DECLINING JAPANESE-BRAZILIAN ADVANTAGE:
RACIAL INEQUALITY IN SÃO PAULO, BRAZIL 1960-2000

By

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With my loving and enduring memories of my father, my brother, and my sister, I devote this study to my mother, hoping for her longevity
ACKNOWLEDGMENTS

There is no way that I could have conceived when I stepped out of my proposal hearing in December 2004 at the Streib conference room that my dissertation would have been taken such a long time to finish. Without the trembled emotion for three family members who left in the last 5 years, I cannot conclude this excruciatingly long journey. First and foremost, I dearly thank my family for their unconditional love and profound understanding whatever I am. I owe you my life and I swear you that I will protect our mother from any cruelty in this world.

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learn how to vividly live like him. I have been so fortunate to be guided by the scholars who I deeply admire and trust. I thank both of them for every aspect of this long passage.

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In my nine years of life in Gainesville, I was privileged to have wonderful colleagues and friends from the beginning. The memories with them in my mind will be the gems in my life forever. My warmest thanks go to Noemi Porro and Elli Sugita-Woods for their friendship over years. The funniest friend of mine, at the same time a very fine scholar, Valerio Gomes was the most helpful and reliable when I encountered issues in Portuguese. Probably he does not remember but I still keep a file holding many pages of helpful notes from him. Nine years is undoubtedly a long period of time and so many friends came and went in the blink of an eye and often I felt horrible thinking I could have done more for them. But certain relationships will remain long after we left the place we met. Therefore, I am especially grateful to Yuko Fujino and Clay Hipke for their unchanged friendship and supports under any conditions.

At the end of this long journey, I should apologize for not expressing nearly enough my feelings toward my mother, Hiroko Chijiwa, and my husband, best friend and colleague, John Reitzel. They are so alike and they are wholly different from me. They are the mirror of my good-half and when another half of mine gets lost, I know who can find the crying-half. Thank
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With my sincere love toward all I have interacted with, I shall open the door into the coming years to rethink the relationships with my passed family. I may never understand who they really are but I can love them completely without understanding them completely. Unlike most Japanese people, I am not a big fan of Ryoma Sakamoto, but I would like to close this acknowledgement with his proverb: “Why would you care what others say about what you do. Only you know about what you truly do [世の人は 我を何とも 云わば云え 我が成すことは 我のみぞ知る].” Fighting with shadows without knowing what I am fighting with. That was my last six years. I just hope someone who is in the same situation can find their way out as I have barely done.

I am sitting in absolute silence finally—I think I am ready to talk with my dearest father, brother, and sister in Tengoku. やっと、終わったよ。
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Due to its unique demographic composition, which stems from its colonial past and various immigration schemes, Brazil is a racially and ethnically diverse nation. Despite these characteristics, few studies have addressed the relationship between health and race in Brazil beyond the white/African comparison. This study focuses on racial inequality in child mortality in São Paulo, Brazil. Child health is a particularly sensitive indicator of quality of life and health. My discussion of race and child mortality features Japanese-Brazilians, the majority of the Asian-Brazilian population, alongside whites and Afro-Brazilians. Although the Japanese migrated into one of the most racially stratified societies as contract agricultural labors in the early 20th century, today Japanese-Brazilians exhibit higher socioeconomic status and lower child mortality rates relative to the whites and African groups.

In order to disentangle the determinants of child mortality, this research estimates variations in child mortality using census data from 1960, 1980, and 2000. The negative binomial regression and multileveled Poisson statistical models identify the covariates of child mortality associated with the mother’s race and socioeconomic status, as well as the composition of the household and the neighborhoods in which children reside.
Results indicate that although child mortality has markedly declined overall, thereby narrowing the racial gaps, a significant Afro-Brazilian disadvantage in child mortality remained over the forty-year span, even after controlling for the various determinants. In contrast, children born to Asian mothers had a survival advantage in 1960 and 1980 compared to whites. More recent estimates indicate that the mortality reducing effect associated with being Asian was no longer statistically significant in 2000. The findings suggest that Japanese-Brazilians may have become increasingly assimilated into Brazilian society, thereby losing the health related norms, values, and behaviors that once gave them an advantage. Alternatively, it is also possible that an increasing number of Asian Brazilians classify themselves as white rather than yellow in the census, which would blur the distinction between the two groups. Other explanations for the declining Japanese advantage are also plausible, including the possibility that the reduced white/Asian mortality gap was due to improved health related behavior among white mothers.
CHAPTER 1
INTRODUCTION

In the middle of the Capital of São Paulo, an overwhelming number of people on the streets crowded into the metro station. As I followed the quiet stream of people, I found myself standing on the platform before I knew it, wondering if I could make it to my destination. Then, a white lady walked toward me. As soon as she caught my eyes, she asked if she was on the right platform – that was what I thought she meant. Moments later the same thing happened again, but this time the woman was African descent. No matter where I was, I encountered people who made me realize in no time in São Paulo that this was the city in which the largest Japanese population outside of Japan has grown and flourished. An inexplicable deep emotion as of the collective thoughts of thousands of Japanese immigrants skimmed across my heart like they felt the ocean breeze while being on board during the crossing from Japan to Brazil.

At the dawn of the last century, the first group of Japanese immigrants sailed across the Pacific Ocean halfway around the planet from their home and established themselves in Brazil. Of the State of São Paulo’s 37,032,403 paulistas in 2000, about 400,000 are of Japanese descent; this population comprises two thirds of the population of Japanese heritage in Brazil (Consulate General of Japan 2008; Instituto Brasileiro de Geografia e Estatística (IBGE) 2000). Like other modern, cosmopolitan, and industrial areas, São Paulo is a city of contrasts. One is a dynamic and diverse economy, which is an enormous benefit for Brazil as a whole (Gall 2007). Another is a metropolis saddled with teeming slums that were left behind when São Paulo mushroomed from some 31,000 in 1870 (Honda and Nishimaki 1977) to 17,878,703 in 2000 (IBGE 2000) by migration from elsewhere in Brazil and beyond.

Statistics provided by the World Bank (1995) also show Brazil to be an extremely unequal society economically, with the most affluent 10% accounting for 51% of the total income. For
reasons related to political-economic processes of development from the slave society, including deficiencies in basic education, disparities in social opportunities have widened over the last four decades. This has contributed to the widening of the gap between rich and poor. The intense immigration of unskilled labor to the metropolitan areas of São Paulo helped establish a peculiar geographic pattern of residential inequality in those areas, with considerable portions of the population living in extreme poverty.

Brazilian society, however, has often been regarded as a harmonious union of blacks and whites which produced a uniquely Brazilian form of “racial democracy.” Some say Brazil is free of prejudice and discrimination, a place that offers genuine equality of opportunity to all nations. This may sound like paradise; however, in the last few decades persistent racial inequalities in Brazil have raised important questions. Why are most Black people in Brazil poorer and less educated? Is ‘racial democracy’ in Brazil true or not? Table 1-1 provides data that address such questions by presenting the means for years of schooling and frequency distributions of sanitation conditions for whites and blacks/browns. The differences in these figures among racial groups indicate that there are racial inequalities in contemporary Brazil.

Brazil is also known as a multiracial society. Brazilian society has been influenced by immigration schemes since the end of the 19th century, which brought in various ethnic groups from around the world. Despite the great deal of attention that has been given to racial relations between whites and blacks, very little research has considered the status of the populations of Asian descent relative to these two racial groups.

People of Japanese descent came to Brazil primarily as farm contract laborers to provide much-needed manual labor on coffee, cotton, and sugar plantations. The Japanese thus entered Brazil’s economic system as cheap labor at the lowest and least privileged status of resident
agricultural laborers (Wood and Jirimutu 1996). By the mid-1950s, however, the majority of Japanese immigrants rose to middle class status in both rural and urban areas by purchasing land to become owner-farmers (Lesser 1999), which, in fact, the Japanese government and Japanese immigrants did not expect this because the majority of the Japanese immigrants planned to return home after the end of the contract. This rapid movement from wage-labor to entrepreneurship may have been facilitated by the fact that Japanese immigrants arrived as family units (one of the requirements from the Brazilian government) which provided the labor and the emotional support to overcome the obstacles of settling in a new country and becoming economically competitive. Table 1-1 shows the level at which the Japanese population reached in Brazilian society in 1991 and 2000. As such, the inclusion of Asian populations in the analysis of race may advance our understanding of racial well-being in Brazil.

This raises questions about key concepts of welfare by which we can compare racial groups. One such concept is child health. This research focuses on racial inequality as evident in terms of child mortality in São Paulo, Brazil. In particular, I focus on the ways in which racial identity corresponds to socioeconomic status and other characteristics that differ across time and geographic space. Health status is an outcome measure that can be used to appraise inequality in standard of living, available resources and environment, and health-related behaviors. Child health is a particularly sensitive indicator of disparity in the quality of life and health, especially of mothers. Child mortality thus reflects the accumulated impact of deprivation throughout a mother’s life on her children. Variation in child mortality reflects a variety of social opportunities and constraints that are central to human development. Although Brazil is considered as a high growth country, its history of severe social inequality has hampered development of universal opportunities across racial groups and social classes that pose threats to
health and survival of disadvantaged groups. Skin color is highly correlated with socioeconomic standing in Brazilian society, which is characterized by extreme social inequality where racial background has played a major factor in class inequality and has been found to be related to numerous differences in child survival.

In order to disentangle the determinants of child mortality, this research attempts to explain variation in child mortality among families and geographic localities and over time. I highlight the relationship of race and child mortality. In turn, my discussion of race and child mortality features Japanese Brazilian populations alongside the more commonly studied whites and Afro-Brazilians. This three-way comparison goes beyond prior work in important ways. Despite being a racial minority, Asians in Brazil exhibit relatively lower child mortality rates and thus longer life expectancies. A three-way comparison that includes Asian Brazilians thus stands to improve our understanding of what the comparatively advantageous components among Asian households are relative to other racial groups. This understanding may provide the type of insightful provisions for improving the standard of living and reducing social inequalities among other minorities in Brazilian society.

The empirical analysis is organized into two parts, each with a distinct analytical approach. First it focuses on the individual-level by examining the linkage between race and child mortality while also considering demographic, socioeconomic, and family structure characteristics influencing child mortality, for multiple time points. Here I emphasize the characteristics of mothers as they affect the prospects for their children in terms of child survival.

The second analysis adds spatially aggregated data in order to examine the impacts of neighborhood-level characteristics as they may interact with individual characteristics such as race and in turn affect child mortality. My purpose with such a multilevel analysis is to define
neighborhoods with distinct racial differentials in terms of child mortality. This may help explain variations in the importance of racial inequality for child mortality by considering neighborhood characteristics alongside individual and family characteristics.

**Research Background and Significance**

**Child Mortality, Race/Ethnicity, Class Inequality in Brazil**

Child mortality has been used as an outcome measure in assessing inequality in terms of standards of living, available environmental resources, and health-related behaviors. Among its various determinants, race/ethnicity is an intriguing feature in child health and survivorship. The effect of racism on health remains unclear despite the fact that it is arguably among the most important public health issues in Brazil.

In Brazilian society, skin color is highly correlated with socioeconomic status, and reflects the major role that race has played in class inequality. Brazilian racial identity is differentiated along a gradation of color from white to black with shades of brown in between (Burgard 2002). However, researchers studying racial inequality in Brazil traditionally use a simplified white versus Afro-Brazilian (black and brown) dichotomization (Burgard 2002; Lovell and Wood 1998; Silva 1985, 2000). But it is unclear where Asian Brazilians fall on the black-white color gradient, and 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, Wood, and Andrade 2004; Harris et al. 1993), because the Japanese population does not fall between white and black in a linear color-class stratification system. Hence, this research offers a more inclusive assessment of the Brazilian system of racial and social stratification by including a neglected portion of the population and
thereby providing a more comprehensive understanding of racial/ethnic differences in child mortality in Brazil.

**Family/Household Structure and Neighborhood Influences on Child Mortality**

Child mortality is often regarded as a reflection of the parent’s health and quality of life due to the child’s absolute dependency on their parents and other family/household members (Watkins, Menken, and Bongaarts 1987; Wood and Lovell 1992). Previous research on the influences of family formation and structure and marital status on the well-being of individuals and children indicates that children born to unmarried and single women (Eberstein, Nam, and Hummer 1990), and black women (Hummer 1993; Hummer et al. 1999; Lovell and Wood 1998), and/or among a large number of siblings (Sastry 1997a), have substantially elevated risks of child death. The magnitude of family structure and marital status effects on child mortality differs depending on certain covariates, notably race/ethnicity (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 create negative impacts on child well-being - financial, physical, emotional, and life course (Desai 1992). Furthermore, family formation/structure varies due to residential environment and the level of industrialization and urbanization (Astone et al. 1999; Desai 1992) which may alter the impact of family formation/structure on individuals’ health outcome.

The family is considered as the minimum social support system. Family systems provide social support within the family on a daily basis. Family obligations are also associated with financial support and are the main source of provisions for gratuitous and unconditional supports. The immediate family thus constitutes a support system that can be considered as the smallest unit of local-level “social capital.” Social capital within the family gives the child access to adult human capital, based on the physical presence of adults in the family and on the attention given
by the adults to the child (Coleman 1988). Therefore, family arrangements may affect the resources available for children, influencing their growth (Bumpass 1990). Racial, ethnic, and cultural factors variably have been shown to have the major influence family formation and perceptions of family functions (Das Gupta 1997; Reher 1998) while children within higher income households and with more educated parents are believed to receive better healthcare and nutrition; therefore, they have a lower mortality risk than those with the lower income and the less educated parents (Gortmaker 1979; Hobcraft, McDonald, and Rutstein 1984). Informal unions are more common among lower class individuals, and as a result, female headed are more common among women with few resources (Burgard 2002). Since parents, particularly fathers, make a substantial financial contribution to children’s sustenance, the marginal commitment to the union (consensual rather than legal marital relationship) may have a negative impact on child survival.

However, families and households themselves exist in a broader social context of neighborhoods and communities. To understand the contextual influences on individual health, socioeconomic status, and family formation/structure, it is important to include neighborhood-level characteristics in the child mortality research. Sastry (1994, 1996) suggests that the relationships between household characteristics and child mortality may be altered by neighborhood 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, neighborhood-level variables are still significantly associated with probabilities of child survival. Unfortunately, neighborhood-level attributes have rarely been included in studies examining the relationship between race and child mortality.
Interest in neighborhood-level determinants of child survival coincides with a growing interest in the spatial variation of child mortality. Recent studies of Brazil have examined spatial variation in infant/child mortality within urban areas (Szwarcwald, Andrade, and Bastos 2002; Szwarcwald et al. 2000). The importance of the effects of neighborhood attributes such as infrastructure levels and ecological settings (e.g., education services, healthcare facilities, and the prevalence of city services, neighborhood stability and population heterogeneity) on child mortality have been addressed in other research, which indicates that relationships between child mortality and individual/household-level covariates are altered by changes in neighborhood characteristics (Sastry 1994, 1996). Multilevel statistical models have been used to develop an understanding of the causal effects of neighborhood characteristics on individual mother’s child outcomes for avoiding, so called, ecological “fallacy” and to account for the different variations across neighborhoods.

**Research Questions**

Based on the foregoing discussion, this study addresses four specific questions:

1. Does race have a significant effect on child mortality, net of the effects of other demographic and socioeconomic status characteristics of mothers?

2. Does the relationship of race and child mortality changed when accounting for family/household structure and family financial characteristics? Does the race-child mortality relationship change differently among different racial groups?

3. Has the relationship between race and child mortality changed over time? Has influence of race on child mortality changed differently among racial groups over time? Has the importance of family/household structure and financial characteristics changed over time?

4. By accounting for neighborhood/spatial characteristics, does the influence of race on child mortality change?

To permit temporal comparisons, this study employs three Brazilian censuses in 1960, 1980, and 2000 and neighborhood-level information from various sources. This study will
address the questions posed above by conducting multivariate analysis of child mortality using both individual-level models and multilevel models. The individual level data is analyzed using the negative binomial approximation, a type of statistical model appropriate for count data that can specifically identify the effect of race on child death counts. The negative binomial approximation also allows us to see if family/household structure modifies the relationship between race and child mortality. I will compare the effects of race and family/household structure across the three censuses to see how their relationships have changed over time. The analysis then considers the effects of contextual variables on two additional levels beyond that of individuals/families, namely for districts and municipalities. For these multilevel models, I employ Poisson regression while incorporating district and municipal characteristics as neighborhood-level determinants of child mortality.

This two-part quantitative investigation will evaluate the many determinants of child mortality derived from both individual/family and neighborhood-level factors as they vary over time. From this analysis, we gain a more refined understanding of the role of race in the determination of child mortality in the context of family structure and neighborhood characteristics.

Overview

The remainder of this dissertation proceeds as follows. In Chapter 2, I portray Japanese immigrants’ background and their situation in the multiracial and racially stratified society of Brazil. To understand Japanese situation in Brazil, I also present a literature review on the Brazilian color scheme. Chapter 3 offers a conceptual framework for the study of child mortality. The framework outlines the determinants of child mortality from the individual to the neighborhood-level. To link the two levels, I feature the concept of social capital, which reflects and is constitutive of various types of social ties, as among e.g., families and networks in
neighborhoods and communities. In the process, this chapter reviews previous studies on the relationships between child mortality and race and other determinants of child survival. Chapter 4 discusses data sources and the specific variables I will use in the statistical modeling. This chapter presents the descriptive statistics and bivariate relationships of the determinants and child mortality. Chapter 5 discusses the models I employ in the two steps of the multivariate analysis. Specifically, this chapter focuses on the Poisson and negative binomial models. I define both and render them for both single level and multilevel modeling. Chapter 6 presents the results from the single-level negative binomial models; Chapter 7 does the same for the multilevel Poisson models. These chapters address the four research questions posed earlier in this introductory chapter. Chapter 8 concludes the dissertation by providing a summary and discussion of the main findings, while noting data limitations that might influence the results. The concluding chapter also raises additional questions for further research.
Table 1-1. Means of years of schooling, household income, and proportion of having piped water and sewage system by color in São Paulo, Brazil, 1991 and 2000

<table>
<thead>
<tr>
<th></th>
<th>1991</th>
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<th>2000</th>
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<tbody>
<tr>
<td></td>
<td>White</td>
<td>Black/Brown</td>
<td>Asian</td>
<td>White</td>
<td>Black/Brown</td>
<td>Asian</td>
</tr>
<tr>
<td>Years of Schooling (Years)</td>
<td>6.93</td>
<td>5.00</td>
<td>10.64</td>
<td>7.33</td>
<td>5.38</td>
<td>10.98</td>
</tr>
<tr>
<td>Safe Water (%)</td>
<td>91.8</td>
<td>84.6</td>
<td>91.8</td>
<td>93.8</td>
<td>92.7</td>
<td>94.3</td>
</tr>
<tr>
<td>Sewage System (%)</td>
<td>76.4</td>
<td>61.0</td>
<td>83.6</td>
<td>84.9</td>
<td>75.2</td>
<td>90.2</td>
</tr>
<tr>
<td>Refrigerator (%)</td>
<td>76.1</td>
<td>67.5</td>
<td>78.1</td>
<td>97.2</td>
<td>94.1</td>
<td>99.2</td>
</tr>
</tbody>
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Note: The unit of analysis is the household and skin color refers to household heads.
CHAPTER 2
JAPANESE IN BRAZIL

This chapter takes up two interrelated topics in this dissertation: the incorporation of Japanese immigrants into Brazilian society, and the significance of race as a source of inequality in Brazilian society. Japanese Brazilians exhibit a unique historical trajectory concerning the context of their arrival in Brazil, their initial insertion into the Brazilian economy and society, and the conditions of their rapid upward social mobility. As such, Japanese Brazilians occupy an unusual social position in Brazil by being racial/ethnic minorities and yet hold a high social status, without encountering racism and conflicts from elites or other groups in Brazilian society. However, this does not mean that racism does not exist in Brazil. Nonetheless, the question of racial inequality in Brazil is a complicated one that has generated a large literature spanning several decades. This literature exhibits several notable changes in recognition of racism and racial inequality, as well as the importance accorded to race in explaining social inequality. Contemporary research on race in Brazil emphasizes that it is very important as an explanation for inequality, which makes race a key factor to consider for social welfare outcomes such as child mortality.

Pathway from Japanese Immigrant to Japanese Brazilian

Theories of Japanese Incorporation into North American Societies

Through historical patterns of immigration, colonial societies have become multiracial and multiethnic. As one racial minority, the Japanese have had substantial experience with many forms of racial antagonism since their arrival in new societies such as the United States, Canada, and Brazil. It has been said that the Japanese have suffered less racial antagonism in Brazil, while those in North America have been subject to more intense prejudice and discrimination.
(Adachi 2006; Makabe 1981, 1999) especially during the Pacific War. In this context, the case of Japanese descent in Brazil may afford a particularly illuminating comparison.

How has the pattern of Japanese-Brazilian assimilation been different from that of Japanese immigrants in the United States? In spite of their substantial economic and cultural influence, Japanese-Brazilians have rarely been a subject in the discourse on race and ethnicity in Brazil. It is a striking contrast to the environment in United States. However, theoretical perspectives on race have paid little attention to this contrast, and as a result, very few empirical studies are available on this subject.

Much social theorizing has emphasized assimilation, the more or less orderly adaptation of immigrant groups to the cultural practices and institutions of an established host population. The assimilation perspective continues to be the primary theoretical framework for sociological research on racial and ethnic inequality (Hirschman 1983). Park (1950) argued that European emigration was a major catalyst for societal reorganization around the globe and intergroup contacts regularly go through stages of “a race relations cycle” in intergroup history. For Park, there is a long-term trend toward assimilation of racial and ethnic minorities in modern societies. Assimilation is a process of interpenetration and fusion in which persons and groups acquire the memories, sentiments, and attitudes of other persons or groups, and, by sharing their experience and history, are incorporated with them in a common cultural life (Park 1950).

Gordon distinguishes a variety of initial encounters between racial/ethnic groups and an array of possible assimilation outcomes (Gordon 1964). He anticipates acculturation first, then geographic and structural integration, and finally eventual group merger. While Gordon presents three competing images of assimilation; “melting pot”, “cultural pluralism”, and “Anglo-Conformity”, he focuses on Anglo-Conformity as the descriptive reality. For him, cultural
assimilation is a very important dimension of intergroup adaptation in the societies like the United States. This view of assimilation usually emphasizes the way in which new groups must conform to the preexisting Anglo-Protestant culture (Feagin and Feagin 1999). In sum, while Park emphasizes structural assimilation, including new primary-group ties such as intergroup friendship, flowed from cultural assimilation, Gordon stresses that these are separate stages or phases of assimilation and may take place at different times (Woodrum 1981; Woodrum, Rhodes, and Feagin 1980).

An assimilation perspective has also predominated in much of the empirical analysis of the situation of Japanese Americans. Japanese Americans have been viewed as the most assimilated of all Asian American groups. For example, Japanese American out-marriage rates are significantly higher (between 30% and 50% for the younger generation) than those Chinese, Vietnamese, Koreans, and Filipinos, with most of these marriages involving whites (Feagin and Feagin 1999). Most assimilation theorists, however, take as their examples of ethnic adaptation European groups migrating more or less voluntarily to the United States. It is plausible to apply the theory of assimilation to the experience of Japanese immigrants in both the United States and Brazil, since structural assimilation at secondary-generation level has been significant for Japanese Americans, particularly in the economic sphere.

Kitano and Daniels argue that Japanese and other Asian Americans can be grouped into two major categories and other minor categories based on degree of overall assimilation to the core culture and institutions, and strength of ethnic identity (2001). They argue that many in the third and later generations and those isolated from large communities are in a “high assimilation, low ethnic identity” category; that is they have made many adaptations to the dominant culture in terms of language and life style and retain only weak ties to the mother language and culture.
These Japanese Americans have strong social ties to whites or have married whites. The other large proportion of the Japanese population belongs to a “high assimilation, and high ethnic identity” category. These people move easily in both the Japanese American community culture and the dominant culture (Feagin and Feagin 1999). Hence, one segment of the Japanese immigrants sought to survive discrimination by isolating themselves from the outside world and immersing themselves in Japanese culture. Others sought to acculturate rapidly, at least in those cultural domains where acculturation was permitted, while maintaining strong social and cultural ties to their relatives and friends. Assimilation also suggests that cultural assimilation in regard to language, religion, and orientation to white-collar and corporate employment, has come rapidly for later generations.

Cultural Pluralists emphasize the persistence of ethnic cultural traits, family practices, subcultural activities, and distinctive identities (Woodrum 1981). Greeley (1974) has developed an interesting concept of “ethnogenesis” and applied it to those white immigrant groups set off by nationality and religion. His perspective sees the ethnic groups sharing traits with the host group and retaining major characteristics of their nationalities as well. A modern ethnic group is one part home-country heritage and one part common culture, mixed together in a distinctive way because of a unique history of development within North American society, including possible discrimination (Greeley 1974). From the ethnogenesis perspective, adaptation means more than the one-way conformity such as Gordon indicates. In ethnogenesis, assimilation is not always toward the dominant Anglo-Protestant culture. Similarly, Petersen (1971) has argued that some groups like Japanese Americans have become a “subnation” in the United States, achieving integration in the economic sphere and exhibiting some cultural adaptation, but still maintaining cohesive, family-centered communities. While traditional assimilation models cannot fully
explain the persistence of ethnicity in the United States (Feagin and Feagin 1999), Japanese American can be seen a clear-cut example of Greeley’s concept of ethnogenesis, since they remain “partly in” but “partly outside” the dominant white culture and society. Based on my observations of Japanese-Brazilians of different generations in São Paulo, cultural pluralism theory may also apply to the situation of Japanese immigrants to Brazil and their descendants.

Beyond cultural assimilation, economic adaptation is crucial to immigrant and host group relations. When viewed from a power-conflict perspective, relative economic power and political power are key determinants of immigrant subordination in colonial societies (Woodrum, Rhodes, and Feagin 1980). Japanese Americans are seen as in the in-between position, what Bonacich (1972) defined a “middleman minority” in the capitalist economy. These middleman minorities find their economic niche as small-business people positioned between other producers and consumers (Woodrum, Rhodes, and Feagin 1980). This is the “spirit labor market” formulated by Bonacich which also argues that the Japanese American sojourning attitude toward migration prompted them to concentrate in certain occupations that engender internal solidarity while avoiding conflict with white interest groups (Feagin and Feagin 1999). In other words, some ethnic groups become small-scale traders and merchants doing jobs that dominant groups are not eager to perform.

As Makabe (1981) suggests, in order to test for differences in economic structure and in the positions occupied within that structure, it may be useful in accounting for the nature of intergroup conflicts, or competition, and the differences in patterns of racial relations. Her hypothesis is applicable to the Japanese-Brazilian social situation. If there is no economic conflict or competition between racial/ethnic groups, no antagonism arises between racial and ethnic groups. There is little disagreement about the existence of racial discrimination against
Japanese immigrants but it is plausible that if they belonged to different economic niches from other subordinated racial groups the level of racial discrimination may have been mitigated.

**Japanese-Brazilian Experience**

Given the foregoing theoretical discussion, it is useful to portray the historical experience of the Japanese coming to Brazil and becoming incorporated into Brazilian society. As noted in Chapter 1, the Japanese entered Brazil’s economic system cheap agricultural laborers. The Japanese immigrants however rose to the middle class by the mid-1950s (Lesser 1999). Their hard work to raise their status can be observed in the diaries and memoirs of Japanese immigrants. While Japanese immigrant upward mobility is not unique, what is unusual is that in Brazil, this mobility did not cause notable competition or conflict with other racial and ethnic groups.

One of the explanations for this situation is the profound involvement of Japanese government in the international migration affairs. Up until the mid-1920s, the main agents promoting emigration were Japan-based emigration companies. The government was only indirectly involved in the business of exporting people until the Oriental Exclusion Act of 1924 (Makabe 1981; Smith 1979). Since then, the Japanese government became actively involved in the emigration of Japanese to Brazil. Because of long-term government involvement in immigration policy, Japanese immigrants to Brazil have long felt a particularly close relationship with the government of Japan, expressed through their strong dependency (Smith 1979). Because of high dependency on their homeland government, Japanese *Issei* (first generation, the Japanese people first to immigrate) immigrated anywhere in America and established their own segregated community (Handa 1978), which was highly visible and self-contained, based on Japanese social structure and customs (Makabe 1981). The *issei* continue to speak their native language, and there are many schools built by the *issei*. There is a saying that when the Brazilians build a town
they begin with the plaza and the church, but the Japanese start with the school (Smith 1979); the school which was purposed to maintain “Japaneseness” in addition to their awareness of the importance of education for upward social mobility. The implication of the issei dedication to help their children to obtain such qualification is that they had irrevocably cast their lot with Brazil for sending their children Catholic schools, dreaming that the next generation would be better-off. Afterward however, they dispensed with the sojourning attitude as they realized that they were not going back.

In addition to dependence on the Japanese government, Makabe’s thesis is also plausible as an explanation for upward mobility among Japanese Brazilian. If there is no economic competition between ethnic groups, no antagonistic relation exists between them, is plausible. Japanese immigrants in Brazil did not experience economic discrimination. In fact, the Japanese in Brazil tended to deny the existence of racism directed against them; they do not feel that they have been victims of racism at any point or stage of their settlement (Honda and Nishimaki 1977; Makabe 1981; Smith 1979). Instead of being rejected by or excluded from the larger society, Makabe argues, the reaction of Japanese immigrants to their minority status in Brazilian society was quite the opposite, a reaction of “self-exclusion” (1981). Self-exclusion was a protective device that the issei in Brazil had developed in the prewar years for the sake of their survival.

This practice of self-exclusion or “voluntarily excluding themselves” from the host society was possible because Japanese immigrants came as family units, the Brazilian-imposed requirement being that there must be at least three able-bodied farm workers in each household¹. Because of these family members it was possible to practice self-exclusion and by reconstructing Japanese culture through practices at home. At the same time, Japanese immigrants also

¹ Children were not accounted as labor (Adachi 2006)
appropriated Brazilian institutions for purposes of upholding Japanese cultural values. For example, Japanese immigrants made a great effort to send their children to Catholic schools because of their association with high social status.

Japanese immigrants were described by Brazilians as hard-working, frugal, and focused on saving money. Brazilians admired the Japanese saying “They were willing to work even in lowland areas and swamps” (Handa 1978) without fear to be infected by tropical diseases. The truth is that Japanese immigrants were eager to cultivate low-lying lands for purposes of producing rice which requires plenty of water. At that time, the Japanese did not know about malaria. But after that, they suffered severely from malaria. In fact, these cultural differences and maybe lack of knowledge of the Brazilian environment may also help explain the lack of conflicts between racial and ethnic groups in the labor market.

**Education and Japanese Community in Brazil**

The arrival of the Japanese in Brazil thus led to a specific trajectory of incorporation involving self-exclusion and decisions that did not invoke conflicts with other race/ethnic groups. As noted above, central to the process of self-exclusion and the construction of Japanese community in Brazil has been the institution of education. Why do the Japanese think education is important? By drawing on Japanese culture, folklore, and the influence of Neo-Confucianism, a cursory explanation can be constructed.

Traditionally, Japanese cultural practices were strongly restricted by ritualistic collective activities. These activities were purposed to educate children to be “adult”. Being adult in the old Japanese communities has a very different meaning from the more individualistic understanding of adulthood in Western societies, for adulthood in Japanese communities was defined in terms of civic responsibility. In the Western cultural context, being educated is permits one to “get ahead” through individual enterprise; but to be educated in traditional Japanese communities was
to take part in one’s community and to have a sense of responsibility within that community so that they would better contribute to the community, thus sharing the notion of equality and dependency. Community members should be equal in every sense including obtaining the same level of education, with everyone attaining no more or less than other community members. These old customs mixed with neo-Confucianism, as educational opportunity (private elementary school) reached to the common people during the long period of the Tokugawa-era (1607-1867).

With the end of isolationism, Western culture flowed into Japan. Some children with higher social status parents received more education than other members of their community. Due to this change, parents began to spend more money to have their children educated. It was in this historical context that Japanese emigration to Brazil proceeded, and the cultural practice of investing heavily in education was evident among first-generation Japanese in Brazil. This helps explain why Japanese immigrants built the school first, and even send their children to Catholic schools.

**Racial Relations in Brazil**

**Color and Class**

Brazil has held a predominant place in the study of race relations in the Americas since Gilberto Freyre’s study of miscegenation. First published in 1933, it led to the optimistic national perspective, “racial democracy” (Freyre [1946] 1986). When we regard the racial system in Brazil as seen from an American perspective, a constant theme reoccurs. Compared to the United States, class matters more than race in Brazil, and from this point of view, racial relations may be seen as being much more benevolent in Brazil than in the United States.

However, as historians and demographers have repeatedly indicated, racial democracy is a myth and has been utilized by the elites and the government for maintaining racial-class strata
and their power (Skidmore [1974] 1993; Telles 1992; Winant 1992). Despite the formidable situation of the non-white under-class in Brazil, there has been no explosive racial upheaval in its history; instead, the nation, to some degree, is still influenced by the notion of racial democracy and embraces the myth. How is this possible? A combination of ideological manipulation, coercion, and intricacies of meaning pertaining to race and racial identity together maintain the cultural/ideological complex of racial democracy, which shapes Brazilian society as well as the ideological and political dynamics of race.

Brazilian racism and racial ideology can be thus understood as a process of constructing the notion of “improving race,” (i.e., “whitening”) which is historically rooted in Brazil, and “critical to the development of Brazilian ideologies concerning the nation and national identity” (Sheriff 2001). The “class over race” perspective was able to appear plausible in explaining Brazilian social order because of the existence of an ideology which was manufactured in the process of improving race by white elite ‘management.’ To locate the Japanese-Brazilian racial position in the Brazilian scheme, I next review the two major concepts of race/class in Brazil.

At the beginning of the twentieth century in Brazil, similar to other former slave societies, a nearly comprehensive view of the race concept was still located at the biological level, where races are defined as “natural” and their characteristics are assumed to be essential, given, and immutable (Cooper 1984; Winant 2000). Simultaneously, the Brazilian population at the turn of the century was predominantly mixed due to the miscegenation commonly and openly practiced in Brazil since its inception as colony of Portugal. Miscegenation was believed by European, North American, and Latin American elites to lead to moral, genetic and psychological degeneracy (Sheriff 2001; Skidmore [1974] 1993). As slavery waned, the ideology “whitening” gained influence in Brazil. The Brazilian elite, facing the impending abolition of slavery in the
late nineteenth century, sought to attract European immigrants to fill its labor needs. Consequently, Brazilian elites assimilated European paradigms of “pseudo-scientific” racism and climatic determinism (Skidmore [1974] 1993).

The goal of whitening was made explicit in nineteenth century debates among the Brazilian elite about how to replace the large slave labor force that would soon be manumitted through Abolition. The elite were also concerned about Brazil’s international status in which the scientific racism of the time caused European countries to look down on Latin America because of its large Afro-Brazilian and Indian populations (Skidmore 1972). European immigrants were expected to increase the proportion of whites in the population and to marry with the nonwhite population to eventually create a “whiter” population (Degler 1971). The constitution of 1891 specifically banned African and Asian immigration into the country, and the national and state governments made the luring of European immigrants to Brazil a priority for national development via the improvement of race (Andrews 1991).

Another feature of Brazil’s racial ideology that dates to the 1930s is its claim to being a racial democracy in which race has no effect on opportunity. Freyre popularized this idea in his historical accounts in which he argued that Brazilians of African descent had not advanced relative to whites, not because of inherent racial inferiority, but because the institution of slavery had blocked their ascent. Freyre went on to highlight the cultural contributions that Africans and indigenous people had nonetheless made to Brazilian national identity (Freyre [1946] 1986). Freyre’s racial democracy thesis supposedly put an end to the whitening ideology and, at the same time, fulfilled the role of transforming racial mixing into a social virtue rather than a degenerative vice (Skidmore [1974] 1993). However, his historical account has been criticized
because it overly praised the virtues of the Brazilian race system while overlooking its subtle and discursive forms of racism (Skidmore [1974] 1993; Telles 1992).

While Freyre developed the argument of a “New World in the tropics” of Brazil as a land almost free of racial prejudice and one which could serve as an example to the rest of the world for how to resolve its racial problems (Andrews 1991), the racial democracy idea was implanted into official ideology by the mostly conservative and military elites who had ruled Brazil since the 1930s. They sought to forestall racial uprisings and to position Brazil internationally as a positive example of race relations (Skidmore 1972). Hence, despite the fact that this nation enslaved more Africans any other American nation, and was the last country to abolish slavery (in 1888), Brazil successfully cultivated an image of itself as the world’s first racial democracy, a land in which blacks and whites lived together in harmony under conditions of almost complete equality (Andrews 1991). The whitening ideology and racial democracy ideology have subsequently been blamed for creating formidable racism, for preventing the formation of ethnic identities based on race, and for defeating attempts to form a black consciousness.

In the 1950s, UNESCO research challenged the Brazilian racial democracy myth by documenting racial discrimination from a socioeconomic approach and discovering a strong correlation between blackness and poverty (Wagley 1952). While most Brazilians approved of racial tolerance, in practice, racial discrimination was widespread. The “class over race” perspective is considered to be initiated by this UNESCO study and offered a revisionist perspective on racism in Brazil. The UNESCO research was conducted by anthropologists and a sociologist (Thales de Azevedo, Roger Bastide, Florestan Fernandes, Marvin Harris, and Charles Wagley, among others) and reported on race relations in four rural communities located in
different regions of Brazil; São Paulo, Rio de Janeiro, Bahia, and Recife, with varying racial and ethnic compositions. Wagley noted reminiscently:

These studies, although motivated by an effort to depict a positive picture of race relations in Brazil as compared to the United States and South Africa, for example, actually uncovered considerable “race” prejudice. They found that, although there was generally considerable tolerance of phenotypical physical appearance, that the rigid class structure of Brazil relegated most blacks and people of mixed ancestry to the lower class; and they found that African ancestry was a definite barrier to social mobility. These studies helped to bring objectivity to the “myth of racial democracy” and perhaps in the process helped somewhat to ameliorate the situation of people of color in Brazil. (1979:14)

The UNESCO studies were effective in dismantling the myth of a non-racist national culture and in challenging the role of various elites in maintaining these myths.

However, while they recognized racial inequalities, researchers tended to stress socioeconomic status as the primary axis of power and deemphasized color and race as an axis of inequality (Hasenbalg 1985; Twine 1998). This deemphasis of race as an axis of power and faith in Brazil’s racial democracy is also implied by the other UNESCO study researchers. For example, research on race and social mobility in the city of Salvador, Bahia, a predominantly Afro-Brazilian state capital, indicated that class conflict was replacing racial conflict (Wagley 1979). In this account, race served as an indicator of status, but the deeper, more “objective” category of class is a matter of economics, not of color or prestige (Winant 1992). Thus, race became less salient in comparison to class formation.

Marvin Harris (1964) further suggested that the Brazilian system of racial identification necessarily subordinated race to class, and argued based on his findings that the varieties of phenotypes in the Brazilian prevent racial discrimination in day-to-day life, stating that:

There are no subjectively meaningful Brazilian social groups based exclusively upon racial criteria. The terms Negro and white could denote clear-cut population segments for nobody but a physical anthropologist. In the actual dynamics of everyday life, superordinate-subordinate relationships are determined by the
interplay between a variety of achieved and ascribed status, of which race is an important but not decisive element. (cited by Andrews 1991:250)

However, such arguments have a tendency to reduce race to class, depriving racial dynamics of their own, autonomous significance which cannot escape from the shortcomings of reductionism. This is also notable in Fernandes’ (1969) conclusion. His research is derived from the question of whether the full modernization of class society could be achieved. This question focuses on class and assumes a process by which race is subordinated to class. Based on his substantial residential research in Rio de Janeiro, Fernandes (1969) contended that racial segregation existed only to the extent that color and class were coterminous, and with industrialization, the salience of race in the labor market would diminish and consequently racism would diminish. In other words, the “class over race” view suggests that once Afro-Brazilians achieve levels of education and income corresponding to their white counterparts, they no longer face barriers to social acceptance. In the realm of employment, the class over race perspective implies that once Afro Brazilians have acquired “human capital,” they will be granted the same pay and career opportunities as those enjoyed by whites with equal credentials (Lovell and Wood 1998). This perspective returns to and enhances the racial democracy ideology.

Despite the class reductionism, a typical limitation of the revisionist literature published by UNESCO researchers in the 1960s was its nearly exclusive focus on racial inequality in their conclusions. This is not to deny the importance of the economic dimensions of race. However, the preoccupation with inequality to the near total exclusion of any other aspect of race is a logical feature of approaches which treat racial dynamics as a manifestation of a more fundamental class relationship. While these approaches tend to take the meaning of race for granted, and to see racial identities as relatively rigid and unchanging, Winant presumes, “racial identity is changeable in the social context but not transforming into other social variables,” and
he claims, “[I]n writing about racial dynamics the revisionists tended to ignore the changing socio-historical meaning of race in Brazil” (Winant 1992).

Nonetheless, the UNESCO revisionists succeeded at exposing racial inequalities in Brazil. This prompted the burgeoning of post-revisionist or structuralist theories of race in Brazil at the beginning of the 1970s. This perspective saw race as a central feature of Brazilian society. Researchers such as Dzidzienyo (1971) and Hasenbalg (1985) looked at the way the Brazilian social order had maintained racial inequalities without encountering significant opposition and conflict. It is a fascinating feature of Brazilian racial relations and demonstrates two contrasting characteristics of racism in Brazil. One is Hasenbalg’s (1985) argument of the absence of serious racial opposition, “the smooth maintenance of racial inequalities” by which discriminatory practices, the avoidance of discussions of discrimination, and the symbolic violence perpetuated against nonwhites reinforce each other. And second, these processes in turn have led blacks and mulattoes to regulate their aspirations according to what is culturally imposed and defined as the “appropriate place” for people of color (Hasenbalg 1985).

In the subsequent period, especially after the 1980s, research income, employment, education, and health indicators such as life expectancy and child mortality provided evidence indicating the existence of racial and class inequality in various regions of Brazil (Bastide and Berghe 1957; Lovell 2000; Lovell and Wood 1998; Silva 1985; Szwarcwald, Andrade, and Bastos 2002; Wood and Lovell 1992). This strengthened arguments of racism as not being reducible to class inequality, and supported the emergence of a “race over class” perspective. The new research on racial inequality in Brazil presents the evidence not against racial democracy but also against the class over race perspective. These findings are consistent with work on residential segregation (Telles 1992, 1995), wage, occupational equality, and residential

“Race over class” research clearly shows that color-based differences in such variables as occupational standing and income level cannot be reduced to differences in human capital alone as researchers in the 1950s and 1960s contended. Also, the interplay between the geography of economic development, racial distribution of the population and wage discrimination in Brazil is striking; wage discrimination is highest in the more developed and predominantly white regions. The labor market is homogeneous across neither region nor race in Brazil. These studies indicate that racial disparities in quality of life within a population do not vary by and are not explained by socioeconomic status. More than one hundred years after the end of slavery, blacks are still overwhelmingly concentrated in the bottom of social strata which undoubtedly suggests that racial discrimination is a crucial determinant of social and economic success. Although the exact processes producing racial inequality in socioeconomic status and health are well known, racial inequality constantly appears to be a major cause of these economic differences.

**Persistence of Racism in Brazil**

In the previous sections, I reviewed the main contributions of the studies related to the Brazilian racial system. The review detailed various perspectives and criticisms which were delineated in the transitions from the racial democracy ideology to the class over race perspective, post-revisionist structuralism, and finally to the race over class perspective. The biologistic racism and racial democracy utilized by the elites and then the military dictatorship, and UNESCO’s reductionism to class are no longer appropriate as consistently shown by more recent demographic studies highlighting racial inequalities. Although post-revisionist structuralism broke through the class reductionist view, the essential problem of structuralism
was its failure to account for the persistence of racism. Instead, structuralism concentrated on explaining the absence of racial opposition.

There are, as far as I know, two approaches to answer this “passive” racism. One can be represented by the extensive field research by anthropologists. As already posited, studies in this tradition conclude that prejudice does lead to discriminatory behavior, and racial inequalities persist even controlling for social class. Nonetheless, the Brazilian racial relationship seems benevolent when contrasted to that of the United States. Andrews (1991) introduces a voice of an informant of his research;

In North America, where prejudice is a fact, the blacks have their life, and the whites have theirs, but not here, but not here; everything in Brazil is ours, except for some minor incidents which one couldn’t really call prejudice. (1991:135)

Andrews answers that the only way out for black people afflicted with this fear was to embrace the whitening thesis and racial democracy (1991). As often noted in psychological studies, the way of thinking by black people about their situation may be considered as a defense mechanism or expected reality (expectancy theory) so that they view themselves as more in control of their own destiny and lead healthier and more successful lives than those with a more external locus of control (William 2003). Given these coping mechanisms, they can then deal with racism in day-to-day life. This perception is also adopted in anthropological qualitative studies (Sheriff 2001; Twine 1998).

Similarly, Sheriff (2001) attends to ideological and discursive patterns which are presented as sustaining mechanisms of racism in Brazilian social life. Sheriff constructs a critical psychological analysis of how racism impacts upon the self-perceptions of black people. Afro-Brazilians concur that blacks in Brazil associate beauty with whiteness and a person is assigned higher social prestige the lighter they are. Blacks seldom discuss within their families the history and causes of their racial oppression. She regards this silence as being a conscious strategy to
contain their anger, and a way of protecting themselves from psychological pain. Many families
discourage their mulatto children from marrying negroes in an attempt to whiten the next
generation. This practice is not based on self-hatred, but rather on pragmatic family policies that
will ensure the next generation will be whiter, and thus have a better chance of economic
mobility. Cultural censorship has suppressed everyday discourses about racism and has made the
experience of racism appear to be a private burden for which no public solutions exist. Likewise,
she found that whites do not talk about slavery in Brazil in order to erase any personal family
connection with the past. In this way, because whites believe they are blameless, they can ignore
the suffering of black people. Passive attitudes, which are displayed by Sheriff, especially when
it represents a historically entrenched cultural etiquette, may not preclude an awareness of
oppression, yet it is very difficult to break.

The other approach to explaining persistent racial inequality in Brazil is offered by
sociologists and historians such as Winant (1992, 1994, 2000) and Andrews (1991). Winant
highlights the racial formation. This perspective understands race as a phenomenon whose
meaning is contested throughout social life (Winant 1992). He explains,

[T]his account race is both a constituent of the individual psyche and of
relationship among individuals, and an irreducible component of collective
identities and social structures. Once it is recognized that race is not a “natural”
attribute but a socially and historically constructed one, it becomes possible to
analyze the process by which racial meanings are decided, and racial identities
assigned, in a given society. (Winant 1992:183)

As a consequence of centuries of inscription of writings in the social order, racial dynamics
inevitably acquire their own autonomous logic, penetrating the fabric of social life and the
cultural system at every level. This approach agrees with Wilson (1980) who created a sensation
when he declared the declining significance of race. He stated in an interview with Kiros:

Although discrimination continues to play an important role in the African
American experience, the consequences of the cumulative effects of past
discrimination have made blacks particularly vulnerable to certain economic changes in society. There are also many cultural aspects, which are affected by race. There are many subtle aspects of race that cannot be understood independent of their structural or cultural basis, and full understanding of the cultural and structural basis requires that they be couched in a historical context and settings. (Kiros 1999: 408)

The meaning of race and the complexities of racial identity seems contested far more intensely than ever before in Brazil. With the increasing brown population by the miscegenation between many ethnic groups in Brazil, the meaning of race, the nature of race identity, and the logic of racial categories is becoming more complex and more controversial. The arguments over racial equality, mobility, redistribution, and allocation along lines of race in Brazil increasingly resemble those of the United States which is highly antagonistic. In the United States, class and race both contribute to economic stratification. The problem is that, as in Brazil, it is difficult to separate the two and quantify their relative contributions to inequality. Considering the intricacy of racial/color and class identities interwoven by Brazilian economic development and stratification systems, any discourses using arguments such as “class over race” or “race over class,” does not satisfactorily explain the inequalities of a racially diverse society like Brazil. In spite of this complex Brazilian racial system, Brazilian demographic censuses categorize the population with a four-fold skin color typology.

Color in Brazilian Demographic Census

Brazil’s demographic census classifies the country’s population by asking individuals to choose one of the following four options: *branco* (white), *preto* (black), *pardo* (brown), and *amarelo* (yellow). However, in the context of racial democracy and racism, designations of race are based on the interaction between phenotype and socioeconomic status. Brazilian law has also never been used to encourage racial equality, probably because this would mean acknowledging the existence of racism and racial inequalities (Skidmore 1972). Under such circumstances, it has
long been known that a correlation exists between racial phenotypes and socioeconomic status 
Wood and Carvalho 1988).

Given the persistent evidence for the color-class correlation, there has been much attention to black-brown differences. A popular thesis in Brazil is that “money whitens” such that a tendency exists for race-color identity to shift toward white among wealthier and better-educated nonwhites. Phenotypically dark but wealthier individuals tend to identify themselves and to be identified by others by terms that connote less resemblance to black phenotypes. In addition, contextual circumstances further modify the labeling of color identity in such a way that persons of mixed phenotypes may be labeled whites if they are well-dressed and playing prestigious roles (Harris et al. 1993).

The Brazilian demographic categorization is carried out with this subjective perception of color by the way in which people think of themselves. This classification system is significant when compared to the one drop thesis in the U.S., wherein persons with only partial black ancestry are considered black in the U.S. (Wright 1994). The fact that social ranks such as income and education play an important role in racial classification suggests that the subjective definition of skin color in Brazil is far more mutable than in countries such as the United States (Carvalho, Wood, and Andrade 2004). Telles and Lim (1998) summarize Brazilian demographic systems in the following way: phenotype, social class, and social context are all layered and have an effect on individuals’ perception and consciousness about one’s identity, while social networks and cultural practices may further affect one’s self-classification. Such ambiguity may be especially conspicuous in countries like Brazil, where race has never been defined under law,
Unlike countries like the United States, where the racial system is based on ancestry rather than appearance.

Researchers have traditionally used the census data in which color classification is self-defined. These estimates may be deficient if one is interested in measuring racial discrimination because racism is based on racial classification by others (Telles and Lim 1998). Income differences by race are at least partly products of discrimination, in which discriminators, such as employers or consumers, reward or punish a person based on their perceptions of the person’s race. Self-identification would be a poor proxy for how one is treated in the labor market. Brazilian census data on race are collected using a combination of self- and interviewer-classification (Carvalho, Wood, and Andrade 2004; Telles and Lim 1998) but the data are produced by an unknown mix of these collection methods (Telles and Lim 1998). Despite the variability of color identification, the census has relied on self-identification because interviewers “feel” certain about a respondent’s race, “automation” creeps into interviewer routines, and interviewers feel uncomfortable asking about race (Telles 2002; Telles and Lim 1998). Inconsistent classification between interviewer and respondent are particularly common among the least-educated Brazilians, whereas the most educated are most likely to self-classify consistently with interviewer assigned classifications. The complexity and ambiguity of the demographic system are themselves embedded in systems for constructing social meaning attached to skin color and race in Brazil.

**Summary**

This chapter showed two things concerning race/ethnicity in Brazil, featuring Japanese Brazilians. First, the Japanese in Brazil occupy an unusually high social status for a racial/ethnic minority because they received Japanese government support, arrived as families and organized as communities around educational institutions, and did not encounter conflicts as they pursued
upward social mobility. And second, race/ethnicity in Brazil involves nuances and subjectivities and interacts in complex ways with social class, which has driven considerable research that in recent years has placed greater emphasis on race as a source of social inequality in Brazil. These two conclusions from the foregoing reviews raises questions about the importance of race for child mortality, particular for the case of Japanese Brazilians. However, it is also the case that the determination of child mortality involves other factors. The next chapter takes up this issue by presenting a conceptual framework for the study of child mortality.
CHAPTER 3
INEQUALITY IN CHILD MORTALITY

Impressive scientific and system improvements in health have greatly contributed to the reduction of infant and child mortality for most middle and less developed nations over the past decades. Some countries appear to have reached a plateau, although a closer look reveals inequalities. Because of the situation of children, especially newborn babies who depend entirely on their parents, child morality is considered as a sensitive measure of their parents’ quality of life associated with different socioeconomic environments; therefore, child mortality is often regarded as an extreme case of poor child health, which is a result of parental health and life chances.

While researchers have recognized the importance of the endogenous biological factors and health practices in child mortality, the investigation of the causal relationships between exogenous factors and the incidence of child mortality has been a major interest among demographers, sociologists, and epidemiologists. Socioeconomic differences in population health are derived from, created in, and reestablished within numerous variables such as income, education, job, living quality, age, gender, place of residence, race, ethnicity, family structures, neighborhood or community environment, and policies related to health. These variables have been used to disentangle the determinants of child mortality. Parents’ social and economic activities comprise several processes that operate through the interactions with their families and in their neighborhoods and communities, Hence, inclusion indicators of family structure and living circumstances in my analysis of how parents’ compositional characteristics relate to their children’s health is essential in an effort to understand child well-being as a whole.

To conceptualize these complex mechanisms, this chapter first discusses social capital, a concept which is thought to explain the relationships between health outcomes and the effects of
individual, family, and neighborhood variables. I then construct a framework that shows possible pathways through which the effects of racial and individual attributes on health outcomes are influenced by social capital; such as family structure and the neighborhood environment. The conceptual framework features measures which are used in statistical analyses in the later chapters. The following section reviews studies of child mortality that have relied on the measures of child survival identifies in the framework. The final section summarizes the expected effects of each variable on child mortality.

**Social Capital, Race, and Well-Being**

In the context of child health and child well-being, economic inequality among social classes has drawn the attention of demographers, sociologists, and epidemiologists. Hence, the relationship between the socioeconomic status of individuals and populations and their health is well established – the socioeconomically better-off do better on most measures of health status. The differences in morbidity and mortality between socioeconomic groups have been observed in many studies and constitute one of the most consistent findings in social epidemiologic research (e.g., Antunes 2008; Cavalini and Ponce de Leon 2008; Cleland 2001; Department of International Economic and Social Affairs 1985; Gortmaker and Wise 1997; Kawachi 1999). The general pattern of better health among the socioeconomically affluent is found across time periods and among different demographic groups. This is not to say that relationships between socioeconomic factors and health are invariant, or play out precisely the same way in different contexts. While socioeconomic determinants offer, say, the most feasible explanation of population health outcomes, I am well aware that some unexplained variation remains. Variables of potential interest include important cultural, institutional, administrative, and political factors that influence how socioeconomic conditions influence health.
Social Capital and Race

In quantitative analysis of child health studies, researchers typically include, either as controls or as main effects, compositional factors such as age, gender, nativity, race, ethnicity, education, income, employment, living condition, and contextual factors. Additional variables include the presence of siblings, family structure, access to health care facilities, and measures assessing neighborhood quality. The interplay of these social phenomena can be seen in Coleman’s concept of social capital:

It is not a single entity, but a variety of different entities having two characteristics in common: They all consist of some aspect of social structure, and they facilitate certain actions of individuals who are within the structure. (1990:302)

Social capital concepts have been employed by numerous researchers to better understand unexplained variations in health outcomes and to develop multilevel modeling (e.g., Antunes 2008; Arieira and Haynes 2001; Astone et al. 1999; Carpiano 2006; Kawachi et al. 1997; Subramanian 2003). These studies find that individuals are more likely receive health benefits from their social connections and memberships. It is a crucial point for this study that one of the criticisms of social capital is the rare focus on race. For instance, Putnam, one of the major contributors of the social capital concept, drops race as an important determinant of social capital, arguing that “race and ethnicity differences in associational membership are not large.” He goes on to say that “the erosion of social capital has affected all races” (1995b:672). However, even though we may have come a long way in the development race relations, in multi-racial societies race is, as Bedolla argues, “still an important factor for people in determining with whom they can feel comfortable and with whom they want to spend time” (2007:10). Therefore, it is logical to think that race would affect individuals’ feelings of attachment to their community and the ways they might want to act upon that attachment. In addition, due to the lack of focus on race or ethnicity, it becomes even more important to include race, especially because the creation and
maintenance of social capital, which is at the core of Putnam’s concept, very much depends on customs and attitudes which are inherently related to race and ethnicity. Thus, in this study, social capital is a key variable in the proposed conceptual framework.

The concept of Social capital crosses disciplinary boundaries and opens up interdisciplinary opportunities. By using the concept of social capital, sociological and demographic researchers can draw in other disciplines such as economics, anthropology, epidemiology, political science, psychology, and geography. The reason why such a wide variety of disciplines have been attracted to social capital could be explained by its ambiguity—the various concepts of social capital can be interpreted in various ways, which is also one of the main criticisms of the concept.

Social Capital in Health and Social Relations

Durkheim was among the first to focus on the importance of social integration and social cohesion. “There is in a cohesive and animated society,” he argued, “a constant interchange of ideas and feelings from all to each to all, something like a mutual moral support, which instead of throwing the individual on his own resources, leads him to share in the collective energy and supports his own when exhausted” ([1897] 1951:210). In the latter half of the twentieth century, seminal works by Loury (1987), Bourdieu (1986), Coleman (1988, 1990), and Putnam (1993, 1995b, 2000) advanced theories of social capital in explaining how inequality in social connections produces adverse outcomes for those who lacked it.

Loury uses social capital to explain how relationships between individuals can provide access to resources that benefit both individuals and groups. According to Loury (1992):

[Social capital refers to] naturally occurring social relationships among persons which promote or assist the acquisition of skills and traits valued in the marketplace.... [It is] an asset which may be as significant as financial bequests in accounting for the maintenance of inequality in our society. (cited by Woolcock 1998:189)
In Loury’s usage, social capital is the set of resources that inhere in family relations and in community social organization, factors which can be useful to the cognitive and social development of a child. Loury (1987:273) discusses social capital as ‘local public goods’ that communities produce. These local public goods may be general in nature, such as education, peer influence, contacts, and friendship networks. He is concerned with the unequal distribution of material and financial capital and how social capital may mitigate these disparities.

After Loury introduced the term “social capital” of community, it has been developed by sociologists Bourdieu (1986), Coleman (1990), and Putnam (1995a, b, 2000). Among them, Robert Putnam has been named in several articles as the most influential social capital theorist within the fields of public health and community development (Carpiano 2006; Lochner, Kawachi, and Kennedy 1999; Macinko and Starfield 2001). Putnam emphasizes the purposive social ties and practices that are embodied in the concept of social capital, stating that “The theory of social capital presumes that, generally speaking, the more we connect with other people, the more we trust them, and vice versa” (1995b:665). This in turn suggests that interpersonal trust, norms of reciprocity, and social engagement can have beneficial outcomes, including health (Carpiano 2007).

By emphasizing the benefits of trust networks, Putnam takes up the challenge presented in David Hume’s anecdote about the farmers’ dilemma,² where Hume concludes that farmers will not cooperate even if they both lose their harvests as a result. In a society lacking collective action, Putnam argues that everyone would be better off if they cooperated. In the absence of

² “Your corn is ripe to-day; mine will be so tomorrow. It is profitable for us both, that I should labour with you to-day, and that you should aid me to-morrow. I have no kindness for you, and know you have as little for me. I will not, therefore, take any pains upon your account; and should I labour with you upon my own account, in expectation of a return, I know I should be disappointed, and that I should in vain depend upon your gratitude. Here then I leave you to labour alone: You treat me in the same manner. The seasons change; and both of us lose our harvests for want of mutual confidence and security” (Hume 1737 [1975]).
trust, which is necessary for coordination, everyone defects, ruefully but rationally, confirming one another’s melancholy expectations (Putnam 1993). Therefore, Putnam conceptualizes social capital,

\[ \text{By analogy with notions of physical capital and human capital – tools and training that enhance individual productivity – “social capital” refers to features of social organization, such as networks, norms, and trust that facilitate coordination and cooperation for mutual benefit. Social capital enhances the benefits of investment in physical and human capital. Whereas physical capital refers to physical objects and human capital refers to the properties of individuals, social capital refers to connections among individuals – social networks and the norms of reciprocity and trustworthiness that arise from them. Hence, social capital is ‘moral resource,’ that is, a resource whose supply increases rather than decreases through use and which, unlike physical capital, becomes depleted if not used. (1993:35-36)} \]

Social capital in this context linked to moral civic life where the moral resources are available to members of social groups. He later explains, “A society of many virtuous but isolated individuals is not necessarily rich in social capital” (Putnam 2000:15). In other words, interaction enables people to build communities, to commit themselves to each other, and to strengthen the social fabric.

While Putnam’s work focuses on the cohesiveness among the members of the community, groups, and institutions to promote population well-being, Bourdieu’s concept of social capital focuses on the resource based nature of social capital in thinking of how social class and inequalities are socially reproduced. Bourdieu, whose early work (1977) sought to establish culture as a dynamic and creative but also structured phenomenon, conceptualizes social capital as:

\[ \text{[T]he aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance and recognition - or in other words, to membership of a group - which provides each of its members with the backing of the collectively-owned capital, a “credential” which entitles them to credit, in various senses of the word. These relationships may exist only in the practical state, in material and/or symbolic exchange which help to maintain them. (1986:248-249)} \]
Actions bring about changes in the world; they have outcomes, which provide “resources” for further actions and networks. For Bourdieu, there are three fundamental species of capital: economic capital, social capital, and cultural capital (Bourdieu 1986). Economic capital constitutes, among others, the financial resources available to and accessible by social actors. Social capital is the sum of resources (actual or virtual) that accrues to individual and groups due to the network of formal and informal relationships of mutual acquaintance and recognition. Cultural capital, also called an informational capital, represents knowledge stemming from family background, varying investments in education, social class, and other cultural resources (language, theories, beliefs). Like other forms of capital, individuals who possess social capital can use it to achieve their purpose.

Both Putnam and Bourdieu note the importance of social networks to build and maintain social capital. The difference between the two sociologists is the form of network. Putnam emphasizes the social cohesion of networks by focusing on the interpersonal trusts and norms of reciprocity whereas Bourdieu emphasizes the resource of networks (Carpiano 2006, 2010) which can be mobilized to access other resources. Conceptualizing social capital in this sense, Carpiano argues,

[M]oves beyond concepts of trust and norms of reciprocity and necessitates consideration of more tangible network-based resources that people use for action. It considers that people differ vastly with regard to their social network composition and, thus, have unequal access to network-based resources, whether psychosocial, material, cultural, symbolic, or political in nature. (2010:84)

Considering that populations are composed of various classes, races, and ethnicities, this account of Bourdieu’s concept of social capital would help understand how different neighborhood environments can influence health outcomes. In contrast to Putnam’s approach, which emphasizes social cohesion (which is difficult to measure), the conceptual approach in this
study relies more heavily on Bourdieu’s notion of social capital within a social network of resources.

**A Conceptual Framework of Child Survival**

To comprehend the relationships between child mortality and various confounding factors, ideally, we would wish to have child specific information on the various dimensions of health status. Unfortunately, the census data generally do not include such information. Therefore, the social capital framework is useful for conceptualizing the connections between child survival and the various proximate factors which can be operationalized using census data from Brazil.

Within the social capital framework, we assume that parents are influenced by the social capital that is represented in family relations and community social organization. Using Bourdieu’s approach, this study focuses on the social processes that are antecedent to the formation of network of resources.

Figure 3-1 depicts the variables that comprise the conceptual framework. As shown at the bottom of the diagram, child survival is most immediately affected by individual level demographic (e.g., maternal age, place of residence) and socioeconomic attributes (e.g., mother’s education, income and housing quality). Within the household, the model anticipates that variations in household composition and the financial contribution of other member of the household can also have an effect, as shown to the left of the figure. The conceptual framework further takes into account the characteristics of the neighborhoods in which the households are located (top of diagram). Neighborhood-level variables include the prevalence of public utilities, measures of neighborhood stability, and indicators of population heterogeneity. Also noted at the neighborhood level are variables that reflect educational infrastructure and the present of health care services. The concept of social capital is positioned at the center of the diagram in order to express the assumption that neighborhood characteristics can serve as proxy measures of the
social networks that have the potential to influence health outcomes and child survival. Finally, the framework illustrates the complex role played by race, which, to one degree or another, can influence individual, household, and neighborhood dynamics, while the relationship between race and child mortality is expected to be altered by these covariates.

Table 3-1 provides a list of variables used in this study, and indicates the expected direction of their association with infant and child mortality. The sections that follow summarize the literature on the various topics and make explicit the rationale for the inclusion of each of the variables noted in the table.

**Inequality in Child Mortality: Literature Review**

Researchers have identified ‘race’ as a socially defined and meaningful construct that acts as a reflection of socio-economic, political, cultural, behavioral, and health differences between groups. Racial background has been found to play a significant role in determining mother’s behavior and health status during the perinatal period, which directly and indirectly affects infants, and children through nutrition, housing, and health care accessibility (e.g., Burgard 2002; Cooper 1984; Donahue et al. 2004; Hummer et al. 1999; Kleinman, Fingerhut, and Prager 1991; Machado 2005; Rathwell and Phillips 1986; Wood and Lovell 1992). Hence, the association between racial values and quality of life is a summary measure that also interacts with an array of individual demographic characteristics and socioeconomic status. Because racial minorities are more likely to fall into disadvantaged social categories, they will have higher mortality. This implies that observed mortality differences are primarily compositional in nature (Kawachi 2006; LeClere, Rogers, and Peters 1997).

A number of studies in the United States conclude that the legacy of African slavery is reflected the higher rates of infant and child mortality observed among the African American population (e.g., Alio et al. 2009; Goza, Stockwell, and Kelly 2006; Hummer et al. 1999; Jaynes
and Robin M. Williams 1989; Kleinman, Fingerhut, and Prager 1991; Mullings et al. 2001; Williams and Collins 1995). The mortality differential has been attributed to a number of factors, including difference in health care practices such as prenatal and postnatal care (Echevarría and Frisbie 2001; Finch 2003; Hummer et al. 1999; McGlade, Saha, and Dahlstrom 2004), difference in marital status and family formation (Albrecht, Miller, and Clarke 1994; Aronson and Huston 2004; Jacknowitz and Schmidt 2008), residential segregation and racism (Bell et al. 2006; Pickett et al. 2005; Subramanian and Kawachi 2003; Vinikoor et al. 2008). Cultural considerations have also received attention, as in the case of the “Latina Paradox,” which refers to the unexpected mortality advantage enjoyed by Hispanics despite their comparatively lower socioeconomic status (McGlade, Saha, and Dahlstrom 2004; Palloni and Morenoff 2001). The paradox has received considerable attention, including the recommendation by Zsembik and Fennel who caution against pan-ethnic groupings, and advocate the need to explicitly acknowledge ethnic group distinctiveness because disparities in their health and factors exist among sub-groups of the Latino population (Zsembik and Fennell 2005).

Geography may also account for racial disparities in child mortality, especially the context of racial segregation and discrimination. Segregation is defined as the spatial separation of one group from another on the basis of race/ethnicity (Massey and Denton 1988). An exclusive focus on risk at the individual level may overlook the way that the residential environment can affect the psychosocial and physiological factors that lead to poor birth outcomes in everyday life (Bell et al. 2006; Diez Roux 2001; Mullings et al. 2001). Using multilevel regression models that controlled for individual and community-level variables, Bell et al. found that among African Americans, higher isolation was associated with lower birth-weight, higher rates of prematurity and higher rates of fetal growth restriction (Bell et al. 2006). Racial “isolation” thus reflects
factors that are deleterious to health, including poor neighborhood quality, persistent discrimination and the intra-group diffusion of harmful health behaviors.

**Mother’s Demographic Characteristics in the Study of Child Mortality**

Mosley and Chen (1984) underscore the importance of a mother’s ‘time’ in caring for her children as well as prenatal visits, breastfeeding, food preparation, sanitation, and sickness care. The physical accessibility to (modern) health services is also largely determined by mothers’ socio-economic standing. Greater physical access to health services improves survival to a greater extent among the children of less educated women than for children of more educated women (Bicego and Boerma 1996; Katende 1994).

Consequently, child health and mortality depend largely upon the general economic circumstances of the household, including level of the parent’s education. Studies find that child mortality and education are plausibly associated, although indirectly. Maternal education may confer skills and attitudes that help women overcome important factors in determining their use of health services. This aspect also stresses the importance of demographic and family structural factors in child well-being in providing financial, physical, and emotional supports for mother and her children.

Research on mother’s age has generally shows it to be positively correlated with child mortality, However, some studies have found somewhat of a U-shaped relationship between age and child such that teen mothers (typically < 16 years) or older mothers (> 35 years) show higher rates compared to women in the intermediate years (Pickett et al. 2005; Vinikoor et al. 2008; Pitt and Sigle 2009). A 2005 study by the Inter-American Development Bank came to the same conclusion (Alves and Belluzzo 2005) The relationship, however, was not consistent across other control variables, and disappeared when an interaction term for mothers weight by age was included in the model (Alves and Belluzzo 2005).
“Place of Residence” is also associated with variations in child mortality, depending on whether mothers live in an urban or a rural setting. Research by Anderson, Rodrigues, and Thome (1983) Caldwell and McDonald (1982), and Sastry (1997b, 2004) measured place of residence in their studies and found that it is associated with other contextual factors such as access to hospitals and health-care clinics, relationships with familiar people such as family and friends, and to stronger ties to the community, all of which are thought to positively affect the health of the mother (Sampson, Morenoff, and Earls 1999). However, the findings for place of residence appear to be mixed, often losing significance when other control variables are included in the models. For example, Sastry (1997b) found that urbanization in Brazil has played a key role in the narrowing the differences between urban and rural residency in child mortality rates, but urban areas still tended to have lower rates of child mortality relative to rural areas and to those on the periphery of urban areas.

“Maternal Nativity” is a demographic variable regarding whether the mother was born in the locale in which she resides. It is hypothesized that mothers living in their native land could be expected to have lower rates of child mortality than mothers not native to a locale (Mathews and MacDorman 2007). Within the context of this study, “Nativity” can be viewed as linked to social capital since it is believed that native mothers would have access to better health care facilities and to informal social networks that would make child mortality less likely to occur. Research by Sastry and Hussey (2003), for instance, found a link between native born women in Chicago and better pregnancy and child health outcomes compared to foreign born women. On the other hand, research on native born mothers’ effect on child mortality in the US by Mathews and MacDorman (2007) showed that native born American mothers had a 39% higher rate of child mortality than mother’s born elsewhere. Some hypotheses about conflicting findings related to
societal differences in nativity’s effects on child mortality have been advanced in recent years. Mathews and MacDorman (2007) suggested that the characteristics of migration selectivity, the type of social support networks peculiar to different migrant groups, and differing risk behaviors might play a role beyond simple nativity.

“Years of Residency” measures the length of time spent in a particular place. It is a contextual factor that has been found to be negatively associated with child mortality. Like other demographic and socioeconomic variables, years of residency may link to other factors that influence variations in child mortality. The negative hypothesis suggests that the longer a mother lives in a place, the more likely she will have stronger social ties to other people in the community. As a result, she can better utilize public services such as ambulances or hospital care. According to Omariba and Boyle (2010), the longer a mother and her children stay in at a particular residence, the lower the likelihood of child mortality.

Mother’s marital status is expected to be positive, such that married mother’s will have better health outcomes with their children and thus lower risk for child mortality compared to single mothers. The association between marital status and child mortality has been examined using various controls such as education (Keller 1978), race (Cramer 1987; Eberstein 1989), race and age (Gee, Lee, and Forthofer 1976), and race and intervening factors (Eberstein, Nam, and Hummer 1990; Hummer et al. 1999). These studies found that the magnitude of marital status effect on child mortality differs depending on the covariates, and the significant interactions between marital status and education, and race and unmarried status, are associated with higher child mortality. However, Cramer found that “marital status,” as in the case of place of residence and age, “may not be an independent risk factor. In general, it is not known which social factor or combination of factors is causally responsible for the observed group differences” (1987:299).
For example, children born to unmarried women may be at higher risk of mortality as a result of inadequate familial resources rather than marital status per se (Eberstein, Nam, and Hummer 1990).

**Socioeconomic Status and Child Mortality**

Setting aside race and ethnicity, a higher incidence of poor pregnancy outcomes and child mortality among women from disadvantaged socioeconomic backgrounds has been found in previous research on determinants of child mortality. Income, which is closely tied to occupation and education, has an important effect on the ability to obtain medical provisions (Hobcraft, McDonald, and Rutstein 1984). Thus, income is an influential factor in consideration of individual socioeconomic status and is an important determinant of child mortality (Gortmaker 1979; Hummer 1993; Mosley and Chen 1984). Upper income families are also likely to have better housing and are more likely to be connected to water supplies and sewage systems. In addition, education expands the role of the socioeconomic variable by disseminating knowledge on medical sanitary requirements. This knowledge can be crucial, especially in developing nations. Knowledge can range from simple information about child health care involving cleanliness and sterilization to more complex knowledge of what drugs and vaccinations are required, as well as the ability to find and use services (Hobcraft, McDonald, and Rutstein 1984). Hence, socioeconomic status, specifically income, can be considered a pivotal human resource in child care and well-being.

However, the mere existence of income differentials does not constitute a satisfactory explanation of the association between these income differences and child mortality (Gortmaker 1979) as family structures and residential location may also be relevant. For example, while the social context has an independent role in the association between income and health status (Kennedy, Kawachi, and Prothrow-Stith 1996; Shouls, Congton, and Curtis 1996), there is little
residential variation in mortality associated with contextual variables, once individual differences in socioeconomic status are accounted for (Fiscella and Franks 1997; Reijneveld 1998). The standard of living circumstances are an important proxy of residents’ social capital and material capital.

“Maternal Education” is an index for socioeconomic status has also been found to be highly correlated with infant and child health and mortality (Cramer 1987; Hogue et al. 1987; Mangold and Powell-Griner 1991; Sastry 1994). Education can serve as an indicator of knowledge and make-up of medical services. Mother’s with more education tend to belong to higher socioeconomic status groups that are better able not only to afford medications and other expensive health care but also have access to valuable information on pregnancy and childbearing (Sastry and Hussey 2003). Accordingly, Sastry and Hussey also found a positive association between mothers’ education and child health. Specifically, they found that increases in education beyond the 11th grade corresponded to positive increases in child health measures and lower rates of child mortality (2003).

Higher income correlates with lower rates of child mortality. Yet, this relationship can be complicated by the presence of mother’s income within a household, which can have contradictory effects. While the mother’s employment generates additional income for the household, which can have positive effects on child mortality (Bicego and Boerma 1996; Katende 1994), the mother’s participation in the labor force also reduces the positive effects of other factors related to mother’s care of their children (Mosley and Chen 1984).

Access to public utilities can be considered as indicator of living standards, although the effect may be context specific. Upper income families who live in remote rural areas may not be connected to city services, and therefore provide their own electricity and water and waste
services. Similarly, poor people may have access to utilities, not because they are wealthy but just because they are living in the central location. In the context of health research, maintaining a higher sanitary condition may reduce the risk of infectious disease, and therefore, reduce mortality (Perz 1997; Wood and Carvalho 1988).

**Family/Household Characteristics in Child Mortality**

The family is regarded as a system that provides social support to all family members. Most literature on family and households consistently mentions the conceptual difficulty of distinguishing between the two. This complexity is a barrier to applying theories to empirical research. For example, Burch argues, “[T]he apparent complexity of a subject matter is in inverse proportion to the state of its theory. In short, good theory makes things look simple, or at least simpler” (1995:103). While the word “household” can have different meanings, as a native unit, among different strata of society (Hammel 1980), it cannot be divorced from how people think about the domestic unit or from symbolic concepts that influence decisions and guide actions (Netting, Wilk, and Arnold 1984). Carter explains this well:

> [T]he familial dimension of the domestic group is distinguished from the household dimension. The former is defined by the origin of the links between its members, links that have their sources in culturally defined relations of birth, adoption, and marriage, regardless of whether those who are so linked live together or engage in any shared tasks. The household dimension of the domestic group, on the contrary, is defined by shared tasks of production and/or consumption, regardless of whether its members are linked by kinship or marriage or are co-resident. (1984:45)

Hence, “household” is considered as a unit in which we can observe three types of relationships between the members within it: conjugal, consanguineous, and residential (co-residential). When considering the household in the context of its social network as a means of practical capital exchange, one might question if there are any crucial differences between a family and a household. Astone and colleagues (1999) for instance conceptualize marriage as a relationship that occurs within a larger system of social exchange. In this account, marriage
embeds each member of the couple in a complex web of social relations other than the nuclear family itself and thus, the utility of being married for achieving ends such as child care may be linked to more extensive kin ties.

Relationships with the cohabitant partner’s family and kin are maintained through family gatherings, holidays, and ceremonies. The cohabitant partner may become a “quasi” family member in a common sense. Much depends on the context and the nature of the family, which varies according to class, religion, culture, and generation. However, the level of cognition among family/kin members and the strength/depth of ties may be weaker than, or at least different, from the “real” family or kin members. Social networks are expected to play catalytic roles for securing assistance, which can be provided by both kin and non-kin. However, when considering the quality of social network, kin and even fictive kin are more reliable investments than non-kin (Astone et al. 1999). Kinship may therefore be an important consideration, although, census data do not allow us to identify kin and family networks. Because census data include information on the household, this study relies on the concept of household as the unit of analysis in the analyses that follow. Within households, there are variations in terms of children’s age at which parents or foster parents should provide appropriate types of support for children. The obligations that fall to the family involve both financial support and the gratuitous provision of various services. Bumpass (1990) lists forms of support or help that include sharing household tasks; such as baby-sitting, emotional support, and financial exchanges. These factors highlight the fabric of interdependency among generations that has the potential to influence child care.

Research on child health suggests that children’s well-being is associated with the parent’s marital status and the type of union involved. McLanahan and Sandefur (1994) find that children
benefit when the parents are married and present compared to children in cohabitant unions, who, in turn, do better than children who reside with a single parent.

Traditionally, men have been responsible for providing the economic basis for the household, and women have played a complementary role, exchanging their domestic expertise for men’s involvement in the labor force (Becker 1991; Schoen and Wooldredge 1989). However, this division of labor, between men who specialize in money making and women who supply domestic services has been in transition since 1960’s. Family patterns are changing rapidly throughout the world and shifting men’s and women’s roles, both in relation to each other and to their children. While some women still stay in their traditional roles, a growing number of women are in the paid labor force, mitigating their contribution to the household.

Changes in union formation have been viewed in this context. Delayed marriage, non-marriage, and marital dissolution are partially caused by women’s economic independence, which modifies their behavior and perceptions of marriage. Bumpass (1990) demonstrates that working wives are twice as likely to report having trouble in their marriage if they regard the division of labor as unfair to them, and their employment therefore may undermine the stability of many marriages. Oppenheimer, on the other hand, states that “real-world conditions indicate that specialization can be a risky and inflexible strategy for maintaining a family’s economic well-being over time” (1997:450). This is a crucial point for women who are also mothers of younger children if only because economic activities and childcare often compete for the mother’s time. The labor force participation of married women with preschool children and the expected division labor within marriage were examined by Leibowitz and Klerman, cited by Goldscheider (1995). Today, married mothers of small children are far more likely to work, mainly because women now have greater income earning opportunities.
Divorce can have negative consequences for child health. As McLanahan and her colleagues (1994) point out, “the consequences for children of variation in the involvement of a non-co-resident father is such that while involvement often has positive direct effect, it also can have major negative indirect effects that operate through increased conflict with the mother over issues related to parenting.” The deterioration of the standard of living of children due to divorce can be mitigated by alternative supports such as social welfare and child care covered by relatives.

The proportion of traditional family formations has declined in most industrialized countries. Consequently, kinship ties and other traditional sources of social support have also declined, meaning that families often turn to other sources of support (Burch 1995) that are provided by kinship or social networks. The social exchanges are observed in “a variety of institutional contexts, including, but not limited to, the markets” (Cook 1991), where people make rational calculation of costs and benefits that structure economic exchange (Curtis 1986; Meeker 1971).

Gender differences in social networks also play a role in facilitating access to differing social resources, including information, material goods, and social support. Moore (1990) highlights the importance of gender differences in the properties of personal networks. Compared to men, women have fewer ties to non-kin (such as co-workers) and more ties to kin (Fischer and Oliker 1983; Marsden 1987; Wellman 1985). Men have more ties to powerful people in work organizations (Brass 1998; Miller 1986), a pattern which might be attributed to contrasting dispositions of men and women toward interpersonal relationships (Miller 1976).

Social relations in a family are thus gendered and take place within an opportunity context that can influence access to social networks. Gender affects the structural opportunities and
constraints in social network (Fischer and Oliker 1983). Moore (1990) suggests that employment opportunities and the potential to earn higher income occur more often for men than for women; and that structural constraints such as domestic work and childcare are more significant for women. Though it may be viewed as a disadvantage to women, role specialization among family members is a practical way to lower risk (Astone et al. 1999). Fisher (1982) and Marsden (1987) find that, in general, women and men have networks of similar size and that number of non-kin in social networks decreases with child bearing and kin ties are rearranged and strengthened. A birth is a family event, and the news is quickly shared with relatives. Hence, children and the childbearing process may increase kin composition and the strength of ties that comprise women’s social networks. In some cases, children can expand women’s social networks among non-kin due to strengthened ties with neighbors.

Gender differences in social network formation and composition can be observed across various socioeconomic classes and race groups. Moore (1990) finds that persons who are more economically, educationally, and occupationally privileged form larger networks and establish closer ties to non-kin than do less privileged persons. From this finding, and considering that structural variables do not fully eliminate the effect of gender on kin network, we may assume that the gender differences may be maintained even in the different classes. In some cases, such as among black and lower-class families, the nature of gender differences in social network could be more significant because of the higher proportion of one-parent households.

**Neighborhood Effects on Health and Child Mortality**

The basic idea underpinning collective efficacy is the ability of a community to manifest common values or ideals in order to adequately maintain informal social controls or to work out community problems (Bursik 1988; Kawachi, Kennedy, and Wilkinson 1999; Sampson and Groves 1989). Neighborhoods characterized by severe economic deprivation, population
heterogeneity and migration, and high numbers of young males are thought to experience higher rates of disorder, including health problems since the residents are unable to effectively utilize the public services or social networks in ways that would promote better health. Accordingly, it is the “persistent contextual effects” of the community that differentiates levels of collective efficacy. Community differences in the ability to collectively organize have been linked to a diverse array of negative health outcomes at the community and individual level. Research in this area includes studies of birth weight, elderly mortality, psychological stress, drug abuse, and serious illness such as coronary heart disease (Berkman and Clark 2003; Boardman et al. 2001; Chandola 2001; Gee and Payne-Sturges 2004; LeClere, Rogers, and Peters 1998; Mohan et al. 2005; Sundquist et al. 2006).

The significance of community attributes, such as infrastructure levels and ecological setting (e.g., educational services, health care facilities, and the prevalence of city services), on child mortality have been addressed in earlier studies. Furthermore, complementary relationships between child mortality and covariates may be altered by changes in community characteristics (Sastry 1994, 1995, 2002). Moreover, the increasing interest in the neighborhood characteristics has pointed to the importance of social capital as a possible explanation of the findings with respect to inequalities in health, and for understanding the relationship between income inequality and health (Almeida-Filho et al. 2003; Kawachi, Kennedy, and Glass 1999; Pearce and Smith 2003). This is particularly the case when contextual effects remain significant after controlling for race and a variety of individual factors (LeClere, Rogers, and Peters 1998).

Definition of neighborhood

Most studies that explore neighborhood effects rely on geographic boundaries, such as school districts, police districts, postal codes, and other boundaries that are defined by the census bureaus and various governmental agencies. These boundaries are often larger than individual
resident’s definitions of “neighborhood.” We often use the term “neighborhood” and “community” almost interchangeably in everyday life, probably because, Weiss et al. explain “neighborhood boundary definitions are subjective, varying even among residents and there is no one precise way to delineate a neighborhood” (2007:6).

Definitions of community however entail both networks and geography (Berkman and Clark 2003). Macintyre and Ellaway (2003) describe three dimensions of “neighborhood” identifiers: services and amenities, the social environment, and the physical environment. Service and amenities refers to the common use of public facilities, such as schools, hospitals, public services, and parks. The social environment refers to social interaction and the symbolic significance to residents. The physical environment relates to housing and population characteristics. The subjectivity of neighborhood boundaries, demonstrated repeatedly in empirical research, is also widely accepted. Hence, these identifiers overlap with residents’ neighborhood definitions, which, in turn, are affected by individual characteristics, such as gender, age, and daily activities (Sastry, Pebley, and Zonta 2002). Particularly in cities, where local travel is easy and frequent, neighborhood boundaries are likely to be malleable (Weiss et al. 2007).

Sastry, Pebley, and Zonta (2002) report that the perception of neighborhood size is associated with family income, education, and having friends in the neighborhood. Non-migrant residents who are more educated and who have higher incomes are more likely to say that their neighborhood is larger compared to other respondents. Racial and ethnic differences may also be relevant. Perceptions of the size of neighborhood are related to food shopping (Latinos), the location of health care services (Asian, Pacific Islander), and attending religious services (African Americans).
**Prevalence of public services**

The local physical environment that might influence health includes but is not limited to housing quality indicated by the availability and quality of public utility services, as well as residential sanitary levels, measured by available garbage disposal and, safety levels, measured by paved roads and installed street lights.

Clean water and sewage disposal are especially important to vulnerable populations. In their study of racial differences in child mortality in Brazil from 1950 to 2000, Wood, Carvalho and Horta (2010) found that the presence of running water in the home and links to city sewage services were persistent and important covariates of child survival. The magnitude of the mortality-reducing effects of these indicators remained more or less constant despite the decline in mortality that has taken place in Brazil in the last 50 years.

Thomas, Strauss, and Henriques (1991) show that among rural households, the existence of publicly provided garbage removal services has a large and positive impact on child height. Prevalence of power supply is associated with taller children and the quality of sewage services affect child height. In the urban sector, on the other hand, they found that none of the infrastructure indicators had these effects.

**Neighborhood stability**

A seminal study of Chicago neighborhoods, by Shaw and Mckay (1942), which emerged in the criminological literature, revealed that neighborhoods marked by high rates of population turnover, economic deprivation, high population heterogeneity, and high percentages of young males, had difficulty organizing to effectively solve community problems. Such neighborhoods, in other words, lacked fundamental collective efficacy and were therefore unable to fully make use of social support networks and informal institutions (Kawachi, Kennedy, and Wilkinson 1999). According to Kornhauser (1978), social networks and informal institutions that assist
residents in such communities have trouble taking root in these types of disadvantaged communities. It appears that many residents had no interest in establishing networks since they did not plan to remain in the community for any appreciable length of time. Because this results in high population turnover due to the constant movement of people into and out of the community, they remain in persistent state of flux. Together, with economic deprivation and other contextual effects, development of social cohesion that promotes better health outcomes is further inhibited (Bursik 1988).

Beyond the factors first identified by Shaw and McKay (1942), the literature has shown that female headed household, high unemployment rates, and low educational levels have significant influence on child mortality and other health outcomes. These factors are good predictors of health-related outcomes, child maltreatment, and infant mortality (Cohen et al. 2003; Gage and Hutchinson 2006; Leventhal and Brooks-Gunn 2003; Machado and Hill 2005; Sampson, Morenoff, and Gannon-Rowley 2002).

In urban neighborhoods, social disorganization is accompanied by poverty, high unemployment rates, and high mobility, increasing the risk of morbidity, and child mortality. These neighborhood effects on morbidity remained almost unaltered after inclusion of the individual-level variables (Sundquist et al. 2006). Others have suggested that the distinction between a compositional and contextual effect may not be so clear because the composition is shaped by the context; for example, the level of unemployment is an indicator of the local labor market which certainly determines any individual’s chances of employment (Macintyre, Ellaway, and Cummins 2002).

Less educated population may be especially vulnerable because they may have lower status jobs and fewer problem solving skills and may thus have limited group experience and training
relevant to dealing with stressors in the neighborhood (Aherna et al. 2008; Rouse and Barrow 2006). On the other hand, higher community educational level may influence child well-being by influencing rules, norms, and behaviors regarding the health care and conducts of everyday life (Sastry 1996).

Some studies of child health and well-being have examined the role that female headed households play in predicting child health outcomes. Barros and colleagues (2001) showed that households headed by females were significantly more likely to experience negative health outcomes for both mother and children than those with two parents. Similarly, Alves and Belluzzo (2004) in their studies of infant mortality in Brazil found a small positive effect for female headed household, suggesting that neighborhoods marked by many single mothers were significantly more likely to have adverse child health outcomes compared to neighborhoods with fewer single mothers. However, this research did not control for many other structural factors, such as socioeconomic differences, which as other research has shown, are important covariates of child survival.

**Population heterogeneity**

Population heterogeneity refers to the diversity and stability of neighborhood composition. Coming out of the social disorganization literature, particularly the more recent literature that focuses on the social capital and collective efficacy, population heterogeneity encompasses three primary variables in this study 1) proportion of migrants; 2) racial/ethnic diversity; and 3) economic disparity.

The concentration of immigrant groups is likely to impede public orientations because of linguistic barriers and cultural isolation. Thus, neighborhoods characterized by concentrated disadvantage and immigration are expected to face multiple barriers to generating collective efficacy for children (Sampson, Raudenbush, and Earls 1997). Accordingly, neighborhoods that
have a high percentage of migrants, particularly a high turnover of such populations, along with a racially and ethnically diverse population, particularly those that have low socioeconomic status, are thought to experience higher rates of negative health outcomes, including higher rates of child mortality.

In neighborhoods in the United States, heterogeneity and population turnover are thought to be key indicators of problem neighborhoods. However, in Latin American countries, including Brazil, some researchers have suggested this might not be the case. In a study by Villareal and Silva (2006), the researchers found that economically disadvantaged neighborhoods in Rio de Janeiro actually had unusually high degrees of social cohesion and interdependency. Subjects in the study reported strong social cohesion with others in the neighborhood, evidenced by numerous friends and relatives upon whom they could rely when in need of assistance. Whereas in the United States, lower class communities, especially minority communities, seem to lack the necessary organization to promote better health, lower socioeconomic communities in Brazil appear to have a level of cohesion that may counter, to some degree, the negative influences of other structural and individual level factors (Villarreal and Silva 2006).

The persistence of negative contextual effects in socially disorganized communities provides insight into variations in health outcomes. Indeed, the inability of neighborhoods to achieve social cohesion in the promotion of health has been shown to lead to a diverse array of negative health outcomes at the community and individual level (National Comission on Social Determinants of Health 2008). As Kawachi (1999) noted, understanding neighborhood variations in health differences can help researchers solve some “puzzling” issues about why some communities are healthier than others.
Educational and health care facilities

Educational facilities in each community are supposed to provide the place for children to obtain education and for mothers in child health and child mortality studies to seek, obtain, and maintain the social networks to help them to provide appropriate care for their children. Schools are expected to disseminate information to the mothers in the community on nutrition, child care, and prevention and treatment of illness and diseases. Therefore, while the level of neighborhood average educational attainment can be either beneficial or deleterious, we can expect that more educational facilities associate to child well-being and improve child health.

Health care facility indices have been included in child mortality studies (Matteson, Burr, and Marshall 1998; Pampel and Pillai 1986; Sastry 1994, 1995, 1996) found that the impact of societal measures of health care on rates of infant mortality is mixed. Countries with a greater number of hospital facilities have lower infant mortality rates but as the per capita number of health professionals increases, the infant mortality rate increases. Sastry (1996) points to the possibility of reverse causation in cases where health facilities are located in areas of high mortality. It is also possible that care facilities and resource may be allocated to specialized, curative facilities and treatments to the detriment of preventive medicine that benefits the less advantaged segments of the population. The limitation of number of health care facility as a measure of population health can be compensated for by taking into consideration “countable” measures such as the number of beds, the number of patients, the availability of equipment, and per capita number of physicians.

Many possibilities exist for community characteristics to affect infant health outcomes net of or in combination with the properties of individuals. The impact of local government spending on health care and welfare programs is a property of the community; studies show that the
delivery of health care and social services has a direct impact on aggregate rates of well-being (Cramer 1995; Matteson, Burr, and Marshall 1998).

Matteson et al. (1998) include available medical insurance coverage for patients and local government expenditures on health care services in their child mortality models. For all causes of infant death combined, the risk of infant death associated with relying on Medicaid or having no insurance coverage was associated to lesser amount of local spending on health care services. For exogenous causes of death, the risk of infant death associated with inadequate prenatal care is reduced when a mother lives in a county that spends more on health care and hospitals. They suggest that local actions in support of the health care infrastructure can have the desired outcome when it comes to off-setting negative health behaviors and lack of personal resources.

Health care services in Brazil are provided in two ways: publicly, through the Unified Health System (SUS, Sistema Único de Saúde), and privately, through supplementary health service operators, regulated by the National Agency for Supplementary Health (ANS), and other private establishments (hospitals, clinics, laboratories and autonomous medical professionals).

In 1988, SUS was created to offer free health care to the population, based on three pillars: universal coverage, integrated health care, and equity (Fernandes et al. 2007). Between 1992 and 2004, national under-five mortality figures dropped from 65 to 27 per thousand and the proportion of poor households accessing health services rose by almost half. Results from a household survey, Pesquisa Nacional por Amostra de Domicílios (PNAD) showed an increase in the number of people declaring that they had used these services in the preceding 2 weeks from 9.73% in 1986 to 14.18% in 2003 (IBGE 2005). Cornwall and Shankland (2008) similarly note that the infant mortality rate was down from 49 per 1000 in 1994 to 10.5 per 1000 in 2006, reflecting the success of the Programa Saúde da Família (PSF).
However, several studies reported that in hospital perinatal, neonatal and infant mortality rates are higher for hospitals contracted to the National Public Health System (SUS) compared with non-SUS contract hospitals (Fernandes et al. 2007). This may be because, as Lansky, Subramanian, and Kawachi (2007) report, compositional effects such as selection of patients who have characteristics of higher risk of child mortality as well as quality of health care (health care process) related to SUS related private hospital. Other concerns point to the uneven distribution of public hospital and SUS contracted hospitals. Despite the fact that SUS provides universal coverage, the proportion of the Brazilian population buying private health plans is around 25%, as estimated by two national surveys done in 1998 and 2003, and by the World Health Survey carried out in 2003 (Barros and Bertoldi 2008). Middle-class consumption of private health insurance has grown enormously since the introduction of the SUS, with private spending rising faster than public spending (Cornwall and Shankland 2008).
Figure 3-1. Framework for the analysis of the effects of compositional and contextual factors on child mortality
Table 3-1. Predictors at individual and neighborhood level expected association with child mortality based on the previous studies within the proposed conceptual framework of child survival in São Paulo, Brazil

<table>
<thead>
<tr>
<th>Individual Level Attributes</th>
<th>Expected Association w/ Child Mortality</th>
<th>Neighborhood Level Attributes</th>
<th>Expected Association w/ Child Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Race</td>
<td>Afro-Brazilian +</td>
<td>Prevalence of</td>
<td>Residential Utility Index -</td>
</tr>
<tr>
<td></td>
<td>Asian -</td>
<td>Public Services</td>
<td>Area Sanitary/Safety Maintenance -</td>
</tr>
<tr>
<td>Demographic</td>
<td>Age +</td>
<td>Neighborhood Stability</td>
<td>Unemployment Rate +</td>
</tr>
<tr>
<td></td>
<td>Place of Residence + -</td>
<td>Educational Level -</td>
<td>Female Household Head +</td>
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<td></td>
<td>Nativity -</td>
<td></td>
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<td></td>
<td>Years of Residency -</td>
<td></td>
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<td></td>
<td>Marital Status -</td>
<td></td>
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<tr>
<td>Socioeconomic</td>
<td>Education -</td>
<td>Community Population</td>
<td>Migrant Origin Diversity Index + -</td>
</tr>
<tr>
<td></td>
<td>Income (self) -</td>
<td>Heterogeneity</td>
<td>Racial Diversity Index (H Index) + -</td>
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<td></td>
<td>Job Situation +</td>
<td></td>
<td>Income Inequality Index + -</td>
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<td></td>
<td>Water Supply -</td>
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<td></td>
<td>Sewage System -</td>
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<td></td>
<td>Electricity -</td>
<td></td>
<td></td>
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<tr>
<td>Family/HH Structure</td>
<td>Mother's Male Parent +</td>
<td>Health Care Facilities</td>
<td>Public Hospitals -</td>
</tr>
<tr>
<td></td>
<td>Mother's Female Parent -</td>
<td></td>
<td>Private Hospitals/Clinics -</td>
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<tr>
<td></td>
<td>Other Adult Males +</td>
<td></td>
<td>Obstetricians -</td>
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<tr>
<td></td>
<td>Other Adult Females -</td>
<td></td>
<td>Pediatricians -</td>
</tr>
<tr>
<td></td>
<td>Children Under 13 +</td>
<td></td>
<td>Ambulance -</td>
</tr>
<tr>
<td></td>
<td>Youth 13 - 19 +</td>
<td></td>
<td>SUS -</td>
</tr>
<tr>
<td>Family/HH</td>
<td>Husband’s/Partner’s Income -</td>
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<tr>
<td>Member’s Income</td>
<td>Parents’ Income -</td>
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<td></td>
<td>Family Members’ Income -</td>
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<td></td>
<td>Other HH Members’ Income -</td>
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CHAPTER 4
DATA AND VARIABLES

Data for this study were drawn from two sources; quantitative information on individual, household, and neighborhood data are mainly derived from Censo Demográfico. Brazilian demographic Census sample data are available in 1960, 1970, 1980, 1991, and 2000 which were conducted by the Brazilian Census Bureau, Instituto Brasileiro de Geografia e Estatística (IBGE). This research uses three sample data from 1960 (Minnesota Population Center 2006), 1980, and 2000 (IBGE 1980; 2000). Reasons of using only three census sample data are, first, the 1970 census which was conducted during the military regime does not include the question about race, and second, the 1991 census is off from the decennial trend. Random samples of census data for the state of São Paulo in 1960, 1980 and 2000 are composed of 5%, 25% and 10% of the census records, respectively. The census data are combined with municipal level information such as educational and health care institutions, obtained from Base de Informações, População e Condição de Vida, Educação 2004 (Ministério da Educação 2005), Estatística da Saúde Assistência Médico – Sanitária 2001 (IBGE 2002) and Pesquisa Municipal Unificada 1999 (Fundação Sistema Estadual de Análise de Dados (SEADE) 1999) for the multilevel analysis.

Brazilian Demographic Census Data

Race Categories and Asian in the Brazilian Censuses

The racial classification in the Brazilian census data is a self-identification question with five color categories; branca (white), preta (black), amarela (yellow), parda (brown/grayish brown), and Indígena (indigenous) in the 1960, 1980, and 2000 censuses. Among Brazil’s racial-ethnic groups, I focus especially on Asian Brazilians. I therefore selected the state of São

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1 The 1960 census data was obtained from Integrated Public Use Microdata Series projects International (IPUMS-I), Minnesota Population Center, University of Minnesota. The data of 1980 and 2000 censuses are from IBGE.
2 Índia in Census 1960.
Paulo as the study area, since it included roughly 60% of the Brazil’s Asian population in 2000. Unfortunately, the Brazilian census questionnaire has never offered further sub-categories of race or question about ethnicity. Nonetheless, available evidence from other sources indicates that most Asians in Brazil reside in São Paulo. The Asian category includes Japanese-Brazilians\(^3\), Chinese-Brazilians (including Taiwanese and Macanese) and Korean-Brazilians\(^4\). The Chinese population in Brazil has been estimated by the Chinese government, the Taiwanese government, and studies of Chinese diaspora. Yamashita (2007) reports that the generally accepted number of the Chinese population is approximately 200,000 in Brazil, and of those, 90% reside in São Paulo. The Korean-Brazilian population became the sixth largest ‘legal’ immigration population in Brazil by 1989 (Buechler 2004). Overseas Koreans Foundation\(^5\) reports that of 50,296 legal Korean immigrants in Brazil in 2005 (2010), 48,746 (96.9\%) resided in São Paulo (Jong-Taick 2007).

Historical immigration records and publicly available estimates indicate that the majority of Asians in Brazil are of Japanese descent (Andrews 1991; Dwyer and Lovell 1990; Hasenbalg 1985; Wood and Lovell 1992). In 1939, Japanese population in Brazil reached 202,211. At that time, there were only 4,875 Japanese Brazilians (2.4\%) residing in São Paulo which then had a population of 80,000 (Editorial Committee of Eighty Years History of Japanese Immigration 1991). According to the official report from the Consulate General of Japan (2008), about 400,000 Japanese-Brazilians resided in the state of São Paulo in 2000.

\(^3\)The check column for Asian-Brazilians for their race category is *amarela* which means ‘yellow’ in Portuguese.

\(^4\)Korean-Brazilian generally indicates people from the Republic of Korea.

\(^5\)Overseas Koreans Foundation is an affiliated organization of the Ministry of Foreign Affairs and Trade since 1998 and charged with the development of post-adoption services for Koreans residing in overseas.
However, there are various estimates of the Japanese-Brazilian population. Honda and
Nishimaki (1977) examined the official reports obtained from Japanese Embassy and Consulate
General offices. They conducted their own population survey focusing on three states, São Paulo,
Paraná, and Mato Grosso, plus sections of the states of Minas Gerais and Goiás. They include
only individuals who are considered as Japanese descendent with a strict definition. They
estimated the Japanese Brazilian population at 465,968 in the state of São Paulo and 250,505 in
the Municipal of São Paulo at the time of their survey in 1975.

The Japanese descendent population survey conducted by the Centro de Estudos Nipo-
Brasileiros (CENB) provides more recent estimates for 1987 and 1988 (CENB 1988). This
source reported 887,000 Japanese in the state of São Paulo, out of the total Japanese population
of 1,228,000 in Brazil (72.2%).

The latest estimation of Japanese-Brazilian was conducted by the CENB (2002). They
based their estimates on the Brazilian demographic censuses of 1980, 1991 and 2000, as well as
two surveys that targeted only Brazilians of Japanese descendent: (1) 1988 Japanese Immigrant
Survey conducted by CENB, and (2) five surveys conducted by an Japanese cultural association
consideration of the Atibaia’s Japanese-Brazilian situation where symptoms of declining
birthrate and aging were already showing in 1998, CENB concludes that the population growth
rate between 1991 and 2000 can be estimated at 0.8% for Japanese-Brazilian population. Using
0.8% growth rate, the Japanese-Brazilian population in the entire Brazil is estimated at 1,419,700
including the *dekasegis* – Japanese descendants born in Latin America who are working in Japan,

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6 Honda and Nishimaki (1977) define *Nikkei* as individuals and their offspring residing Brazil permanently. For the
population selection, while children born between a *Nikkei* father and a non-*Nikkei* mother are included as well as
the non-*Nikkei* mother, other children born between a non-*Nikkei* father and a *Nikkei* mother are excluded along with
the *Nikkei* mother.
and it can be estimated at 1,022,184 if the proportion of Japanese population residing in São Paulo as opposed to its entire population in Brazil is still around 72% of the total.

These estimates are larger than the Asian Brazilian population enumerated in Brazil’s 2000 Demographic Census in the state of São Paulo. The 2000 Census counted 456,420 Asian Brazilians, a smaller enumeration than the estimated Japanese-Brazilian population of more than 1,000,000. This gap results from differences in terminology used to define the Japanese ethnic population among Japanese immigrants. “Japanese” refers to Japanese people who emigrated from Japan and their descendants, called Nikkei. Literally stated, Nikkei means “Japanese origin,” and Nikkei-jin indicates individuals who have Japanese origin. In the preface of the Nikkei Population Survey of 1987 and 1988, CENB specifically states that “[W]e herein mean ‘Nikkei-jin’ Japanese immigrants and Japanese permanent residents as well as their descendants, and the residents in Brazil who relates to one of those Nikkei-jin are included” (1988:15). This is a relatively inclusive definition that will result in a larger population estimate.

However, in my interviews with Japanese-Brazilians and in focus group discussions in São Paulo in 2005, I found a somewhat narrower understanding of Japanese ethnicity. While they naturally consider themselves Nikkei-jin, and probably biologically accept their Japanese descent, a number of participants mentioned that they no longer choose amarela in the race question of census questionnaire. Some of them asserted that their children are definitely not amarela but blanca even though both parents are Japanese origin. This implies that the census excludes some Brazilians of Japanese descent from being identified as Japanese Brazilian, while those people would be counted as Japanese Brazilian in CENB’s estimates.

If there are subtleties in counting Japanese Brazilians, counting Korean Brazilians and Chinese Brazilians is especially difficult. A major reason for this is that there are many
undocumented immigrants from South Korea and China residing in Brazil (Buechler 2004). Yamashita (2007) reports statistics for the Chinese-Brazilian population. Basing his figures on the Yearbook of the Ethnic Chinese Economy, Yamashita estimates 250,000 Chinese Brazilians in 1999. In addition, other sources with estimates from Brazil’s federal police suggest that there may be 200,000 Korean immigrants illegally residing in Brazil in 1990 (Benavides 2002; Buechler 2004).

In contrast to the Chinese and Korean populations in Brazil, the Japanese population has decreased. The reasons are due to a declining birthrate, population aging, and miscegenation. In addition, the declining Japanese population must have been accelerated from 1990 by so called *dekasegis*, Japanese descent who were born abroad, but have immigrated back to Japan with their eligibility to work in Japan. Nonetheless, it appears that the largest portion of Asian Brazilians in São Paulo is of Japanese descent. Even if we include illegal Korean and Chinese immigrants and use conservative figures for the Japanese, as of 2000, the state of São Paulo had approximately 400,000 Japanese, compared to approximately 225,000 Chinese and 210,000 Koreans. It is therefore plausible that the majority of the Asian origin population in São Paulo has been Japanese or Japanese-Brazilian in the category of *amarela* in Brazilian censuses, especially in earlier censuses.

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7 Miscegenation between Japanese and other ethnic groups has been accelerated over generations. Second generation’s miscegenation is 2%, the third generation is 42%, and the fourth generation is 63% (Consulate General of Japan, São Paulo. 2005). Considering this situation, we need a precaution about the ethnic differences among Asian population in Brazil in the future study.

8 The total number of *dekasegis* from Brazil as registered foreign nationals, according to Immigration Office of Japan, Ministry of Justice (2004), was 2,250 in 1987; however the number jumped up to 56,429 in 1990 and to 254,394 in 2000. The phenomena can be explained three close successive events happened in Brazil and Japan: the severe inflation after the Brazilian economic miracle at the end of 1980, the continuous Japanese economic prosperity in the 1990s, and the revision of Japanese immigration law (Immigration Control and Refugee Recognition Act) in 1990 under which Japanese descendants up to third generation and their spouses and children are permitted entry for three years to work without restraint. The flux of Japanese population due to these *dekasegis* less likely influenced the composition of Asian-Brazilian population until 1990 but certainly impacted on that for Brazilian census in 2000.
Sample Data Restrictions

In this dissertation, I use Brazilian demographic census sample data for individuals and households. I restrict the sample employed for analysis in several respects. First, the analysis focuses on the state of São Paulo. By population this is the largest state in Brazil, so census sample data still afford a large sample size. Further, as noted earlier, São Paulo has a large proportion of Brazil’s Asian population.

The second restriction applies to race groups. Because of the fluidity and ambiguity of racial identification between black and brown, I collapsed these two color categories into one category called “Afro-Brazilian” in this study. This decision follows previous research on race and ethnicity in Brazil (e.g., Carvalho, Wood, and Andrade 2004; Hasenbalg 1985; Lovell and Wood 1998; Silva 1985; Wood and Carvalho 1988) as discussed in the earlier chapter. This study therefore focuses on the comparisons among Whites, Afro-Brazilians, and Asian-Brazilians. Thus, the indigenous population and respondents who did not answer the census question about color are excluded from my analyses.

Another key restriction is that I focus on women. This is necessary in an analysis of child mortality using census data, since information on child mortality comes from data on children ever born and children surviving, which is attached to data records for individual women for this analytical research. Specifically I include in the analysis women who (1) have had at least one child, (2) are 20-34 years of age, (3) are the wife of the household head or are themselves household heads, and (4) are not institutionalized (hospital, social care facilities, etc.). Women with missing data for any explanatory variables were excluded from the analysis. Thus, there are no missing answers in the sample data. The reason for restricting the sample to women who have had at least one child born is to allow observation of women at risk of losing a child. It is possible to include women with stillbirths, but only for some censuses, which hampers
comparisons over time.\textsuperscript{9} Hence the analysis excluded women reporting never having had at least one child.

Only mothers aged 20-34 years are included. 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 and individual mothers’ social and economic condition may have been changed considerably (Sastry 2002; Wood and Lovell 1990). The important assumption behind these estimates is that fertility and child mortality levels have been constant in the “recent past” (Sastry 2002). Although restricted to only mothers aged 20-34, there are still 15 years difference and it is nevertheless likely that mothers who bore their children in the more distant past were influenced by different socioeconomic conditions from those of the year when a subsequent census was conducted. Nonetheless, this restriction reduces temporal problems of relating socioeconomic conditions to child mortality.

Restricting the sample of women to wives of household heads or female household heads is necessary to analyze data composed of one mother per household. The analysis includes household-level measures; therefore, if the data included multiple mothers per household, those households would be over-represented in the sample population. This procedure selects out one mother from each household by restricting to the wives of household head or female household heads so that we can avoid data being skewed to the characteristics of larger households.

Having restricted the census sample data by the criteria discussed above, the samples used in the data analysis include 46,660, 480,035, and 270,851 cases in 1960, 1980, and 2000, respectively. The variation in sample size is due to differing data sample size; 5% for 1960, 25% for 1980, and 10% for 2000, made available from IBGE (1980, 2000) and IPUMS-International

\textsuperscript{9} The census 1980 does have the stillbirth information. However, in order to maintain the consistency of analysis using three censuses, stillbirth information in 1980 was not taken into consideration.
Table 4-1 compares the racial distribution among women aged 20-34 for the overall census population, in rows (1), the entire sample population, the rows (2), and the restricted sample population, the rows (3). The majority race group is white in all three censuses. The right side column of each race group provides the proportion of each race population and enables us to see the proportion changes over years. The white proportion within three race groups, for example in the actual population decreased over time; from 82.8% in 1960 to 71.3% in 2000. Meanwhile, the proportion of that of Afro-Brazilians grew from 14.4% in 1960 to 23.0% in 2000. This was most likely due to the increasing population in the “brown” category as I discussed in a previous chapter. By contrast, the Asian population is very small when compared to the size of the other two racial groups. Moreover, its proportion declined from 2.8% in 1960 to 1.24% in 2000. As the figures row (3) shows, the sample restriction processes do not greatly alter the proportions of white and Afro-Brazilian racial groups, though the proportion of Asian-Brazilian was reduced by the restrictions. This occurred due to the lower fertility rate among Asian Brazilians when compared to the other two racial groups.

Table 4-2 explores this issue further by showing racial differences in childlessness in each census year. Among Asian-Brazilian women who belong to the youngest age group (20-24 years of age), 50.2% had no child as of the 2000 census. From the 2000 census data, overall 731 Asian-Brazilian women were excluded, which corresponds to 37.6% of the Asian Brazilian women aged 20-34 who were the wife of household head or the household head. By contrast, the childlessness restriction only reduced the sample of white women by 21.9% and the Afro-Brazilian women by 15.5% in 2000. The childlessness restriction similarly impacts the sample population of Asian women in the 1980 census. The reduction for Asian Brazilian women was 1618 cases (23.4%), while the reduction for white women was 16.5% and that of Afro-Brazilian
13.7%. However, as seen in Table 4-2, the reduction in Asians in 1960 (110 cases, 11.2%) matches those for whites and Afro-Brazilians.

**Children Ever Born and Child Deaths**

Given these restrictions to the census sample data, the unit of analysis of this study is individual women who had at least one child by the time a census was conducted. Since I focus on mothers to evaluate child mortality, the dependent variable is the number of child deaths experienced by individual mothers. Brazilian demographic censuses in 1960, 1980 and 2000 each include four questions which can be used for computing child mortality among individual mothers: total boys ever born, total girls ever born, total boys alive at present, and total girls alive at present. The variable of “total child deaths” is therefore calculated by subtracting the total number of boys and girls alive from the total number of boys and girls ever born. These calculations reveal that the proportion of mothers who never experienced child loss are 75.08% in 1960, 85.98% in 1980, and 96.26% in 2000. Table 4-3 shows changes in fertility and child mortality over time. Child mortality declined dramatically by half from 1960 to 1980 and then by a quarter from 1980 to 2000.

Child mortality studies with Brazilian census data have often used the child mortality ratio of individual mothers (Perz, Warren, and Kennedy 2008; Sastry 2004; Valle, Fernández, and Potter 2009; Wood and Lovell 1992). In these studies, indirect demographic estimation techniques are used to obtain the child mortality ratio from proportions of dead amongst children ever born by women categorized by age groups for a given census. This technique is based on the Brass method (Brass et al. 1968) as modified by Trussell and Preston (Trussell 1975; Trussell and Preston 1982). This method needs only two types of information: (1) the mother’s age or duration of marriage, and (2) the number of live children ever born and the number of surviving children. With these variables, which are included in Brazilian census sample data, we can
estimate child mortality without using vital registration statistics, which are often be unreliable in developing countries (Wood and Lovell 1990).

While indirect estimation methods have advantages, they also important limitations. One such limitation is that it makes no the distinction between women who lost one child out of one child and women who lost ten out of ten children. If two such women are in the same 5-year age category, their child mortality ratios will be identical, despite very different numbers of child deaths. Since fertility is considered to have an association with income, place of residence, as well as cultural norms and behaviors which have changed over time (Ebanks 1984; Harewood 1978; Perz, Warren, and Kennedy 2008; Travassos and R.Williams 2004; Wood 1975), I consider this limitation to be crucial in research on the relationship between race and child mortality. Therefore, instead of using the child mortality ratio, I employ child death counts for individual mothers as the dependent variable. To manage the effects of maternal age and fertility (children ever born), I include both of these factors as control variables in my models of child mortality.

The most relevant and strongest determinant of the probability of child death is the number of children who were born to a mother. Table 4-3 shows a strong correlation of children ever born with child deaths; the greater the number of births, the greater the possible number of child deaths, especially in 1960 and 1980. Although the association between child mortality and the number of children ever born has weaken over time as 0.607 in 1960, 0.431 in 1980, and .315 in 2000, inclusion of children ever born as a covariate could be too dominant over other covariates. Nonetheless, estimation of the effects of other covariates of child mortality without the number of children born to a mother could lead to biased estimates that merely reflect the fertility of individual women. In order to contend with this methodological issue, the offset option (i.e.,
exposure option) for the variable of children ever born to individual women in count models is included in the analysis. In the next chapter, I will discuss the models appropriate for count outcomes, including further treatment of the question of the offset (or exposure) option.

Explanatory Variables

This study uses explanatory variables at the individual, household, and neighborhood-level in both single-level and multilevel regression models. Individual compositional characters include (1) six demographic variables including race, and (2) six socioeconomic variables. Household level variable cluster is composed of (3) eight variables representing family/household structural compositions and (4) four variables representing family/household members’ financial situation. In the multilevel models, two clusters of neighborhood-level aggregated variables are also included. One cluster of variables is (5) district-level variables which includes eight aggregated variables which designate to describe prevalence of public services, neighborhood stability, and neighborhood population heterogeneity. Another cluster of variable is (6) eight municipal-level variables portraying educational facilities and health care services.

Individual-Level Explanatory Variables

Mother’s demographic characteristics in the study of child mortality

The first cluster of covariates consists of demographic information including racial background, mother’s age at the time when the censuses were conducted, place of residence, if being born in the present municipal, and years of residency. Table 4-4 summarizes these individual mothers’ variables and the units in which the variables are measured.

Race dummy variables

As presented earlier in this chapter, three racial groups are included in the analysis. In the statistical models, two dummy variables for racial identity are included. The dummy variable
called “Afro-Brazilian” refers to mothers who are in the race categories of preta (black) or parda (brown), and they are coded 1 and otherwise coded 0. Another dummy variable is labeled as “Asian-Brazilian.” If a mother is in the race category of amarela (yellow), they are coded 1 and otherwise coded 0. Therefore, white mothers are entered in the equation as the reference category for race.

Table 4-5 presents the trajectory of mean child mortality and mean fertility from 1960 to 2000 crossclassified by three racial categories. All race groups’ mean child deaths declined over time; -.334 (-88.8%) for whites, -.616 (-90.2%) for Afro-Brazilians, and -.17 (-87.6%) for Asian-Brazilians, respectively. Although, Afro-Brazilian’s child mortality moderated to less than one-tenths from 1960 to 2000, the obvious disadvantage of Afro-Brazilian comparing the other racial groups remains in 2000; +.025 against whites and +.043 against Asian-Brazilian. Asian-Brazilian had a lower child mortality even in 1960 (-.182) when they had a higher fertility than white (+.075).

Mother’s age

Childbirth at younger and older maternal age is considered to have detrimental consequences for child health and survival (Sastry 1996). Childbirth opportunity increases with age and marriage but it declines and eventually terminates with her maturity. Therefore child mortality models often include squared maternal age in addition to maternal age for accounting the non-linear effect of age on the child mortality.

The preliminary analysis using the sample datasets for this study, however, revealed that squared maternal age has no statistical significance in all three censuses which means there is no quadratic effect of maternal age on child mortality. Thus my analysis only account for the linear effect of mother’s age. It is most likely due to limit the data to mothers aged 20 to 34; the age
groups which are most stable for childbearing. In addition, since the census data usually do not offer mothers’ age at the time of delivery, this study uses their age at the time when each census survey was conducted. Although the sample is restricted to only mothers aged between 20 and 34, the time when mothers gave birth could be years ago. In such cases, unfortunately her age does not reflect the reality relating maternal age risks based on her age and ‘age’ variable can only function as an “offset.”

**Place of residence, nativity, and years of residency**

Place of residence, nativity (if being born in the present municipal), and years of residency are included in the analysis to capture the rural and urban environmental differences in the presence of their nativity in the community and familiarity to the community. Urban-rural difference is considered as not only a variable which is attributed to socioeconomic status and accessibility to the public utility services, health services, educational facilities. It may be also considered as a social capital variable showing the different nature of urban and rural communities endowed by the strength of individual mothers’ association to their neighborhood and community. The variable of the urban-rural residential difference is dichotomous; urban residents are coded 1 and rural residents are coded 0 as the reference group. Nativity is also a dummy variable. Mothers who were born in the present municipality are coded 1 and otherwise coded 0.

Positive contextual effects of stability on health is found in a study examining the relationship between collective efficacy and child well-being (Sampson, Morenoff, and Earls

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10 There are three categories for the variable of place of residence in the Census 1960: urban, suburban, and rural. After cross-referencing between the censuses 1970 and 1960, I found that suburban areas in 1960 were identified as rural areas in the Census 1970; hence, I decide to collapse suburban areas into rural areas for the Census 1960.

11 The information about nativity in 1960 is available from the variable of the years of residence which has the category of ‘not migrant.’
Living in the place where a mother was born and is surrounded by familiar faces can more likely provide psychological help than material help for mothers who are about to have their children. If the situation is opposite, for example, in a case where a mother has just moved into a new neighborhood and is unfamiliar to her living circumstances and her neighbors, then the mother’s compositional factors, such as education and income, may be more influential to her health and her child’s well-being. The inclusion of nativity and length of residency may allow us to see if individuals’ association with the community, which measured by physical existence in the present resident, modifies the relationship between child mortality and the urban-rural difference.

For the variable of years of residence in the present municipality, the census 2000 has the actual years of residence. The 1960 census categorized the migrants from other municipals who had lived in the municipality for 11 years or more in the open-end interval and those who had lived in the municipality for 6 to 10 years in the one preceding the open-end interval. The 1980 census’ categorization is similar to the 1960 census but the open-end interval is more than 10 years and the interval of the one preceding is from 6 to 9. For the migrants in these two higher categories, I estimated the mean values by fitting a Pareto curve\(^\text{12}\) to minimize biases.

Table 4-6 presents sample means of demographic variables and correlation between those variables and child death counts are presented. Under the demographic variable cluster, we can identify that the three variables are all negatively associated to child mortality; i.e., urban residents, women who were born in the presently residing municipal and were living longer in the presently residing municipal are more likely to have fewer child loss experiences. The strength of these associations reduced over time. The growth of urban population is obvious,

especially between 1960 and 1980. During the 1970’s and 1980’s, Brazil experienced an excessive amount of internal migration that is evidently shown in the growth of urban population, the means of nativity, and years of residency in the 1980 census.

Table 4-7 shows demographic characteristics in each census year crossclassified by three racial categories. In 1960, the Asian population resided in rural areas compared to the other two racial groups but the population migrated into urban areas or in areas where the Asian population has been has become concentrated; therefore by 2000, the Asian population more likely resided in urban areas compared to the other groups. Only for Asians do the data consistently show that the proportion of people who were born in the municipality expanded and the years of residency in the present municipality extended over time. If living in the urban or rural and longer physical existence in their residency are matter for their childbearing, we may see how these changes have affected their health outcomes while the Asian population maintained their relationship in the areas where they live closely to their people while another portion of Asian population were acculturating into more mixed racial environments. As we already seen, Asian population’s child loss was the lowest from 1960 to 2000; therefore, we can expect that Asian population may have maintained relatively different characteristics beyond the different natures of urban and rural communities endowed by the strength of individual mothers’ association to their neighborhood or community.

**Marital status**

The Brazilian Census has nine categories for classifying the respondents’ marital status: ‘legally and religiously married,’ ‘legally married,’ ‘religiously married,’ ‘single, legally separated,’ ‘separated but not legally,’ ‘divorced,’ ‘widowed,’ and ‘other status.’ The marital status question in the Census 1980 is divided into two questions; the nature of union and marital
status, and there is no overlap. The Census 2000 also has two questions about the marital status; nature of the ‘latest’ union and marital status. I found that some respondents’ answers were conflicting such that while women declared being legally married in the question of ‘nature of the latest union,’ they also answered that they were ‘separated legally’ or ‘not separated legally’ in the question of ‘marital status.’ It commonly occurs because of their religion affiliation. In order to maintain the marital status variable in all three censuses constant I dichotomized the marital status answers into two categories, ‘legally and religiously married’ (not included only ‘legally married’ or ‘religiously married’) and otherwise.

Marital status serves as an indicator of the mothers’ availability of intimate human and capital resources which their husbands are liable to provide. The security from the relationship can be the most fundamental and important feature of childbearing; therefore, marital status can be considered to be substitutive to the individual mothers’ level of quality-of-life. There is considerable evidence on the difference between racial/ethnic groups in the dominant form of marital union which reflect significant cultural distinctions. The last row in Table 4-6 indicates that overall, the proportion of married mothers has reduced over time;

The striking racial difference in marital status is shown in Table 4-7, especially when observing relatively very low percentage among Afro-Brazilians. The preliminary analysis revealed that even after controlling for religion, racial background has a distinctive association with the dominant type of marital union. Therefore, investigating whether married mothers have lower child mortality means determining their race group, which has a lower probability of being married and therefore are subject to the additional disadvantages of higher probability of child mortality.
The Asian Brazilian figure in 1960 seems a little odd considering the more conservative way of life in 1960 than later years. The previous research indicates that the Asian population in any society is more likely to maintain their marriage than other racial/ethnic groups. This situation may be due to multiple categories for marital situation; (1) legally and religiously married, (2) legally married, and (3) religiously married. The frequency distribution shown in Table 4-8 clearly demonstrates the reason behind this situation. Once Asian mothers in the two categories of marital status, ‘legally married’ and ‘legally and religiously married,’ are combined into one, the proportion of married women among Asian mothers is 97.23% against that among white mothers 93.11% and among Afro-Brazilian mothers 78.34%.

Referring to the extensive survey of Japanese population in Brazil which conducted in 1958 by Comissão de Recenseamento da Colônia Japonesa (CRCJ), the majority was Buddhist for nearly 50 years after the first Japanese immigrants arrived in Brazil (CRCJ 1964). This research also presents the marital status among Japanese immigrants in Brazil but the marital question does not have multiple categories for married people like the Brazilian census. Another survey conducted by the CENB in 1987 (CENB 1988) also reports that the majority of religious affiliation among Japanese-Brazilian is also Buddhism that is also identical to the report of CRCJ mentioned above and it does not have multiple categories for marital status. Thus, it is plausible that for the Asian population, of which Japanese are assumed to be the majority descent, marital status of religiously married in addition to legally married was not common practice in the past. However, it may have gradually become the primary practice among the Asian population too. For practical purposes, both legally and religiously married Asian mothers were combined into legally married in the category of ‘married’ in the Census 1960 data.
Mother’s socioeconomic status

Mothers’ socioeconomic background are represented by marital status, years of schooling, mother’s income, job situation, if public water is piped into the residence, if public sewage system connect to the residence, and if electricity is provided to the residence. There are a variety of proximate and intervening factors related to child mortality that are also associated with income and education; and thus needed to be controlled. Therefore, mothers’ socioeconomic status is also represented by their work situation; working or not working. Mothers’ working situation can provide an additional income while mothers’ unprivileged situation demands them to work, which results in a reduced allocation of time dedicated to taking care of their children. In the presence of other socioeconomic indices; education and income, working situation is usually associated with higher child mortality through situations such as less opportunity for good childcare, less frequent breastfeeding, and mothers’ poor health.

Mother’s education

The question about years of schooling in 2000 has a scale of 0 (no education or less than 1 year) to 17 (17 years or more). However, it is not the case for the censuses 1960 and 1980 which have two questions regarding individual’s educational attainment; última série concluída (grade completed) and grau da última série concluída (highest degree completed). Due to the educational reform implemented by the Basic Educational Law in 1961 (Plank 1996), there were significant changes in the Brazilian educational system; however, basically it was divided into three levels in several divisions with several grades. Divisions and degrees are captured by the

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13 The 1960 demographic census 5% sample data set from Minnesota Population Center includes the variable of years of schooling, which is created by combining the two variables of educational attainment available in the original 1960 demographic census.
questions of “highest degree completed”\textsuperscript{14} and “grade completed”. To create a scale variable for “years of schooling”, these two variables were needed to be combined. After combined the two variables into one, the variable of “years of schooling” for both 1960 and 1980 has a scale of 0 to 17.

Mean years of schooling increased from 2.63 years in 1960 to 3.64 in 2000, as shown in the top row of the second tier in Table 4-6. The racial disparity in years of schooling between white mothers and Afro-Brazilian mothers moderated (Table 4-7); white mothers’ mean years of education is 2.15 times more than that of Afro-Brazilians in 1960 but the difference between them in 2000 is 1.24 times. The Asian-Brazilian mothers’ advantage in years of schooling comparing to white mothers, however, widened from 1.12 times longer in 1960 to 1.43 times in 2000. Since the years of schooling variable is negatively associated to child mortality, we can expect Asian-Brazilians’ advantage in child mortality in the regression models.

Note that “years of schooling” here is a non-transformed value for the purpose of providing a series of straightforward summary statistics, but in the regression models, the variable of education (years of schooling) is included as a log-transformed variable; same as the age variable, I examined if there is any non-linear effect of “years of schooling” on child mortality.

Preliminary analyses using the sample datasets for this study indicated that the squared “years of schooling” has no statistical significance in all three censuses; however, the log transformed “years of schooling” in models for all three censuses had statistical significance in the presence of the income variable. I also assessed whether there is a non-linear effect of “income” which I

\textsuperscript{14} In 1960, the variable of “highest degree completed” included six choices; none, 1 year, elementary, middle school first half cycle, middle school second half cycle, and superior. The choices in 1980 are further detailed due to the educational reform. Therefore, the variable included eight choices and ignored answers; none, adult literacy course, elementary school, secondary school, general education 1st level, general education 2nd level, and senior high school, higher education, and masters and doctor degrees. The variable of “grade completed” has a scale of 0 to 7 in 1960 and a scale of 0 to 8 in 1980 in 1980.
present next. Usually the income variable is expected to have a non-linear relationship with health outcomes. However, preliminary examination showed that none of the various transformations (squared-income, logarithmic-income, along with a linear function of income) were statistically significant in any year. This result may be caused by the strong effect of years of schooling, which highly correlates with income. Additional analyses similarly showed that transformation of the schooling variable were not statistically significant. As such, I include the logged years of schooling variable and the income variable is included as a linear effect in the regression models.

**Mother’s individual income**

Brazilian demographic censuses have income information for each individual in the household. The censuses 1980 and 2000 provide total individual income in scale but the census 1960 has a categorical income variable\textsuperscript{15}; therefore, the median value of each income category is assigned to each individual within that income category except for the highest income category. The income category in the census 1960 has an open ended interval (Cr$ 50,000 or more); therefore, the Pareto curve method is used to estimate the mean values in order to minimize biases as I did for the years of residence variable above. While the census 2000 sample data have a single variable capturing the total income of individuals, the census 1980 provides itemized income variables which inquire to be combined to create the total income. Since statistical models include other family members’ income, the variable herein is strictly mother’s individual income.

\textsuperscript{15} The census 1960’s income variable has nine categories (in old cruzeiros); no income, 1 to 2,100, 2,101-3,300, 3,301-4,500, 4,501-6,000, 6,001-10,000, 10,001-20,000, 20,001-5,0000, 50,000 or more, and ignored.
Brazil has experienced seven currency changes since 1967 (MeasuringWorth 2010)\(^{16}\); therefore, each census’ income variable has different currency, Old Cruzeiros in 1960, New Cruzeiros in 1980, and Reais in 2000. In order for currency to be constant and comparable among three censuses, income variables needed to be expressed in Reais. Jannuzzi (2003) proposed multipliers, a deflator index, for converting currency values recorded in each demographic censuses between 1960 to 1991 in Reais in 2000. He formed this deflator index using of the IPC (Consumer Price Index, Getulio Vargas Foundation) between 1960 and 1979, and the INPC (National Consumer Prices Index, IBGE) between 1980 and 2000 incorporating a series of minimum salaries. Using the multipliers, the income variable has an interval of R$ 0.00 and R$ 2,495.171 in 1960 and R$0.00 and R$ 38,187.75 in 1980.

The mean for mother’s income is negatively associated to child mortality as described in Table 4-6. Racial difference in income between white mothers and Afro-Brazilian mothers have somewhat diminished. As we can see in Table 4-7, white mothers earned 1.83 times more income than Afro-Brazilian mothers in 1960, 1.61 in 1980, and 1.24 times in 2000. On the other hand, in 1960, white mothers earned 1.65 times more than Asian mothers but the situation was reversed in 1980, the Asian mothers’ advantage in income in 2000 is 2.45 times more than white Brazilians. The racial difference between white and Asian in this pattern is also found in mother’s employment status in the next.

**Mother’s job situation**

Mother’s job situation is a dichotomous variable; mothers who have a job are coded 1 and otherwise coded 0. For the census 2000, which has six questions directly related to respondents’

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job situation, the variable of mother’s job situation is created using the variable “how many job
did you have during the week of July 23-29, 2000” which has two answering options; “one” and
“one or more” (otherwise, missing). Those who answered either of the two answers were coded 1.
For the census 1980, I used the variable “If worked in last 12 months between Sept 1, 1979 and
Aug 31, 1980” which is a “yes” or “no” question. Because of the data conflict, I had to use two
variables to create the job situation variable for the census 1960. If respondents who answered
that they were working during the previous week were crosschecked using the income variable
and their occupation codes. If the respondents do not have conflicted answers, then they are
coded 1.

Working population among mothers had grown from 7.8% in 1960 to 40.8% in 2000
(Table 4-6). While the proportion of working mothers grew in all race groups, we can see that
among the three race groups the situation for Asian mothers changed dramatically from having
the lowest percentage working mothers, 5.7%, in 1960 to the highest percentage, 47.1%, in 2000
as Table 4-7 shows. What is of some concern to me, however, is the negative correlation with
child mortality in 1960 and 2000 (Table 4-6) which seems to have unexpected association with
child mortality, at the same time, it has statistically significant. Working mother’s situation, as
Mosley and Chen indicate, is thought to have a positive effect on child mortality because
working time may conflict the time to provide quality of care to children.

**Household sanitary condition: utility accessibility and availability**

I include three public utilities in the analysis available from all three demographic census
data sets; water supply, sewage, and electricity. These public utilities are used in the regression
models to see the variation in the effects of mother’s living condition on child mortality.
Brazilian demographic census 2000 asked respondents about water source in two questions. One
question has three options: “general system”, “well or spring”, and “other.” The consecutive question asked if respondents have access to “general system” and contains three options; “water line is connected to at least one indoor plumbing”, “water line is connected to only the premises”, and “not connected to general system”. The 1960 and 1980 censuses had one question for water supply, which contained answer options that were basically the same as the combined options from the two water supply questions in 2000. As for the sewage disposal, each census had several options but common options among three censuses are “the toilet is connected to a general sewage system”, “residence has a septic tank”, and “residence is connected to rustic sewage lines”. For electric power supply, each census basically dichotomous answer; have electric power or have not.

To examine the impact of proper sanitary system maintenance, especially water supply and sewage system, on household members’ health, therefore on child mortality, mothers whose residence is “directly connected to a general supply system” is coded 1 as dummy variable and otherwise coded 0 which treated as the excluded reference category for all three census datasets. Similarly, mothers, whose residence is “directly connected to general sewage system” and has “electric power supply” are coded 1 and coded 0 otherwise, for respective variables.

The bottom three rows in Table 4-6 provide the profile of the characteristics of the women in each census sample in terms of public utility possession. The proportions of mothers whose residence is directly connected to general water system was doubled from 1960 (43.9%) to 2000 (88.28%) and residence directly connected to general sewage system tripled from 1960 (67%) to 2000 (74.4%). Electric power almost universally supplied in 2000. These utility variables are

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In addition to the connection to the main sewage system, the census 1980 has another question related to sewage which asked respondents if “sewage disposal is for the exclusive use of the household” or “the sewage disposal is common to more than one household”.

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negatively correlated to child mortality throughout three censuses. The values shown in the bottom three rows in Table 2 describe the prevalence of public utility within each race group. Low standards within the Afro-Brazilian group is striking especially up to 1980 and still we can see their clear disadvantage against other two race groups in 2000.

Family/Household Attributes

The previous child health and child mortality research includes family/household size, number of siblings, and presence of other family and household members (Bawah and Zuberi 2004; Ceballo and McLoyd 2002; Kataoka-Yahiro, Ceria, and Caulfield 2004; Schaffer and Lie-Hoagberg 1997; St Clair et al. 1989) to examine if a larger household and sibling size constrain resources and if presence of other family members and extended household members in family/household may help in assisting mother for childbearing and providing financial help. These findings are generally consistent in pointing out the potential liabilities of households where family system may not function well for providing appropriate supports to mothers and their childbearing; therefore substantially elevated risks of child death. However, there is a mix of familial inputs likely to affect survival probabilities; therefore, some studies reported that large household and sibling size has a lower risk in child mortality (Bawah and Zuberi 2004) and kin assistance is not reliable source of child care giving (Casper and Hoga 1990). Although the studies agree with the view of the pro-Malthusian school which argues that large number of children constrain resources or the concept of social capital as considering family as the minimum social support system, as far as I could find in this sort of research, these do not include both potential care givers and children who need cares in the model of child mortality at once. In addition, little study includes family/household members’ capital contribution in the model. To examine what aspect of family and household member can be helpful to improve
childbirth outcome, this study includes several variables for portraying physical presence of family/household members and their financial situation.

**Family/household structural compositions**

For family/household structure, there will be eight proxy variables. As quantitative measures of available physical help for mothers in child bearing; if any male parent of mother lives with or not (henceforth called “grandfather”), if any female parent of mother lives with or not (henceforth called “grandmother”), number of adult males in the household which is not include the respondent’s husband and partner (henceforth called “males), number of adult females in the household (henceforth called females). Children in the household are classified into two groups depending on the relationship with household head; if they are family (household head’s child/children) or non-family members (extended family member or other). Because children aged12 or younger are thought to require more assistance from adults, and children in their youth may potentially provide their siblings help for their mother, children under 13 and youth between 14 and 19 are distinguished.

Brazilian censuses have a variable which identifies each individual by their relationship with the household head. Using the three variables, “relationship with household head”, “age”, and “sex”, the new variables of “grandfather”, “grandmother”, “males”, “females”, “family children”, “family youth”, “household children”, and “household youth” were created. Note that, while children can be identified by the information drawn from the variables in the censuses whether or not they are the children of mothers in analysis, unfortunately we cannot distinguish between “grandfathers” and “grandmothers” if they are the biological parents or in-laws to the mothers in the analysis.

The top three rows in Table 4-12 provide additional information regarding the racial difference in household size which shows the proportion of small household which is composed
of 5 or less household members has been more prevalent and large household was almost extinct in 2000. In all three years, mothers with small household were clearly shown to have lower risk in child loss. The racial difference in family size is indicated in the rows of (1) in Table 4-13. While all race groups completely shifted to small family size from 1960 to 2000, Afro-Brazilian mothers are the least changed group in terms of family size over years. Asian mothers appear to have relatively bigger household in 1960 compared to other two racial groups but in 2000, family attributes appear to shift toward the nuclear type.

For grandfather and grandmothers, the percentage of mothers living with their parents has declined over time (Table 4-12 (4) and (5)). Both grandfather and grandmother seem to contribute to the reduction in risk of child mortality but the strength of influence is greater for grandmother. Although the proportion of mothers who live with their parents is subtle, we can herein observe a distinct feature of Asian population that they more tended to live with their parents (Table 4-13 (4) and (5)).

Unexpectedly, all other adult males and females in the household do not seem to be helpful in reducing the risk of child mortality in any censuses. Also they have very weak relationship with child mortality. These variables also reflect the on-going trend of family size reduction which is prevalent throughout race groups (Tables 4-12 (6) and (7) and 4-13 (6) and (7)).

Except for “household youth” in 1960 (which is not statistically significant in its correlation coefficient), all categories of number of children and youth are positively associated to child mortality (Table 4-12 (6), (7), (8), and (9)). Notably, “family children” and “family youth”, especially in earlier years, have a stronger correlation with child mortality compared to other child and youth categories. Table 4-13 (6), (7), (8), and (9) shows a higher rate among Afro-Brazilian mothers living with children and youths except for family children and household
youths under Asian column in 1960 (Table 4-13 (6) and (9)). This is due to the large population among Japanese-Brazilian living in rural areas as agricultural workers.

**Family/household members’ financial situation**

For creating variables which attempt to measure whether or not the financial status of family/household members living with mothers would help in reducing the risk of child mortality, the variables “relationship with household head” and the income variables available from each Brazilian demographic census date were included. The total income in 1980 and 1960 variables required creating new variables because the census 1980 has itemized income variables (wage and several other income variables) and the census 1960 has categorical income variable which has open ended interval. In addition, the currency in both 1960 and 1980 were needed to adjust to the Brazilian Real. Therefore, the same procedures for creating the mother’s individual income variable were used to construct the four family/household incomes; husband’s/partner’s income, parent’s income, family members’ income, and other household member’s income. The sum of these income variables is exactly the differential between the household income and the individual mothers’ income.

The family members’ income indicates the income earned by the children of the household head. Since the age of mothers in my analysis range only from 20 and 34, normally we can assume that these children are less than 16 years, but in some case, family youths can be older than 16 if they were adopted or if they were the children from father’s former marriage.

The correlation between the incomes of husband/partner and parents and child mortality shown in the rows of (1) and (2) in Table 4-14 undoubtedly account for the decline in child mortality but seemingly reduced the strength of relationship with child mortality from 1960 to 2000. On the other hand, although the negative association of other household members’ income on child mortality was small but existed in 1960 and 1980, the effect of other members’ income
on child mortality is no longer accounted for in 2000 (Table 4-14 (4)). Higher child mortality is found for family members’ income (Table 4-14 (3)). This variable captures the income within family members who are household head’s sons or daughters. They were neither young, as considered in the biological relationship with mothers, nor were they older because of the relationships with mothers other than biological, earnings of the family members do not appear to have an effect to reduce the risk of child mortality.

Throughout 1960-2000, the Asian-Brazilian group had higher mean incomes in the three family/household income variables; husband’s/partner’s income, parents’ income, and other household members’ income (shown in the rows (1), (2), and (4) in Table 14-15), which are negatively associated to child mortality as portrayed in Table 4-14. Another family/household income variable, family members’ income, has higher values in Afro-Brazilian group in 1960 and 1980 (Table 4-15 (3)). Since the variable was shown to increase the risk of child mortality in Table 4-14, again Afro-Brazilian mothers have a negative feature of family/household composition in terms of child survival. In the latest year, the white mother group has the highest mean income in this unfavorable variable for child well-being; however, the correlation coefficient is not statistically significant in 2000.

**Neighborhood Characteristics and Community Assets**

In this study the multilevel data has three levels; individual, district, and municipality. Individual-level contains demographic and socioeconomic predictors. Table 4-16 shows all variables which were used in the multilevel models. District-level, level-two, includes three clusters of variables. Two variables represent the prevalence of public services, three variables serve as indicators of neighborhood stability, and three variables measure population heterogeneity. These variables are aggregated from Censo Demográfico 2000 using all valid households and individuals. In the process of aggregating data, weights were used, thus the
values reflect the universal population. At the municipal-level, level-three, I include indicators of the available educational and healthcare facilities.

The state of São Paulo is composed of 833 districts and 645 municipals in 2000. Figure 4-1 is the map of the state of São Paulo which shows the boundaries of districts described in green lines and municipalities described in gray lines. Among 645 municipalities, 573 have only one census district, and 72 municipalities have more than two districts. The municipal of São Paulo is composed of 96 census districts by which the population of the municipal of São Paulo (10,435,546 people in 2000) is divided. The mothers in my data from the municipal of São Paulo account for 23.9% of the data; therefore, if the multilevel models do not use the district-level, the estimation would be a mere contrast between the municipal of São Paulo and the rest of the state in terms of geographic variations. Also, 72 municipalities which contain more than two districts have a great population number. Since the unbalanced distribution is not an issue for multilevel modeling (Rasbash et al. 2009)\textsuperscript{18} the multilevel modeling of this study involves three levels.

**District-level attributes**

**Prevalence of public services**

The first group of district level attributes are purposed to describe the district difference in levels of public service prevalence which includes water supply (piped into residence or not), sewage infrastructure (piped into residence or not), electricity supply (residence has or not), garbage collection (if garbage is collected at residence), street lights (if street lights exist in front of the residence), and street pavement (if the street in front of the house is paved). These utility and public service variables are heavily related to urbanization and correlated to each other.

\textsuperscript{18} Rasbash et al. (2009) instruct that “In multilevel structures we do not require balanced data to obtain efficient estimates. In other words, it is not necessary to have the same number of lower-level units within each higher-level unit.”
Therefore, to avoid a possible collinearity effect among these variables in the multilevel models and to explore a plausibly appropriate value for each variable for constructing a meaningful index of quality of public services, the six public service variables available from the demographic census 2000 were inspected using factor analysis. This allowed for a selection of factors that are considered adequate in explaining the relationships among the variables.

The six variables were first aggregated at district-level loaded on two factors; water, sewage, and electricity in one factor and garbage collection, street lights, and street pavement in the other. The factor loadings, representing the degree of correlation between the variable, are used to weight each of the variables and then these values are combined into a composite index for each group. In one factor which is composed of three utilities, water, sewage, and electricity, can be interpreted as a measure of domestic use public service which I call “residential utility index.” Likewise, garbage collection, street lights, and street pavement are loaded into another factor and can be considered as the shared space public services and in this study it is called “sanitary and safety maintenance index.”

After the variables are weighted, the weighted values are combined into each of two factors respectively. Table 4-17 provides the statistics of the two newly created variables. The variable “residential utility index” is ranged 1.003 to 2.997 and its mean is 2.522. The variable “sanitary/safety maintenance index” has a scale of .168 and 2.589 and the mean is 1.998.

**Neighborhood stability and population heterogeneity**

The second neighborhood variable group is intended to capture the neighborhood (in)stability which has been found durable correlates of many problem in infant mortality, health outcomes, and behaviors (LeClere, Rogers, and Peters 1998; Sampson, Morenoff, and Earls
The neighborhood instability concept or residential disorder can be applied to the third variable group of neighborhood population heterogeneity.

Unemployment rate, mean years of schooling, and female-headed household proportion were computed using the entire sample (weighted) at the district level. Unemployment rate estimation required restricting the data to only people who are in the labor force, which excludes those under 16, members of military, persons in institutions, disabilities, retired, students, and individuals who choose not to work. For defining these individuals who are not in the labor force and to compute unemployment rate for each district in São Paulo, I used twelve variables; type of building where the respondent reside, age, if the respondents have disability (four variables), two education variables, if seeking job, two variables related to retirement, and how many job have. In this calculation, I additionally restricted it to male-only population to avoid the conflict with the variable of the percentage of female-headed household.

**Neighborhood population heterogeneity**

The last group of district level variable includes three types of population heterogeneity; resident origin diversity index (place of origin), racial diversity index, and income inequality index (Gini coefficient), in order to attempt to measure disadvantaged environment for population who are not in the majority within the neighborhood. Lack of social cohesion, lack of trust, the gap in common sense obstruct those minorities to build social network and accumulate social resources which eventually cause poor child health. Although Brazilian census question on race includes only five categories, Brazil is known as one of the world’s most heterogeneous societies and with the total landmass of 3,287,612 square miles, the fifth largest country on the planet. It is a very contrasting situation especially considering the Japanese population whose ancestors came from a geographically small and racially homogeneous nation.
Resident origin diversity index and racial diversity index were computed using the method of the multigroup information theory or the multigroup version of Theil’s $H$ (Theil 1972) which assesses how diverse or uneven an area is. This method allows for comparison of an unlimited number of groups (Massey and Denton 1988). The formula is typically described as follows:

$$H = -\sum_{k=1}^{n} [(P_k / P) \times \log(P_k / P)]$$

where, \(n\) is total number of subgroups present in the population, \(P_k\) is the total population of the \(k\)th subgroup, and \(P\) is the total population of all subgroups included in the index. For the computation of racial diversity, I included all five racial categories, white, black, brown, yellow, and indigenous, from the census data.

The census 2000 include several migration questions and I used three variables to create “residents origin diversity index” that is comprised of the code of state where the respondents resided on July 31, 1995, the code of municipality where the respondents resided on July 31, 1995” and place of residence (rural or urban). Using these three variables, nine categories were arranged by their origin; (1) lived in the same municipal, (2) moved within municipal from urban area to rural area or vise-versa, (3) moved within the state of São Paulo but to different municipal, (4) from the north region, (5) from the northeast region, (6) from the southeast region, (7) from the south region, (8) from the central-west, and (9) from foreign country. The proportion to the total São Paul population who moved before July 31, 1995 is 46.9%.

The diversity index varies between 0 and 1. The lowest 0 is when all groups are equally presented, i.e., maximum integration by one group, and the highest 1, when one group dominates a district, i.e., maximum dissimilarity. Therefore, as shown in Table 4-17, the most highly dominated district by one resident’s origin has the score of .668 and the district where every group mostly equally represented has .218. As for racial diversity, the district where mostly one
racial group dominant has .684 and the district where the most racially diverse has the score of 0.17.

The last variable for the district level is income inequality index which is computed using the method calculating Gini coefficient. The statistic is as follows:

\[
G = \left| 1 - \sum_{k=1}^{N} (\sigma Y_{k-1} + \sigma Y_{k})(\sigma X_{k-1} - X_{k}) \right|
\]

where \( \sigma X \) and \( \sigma Y \) are cumulative percentages of \( X \)s and \( Y \)s (in fractions) and \( N \) is the number of observations. The Gini coefficient can range from 0 to 1. In the regression analysis, the value of the income inequality is multiplied by 100 to range between 0 and 100. A low Gini coefficient indicates a more equal distribution, with 0 corresponding to complete equality, while higher Gini coefficients indicate more unequal distribution, with 1 corresponding to complete inequality.

Brazil is ranked the 9th highest income inequality nation in 2009 with Gini coefficient of 56.7. In the data of this study, the mean income equality score is 51.31 and its range is 27.82 and 73.28 (Table 4-17).

**Municipal-level attributes**

Predictors in the last cluster enlisted in the multilevel models represent community assets; educational facilities and health care services. These variables of health care institutions are objected to seek the possibility of moderating higher child mortality or reverse causation by ways of promoting child care knowledge and establishing social network, therefore, accumulating social resources by schools and providing personalized health cares by hospitals and clinics.

**Educational facilities**

In earlier section of this chapter, I introduced the variable of average years of schooling at district level as a neighborhood stability measurement to see if a lower educational level among neighbors confound child well-being or a higher educational level further promote healthier child
health. The educational facilities for children is expected to promote child health in various ways such as protect children, educate children and mothers, and provide the places and occasions to interact with other mothers and sharing information and possibly sharing emotional burdens as being mothers.

The educational institution information was obtained from *Censo Educacional 2004* (Ministério da Educação 2005) which contains distribution of educational facilities both public and private for preschool, elementary school, secondary school, teachers, administrators, etc. I used two items; one is public preschool and public elementary schools. Nurseries (for children under 2), kindergartens (for 2-3 year olds), and preschools (for children 4 and up) are all included in preschool category. Because private preschool schools’ tuition ranges from R$ 150 (US$88.00) to a high R$ 1,200 (US$700.00) a month (depending on region and residential area), it cannot be accessible for economically disadvantaged children who are in danger of poor health and environment. The Brazilian public elementary schools are free for everyone although poor attendance has been a major issue which can be solvable if the school accessibility is higher. The public preschool accounts for 76% of all free childcare in Brazil and four-fifths of the private preschool attendance is from the wealthiest family (World Bank 2003), inclusion of private preschool is also difficult to think its meaningfulness.

The total number of preschool for each municipality is adjusted by 1000 children aged 4 to 6. Similarly, the number of elementary school is controlled by 1000 pupils aged 7 to 14.

**Health care facilities**

The indicators of health care facilities are expected to show the accessibility can promote child health directly or mother’s health; therefore, consequently contributes to child survival. Health care facility information was drawn from *Pesquisa Municipal Unificada 1999* (SEADE
the number of obstetrician, the number of pediatrician, and the number of ambulance, and from *Estatística da Saúde Assistência Médico-Sanitária* 2001 (IBGE 2002), the number of public hospital, the number of private hospital/clinic, and the private SUS (*Sistema Único de Saúde*) contracted hospitals.

These six medical service indices also were adjusted by possible appropriate population. Each of public hospital and private hospital is expressed per 10,000 population of each municipality, yields a public hospital density at average 2.36 per 10,000 people with a range of 0 to 13.4, and a private hospital density at average .68 with a range of 0 to 5.38 (Table 4-17). Similarly, after number of ambulance and number of SUS contracted hospital were applied the same denominator, average ambulance rate is 3.59 with a range of .72 to 16.23 and that of private SUS contracted hospital is .409 and has a scale of 0 to 5.44. For adjusting obstetrician, I used the female population aged 15 to 49 (per 1,000) which yields a density of obstetrician 7.65 per 1,000 female aged 15-49 at average, and for pediatrician, the number of children aged 0 to 12 (per 1,000) which returns mean pediatrician density of .409 per 1,000 children aged 0 to 12.

The municipalities with the minimum density for each health care facility variable are all located in rural areas. Not only the medical facilities tend to be located in urban areas but also situated in very close to each other, such as medical complexes and general public hospitals in non-residential areas. In fact, while 1,759 medical facilities locate in the municipal of São Paulo in 1999, followed by 325 facilities in Campinas, 178 out of the 646 municipalities had only one facility. However, as far as the numbers in Table 4-17 indicate, the large number of medical facilities in the municipal of São Paulo moderately divided by its residents.

**Summary**

This chapter presented how I handled three Brazilian demographic census data, each of which has different variable structures from other years. I also discussed the caveats to deal with
Asian-Brazilian race category. As of 2000, it is still safe to say that the majority among Asian population in Brazil is Japanese descent; however, considering Asian version of ‘whitening’ has been evidently more prevalence among Japanese-Brazilian, we may need more caution when we use the next Brazilian census.

Child mortality has been reduced however the racial disadvantage in child mortality among Afro-Brazilian mothers compared to white and Asian mothers clearly remain in 2000 as shown in the series of bivariate analysis. These statistics also indicated that Afro-Brazilian have tended to have many negative characteristics associated to child survival. We know for sure from the numerous previous studies that the magnitude of the relationship between race and child mortality are not purely derived from people’s complexion. However, the relationships between race and a bunch of covariates rarely portray magnitudes on the child mortality relative to other covariates. To disentangle congregated covariates in child mortality, this study uses the count models which are appropriate to the dependent variable of this study, child death counts. In the next chapter, single-level Poission model, which is fundamental to more advanced count models, is first determined and then followed by the negative binomial regression model. Total 40 variables across individual, family, and neighborhood characteristics and three census data will be used in the single-level and multilevel count models to aim to uncover how family and household and neighborhood characteristics modify the relationship between race and child mortality.
Table 4-1. Comparison of race distribution between universal census data, sample data, and restricted sample data, women aged 20-34, São Paulo, Brazil, 1960, 1980, 2000

<table>
<thead>
<tr>
<th>Year</th>
<th>Total population within race</th>
<th>White</th>
<th>Afro-Brazilian</th>
<th>Asian-Brazilian</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960</td>
<td>(1) 10,605,624</td>
<td>82.84%</td>
<td>1,839,738</td>
<td>2.79%</td>
</tr>
<tr>
<td></td>
<td>(2) 5% sample population</td>
<td>82.84%</td>
<td>95,626</td>
<td>2.83%</td>
</tr>
<tr>
<td></td>
<td>(3) Restricted sample population</td>
<td>83.89%</td>
<td>6,692</td>
<td>1.77%</td>
</tr>
<tr>
<td></td>
<td>(4) (2)/(1)</td>
<td>5.17%</td>
<td>5.20%</td>
<td>5.25%</td>
</tr>
<tr>
<td></td>
<td>(5) (3)/(2)</td>
<td>7.14%</td>
<td>7.00%</td>
<td>4.40%</td>
</tr>
<tr>
<td>1980</td>
<td>(1) 18,712,914</td>
<td>74.99%</td>
<td>5,764,369</td>
<td>23.10%</td>
</tr>
<tr>
<td></td>
<td>(2) 25% sample population</td>
<td>75.35%</td>
<td>1,407,147</td>
<td>22.75%</td>
</tr>
<tr>
<td></td>
<td>(3) Restricted sample population</td>
<td>75.71%</td>
<td>111,329</td>
<td>23.19%</td>
</tr>
<tr>
<td></td>
<td>(4) (2)/(1)</td>
<td>24.90%</td>
<td>24.41%</td>
<td>24.63%</td>
</tr>
<tr>
<td></td>
<td>(5) (3)/(2)</td>
<td>7.80%</td>
<td>7.91%</td>
<td>4.51%</td>
</tr>
<tr>
<td>2000</td>
<td>(1) 26,185,687</td>
<td>71.30%</td>
<td>10,083,985</td>
<td>27.46%</td>
</tr>
<tr>
<td></td>
<td>(2) 10% sample population</td>
<td>75.83%</td>
<td>919,915</td>
<td>22.97%</td>
</tr>
<tr>
<td></td>
<td>(3) Restricted sample population</td>
<td>69.17%</td>
<td>82,330</td>
<td>30.40%</td>
</tr>
<tr>
<td></td>
<td>(4) (2)/(1)</td>
<td>11.60%</td>
<td>9.12%</td>
<td>10.52%</td>
</tr>
<tr>
<td></td>
<td>(5) (3)/(2)</td>
<td>6.17%</td>
<td>8.95%</td>
<td>2.44%</td>
</tr>
</tbody>
</table>

Sources: Censo Demográfico 1980, 2000 (IBGE).  
Censo Demográfico 1960 (IBGE, distributed by IPUMS-International).  
Note: The percentages shown in the table are calculated from the data including only white, Afro-Brazilian, and Asian-Brazilian.
Table 4-2. Racial group comparison in childlessness among women aged 20-34, São Paulo, Brazil, 1960, 1980, 2000

<table>
<thead>
<tr>
<th>Census Year</th>
<th>Age category</th>
<th>White</th>
<th>Afro</th>
<th>Asian</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960</td>
<td>20-24</td>
<td>18.3%</td>
<td>15.9%</td>
<td>29.4%</td>
</tr>
<tr>
<td></td>
<td>25-29</td>
<td>8.7%</td>
<td>9.3%</td>
<td>11.5%</td>
</tr>
<tr>
<td></td>
<td>30-34</td>
<td>6.3%</td>
<td>7.5%</td>
<td>4.9%</td>
</tr>
<tr>
<td>1980</td>
<td>20-24</td>
<td>23.6%</td>
<td>18.6%</td>
<td>44.2%</td>
</tr>
<tr>
<td></td>
<td>25-29</td>
<td>13.2%</td>
<td>10.6%</td>
<td>29.3%</td>
</tr>
<tr>
<td></td>
<td>30-34</td>
<td>7.4%</td>
<td>7.4%</td>
<td>14.7%</td>
</tr>
<tr>
<td>2000</td>
<td>20-24</td>
<td>27.0%</td>
<td>20.9%</td>
<td>50.2%</td>
</tr>
<tr>
<td></td>
<td>25-29</td>
<td>19.7%</td>
<td>13.7%</td>
<td>45.5%</td>
</tr>
<tr>
<td></td>
<td>30-34</td>
<td>11.6%</td>
<td>8.7%</td>
<td>31.3%</td>
</tr>
</tbody>
</table>

Sources: Censo Demográfico 1980, 2000 (IBGE)
          Censo Demográfico 1960 (IBGE, distributed by IPUMS-International).

Table 4-3. Summary statistics of child death counts and number or children ever born among mothers aged 20-34, São Paulo, Brazil, 1960, 1980, 2000

<table>
<thead>
<tr>
<th>Variable</th>
<th>1960</th>
<th>1980</th>
<th>2000</th>
</tr>
</thead>
<tbody>
<tr>
<td># Child Deaths</td>
<td>.4168</td>
<td>.931</td>
<td>-</td>
</tr>
<tr>
<td># Children Ever Born</td>
<td>3.0758</td>
<td>1.984</td>
<td>.6074</td>
</tr>
<tr>
<td># Observations</td>
<td>46,660</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sources: Censo Demográfico 1980, 2000 (IBGE)
          Censo Demográfico 1960 (IBGE, distributed by IPUMS-International).
Note: All correlation coefficients are statistically significant less than .01 in 1960, 1980, and 2000.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Between 20 and 34</td>
</tr>
<tr>
<td>Color</td>
<td></td>
</tr>
<tr>
<td>White [Reference]</td>
<td></td>
</tr>
<tr>
<td>Afro-Brazilian</td>
<td>1 = preta (black) or parda (brown), 0 = otherwise</td>
</tr>
<tr>
<td>Asian</td>
<td>1 = amarela (yellow/Asian), 0 = otherwise</td>
</tr>
<tr>
<td>Demographic</td>
<td></td>
</tr>
<tr>
<td>Place of Residence</td>
<td>1 = reside in urban areas, 0 = otherwise</td>
</tr>
<tr>
<td>Nativity</td>
<td>1 = born in the municipality where residing at present, 0 = otherwise</td>
</tr>
<tr>
<td>Years of Residency</td>
<td>Years of living in the present municipality 0-34 years</td>
</tr>
<tr>
<td>Marital Status</td>
<td>1 = religiously and judicially married, 0 = otherwise</td>
</tr>
<tr>
<td>Socioeconomic Status</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>Years of schooling 0 (0 year) -17 (17 years or more)</td>
</tr>
<tr>
<td>Income</td>
<td>Only mother’s total incomes (R$)</td>
</tr>
<tr>
<td>Job Situation</td>
<td>1 = employed, 0 = otherwise</td>
</tr>
<tr>
<td>Water Supply</td>
<td>1 = water piped to residence from the main network system, 0 = otherwise</td>
</tr>
<tr>
<td>Sewage System</td>
<td>1 = sewage connected to residence from the main network system, 0 = otherwise</td>
</tr>
<tr>
<td>Electricity</td>
<td>1 = electricity is supplied, 0 = otherwise</td>
</tr>
</tbody>
</table>

Note: Currency units of 1960 and 1980 are adjusted to Brazilian Real.
Table 4-5. Racial variations among mothers aged 20-34 in São Paulo, Brazil. 1960, 1980, 2000

<table>
<thead>
<tr>
<th>Variable</th>
<th>1960</th>
<th>1980</th>
<th>2000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>White</td>
<td>Afro</td>
<td>Asian</td>
</tr>
<tr>
<td>Number of Child Deaths</td>
<td>.376</td>
<td>.683</td>
<td>.194</td>
</tr>
<tr>
<td>Total Child Ever Born</td>
<td>2.983</td>
<td>3.620</td>
<td>3.058</td>
</tr>
</tbody>
</table>

# Cases in Race Category

<table>
<thead>
<tr>
<th># Cases in Sample Data</th>
<th>1960</th>
<th>1980</th>
<th>2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>39,142</td>
<td>6,692</td>
<td>826</td>
</tr>
<tr>
<td>Afro</td>
<td>363,419</td>
<td>111,329</td>
<td>5,287</td>
</tr>
<tr>
<td>Asian</td>
<td>187,351</td>
<td>82,330</td>
<td>1,170</td>
</tr>
</tbody>
</table>

Sources: Censo Demográfico 1980, 2000 (IBGE)
Censo Demográfico 1960 (IBGE, distributed by IPUMS-International).
Table 4-6. Summary statistics of demographic variables among mothers aged 20-34, São Paulo, Brazil, 1960, 1980, 2000

<table>
<thead>
<tr>
<th>Variable</th>
<th>1960</th>
<th></th>
<th>1980</th>
<th></th>
<th>2000</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean or</td>
<td>s.d.</td>
<td>Corr. w/ child death</td>
<td>Mean or</td>
<td>s.d.</td>
<td>Corr. w/ child death</td>
</tr>
<tr>
<td></td>
<td>Percentage</td>
<td></td>
<td></td>
<td>Percentage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>27.58</td>
<td>4.01</td>
<td>.1381</td>
<td>27.63</td>
<td>4.02</td>
<td>.0697</td>
</tr>
<tr>
<td>Color</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>83.89 %</td>
<td>- .0999</td>
<td></td>
<td>75.71 %</td>
<td>- .0844</td>
<td></td>
</tr>
<tr>
<td>Afro-Brazilian</td>
<td>14.34 %</td>
<td>.1169</td>
<td></td>
<td>23.19 %</td>
<td>.0902</td>
<td></td>
</tr>
<tr>
<td>Asian-Brazilian</td>
<td>1.77 %</td>
<td>- .0322</td>
<td></td>
<td>1.10 %</td>
<td>- .0178</td>
<td></td>
</tr>
<tr>
<td>Demographic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Place of Residence [Urban]</td>
<td>60.41 %</td>
<td>- .1051</td>
<td></td>
<td>87.78 %</td>
<td>- .0225</td>
<td></td>
</tr>
<tr>
<td>Nativity [Born in the municipality]</td>
<td>40.46 %</td>
<td>- .0679</td>
<td>29.44 %</td>
<td>- .0481</td>
<td>38.48 %</td>
<td>- .0221</td>
</tr>
<tr>
<td>Years of Residency</td>
<td>15.84</td>
<td>10.86</td>
<td>- .0526</td>
<td>13.69</td>
<td>9.79</td>
<td>- .0405</td>
</tr>
<tr>
<td>Marital Status [Married]</td>
<td>79.35 %</td>
<td>- .1168</td>
<td></td>
<td>68.23 %</td>
<td>- .0942</td>
<td></td>
</tr>
</tbody>
</table>


Sources: Censo Demográfico 1980, 2000 (IBGE)
Censo Demográfico 1960 (IBGE, distributed by IPUMS-International).

Note: All correlation coefficients are statistically significant less than .01 in 1960, 1980, and 2000.

Table 4-7. Racial variations in demographic variables among mothers aged 20-34, São Paulo, Brazil, 1960, 1980, 2000

<table>
<thead>
<tr>
<th>Demographic Variable</th>
<th>1960</th>
<th></th>
<th>1980</th>
<th></th>
<th>2000</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>White</td>
<td>Afro</td>
<td>Asian</td>
<td>White</td>
<td>Afro</td>
<td>Asian</td>
</tr>
<tr>
<td></td>
<td>Mean or Percentage</td>
<td>s.d.</td>
<td>Corr. w/ child death</td>
<td>Mean or Percentage</td>
<td>s.d.</td>
<td>Corr. w/ child death</td>
</tr>
<tr>
<td>Age</td>
<td>27.63</td>
<td>27.16</td>
<td>29.05</td>
<td>27.68</td>
<td>27.34</td>
<td>29.73</td>
</tr>
<tr>
<td>Place of Residence [Urban]</td>
<td>.620</td>
<td>.510</td>
<td>.600</td>
<td>.878</td>
<td>.875</td>
<td>.906</td>
</tr>
<tr>
<td>Nativity [Born in the municipality]</td>
<td>.436</td>
<td>.245</td>
<td>.186</td>
<td>.329</td>
<td>.188</td>
<td>.180</td>
</tr>
<tr>
<td>Years of Residency</td>
<td>16.55</td>
<td>12.19</td>
<td>11.61</td>
<td>14.36</td>
<td>11.36</td>
<td>12.80</td>
</tr>
<tr>
<td>Marital Status [Married]</td>
<td>.834</td>
<td>.605</td>
<td>.401</td>
<td>.732</td>
<td>.516</td>
<td>.758</td>
</tr>
</tbody>
</table>


Sources: Censo Demográfico 1980, 2000 (IBGE)
Censo Demográfico 1960 (IBGE, distributed by IPUMS-International).

Note: All associations between Race and the other independent variables are statistically significant less than .01 in chi-squared test of independence.
Table 4-8. Racial differences in the distribution of marital status among mothers aged 20-34, São Paulo, Brazil, 1960

<table>
<thead>
<tr>
<th>Marital Status Categories</th>
<th>White</th>
<th>Afro</th>
<th>Asian</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never Married</td>
<td>.17%</td>
<td>.39%</td>
<td>.00%</td>
</tr>
<tr>
<td>Married Legally and Religiously</td>
<td>83.31%</td>
<td>60.15%</td>
<td>40.12%</td>
</tr>
<tr>
<td>Married Legally</td>
<td>9.80%</td>
<td>18.19%</td>
<td>57.11%</td>
</tr>
<tr>
<td>Married Religiously</td>
<td>3.74%</td>
<td>12.84%</td>
<td>.81%</td>
</tr>
<tr>
<td>Union</td>
<td>1.76%</td>
<td>5.62%</td>
<td>.92%</td>
</tr>
<tr>
<td>Separated Legally</td>
<td>.08%</td>
<td>.06%</td>
<td>.12%</td>
</tr>
<tr>
<td>Separated De-Facto</td>
<td>.60%</td>
<td>1.55%</td>
<td>.35%</td>
</tr>
<tr>
<td>Widowed</td>
<td>.54%</td>
<td>1.19%</td>
<td>.58%</td>
</tr>
</tbody>
</table>

Source: Censo Demográfico 1960 (IBGE, distributed by IPUMS-International).
Table 4-9. Summary statistics of socioeconomic variables among mothers aged 20-34, São Paulo, Brazil, 1960, 1980, 2000

<table>
<thead>
<tr>
<th>Socioeconomic Status Variables</th>
<th>1960</th>
<th>1980</th>
<th>2000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean or Percentage</td>
<td>s.d.</td>
<td>Corr. w/ child death</td>
</tr>
<tr>
<td>Education</td>
<td>2.60</td>
<td>2.63</td>
<td>-.2024</td>
</tr>
<tr>
<td>Income (RS) [Mother’s only]</td>
<td>13.67</td>
<td>70.3</td>
<td>-.0429</td>
</tr>
<tr>
<td>Job Situation</td>
<td>7.80 %</td>
<td>.0143</td>
<td>23.59 %</td>
</tr>
<tr>
<td>Water Supply</td>
<td>43.92 %</td>
<td>-.1580</td>
<td>70.35 %</td>
</tr>
<tr>
<td>Sewage System</td>
<td>22.29 %</td>
<td>-.1248</td>
<td>48.63 %</td>
</tr>
<tr>
<td>Electricity</td>
<td>66.95 %</td>
<td>-.1235</td>
<td>93.55 %</td>
</tr>
</tbody>
</table>

Number of Observations: 46,660 480,035 270,851

Sources: Censo Demográfico 1980, 2000 (IBGE)
Censo Demográfico 1960 (IBGE, distributed by IPUMS-International).
Notes: All correlation coefficients are statistically significant less than .01 in 1960, 1980, and 2000. Currency units of 1960 and 1980 are adjusted to Brazilian Real.

Table 4-10. Racial variations in socioeconomic variables among mothers aged 20-34, São Paulo, Brazil, 1960, 1980, 2000

<table>
<thead>
<tr>
<th>Socioeconomic Status Variables</th>
<th>1960</th>
<th>1980</th>
<th>2000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>White</td>
<td>Afro</td>
<td>Asian</td>
</tr>
<tr>
<td>Education</td>
<td>2.80</td>
<td>1.32</td>
<td>3.13</td>
</tr>
<tr>
<td>Income (RS) [Mother’s only]</td>
<td>14.75</td>
<td>7.99</td>
<td>8.89</td>
</tr>
<tr>
<td>Job Situation</td>
<td>.076</td>
<td>.090</td>
<td>.057</td>
</tr>
<tr>
<td>Water Supply</td>
<td>.474</td>
<td>.228</td>
<td>.485</td>
</tr>
<tr>
<td>Sewage System</td>
<td>.248</td>
<td>.075</td>
<td>.225</td>
</tr>
<tr>
<td>Electricity</td>
<td>.689</td>
<td>.552</td>
<td>.684</td>
</tr>
</tbody>
</table>

# Cases in Race: 39,142 6,692 826 363,419 111,329 5,287 187,351 82,330 1,170

# Cases in Census Data: 46,660 480,035 270,851

Sources: Censo Demográfico 1980, 2000 (IBGE)
Censo Demográfico 1960 (IBGE, distributed by IPUMS-International).
Notes: All associations between Race and the other independent variables are statistically significant less than .01 in chi-squared test of independence. Currency units of 1960 and 1980 are adjusted to Brazilian Real.
Table 4-11. Definitions of family/household variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household Size: Small</td>
<td>Number of household members less than 4</td>
</tr>
<tr>
<td>Medium</td>
<td>Number of household members between 5 - 9</td>
</tr>
<tr>
<td>Large</td>
<td>Number of household members 10 or more</td>
</tr>
<tr>
<td>Family/Household Structure</td>
<td></td>
</tr>
<tr>
<td>Grandparent</td>
<td>$1 = $lives with male parent(s) of mother, $0 = otherwise</td>
</tr>
<tr>
<td>Grandmother</td>
<td>$1 = lives with female parent(s) of mother, $0 = otherwise</td>
</tr>
<tr>
<td>Males</td>
<td>Number of males older than 20 years who are out of the second degree relation to household head and are not parents of household head</td>
</tr>
<tr>
<td>Females</td>
<td>Number of females older than 20 years who are out of the second degree relation to household head and are not parents of household head</td>
</tr>
<tr>
<td>Family Children</td>
<td>Number of children age under 13 years old within family</td>
</tr>
<tr>
<td>Household Children</td>
<td>Number of other children under 13 years old in household except for children of household head</td>
</tr>
<tr>
<td>Family Youths</td>
<td>Number of youth between 13 and 19 years old within family</td>
</tr>
<tr>
<td>Household Youths</td>
<td>Number of youth between 13 and 19 years old in household except for children in their youth of household head</td>
</tr>
<tr>
<td>Family/Household Members’ Income</td>
<td></td>
</tr>
<tr>
<td>Husband’s/Partner’s Income</td>
<td>Total incomes of husband (R$)</td>
</tr>
<tr>
<td>Parents’ Income</td>
<td>Total income of parents or parents-in-law (R$)</td>
</tr>
<tr>
<td>Family Members’ Income</td>
<td>Total income within the second degree relation to the household head except for incomes of household head’s parents and in-laws (R$)</td>
</tr>
<tr>
<td>Other HH Members’ Income</td>
<td>Total income of other household members who are out of the second degree relation to household head (R$)</td>
</tr>
</tbody>
</table>

Note: Currency units of 1960 and 1980 are adjusted to Brazilian Real.
Table 4-12. Summary statistics of family/household structure variables among mothers aged 20-34, São Paulo, Brazil, 1960, 1980, 2000

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean or Percentage</td>
<td>s.d.</td>
<td>Corr. w/ child death</td>
</tr>
<tr>
<td>(1) Household Size: Small</td>
<td>70.24 %</td>
<td>-.1395 **</td>
<td>82.58 %</td>
</tr>
<tr>
<td>Medium</td>
<td>27.90 %</td>
<td>.1258 **</td>
<td>16.61 %</td>
</tr>
<tr>
<td>Large</td>
<td>1.86 %</td>
<td>.0543 **</td>
<td>0.80 %</td>
</tr>
<tr>
<td>(2) Any Grandparent</td>
<td>2.71 %</td>
<td>-.0143 **</td>
<td>1.55 %</td>
</tr>
<tr>
<td>(3) Any Grandparent</td>
<td>6.68 %</td>
<td>-.0172 **</td>
<td>4.42 %</td>
</tr>
<tr>
<td>(4) # Males</td>
<td>.054</td>
<td>.266</td>
<td>.0075</td>
</tr>
<tr>
<td>(5) # Females</td>
<td>.038</td>
<td>.216</td>
<td>-.0079 *</td>
</tr>
<tr>
<td>(6) # Family Children</td>
<td>2.221</td>
<td>1.309</td>
<td>.0846 **</td>
</tr>
<tr>
<td>(7) # Household Children</td>
<td>.021</td>
<td>.207</td>
<td>.0118 *</td>
</tr>
<tr>
<td>(8) # Family Youths</td>
<td>.404</td>
<td>.823</td>
<td>.0172 **</td>
</tr>
<tr>
<td>(9) # Household Youths</td>
<td>.052</td>
<td>.277</td>
<td>-.0004</td>
</tr>
</tbody>
</table>

Number of Observations 46,660 480,035 270,851

Sources: Censo Demográfico 1980, 2000 (IBGE)
Censo Demográfico 1960 (IBGE, distributed by IPUMS-International).
Statistical significance: * .05 < p < .01, ** p < .01.
Table 4-13. Racial variations in family/household structure among mothers aged 20-34, São Paulo, Brazil, 1960, 1980, 2000

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>White</td>
<td>Afro</td>
<td>Asian</td>
</tr>
<tr>
<td>(1) Household Size: Small</td>
<td>.718</td>
<td>.629</td>
<td>.550</td>
</tr>
<tr>
<td>Medium</td>
<td>.266</td>
<td>.343</td>
<td>.387</td>
</tr>
<tr>
<td>Large</td>
<td>.016</td>
<td>.028</td>
<td>.063</td>
</tr>
<tr>
<td>(2) Any Grandparent</td>
<td>.027</td>
<td>.017</td>
<td>.128</td>
</tr>
<tr>
<td>(3) Any Grandparent</td>
<td>.065</td>
<td>.063</td>
<td>.197</td>
</tr>
<tr>
<td>(4) # Males</td>
<td>.050</td>
<td>.059</td>
<td>.196</td>
</tr>
<tr>
<td>(5) # Females</td>
<td>.035</td>
<td>.046</td>
<td>.119</td>
</tr>
<tr>
<td>(6) # Family Children</td>
<td>2.178</td>
<td>2.448</td>
<td>2.452</td>
</tr>
<tr>
<td>(7) # Household Children</td>
<td>.019</td>
<td>.035</td>
<td>.024</td>
</tr>
<tr>
<td>(8) # Family Youths</td>
<td>.397</td>
<td>.444</td>
<td>.383</td>
</tr>
<tr>
<td>(9) # Household Youths</td>
<td>.046</td>
<td>.072</td>
<td>.155</td>
</tr>
<tr>
<td># Cases in Race Category</td>
<td>39,142</td>
<td>6,692</td>
<td>826</td>
</tr>
<tr>
<td># Cases in Census Data</td>
<td>46,660</td>
<td>480,035</td>
<td>270,851</td>
</tr>
</tbody>
</table>

Sources: Censo Demográfico 1980, 2000 (IBGE)
Censo Demográfico 1960 (IBGE, distributed by IPUMS-International).

Note: All associations between Race and the other independent variables are statistically significant less than .01 in chi-squared test of independence.
Table 4-14. Summary statistics of family/household member’s income variables among mothers aged 20-34, São Paulo, Brazil, 1960, 1980, 2000

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Husband’s/Partner’s Income</td>
<td>244.7</td>
<td>312.9</td>
<td>-.1140 **</td>
<td>979.3</td>
<td>1536.4</td>
<td>-.0708 **</td>
<td>744.5</td>
<td>1801.5</td>
<td>-.0216 **</td>
</tr>
<tr>
<td>(2) Parents’ Income</td>
<td>3.2</td>
<td>40.4</td>
<td>-.0199 **</td>
<td>11.1</td>
<td>122.7</td>
<td>-.0111 **</td>
<td>15.0</td>
<td>166.8</td>
<td>-.0049 **</td>
</tr>
<tr>
<td>(3) Family Members’ Income</td>
<td>2.7</td>
<td>24.0</td>
<td>.0624 **</td>
<td>12.1</td>
<td>84.7</td>
<td>.0576 **</td>
<td>12.2</td>
<td>102.1</td>
<td>.0157 **</td>
</tr>
<tr>
<td>(4) Other HH Members’ Income</td>
<td>10.0</td>
<td>64.0</td>
<td>-.0138 **</td>
<td>28.1</td>
<td>314.6</td>
<td>-.0020 **</td>
<td>21.8</td>
<td>195.3</td>
<td>.0014</td>
</tr>
</tbody>
</table>

Number of Observations 46,660 480,035 270,851

Sources: Censo Demográfico 1980, 2000 (IBGE)
Censo Demográfico 1960 (IBGE, distributed by IPUMS-International).
Note: Currency units of 1960 and 1980 are adjusted to Brazilian Real.
Statistical significance: * 0.05 < p < 0.01, ** p < 0.01.

Table 4-15. Racial variations in family/household incomes among mothers aged 20-34, São Paulo, Brazil, 1960, 1980, 2000

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Husband’s/Partner’s Income</td>
<td>258.49</td>
<td>147.78</td>
<td>375.07</td>
<td>1,087.56</td>
<td>567.05</td>
<td>2,222.08</td>
<td>859.79</td>
<td>467.65</td>
<td>1,810.65</td>
</tr>
<tr>
<td>(2) Parents’ Income</td>
<td>3.52</td>
<td>1.46</td>
<td>4.14</td>
<td>12.31</td>
<td>6.02</td>
<td>37.03</td>
<td>16.77</td>
<td>10.31</td>
<td>63.16</td>
</tr>
<tr>
<td>(3) Family Members’ Income*</td>
<td>2.55</td>
<td>3.74</td>
<td>2.04</td>
<td>11.26</td>
<td>15.12</td>
<td>7.21</td>
<td>12.43</td>
<td>11.82</td>
<td>9.77</td>
</tr>
<tr>
<td>(4) Other HH Members’ Income</td>
<td>9.85</td>
<td>8.33</td>
<td>33.28</td>
<td>26.11</td>
<td>31.07</td>
<td>95.42</td>
<td>21.38</td>
<td>22.67</td>
<td>38.00</td>
</tr>
</tbody>
</table>

# Cases in Race Category 39,142 6,692 826 363,419 111,329 5,287 187,351 82,330 1,170

# Cases in Census Data 46,660 480,035 270,851

Sources: Censo Demográfico 1980, 2000 (IBGE)
Censo Demográfico 1960 (IBGE, distributed by IPUMS-International).
Notes: * Except for “family member’s income” in 2000, all other associations between Race and the other independent variables in the table are statistically significant less than .01 in chi-squared test of independence. Currency units of 1960 and 1980 are adjusted to Brazilian Real.
Figure 4-1. Boundaries of districts and municipalities in São Paulo, Brazil in 2000
<table>
<thead>
<tr>
<th>Variable Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>District-Level Attributes</strong></td>
</tr>
<tr>
<td><strong>Prevalence of Public Services</strong></td>
</tr>
<tr>
<td>Residential Utility Index</td>
</tr>
<tr>
<td>Area Sanitary/Safety Maintenance Index</td>
</tr>
<tr>
<td><strong>Neighborhood Stability</strong></td>
</tr>
<tr>
<td>Unemployment Rate</td>
</tr>
<tr>
<td>Educational Level</td>
</tr>
<tr>
<td>Female Household Head</td>
</tr>
<tr>
<td><strong>Neighborhood Population Heterogeneity</strong></td>
</tr>
<tr>
<td>Resident Origin Diversity Index</td>
</tr>
<tr>
<td>Racial Diversity Index</td>
</tr>
<tr>
<td>Income Inequality Index</td>
</tr>
<tr>
<td><strong>Municipal-Level Attributes</strong></td>
</tr>
<tr>
<td>Educational Facilities</td>
</tr>
<tr>
<td>Preparatory Schools</td>
</tr>
<tr>
<td>Primary Schools</td>
</tr>
<tr>
<td>Health Care Services</td>
</tr>
<tr>
<td>Public Hospitals</td>
</tr>
<tr>
<td>Private Hospitals/Clincs</td>
</tr>
<tr>
<td>Obstetricians</td>
</tr>
<tr>
<td>Pediatricians</td>
</tr>
<tr>
<td>Ambulance</td>
</tr>
<tr>
<td>SUS</td>
</tr>
</tbody>
</table>

### Table 4-17. Summary statistics for district and municipal-level variables, São Paulo, Brazil, 2000

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>s.d.</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>District-Level Attributes [833 districts]</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prevalence of Public Services</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residential Utility Index</td>
<td>2.522</td>
<td>.389</td>
<td>1.003</td>
<td>2.997</td>
</tr>
<tr>
<td>Area Sanitary/Safety Maintenance Index</td>
<td>1.998</td>
<td>.343</td>
<td>.168</td>
<td>2.589</td>
</tr>
<tr>
<td>Neighborhood Stability</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unemployment Rate</td>
<td>.084</td>
<td>.043</td>
<td>.000</td>
<td>.215</td>
</tr>
<tr>
<td>Educational Level</td>
<td>5.991</td>
<td>1.382</td>
<td>3.325</td>
<td>12.826</td>
</tr>
<tr>
<td>Female-headed household</td>
<td>.195</td>
<td>.057</td>
<td>.023</td>
<td>.443</td>
</tr>
<tr>
<td>Neighborhood Population Heterogeneity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resident Origin Diversity Index</td>
<td>.458</td>
<td>.060</td>
<td>.218</td>
<td>.668</td>
</tr>
<tr>
<td>Racial Diversity Index</td>
<td>.423</td>
<td>.103</td>
<td>.017</td>
<td>.684</td>
</tr>
<tr>
<td>Income Inequality Index</td>
<td>51.31</td>
<td>5.662</td>
<td>27.820</td>
<td>73.280</td>
</tr>
<tr>
<td><strong>Municipal-Level Attributes [645 municipalities]</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Educational Facilities</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td># Preparatory Schools</td>
<td>6.058</td>
<td>4.397</td>
<td>.456</td>
<td>47.689</td>
</tr>
<tr>
<td># Primary Schools</td>
<td>3.540</td>
<td>2.509</td>
<td>1.036</td>
<td>23.696</td>
</tr>
<tr>
<td>Health Care Facilities</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td># Public Hospitals</td>
<td>2.363</td>
<td>1.873</td>
<td>.000</td>
<td>13.360</td>
</tr>
<tr>
<td># Private Hospitals/Clinics</td>
<td>.689</td>
<td>.857</td>
<td>.000</td>
<td>5.384</td>
</tr>
<tr>
<td># Obstetricians</td>
<td>7.645</td>
<td>6.491</td>
<td>.000</td>
<td>5.242</td>
</tr>
<tr>
<td># Pediatricians</td>
<td>9.568</td>
<td>7.667</td>
<td>.000</td>
<td>5.740</td>
</tr>
<tr>
<td># Ambulance</td>
<td>3.585</td>
<td>1.954</td>
<td>.723</td>
<td>16.234</td>
</tr>
<tr>
<td># SUS</td>
<td>.409</td>
<td>.606</td>
<td>.000</td>
<td>5.444</td>
</tr>
</tbody>
</table>

Sources: Censo Demográfico 2000 (IBGE).
Pesquisa Municipal Unificada (SEADE).
Estatística da Saúde Assistência Médico-Sanitária 2001 (IBGE).
CHAPTER 5
STATISTICAL METHODS

This study is an investigation of temporal and neighborhood effects on the relationship between race and child mortality as a proxy of population well-being in São Paulo, Brazil. To recognize how individual mothers’ condition influence on their children’s survival under given family and neighborhood conditions, Chapter 3 introduced the concept of social capital in the construction of a conceptual framework. Social capital, which refers to resources inhered within one’s social network, posits that individuals’ compositional characteristics can reciprocally and antecedently influence and be influenced by their social capital; therefore, then the influence of individual’s characteristics on child survival would depend on social capital derived from family and neighborhood as forms of social resources.

In order to illustrate the effects of race on child mortality within the constructed framework, using the individual characteristics, family/household composition, and district (neighborhood) and municipal (county) levels attributes, I chose count models for both single and multilevel statistical modeling. The chosen statistical models are appropriate for measuring the highly skewed count dependent variables such as total number of children ever born and total number of child deaths. Multilevel count models provide corrected parameter estimates and standard errors accounting for the hierarchically clustered data by including random-effects.

**Count Model for Child Mortality Estimation**

Raw data for fertility and child mortality amount to counts of births and deaths. Count variables in demography as elsewhere take non-normal distributions with many cases at or near a value of 0. Figure 5.1 is the distribution of child death counts in Brazilian demographic censuses
for 1960, 1980, and 2000. The figure shows that child death count distributions are heavily right-censored for all years. For these count data, linear regression models such as ordinary least squares (OLS) regression will yield biased estimates of coefficients. Specifically, OLS regression of count data underestimates the intercept and overestimates the slope (Long 1997). Though there are situations in which OLS regression provides “reasonable” results, it is much safer to use models specifically designed for count outcomes (Long and Freese 2003).

A useful first approximation is the Poisson model. A Poisson probability distribution is the basic count model upon which a variety of other single and multilevel count models are based such as negative binomial models, zero-inflated Poisson models, zero-inflated negative binomial models, zero-truncated models, hurdle regression models and so on. These models are very useful for epidemiological studies with count data and they have been increasingly used within the study of child survival and health (Bawah and Zuberi 2004; Goldani et al. 2004; Macinko et al. 2007; Rutaremwa 2000; Subramanian et al. 2009; Valle, Fernández, and Potter 2009; Wood, Carvalho, and Horta 2010). Count models have been described in various ways in a vast number of references (Cameron and Trivedi 1998; Hardin and Hilbe 2001; Long and Freese 2006). I begin with the Poisson distribution, followed by the descriptions of the Poisson model and then the negative binomial model.

**Poisson Regression Model with Exposure Term**

The Poisson distribution has the defining characteristic that the mean of the outcome is equal to the variance, and this characteristic is fundamental to regression models for counts. The relationship between the expected count and the random variable indicating probability of observing any observed count can be characterized as:

---

1 Figure 5.1 only includes 0-8 child deaths count. The actual ranges of child death counts in the sample data are 0-14 in 1960 and 0-16 in 1980 and 2000.
\[ \Pr(y \mid \mu) = \frac{e^{-\mu} \mu^y}{y!}, \quad y = 0, 1, 2, \ldots; \quad \mu > 0 \] (5.1)

where the random variable \( y \) is the count response, parameter \( \mu \) is the mean (i.e., rate or intensity parameter), \( e \) is the inverse natural logarithm, and \( y! \) is the factorial of \( y \). In my data, \( \mu \) is the expected number of child death that occurred to a mother, and \( y \) is the probability that there are exactly \( y \) occurrences to the mother. The Poisson regression model assumes that the observed count for observation \( i \) is drawn from a Poisson distribution with mean \( \mu_i \), which is written as:

\[ \mu_i = E(y_i \mid x_i) = \exp(x_i \beta), \quad y_i = 0, 1, \ldots, \quad i = 1, \ldots, N \] (5.2)

where \( x_i \) is a vector of covariates and \( i = 1, \ldots, N \), which indexes the \( N \) observations in a random sample. This is a nonlinear regression which has conditional mean function and heteroskedastic conditional variance,

\[ \text{Var}(y_i \mid x_i) = \mu_i. \] (5.3)

Including a set of covariates, a simple form of the Poisson model can be specified as:

\[ \ln(\mu_i) = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \ldots + \beta_k x_{ik}. \] (5.4)

A useful feature of count models is the inclusion of an offset variable in the equation. Usually we are interested in the rate of child mortality rather than the actual counts, because individual mothers have different numbers of children. If we were to use the raw counts of child deaths, the mothers who have more children would have larger counts. In order to account for the effect of fertility and duration of the mother’s exposure to the risk of child deaths, we need to include an offset\(^2\) variable associated with \( \mu \). An offset term enters into count models as the natural logarithm of the variable which expresses the different exposure duration or times for each

---

\(^2\) In epidemiology, the notion of offset is often interpreted as exposure (Hardin and Hilbe 2001) as the number of children that are exposed to a risk of death.
observation corresponding to the dependent variable in a count model. In this study, therefore, the logarithm of total number of children ever born to a mother is introduced in the regression model as an offset variable. By including the log of total number of children ever born in the equation, it can be differentiated from other coefficients in the regression model by being carried through as a constant and forced to have a coefficient of 1. If the number of children ever born to a mother is 1, then the Poisson probability distribution reduces to the standard form. Let \( \tau \) be the number of children that mother \( i \) is at risk and be the rate for that case is \( \mu \). The fitted value is expressed as,

\[
\mu_i(\tau_i) = (\exp(x_i \beta)) \times \tau_i. \tag{5.5}
\]

Since \( \tau = \exp(\log \tau) \) and the natural logarithm maps multiplication into addition, the equation can be rewritten as,

\[
\mu_i = \exp(x_i \beta + \ln(\tau_i)), \\
\ln(\mu_i) = x_i \beta + \ln(\tau_i). \tag{5.6}
\]

The Poisson count equation (5.4) can be rewritten including the offset term as,

\[
\ln(\mu_i) = \ln(\tau_i) + \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + ... + \beta_k x_{ki}. \tag{5.7}
\]

With this equation, the Poisson model assumes that the mean and the variance of the outcome variable are equal. This is called equidispersion and it accounts for observed heterogeneity such as observed differences among sample members by specifying the rate \( \mu_i \). However, in practice, the variance often exceeds the mean (Long 1997; Piquero, MacDonald, and Parker 2002). That is called overdispersion and the effects of unobserved heterogeneity causes the model to underfit the amount of dispersion in the outcome, which in turn leads to underestimation of standard errors. Consequently, a variable may appear to be a significant predictor when in fact it is not (Hardin and Hilbe 2001).
Overdispersion and Negative Binomial

In order to address the limitations of the Poisson model, the negative binomial model adds an error term, $\varepsilon$, that reflects unobserved heterogeneity among observations and is assumed to be uncorrelated with the predictors. The negative binomial model is expressed as:

$$
\ln(\mu_i) = \ln(\tau_i) + \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \ldots + \beta_k x_{ik} + \alpha \varepsilon_i,
$$

$$
\alpha \varepsilon_i = \exp(\varepsilon_i),
$$

(5.8)

where, the error term $\alpha \varepsilon_i = \exp(\varepsilon_i)$. The variance or dispersion function of the Poisson model is $\text{Var}(y_i \mid x_i) = E(y_i \mid x_i) = \mu_i$, as shown in Equations 5.2 and 5.3, which is a loglinear conditional mean function. The conditional mean equals the conditional variance, yielding equidispersion. The variance function for the negative binomial has been considered in various ways, but the most commonly-used function uses a one-parameter Gamma probability distribution with parameter $v_i$,

$$
g(\delta_i) = \frac{v_i^v}{\Gamma(v_i)} \delta_i^{v_i-1} \exp(-\delta_i v_i),
$$

$$
v_i > 0, \quad \exp(\varepsilon_i) = \delta_i.
$$

(5.9)

where $\delta$ is the gamma scale parameter. With the assumptions, $E(\delta_i) = 1$ and $\text{Var}(\delta_i) = 1 / v_i$, the negative binomial probability distribution can be specified as,

$$
\Pr(y_i \mid x_i) = \frac{\Gamma(y_i + v_i)}{y! \Gamma(v_i)} \left( \frac{v_i}{v_i + \mu_i} \right)^v \left( \frac{\mu_i}{v_i + \mu_i} \right)^y,
$$

$$
\text{Var}(y_i \mid x_i) = \mu_i \left( 1 + \frac{\mu_i}{v_i} \right).
$$

(5.10)

Because the negative binomial shares the same conditional mean with the Poisson model, as $\mu$ increases, the conditional variance of $y$ increases, and the negative binomial distribution around the expected value approximates the Poisson distribution (Long and Freese 2006); however its
conditional variance is different from the Poisson model. From Equations 5.2 and 5.3, 
$$ \mu_i = \exp(x_i \beta) $$
Thus Equation 5.9 for the variance of the negative binomial can be rewritten as
$$ \text{Var}(y_i | x) = \mu_i \left(1 + \frac{\mu_i}{\nu_i}\right) = \exp(x_i \beta) \left(1 + \frac{\exp(x_i \beta)}{\nu_i}\right). $$
(5.11)

Since $\mu$ and $\nu$ are positive, the variance of $y$ should be larger than the mean $\exp(x_i \beta)$. To fully understand the variance structure, the most common identifying assumption is that the gamma scale parameter $\nu$ is the same for all individuals which calls for inverting $\nu$. This yields $\alpha$, the negative binomial overdispersion parameter:
$$ \nu_i = \alpha^{-1} \quad \text{for } \alpha > 0 $$

The resulting negative binomial variance function is written by substituting $\nu_i = \alpha^{-1}$ into Equation 5.10:
$$ \text{Var}(y_i | x) = \mu_i \left(1 + \frac{\mu_i}{\alpha^{-1}}\right) = \mu_i (1 + \alpha \mu_i) = \mu_i + \alpha \mu_i^2. $$
(5.12)

Due to this variance function, the conditional variance is quadratic in the mean and the negative binomial model has greater flexibility in modeling the relationship between the expected value and the variance of $y_i$ than the Poisson model. This is the most commonly used conditional variance function which is labeled the NEGBIN 2 (NB2) in reference to the appearance of the squared term for $\mu_i$ that 2 indicates the degree of the exponential term.³

With this variance function, the negative binomial model is based on full maximum-likelihood estimation that includes regression parameters for the log expected count and the overdispersion parameter (Rogers 1993). The standard errors are unconditional estimates derived

³ A variety of variance function which are possible with the negative binomial regression model are shown by Cameron and Triveti (1986). The NEGBIN 2 is most often in applied research (Long and Freese 2006) and this is the only version of the negative binomial model available in Stata before version 9. Hence this research used NEGBIN 2 variance function.
from the second derivative of the log-likelihood function. To assess the model fitness and comparison, a likelihood ratio test can be used. In order to present the results from the negative binomial models on a convenient scale, I report the incidence rate ratio (IRR) as the rate of change in the outcome or ‘incidence.’ IRRs are calculated by exponentiating negative binomial coefficients. An incidence rate ratio of, for example, 1.50 indicates that there is 1.5 times the incidence if the associated covariate is increased by one unit.

It is worth visualizing the comparison between the observed counts and the predicted counts from the Poisson model and negative binomial models. Figure 5.2 provides this comparison using the sample data from the 2000 Brazilian demographic census. Points above 0 on the y-axis indicate more observed counts than predicted and those below 0 indicate more predicted counts than observed. The graph shows that the average predicted probabilities of counts 0-8 from the empty Poisson model is less powerful comparing to that from the empty negative binomial model. In particular, relative to the negative binomial model, the Poisson model predicts too many 0s and too few 1s. The increased variance in the negative binomial results in larger probabilities for small counts (Long 1997). In Figure 5.2, the difference from the observed probability reduces from 0.01087 for the Poisson model to 0.00053 for the negative binomial model.

The child death count variable used in this study is highly overdispersed. Therefore, I will use the negative binomial distribution throughout for my single-level (household-level) analyses. As explained in Chapter 4, the sample data are restricted to one mother per household in order to avoid over-representation of larger households with multiple mothers. Therefore, child mortality models using the characteristics of individual mothers and her family/household as independent variables are strictly single-level models.
Multilevel Methods and Analysis

The data also include variables at municipality (county) and district (neighborhood) levels. In order to analyze these hierarchically structured data, I also consider a three-level nested count model.

Multilevel approaches have attracted researchers in various disciplines and are referred using different terms. The term “multilevel model” is most often seen in sociological research (Anderson et al. 1994; Firebaugh 2008; Goldstein 2003; Oakes and Rossi 2003), and that is the term I employ in this study. “Hierarchical models” are found in publications from social epidemiology (Diez-Roux 2000; Kawachi 2002; Subramanian et al. 2009; Szwarcwald, Andrade, and Bastos 2002), and in the statistics and biometrics literatures (Banerjee, Carlin, and Gelfand 2004; Millar 2009). Raudenbush is a sociologist and a statistician who uses the term “hierarchical models” and offers examples of models involving nested or stratified data. Such models are also called “mixed effect models,” “random-effect models,” “random coefficient regression models,” and “covariance components models” (Raudenbush and Bryk 2002).

Research with models using nested or stratified data is steadily growing because of their ability to allow relationships to vary across different settings (Subramanian, Jones, and Duncan 2003). Variations in health outcomes across different contexts, have led to considerable attention to those circumstances, variously described as contextual, compositional, residential, ecological and temporal effects. In these cases, it becomes important to disentangle the effects of these contextual factors on a population’s health and well-being from those of individuals in the population. That in turn can provide the basis to see if there are multilevel processes at play as a means of providing efficiently targeted interventions to specific subpopulation in particularly great need of assistance.
There have been debates for six decades over the issue of the “ecological fallacy” and “Simpson’s Paradox.” Both call for caution when making assumptions about individual characteristics and behaviors based on stereotyping the groups to which individuals belong. The issue of ecological correlation was pointed out by Robinson (1950) who showed the invalidity of transferring results from analyses at the “ecological” level (aggregated individual values) to the individual level. Care in interpreting results must be taken when making causal inferences from group data to individual characteristics. Stereotyping individual behavior based on group membership not only yields confusing conclusions from research findings but can also sometimes be quite harmful when applied to political/legal activity (Oakes 2009).

In this light, there are various criticisms of multilevel models. One concerns the improper use of aggregate data as a proxy for individual data when employing an ecological perspective (Macintyre and Ellaway 2000). However, the most important issue is the failure to acknowledge a hierarchical structure (Goldstein 2003) which is intrinsic to societies and social life. As a result, the existence of unique relationships observable at multiple levels would be discounted although each level is important in its own right (Subramanian, Jones, and Duncan 2003). This reflects Coleman’s multilevel theory of society, where individuals make up society and society is made up of individuals and these levels are interactional (Coleman 1990). Thus, social processes yielding outcomes of interest usually do not exist in a single layer, but rather occur on multiple hierarchical levels, with the effect of contexts at one level influencing and being influenced by other levels. These influences are thus not only horizontal, e.g., involving causation among individual-level characteristics, but are also vertical, e.g., involving causation from an aggregate to an individual level. Therefore, we should consider contextual settings in the examination of health variations. Specifically we do not want to confuse causality at the individual level (e.g.,
individuals with lower income are more likely to exhibit ill health), with causality at the contextual level (e.g., areas with a higher percentage of lower income households tend to contain more people in poor health), or with individual-contextual relationships (e.g., higher probabilities of being in poorer health are particularly likely among people with lower incomes living in areas with a higher percentage of lower income people). From the statistical standpoint, if individual data are aggregated to a contextual level, then information about individuals and individual-context relationships would be lost, and analysis may yield incorrect estimates of the significance of the independent variables.

In multilevel modeling, there is particular interest in understanding if the effect of individual characteristics on an outcome is constant across groups or locations, i.e., if individual effects are independent from contextual differences. Subramanian, Jones, and Duncan (2003) outline several questions which are derived from concepts in multilevel modeling. My research is concerned with two of these questions, namely, “contextual heterogeneity” and “individual heterogeneity.” The first, concerning contextual heterogeneity, asks whether variations in health are truly the result of contextual circumstances or if they are compositional. Applied to my research, contextual heterogeneity is concerned to see if, after controlling for mother’s characteristics, the contextual characteristics (e.g., different geographical settings/characteristics) can significantly explain differences in health outcomes. If significant, then the child mortality variation is due to their neighborhood characteristics. Alternatively, variations are may be compositional since certain types of mothers may be more likely to have experienced one or more child losses due to their individual characteristics.

The second question, concerning individual heterogeneity, asks whether the contextual neighborhood effect has different impacts on different population groups after controlling for the
individual composition of the neighborhood. Applying to mothers’ racial background, while
neighborhood context may be important for child mortality in a certain racial group, the same
impact may not be seen on mothers in other racial groups in the same neighborhood. To answer
these questions, I will employ multilevel count models which I will discuss in the next section.

It is important to note here that the negative binomial approximation was initially intended
to be employed for multilevel modeling. However, I will pursue multilevel regression models
with Poisson regression. There are several reasons for making this choice. First, maximum
likelihood estimation is computationally intensive for discrete response multilevel models
(Rasbash et al. 2005). As of June 2010, the negative binomial estimation in MLwiN (Center for
Multilevel Modelling 2010), in which I develop multilevel models, uses quasi-likelihood
methods (iterative generalized least squares, IGLS or reweighted IGLS, RIGLS). While IGLS is
reasonably robust (Leyland 2001) and fast, it is said to be improper for testing models using
likelihood ratio tests. Alternatively, the Markov Chain Monte Carlo (MCMC) method is
available and recommended to fit count models. However, negative binomial models in MLwiN
cannot use MCMC method. On the other hand, Poisson models can be fitted using MCMC,
which allows the use of the Deviance information criterion (DIC) statistics for testing model
adequacy. Despite its drawbacks, the Poisson model is thus more viable for evaluating multilevel
relationships individual and contextual variables and child mortality.

**Multilevel Poisson Regression Model**

The multilevel models in this study have three levels: individual, district, and municipal.
As noted earlier, the Brazilian demographic census data contain two different levels of
contextual variables. One cluster of variables represents neighborhood characteristics at the
“district” level, and another cluster of variables is a proxy for characteristics at the “municipal”
level. The level-1 units, individual mothers, are nested in the level-2 units, districts, which are nested in the level-3 units of municipalities in the state of São Paulo.

In multilevel models, each of the levels in the structure is formally represented by its own sub-model. These sub-models express relationships among variables within a given level, and specify how variables at one level influence the relationship occurring at another levels (Raudenbush and Bryk 2002). I am particularly interested in whether contextual variables any higher levels influences the relationship between the racial variables and the child death counts. To examine within-level effects, I employ a random intercept Poisson model. To address the possibility of contextual variables affecting relationships among individual level variables, I will specify a cross-level interaction model.

For single level data, the natural logarithm, \( \ln(\mu) \), is used as the link function for expected counts and it leads to the Poisson regression model. For multilevel data, I consider models using the logarithm of \( \mu_{ij} \). The count data for multilevel models also require a log transformation of the offset term, \( \ln(\tau_{ijk}) \). Based on the single-single level Poisson distribution (Equation 5.1), the two-level Poisson probability distribution is specified as:

\[
\Pr(Y_{ijk} \mid \mu_{ijk}) = \frac{\exp(-\mu_{ijk})^{Y_{ijk}}}{Y_{ijk}!}, \quad Y_{ijk} = 0, 1, 2, \ldots
\]

where \( i \) indexes each individual mother \( (i = 1, 2, \ldots, n_j) \) within the \( j \)-th district \( (j = 1, 2, \ldots, J) \), and within the \( k \)-th municipal \( (k = 1, 2, \ldots, K) \) with the property of the Poisson probability distribution with equidispersion, such that \( E(Y_{ijk} \mid X_{ijk}) = \text{var}(Y_{ijk} \mid X_{ijk}) = \mu_{ijk} \). There are three clusters of variables at each of the three levels, namely individual compositional variables \( X \) at the level-1, neighborhood communal characteristics variables \( Y \) at the district-level, and neighborhood asset
variables $Z$ at the municipal-level. Applying a log transformation to model, the mean $\ln(\mu_{ijk})$, a three-level random intercept Poisson model typically can be written as:

$$\ln(\mu_{ijk}) = \log(\tau_{ijk}) + \beta_{0jk} + \beta_{1jk}X_{ijk} + \beta_{2jk}Y_{jk} + \beta_{3}Z_k,$$

(5.13)

where, $\beta_{0jk}$ is the intercept in district-level unit $j$ within municipal-level unit $k$. The difference with the Poisson for the single-level data is that the multilevel model assumes each district-level unit has a different intercept $\beta_{0jk}$. Since the intercept varies across districts as well as municipalities, the between-group variability needs to be specified. The group-dependent intercept (random intercept) can be split into an average intercept and group-dependent deviations. The level-2 model for the intercept can be written as:

$$\beta_{0jk} = \delta_{00k} + u_{0jk},$$

(5.14)

where, $\delta_{00k}$ is the average intercept in municipal-level unit $k$, and $u_{0jk}$ is the residual error term at the level-2. For this average intercept $\delta_{00k}$, we have the level-3 model as follows,

$$\delta_{00k} = \gamma_{000} + v_{000},$$

(5.15)

where, $\gamma_{000}$ is the average intercept for each mother within each district within each municipality; i.e., general intercept or fixed intercept. The term $v_{00k}$ is the residual term at the level-3.

Substituting Equations 5.14 and 5.15 into the level-1 model (Equation 5.13), we obtain:

$$\ln(\mu_{ijk}) = \log(\tau_{ijk}) + \gamma_{000} + \gamma_{100}X_{ijk} + \gamma_{010}Y_{jk} + \gamma_{001}Z_k + u_{0jk} + v_{00k},$$

(5.16)

where the regression coefficient $\beta_1$ is substituted by the triple indexing notation $\gamma_{100}$. Similarly, $\beta_2$ is substituted by $\gamma_{010}$, and $\beta_3$, is substituted by $\gamma_{001}$, respectively. The segment $[\gamma_{000} + \gamma_{100}X_{ijk} + \gamma_{010}Y_{jk} + \gamma_{001}Z_k]$ contains the fixed coefficients and the coefficients in the remaining segment $[u_{0jk} + v_{00k}]$ are called random coefficients.
Equation 5.16 thus exhibits one residual at each of the higher two levels; the district-level $u_{0jk}$ which is denoted by $\tau^2$, and the municipal level $\nu_{00k}$ denoted by $\phi^2$. Note that since the Poisson model assumes mean = variance, the individual level does not have a residual term. The total variance between all district-level units equals $\tau^2 + \phi^2$ and the population variance between all municipal-level units is now called $\phi^2$. The values of these residuals are used for assessing the degree of resemblance between levels. This is called the interclass correlation, and it measures the extent to which the outcome values of individuals in the same group resemble each other as compared to those from individuals in different groups. It may also be interpreted as the proportion of the total residual variation that is due to differences between groups which is called the variance partition coefficient (Goldstein 2003). Since there is a residual at each of the two higher levels, the intraclass correlation coefficient $\rho$ is defined as:

$$\rho = \frac{\tau^2}{\tau^2 + \phi^2} \quad \text{or} \quad \rho = \frac{\phi^2}{\tau^2 + \phi^2}.$$  \hspace{1cm} (5.17)

The first equation expresses the proportion of variance that is accounted for by the district level and the latter is the proportion of variance that is accounted for by the municipal level. Simply stated, comparison of the two variance partition coefficients tells us which level, if any, would contribute more to the multilevel modeling for my count data.

The model with interaction terms between race and explanatory variables at higher levels is straightforward since it will be included in the model as a fixed term. Let us separate two dummy variables of race from the individual level variables: Afro-Brazilian is denoted as $x_{1ijk}$, Asian-Brazilian is denoted as $x_{2ijk}$. The other individual level variables are $X_{ijk}$ as specified earlier. Further, let us assume that there is one district-level variable, say, utilities, in the model which is denoted as $y_{1jk}$ and the other district-level variables as $Y_{jk}$. This gives:
\[ \ln(\mu_{ijk}) = \log(\tau_{ij}) + \gamma_{000} + \gamma_{100} x_{ij} + \gamma_{200} x_{2ij} + \gamma_{300} x_{3jk} \\
+ \gamma_{010} y_{1jk} + \gamma_{110} x_{ij} * y_{1jk} + \gamma_{210} x_{2ij} * y_{1jk} + \gamma_{020} y_{jk} \\
+ \gamma_{001} Z_k + u_{0jk} + v_{00k}, \]  

Using variable labels and naming other variables grouped at each level instead of algebraic symbols, the full model can be stated as

\[ \ln(\mu_{ijk}) = \log(\tau_{ij}) + \gamma_{000} + \gamma_{100} Afro_{ij} + \gamma_{200} Asian_{ijk} + \gamma_{300} individual\, charactors_{ijk} \\
+ \gamma_{010} utilities_{1jk} + \gamma_{110} Afro_{ij} * utilities_{1jk} + \gamma_{210} Asian_{2ijk} * utilities_{1jk} \\
+ \gamma_{020} district\, level\, attributes_{jk} + \gamma_{001} municipal\, level\, attributes_{k} + u_{0jk} + v_{00k}. \]

This model is used to differentiate individuals belonging to a group at a higher level (district or municipality) from individuals in different groups. Principally, multilevel modeling is needed because observations from the same group are generally more similar to each other than observations from different groups, and this violates the assumption of independence among observations (Hox 2010). Although my primary interest is the racial difference in child mortality, this model is not specified to examine racial differences at the contextual levels. In other words, the model specified above does not provide the different slopes for race variables at the higher levels (district or municipality). For that purpose, we need to randomize the race variables.

Instead, by including the interaction terms between race variables and higher level variables which appear to be influential on the dependent variable in the model specified by Equation 5.16, I seek to observe specific relationship between contextual variables and race as they influence child mortality in the state of São Paulo.

I carried out the multilevel analysis by employing the statistical package MLwiN. This package enables one to estimate Poisson regression models on child death counts via MCMC in a Bayesian framework. These methods “incorporate prior distribution assumptions and, based upon successively sampling from posterior distributions of the model parameters, yields a ‘chain’
which is then used for making point and interval estimates” (Goldstein 2003:39). This approach to estimate is characterized by simulation-based procedures. Rather than producing point estimates, the observations are processed for numerous iterations, and at each iteration, an estimate for each unknown parameter is produced. To “incorporate prior distributions,” the method chooses starting values for each parameter which are taken from values derived from a preliminary IGLS estimation as the prior distribution assumptions; “successive sampling” is obtained via the Gibbs sampling procedure (Browne 2005; Goldstein 2003). The question of how large a sample is needed is addressed via accuracy diagnostics such as the Raftery-Lewis and Brooks-Draper tests (Browne 2005). Both diagnostics are based on the Monte Carlo standard error, an indication of the accuracy of the mean estimate.

The results from MCMC estimations of Poisson multilevel regression models are assessed in terms how well the models fit the count data by the deviance information criterion, DIC (Spiegelhalter et al. 2002), a hierarchical modeling generalization of the AIC (Akaike information criterion) and BIC (Bayesian information criterion). The DIC is calculated as

\[ DIC = \bar{D} + p_D = D(\bar{\theta}) + 2p_D = 2\bar{D} - D(\bar{\theta}). \]  

(5.19)

\( \bar{D} \) is the average deviance from the number of iterations of a particular model; the effective number of parameters is called \( p_D \), which can be calculated as \( \bar{D} - D(\bar{\theta}) \). \( \theta \) refers to the unknown parameters of the model, and \( D(\bar{\theta}) \) refers to the expected value of the unknown parameters. Since \( \bar{D} \) decreases as the number of parameters in a model increases, the \( p_D \) term compensates for this effect by favoring models with a smaller number of parameters (Browne 2005; Gelman and Hill 2007; Spiegelhalter et al. 2002).
Figure 5-1. Distribution of observed child death counts from census sample data, São Paulo, Brazil, 1960, 1980, 2000
Figure 5-2. Comparison between Poisson model and negative binomial model in the deviation of mean predicted probability for each count from the observed probability, São Paulo, Brazil, 2000
CHAPTER 6
INFLUENCE OF INDIVIDUAL-LEVEL VARIABLES ON CHILD MORTALITY:
NEGATIVE BINOMIAL MODELS

To test the relationship between the health and race I used samples drawn from the
Brazilian demographic censuses in 1960, 1980, and 2000. In this chapter, I first estimated
negative binomial models of child mortality among mothers aged 20 to 34 who lived in the State
of São Paulo at the time the censuses were conducted. The main objective is to examine the
temporal persistence of racial effects on individual mothers’ experience of child loss, after
controlling for individual characteristics and family/household structure indicators. The
covariates included in the analysis were selected in accordance with the conceptual framework
documented in Chapter 3, the availability of data, and on the basis of diagnostics tests of
variability and collinearity.

I begin by first presenting results of the child mortality models, controlling for mothers’
race and age. The second set of negative binomial models provides estimates of the direct effects
of individual-level demographic and socioeconomic characteristics on incidence of child
mortality. The third set of models introduce family and household characteristics in determine
the degree to which these variables modify the magnitude of the mortality effect mother’s racial
identity.

Mother’s Compositional Characteristics: Race, Demographic, and Socioeconomic
Characteristics

Table 6-1 presents the results for each census date. The negative binomial regression
models predict the probability of death, controlling for age and race, which is treated as a dummy
variable (white = 0; Afro-Brazilian = 1) All models in this and in the next chapter further include
the number of live children ever born to a mother as the offset variable.
The results show that there are marked differences among race groups. In 1960, the probability of a child death among Afro-Brazilian mothers was 1.5 times greater than among children born to white mothers. Asian-Brazilian mothers, on the other hand, had approximately 49% (0.5102[IRR] – 1 = 48.98) fewer children lost compared to white mothers. The observed racial differences persisted in 1980 and 2000. Since the results are from different data, we cannot compare these coefficients. However, it is plausible that the gaps between race groups may have narrowed during the forty-year period, both between whites and Afro-Brazilians and between whites and Asian-Brazilians.

Notably, the age coefficient in 1980 was negative, meaning that the number of children lost was reduced by 0.5% for every additional year of age. I then added the squared term of age because a quadratic relationship between child death counts and age was suspected. The results indicated that, although both the linear effect of age and the squared term of age were statistically significant in all 1980 models, the inclusion of the squared term did not alter the effect of the other covariates. Inclusion of the age-squared variable improved the models (likelihood ratio chi-square 19.62 with \(df = 1\), in the model with age and race). However, given that there was no significant effect on the covariates, and because there was no evidence for non-linearity in the 1960 and 2000 data, I decided to keep the models simple by excluding square term of age, which was consistent with the 1960 and 2000 models.

**Race and Demographic Characteristics Effects**

The next set of models is shown in Table 6-2. In addition to age and the race dummy categories, the regressions include demographic and socioeconomic variables. The bold script identifies the statistically significant coefficients. The most important findings in the models concern the changes observed in the coefficients for Asian-Brazilians. Controlling for demographic and socioeconomic covariates, the mortality effect of being Asian-Brazilian on
child mortality is stable or slightly greater in 1960, compared to the effect of being Asian in 1960 (Table 6.1). The negative sign indicates that the children born to Asian women have 50.56% lower mortality compared to the children born to white women. Especially noteworthy is the change in the coefficient over the three time periods. Compared to 1960, the Asian effect is lower in 1980 and becomes statistically insignificant in 2000. The results shown in Tables 6-1 and 6-2 therefore indicate that the Asian-Brazilian’s low child mortality was increasingly due to demographic and socioeconomic compositional factors in 1980 and 2000.

The coefficients for Afro-Brazilian were also influenced by the inclusion of demographic and socioeconomic covariates. While all coefficients for African-Brazilian dummy variable kept their statistical significance, the difference compared to whites was reduced in all census years by 29.8% in 1960, 28.1% in 1980, and 17.5% in 2000. Taken together, it is evident that forty years ago, the mother’s racial/ethnic identity exerted a strong independent effect on child mortality – which was positive in the case of Afro-Brazilians and negative in the case of Asian-Brazilians – but that, over time, socio-demographic factors assumed greater importance.

Other variables in the equations provide important insights into the covariates of child mortality. Mothers residing in urban areas have a higher risk of child mortality. Similarly, mother’s Years of Residency, which serves as a proxy of the neighborhood social connections, has the expected effect of reducing child mortality, as does the mother’s marital status. Marital status works in favor of married mothers in reducing the risk of child loss by 18.1% in 1960, 23.1% in 1980, and 20.3% in 2000, respectively. Length of residence in the municipality also has a negative effect on child mortality. The expected number of child loss for mothers residing longer in the present municipality is 0.73% less for each additional year of residency in 1960, 0.43% less in 1980, and 0.88% less in 2000, respectively. Nativity, that is, whether mothers were
born in the municipality where they were residing at the time of censuses, was also included in
the models as a proxy of the neighborhood connectivity to determine if mother’s native place
introduces an additional mortality advantage beyond the effects of being a longer resident. The
findings show that the coefficients for the Nativity variable were not statistically significant
which may be due to collinearity with the Years of Residence variable.⁴

**Socioeconomic Characteristics Effects**

The bottom tier of Table 6-2 shows the mortality effects of mother’s education, mother’s
income, mother’s job situation, and utilities availability in the home. All coefficients are
consistent with the vast literature that finds that higher socioeconomic status is associated with a
lower risk of child loss. The education variable (years of schooling) is log-transformed. The
result in a double log functional form given that the negative binomial functional form is
mathematically equivalent to a logarithmic transformation of the independent variable (e.g.,
\[ \ln(y) = \alpha + \beta \ln(x) + \epsilon \]). In such a case, coefficients are called elasticity coefficients. The
elasticity coefficient means that a one 1 percent change in \( x \) will cause \( \beta \% \) change in \( y \).

Therefore, we can use the values in the b-coefficient column as the percent change in mortality
associated with education. Here, in the models predicting child death counts, every year of
schooling reduces the expected number of child death by 0.31% in 1960, 0.23% in 1980, and
0.33% in 2000, respectively.

The mother’s income is included in the model as a linear effect. Although income and
years of schooling are strongly correlated with one another, both variables had a statistically

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⁴ The reference category for “nativity”, mothers who had not been born in the municipality where they resided at the
time the censuses were conducted, includes four categories; mothers were, (1) born in different municipality within
the State of São Paulo, (2) born outside of the State of São Paulo, (3) born in foreign country and naturalized, and
(4) foreigners. Insignificance of “nativity” coefficients may be caused by collinearity with years of residency but it
may be also suspected causation between health and immigrants such as an epidemiological paradox, healthy
immigrant, and acculturation theories.
significant on reducing child mortality. Every R$100 of mother’s income reduced the number of child lost by 0.18% in 1960, 1.51% in 1980, and 1.31% in 2000. In 1980, a one percent reduction associated with the education effect is lower than 1960 and 2000. The effect of income in 1980 seems stronger than 1960 and 2000; therefore, the lower effect of education may have reflected the stronger effect of income in 1980 compared to 1960 and 2000.

Mothers who had a job at the time of census are 11.69% more likely to have a higher number of child lost compared to mothers who did not work in 1960. The disadvantage to working mothers in child loss persists in the others years. The probability of child lost to those mothers is 11.69% higher in 1980 and 7.60% higher in 2000 compared to women who were not working. The negative effect of women’s employment on child mortality is a finding consistent with other research on child health. It appears that the income generated from working reduces child mortality, yet, at the same time, the woman’s commitment to the labor force also puts competing demands on her time such that employment outside the home increases the probability of a child death.

Influence of Family/Household Characteristics

I now turn to the child mortality effects of family and household variables. The models shown in Table 6-3 add the following indicators to the analysis: the presence of a male or female parent; the number of adult males in the household; the number of other adult females; the number of children under 10 years of age in the family; the number of other children under 10 years of age in the family; the number of youths 10-19 years of age, and the number other youths 10-19 years of age. I include these variables in the analysis on the assumption that intra-household characteristics, such as the presence of adults and youths, influence the health outcome of infants and children.
Effects of Structural Variations in Family and Household

Before examining the effects of each of the intra-household variables, it is worth noting that their inclusion in the equation does not significantly alter the effects of the dummy variables for color. This is evident in the case of Afro-Brazilians. When I compare the effects of color in Table 6-2, which excluded the intra-family/household variables, with those in Table 6-3, which includes them, the results show that the coefficients are statistically significant in both models, and that the size of the mortality-enhancing effect of being Afro-Brazilian is more or less the same in the two tables. The same can be said for Asian-Brazilians. Models that exclude family/household indicators (Table 6-2) and models that include them (Table 6-3) come to basically the same conclusion: the positive Asian effect was large and statistically significant in 1960; the effect was reduced in 1980, but remained significant; and, by 2000, the mortality of children born to Asian mothers did not differ from the reference group.

The effects of all socioeconomic characteristics shift toward less child mortality in all years, and most of coefficients are statistically significant. It is worth noting that the effect of being a working mother is no longer statistically significant in 1960 and 2000, and the number of child death count is increased by 11.89% for working mothers in 1980, which decreased from 18.23% (-6.34%) compared to the previous model (Table 6-2).

Turning now to the effects of the variables shown in the lower portion of Table 6-3, it is apparent that the mortality effect of most of the variables operates in the expected direction, but with some revealing exceptions. In 1960, the presence of an adult male other than mother’s husband or partner increased the risk of child loss. For every additional adult male in the household, child mortality rose by 6.53%. Evidently the presence of adult men has a negative effect on children’s health environment, a finding that feminist would not find surprising. In contrast to the effect of adult males, the presence of family youth aged 10-19 and family children

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under 10 reduces the risk in child loss. One additional family youth in the household reduces child loss by 8.95%. The child care provided by such individuals could be the reasons for these findings.

The number of children under 10 in the family was expected to be positively associated to child mortality, because, as the number of children in the family and household increases, mothers are required to provide more physical and financial support. We found instead that one additional child under 10 in the family was associated with a 22.8% decrease in the expected number of children lost. Perhaps mothers with more children are better experienced in childbearing and possess more knowledge of childbearing practices.

The effect and direction of coefficients in 1980 are, overall, parallel to those in 1960 but more of the variables in 1980 are statistically significant. The presence of a female parent (i.e., the grandmother to the children at risk of dying) reduces the number of child deaths by 8.24%, a finding that probably reflects the importance of grandparents in the care of children. The woman’s mother is most likely the first and closest person who mothers can rely on for information about childbearing. Unfortunately there is no way to determine in these data whether the “parent” of household head refers to in-law or to the mother’s own mother. That issue aside, there is no doubt about mother’s own mother or mother-in-law having some experiences in childbearing and they can be the most reliable source as experienced child care providers for mothers.

The presence of adult female in the household is expected to have a negative relationship with child mortality because with the presence of another female household member is assumed to enhance the total amount of time devoted to the care and protection of children. Contrary to this expectation, child loss increased by 2.33% for every additional adult female in the household.
Data limitations do not allow me to determine the precise reasons for the unexpected positive association with child mortality.

Incomes of Family and Household Members As Economic Support for Mothers

The regression models presented in Table 6-4 add variables that reflect the financial contribution of other members of the household. This category of variables includes incomes of husband/partners, mother’s parents, family members, and other household members. Regrettably, the data do not give any indication of whether the income derived from different sources is pooled and shared within the household. Despite this limitation, we can nonetheless determine whether their incomes alter the relationships between the child loss and other covariates. Similarly, we can determine whether the various sources of income have separate effects on child survival.

The inclusion of variables representing family and household physical presence widened the racial gaps between whites and Afro-Brazilian for all years but those gaps now are reduced. Compared to the coefficient of the dummy variable for Afro-Brazilian in Table 6-3, the racial gaps in the number of child loss between whites and Afro-Brazilians slightly decreased by 0.83% in 1960, 1.5% in 1980, and 1.54% in 2000. However, the racial gap between whites and Afro-Brazilians are still larger compared to the racial gap in the model without family and household indices (Table 6-2). For Afro-Brazilians, on average, having additional household members without income seems to lead to a higher probability of child loss. We can conclude that, other things equal, the family and household characteristics negatively affect to child survival among Afro-Brazilian mothers in my all data from 1960 to 2000. Additionally even if the household members have income, to the effect does not eliminate the negative mortality consequence of other household members.
Among Asia-Brazilians the mortality differences compared to whites were reduced in relation to those observed in Model 2, which included only demographic and socioeconomic characteristics (Table 6-2). This finding implies that, whereas the physical presence of their relatives within the household may yield an advantage in child mortality compared to whites, once the incomes of family and household members are included, the human resources within family/household is overpowered. Husband’s or partner’s income is considered to be the most powerful predictor of child mortality and a large portion of the characteristics of Asian-Brazilian in child mortality may be attributed to their financial advantage in all years. Although the coefficients from different data are not fully comparable, we can observe their tendencies after controlling for individual and family/household compositional attributes. The effect of being Asian on child mortality decreased from -46.45% in 1960 to -17.47% in 1980 and -22.17% in 2000 compared to the corresponding figures in Model 3 (Table 6-3). Since the coefficient for Asian-Brazilian lost its statistical significance when the socioeconomic status is included, “Asianess” was not associated with an advantage in child survival in 2000.

Most variables in the cluster of demographic and socioeconomic characteristics continue to be statistically significant and the signs of the coefficients remain the same. One noteworthy change from Model 2 to Models 3 and 4 concerns mothers’ job status. The effect of being a working mother in all census years increased the risk of child mortality and was statistically significant in Model 2 without family/household indices; however, in 1960 and 2000 they lost their statistical significance and in 1980 it reduced its effect by the inclusion of family/household physical presence in Model 3. Further, the effect of being a working mother is the only coefficient that continued to reduce its association with child mortality and the sign of the coefficients in 1960 and 2000 became negative. These findings are encouraging for working
mothers if they have relatives within household. Finally, as expected, every R$100 increase in husband’s or partner’s income reduces child loss by 5.53% in 1960, 1.07% in 1980, and 0.96% in 2000.

To summarize, the complete model, which is presented in Table 6-4 provides important insights into the covariates of mortality among infants and children. Examining the results for 2000, it is worth noting that the most relevant findings are in the anticipated direction. Where people live (rural/urban) makes a difference, as does their migration (years of residence) and marital status. Similarly, the higher socio-demographic status, as measured by mother’s income and educational achievement, the lower the probability of a death of a child. The coefficients presented in the bottom two panels further show that the internal characteristics of the household also matter, as does the income earned by other individuals who form part of the household unit. Given the main focus of this dissertation, a particularly relevant conclusion concerns the mortality effect of racial/ethnic identity. The mortality disadvantage among Afro-Brazilians is persistent and may have increased in 2000, after introduced all of the control variables. In the case of Asians, the mortality advantage experienced in 1960 and 1980 was no longer the case in 2000, when the coefficient for the Asian-Brazilian dummy variable was not statistically significant. Whereas the infant and child mortality rate was lower among Asians compared to the other groups, in 2000 Asian identity itself did not explain variance beyond the variance explained by the other variables in the equation.
Table 6-1. Negative binomial regression model (1): Predicting the number of child death count controlling for age and race, São Paulo, Brazil in 1960, 1980, 2000

<table>
<thead>
<tr>
<th>Variable</th>
<th>1960</th>
<th>1980</th>
<th>2000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>b coef.</td>
<td>(z-stat.)</td>
<td>IRR</td>
</tr>
<tr>
<td>Intercept</td>
<td>-2.7749</td>
<td>(43.89)</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>.0223</td>
<td>(10.21)</td>
<td>1.0225</td>
</tr>
<tr>
<td>COLOR: White [Reference]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Afro-Brazilian</td>
<td>.4083</td>
<td>(19.98)</td>
<td>1.5042</td>
</tr>
<tr>
<td>Asian</td>
<td>-.6730</td>
<td>(7.90)</td>
<td>.5102</td>
</tr>
<tr>
<td>Log Likelihood</td>
<td>-33063.43</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Likelihood Ratio $\chi^2 (df=3)$</td>
<td>556.19</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Censo Demográfico 1960, Minnesota Population Center.

Note: z-statistic is the absolute value of the estimate of each variable divided by its standard error. The critical value for z-statistic at the .01 level is 2.575, at the .05 level is 1.960, and at the .10 level is 1.645. All coefficients are statistically significant.
Table 6-2. Negative binomial regression model (2): Predicting the number of child death count controlling for individual characteristics, São Paulo, Brazil in 1960, 1980, 2000

<table>
<thead>
<tr>
<th>Variable</th>
<th>1960</th>
<th>1980</th>
<th>2000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>b coef. (z-stat.)</td>
<td>IRR</td>
<td>b coef. (z-stat.)</td>
</tr>
<tr>
<td>Intercept</td>
<td>-2.3505 (35.86)</td>
<td></td>
<td>-1.9641 (61.62)</td>
</tr>
<tr>
<td>Age</td>
<td>.0273 (11.74)</td>
<td>1.0277</td>
<td></td>
</tr>
<tr>
<td>COLOR: White [reference]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Afro-Brazilian</td>
<td>.1871 (8.97)</td>
<td>1.2058</td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>-.7045 (8.25)</td>
<td>.4944</td>
<td></td>
</tr>
<tr>
<td>DEMOGRAPHIC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Place of Residence [urban]</td>
<td>.0628 (2.95)</td>
<td>1.0648</td>
<td></td>
</tr>
<tr>
<td>Nativity [born in the municipality]</td>
<td>.0608 (1.50)</td>
<td>1.0627</td>
<td></td>
</tr>
<tr>
<td>Years of Residency</td>
<td>-.0073 (4.18)</td>
<td>.9927</td>
<td></td>
</tr>
<tr>
<td>Marital Status [married]</td>
<td>-.1999 (10.49)</td>
<td>.8188</td>
<td></td>
</tr>
<tr>
<td>SOCIOECONOMIC STATUS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Years of Schooling [log]</td>
<td>-.3108 (23.96)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income: mother’s only [R$100]</td>
<td>-.0018 (2.88)</td>
<td>.9982</td>
<td></td>
</tr>
<tr>
<td>Job Situation</td>
<td>.1105 (2.60)</td>
<td>1.1169</td>
<td></td>
</tr>
<tr>
<td>Water Supply</td>
<td>-.1546 (6.18)</td>
<td>.8568</td>
<td></td>
</tr>
<tr>
<td>Sewage System</td>
<td>-.1763 (5.63)</td>
<td>.8384</td>
<td></td>
</tr>
<tr>
<td>Electricity</td>
<td>-.0032 (0.15)</td>
<td>.9968</td>
<td></td>
</tr>
</tbody>
</table>

Log Likelihood: -32258.68, -225513.88, -44797.08
Likelihood Ratio $\chi^2$ (df =13): 2165.69, 8915.30, 1192.89
Sample Population: 46,660, 480,035, 270,851


Note: Critical value for z-statistic at the .01 level is 2.575, at the .05 level is 1.960, and at the .10 level is 1.645. Statistically significant coefficients are bold fonts.
Table 6-3. Negative binomial regression model (3): Predicting the number of child death count controlling for individual and family/household (structure) indices, São Paulo, Brazil in 1960, 1980, 2000

<table>
<thead>
<tr>
<th>Variable</th>
<th>1960</th>
<th>1980</th>
<th>2000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>b coef. (z-stat.)</td>
<td>IRR</td>
<td>b coef. (z-stat.)</td>
</tr>
<tr>
<td>Intercept</td>
<td>-2.1861 (32.03)</td>
<td>.17375 (52.38)</td>
<td>-3.1842 (26.11)</td>
</tr>
<tr>
<td>Age</td>
<td>.0471 (18.76)</td>
<td>1.0482</td>
<td>.0143 (12.80)</td>
</tr>
<tr>
<td>COLOR: White [reference]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Afro-Brazilian</td>
<td>.2056 (10.36)</td>
<td>1.2283</td>
<td>.1718 (20.58)</td>
</tr>
<tr>
<td>Asian</td>
<td>-.6684 (7.99)</td>
<td>.5125</td>
<td>-.1920 (4.09)</td>
</tr>
<tr>
<td>DEMOGRAPHIC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Place of Residence [urban]</td>
<td>.0229 (1.12)</td>
<td>1.0232</td>
<td>.2158 (17.70)</td>
</tr>
<tr>
<td>Nativity [born in the municipality]</td>
<td>.0174 (0.45)</td>
<td>1.0175</td>
<td>.0133 (0.99)</td>
</tr>
<tr>
<td>Years of Residency</td>
<td>-.0061 (3.63)</td>
<td>.9940</td>
<td>-.0044 (7.19)</td>
</tr>
<tr>
<td>Marital Status [married]</td>
<td>-.1944 (10.69)</td>
<td>.8233</td>
<td>-.2431 (30.99)</td>
</tr>
<tr>
<td>SOCIOECONOMIC STATUS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Years of Schooling [log]</td>
<td>-.3326 (26.55)</td>
<td>.2730 (51.92)</td>
<td>-.3830 (22.83)</td>
</tr>
<tr>
<td>Income: mother’s only [R$100]</td>
<td>-.0024 (3.77)</td>
<td>.9976</td>
<td>-.0200 (10.13)</td>
</tr>
<tr>
<td>Job Situation</td>
<td>.0140 (0.34)</td>
<td>1.0141</td>
<td>.1189 (10.92)</td>
</tr>
<tr>
<td>Water Supply</td>
<td>-.2024 (8.38)</td>
<td>.8168</td>
<td>-.2242 (23.03)</td>
</tr>
<tr>
<td>Sewage System</td>
<td>-.2082 (6.85)</td>
<td>.8120</td>
<td>-.2002 (22.05)</td>
</tr>
<tr>
<td>Electricity</td>
<td>-.0386 (1.85)</td>
<td>.9621</td>
<td>-.0962 (7.09)</td>
</tr>
<tr>
<td>FAMILY/HH STRUCTURE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any Male Parent</td>
<td>-.0733 (1.34)</td>
<td>.9293</td>
<td>-.0332 (1.03)</td>
</tr>
<tr>
<td>Any Female Parent</td>
<td>.0040 (0.11)</td>
<td>1.0040</td>
<td>-.0860 (4.35)</td>
</tr>
<tr>
<td># Other Adult Males in HH</td>
<td>.0653 (2.15)</td>
<td>1.0675</td>
<td>.0472 (2.52)</td>
</tr>
<tr>
<td># Other Adult Females in HH</td>
<td>-.0105 (0.25)</td>
<td>.9895</td>
<td>.0233 (1.01)</td>
</tr>
<tr>
<td># Children under 10 in Family</td>
<td>-.2271 (38.98)</td>
<td>.7969</td>
<td>-.2588 (80.13)</td>
</tr>
<tr>
<td># Other Children under 10 in HH</td>
<td>.0052 (0.15)</td>
<td>1.0053</td>
<td>.0883 (2.77)</td>
</tr>
<tr>
<td># Youth 10 - 19 in Family</td>
<td>-.0895 (10.03)</td>
<td>.9144</td>
<td>-.1050 (24.58)</td>
</tr>
<tr>
<td># Other Youth 10 - 19 in HH</td>
<td>.0296 (1.00)</td>
<td>1.0301</td>
<td>.0956 (5.13)</td>
</tr>
</tbody>
</table>

Log Likelihood: -31473.28 -222104.88 -44436.43
Likelihood Ratio $\chi^2 (df=21)$: 3736.48 15733.29 1914.18
Sample Population: 46,660 480,035 270,851

Note: Critical value for z-statistic at the .01 level is 2.575, at the .05 level is 1.960, and at the .10 level is 1.645. Statistically significant coefficients are bold fonts.
Table 6-4. Negative binomial regression model (4): Predicting the number of child death count controlling for individual and family/household (structure and income) indices, São Paulo, Brazil in 1960, 1980, 2000

<table>
<thead>
<tr>
<th>Variable</th>
<th>1960</th>
<th>1980</th>
<th>2000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>b coef.</td>
<td>IRR</td>
<td>b coef.</td>
</tr>
<tr>
<td>Intercept</td>
<td>-2.1928 (32.16)</td>
<td>1.0503</td>
<td>-1.8019 (54.12)</td>
</tr>
<tr>
<td>Age</td>
<td>.0491 (19.56)</td>
<td>1.0503</td>
<td>.0169 (15.13)</td>
</tr>
<tr>
<td>COLOR: White [reference]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Afro-Brazilian</td>
<td>.1988 (10.05)</td>
<td>1.2200</td>
<td>.1590 (19.08)</td>
</tr>
<tr>
<td>Asian</td>
<td>-.6246 (7.46)</td>
<td>.5355</td>
<td>-.1141 (2.42)</td>
</tr>
<tr>
<td>DEMOGRAPHIC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Place of Residence [urban]</td>
<td>.0382 (1.87)</td>
<td>1.0389</td>
<td>.0138 (1.03)</td>
</tr>
<tr>
<td>Nativity [born in the municipality]</td>
<td>.0096 (0.25)</td>
<td>1.0097</td>
<td>.0138 (1.03)</td>
</tr>
<tr>
<td>Years of Residency</td>
<td>-.0061 (3.68)</td>
<td>.9922</td>
<td>-.0044 (7.28)</td>
</tr>
<tr>
<td>Marital Status [married]</td>
<td>-.1883 (10.38)</td>
<td>.8283</td>
<td>-.2240 (28.44)</td>
</tr>
<tr>
<td>SOCIOECONOMIC STATUS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Years of Schooling [log]</td>
<td>-.2965 (23.08)</td>
<td>-.2459 (45.41)</td>
<td>-.3617 (21.24)</td>
</tr>
<tr>
<td>Income: mother’s only [R$100]</td>
<td>-.0022 (3.44)</td>
<td>.9978</td>
<td>-.0157 (7.90)</td>
</tr>
<tr>
<td>Job Situation</td>
<td>-.0262 (0.64)</td>
<td>.9741</td>
<td>.0849 (7.75)</td>
</tr>
<tr>
<td>Water Supply</td>
<td>-.1718 (7.10)</td>
<td>.8422</td>
<td>-.2056 (21.11)</td>
</tr>
<tr>
<td>Sewage System</td>
<td>-.1726 (5.66)</td>
<td>.8415</td>
<td>-.1800 (19.78)</td>
</tr>
<tr>
<td>Electricity</td>
<td>-.0241 (1.15)</td>
<td>.9762</td>
<td>-.0887 (6.56)</td>
</tr>
<tr>
<td>FAMILY/HH STRUCTURE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any Male Parent</td>
<td>-.0252 (0.42)</td>
<td>.9751</td>
<td>-.0378 (1.12)</td>
</tr>
<tr>
<td>Any Female Parent</td>
<td>.0115 (0.32)</td>
<td>1.0116</td>
<td>-.0879 (4.32)</td>
</tr>
<tr>
<td># Other Adult Males in HH</td>
<td>.0868 (2.09)</td>
<td>1.0907</td>
<td>.0829 (3.31)</td>
</tr>
<tr>
<td># Other Adult Females in HH</td>
<td>.0026 (0.66)</td>
<td>1.0026</td>
<td>.0424 (1.72)</td>
</tr>
<tr>
<td># Children under 10 in Family</td>
<td>-.2278 (39.14)</td>
<td>.7963</td>
<td>-.2579 (79.93)</td>
</tr>
<tr>
<td># Other Children under 10 in HH</td>
<td>-.0019 (0.05)</td>
<td>.9981</td>
<td>.0834 (2.62)</td>
</tr>
<tr>
<td># Youth 10 - 19 in Family</td>
<td>-.0962 (10.27)</td>
<td>.9083</td>
<td>-.1090 (23.74)</td>
</tr>
<tr>
<td># Other Youth 10 - 19 in HH</td>
<td>.0331 (1.12)</td>
<td>1.0336</td>
<td>.0946 (5.09)</td>
</tr>
<tr>
<td>FAMILY/HH MEMBERS' INCOME</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Husband’s/Partner’s Inc. [R$100]</td>
<td>-.0535 (10.66)</td>
<td>.9479</td>
<td>-.0107 (21.13)</td>
</tr>
<tr>
<td>Parents’ Income [R$100]</td>
<td>-.0668 (1.80)</td>
<td>.9354</td>
<td>.0019 (0.48)</td>
</tr>
<tr>
<td>Family Members’ Income [R$100]</td>
<td>.0516 (1.42)</td>
<td>1.0530</td>
<td>-.0018 (0.42)</td>
</tr>
<tr>
<td>Other HH Members’ Inc. [R$100]</td>
<td>-.0206 (0.86)</td>
<td>.9796</td>
<td>-.0092 (2.43)</td>
</tr>
</tbody>
</table>

Log Likelihood                          | -31400.38     | -221830.07   | -44402.18     |
Likelihood Ratio $\chi^2 (df=25)$        | 3882.28       | 16282.92     | 1982.69       |
Sample Population                        | 46,660        | 480,035      | 270,851       |


Note: Critical value for z-statistic at the .01 level is 2.575, at the .05 level is 1.960, and at the .10 level is 1.645. Statistically significant coefficients are bold fonts.
CHAPTER 7
NEIGHBORHOOD SETTINGS AND CHILD MORTALITY

The analyses in previous chapters have shown that the probability of death in the early years of life is influenced by such factors as the mother’s characteristics, the composition of the household, and the mother’s racial identity. Having examined the effects of family/household and the temporal effects by comparing estimates from three census years, we now focus on the higher level variability using only data from the census 2000. Going beyond the individual-level associations, the goal of this chapter is to incorporate into the analysis variables that measure attributes of the geographic context within which the individual-level relationships occur. The purpose of turning to a multileveled approach is twofold: One objective is to test the hypothesis that factors at the aggregate level affect child mortality in a manner that is independent of the individual-level determinants. A second objective is to determine the degree to which controlling for contextual variables modifies the relationships reported at the individual level.

In this study the multilevel data has three levels; individual, district, and municipality. Individual-level contains eleven demographic and socioeconomic predictors. In addition to the variables used in the demographic and socioeconomic model in the previous chapter (Model 2, Table 6-2), I include a measure of public utilities and one other variable. Three utilities were combined into a single indicator: water (if piped to network), sewage (if connected to the system), and electricity (if supplied). The additional variable included is household income but excluding the mother’s income.

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5 This decision is made mainly because these variables are not only correlated with each other but often highly geographically correlated in the context of urbanization and constraint within locations. Also, the higher-levels include the prevalence of public utilities and services. Consequently, my preliminary analyses indicated that there is no significant relationship with child death counts when these variables are independently employed in the multilevel models.

6 One of this study’s main foci in the previous chapter was to examine the influence of family/household structure and income of the family/household members. Therefore, mother’s income was only included in the cluster of
District-level, level-2, includes three clusters of variables. Two variables represent the prevalence of public services, three variables serve as indicators of neighborhood stability, and three variables measure population heterogeneity. These variables are aggregated from Censo Demográfico 2000 using all valid households (1,119,972) and individuals (4,018,428)\(^7\) in the sample data. At the municipal-level, level-three, I include indicators of the available educational and healthcare facilities.

**Variance Components Model of Child Count Deaths**

In the three-level multilevel regression analysis, level-1 contains 270,851 mothers nested within 833 districts at level-2, and districts are nested within 645 municipalities at level-3. The first model, shown in the first column in Table 7-1, is referred to as an “empty model” because it does not include explanatory variables. For this model, the variance is partitioned into components that correspond to each level in the hierarchy. As such, the model is sometimes called a variance components model in which mothers are nested within districts which, in turn, are nested within municipalities and the intercept in the only random part of the model. This result provides a baseline to compare with subsequent models.

The within-district variance of number of child death counts from the empty three-level model in Table 7-1 is .0787 and the within-municipality variance is .0295. Using these two estimates, we can calculate intraclass correlation coefficients. The latter is defined as: \( \rho = \frac{\text{group level variance}}{\text{total variance}} \) and is interpreted as the proportion of the variance explained by the grouping structure in the population. For the empty model, the intraclass correlation

---

*mother’s characteristics. However, for multilevel modeling, the family/household indices were excluded in order to focus on examining neighborhood effects on the relationship between the number of child deaths and race. In addition, as a result of the strong effect that income has on the child mortality, and to specify individual mother’s situation in the neighborhood coherently, I decided to include the sum of other household member’s income along with mother’s income.

\(^7\) Weight was used in the process of aggregating data.
The coefficient is \( \hat{\rho} = 0.0295 / (0.0295 + 0.0787) = 0.273 \). This value is considered as a rather high intraclass correlation, which typically varies between 0.05-0.20. District variation is therefore larger than municipal variation, indicating that districts differ more from each other than do municipalities (Snijders and Bosker 1999).

The high intraclass correlation is caused by the structure of the data at hand. Among 645 municipalities in the State of São Paulo, 573 have only one census district, and 72 municipalities have more than 2 districts. The municipal of São Paulo, on the other hand, is composed of 96 census districts. The structure of the data reflects the availability of data, which were taken from sources which did not always provide district level information.\(^8\)

Considering the geographical size of the state and the number of people in the municipal of São Paulo and in other large municipalities that contain multiple districts, as well as the fact that data on educational and medical/health care facilities were available only at the municipal-level, I decided to keep three levels in the multilevel modeling. The variances at the level-2 and level-3 in the empty model along with the DIC diagnostics can be used to indicate how much reduction in variance takes place in each or one level, when explanatory variables are introduced to models.

**Individual Mother’s Characteristics in Multilevel Model**

The second model in Table 7.1 introduces mothers’ demographic and socioeconomic characteristics. With the exception of the nativity variable (which became statistically significant in this model), the results here do not differ much from the results presented in the previous chapter.

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\(^8\) I experimented by constructing 2-level models with aggregated data at the municipal-level which provided almost same coefficients as the 3-level models which fit better than 2-level models according DIC statistics of model adequacy test. It is probably caused by the enormous population of the municipal of São Paulo, which is divided into 96 districts. Mothers from the municipal of São Paulo account for 23.9% of the data. Defining ‘neighborhood’ has been most challenging and inevitable for us to confront in studying the influence of neighborhood on individuals.
The total variance is 0.0788, which is the sum of the two variance components and indicates that 7.9% of the error at the individual level explained by district and municipal levels. The variance component at the district level is .0675. Of the total variance, 14.3% (0.0113/0.0788) is situated at the municipal-level, which indicates that mothers in the same municipalities tend to be similar to one another. The intraclass correlation between districts and municipalities was 85.7% (0.0675/0.0788), indicating that the likeliness of mothers in the same districts and the same municipalities was 85.7%. Alternatively, we can check the likeliness of districts in the same municipalities, which is 0.0133/(0.0133+0.0675)=0.1646. The district-level contributes a greater portion of variability than the municipal-level. Put another way, if you randomly select two districts within one municipal and compute the average child mortality level in one of the two districts, the average is likely to differ from another randomly selected district. However, as noted earlier, 573 out of 645 municipalities (88.8%) have only one district. Hence, the interpretation is only partially plausible. However, these 573 municipalities comprise less than a half (48.57%) of the sample population of this study. From the intraclass correlation coefficient above, 0.1646, we can reasonably conclude that the variability within the municipalities, which are composed of multiple districts and large population, largely influence the outcome.

The Deviance Information Criterion (DIC) described in Chapter 4 is a measure of model fitness. I will compare the DIC estimates from two demographic and socioeconomic models, one is with a random intercept and the other is with a fixed intercept (not shown). Two DICs were produced from the models, 96763.78 from the fixed intercept model, and 96326.30 from the random intercept model. There is only one added parameter (the random intercept) which reduced by approximately 437.5. Because the difference in DIC estimates from the two models is
considerably large (which implies a substantial improvement on the model with random intercept), I concluded that the multilevel modeling was necessary.9

**Neighborhood Influence on Child Mortality**

Does the neighborhood environment influence child well-being? Do neighborhood contextual variables modify the relationship between mother’s race and the probability of child mortality? The multilevel analyses presented in Models 7 in Table 7-2 are designed to answer these two important questions.

Model 7 includes mother’s individual compositional variables and sixteen variables representing neighborhood attributes at the district and municipal-levels. The most important conclusion we can come to is the remarkable stability of the individual-level effects, as the findings in Table 7-2 do not differ substantially from the findings presented in the previous chapter (Table 6-2). Even with the inclusion of higher level variables, the Asian coefficient continues to be statistically non-significant, the Afro-Brazilian coefficient continues to be statistically significant (and negative), and the size and direction of the other individual variables do not differ much from what was reported earlier. A relatively tangible change is in ‘utility availability’ coefficient. Every unit change in this indicator is associated with a 24.8% decrease in the probability of the number of children lost.

The following three clusters of variables are contingent on census district boundaries. The first cluster refers to the prevalence of public services, which comprises two indicators: the residential utility index and the sanitary and safety management index. The utility index at the

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9 The smaller DIC suggests better model fit. WinBug (Bayesian inference Using Gibbs Sampling project) website run by Spiegelhalter et al., who proposed DIC in 2002 (Spiegelhalter et al. 2002), provides brief explanation, “It is difficult to say what would constitute an important difference in DIC. Very roughly, differences of more than 10 might definitely rule out the model with the higher DIC, difference between 5 and 10 are substantial, but if the difference in DIC is, say, less than 5, and the models make very different inferences, then it could be misleading just to report the model with the lowest DIC” (http://www.mrc-bsu.cam.ac.uk/bugs/winbugs/dicpage.shtml#q6).
district level is not statistically significant. This may be due to the correlation between this index and the next one in the equation, the sanitary and safety index. The coefficient for the latter is statistically significant and the effect is large. This index represents the prevalence of garbage collection, the degree to which streets are paved, and the degree of which street lights exists. The findings show that a unit increase in this variable is associated with a 17.2% reduction child mortality.

The indicators of neighborhood stability appear to behave as expected. The unemployment rate and number of female-headed households, which are variables that often appear in crime and psychological studies, seem to be associated with higher child loss. The district level education variable is negatively associated with child mortality. While these three variables are not statistically significant, it is worth noting that the education variable and the proportion of female headed households are close to the .05 criterion for statistical significance. Recent infant/child mortality and health studies indicate that the percentage of female-headed households reflects the health status of the population. The coefficient suggests that for every one percent change in female-headed household, there a 2.43% increase in child mortality.

The next three indices describe neighborhood heterogeneity in three ways: the diversity of emigrant origins, the homogeneity of racial composition, and income inequality. All three variables are statistically significant. The coefficient for the racial diversity index is positive. The measure of racial diversity is based on H-index. The higher the value of H, the more equal the representation of all groups. The estimate indicates that every one unit change in the racial diversity index decreases the number of child count deaths at 0.17% which can be interpreted

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10 243% divided by 100% since the variable unit is percentage.
that the areas where all racial groups more equally represent may reduce the risk of child mortality.

The other two heterogeneity indices are negatively associated with child survival. Migrants’ origin diversity index is also based on H-index; therefore, higher values describe evenly distributed population based on their origin. The likelihood of having a higher number of children lost increases by 62.0% for every one unit change in the diversity in migrant origin.

The Gini index describes the socioeconomic heterogeneity of people within districts. When there is complete income equality, the Gini measure is 0. Higher numbers indicate greater inequality in income. Therefore, every one unit change in income inequality increases the likelihood of child loss by 1% (0.98%). Net of individual-level characteristics and the other aggregate indicators in the equation, the higher the degree of income inequality, the higher the child mortality.

The last cluster to be included in the multilevel model includes educational facilities and healthcare institutions. There are a few important concerns about these establishments. The medical facilities tend to be located close to each other, such as medical complexes and general public hospitals. In addition, these facilities tend not to be located in residential areas and are often concentrated in particular municipalities. Another problem is that we do not know where women had their children, which is especially problematic with respect to the migrant population. These considerations may account for the fact that only two out of eight variables are statistically significant.

The beneficial effects on child survival can be seen in the number of obstetrician and the number of ambulances, because both variables are statistically significant. Their coefficients suggest that a one unit change in the number of obstetrician per 1000 women aged 15-49 in the
municipality decreases the likelihood of child death by 0.9%, and every one unit change in the number of ambulance per 10,000 persons in the municipality is associated with a 2.1% decline in mortality among infants and children.

The DIC statistic for this model is 96320.34, which is nearly identical to the DIC value in Model 7 (96326.30) in Table 7-1. Hence, the reduction associated with the additional sixteen variables is quite small, -5.96. While there is no established threshold value for assessing the significance of the DIC indicator, the findings suggests that Model 8 is only marginally better than the model that only contains the individual-level demographic and socioeconomic variables.
Table 7-1. Empty model and mother’s individual characteristics: random effect multilevel Poisson regression models (5) and (6) predicting number of child deaths, São Paulo, Brazil in 2000 [MCMC method]

<table>
<thead>
<tr>
<th>Variable</th>
<th>Empty Model</th>
<th>Mother’s Individual Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>b coef.</td>
<td>(z-stat.)</td>
</tr>
<tr>
<td><strong>Level-One Individual Characteristics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>-3.709</td>
<td>(49.44)</td>
</tr>
<tr>
<td>Age</td>
<td>.0321</td>
<td>(12.89)</td>
</tr>
<tr>
<td>Race: White [Reference]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Afro-Brazilian</td>
<td>.1564</td>
<td>(8.50)</td>
</tr>
<tr>
<td>Asian</td>
<td>-.2626</td>
<td>(1.37)</td>
</tr>
<tr>
<td><strong>Demographic</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Place of Residence [urban]</td>
<td>.1246</td>
<td>(3.53)</td>
</tr>
<tr>
<td>Nativity [born in the municipality]</td>
<td>.0807</td>
<td>(2.53)</td>
</tr>
<tr>
<td>Years of Residency</td>
<td>-.0104</td>
<td>(7.63)</td>
</tr>
<tr>
<td>Marital Status [married]</td>
<td>-.2144</td>
<td>(10.77)</td>
</tr>
<tr>
<td><strong>Socioeconomic Status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Years of Schooling [log]</td>
<td>-.3237</td>
<td>(23.56)</td>
</tr>
<tr>
<td>Mother’s Income Only [R$100]</td>
<td>-.0095</td>
<td>(3.05)</td>
</tr>
<tr>
<td>Household Income: excl. mother's [R$100]</td>
<td>-.0074</td>
<td>(6.15)</td>
</tr>
<tr>
<td>Job Situation</td>
<td>.0568</td>
<td>(2.63)</td>
</tr>
<tr>
<td>Utility Availability</td>
<td>-.3091</td>
<td>(7.18)</td>
</tr>
<tr>
<td><strong>Random Effects</strong></td>
<td>var. comp.</td>
<td>(z-stat.)</td>
</tr>
<tr>
<td>Level-three variance</td>
<td>.0295</td>
<td>(1.92)</td>
</tr>
<tr>
<td>Level-two variance</td>
<td>.0787</td>
<td>(5.44)</td>
</tr>
</tbody>
</table>

| Iterations                              | 10,000      | 100,000     |
| Effective number of parameters          | 372.83      | 339.81      |
| Deviance Information Criterion          | 97949.56    | 96326.30    |

Sample size: 270,851 cases.
Sources: Censo Demográfico 2000 (IBGE).
Pesquisa Municipal Unificada (SEADE).
Estatística da Saúde Assistência Médico-Sanitária 2001 (IBGE).

Note: z-statistic is the absolute value of the estimate of each variable divided by its standard error. The critical value for z-statistic at the .01 level is 2.575, at the .05 level is 1.960, and at the .10 level is 1.645.
Table 7-2. Combined effect of district and municipal-level indices in multilevel Poisson regression model (7) predicting number of child deaths, São Paulo, Brazil in 2000 [MCMC method]

<table>
<thead>
<tr>
<th>Variable</th>
<th>Fixed Effects</th>
<th>Mother’s Characteristics + District and Municipal Level Indices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level-one Individual Characteristics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>-4.166</td>
<td>(14.81)</td>
</tr>
<tr>
<td>Age</td>
<td>.0319</td>
<td>(13.35)</td>
</tr>
<tr>
<td>Race: White [Reference]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Afro-Brazilian</td>
<td>.1558</td>
<td>(8.48)</td>
</tr>
<tr>
<td>Asian</td>
<td>-.2641</td>
<td>(1.38)</td>
</tr>
<tr>
<td>Demographic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Place of Residence [urban]</td>
<td>.1155</td>
<td>(3.17)</td>
</tr>
<tr>
<td>Nativity [born in the municipality]</td>
<td>.0768</td>
<td>(2.40)</td>
</tr>
<tr>
<td>Years of Residency</td>
<td>-.0102</td>
<td>(7.46)</td>
</tr>
<tr>
<td>Marital Status [married]</td>
<td>-.2100</td>
<td>(10.51)</td>
</tr>
<tr>
<td>Socioeconomic Status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Years of Schooling [log]</td>
<td>-.3233</td>
<td>(23.41)</td>
</tr>
<tr>
<td>Mother’s Income Only [R$100]</td>
<td>-.0098</td>
<td>(3.10)</td>
</tr>
<tr>
<td>Household Income: excl. mother’s [R$100]</td>
<td>-.0073</td>
<td>(5.99)</td>
</tr>
<tr>
<td>Job Situation</td>
<td>.0592</td>
<td>(2.75)</td>
</tr>
<tr>
<td>Utility Availability</td>
<td>-.2846</td>
<td>(6.46)</td>
</tr>
<tr>
<td>Level-Two District Attributes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prevalence of Public Services</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residential Utility Index</td>
<td>.0947</td>
<td>(1.13)</td>
</tr>
<tr>
<td>Area Sanitary/Safety Mtn. Index</td>
<td>-.1886</td>
<td>(1.87)</td>
</tr>
<tr>
<td>Neighborhood Stability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unemployment Rate</td>
<td>.2777</td>
<td>(.57)</td>
</tr>
<tr>
<td>Educational Level</td>
<td>-.0390</td>
<td>(1.59)</td>
</tr>
<tr>
<td>Female Household Head</td>
<td>.8878</td>
<td>(1.52)</td>
</tr>
<tr>
<td>Community Population Heterogeneity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Migrant Origin Diversity Index</td>
<td>.4825</td>
<td>(1.65)</td>
</tr>
<tr>
<td>Racial Diversity Index</td>
<td>-.1837</td>
<td>(1.90)</td>
</tr>
<tr>
<td>Income Inequality Index</td>
<td>.0098</td>
<td>(3.15)</td>
</tr>
</tbody>
</table>
Table 7-2. Continued.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mother’s Characteristics</th>
<th>Fixed Effects</th>
<th>Random Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>b coef. (z-stat.)</td>
<td>var. comp. (z-stat.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IRR</td>
<td>Level-three variance</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>.0077 (1.01)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Iterations</td>
</tr>
<tr>
<td>Level-Three Municipal Attributes</td>
<td></td>
<td>,.0040 (.73)</td>
<td>.999</td>
</tr>
<tr>
<td>Educational Facilities</td>
<td>Preparatory Schools</td>
<td>.0040 (.73)</td>
<td>1.004</td>
</tr>
<tr>
<td></td>
<td>Primary Schools</td>
<td>-.0014 (.13)</td>
<td>.999</td>
</tr>
<tr>
<td>Health Institutions</td>
<td>Public Hospitals</td>
<td>-.00669 (.39)</td>
<td>.993</td>
</tr>
<tr>
<td></td>
<td>Private Hospitals/Clinics</td>
<td>-.0063 (.27)</td>
<td>.994</td>
</tr>
<tr>
<td></td>
<td>Obstetricians</td>
<td>-.0093 (1.74)</td>
<td>.991</td>
</tr>
<tr>
<td></td>
<td>Pediatricians</td>
<td>-.00374 (.93)</td>
<td>.996</td>
</tr>
<tr>
<td></td>
<td>SUS</td>
<td>-.0205 (.51)</td>
<td>.980</td>
</tr>
<tr>
<td></td>
<td>Ambulance</td>
<td>-.0215 (1.66)</td>
<td>.979</td>
</tr>
<tr>
<td>Random Effects</td>
<td>Level-three variance</td>
<td>.0077 (1.01)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Level-two variance</td>
<td>.0663 (6.23)</td>
<td></td>
</tr>
<tr>
<td>Sample size: 270,851 cases.</td>
<td>Iterations</td>
<td>200,000</td>
<td></td>
</tr>
<tr>
<td>Sources:</td>
<td>Effective number of parameters</td>
<td>337.71</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Deviance Information Criterion</td>
<td>96320.34</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Note: z-statistic is the absolute value of the estimate of each variable divided by its standard error. The critical value for z-statistic at the .01 level is 2.575, at the .05 level is 1.960, and at the .10 level is 1.645.</td>
<td></td>
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</tbody>
</table>
CHAPTER 8
CONCLUSION AND REMARKS

More than one hundred years have passed since Japanese immigrants first stepped foot in Brazil. From the Social Darwinist perspective of the day, the Japanese were considered inferior beings and hardly fit the image of the kind of immigrant that many Brazilians sought to attract to their country. With these inauspicious beginnings, their economic advancement in Brazil and their social and cultural contributions to the country is truly remarkable. In the span of five generations in Brazil, their identity has changed from Japanese, *Nikkei*, to *nipo-brasireilo*, a transformation that was accompanied by changes in their way of life. Having come from a monocultural country, they suddenly found themselves in one of the most racially stratified societies in the world. How this minority survived and prospered in their adopted country is a story that can be told from different points of view. One way to proceed is to focus on child mortality which can be considered a robust indicator of the health status of the Japanese population.

The general aim of my dissertation was to disentangle how racial identity and other demographic and socioeconomic factors influence child mortality in a Brazilian society. The analysis focuses not only on the Japanese population, but also on the white and Afro-Brazilian groups. In that sense, the conceptual discussion and the quantitative findings presented here depart from the vast majority of the literature in the field. Whereas nearly all studies narrow the racial concern to the African descent population, here I have carried out a comparative analysis of all three groups. A second innovative feature of this dissertation is the analysis of the covariates of child mortality at three points in time, based on samples of the demographic censuses in 1960, 1980, and 2000. A third contribution derives from the inclusion of variables at different levels of social organization. The multivariate analysis of child mortality in 2000 explored the individual and the neighborhood factors that influence health outcomes, and used
the concept of social capital as framework for interpreting the aggregate-level associations. Taken together, these attributes of the study offer new insights into the racial stratification and into the determinants of infant and child mortality in Brazil.

The study used two statistical approaches: negative binomial approximation for single-level modeling and for the other count model, Poisson approximation for multilevel modeling. The single-level negative binomial was employed to model child mortality using census data that spanned 40 years, from 1960 to 2000. The objective was to demonstrate the temporal effects of child mortality as a framework for understanding the relationship between inequality and racial identity in Brazil.

In keeping with the results of other studies, the findings presented here confirmed the importance of variables long thought to influence child survival. The mother’s level of income and place of residence played a role, as did mothers’ marital situation, the educational attainment, and various indicators of housing quality, such as the presence of running water and access to sewage services. These variables were shown to be significant in 1960, 1980 and 2000, although the size of the corresponding coefficients changed over the years. Elements of the family structure were similarly important, including the number of children under 10 years of age, the number of young people 10 to 19 years of age, and the income contributions to the household budget provided by the husband, parents, and other members of the domestic unit.

In terms of the objectives of this study, the most important finding concerns the coefficients associated with each racial classification. The results leave little doubt that, compared to the mortality experience of children born to white mothers, children born to Afro-Brazilians experienced significantly higher mortality rates. Of particular interest is the observation that the mortality disadvantage among Afro-Brazilian children was present after
controlling for all characteristics of mothers; demographic, socioeconomic status, family structure, and the financial contribution of other family members. Equally important is the observation that the magnitude of the gap between white and Afro-Brazilian in child mortality remained more or less unchanged when I compared the results for 1960, 1980 and 2000. Although the racial gap has narrowed, while child mortality level has markedly declined for all race groups, Afro-Brazilian’s disadvantaged status remained statistically significant over this forty-year span, even after entering the various control variables, which can be interpreted as the presence of racial discrimination in São Paulo, Brazil.

The Afro-Brazilian experience contrasts with that of the Asian-Brazilian population. In 1960 and in 1980, children born to Asian women had lower mortality compared to the reference group, children born to white women. However, by 2000 the Asian advantage disappeared, as the coefficient for the Asian dummy variable was no longer statistically significant. This finding indicates that the Asian-Brazilian’s low child mortality may be attributed to demographic and socioeconomic factors in 2000, while the racial factor may be independent from other covariates in 1980 and 1960. Afro-Brazilian, on the other hand, appeared to be still held back in the racial inequality situation. Although the racial gap in child mortality seemed to decrease, it persisted over 40 years.

A closer look at the findings presented offer additional insights. Results of the inclusion of family and household factors, for example, show little influence on the effect of race on child mortality. Some reduction in the effect of being Asian-Brazilian in 1960 by the inclusion of family/household factors may be explained by their advantage in the physical presence of family and household members which may be helpful in providing support by means of domestic work, childcare, and supervision of children for working mothers. On the other hand, some increase in
the effect of being Asian-Brazilian in 1980 could be considered as an additional advantage when family and household members were with Asian mothers. The gap between Afro-Brazilians and whites widened over time. The widening of the gap may mean that Afro-Brazilians hold unfavorable family and household structural characteristics, a condition that became more notable in 2000.

The models that included family and household structural characteristics showed that the mortality-reducing impact of the mother’s participation in the labor force. However, which household members contributed the advantage of Asian mothers is unclear from the coefficients of family and household composition. Although the presence of the mother’s female parents and the presence of other female household members were expected to be beneficial, the results from the data showed that the influence of their presence on child mortality was, at most, inconsistent. They had a negative effect on child survival in 1960 but by 2000, they appeared to be more beneficial, yet the association to child mortality was very weak.

The model including family and household members’ income revealed some scenarios for both Afro-Brazilian mothers and Asian mothers. Comparing the models with family and household income and the model without them, the racial inequality between white and Afro-Brazilian was reduced by family and household incomes. For Afro-Brazilians, having additional household members without income seems to have been an additional burden for their children’s well-being. In the model with family and household member’s income, among Asian mothers, child mortality difference compared to whites was reduced in relation to those observed in the model without all family and household indices. It is, however, almost identical to the model that only included demographic and socioeconomic characteristics. This finding implies that the physical presence of their family and/or household members may account for their advantage in
child mortality compared to whites. Once the incomes of family and household members are included, the beneficial human capital aspect took over the social capital aspect within household.

Asian mothers had a large advantage in child health compared to white mothers. However, the Asian’s advantage reduced to becoming an artifact of their economic advantages in both mother’s and family/household members’ incomes in 2000. Is this the universal experience among Asians in São Paulo or did location within the state of São Paulo have an influence on health outcomes? This question led to the construction of a multilevel Poisson model with the objective to see whether or not the factors at the neighborhood-level affect child health outcome and whether or not the influence of race is changed by correcting the geographical difference.

The results of the multilevel models show that some of aggregate-level variables were associated with child mortality. For example, the sanitary services indicator reduced child mortality whereas the migrant diversity index and racial diversity had the negative effect on child survival. Neighborhoods where the population is more mixed by people from various origins and various race groups have higher child mortality. A particularly relevant finding concerns the measure of income inequality within the district, as measured by the Gini index. Other things being equal, higher mortality was observed in areas where income inequality was greater. The evidence further confirmed that, accounting for neighborhood effect, the mortality advantage among Asian children was not statistically significant. Afro-Brazilians, on the other hand, continued to be disadvantaged in child survival, even after introducing numerous district- and municipal-level variables.

**Has the Japanese-Brazilian’s Advantage Declined?**

Although the income among the Asian-Brazilian population was approximately 40% lower than that among the white population in 1960, the Asian Brazilian child mortality level was lower than that of whites. There are several explanations for this finding. The first is related to
longevity among the Japanese which is related to a second possible explanation, namely their traditional nutrition in their country of origin. The third possible explanation is related to selective immigration. Initially Japanese migrants in the very early stage to Brazil were drawn from middle socioeconomic or higher strata. This positive selectivity was due to the fact that the head of household needed to be able to pay partial travel expenses for at least four family members, a factor that links to the forth possible explanation. Because the Brazilian government required that the Japanese migrate immigrate as a family unit, newcomers arrived in their destination with a ready-made support group. The presence of household members provided labor in performing agricultural jobs and enabled the family to overcome many of the hardships that they encountered. Moreover, the presence of family members provided support for child care. By sharing the hardships, Japanese migrants were able to form their own communities where they could practice their Japanese-ness and thereby survive and prosper economically. The fifth explanation for the Japanese advantage thus points to the existence of a strong community that provided its members with various forms of support.

From this starting point in 1960, the child mortality rate for all racial groups has continuously dropped and has reached to the point of almost leveling out. Although this study aimed to disentangle the interwoven relationship between racial identity and other demographic and socioeconomic factors and their effects on child mortality, the strong and persistent effects of education and economic resources on child well-being were striking. The findings from the 1960, 1980, and 2000 censuses show that socioeconomic factors became increasingly important over time. By 1980 the Japanese were no longer an underclass in Brazil as their socioeconomic status became higher than that of the white population. Yet the children born to Asian mothers in 1980 continued to have a mortality advantage after controlling for socio-economic standing,
although the magnitude of that advantage was smaller than in 1960. Furthermore, in the next twenty years, Asian’s economic status continued to improve from 2.2 times to 2.4 times more income compared to the white population. Estimates based on the 2000 census data indicate that these improvements in social standing had a mortality reducing effect, but the findings also indicated that the dummy variable for Asian status was no longer statistically significant, which in other words, the advantage within the group of Asian mothers in child survival became unexplainable by Asian identity. This is what I called “the declining Japanese advantage” which occurred by way of reducing their advantage derived from their ethnic trait to becoming merely an economically advantaged population group in Brazil.

As income rose and mortality declined among Asian children, why did Asian identity per se became a less important determinant of child survival? One explanation for this finding points to the assimilation of the Japanese population into Brazilian society. According to this line of reasoning, the Japanese may have lost their advantage in child mortality by adopting the norms, values, and behavioral characteristics of the rest of the Brazilian population. But there are a number of other possible explanations, each of which tells us something about the difficulty of coming to a firm conclusion.

First, the declining Japanese advantage may not have been caused so much by a change in the behavior of the Asian population as by the changes that may have taken place among the white population. The simple bivariate analysis shown in Table 4-5 indicated that there has been a decline in child mortality manifested for both white mothers and Asian-Brazilians between 1960 and 2000. Therefore, the smaller differential in child mortality between the children born to white mothers and the children born to Asian-Brazilian mothers may have been due to the
comparatively more rapid improvements among the white group, thus reducing the mortality gap between white and Asian children.

The second and third explanations point to changes in population composition in the Brazilian society. As discussed in Chapter 4, one issue of population composition is the increasingly diverse ethnic profile of the Asian population in Brazil. The stream of migrants from Japan ended in late 1970, and after the severe inflation at the end of 1980, a considerable number of Japanese-Brazilian migrated back to Japan. In the meantime, numerous Chinese and South Koreans entered Brazil since the 1990s. Today, the Japanese section of town established by Japanese immigrants in Liberdade, São Paulo, has more Chinese and Korean inhabitants and shops than Japanese. The relatively small number of the Asians in the population, who cannot identify their origin of country, is considered a statistical and methodological limitation. More importantly, as other Asian populations continue to grow, the characteristics of the Asian population have become more diverse. If new immigrants to Brazil are from lower socioeconomic status, hold different cultural practices and behavior related to their ethnicity, and are classified as Asian in the census, then the “yellow” group might not only lose its relative advantage in terms of child mortality but also may augment the variance among Asian population.

Another issue related to population composition is the increasing tendency for Asians to classify themselves as “white” rather than “yellow” in the census, a phenomenon that has been documented among the Afro-Brazilian population. We again cannot determine if this is evidence that the Japanese are losing their ethnic identity or only adopting Brazilian social behaviors or both. If there is a tendency for not only the Japanese but also other Asian population groups to opt for the “white” rather than “yellow” designation in the 2000 census, the effect would be to
obscure the distinction between the whites and the Asians. Moreover, if the compositional changes in Asian population due to the self-identification continue, the use of the “yellow” designation in empirical analyses may become increasingly problematic.

The fourth explanation of the narrowing gap between white mothers and Asian mothers is related to data. I used samples of three censuses but the data sets are not of the same size. The 1960 census, the smallest sample, has 5% of the population and includes only 826 Asian mothers out of a total of 46,660 mothers. The 2000 census includes 344 more Asian-Brazilian mothers than the census 1960, yet the number of child mortality events is substantially smaller due to the overall decline in child mortality. These two factors raise the possibility that the lack of statistical significance of the Asian dummy variable in 2000 could be an artifact of the small sample size and to a larger variance for Asian-Brazilian population.

Yet another factor may be associated with changes in the cause of death. As a qualitative aspect of child death, when mortality drops to low levels, the main cause of child death changes from exogenous to endogenous factors. This is relevant because exogenous factors are more sensitive to socioeconomic and behavioral variables compared to endogenous factors. This means that child survival may have become increasingly less sensitive to the health-related behaviors that once gave Asian children a survival advantage.

**Limitation of This Study and Recommendation**

While a multilevel statistical analysis approach using census data can provide an essential and fundamental understanding of racial differences in child mortality, the approach is not without limitations. In addition to the issues related to the population composition and different sample sizes, the most critical limitation that warrants mentioning here is that census data are not well suited for establishing the causes of child mortality because the data do not provide information on health related factors such as mother’s and children’s health status, mother’s age
at the time of birth, cause of death, and age of death, and health orientation/practices. This is especially relevant as mortality declines to the low levels and the causes of child death become more endogenous in nature.

Other limitations relate to the spatial processes in the data. Spatial units employed may or may not correspond to the geography of the spatial processes that operate in the real world. If that is the case, then there will be spatial auto correlation, and the estimated coefficients may be biased. This then becomes an avenue for future inquiry. Multilevel modeling is statistically appropriate for the analysis of hierarchically structured data and it explicitly takes variability at different levels into account and can partially moderate the effect of spatial autocorrelation. When employed in large places like São Paulo, often spatial dependency is structured differently from the nested stratified data. Within the multilevel approach cross-scale dynamics can be modeled by including cross-level interactions. However, a clustering pattern in the spatial distribution of some variables is due to the fact that the incidences are physically close together; meaning they are in geographical proximity and are not independent of each other, but somehow geographically linked.

Spatial autocorrelation is a major difficulty in using standard statistical techniques. When considering a random sample of a population, the sample will not be random unless the individuals are also randomly distributed over the map area. Even if people are randomly distributed, the main issue is the way in which individuals cluster together. Spatial autocorrelation follows Tobler’s ‘First Law of Geography’ that “[E]verything is related to everything else. Superficially considered this would suggest a model of infinite complexity; a corollary inference often made is that social systems are difficult because they contain many variables; numerous people confuse the number of variables with the degree of complexity”
(Tobler 1970:234). Each of these interrelated aspects of demographic change has spatiotemporal component, which, when understood, adds to our knowledge of how and why these transitions occur. However, disentangling these factors is challenging. Although the multilevel modeling specifies the multilayered society, the connectedness between the adjoining spaces and lands (districts, municipalities, communities, neighborhood and so on) cannot be addressed. People whose residence is on or near a border could receive benefits but could also be subject to harmful influences. Therefore, if my data fall into such a case that spatial autocorrelation exists, the coefficients of the multileveled models may be biased. For further clarity of this issue, spatial analysis is required. It is especially important to determine the segments of the population most likely to be exposed to the risk of child mortality and to identify the community ecological factors, which work against improving the level of child well-being.

With respect to a sociological understanding of racial/ethnic inequality, cultural information is not collected in the census. One way to explore the inequality related to racial and ethnic identity is to use census data to compare the Japanese population in São Paulo to other areas where the second and third largest Japanese communities exist in Brazil. These are located in Northern Parana (Maringa, Londrina, and Curitiba) and Tomé-Açu, Pará. Those cities in Northern Parana have an urban environment with 35,000 Japanese descents. Tomé-Açu is located in the northern Brazil and is considered as the poorer regions in the nation with high child mortality rates.

Another possible way to compensate for the noted data limitations would be to integrate qualitative research into the quantitative research in identifying the consequences of individual’s behavior/practices as it relates to health that are driven by cultural norms and variations. In doing so, the research may provide a better framework to understand the consequences of individual’s
behavior/practices driven by cultural norms stemming from their origin in family and social relations. In particular, the qualitative information should illuminate how the Japanese Brazilian’s cultural orientations and practices may have differentiated them from other groups in terms of health outcomes. Similarly, the Brazilian system of racial and social stratification can be delved into more deeply using a more grounded interpretation based on the qualitative information. Data of this kind would, in turn, provide a more comprehensive understanding of racial differences in family/household formation and social interactions that influence the survival probabilities of infants and children.
LIST OF REFERENCES


Fiscella, Kevin and Peter Franks. 1997. “Poverty or Income Inequality as Predictor of Mortality: Longitudinal Cohort Study.” *British Medical Journal* 314:1724-1727.


Goldani, Marcelo Zubaran, Marco Antonio Barbieri, Roberto Jorge Rona, Antônio Augusto Moura Da Silva, and Heloisa Bettiol. 2004. “Increasing Pre-Term and Low-Birth-Weight


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BIOGRAPHICAL SKETCH

Kuniko Chijiwa was born and raised in Kitakyushu-shi, Fukuoka, Japan. She earned her first bachelor’s degree in interior design at Tama Art University, Tokyo, Japan. She then worked for television advertising companies as a production manager, including two movie films. During these years she had several opportunities to work in developing countries including the Caribbean region. In 1993, she returned to school to obtain another bachelor’s degree in social sciences at Waseda University in Tokyo.

Kuniko came to the University of Florida where she earned a master’s degree in Latin American Studies with a thesis titled the Prism of Ethnicity in Trinidad: An Analysis of the Basis of Relationships between Two Major Ethnic Groups. Upon earning her first master’s degree in the Spring 2001, she entered the master’s program in sociology at the University of Florida. In May 2003, she earned her second master’s degree in sociology with a thesis titled Locating Ethnic Context: Mother’s Characteristics and Child Mortality in Trinidad and Tobago. Her academic interests focus on racial/ethnic relations and social inequality; paying particular attention to how cultural variations incorporate the social status and the quality of health in multi-racial/ethnic nations. After completing her doctorate, she continues studying racial and ethnic issues in health using individual contextual data and spatially stratified data.

When Kuniko became an ABD, she moved from Florida to Richmond, Virginia with her husband, John Reitzel, who teaches Criminology at the Virginia Commonwealth University. They were cohorts in the master’s and doctorate programs in sociology at the University of Florida and have been together for 10 years. They have four adorable cats who were born in Gainesville, Florida and who love harassing wild birds and squirrels to whom they provide food in return as a token of deep apology for their cats’ bad behaviors toward wildlife.