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Sibling composition during childhood and adult blood pressure among native Amazonians in Bolivia☆

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ABSTRACT

Sibling configuration, including birth order, or the number, age, and sex of siblings is associated with parental resource allocation between children and is thus associated with a person's well-being. Little is known about the association between specific types of siblings and adult health outcomes. Here we test several hypotheses about sibling composition (number of older brothers, older sisters, younger sisters, younger brothers) and adult blood pressure in a foraging-farming society of native Amazonians in Bolivia (Tsimane'). We collected data in 2007 from 374 adults (16–60 years of age) from 196 households in 13 villages. Household random-effects multiple regressions were run using systolic (SBP) or diastolic blood pressure (DBP) as outcomes; covariates included the four sibling categories and control variables (e.g., sex, age, education, body mass index [BMI]). Mean SBP and DBP were 114 (SD = 14) and 66 (SD = 11) mmHg. The prevalence of hypertension was 5.08%. Having an additional younger brother bore a small (3.3–5.9%) positive association with both SBP and DBP, with the effect weakening as people aged. Having an additional younger sister was associated with a small (3.8%) increase in SBP among women, with the magnitude shrinking as people aged. In a large family, the number of younger brothers may exert an impact on an individual's blood pressure.

1. Introduction

Sibling configuration, including birth order or the number, age, and sex of siblings is associated with the allocation of parental resource between offspring (Butcher and Case, 1994; Conley, 2000; Dayioðlu et al., 2009; Garg and Morduch, 1998; Khoury et al., 1984; Zeng et al., 2012), and is thus associated with a person's well-being. Steelman et al. (2002) reviewed the literature on sibling configuration and concluded that people with many siblings had less

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education and less wealth in adulthood, and that birth order affected a person's educational attainment.

Recently, studies on sibling configuration have been extended to health outcomes. Some studies have documented the links between (a) adult health and either (b) sibling size or with birth order. Lawson and Mace (2008) followed 13,176 British children from birth to 10 years of age and found that an additional older sibling of either sex depressed the growth rate and height of younger siblings. Garg and Morduch (1998) studied 5203 children in Ghana and found that an additional sister was associated with a greater *Z*-score of height-for-age among older siblings. Wang et al. (2007) studied 7959 junior high-school students in Japan and found that the risk of being overweight among boys was negatively associated with the number of older sisters, whereas the risk of being overweight among girls was negatively associated with the number of any siblings. Several studies (Bernsen et al., 2003; Karmaus et al., 2001; Karmaus and Botezan, 2002; Miyake et al., 2004; Ohfuji et al., 2009; Westergaard et al., 2005) suggest that having older siblings protects against the risk for allergies and respiratory infections.

We draw two conclusions from this literature. First, there seems to be a link between sibling configuration and health among children, and some of these links may persist into adulthood. Second, researchers have generally examined how broad categories of siblings (e.g., sisters versus brothers; older siblings versus younger siblings) affect health, but they have paid less attention to the comparative effects of specific sibling categories (e.g., having an additional older brother) on health. We equate the term *sibling size* with the total number of siblings, and use it instead of the synonym *sibship size*. We shall have more to say about the term *sibling composition*, but for the most part we use it to refer to the specific number of older brothers, older sisters, younger brothers, and younger sisters of a person.

Despite increasing interest in the relation between siblings and health, there is still disagreement on whether siblings contribute to a person's good health (Williams, 1997). The disagreement arises from four possible reasons. First, most studies use sibling size, birth order, or sex composition without distinguishing the role of specific sibling categories, which may matter when specific sibling categories play a prominent role (e.g. older brother versus older sister). Second, some health indicators may be more sensitive to early life events while others not. Careful selection of indicators would strengthen the internal validity of the research. Third, the social setting probably matters. In a society with a pro-male bias, brothers would likely affect the education and health of sisters, but the effects of brothers would be less salient in a society without a marked pro-male bias. Last, sibling composition is endogenous, and likely reflects parents' biological characteristics and parental preferences for the sex and number of offspring (Khoury et al., 1984; Ruder, 1985). The inability to address the endogeneity of sibling configuration may bias results.

Here, we use data from a native Amazonian society of forager-farmers in Bolivia, Tsimane', to examine the association between particular types of siblings and blood pressure in adulthood. The use of the Tsimane' as a case study has merit because Tsimane' families are large with many siblings, and because the impact of siblings on health is likely to be prominent because the Tsimane' face many resource constraints (Rucas et al., 2010; Godoy et al., 2005).

We selected blood pressure as an outcome for two reasons. First, blood pressure predicts risks of cardiovascular diseases (Beevers, 2004; Pastor-Barriuso et al., 2003), the leading cause of death in industrializing nations (Gaziano, 2007). Second, studies have shown contemporaneous associations between (a) blood pressure and variables associated with socioeconomic status (SES; e.g., schooling) and between (b) sibling composition and these same variables for socioeconomic status (Blane et al., 1996; Lawlor et al., 2006; Steelman et al., 2002; Sweet et al., 2007). Therefore, we expect a relation between blood pressure and sibling composition.

Drawing on the theory of human capital (Becker, 1991) and on the ethnographic characteristics of the Tsimane', in this exploratory study we test four hypotheses about the links between sibling composition and adult blood pressure:

1. Having older brothers will increase the blood pressure of younger siblings, particularly of sisters. The theory of human capital predicts that in a pro-male society parents will skew investments to boys because the labor market favors males (Gibson and Sear, 2010; Garg and Morduch, 1998). Tsimane' women have lower economic and educational attainment than Tsimane' men of the same sex and age (Godoy et al., 2006b). Under such conditions, having older brothers will harm girls because brothers will compete for and dilute the fixed amount of parental resources available to invest in all offspring. Given the negative association between socioeconomic status and blood pressure (Blane et al., 1996; Lawlor et al., 2006), having older brothers should be associated with higher blood pressure among younger siblings.
2. Having older sisters will be associated with an increase in the blood pressure of younger siblings, mostly of younger sisters. Older sisters divert resources away from younger siblings. In a society with a pro-male bias, such as Bolivia, the impact of older sisters may not be strong among younger brothers, but may be more prominent among younger sisters.
3. Younger siblings, particularly younger brothers, will increase the blood pressure of older siblings, particularly of older sisters. Given the responsibilities of older sisters (e.g. taking care of younger siblings) and older brothers (e.g. finding job for younger brothers) in Tsimane' society, younger siblings are likely to likely to increase the work load and stress of older siblings, which should result in higher blood pressure among older siblings.
4. The associations between sibling configuration and adult blood pressure will be more marked in poorer households. The theory of human capital makes clear predictions about the strength of the associations between sibling composition and parental investments. It predicts that the effects will be most marked in