



# The effects of community income inequality on health: Evidence from a randomized control trial in the Bolivian Amazon



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## ABSTRACT

Research suggests that poorer people have worse health than the better-off and, more controversially, that income inequality harms health. But causal interpretations suffer from endogeneity. We addressed the gap by using a randomized control trial among a society of forager-farmers in the Bolivian Amazon. Treatments included one-time unconditional income transfers ( $T_1$ ) to all households and ( $T_2$ ) only to the poorest 20% of households, with other villages as controls. We assessed the effects of income inequality, absolute income, and spillovers within villages on self-reported health, objective indicators of health and nutrition, and adults' substance consumption. Most effects came from relative income. Targeted transfers increased the perceived stress of participants in better-off households. Evidence suggests increased work efforts among better-off households when the lot of the poor improved, possibly due to a preference for rank preservation. The study points to new paths by which inequality might affect health.

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## 1. Introduction

Research suggests that poorer people have worst health than richer people. But mounting evidence suggests that income inequality may harm health beyond the social gradient (Deaton, 2013; Kawachi and Subramaniam, 2014; Pickett and Wilkinson, 2015). Why this might happen is a debate in progress. The relation between income inequality and health is largely explained by (i) absolute income or material living standards and (ii) psychosocial and behavioral mechanisms (Lynch et al., 2000), but previous

studies have relied on observational data and are limited by endogeneity bias.

The absolute income approach focuses on the impact of material deprivation, access to healthcare, and poor nutrition and sanitation on health. Income inequality leads to an underinvestment in areas such as infrastructure and health services which affect mainly the poor (Lynch et al., 2000; Stiglitz, 2012). If so, we would expect a decreasing effect as income increases. Material deprivation harms health and nutritional status, but the effect of income inequality on health remains unclear (Deaton, 2013).

Other researchers stress the psychosocial paths by which income inequality might affect health, the relative income hypothesis. Having lived and evolved during a broad swath of history in largely egalitarian hunter-gatherer societies with reciprocity norms, significant inequities might undermine health through psychosocial stress from social comparisons (Wilkinson, 2000). These comparisons erode social capital and cohesion, and fuel

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psychosocial stress that may affect health through various biological mechanisms (Brunner, 1997; McEwen, 2012).

Using a randomized control trial (RCT) among a society of forager-farmers in the Bolivian Amazon, the Tsimane', we examined the effects of absolute income and community income inequality on indicators of individual health. We gave income transfers in the form of edible rice (Tsimane' main cash crop) to all households in 13 villages to estimate absolute income effects ( $T_1$ ), only to households at the bottom 20% of the village income distribution in another 13 villages to reduce village income inequality ( $T_2$ ), and included 14 villages as controls. Households in control villages and those at the top 80% of the village income distribution in  $T_2$  villages received a much smaller amount of rice seeds as a consolation price. Besides assessing the direct effects of the income transfers, we examined spillover effects. To our knowledge, two RCTs have assessed spillover effects of income transfers. A conditional income transfer program in Mexico found spillover effects within the community (Angelucci and De Giorgi, 2009; Bobonis and Finan, 2009), but an unconditional income transfer program in Kenya found negligible effects (Haushofer and Shapiro, 2013). Overlooking spillover effects within a community might result in an underestimation of the effects of income transfers or in the unwarranted conclusion that health improvements took place from a decrease in inequality.

The debate about the role of income and income inequality on health matters. If worse health results mainly from deprivation, improving health would require policies targeted at the poor through, for example, income transfers. If, instead, worse health results mainly from unequal distribution of income, then improving health would require policies to reduce income disparities. Our study design has at least two advantages. First, the small scale of villages and occupational homogeneity allowed us to rule out many confounders that plague studies in industrial nations (e.g., ethnicity, residential segregation, healthcare coverage). Second, randomizing the treatment across villages allows us to both remove endogeneity biases and estimate the impact of transfers on the entire village economy.

## 2. The people

Tsimane' are a tightly-knit endogamic native Amazonian society of forager-farmers in Bolivia (Fig. 1). Recent estimates suggest they number about 14,200 individuals, living in about 95 villages of at least eight households. A typical Tsimane' village has about 20 households (standard deviation,  $SD = 24$ ) with an average of six people per household. Despite occasional contact with Europeans since the sixteenth century, the Tsimane' remained relatively isolated until Protestant missionaries and road-building projects arrived to the area in the 1950s and 1970s.

Tsimane' are economically self-sufficient. Subsistence centers on foraging and slash-and-burn agriculture, with the sale of thatch palm and cash cropping of rice and plantains becoming increasingly important. In a world-wide comparative study of 15 small-scale rural societies, Tsimane' ranked next to lowest in market exposure, with about seven percent of households' food energy consumption purchased in the market (Henrich et al., 2010). Another study (1999–2000) found that goods bought in the market accounted for <3% the value of household consumption, and only 2.5% of goods came from outside the village (Godoy et al., 2004). Tsimane' have low wealth inequality and mobility in economic rank (Undurraga et al., 2010).

As is true of other native Amazonian societies, Tsimane' have norms of extensive sharing and reciprocity (Godoy et al., 2004). The Tsimane' language does not have a word for stress. In population-based studies, the Tsimane' have one of the lowest reported

cortisol concentrations, a stress-related biomarker (Nyberg, 2012). Adult blood pressure is slightly above other native Amazonian societies, with 4–6% having hypertension (Curven et al., 2012; Zeng et al., 2013b).

About 33–40% of Tsimane' children are growth-stunted (Foster et al., 2005; Godoy et al., 2010), and have low hemoglobin levels (Lindsay et al., 2003). However, the Tsimane' diet meets daily energy and protein requirements, so child-stunting is probably explained by high infectious disease burden (Godoy et al., 2005). Tsimane' men of higher social status have better nutritional indicators than men of lower status (Reyes-García et al., 2008) and parental wealth is positively associated with children's nutritional status (Godoy et al., 2006), providing some support to the absolute income hypothesis. Inequality may affect nutritional status through the relative ability of high social status individuals to gain preferential access to resources (Patton, 2005; Reyes-García et al., 2009). While the average Tsimane' body mass index has increased over recent years, Tsimane' are not experiencing increased obesity (Zeng et al., 2013a). (See [supplementary material](#) for further background on the Tsimane').

## 3. Experimental design and methods

### 3.1. Data, sample, and treatments

The RCT had two treatments (Fig. 2). In treatment 1 ( $T_1$ ) all households in the village received the income transfer, hence increasing the available household income while maintaining the same village income distribution. In treatment 2 ( $T_2$ ) only the poorest 20% of households in a village received the transfer, maintaining the same overall impact in the village economy as in  $T_1$ , but decreasing the village income inequality. Households in the top 80% of the income distribution in  $T_2$  villages, and all households in the control villages received improved rice seeds. Randomization was done at the village level to assess the impact of transfers on the entire local economy, rather than only on treated households. We also randomized the assignment of income transfers to female versus male heads in each household in both treatments and in control villages, to assess whether income in the hands of female household heads benefits children more than income in the hands of men (preliminary results are shown in Undurraga et al., 2014a; see [supplementary material](#)).

The trial included 40 Tsimane' villages and was informed by an annual panel study (2002–2010) and almost two decades of ethnographic work among the Tsimane' (Fig. 1) (Leonard et al., 2015). We excluded from our sample villages that were participating in other studies, were too small, were too costly to reach, or contained other ethnic groups. This left 65 villages of which we selected the 40 villages for the trial based on accessibility and safety.

We did the baseline survey during February–May 2008, transferred income during October 2008–January 2009, and did the follow-up survey during February–May 2009. We collected demographic, anthropometric, and self-reported health data from all household members (or their parents in the case of children <16 years old), but limited collection of other data to adults ( $\geq 16$  years old or younger if they headed a household). The baseline sample included 3449 individuals in 563 households; about 20% of the sample had left by the time of the follow-up survey. We did not track attriters due to budgetary limitations, but we test for attrition bias in the robustness analysis. The final sample included 494 households and 2555 people.

We did not use cash transfers because of the limited use of money among the Tsimane' in isolated villages. Instead, we used edible rice as in-kind income because rice is their main cash crop

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