Consequences of 'Color' in Family, Place, and Child Mortality in São Paulo, Brazil

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This research addresses the importance of race/ethnicity on child mortality in São Paulo, Brazil, via statistical and spatial models for disentangling the effects of cultural and ecological factors surrounding children. The research considers, along with other race groups, Japanese Brazilians, who comprise the largest Asian population group in São Paulo, and who have had very different historical, cultural, and economic development experiences relative to other race/ethnic groups. Inclusion of the Japanese population in the examination of racial inequality in child mortality aims to elucidate our understanding of how cultural factors relate to their advantageous health outcomes for assessing multi-dimensional racial stratification rather than the traditional race-class stratification system in Brazil. In addition to socioeconomic status (SES), I control for family/household structure and community attributes, which have rarely been incorporated into previous studies of the relationship between child mortality and race in a Brazilian society. The research objectives are; first, to investigate how the effects of Brazilian mothers' social and ecological factors differ in their children's survival chances depending on their racial/ethnic background and second, to examine how the impacts of family/household structure and community attributes of Brazilian mothers on their children's survival chances are different among racial/ethnic groups.

Multilevel analysis employs negative binomial regression for child death counts among individual mothers in order to avoid problems associated with other, more common measures of child mortality. The results from the multilevel statistical models in showing the global effects of race/ethnicity, family structure, and community attributes on child mortality will be further explored by using Geographically Weighted Regression for showing spatial processes in the distribution of child mortality. By analyzing variability over space, I will present a more grounded interpretation of the contextual effects of race, family, and community on child outcomes, which also helps provide less biased parameter estimates in reflecting spatial process and spatial variations in Brazilian society.

Child Mortality, Race/Ethnicity, Class Inequality in Brazil

Child mortality has been used as an outcome measure in assessing inequality in the standard-of-living, available environmental resources, and health-related behaviors. It is a sensitive indicator of disparities in levels of mothers' quality of life and health, which reflects the accumulated impact of deprivation throughout the mothers' life on their children. Among confounding factors, race/ethnicity is an intriguing feature in child health and survivorship. The association of race-class inequality with health and the effects of racism on health remain unclear despite the fact that they are arguably among some of the most important public health issues in Brazil.

Brazilian society is a diverse nation in terms of race/ethnicity. Its unique racial/ethnic composition stems from the legacy of its colonial past and various immigration schemes. Skin color is highly correlated with SES, and reflects the critical role that race plays in class inequality. Although Brazilian racial identity resembles a gradation of color from white to black with shades of brown in between (Burgard 2002), researchers studying racial inequality in Brazil traditionally use a simplified white versus Afro-Brazilian (black and brown) dichotomization (e.g., Burgard 2002; Lovell and Wood 1998; Silva 1985, 2000). Very few studies have compared the relative status of the Japanese, specifically, or Asian population, generally, to the other racial/ethnic groups. This is particularly problematic when considering the fact that racial categorization is based on a combination of phenotype and class categorizations in Brazil (Carvalho et al. 2004; Harris et al. 1993; Telles and Lim 1998), because the Japanese population does not fall between white and black in a linear color-class stratification system. Hence, this research offers an assessment of the Brazilian system of racial and social stratification by including a neglected portion of the population in providing a more comprehensive understanding of racial/ethnic differences in child mortality in Brazil.

Japanese-Brazilian

Brazilian society has experienced a significant reduction in child mortality thereby resulting in a positive effect on all three racial groups; however, the differences in child mortality among three racial groups are still clear in 2000. Although the Asian population experienced the lowest levels in standard-of-living as indentured laborers and through color-class discrimination, on average, their child survival rate is better than even whites. If discrimination matters and continues to persist in contemporary Brazilian society, the question that should be asked is why does Brazil's Asian population have lower child mortality than the white population?

The first possible explanation is the higher socioeconomic level of Japanese-Brazilian. While the standard-of-living for all three groups has improved, obvious racial inequalities in SES exist; especially, the conspicuously higher educational achievement among Asians. A majority of Japanese immigrants began their life in Brazil at the lowest and least privileged status of agricultural resident farm laborers (Jirimutu 1994; Lesser 1999). Most, however, rose to middle class in both rural and urban areas by the mid 1950s (Lesser 1999; Makabe 1981, Suzuki 1981). This situation was possible mostly because of the Japanese government's involvement and sharing an enclave economy among Japanese, which provides a mechanism for employing their own people and fosters social interdependence, ethnic unity, and strong familial commitments. The rapid movement from wage-labor to entrepreneurship was facilitated by the fact that Japanese immigrants arrived as family units (Wood and Jirimutu 1996). The family was particularly important in providing the emotional support in overcoming the obstacles of settling in a new country and becoming economically competitive.

The second possible explanation is their family-centered communities. Some immigrant groups like the Japanese have become a 'sub-nation' in host societies often maintaining cohesive and family-centered communities (Petersen 1971). While Japanese-Americans have achieved integration in the host society's economic sphere, they suffer more from racial antagonism than in Brazil (Makabe 1981; Smith 1979). On the other hand, Japanese-Brazilians have maintained their community largely by self-exclusion instead of being rejected by or excluded from the larger society (Handa 1978; Makabe 1981). Family based immigrant communities protected them from being exposed to racial discrimination (Handa 1978). Ultimately, the self-enclave attitudes of Japanese migrants enabled them to maintain their cultural traits in their social relationships, practices, and beliefs over generations.

The third possible explanation is selectivity. The Brazilian-imposed requirement was that there must be at least three farm workers in each household immediately available after arrival in the settlements. Japan-based emigration companies screened out the families which could not provide the minimum number of healthy labor-force participants. The Brazilian government's requirement spontaneously led to more viable 'healthy' families to migrate from Japan. Maintaining a healthy workforce and 'good' family structure were indispensable conditions for Japanese immigrants while continually struggling with unfamiliar humid weather and tropical diseases (Busho 1978).

Family/Household Structure and Ecological Influences on Child Mortality

Researchers often view child mortality as a reflection of parent's health and quality of life due to children's absolute dependency on their parents and other family/household members (Wood and Lovell 1992; Watkins et al. 1987). Previous research on the influences of family formation/structure and marital status on individuals' and children's well-being indicates that children born to unmarried and single women (Eberstein et al. 1990), among a large number of siblings with combined effects of high birth order and a short preceding birth interval (Sastry 1997), and black women (Hummer 1993; Hummer et al. 1999; Lovell and Wood 1998), have substantially elevated risks of child death. The magnitude of family structure and marital status effects on child mortality differs depending on the covariates. The racial, ethnic, and cultural factors variably influence family formation and perceptions of family functions (Das Gupta 1997; Reher 1998). Family/household characteristics have been modified by the dissolution of the family system and by changes in family roles and moral obligations over time, which negatively impacts upon child well-being - financially, physically, emotionally, and over the life course (Desai, 1992). Furthermore, the family formation/structure varies due to residential environment and the levels of industrialization and urbanization (Astone et al. 1999; Desai 1992) that may alter the impact of family formation/structure on individuals' health outcome.

To understand the ecological influences on individuals' health, SES, and family formation/structure, a rural-urban dichotomy would be inappropriate. Instead, examining community-level characteristics is more fitting. Unfortunately, community-level spatial attributes have rarely been included in studies examining their association with child mortality. Sastry (1994, 1996, 2002) suggests that the relationships between household characteristics and child mortality may be altered by community attributes such as water and sewage networks, trash collection services, and health care services. Importantly, even when differentials by rural-urban place of residence are included, community-level variables are still significantly associated with child survival chances.

Spatial Components in Study of Child Mortality

There is a growing interest in the spatial variation of infant/child mortality. Typically, mothers' place of residence, which is mainly a rural-urban dichotomy, is used as a covariate of the major social factors of child mortality such as income and education and as a proxy measure for living conditions in illustrating both public and medical health provisions. Recent studies of Brazil have examined spatial variation in infant/child mortality within urban areas (Antunes and Waldman 2002; Szwarcwald et al. 2000, 2002); however, they simply show spatial difference in health or mortality via basic visualization using GIS. None of these studies include community covariates or address the changes in associations between child mortality and predictors.

The importance of the effects of community attributes such as infrastructure levels and ecological settings (e.g. education services, healthcare facilities, and the prevalence of city services) on child mortality have been addressed in other research, which indicates that complementary relationships between child mortality and covariates are altered by changes in community characteristics (Sastry 1994, 1996, 2002). Multilevel statistical models have been employed to develop an understanding of the causal effects of community characteristics on child outcomes, accounting for the correlation among observations measured at the same level. The assumption behind these models is that the set of parameters represent the situation in every part of the study area, namely, global statistics which are spatially stationary. However, an explanatory variable might be highly relevant in one area but seemingly irrelevant in another or parameters describing the some relationship might be negative in one area but positive in another (Fotheringham et al. 2002). We may assume that the relationships between child mortality and causal factors vary across space. In order to more precisely measure contextual effects reflecting local conditions, the issue of spatial stationarity has to be solved by employing multilevel spatial models.

Data and Methods

This paper uses the demographic and socioeconomic information derived from three Brazilian censuses of 1960, 1980, and 2000 in São Paulo and the community level health information derived from *Enciclopédia dos Municípios Brasileiros* for 1960 (IBGE 1958) and *Estatistica da Saúde: Asistensia Médico-Sanitaría* for 1980 and 2000 (IBGE 1981, 1999) in the multivariate statistical analysis. In the analysis, only women aged 20-34 years will be included. This is because mother's age is used to control for the duration of exposure to the risk of death, and hence, child deaths among older women correspond to births occurring in the more distant past from which the value of money and other social indicators have changed over time (Sastry 2004; Wood and Lovell 1990). Therefore, restricting the analysis to women aged 20-34 can minimize potential temporal problems.

The dependent variable is the number of child deaths of individual women. Previous child mortality studies involving census data often used a child mortality ratio (Sastry 2002, 2004; Wood and Lovell 1990). In these studies, the indirect estimation techniques (Brass et al. 1968; Trussell 1975; Trussell and Preston 1982) are used to obtain the child mortality ratio from proportions of dead amongst children ever born by women categorized by age groups in a single-round census. However, there is one limitation. The distinction between women who lost one child out of one child and women who lost ten out of ten children is technically impossible. Since fertility is considered to have a strong association with cultural behavior and practices, this limitation could be crucial in the research on the racial/ethnic influence on child survival. Hence, instead of using the child mortality ratio, I use child deaths count and a model appropriate for count data controlling for number of children ever born to mothers and mothers' age. A useful first approximation is the Poisson model, which assumes that the mean and the variance of the outcome variable are equal. Often, this assumption is violated by over-dispersion in the data (i.e., mean/variance inequality). To control for over-dispersion, I will estimate a negative binomial model, which includes a random disturbance term that provides a better fit than other negative binomial models or Poisson models. The empirical research will use demographic, socioeconomic indicators, family/household structure, and municipal-level explanatory variables (see the table below).

The analysis of spatially varying relationships is based on the premise that relationships between variables measured at different locations might not be constant over space (non-stationarity). If relationships actually vary significantly over space, then the serious limitation relating to traditional multilevel statistical models of contextual effects on child mortality have to be addressed. It is important to note that when spatial data are examined using ordinary statistical regression models, the relationship between the dependent variable and any independent variables are assumed to be stationary over space. To address the issue of the error derived from stationarity, the data are weighted geographically around a point in space so that neighboring data weigh more heavily than data further away in GWR. Non-stationarity is modeled directly through GWR which simultaneously deals with problems of spatially autocorrelated error terms rather than allowing the non-stationarity to be reflected through the error terms in the model (Brunsdon et al. 2002; Fotheringham et al. 2002).

The spatial information at the municipal-level necessary for spatial analysis is derived from digital maps containing municipal boundaries for 1980 and 2000. Since a digital map for 1960 is not available, I will manually digitalize a map using the paper maps created in 1965 with municipal boundaries corresponding to Censo 1960. New variables are created by aggregating counts or computing means or ratios at the municipal-level from the individual data in the census data. In addition, municipal-level characteristics such as medical services are combined in each census dataset.

Explanatory Variables Used in Statistical Analysis of Child Death Counts

CONTROL	**HOUSEHOLD STRUCTURE**	**COMMUNITY ATTRIBUTE**
Total Children Ever Born		
Mother's Age	Family Indices	Development, Infrastructure Indices
Rural (Reference), Urban	# Household Member	% Urban Population
	# Adult Males within Family	Average of Years Living in the Community
RACE	# Adult Females within Family	% Household with Piped Water
White (reference)	Living with Female Parent (Yes=1)	% Household with Sewage System
Afro-Brazilian, Asian-Brazilian	Financial Support within Family (R$, Cr$)	% Household with Electricity
		Avarage of Years of Education
SOCIOECONOMIC STATUS	Household Indices	
Years of Education	# Children Under 10	Health Fascility
Income (R$, Cr$)	# Other Male Household Members	General Hospital per 1000 persons
Job Situation (employed = 1)	# Other Female Household Members	Private Hospital per 1000 persons
Marital Status (married = 1)	Other HH Members' Income (R$, Cr$)	Number of Beds per Hospital
Husband's Years of Schooling	Born in the Community	
Husband's Income (R$, Cr$)	Years Living in the Community	

Preliminary Findings and Anticipated Results

The analyses using negative binomial regression model indicate that the ethnic significance of Asian-Brazilian in child survival has weakened over time while the differences between white and Afro-Brazilian remain significant. For instance, after controlling for number of total children ever born and mother's age, and socioeconomic status, Asian-Brazilian is negatively associated to child deaths count in 1960; however, although Asian-Brazilian identity still negatively associated to child deaths in 1980, it becomes statistically insignificant once socioeconomic factors are introduced in the model. As for 2000, Asian-Brazilian is yet negatively associated with child mortality after controlling for only age, nevertheless, once total number of children ever born is included in the model, ethnic advantage is no longer recognized.

As for family/household structure indices, living with female parents, and the number of other household male and female members are positively associated with child mortality while the number of household members and the number of children under 10 years old are negatively associated with child mortality. The evidence is consistent over the three censuses. These results may suggest that the reason for being a large family/household may be economically driven and the economic burden among large families/households may overwhelm the expected merit having more adult help within family/household and fail to provide the assistance needed for mothers and child bearing among family/household members. The interaction terms between Asian-Brazilian and family/household do not seem consistent over time. This may be due to the small number of population of Asian-Brazilian and their socioeconomic and circumstantial changes relatively short period of time. For instance, the product term between Asian-Brazilian and the variable of 'born in the community' is negatively associated with child mortality in 2000 indicating that Asian's lower probability in child loss becomes more likely dependent on the connectivity with community in 2000, but in contrast, it is attributed to the connectivity to community in 1960 and 1980.

The multilevel statistical model results do not observe the interactions between 'color' and community attributes. While family/household and community effects existing in a model at the same time require an extreme cautious interpretation, a plausible reason is that the statistical model only shows the global effects of race/ethnicity, family structure, and community attributes on child mortality and overlooks their local variability. I expect GWR models to show spatial processes in the distribution of child mortality and to indicate the spatial variability of child mortality among racial/ethnic groups and the important measures of local variations.