1996), "health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity."

A person's wealth rank. Studies of health and economic inequality in industrial nations use individual or household monetary income as a marker of economic

Table 1. Definition of Variables Measured Annually, 2002–06 (Inclusive), Used in the Regressions for Tsimane' >16 Years of Age

Name of variable	Definition of variable	Obs	Mean	SD
A. Dependent variable				
# of days in bed	Total number of self-reported days in bed due to illness during the 14 days before the day of the interview. Total # of days. In regression, +1 added to raw values before taking natural logarithms	3107	1.818	3.701
B. Explanatory variables				
I. Economic inequality				
Person's wealth rank in village	Person's rank in wealth in the village (1 = person with least wealth; 2 = next wealthiest . . .). See V below for definition of wealth	3011	27.34	17.81
Gini wealth-village	Gini coefficient of individual wealth in a village	13	0.47	0.06
II. Social capital				
Gifts	Person made gifts to others during the seven days before the day of the interview = 1; 0 = otherwise	3014	0.34	0.47
Drinks	Person consumed traditional fermented beverage (*chicha*) during the seven days before the day of the interview = 1; 0 = otherwise	2895	0.32	0.47
Credit	Dichotomous variable for whether person reported having access to credit in an emergency (1 = access; 0 = no access)	3006	0.39	0.49
III. Negative emotions				
Sadness	Did not laugh during the interview = 1; 0 = laughed	2879	0.48	0.50
Anger	Person experienced the emotion during the seven days before the day of the interview = 1; 0 = otherwise	2889	0.29	0.45
Fear	Person experienced the emotion during the seven days before the day of the interview = 1; 0 = otherwise	2889	0.40	0.49
IV. Individual resources				
Standing stature	Standing physical stature in centimeters In regression, value transformed into natural logarithm	2800	156.67	7.89
BMI	Body-mass index; body weight in kg/stature^2. In regression, value transformed into natural logarithm	2800	23.45	2.68
Schooling	Maximum school grade completed by person (years of education)	3024	1.98	2.33

(Continued)

Table 1. Continued

Name of variable	Definition of variable	Obs	Mean	SD
V. Controls				
Household size	Number of people in the household	3107	6.78	3.00
Mean individual wealth	Mean of individual wealth by village Wealth is the monetary value of sum of five traditional physical assets (e.g., canoes, bows) + 13 modern physical assets (e.g., radios, cutlasses) + four domesticated animals (e.g., cattle, chickens, ducks) owned by the person. [Bolivianos]	13	1136.92	318.15
Male	Person's sex (male = 1; female = 0)	3143	0.51	0.50
Age	Person's age in years	3133	35.74	17.34
Year	Year of survey	5	–	–

resource because monetary income affects many indicators of health and well-being (Kawachi 2000; Lynch et al. 2004a, 2004b). In small-scale, preindustrial rural societies, the measure of monetary income poses problems because much of rural people's income comes from consuming goods they produce themselves (Godoy et al. 2007; Deaton 1997). For this reason and because of the ease of collection, we focus on physical assets rather than on monetary income as the main economic indicator (Davies et al. 2008; Filmer and Prichett 2001). In addition, all adults had some physical assets, whereas nearly a third of adults had no monetary income.

We measured wealth by first adding the nominal monetary value of 22 physical assets owned by the person: (1) five traditional physical assets central to their subsistence (e.g., canoes, bows), (2) 13 modern physical assets that capture some luxury goods (e.g., radios) and modern technologies for agricultural production (e.g., cutlasses), and (3) four domesticated animals (e.g., chickens, ducks) that contribute to consumption and that buffer people against adverse mishaps. Based on ethnographic knowledge of the Tsimane' (Huanca 2006; Martínez-Rodríguez 2009; Reyes-García 2001), we selected a range of physical assets to capture wealth differences in the entire sample, and between women and men. For instance, the poorest people own bows, arrows, and small animals (e.g., chickens), but wealthier people are more likely to own large domesticated animals (e.g., cattle) and expensive industrial goods (e.g., guns). Among the assets we measured, we included assets that women own (e.g., bags, pots) and assets that men own (e.g., cattle, guns). We multiplied the quantity of each asset owned by the selling price of the asset in the village to estimate the monetary value of the asset, and then totaled the value of the different assets to arrive at the nominal value of total wealth for the person. Current nominal values for wealth were transformed into inflation-adjusted (hereafter, "real") values using the consumer price index of Bolivia.[4]

Because every adult had some assets, we computed a measure of wealth rank for each person in a village during each of the five years. For example, for the year 2002 and for the first village, we assigned a rank of one to the person with the lowest real wealth in the village; we assigned a rank of two to the next wealthiest person

in that village, and so on. We repeated the steps for each person of the first village for the years 2003, 2004, 2005, and 2006, and for all the people in the remaining villages.

Village wealth inequality. From measures of real wealth for each person (as described above), we computed the Gini coefficient of wealth inequality in a village for each of the five years. As shown in Figure 2, the Gini coefficient is the ratio of the area [A] between the "line of perfect equality" [xy] and the Lorenz curve (cumulative frequency distribution that shows the percentage of wealth owned by a determined percentage of the population), over the area [A+B] enclosed between the line of perfect equality and the line of perfect inequality. The Gini coefficient has become the gold standard in measures of community economic inequality (Deaton 1997; Sen 1973, 1976).

The relation between community income inequality and health might be a statistical artifact as noted by Gravelle (1998). The observed relation between health and economic inequality might not be linear, and if levels of poor health decline with income at a decreasing rate, then the correlation between community income inequality and average community health might be an artifact of how one aggregates data. This ecological fallacy problem arises when using aggregate rather than individual data, for example when comparing inequality as measure by the Gini coefficient between communities with health measures averaged at the community level. In a relatively egalitarian village most individuals would be relatively near to the mean income; that is, the average poor will have higher individual income, thus showing better health than in other villages with more unequal distributions.

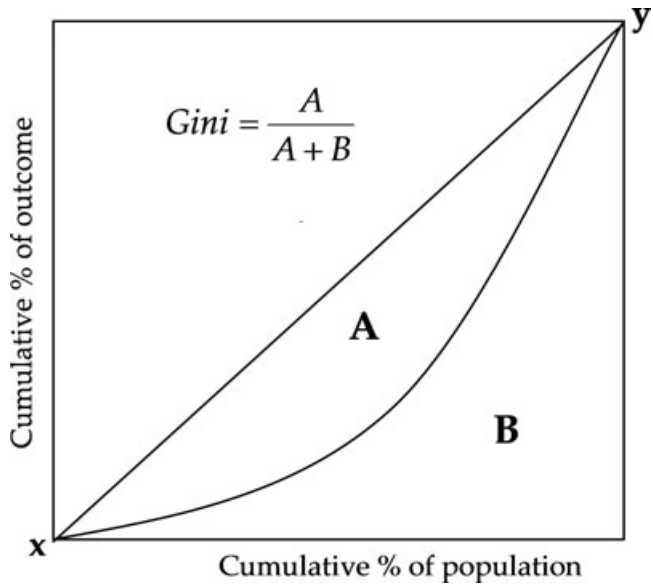

Figure 2 Estimation of the Gini coefficient.

To address this concern, we run the regressions using individual-level measures of health outcomes and village-level data as covariates (e.g., Gini coefficient of wealth inequality), but we also control for the average village measure of individual wealth (Blakely and Kawachi 2001).

Social capital. We used three separate variables to measure a person's social capital: (1) the number of times the person made gifts to others during the seven days preceding the interview, (2) a person's ability to borrow $100 *bolivianos* in an emergency ($1 = averaged $\sim$ 8 *bolivianos* during the study period), and (3) the number of times the person had drunk *chicha* during the seven days before the day of the interview. Fermented from crops such as manioc, plantains, or maize, *chicha* is generally drunk in a group and is the preferred way through which native Amazonians share experiences with each other and is a cornerstone of Tsimane' social life (Overing and Passes 2007). Unfortunately, we did not ask study participants whether they had consumed *chicha* in a group or alone.

Negative emotions. As proxies for psychosocial factors, we measured three negative emotions: (1) sadness, (2) anger, and (3) fear. We created a sadness variable, which took the value of one if the person neither smiled nor laughed, or only smiled during the interview, and zero if the person laughed and smiled many times. We recognize the importance of affect and personality as a filter for the individual experience of status (Sapolsky 2004) and have reviewed the cross-cultural literature showing the validity of smiles as a reliable marker of mirth elsewhere (Godoy et al. 2005b). To measure anger and fear, we created separate dummy variables based on the interview responses: if a person did not report experiencing the emotion within the previous seven days they were assigned a zero, whereas if they reported one or more episodes of that emotion they were assigned a one.

Individual resources included the person's wealth, standing physical stature, body-mass index (BMI; body weight in kg/standing height in m^2), and a person's maximum school grade attained. Household resources included total wealth (excluding the wealth of the subject) and household size measured with a head count of all people living in the household at the time of the annual survey. Control variables included the person's age in years, the mean of individual wealth by village, the survey year, and a full set of dummy variables for villages ($n = 13 - 1 = 12$) to control for village attributes that remain fixed during 2002–06.

Analysis

For the main analysis we use panel linear regressions with individual and community fixed effects, clustering by individual, and robust standard errors. We use fixed effects regressions to remove unobserved effects that do not change during the study period and that might affect health and economic conditions. For instance, some people may be innately more resilient or have a "thicker skin," or may be more prone to climb the socioeconomic ladder. Also, some villages are located nearer to towns than others, which allows for more frequent contact with outsiders, thereby increasing their risk of acquiring diseases and of engaging in market exchanges. Failure to control for these traits that remain stable over the study period would result in biased and inconsistent estimates.[5]

In addition, we also included negative binomial regressions (NBR) with individual fixed effects because the dependent variable—number of days ill—is a count variable (i.e., does not have a normal distribution) and is also problematic because events are interdependent; for example illness on an initial occurrence increases the probability of illness on a future occurrence. Using a Poisson model would result in inefficient and biased estimates because we found interdependence and overdispersion in the outcome variable (mean = 1.81, overdispersion = 5.28; Winkelmann 1995). (For the comparison of fit between Poisson and negative binomial distribution for bed-ridden days see Figure S.1 under supplementary material.) For the statistical analysis we used Stata for Windows, ver. 10 (Stata Corporation, College Station, Texas).

Main Results

Table 2 shows three important results. The estimated coefficients tell basically the same story in the two specifications of the model. First, we find confirmation for hypothesis #1, that a person's wealth rank bears a negative association with self-reported poor health. A fixed-effects regression (Table 2, column 1) suggests that if a person moves up one step in the annual wealth hierarchy of the village, then the total number of self-reported days spent in bed from illness falls by 0.40 percent ($p = .02$). The descriptive statistics of Table 1 suggest that an adult in the sample reported spending on average 0.91 days in bed each week from illness. Assuming no seasonality in morbidity across the year, this mean value implies that an adult in one year would have spent 47 days in bed from illness (47.3 days = 0.91 days/week*52 weeks). The regression coefficient of 0.40 percent implies that moving up the village wealth hierarchy by one step would lower by only 0.18 days the number of bed-ridden days in one year (0.18 days = 47.3 bed-ridden days/year*0.004). For example, in a village with 55 adults, moving from the median wealth rank to the highest would lower the number of bed-ridden days by 5.1 days. However, when we examine the entire sample of adults over the five years, we find that a typical adult changed wealth rank by only one place during the entire five years (mean = 1.13 places; median = 1.25, standard deviation = 12.45), suggesting that a person's wealth rank is relatively stable in the short run. The NBR coefficient (column 4) suggests that for a unit increase in wealth rank the number of bed-ridden days is expected to decrease by a factor of 0.994 ($p = .08$; $0.994 = \exp[-0.006]$).[6] For instance, for an average person in the sample passing from a wealth rank of 10 to 11 in a year implies a reduction of 0.28 bed-ridden days. Therefore, each unit increase in a person's wealth rank in the village protects against poor health, but the effect is minor in actual health terms, despite its statistical significance.

Second, we do not find confirmation for hypothesis #2, that community wealth inequality bears a positive association with a person's self-reported poor health. The Gini coefficient of columns [1] and [4] in Table 2 had the positive sign predicted in hypothesis #2, but neither result was statistically significant (SR column [1] $p = .28$, NBR column [4] $p = .41$).

Third, we find mixed confirmation for hypothesis #3, that once we condition for the mediating path variables of social capital and of negative emotions (Table 2, columns [2–3]), the effect of village wealth inequality or of a person's wealth rank

Table 2. Relation among Self-Reported and (I) economic inequality, (II) social capital, and (III) negative emotions in Tsimane' > 16 Years of Age

		Dependent variable: natural logarithm of number of days in bed from illness during the 14 days before the interview					
Category	Explanatory variables:	[1] OLS	[2] OLS	[3] OLS	[4] NBR	[5] NBR	[6] NBR
I. Economic inequality	Person's wealth rank in village	−0.004**	−0.003**	−0.003*	−0.006*	−0.007**	−0.007*
		(0.002)	(0.002)	(0.002)	(0.004)	(0.004)	(0.004)
	Gini wealth in village	0.377	0.079	0.102	0.597	0.133	0.250
		(0.354)	(0.347)	(0.343)	(0.737)	(0.755)	(0.762)
II. Social capital	Gifts		0.095***	0.098***		0.217**	0.215**
			(0.035)	(0.035)		(0.084)	(0.084)
	Drinks		0.009	0.010		0.018	0.020
			(0.035)	(0.035)		(0.091)	(0.091)
	Credit		0.068*	0.077*		0.112	0.145
			(0.040)	(0.040)		(0.098)	(0.099)
III. Negative emotions	Sadness			0.111***			0.298***
				(0.031)			(0.084)
	Anger			0.009			0.016
				(0.038)			(0.096)
	Fear			0.030			0.131
				(0.036)			(0.090)
	R-squared: overall	0.007	0.010	0.013	–	–	–
	Observations	2692	2652	2640	1885	1826	1817

Note. Results of individual fixed-effect OLS (OLS) and negative binomial (NBR) panel regressions with annual panel data 2002–06 (inclusive). All regressions include clustering by subject and the variables (not shown) under individual resources and controls as shown in Table 1.
All regressions include clustering by subject and the variables (not shown) under individual resources and controls as shown in Table 1. OLS regressions include a full set of dummy variables for villages (n = 13–1 = 12) and robust standard errors in parenthesis.
Because the negative binomial estimation fails when including dummy variables for villages, we controlled for village effects using walking distance to village (hrs), which range from 0.08 to 45 hours. NBR regressions show standard errors in parentheses, and bed-ridden days are not logged.
Because the negative binomial estimation fails when including dummy variables for villages, we controlled for village effects using walking distance to village (hrs), range from 0.08 to 45 hours. Standard errors in parentheses. Bed-ridden days are not logged. Significance: * = ≤10%, ** = ≤5% and *** = ≤1%.

on self-reported poor health wanes.[7] We say "mixed confirmation" for two reasons. First, the coefficients of both a person's wealth rank and the Gini coefficient of village wealth inequality become smaller—as hypothesized—once we conditioned for path variables. After conditioning for both a person's social capital and for negative emotions, we find that the coefficient of a person's wealth rank falls from −0.004 ($p = .02$, column [1]) to −0.003 ($p = .06$, column [3]), and the Gini coefficient of wealth inequality in the village drops from 0.377 ($p = .25$) in column [1] to 0.102 ($p = .76$) in column [3] (although not statistically significant). However, these findings do not hold when running NBR (Table 2, columns [5] and [6]). We see that the effect marginally increases when conditioning for path variables. The incidence rate ratio decreases from 0.994 ($p = .08$) in column [4] to 0.993 ($p = .06$) in column [6]. Second, and on a more technical note, the coefficient of a person's wealth rank (−0.003) in column [3] using linear fixed-effect regression remains statistically significant ($p = .06$) even after controlling for path variables, and the same holds for the coefficient in column [6] using NBR ($p = .06$). Thus, one could tentatively conclude that a person's wealth rank bears a statistically significant association with a person's poor health even after conditioning on path variables. Note, however, that the magnitude of the association between self-reported poor health and a person's wealth rank continues to be small in actual health terms. The coefficients for the variable of a person's wealth rank in column [1], −0.004, compared with columns [2] or [3], −0.003, are virtually identical and suggest that the average adult Tsimane' would expect to see a reduction of only ∼0.14 days in bed from illness from a typical yearly change of economic rank in the sample after we condition for path variables (0.14 days = 47 bed-ridden days/year*0.003). The same can be said for the coefficients for wealth rank using NBR in column [4], −0.006, column [5], −0.007, and [6], −0.007.

An unexpected finding from our analysis was that the mean of individual wealth by village, used as a control variable, was positively and significantly associated with a person's self-reported health when running NBR regressions (not shown). For regression in column [4] coefficient = 0.0005, $p = .001$; column [5] coefficient = 0.0005, $p = .002$; column [6] coefficient = 0.0004, $p = .01$). This coefficient suggests that for every additional boliviano ($1 ∼ 7 bolivianos) in the mean individual wealth by village, the number of self-reported bed-ridden days is expected to increase by a factor of 1.0005. For example, if the mean individual wealth in a village increases by 70 bolivianos (∼$10), on average an adult will spend 0.035 additional days in bed per week, which implies an increase in 1.82 bed-ridden days per year. This finding is counterintuitive, as it is indicating that as the community becomes richer (measured as a sum of traditional + modern physical assets), the self-rated health of individuals gets worse. The relation between mean self-reported bed-ridden days, mean predicted bed-ridden days from Table 2 column [6], and mean individual wealth in a village are shown in Figure 3.

Additional Analysis

We did further analysis to test the robustness of the main results shown in column [3] of Table 2. Table 3 contains the results of the additional analysis. First,

Table 3. Sensitivity Analysis among Tsimane' >16 Years of Age

		Dependent variable: natural logarithm of number of days in bed from illness during the 14 days before the interview					
Category	Explanatory variables:	[1] HLM[a]	[2] HLM[b]	[3] NBR[c]	[4] NBR[c]	[5] NBR[c]	[6] Tobit RE
I. Economic inequality	Person's wealth rank in village	−0.001	−0.001	−0.005	−0.007*	−0.009**	0.001
		(0.001)	(0.001)	(0.005)	(0.004)	(0.004)	(0.003)
	Gini wealth in village	0.102	0.057	0.284	−0.287	0.204	0.276
		(0.275)	(0.276)	(0.765)	(1.123)	(0.763)	(0.905)
II. Social capital	Gifts	0.129***	0.128***	0.214**	0.214**	0.219***	0.320***
		(0.028)	(0.028)	(0.084)	(0.085)	(0.085)	(0.084)
	Drinks	−0.004	−0.003	0.019	0.016	0.021	−0.001
		(0.028)	(0.029)	(0.091)	(0.091)	(0.091)	(0.086)
	Credit	0.073**	0.077**	0.145	0.141	0.142	0.228**
		(0.032)	(0.032)	(0.099)	(0.099)	(0.099)	(0.097)
III. Negative emotions	Sadness	0.100***	0.099***	0.300***	0.296***	0.299***	0.289***
		(0.026)	(0.026)	(0.084)	(0.084)	(0.083)	(0.080)
	Anger	0.032	0.028	0.014	0.018	0.023	0.101
		(0.030)	(0.030)	(0.096)	(0.096)	(0.097)	(0.092)
	Fear	0.088***	0.088***	0.132	0.129	0.131	0.230***
		(0.028)	(0.028)	(0.090)	(0.090)	(0.090)	(0.085)
IV. Interaction terms	Rank*individual wealth			−0.001			
				(0.001)			
	Rank*Gini				0.026		
					(0.043)		
	Rank*male					0.009	
						(0.008)	
	Observations	2640	2640	1817	1817	1817	2640

Note. Relation between self-reported bed-ridden days during 14 days before interview among Tsimane' >16 years of age (dependent variable) and a person's wealth rank and village wealth inequality, individual social capital, negative emotions. Regressions include clustering by subject and the following (not shown): constant, individual resources, and controls as shown in Table 1. Regressions include a full set of dummy variables for villages (n = 13 – 1 = 12) and standard errors in parentheses. [a] Hierarchical Linear Model [HLM] (random intercept). Random parameters (variance): $\tau_{00} = 0.003$ (standard error = 0.002); $\sigma^2 = 0.432$ (standard error = .012). [b] HLM (random intercept, random slope for social rank). Random parameters (variance): $\tau_{00} = 0.003$ (s.e. = 0.004); $\sigma^2 = 0.432$ (s.e. = 0.012); τ_{11} (social rank) = 0.0001 (s.e. = 0.0001); cov (u_{oj} (intercept); u_{1j}(socialrank)) = 0.0001 (s.e. = 0.0001). [c] Bed-ridden days not logged. Village effect controlled by walking distance to village (hrs).

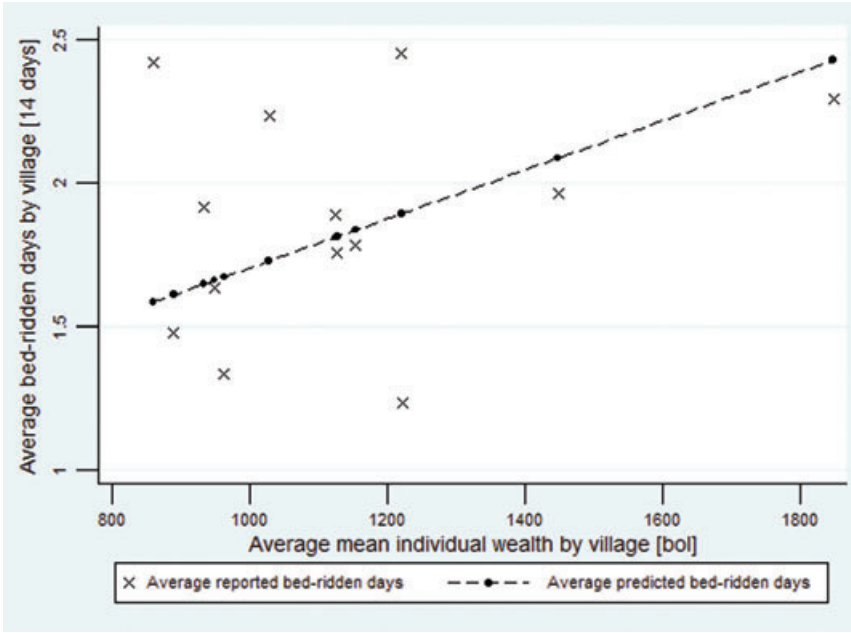

Figure 3 Average village self-reported bed-ridden days in the two weeks before the day of the interview and average predicted bed-ridden days from Table 2, column 6, by average mean individual wealth by village.

we estimated the results using hierarchical linear modeling (hereafter, "HLM"). This model allows for the simultaneous analysis of an individual-level outcome (e.g., health status) using both group-level and individual-level factors, considering individuals as nested within villages (Diez-Roux 2000; Raudenbush and Bryk 2002). We did not use this method in our main analysis because we only have 13 villages at level 2, which seriously limits our ability to make inferences on the between-village variations. To estimate a hierarchical linear model, we first estimated an unconditional means model with no independent variables (not shown). The intraclass correlation coefficient (ICC) reveals that only 1.22 percent of the total variance in health outcomes was between villages, and the variation in mean health outcomes because of differences between villages was almost negligible ($\tau_{00} = 0.009$, $p = .08$). Almost all the variation registered in health outcomes was across individuals within villages (98.8 percent; $\sigma^2 = 0.721$, $p < .001$), indicating that health outcomes are more related to individual characteristics than to village characteristics (Hogan and Campbell 2005; Raudenbush and Bryk 2002). Then, we estimated a random intercept model (column [1]), and finally we allowed the effects of wealth rank to vary across villages (column [2]). As shown in Table 3, columns [1] and [2], we found no statistically significant effects of the Gini coefficient of wealth inequalities in the village or of individual wealth rank on individual health.

Second, we reestimated the regression of Table 2, column [6] but included an interaction term between a person's wealth rank (centered) and the level of wealth of the person because a person's wealth rank might affect health, but only along certain places of the wealth hierarchy. For instance, it may be easier to switch ranks if one is at the bottom of the wealth hierarchy. If so, then a person's wealth rank might bear an association with self-reported health, but mostly if the person is toward the bottom of the wealth hierarchy. We found no significant effect for the interaction term ($p = .60$), suggesting that the effect of a person's wealth rank on self-reported poor health does not vary in relation to the level of a person's wealth (Table 3, column [3]). We also tested the idea that individual wealth rank matters, but only when the wealth inequality in a village is large, as discussed in the introduction. For example, social comparison or differential access to resources between neighbors may be less important than the overall hierarchies in a society (Wilkinson 2009). To explore the idea, we included in the fixed effect regression an interaction term between a person's wealth rank (centered) and the Gini coefficient of village wealth inequality, as shown in Table 3, column [4]. Again, we found no significant interaction effect ($p = .52$).

Third, we tested whether wealth rank tended to protect differently female and male Tsimane'. We ran our regression model including an interaction term between wealth rank (centered) and a male dummy variable (Table 3, column [5]). We found no differential effect between females and males; the p statistic for the interaction term was 0.33. As we are using individual fixed-effects regressions, we are not able to determine the main effect of gender on self-reported health (gender is not time-variant). It is possible that wealth rank affects health, but only when one measures rank along sex lines. If people compare their wealth to other people of the same sex, the overall measures of wealth rank, in a village would be inappropriate. Using sex-specific measures of a person's wealth rank we found that the coefficient of a person's wealth rank continued to be negative and increased from -0.003 (column [3], Table 2) to -0.01 ($p = .015$) in the new regression (not shown).

Last, because number of bed-ridden days is a limited dependent variable where a considerable fraction of the population piles up at zero (64 percent of participants reported not having been bed-ridden during the 14 days before the day of the interview), the ideal way of modeling it would have been using a zero-inflated negative binomial model. As this was not possible, we reestimated the regression of column [3], Table 2, using a lowered-censored, random-effect Tobit model. We found that the Gini coefficient of wealth inequality in the village remained statistically insignificant ($p = .76$), and the coefficient of a person's wealth rank lost its statistical significance ($p = .73$), as shown in Table 3, column [6].

Discussion and Conclusions

We found no evidence that community wealth inequality bears a positive association with a person's self-reported poor health. This unsupportive finding may be because of its measurement at a local scale. Analyzing data from 168 studies, Wilkinson and Pickett (2006) show that, when measured across societies, inequality (and not average income) predicts well health, whereas when it is measured in small areas the relationship is weaker for inequality and stronger for average income. This might

happen because the comparison between worse and better-off neighbors is less important than the overall burden of stratification in a society (Wilkinson 2009). Among Tsimane', the possible harmful effects of within-village economic inequality might be even further attenuated by the presence of strong kinship ties.

Why does a person's wealth rank in a village exert only a modest beneficial effect on that person's self-reported health? Our data allows us to rule out at least one possible explanation. We can rule out the idea that a person's wealth rank has a modest beneficial effect on a person's health because wealth rank is fluid. Over the five years of our panel study, the average person moved only one rung in the wealth ladder. From this one might conclude that, at least in the short run, Tsimane' society is fairly rigid in wealth hierarchy—once in a rung, always in that rung. This leaves at least six other possible explanations for why a person's wealth rank might exert only a modest effect on individual health.

First, when asking about bed-ridden days we limited the recall period to the 14 days before the day of the interview to enhance recall accuracy, but in limiting the recall period we may have lowered the true variance in self-reported morbidity. Remember that with a short recall period of 14 days, 65 percent of the observations had a value of zero. A longer recall period may have produced more variance and higher number of reported days ill. However, using similar measurements of self-reported health ($n = 72$ individuals and 43 households), Leatherman (1998) found that poor households in the Peruvian Andean community of Nuñoa reported eight percent more symptoms and more than twice the number of days of work lost than wealthier households. Leatherman's finding weakens the first plausible explanation, leading us to look for reasons.

Second, a person's wealth rank might have no visible effect on self-reported poor health because of low wealth inequality in the village. To explore the topic of how low is low, we computed Gini coefficients of household (not individual) wealth inequality in the village over the five years. To facilitate comparisons with other studies, we computed the Gini coefficient of household wealth inequality and found that the mean and median village inequality in household wealth in the 13 villages of the study over the five years were both 0.30 (SD = 0.08), but there was considerable variation around the mean and median values, with a minimum Gini of 0.08 and a maximum Gini of 0.51. We found no significant change in the Gini coefficient during the five years of observations; the Gini coefficient grew by about 1.64 percent/year. If we pool all Tsimane' villages over the five years to obtain only one summary measure of Gini household wealth inequality for the entire sample, we find a Gini coefficient of 0.36. A recent international study suggests that the three countries with the least inequality in household wealth are Japan, China, and Spain, with respective Gini coefficients of 0.54, 0.55, and 0.57 (Davies et al. 2008). Wealth inequality for a typical Tsimane' village falls well below averages for these countries.[8]

Third, it may not be the objective wealth rank of the person that affects a person's health, but self-perceived individual rank. Feeling poorer or of lower status may be at the core of predicting why being poor might worsen health (Sapolsky 2004; Wilkinson 2000). Recent studies suggest that subjective ratings of one's social rank and socioeconomic status might predict health and changes in health better than objective measures of socioeconomic status, such as schooling, income, or

occupation (Adler et al. 2008; Cohen et al. 2008; Demakakos et al. 2008; Hu et al. 2005; Macleod et al. 2006; Singh-Manoux et al. 2005).

Fourth, a more anthropological explanation alluded to earlier would trace the weak effects to the kin-based fabric of preindustrial rural societies. Like many native Amazonian societies, the Tsimane' practice cross-cousin marriage (man marries mother's brother's daughter or father's sister's daughter), a preferential, endogamous system of marriage that, over generations, creates a thick and wide web of people, all linked by ties of blood and marriage. When people in a society are linked by affinal and consanguineal ties, then it is possible that village wealth inequality or a person's wealth rank within the village might not affect a person's health because society is family writ large. If the person above one in the economic hierarchy of a community is an uncle or a cousin, then this might not cause as much grievance and resentment and harm health as much as if the person above one is a stranger. These particular characteristic of the Tsimane' society might well explain the difference in magnitude (although not in statistical significance) between our results and the results of Leatherman (1998).

Fifth is that individuals may belong to multiple hierarchies, so there may be other important dimensions of Tsimane' status not captured through the use of economic wealth rank (Sapolsky 2005). While individuals often value most the sphere in which they have the highest rank, having incongruent status between multiple hierarchies (e.g., high prestige in occupation, low economic rank, or inconsistency between achieved status in material goods and perceived SES) has been shown to elicit elevated levels of psychosocial stress in several population-based studies (Dressler and Bindon 1997; McDade 2001). For an expanded discussion, see a companion article recently published in which we used a culturally informed measure of social rank to evaluate the social gradient in health (Reyes-García et al. 2008).

Sixth has to do with the range of negative emotions associated with a person's wealth rank that we did not measure. The measured negative emotions of sadness, anger, and fear may represent imperfect proxies for psychosocial experience. We did not measure a range of other emotions such as perceived stress, revenge, resentment, humiliation, envy, sarcasm, or a sense of control, which are likely to be inversely associated with a person's wealth rank, but are likely to be positively associated with self-reported poor health (Gallo and Matthews 2003). Their omission from the regressions would produce a downward bias in the estimated coefficient of wealth rank on individual poor health. These psychosocial factors associated with low status, and the accompanying feelings of having less control over one's life affect health through the physiological burden of chronic stress and stress-induced immunosuppression, as well as through their impact on health-related behaviors (Marmot 2004; McEwen and Seeman 1999; Wilkinson and Pickett 2006).

In sum, we find support for the idea that a person's wealth rank in a village bears the expected negative association with poor health—higher wealth rank in a village, lower self-reported poor health—but the actual effect on self-reported health is small owing perhaps to the social fabric of the society, to the modest wealth inequality in the village, and from omitting other measures of psychosocial experience. Our second finding is the relative rigidity of individual wealth rank throughout the five years of the study: Tsimane' status hierarchy remains stable, leaving little room for upward mobility for individuals or attainment of the

health-protective effects of higher status. Our third finding is negative—we found little support for the idea that community income inequality damages individual health. While income inequality did not grow over the duration of this study, for small-scale societies like the Tsimane' who are undergoing rapid social and cultural changes, increasing engagement in market activities may eventually facilitate the growth of income inequality, with possible serious implications for the erosion of health and well-being. Finally, we found that an increase in the mean individual wealth by village was related to worse self-reported health. This finding is striking, as it suggests that as the village in which an individual lives becomes richer, measured as a sum of traditional and modern physical assets, self-reported health worsens. We have already noticed a difference in Tsimane' attitudes between traditional and modern assets, with some households even guarding their possessions with locks. As the Tsimane' integrate into the market economy, their possibilities of wealth accumulation rises, which may affect their well-being. Further research is needed to disentangle the effects of wealth from the contextual effects of culture change and assimilation in health status and well-being.

Notes

Acknowledgments. This research was funded by the Cultural and Physical Anthropology Programs of NSF, USA. The Institutional Review Board for research with human subjects of Northwestern University, Brandeis University, and the Great Tsimane' Council approved the study. We are also grateful to four anonymous reviewers and the editors for their comments on earlier drafts.

1. We did not ask Tsimane' below 16 years of age about economic activities or social capital because Tsimane' typically set up their own households and begin to perform agricultural chores on their own (apart from their parents) by the time they reach 16 years of age.

2. As we interviewed all adults in the 13 villages there is a potential correlation of the residuals for adults within the same household. We used robust standard errors in all linear fixed-effects regressions (Table 2, columns [1–3]), but there might be some unobservable effect not accounted for at the household level.

3. Using a randomized sample representative of the Tsimane' population is an ideal, but it is an almost impossible task because there is no socioeconomic census of all Tsimane' and because, even if such census existed, it would be expensive to track annually in a panel study of people residing in very remote villages. Even within the sample considered here, there are villages that are three days from the nearest town (San Borja). Our sample is likely to differ from a randomized sample in that the Tsimane' included have had, on average, more contact with the Bolivian *mestizo* culture than the overall Tsimane' population. According to our fieldwork experience, our sample is likely to be overrepresenting modern wealth (as defined in our article) and schooling. We also expect more isolated villages to have lower Gini coefficients as traditional assets are more evenly distributed and are also more readily available to everyone in the village. The use of a convenience sample provides the reader useful comparative information, although it is not ideal. This is why generalizations of our results to the overall Tsimane' population should be viewed with caution.

4. The deflators come from the Unidad de Análisis de Políticas Sociales y Económicas (UDAPE), a policy analysis bureau of the Bolivian government. The information was downloaded on March 3, 2008, from the following web address of UDAPE: http://www.

udape.gov.bo/ (Table 1.1.5, Deflactores implícitos del PIB por rama de actividad económica). The deflators (base = 1990) were: 2002 = 222.23, 2003 = 231.50, 2004 = 257.70, 2005 = 235.14, and 2006 = 247.85.

5. We tested for the presence of an unobserved effect using Breusch and Pagan Lagrangian multiplier test ($\chi^2 = 18.07$, $df = 1$, $p = .00$), and concluded that we should use either fixed or random effects instead of an OLS regression (Norton et al. 2002). We discarded using random-effects estimation because we cannot assume that the unobserved effects are uncorrelated to some of the explanatory variables in the regression, such as schooling or BMI.

6. The coefficients of the negative binomial regression model in Table 2 have to be interpreted as follows: "for a unit change in xk, the expected count changes by a factor of exp(βk), holding all the other variables constant" (Long and Freese 2006:360).

7. A mediating path variable is used to reveal the underlying structure of an observed causal relation between a dependent variable (health) and an independent variable (wealth). In this case, we hypothesize that social capital and negative emotions "mediate" the relationship between health and wealth. For example, we observe that wealthier Tsimane' are healthier (wealth [+] → health [+]). By including a mediating path variable we test, for example, if wealthier persons have fewer negative emotions, which would contribute to better health (wealth [+] → negative emotions [−] → health [+]). In this sense, mediating variables can modify the observed relation between two variables by moderating or augmenting it.

8. We draw the comparison to illustrate a point that Tsimane' society may be fairly egalitarian when compared to industrial nations, but we are aware that the comparison is problematic for many reasons. For example, international comparisons adjust for purchasing power parity, whereas we use the local currency. Industrial nations tend to have large populations and ethnic heterogeneity, whereas the Tsimane' are a small-scale, highly endogamous society of only about 8,000 people. A more appropriate comparison would have been with other foraging societies, but as far as we know there are no estimates of Gini coefficients for such societies.

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