



# The role of city income inequality, sex ratio and youth mortality rates in the effect of violent victimization on health-risk behaviors in Brazilian adolescents



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## ABSTRACT

This study integrates insights from evolutionary psychology and social epidemiology to present a novel approach to contextual effects on health-risk behaviors (unprotected sex, drunkenness episodes, drugs and tobacco experimentation) among adolescents. Using data from the 2012 Brazilian National Survey of Adolescent Health (PeNSE), we first analyzed the effects of self-reported violent victimization on health-risk behaviors of 47,371 adolescents aged 10–19 nested in the 26 Brazilian state capitals and the Federal District. We then explored whether the magnitude of these associations was correlated with cues of environmental harshness and unpredictability (youth external mortality and income inequality) and mating competition (sex ratio) from the city level. Results indicated that self-reported violent victimization is associated with an increased chance of engagement in health-risk behaviors in all Brazilian state capitals, for both males and females, but the magnitude of these associations varies in relation to broader environmental factors, such as the cities' age-specific mortality rates, and specifically for females, income inequality and sex ratio. In addition to introducing a novel theoretical and empirical approach to contextual effects on adolescent health-risk behaviors, our findings reinforce the need to consider synergies between people's life experiences and the conditions where they live, when studying health-risk behaviors in adolescence.

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## 1. Introduction

Underage drinking and drunkenness, drug use, unprotected sex, and other forms of risky behavior in adolescence have been studied by epidemiologists because they are closely related to increased morbidity and mortality for young people, and therefore represent major public health challenges (Hale et al., 2014). These risk-taking behaviors typically emerge and rise rapidly in adolescence (WHO, 2015; Steinberg et al., 2008), and there is a variety of models

dedicated to the investigation of their underlying causal mechanisms (Boyer, 2006).

One model that has been increasingly applied to explain population and individual differences in risk behavior is evolutionary Life History Theory (Del Giudice et al., 2015). According to one influential version of the theory, the diversity of life history “strategies” between and within species can be arranged on a continuum from *fast*—early maturation and reproduction, fast growth, small body size, high fertility, short lifespan, and low investment in offspring quality—to *slow*—late maturation and reproduction, slow growth, large body size, low fertility, long lifespan, and high investment in offspring (Brumbach et al., 2009; Del Giudice et al., 2015; Ellis et al., 2012; Wang et al., 2009). According to this framework, risky behavior should be affected by cues predictive of life expectancy and other aspects of the environment, specifically, cues of environmental harshness (the rates at which extrinsic

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factors cause disability and death at each age in a population) and unpredictability (stochastic variation in salient environmental conditions) (Rogers, 1994).

When environments are unpredictable and life expectancies are short, risk taking may be more adaptive than risk avoidance, leading to “future discounting” in behavioral choices (Daly and Wilson, 2001, 2005; Ramos et al., 2013; Wang et al., 2009; Wilson and Daly, 1997). There is substantial empirical evidence that exposure to harsh (high mortality–morbidity) environments is indeed associated with the development of *fast* life history strategies and can explain variability in risky behavior, especially in adolescence (Brumbach et al., 2009; Ellis and Del Giudice, 2014; Ellis et al., 2012; Ellis et al., 2009). However, studies of the effects of attributes of the environment at different levels of proximity (e.g. one’s neighborhood, city, state, etc.) are still a novelty in the risk behavior literature.

Recently, Copping and Campbell’s study was one of the first to demonstrate such effects through a multilevel perspective. They found that neighborhood circumstances in 2001 predicted criminal violence and teenage pregnancy ten years later, and that individuals’ perceptions of these neighborhood circumstances were associated with aggression and risky sexual behavior (Copping and Campbell, 2015). Furthermore, there was a clear similarity between neighborhood and individual level associations in both their direction and causal pathways, analyzed through structural modeling. This conceptual convergence between group and individual level measures presents a compelling argument for studies addressing how risky behavioral expression is influenced by environmental circumstances at different spatial levels.

As proposed by Diez Roux and Mair (2010), different spatial levels may contribute synergistically to the relationship between one’s immediate environmental experiences and behaviors. Features of a city, for example, may serve to buffer or enhance the consequences of other sources of stress, as well as reinforce the environment–behavior associations happening at a lower level. Diez-Roux & Mair propose that these effects are often synergistic, such that whether certain variables affect one’s behavior is itself influenced by broader ecological conditions. Exploring this hypothesis from a Life History Theory perspective, we believe that cities characterized by safety and better resource distribution may have stress reducing properties, whereas those characterized by danger, i.e., high mortality and resource uncertainty, may enhance the salience and hence the impact of other sources of risk-taking, ultimately increasing the rates of adolescent risk behaviors. This is especially relevant for the situation in Brazil, where rates of violence exhibit great variability across cities.

### 1.1. The Brazilian scenario

Over the last three decades, violence has emerged as one of the most significant problems in Brazil (Dahlberg and Krug, 2006; Minayo, 1990, 2004). While recent trends have been encouraging, with the rates decreasing within the past five years, homicide remains the leading cause of death among adolescents (Waiselfisz, 2013). During this period, an increasing number of studies have sought to characterize youth violence and the contexts in which it occurs, and to pinpoint risk and protective factors (Cardia, 2003; Castro and Abramovay, 2002; Cocco and Lopes, 2010; Formiga and Sintra, 2011; Jorge, 2002).

Recent data indicate that a significant proportion of Brazilian youth is exposed to violence in the form of direct and indirect victimization. Mortality by violent causes is maximal in young adulthood, as is the percentage of deaths that are due to external causes (Waiselfisz, 2013). However, violence does not affect the young population uniformly: the risk of death by violent causes

varies greatly across Brazil’s five regions and 27 state capitals.

Analyzing 2013’s youth homicides, Waiselfisz (2014) observed that the rates varied between 17 per 100 thousand inhabitants in Campo Grande (Center-West) and 268 per 100 thousand inhabitants in Fortaleza (Northeast). The greatest variability was found among the four state capitals in the Southeast region where there was a standard deviation of 84 in the youth homicide rates between these cities (from 28.5 in São Paulo to 209 in Vitória) and the lowest variability in homicide rates was found in the Northeast region ( $SD = 25$ ), with Belém having the highest rate (107) and Recife the lowest (92.1).

This variability within regions suggests the need for research to examine how the associations between exposure to violence during adolescence and risk behavior might be affected by such different environments. Being victimized in a city where youth mortality is low could be more impactful than being victimized in a city where the rates are high, but the reverse is also possible.

Despite the abundant literature on adolescent risk behavior and contextual risk factors, we know relatively little about the relative contribution of direct violent victimization and other, evolutionarily relevant, city level variables. Accordingly, our study used data from a nationally representative sample of 9th graders (ages 10 to 19) to investigate the effects of self-reported individual violent victimization and of relevant city level factors (i.e. youth mortality rates, income inequality and sex ratio) on adolescent health-risk behaviors (i.e. self-reported unprotected sexual activity, drunkenness, drug and tobacco use), and to assess whether the city level variables might influence the magnitude of the effects of the individual level variables.

Cues of competitive disadvantage also play a role in risk taking, arguably because each individual not only needs to do well, but also to beat its competitors for evolutionarily relevant resources (e.g., Daly and Wilson, 2001; Frank, 2000; Luttmmer, 2005). Risk-sensitivity theory predicts that those who are competitively disadvantaged are less likely to succeed in social competition and should therefore exhibit elevated risk taking (Mishra et al., 2014). The theory applies equally to both sexes (Mishra and Lalumière, 2010), but the domains that matter for each may differ (Buss, 1989; Campbell, 1995; Ermer et al., 2008; Hill and Buss, 2010). Therefore, we also tested whether city sex ratio (males per 100 females), an indicator of mating competition, is associated with the effect of violence on adolescent health-risk behavior. In sexually reproducing animals, individuals of one sex may have to compete for access to mating partners of the opposite sex. Thus, sex ratio is central in predicting the intensity of mating competition and which sex is competing for which (Kvarnemo and Ahnesjö, 1996). One rationale for looking into sex ratio is to ask whether health-risk behavior is more affected by violence within the sex that is more strongly in competition for the other rarer sex.

The goals of our study were threefold. First, we sought to analyze the effect of self-reported violent victimization on four different types of health-risk behaviors among Brazilian students. Second, we sought to determine whether the associations between self-report of violent victimization and health-risk behaviors differ among the 27 state capitals, using effect size measures. Finally, we examined the associations between city level factors (youth mortality rates, income inequality and sex ratio) and these effect sizes, to determine what local factors modulate the effects of violent victimization. Because males and females are known to have not only distinct risk taking strategies (Daly and Wilson, 2001), but also different levels of risk sensitivity by domain (Buss, 1989; Campbell, 1995; Ermer et al., 2008; Hill and Buss, 2010), all our results are presented first for the whole sample and are then stratified by sex.

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