Assessing the health impact of community participation in public health: the infant mortality rate and municipal health councils of Brazil

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Abstract

Brazil institutes municipal health councils (MHCs) in which representatives from various sectors, including community, are expected to collectively make public health decisions. While it seems that community has been able to affect health system decisionmaking via MHCs in some municipalities, decision-making among MHCs is generally dominated by health administrators. Based on social capital theory, MHCs should foster better health. After bivariate and multivariate analysis, I observed no significant relationship between the infant mortality rate and community participation in public health, as measured in this study. I also assess how much variables of social structure, access to medical services, biological risk, and access to environmental sanitation predict health outcomes. Of the social determinant of health categories assessed, social structure and access to medical services are the strongest predictors of health. The significant variables of regression are female illiteracy, fertility, and water supply.

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Introduction

Important principles of Brazil's free universal health system, called O Sistema Único de Saúde (SUS), or "The Unified Health System" in English, are decentralization, democratization, and community participation.i The 1988 Constitution of Brazil institutes community participation in SUS, and health councils are among the primary means through which local communities are engaged in public health.ii Within health councils, health administrators, health practitioners, and community representatives are to collectively make decisions related to the local public health system. Based on the notion of social capital theory that coordinated action may increase efficiency in society,iii I hypothesize that Brazil's municipal health councils have improved health across Brazilian states. In this paper I will analyze whether community participation in health via municipal health councils contributes to improvement in health, while accounting for confounding influences and other social determinants of health.

Gaining a better understanding of how community participation in public health may impact health could result in expanded establishment of lower-cost, more effective health systems.iv Community participation in health could be especially valuable in developing countries, where health systems typically lack funding and medical supplies.v Additionally, including community participation in public health has the potential to be replicated in nonhealth sectors.

While there is pre-existing research on the extent to which municipal health councils embody democracy, may differ from each other, and how they function and perform, perhaps surprisingly, I have encountered none that attempts to explain whether municipal health councils have impacted health.

My assessment is done through bivariate and multivariate analysis. The noncommunity participation variables I assess represent social structure, access to medical services, biological risk, and access to environmental sanitation.

I observed no significant relationship between the infant mortality rate and community participation in health, as measured in this study. Of the social determinant of health categories assessed, social structure and access to medical services are the strongest predictors of health. The significant variables of the regression models are female illiteracy, fertility, and water supply.

Literature Review

Municipal Health Councils and Social Capital

The representative structure of municipal health councils is favorable for fostering social capital, therefore the councils have the potential to improve public health. According to Robert Putnam, social capital includes "characteristics of social organization such as trust, norms, and systems that contribute to increasing the efficiency of society by facilitating coordinated actions."vi Municipal councils could build social capital by virtue of their habitual meetings and discussions that include health administrators, health practitioners, and community representatives.vii A particularly unique aspect of Brazil's municipal health councils is that 50 percent of their members must be community representatives. Brazilian states might be achieving community participation in public health via municipal health councils, which would be a difficult feat and conducive to better health outcomes.viii

Community participation in public health could result in better health outcomes, as citizens would help develop and inform initiatives that would be applied to themselves. Community participation in health planning can mobilize resources and energy, result in

holistic and integrated approaches, legitimize health decisions, and ensure ownership and sustainability of programs.ix

Members of municipal health councils draft the distribution of health funding for initiatives of the local health system, x including the Family Health Program. Many studies credit the Family Health Program with much of the decline in the infant mortality rate that has been observed across Brazilian states.xi The Family Health Program was started in 1994, and it emphasizes primary health care through promotion and prevention. The main component of the Family Health Program is its health units, which are served by health teams.xii The Family Health Program health teams typically consist of one physician, one nurse, several community health agents, and sometimes dental and social workers.xiii The Family Health Program is intended to bolster the accessibility of primary health services by placing health units in individual communities; no health unit is to serve more than 45,000 people.xiv

Brazil's municipal health councils could be a model for other developing countries, where health systems are generally characterized by scare public financing, prominence of the public system in providing health care, inability of government to allocate adequate funding to its health system, low salaries of health workers, and lack of medical supplies.xv Not only could community participation in public health result in better health outcomes; the ability of municipal representatives to determine how health funding is allocated throughout their local health system may be critical for improving access to health care, specifically,xvi and capable of improving health system efficiency and public health.xvii However, Peters et al. highlight that appropriate health system initiatives may vary by country and depend on their respective strength and that of their civil society regulatory arrangements.xviii

Establishment of municipal health councils in Brazil was set forth by the creation of

Law no. 8.142 in 1990.xix Law no. 8.142 institutes community participation in SUS and legally obliges that national, state, and municipal government has health councils. Health councils are expected to be permanent after establishment. Brazilian health councils, regardless of level of government, are meant to be bodies in which members meet monthly and collectively make decisions on matters related to policies, economics, and finances of the local health system.xx The representative structure of the health councils is meant to facilitate community participation in health, as 50 percent of members are community representatives, 25 percent are health practitioners, and 25 percent are health administrators.xxi Community representatives may include elected members of church, ethnic movements, student groups, professional organizations, etc.xxii Community and health worker representatives have two year terms. Election procedures of municipal health councils vary based upon their individual internal policies.xxiii

Each level of government has a role in the functioning of Brazil's municipal health councils. The Federal government transfers money directly to the Municipal Health Fund, which is managed by the Municipal Health Department and supervised by the municipal health council. State health councils are responsible for approving, supporting, and regulating municipal health councils.xxiv Based on the functioning of two municipal health councils in the state of Pernambuco, when municipal health councils compose budgets they request specific amounts of money for individual initiatives, which may include primary care, the community health agent program, oral health, health surveillance, the family health program, and primary pharmacy.xxv The budgets drafted by municipal health councils are to be collectively approved of by council members.xxvi

Murray discusses the levels of community participation as defined by Arnstein's

"ladder of citizen participation," and highlights that the first six of eight levels may be "meaningful and useful."xxvii Arnstein orders the levels of participation by group and from strong to weak; Arnstein's levels of citizen participation are degree of citizen power: 1) citizen control, 2) delegated power, and 3) partnership, degree of tokenism: 4) placation, 5) consultation, and 6) informing, and non-participation: 7) therapy, and 8) manipulation.xxviii, 1 Degree of citizen power can be thought of as active, genuine participation, while degree of tokenism is more passive participation.xxix Having clear lines of accountability and direct involvement in decision-making constitutes active community participation, while final decisions being made by an agency and only having opinions and information collected constitutes limited, passive community participation.2

Community development, which is associated with active community participation, enables citizens to have more control over their health and lives and is characterized by "democratic involvement in decision-making."xxx Community participation in bureaucratic processes is far more likely to be passive rather than active;xxxi achieving the latter is difficult and may require more radical organizational change.xxxii

Health councils can serve to foster community participation, rather than entities that guarantee community participation. The performance of municipal health councils varies by council. A study by Atkinson et al. suggests that the impact and effectiveness of municipal health councils depends on their leadership, structure, and the quality of their inter-sectoral partnerships.xxxiii By comparing the characteristics of two municipal health councils in the state of Ceará, one having more community engagement, progressive leadership, vision, and decentralized decision-making than the other, the research team demonstrated that

¹ See Figure 4 for descriptions of levels of community participation.

² See Figure 4.

community participation may contribute to more activities and innovation in SUS health programs.xxxiv

Although community participation in public health has structural support through SUS policy and some communities have likely affected their local health system via municipal health councils,xxxv it appears that decision-making within health councils is generally health administrator dominant. Barriers to community representatives having more control in municipal health councils include problems at the operational and community level, particularly unwillingness of health administrators to permit such power and lack of familiarity with technical terminology and directly engaging in public policy among community representatives.xxxvi

The performance of municipal health councils has been constrained by underfinancing and non-prioritization of health due to fiscal economic concerns and concentration on other social issues. For these reasons, Modesto, Costa, and Bahia assert that municipal health council meetings are often either "embroiled" in discussion of health funding allocation or "in disarray" in the midst of many general problems that concern health. They contend that consensus is hardly established after discussion, and thus responsibility for health decisionmaking has been transferred to public participation forums, judicial bodies, and the Public Prosecutor.xxxviii

The biggest problem of the municipal health councils seems to be their domination and corruption by administrators and special interest groups. Community representatives in health councils are trained and "professionalized," especially if they are repeatedly elected to serve on the councils.xxxix Such professionalization and continued service can convert them from community representatives to bureaucrats, in addition to familiarizing them with health

policies and activities. Based on her observations of a municipal health council in a small northeastern city between 2003 and 2006, Cornwall suggests that community "representatives" are often helped by health administrators to obtain a council position if determined they would be passive or compliant with corrupt activity. Also, regulation of municipal health councils can be manipulated such that the community representatives "can only agree" with the measures health administrators want implemented.xl Finally, community organizations/groups represented in the councils often changes, and there is "variable" effort made by community representatives to consult with and be accountable to constituencies.xli

The leadership of health councils can largely determine whether decisions within them are made via consensus or vote casting.xlii Voting in the municipal health councils is sometimes done by public show of hands, which can threaten genuine community participation in decision-making; members often vote for the position of health administrators out of fear of losing contracts or favor.xliii Additionally, members of community other than those who are "representatives" are allowed to attend health council meetings and speak, but have no council voting rights.xxliv

Reasons for the malfunctioning of municipal health councils could exceed corruption of internal power relations. Collins, Araujo, and Barbosa assert that many municipalities of Brazil simply lack the population size, expertise, leadership, and resources necessary for them to manage their own health system. xlv A WHO document suggests that effectiveness of Brazilian health policy has been constrained by disconnect between knowledge and decisionmaking processes.xlvi Another problem may be lack of clarity in what constitutes "community" and "participation."xlvii Also, there is competition among the various municipal health councils over receiving federal resources, which are limited and "precarious."xlviii

Cornwall notes that elements of both "old" Brazil (authoritarianism, bargaining, favoring, and political intimidation) and a newer Brazil (democracy and community participation) are evident among the municipal health councils.xlix According to Cornwall, a trend toward democracy and community participation within the municipal health councils manifests in speeches and calls for consensus and fairness from community representatives, and argument over rules, procedures, and policies among the multi-sector council members.l Cornwall contends that the municipal health councils make real changes in power relations possible and enable Brazilians to experience and engage in politics like never before.xsli

The benefits of including community participation in public health may outweigh the costs. Community participation in government institutions can result in less expensive, more effective initiatives.lii Community participation in public health could prove to be especially powerful in large areas, where there tends to be more government deficit due to greater demand for expenditures relative to revenues drawn from taxation.liii Interestingly, Moreira and Escorel found that municipal health councils function best in municipalities with population size that exceeds 250, 000.liv Furthermore, all parties involved in the municipal health councils may have incentive to cooperate. Members of community would be happier if their health improved.lv Doctors have fixed salaries instead of being paid per service,lvi therefore their job satisfaction would increase following better health among patients and having more appropriate health resources.lvii Municipal secretaries of health would possibly receive more funding as a result of preservation of life, since federal health funding transfer is done on a "per capita" basis via one of the two allocation formulas.lviii

According to Murray, successful community participation may require overcoming barriers at the structural, operational, and community level. At the structural level there needs

to be professional support and commitment to community participation. At the operational level there needs to be political will, lix political, bureaucratic, and administrative support, and adequate information. Commitment to community health, trust of the process that would include community and others, leadership, "readiness" among citizens to become involved in planning, active citizen culture, and comfort with being involved is necessary at the community level.lx

Research suggests that social capital positively contributes to economic development, as well as quality of education and health.lxi There are various definitions of social capital, but most include reference to social relationships, components of social relationships that facilitate coordinated action, and products/components of social relationships.lxii Many social capital scholars consider trust to be a critical component of social capital (i.e., Coleman, Putnam, and Fukuyama),lxiii however, others maintain that trust is a product of social capital.lxiv According to the World Bank, sources of social capital include family (the most primary), communities, firms, civil society, the public sector, ethnicity, and gender.lxv Brown and Ashman suggest that collective participation at various levels of society leads to greater success of programs, due to the wide range of social capital that such participation creates.lxvi In this paper I use Robert Putnam's definition of social capital, which is "characteristics of social organization such as trust, norms, and systems that contribute to increasing the efficiency of society by facilitating coordinated actions."Ixvii

Szreter and Woolcock offer three classifications of social capital: linking, bridging, and bonding. Linking social capital refers to norms of trust and respect among parties with unequal amounts of power, bridging social capital is between parties from different demographic and/or spatial groups of relatively equal status, and bonding social capital is among parties

within common networks with similar status.lxviii They argue that a 'rich endowment' of each type of social capital is necessary for a healthy society.lxix Municipal health councils can foster each form of social capital; they involve linking social capital in that they connect community representatives with political and health authorities, bridging social capital because community representatives and health practitioners from different areas within municipalities are brought together, and bonding social capital because of the organizing effect they may have among health administrators, health practitioners, and community leaders.lxx

The World Bank states that social capital can substitute for human and physical capital, lxxi a view that opposes that of DeFilippis, who suggests that social capital is ineffective for development without sufficient money and directly addressing inequality. DeFilippis raises the point that exclusionary networks of social capital exist which only benefit those already in power. Despite this, he suggests that social capital can be constructed or reconstructed such that it mutually benefits more interest groups.lxxii Affirming the perspective of the World Bank, social capital has been successfully utilized to help operate and secure institutions in the midst of low funding. For example, the Grameen Bank, a mircolending institution, successfully functions at lower costs than other micro-lending institutions by using products of social capital in the form of "peer pressure and peer support" among groups of individuals to prevent loan default, rather than spending money on client social screening and monitoring.

Gilson argues that health systems become more effective as trust, and thus social capital, increases throughout them. She states that the design of decision-making processes, including mechanisms for resource allocation and dialogue with citizens, "influences the

extent to which the [health] systems provide the basis for trust-building."lxxiii She implies that trust-building mechanisms in health systems increase their legitimacy, which results in citizens being more likely to follow health related procedures and advice.lxxiv She further suggests that cooperation at every level of health care is likely to improve with more trust in the health system, including in doctor-patient interactions.lxxv Gilson considers trust-instilling practices to be those which foster engagement, open dialogue, and opportunities for interpersonal interaction.lxxvi The intended cooperative and participatory nature of municipal health councils makes them potentially "high trust" institutions that would facilitate improvement of public health.lxxvii

Governments with institutions that are democratic and allow community participation may be more efficient and satisfactory for citizens. Based upon research on Italy from 1978-1985, Putnam argues that the effectiveness of regional governments is closely linked to the extent to which power within the region is organized horizontally or 'hierarchically.' The more horizontally, or equally, power, rights, and obligations are distributed, the more effective is government.lxxviii When a community is horizontally organized as opposed to hierarchically, relationships are characterized by reciprocity and cooperation rather than authority and dependency.lxxix . According to Putnam, 'civic community' is constituted by communities with 'patterns of civic involvement and social solidarity.'lxxx Putnam found that the more civic a community is, the happier its citizens.lxxxi

Efforts are currently underway to change England's national health system (NHS) such that general practitioners, rather than the boards of primary care trusts, have the majority of control over health spending. NHS primary care trusts are similar to Brazil's municipal health councils; health administrators are largely in control of primary health trust spending,lxxxii

and a "Professional Executive Committee" comprised of members that may include a combination of health care professionals, executive directors, and a social services representative gives clinical direction to the trusts.lxxxiii Key differences between the primary health trusts and municipal health councils are that there is no required, specific level of community participation in the trusts, and that each primary care trust is explicitly "responsible for planning and securing quality healthcare services, reducing inequalities, and improving the health of the local population" of its base city and surrounding areas."lxxxiv Reasons cited for shifting decision-making power to general practitioners include that it may improve productivity and responsiveness to the needs of patients, and also lower public health costs.lxxxv, 3

Brazilian municipal health councils hold the potential for resulting in a more efficient and effective health system. Unfortunately, they seem to be lacking elements at the operational and community level that would foster genuine community participation in public health. Although Brazil may not have genuine community participation in public health overall, it is making advances toward achieving it; community representatives of health councils at least have the opportunity to express themselves directly to health authorities. Finally, while ensuring more democratic processes within the municipal health councils would probably result in better health outcomes, changing the representative structure of the councils such that health practitioners have more relative presence within them may warrant

³ Despite the possible benefits of transferring more health system decision-making power to general practitioners, this change has been criticized for lack of evidence that such health system structuring will be functional and successful.(http://news.uk4net.com/2011/04/04/lansley-to-clarify-nhs-shake-up/) general practitioners, this change has been criticized for lack of evidence promising that such health system structuring will be functional and successful.(http://news.uk4net.com/2011/04/04/lansley-to-clarify-nhs-shake-up/)

investigation to observe its health improving potential as well.

The Infant Mortality Rate and Non-Community Participation Independent Variables

Possible social determinants of health other than community participation that I will assess are social structure, access to medical services, biological risk, and access to environmental sanitation. I conduct bivariate and multivariate analysis with variables of these categories, in addition to variables for community participation, and the infant mortality rate. In this section I discuss the relationship between variables of the aforementioned determinants of health other than community participation and the infant mortality rate found in previous research.

The infant mortality rate is a strong indicator of the impact of external factors on health. Infant mortality rate may be a better measure of health in this regard due to the higher vulnerability of infancy, and therefore, the increased relevance of external factors relative to individual factors in ensuring good health.lxxxvi Also, high infant mortality rate has been linked to low group membership and social trust, and therefore, low social capital.lxxxvi

As in several other developing countries, the infant mortality rate of Brazil has been declining for the past few decades.lxxxviii Alves and Belluzzo assessed the infant mortality rate in Brazil between 1970 and 2000, and found that it fell by 47.9 percent "solely as a result of forces captured by the action of time," which they state include technological progress and cultural change.lxxxix Macinko, Guanais, and Souza state that the main determinants of the infant mortality rate in Brazil between 1990 and 2000 were primary care and hospital bed availability, access to clean water, income, women's literacy, and fertility.xc Results from other studies also suggest that sanitation is a main explanatory variable of the infant mortality rate, in addition to income inequality.xci

Parental education, particularly that of females, is consistently found to be one of the most significant predictors of the infant mortality rate. Based on research conducted in Brazil between 1990 and 2002, Macinko, Guanais, and Souza found that a ten percent decrease in female illiteracy would decrease the infant mortality rate by more than all of the other variables in their study combined.xcii One reason that the infants of educated mothers experience lower mortality rates is that educated mothers are more likely to be aware of how to ensure the health of their child. Also, educated women are more likely to embrace health promoting practices and technologies regardless of whether they are traditional. Finally, educated women are more likely to command the attention of medical professionals and demand their right to healthcare, an especially important point given the high levels of social inequality in Brazil.

The ratio of female to male education levels can be a measure of the rights and status of women, and specifically, can indicate the extent to which women have control over resource allocation. From a cross national study using data of the year 1993, Zakir and Wunnava found that a ten percent increase in female literacy results in a seven percent decrease in the infant mortality rate.xciii Wood, Carvalho, and Horta found that in Brazil between 1950 and 2000, father's education level also impacted the infant mortality rate, but only about half as much as mother's education.xciv Based on cross-national research for years spanning the 1950s to the 1970s, Flegg suggests that expansion of education, in addition to reduction of income inequality, more rapidly triggers a fall in the infant mortality rate than other factors.xcv

Income is also an important predictor of the infant mortality rate, as it can largely determine the extent to which one has access to basic necessities such as food and shelter, as

well as education and healthcare.xcvi The Oswaldo Cruz Foundation found that in Brazil, poverty is disproportionately accompanied by morbidity, mortality, malnutrition, micronutrient deficiencies, and less than favorable prenatal care, birth weight, cognitive development, immunizations, and preventive medical care.xcvii In their previously mentioned study, Zakir and Wunnava found that a ten percent increase in GNP decreases infant mortality rate by 1.4 percent, ceteris paribus.xcviii From their research on Brazil between 1990 and 2002, Macinko, Guanais, and Souza found that percent change in income per capita has a 'modest' positive effect on the infant mortality rate, however, they suggest that the result could be due to another factor in the infant mortality rate: increasing inequality.xcix

According to the Brazilian National Commission on Social Determinants of Health, after a certain level of economic growth has been attained, income distribution becomes the strongest determinant of health across a country.c This likely reflects relative deprivation theory, which states that "someone with a given income would have better health if he or she lived in a society where income was distributed more equally than in a society where the rich are richer and the poor are poorer."ci The impact of income distribution on health should be especially significant in Brazil, where there are "strata of the population living in such poverty that they cannot access the minimum essential conditions and goods for their health." In Brazil, the income of the wealthiest 20 percent of the population is 26 times that of the poorest 20 percent.cii Income inequality could impart a unique element of stress that is not characteristic of poverty itself. Stress resultant of income inequality could be due to low social status, low perception of control, and receiving small rewards for high effort.ciii Stress and other psychosocial responses to relative deprivation, including frustration, hopelessness, hostility, shame, and distrust, could contribute to increasing the infant mortality rate by

increasing one's likelihood of engaging in risky behavior.civ Studies have shown that high income inequality decreases social capital, and that this relationship is the main reason why health declines with income inequality. Income inequality weakens bonds among citizens, and presumably, social integration and political participation as well. cv Middle-income countries with high levels of income inequality, such as Brazil, perform worse in health indicators than lower-income countries where income is more equal.cvi

Race is a major determinant of health in Brazil. The effects of colonialism and slavery are still evident in Brazil today, as whites have better indicators than all other color groups in virtually all factors that would improve health. Wood, Carvalho, and Horta found that between 1950 and 2000, there was virtually no change in the life expectancy gap (about seven years) between white and black Brazilians. Unfortunately, race seems to be becoming a more significant factor in explaining the infant mortality rate.cvii Matijasevich found that between 1984 and 2004, the infant mortality rate declined more for infants born to white Brazilian women relative to those born to black Brazilian women.cviii Brazil's 'white advantage' manifests in many ways, including in that white women are more likely than other women to have had a gynecological exam in the past year, resources to obtain care, not have health problems, have health coverage, live in a less congested environment, and have stable employment.cix Due to racist sentiment, non-white Brazilians are generally thought to be inferior by wealthy, white Brazilians, and are therefore discriminated against in hiring for better jobs.cx

By racial group, black Brazilians most substantially experience leading factors in high infant mortality rate, including poor education and low income.cxi Black Brazilians have higher risks of infant mortality than white Brazilians, as they are more likely to live in health-

threatening areas, such as those with low access to health services and high environmental risks.cxii In 2000, about 13 percent of the infant mortality rate in Brazil could be explained by color.cxiii As Matijasevich et al. found, at least some of the ethnic group differences in the infant mortality rate are explained by differences in poverty and prenatal care.cxiv

Degree of urbanization seems to have a positive relationship with the infant mortality rate across Brazilian states. North and Northeast Brazil have consistently had higher infant mortality rates than the other regions of Brazil, and have also consistently had the smallest urban populations by proportion. In 1996, the infant mortality rate was 55 percent higher in rural areas than in urban areas.cxv Interestingly, the University of São Paulo posits that urbanization is not "particularly important" in explaining health conditions. The effect of urbanization on the infant mortality rate is likely in both directions. While there is presumably better access to health institutions in urban areas than in rural areas, diseases spread more easily where populations are more highly concentrated.cxvi Szwarcwald et al., who conducted research on Rio de Janeiro using data from the year 1991, argue that residential poverty clustering may most significantly explain the infant mortality rate.cxvii Through research conducted on Brazil between 1980 and 2000, Barfuri, Haddad, and Paez found that high urbanization reduces the infant mortality rate in a measure with aggregated data for several cities, with a stronger effect in more recent years. They argue that their findings show that urbanization has spillover effects for reducing the infant mortality rate in areas around those that are urban.cxviii The authors also found that urbanization has no effect on the infant mortality rate in urban centers themselves, which they state could be due to its effect being indirectly captured by other variables.cxix The spillover effect they observe could be due to higher access to health facilities and social services for those who live around urban

peripheries relative to those who live in isolated rural areas.

Health expenditure can foster the presence of health programs, institutions, and infrastructure. Much literature highlights that while increasing health expenditure alone will not reduce infant mortality rates, when health funding is allocated to appropriate initiatives infant mortality rates can be reduced.cxx According to Hanmer, Lensink, and White, analysis on various developing countries indicates that government social programs have been 'pivotal' in speeding infant mortality rate reduction.cxxi

Immunizations are a key service of primary health, and focusing on primary health may be capable of making "considerable improvements in health outcomes."cxxii Also, immunizations have been found to be particularly cost effective at improving health.cxxiii According to Hanmer, Lensink, and White based on research conducted in Brazil between the 1960s and 1990s, tuberculosis immunizations significantly reduce infant mortality rate,cxxiv and Costa et al. found in Brazil during the 1980s and 1990s that anti-measles immunizations may contribute to infant mortality rate reduction.cxxv Macinko, Guanais, and Souza found no relationship between the infant mortality rate and immunizations in Brazil at the state level between 1990 and 2002, however, they expected this result because immunization coverage was high and changed little throughout their research period.

Availability of medical care has been shown to have a negative relationship with the infant mortality rate. Flegg showed that nurses and doctors per capita positively affect the infant mortality rate. Macinko, Guanais, and Souza, however, found no significant relationship between doctor and nurse supply and reduction in the infant mortality rate based upon their research conducted on Brazil between 1990 and 2002. In fact, they noted a positive relationship between nurses per capita and the infant mortality rate.cxxvi This could

be due to deployment of nurses to areas that have greater health needs. Based upon research on Brazil, Barufi, Haddad, and Paez found a positive relationship between the infant mortality rate and prenatal consultation between 1980 and 2000.cxxvii Barufi, Haddad, and Paez found that in Brazil between 1980 and 2000, as the number of health care institutions increases, the infant mortality rate decreases.cxxviii Despite this, they claim that the number of health care facilities is not as important as the literature suggests it should be, and that there are diminishing returns to each additional health facility. They state that preventive behaviors in the home come to replace health care institutions in positively impacting health over time.cxxix They also believe that health care institutions and infrastructure can have spillover effects, and that therefore, health care institutions and infrastructure can have far reach.cxxx Macinko, Guanais, and Souza conducted research on Brazil between 1990 and 2002 showing a negative relationship between hospital beds per capita and the infant mortality rate, as the infant mortality rate fell by 1.35 percent with a ten percent increase in beds.cxxxi Hospital beds per capita may indicate quality and availability of delivery care, especially for low weight babies, and aspects of prenatal care.cxxxii

Many studies have found that there is a strong, positive relationship between fertility and the infant mortality rate. In a cross-national study using data from the year 1993, Zakir and Wunnava found that a ten percent increase in the fertility rate is associated with an 8.2 percent increase in the infant mortality rate.cxxxiii Such a relationship exists between fertility and the infant mortality rate because women with higher fertility rate are more likely to be older, malnourished, have birth abnormalities/complications, babies with low weight, little space between births, and wean earlier.cxxxiv The causal relationship between the infant mortality rate and fertility may run in both directions. As Chowdhury purports, because a

woman's children are more likely to die as she has more of them, she bears more children in response to the possibility that some may die.cxxxv

Brazil has a high rate of cesarean section, with an estimated national average of 42 percent of all births.cxxxvi Research on Brazil between 1995 and 1997 has found both positive and negative effects of cesarean section on the infant mortality rate.cxxxvii The results suggest that cesarean section birth could prevent perinatal complications in giving birth, however, the studies did not control for socioeconomic variables, level of gestational risk, nor whether cesarean birth was elective.cxxxviii Despite these conflicting findings, the general consensus in the literature is that vaginal birth reduces the risk of infant mortality, while caesarean sections increase the risk, most likely due to increased risk of birth trauma and anoxia/hypoxia.cxxxix

Environmental sanitation includes access to water supply network, sewerage service, and trash collection, and is associated with reduction in the infant mortality rate. Sanitation could contribute to reduction in the infant mortality rate by preventing water-borne illnesses. cxl According to research of Alves and Bulluzzo on Brazil between 1970 and 2000, improvement of sanitation (which includes provision of sewerage service and treated running water) reduces the infant mortality rate, but its impact is small compared to that of education and per capita income.cxli Additionally, they found that garbage collection (a component of environmental sanitation) has also been shown to have a negative relationship with the infant mortality rate.cxlii The results of Barufi, Haddad, and Paez' research on Brazil between 1990 and 2002 echo the findings of Alves and Bulluzzo, which are that a ten percent increase in water supply reduces the infant mortality rate by only 3 percent.cxliii However, Wood, Carvalho, and Horta found that in Brazil in 1960, running water and access to sewerage lines

reduced the infant mortality rate by 14.2 percent and 9.7 percent, respectively, which is more than the effects they found for maternal education.cxliv Neither Alves and Bulluzzo nor Wood, Carvalho, and Horta accounted for the fact that it may take time for improved sanitation to impact infant mortality rates.cxlv Barufi, Haddad, and Paez used sanitation measures from up to ten years before those for the infant mortality rate, and found that sanitation and the infant mortality rate have a negative relationship.cxlvi However, through research conducted on the United States between 1960 and 1998, Watson found that the effects of sanitation on the infant mortality rate are significant only between two and seven years after a sanitation project is completed.cxlvii

For the purpose of assessment, I group each of the aforementioned social determinants of health into the following categories: 1) social structure: female illiteracy, ratio of female to male education, income, income inequality, and racial inequality, 2) access to medical services: degree of urbanization, health expenditure, immunization coverage, nurses and doctors per capita, number of pre-natal consultations, and number of hospital beds per capita 3) biological risk: fertility rate and occurrence of cesarean section, and 4) access to environmental sanitation: access to water supply, sewerage service, and trash collection.

Data and Methods

The primary purpose of this paper is to examine the effect of community participation in public health on health outcomes. While examining community participation, I also test how variables of other social determinants of health impact my measure of health outcomes, the infant mortality rate, including social structure, access to medical services, environmental sanitation, and biological risk. I hypothesize that states with higher levels of community participation in public health, operationalized as more municipal health councils, have lower

infant mortality rates.

The data are from DATASUS and ParticipaNetSUS, databases of the Brazilian Ministry of Health that contain information on the health system and demographic and health indicators of Brazil. The data found in DATASUS are collected by the Brazilian Ministry of Health, the Brazilian Institute of Geography and Statistics, the Institute of Economic Research, and the Ministry of Social Welfare.cxlix The data from ParticipaNetSUS are from research by the Brazilian Ministry of Health.cl ParticipaNetSUS allows disaggregation by region, state, municipality, and proportion of the population, and the data of DATASUS can often be disaggregated by state, region, capital, age, sex, and year.cli I use data on municipal health councils, infant mortality, social structure, access to medical services, environmental sanitation, and biological risk from each of Brazil's 26 states. I performed all quantitative analysis, which include bivariate and multivariate analysis, with IMB SPSS Statistics. The data come from the period pre-1991 to 2000, and is all based on state-level values for individual years. My dependent variables are average infant mortality rate and the percent change in infant mortality rate between 1997 and 2007; the research time period reflects data availability. The infant mortality rate is found as the number of deaths of infants under one year of age per thousand live births.clii

I measure community participation in public health as both the number of municipal health councils that have ever been created per thousand inhabitants, and as the number of municipal health councils that have ever been created per thousand inhabitants, weighted by when they were created. The former measure assumes that after creation, a council perpetually survives, which is not ideal, but data are not available on the total number of councils in existence at one point in time. The latter measure takes into account that older

councils may have a greater effect on health than newer ones. Data on municipal health council creation exists for every year from 1991 through 2007. I assess community participation in public health by the councils for the year they were created, and by a lag effect -- the councils for five years after they were created. I lag health councils by five years based upon the assumption that health councils require time to organize after they are created before being effective. I expect an inverse relationship between prevalence of municipal health councils and the infant mortality rate.

I analyze the effects of social structure on the infant mortality rate with the following variables: income inequality, racial inequality, income, lack of education, and gender inequality. I measure income inequality by the number of times the income of the richest 20 percent of the population exceeds that of the poorest 20 percent.cliii The level of black unemployment represents racial inequality. Unemployment in this paper is measured by the percentage of persons ten years of age and older who are both looking for and without work during the reference week of recording. In this paper, 'black' Brazilians are those who identify as either "preta" (black) or "parda" (brown). This is to account for frequent movement between the two color groups in self-identification due to changing social consciousness, perspectives on racial identity, political motivations, and indicators of social rank.cliv Average household income per capita is the measure of income, which is the average income per capita of residents' household incomes. Household income per capita refers to the sum of monthly incomes of people in the household divided by the number of household residents. The data for this measure reflect sample survey reporting.clv Female illiteracy represents lack of education, which is calculated as the percentage of females aged 15 years and older who can neither read nor write a 'simple note' in the language they know divided by the total female

population of the same age range.clvi The ratio of female illiteracy to male illiteracy is the measure for gender inequality, which is calculated as the number of females to males that are illiterate. I expect direct relationships between the infant mortality rate and these variables except for income, for which I expect an inverse relationship. All data are missing for income inequality, racial inequality, and education for the year 2000.

There are eight measures of access to medical services: nurses per capita, doctors per capita, absence of prenatal consultation, immunization coverage, public beds per capita, private beds per capita, health expenditure, and level of urbanization. I include both nurses and doctors per capita, given Flegg's finding that the r value of doctors and nurses per capita is 0.48. This could indicate that doctors and nurses often do not cover the same area; however, the presence of doctors and nurses, separately, is likely to impact the infant mortality rate. Doctors and nurses per capita are calculated as their number per thousand inhabitants.clvii Absence of prenatal consultation is calculated as the percentage distribution of women with live births who did not receive prenatal consultation.clviiil I included variables measuring both private and public hospital bed access because the infant mortality rate data cannot be disaggregated based on usage of private or public health services. Number of hospital beds per capita is calculated as their number per thousand inhabitants.clix Data on hospitals in both sectors is missing for every state for the year 2004, and for the state of Roraima, missing for every year except 2001 and 2002. For health expenditure I analyze municipal health expenditure on public health actions and services per inhabitant, clx and only between 2000 and 2007 due to limited data availability. The specific variable for immunization coverage is that of the current tuberculosis vaccine, Bacille Calmette Guerin. Immunization coverage is measured as the percentage of children immunized with the given vaccine.clxi I include

degree of urbanization as a variable of access to medical services because such access is generally higher in urban areas. Degree of urbanization is calculated as the percentage of population living in urban areas.clxii I expect an inverse relationship between the access to medical services variables and the infant mortality rate, except for absence of pre-natal consultation, which I presume will have a direct relationship with the infant mortality rate.

I measure biological risk of infant mortality with fertility rate and occurrence of cesarean section. I measure fertility rate as the average number of live births had by a woman by the end of her reproductive period, while occurrence of cesarean section is found as the percentage of cesarean deliveries in total hospital births, recorded by the state of the mother's residence.clxiii I expect direct relationships between these variables and the infant mortality rate.

The variables for environmental sanitation are coverage of water supply network, coverage of sanitation service, and coverage of garbage collection. I measure each of these variables with a five year lag, which is based on Watson's finding that the impact of sewerage on the infant mortality rate can be observed between two and seven years after commencement of sewage service provision.xclxiv Coverage of water supply network is measured as the percentage of the population served by the public water supply system, with or without home plumbing.clxv Coverage of sanitation service is calculated as the percentage of the population that has waste drainage through connection to a household collection system or septic tank.clxvi Coverage of trash collection is calculated as the percentage of population served directly or indirectly by regular service of trash collection.clxvii All 2004 data for these variables is missing. I hypothesize that there are inverse relationships between these variables and the infant mortality rate.

Descriptive statistics

Table 1 presents descriptive statistics for the variables in my analysis, which suggest the development status, levels of inequality, and access to the public health system and environmental sanitation services of Brazil. The range between the minimum (14.8) and maximum (53.2) state levels of infant mortality rate reflects the range of levels generally observed between upper-middle income and least-developed countries, for example, between Malaysia and Haiti.clxviii High percent change indicates the growing wealth and investment into public services of the country. The mean rate of cesarean section is very high, 37 percent of all births, which is more than double the recommended rate of cesarean section for a country by the World Organization's standards.clxix

Table 1. Descriptive Statistics

	Ν	Minimu m	Maximu m	Mea n	Std. Deviati on		Ν	Minimu m	Maximu m	Mea n	Std. Deviati on
average IMR	26. 0	14.8	53.2	27.7	10.0	average nurses	26. 0	22.1	84.4	47.2	17.3
percent IMR	26. 0	-48.9	-19.0	- 34.6	7.6	average absence of prenatal consultatio n	26. 0	1.1	17.8	6.0	4.6
average C-section	26. 0	20.0	51.6	37.1	9.9	average private beds	26. 0	0.0	2.8	1.4	0.7
average doctors	26. 0	45.3	300.8	109. 6	56.0	average racial inequality	26. 0	5.5	14.8	9.3	2.2
average public beds	26. 0	0.3	2.3	1.0	0.5	average sewerage coverage lag	26. 0	9.2	88.1	46.9	20.6
average fertility	26. 0	1.9	3.4	2.4	0.5	average TB Immunizati on coverage	26. 0	97.9	124.8	111. 9	6.3
average female illiteracy	26. 0	5.9	28.8	14.3	6.8	average trash collection coverage	26. 0	28.3	94.6	68.1	14.8
average female to male illiteracy	26. 0	0.8	1.4	1.0	0.2	average urbanizatio n	26. 0	64.0	96.2	77.6	8.8
average water supply coverage lag	26. 0	47.2	96.0	70.0	12.2	percent C- section	26. 0	-4.6	108.9	31.6	26.2
average income	26. 0	229.7	710.8	427. 1	134.6	percent doctors	26. 0	11.6	110.5	44.4	27.1
average income inequalit y	26. 0	11.8	27.4	19.7	3.9	percent fertility	26. 0	-34.7	-8.0	- 22.3	7.3
average municipa l health expen PC	26. 0	45.7	131.9	74.5	22.2	percent female illiteracy	26. 0	-48.5	-8.3	- 31.4	9.4

	N	Minimu m	Maximu m	Mea n	Std. Deviati on		N	Minimu m	Maximu m	Mea n	Std. Deviati on
percent female to male illiteracy	26. 0	-31.6	31.7	-4.6	11.8	percent TB Immunizati on coverage	26. 0	-21.8	29.8	1.6	15.4
percent water supply coverage lag	26. 0	-21.8	62.7	14.3	21.5	percent trash collection coverage	26. 0	6.8	198.5	52.3	43.8
percent income	26. 0	-20.8	70.4	15.1	20.0	percent urbanizatio n	26. 0	0.5	32.2	9.0	6.5
percent income inequalit y	26. 0	-62.6	36.5	- 24.2	24.7	average MHCs PC, unweighte d and lag	26. 0	0.2	29.7	5.2	8.1
percent municipa l health expen PC	26. 0	157.4	1767.8	393. 7	310.7	average MHCs PC, unweighte d and no lag	26. 0	0.2	24.6	4.9	6.7
percent nurses	26. 0	23.8	1823.8	356. 6	448.1	percent MHCs PC, unweighte d and lag	26. 0	29.4	864.3	221. 5	192.9
percent abscence of prenatal consulati on	26. 0	-92.1	-51.8	- 74.9	13.0	percent MHCs PC, unweighte d and no lag	26. 0	-25.5	15.8	-3.6	8.6
percent private beds	25. 0	-85.8	-29.1	- 50.5	15.4	average MHCs PC, weighted and lag	26. 0	2.3	440.1	78.4	122.4
percent public beds	26. 0	-55.4	381.8	30.5	82.0	average MHCs PC, weighted and no lag	26. 0	3.4	362.5	70.2	99.4
percent racial inequalit y	26. 0	-57.3	356.1	24.0	77.5	percent MHCs PC, weighted and lag	26. 0	92.7	502.7	207. 8	101.6

Table 2. Bivariate Correlations

		averaş IMR	ge pe IN	ercent ∕IR	percent fertili	ty	perce fema illiter	ent ale racy	perce wate supp cove lag	ent er oly erage	perce MHC PC, weig and	ent Es hted lag	perc MH weig and	ent Cs PC, ghted no lag	perce urbai	ent nization	averag sectior	ge C- 1	ave doc	erage ctors
average P IMR C	Pearson Correlation	1.00	-C).64	-0.02		0.26		0.15		0.14		0.20)	0.37		-0.65		-0.4	14
percent P IMR C	Pearson Correlation	-0.64	1.	.00	0.00		-0.19	9	-0.31	1	-0.01		-0.1	3	-0.17	,	0.23		0.0	4
average public beds	average fertility	av fei ill	/erage male iteracy	average female to male illiteracy	average water supply coverage	avera incor	ige ne	averag income inequa y	je e alit	avera munie I heal exper	ge cipa th n PC	avera nurse	age es	average absenc prenata consult n	e of al tatio	average private beds	ave	rage rac quality	cial	average sewerage coverage lag
0.19	0.42	0.	.91	-0.72	-0.48	-0.81		0.67		-0.69		-0.13	3	0.54		-0.10	-0.2	2		-0.57
-0.24	-0.04	-0	0.68	0.43	0.16	0.45		-0.50		0.24		-0.02	7	-0.09		0.01	0.1	1		0.16

average TB Immunization coverage	average trash collection coverage	average urbanizati on	percent C- section	percent doctors	percent female to male illiteracy	percent income	percent income inequalit y	percent municipa l health expen PC	percent nurses	percent absence of prenatal consultation	percent private beds	percent public beds
0.23	-0.59	-0.66	0.53	-0.15	0.41	0.17	-0.13	0.27	-0.16	-0.59	0.17	-0.24
-0.19	0.39	0.36	-0.13	0.24	-0.29	-0.15	0.00	0.02	0.26	0.54	-0.18	0.28

percent racial inequality	percent sewerage coverage lag	percent TB Immunization coverage	percent trash collecti on coverag e	average MHCs PC, unweighted and lag	average MHCs PC, unweighted and no lag	percent MHCs PC, unweighted and lag	percent MHCs PC, unweighted and no lag	average MHCs PC, weighted and lag	average MHCs PC, weighted and no lag
-0.21	0.03	-0.43	0.27	0.01	0.07	0.06	0.11	0.01	0.08
0.15	0.10	-0.11	-0.15	0.04	0.08	0.09	0.09	0.03	0.06

Table 3. Standardized Coefficients of Linear Regressions Predicting Infant Mortality at the

	Model 1		Model 2		Model 3	
	(a)	(b)	(a)	(b)	(a)	(b)
MHC Unlagged	X	-0.08	Х	0.13	Х	-0.06
MHC Lagged	-0.13	X	0.09	X	-0.08	Х
Female illiteracy	0.89***	0.89***	-0.84***	-0.85***	-0.57*	-0.59*
Urbanization	-0.002	0.02	0.11	0.09	-0.01	-0.02
Fertility	0.26*	0.23*	0.12	0.12	-0.32	-0.30
H20 Coverage	0.08	0.04	-0.36	-0.34	-0.70*	-0.66*
N	26	26	26	26	26	26
R2	87.7%	86.9%	54.7%	55.6%	32.8%	32.8%

State Level, Brazil

Note: * p < 0.05, ** p < 0.01, *** p < 0.001

Bivariate Correlations

My primary objective was to examine the effect of community participation in public health on health, and specifically, to test whether it improves health. None of the eight versions of the municipal health council variable is statistically significant; this makes community participation, as measured in this paper, the category of variables with the least explanatory power. The measure of community participation closest to being significant is percent change in the number of municipal health councils per capita, unlagged, and weighted for the year each council was established. The significance value for the relationship between this operationalization of community participation and average infant mortality rate is 0.32, with a Pearson's r value of just 0.20. Lack of significance among the community participation variables does not support the hypothesis that community participation in public health influences health, but is not wholly surprising given the findings from the literature that health councils tend to lack full democratization and integration of community concerns into decision-making.

Of all the categories of variables examined, the social structure variables have the strongest relationships with the infant mortality rate. Average female illiteracy has the strongest relationship with either version of the dependent variable among the independent variables; its r in relation to the average infant mortality rate is 0.91, which is highly significant. The other social structure variables that have significant relationships with the average infant mortality rate are average household income, average ratio between female and male illiteracy, average income inequality, and percent change in female to male illiteracy. The social structure variables that significantly correlate with percent change in the infant mortality rate are average female illiteracy, average income inequality, average income, and average ratio of female to male illiteracy. Interestingly, for each social structure variable that has a significant relationship with both versions of the infant mortality rate, the directions of the relationships are opposite. The only social structure variable that has no relationship with either version of the infant mortality rate is racial inequality. Given the findings of the literature which support that racial inequality is a determinant of health in Brazil, the operationalization of racial inequality in this study is probably inadequate.

Because of the relationship direction of the more significant version of gender inequality, gender inequality is the only variable whose relationship with the *average* infant mortality rate that does not support my hypotheses. However, considering relationships between variables and the *percent change* in the infant mortality rate, neither average education, average income inequality, nor average income supports my hypotheses; only gender inequality does. The relationship directions that do not support my hypotheses are

perplexing. It appears that the different versions of the infant mortality rate experience opposite effects of the social structure variables.

When comparing access to medical services and the infant mortality rate, average municipal health expenditure per capita has the strongest relationship (r= -0.69). Average level of urbanization has a similar relationship with average infant mortality rate. Other access to medical services variables with significant relationships with the average infant mortality rate are percent change in absence of prenatal consultation, average absence of prenatal consultation, average number of doctors per capita, and percent change in immunization coverage. Percent change in absence of prenatal consultation was the only access to medical services variable that had a significant relationship with percent change in the infant mortality rate. The only access to medical services variable that did not have the expected relationship with the dependent variable is average absence of prenatal consultation. This could be resultant of prenatal consultation possibly being less emphasized in states where the infant mortality rate is lower.

The percentage of women receiving cesarean section surgery is the most significant biological risk measure, as both versions of the variable are significantly correlated with the average infant mortality rate. Average fertility also has a significant relationship with the average infant mortality rate. Except for the average level of cesarean section variable, which probably reflects the confounding influence of average income level, these relationships both support my hypotheses.

The environmental sanitation variables, when measured as a percent change, are not significantly correlated with the infant mortality rate, however, when measured as an average

level, all the environmental sanitation variables are significantly correlated with the infant mortality rate. These relationships support my hypotheses.

Multivariate Regression

I ran six linear regressions. The selection of variables included in the regressions reflects exclusion of variables with colinearity of r > 0.5 and apparent strong influence from other external factors from the models. Due to the small sample size (N = 26), it was necessary to choose a small number of variables. Therefore, for each category of factors I chose the variable that, when measured as the average level, has the strongest bivariate correlation with the average infant mortality rate. The only exceptions to this rule were the community participation and biological risk variables. For community participation, because no form of the variable had a significant relationship with regression, I chose the measure based upon its qualitative characteristics: the number of municipal health councils ever created in each state per thousand inhabitants, weighted for the year each council was created. I experiment with two forms of this variable: one is lagged by five years, while the other is unlagged. I did not include the most significant biological risk variable, occurrence of cesarean section, because the variable does not seem to measure the expected relationship, namely an increased risk of infant mortality. Instead, the cesarean section variable has a negative relationship with the infant mortality rate, suggesting that it is picking up the fact that cesarean section is more common in wealthier states. As a result, I include the other biological risk variable, the fertility rate, in my regressions.

My regression models are Model 1a, 1b, 2a, 2b, 3a, and 3b. Models 1, 2, and 3 have different versions of the independent variables; while the "a" models use the municipal health councils per thousand inhabitants weighted by the year they were created, lagged, the "b"

models use the unlagged version of the municipal health councils variable. The different combinations of variables in the models are: 1) average infant mortality rate and average independent variables, 2) percent change in the infant mortality rate and average independent variables, and 3) percent change in the infant mortality rate and percent change in the independent variables. In each model, female illiteracy represents social factors, urbanization represents access to medical services, fertility represents biological risk, and water supply coverage represents access to environmental sanitation.

The community participation variable included in the models has minimal impact. The "a" models and "b" models have similar r-squared values. The r-squared values for Models (1), (2), and (3), however, vary widely. Model 1 explains the greatest amount of variation in the infant mortality rate, which is 87 to 88 percent. Model 2 explains the next highest amount of variation, which is 55 to 57 percent. The weakest model is Model 3, which explains just 33 percent of the variation in the infant mortality rate.

Models "a" and "b" have the same significant variables, but the significant variables in Models (1), (2), and (3) vary. Female illiteracy is the only common significant variable across the models. The significant regression variables are female illiteracy and fertility for Model 1, female illiteracy for Model 2, and female illiteracy and water supply for Model 3.

Conclusion

Based on the data analysis above, community participation in public health, as measured by number of municipal health councils per capita, has no significant relationship with health, as measured by the infant mortality rate. I did find, however, that variables measuring social structure, access to medical services, biological risk, and environmental sanitation influence the infant mortality rate. Social structure variables, followed by those

measuring access to medical services, have the strongest relationships with the infant mortality rate of Brazilian states. Female illiteracy, a social structure variable, has the strongest relationship with average the infant mortality rate. When analyzing percent change in the infant mortality rate, percent change in access to water supply has the strongest relationship.

The results do not support the hypothesis that community participation in public health improves health. This could indicate that my measure of community participation in public health is inadequate, community participation in public health in Brazil is more passive than active, and/or community participation in public health is not a significant determinant of health in Brazil. Based upon the literature, the most plausible reason for no relationship between community participation in public health and health is passive, limited community participation. Municipal health councils are meant to foster decentralization, democratization, and community participation; however, domination of health administrators within them inhibits the democratic action that enables more active and "genuine" community participation.

As a category, social structure is the strongest determinant of the infant mortality rate. Consistent with the literature, the most significant predictor of the infant mortality rate is average female illiteracy. The significant social structure variables are average household income, average and percent change in gender inequality, average female illiteracy, and average income inequality, however two directions are observed for all of these variables except percent change in gender inequality. Based upon the stronger relationship between each social structure variable and the infant mortality rate, the literature is consistent with the relationship directions.

Access to medical services is the next strongest determinant of the infant mortality rate. The significant variables of access to medical services are average municipal health expenditure per capita, average level of urbanization, percent change in absence of prenatal consultation, average absence of prenatal consultation, average number of doctors per capita, and percent change in immunization coverage. The relationship between urbanization and the infant mortality rate is not consistent with those of the University of São Paulo; I found that urbanization *is* an important predictor of the infant mortality rate, which supports the findings of Barfuri, Haddad, and Paez. I found a negative relationship between immunization coverage and the infant mortality rate, which reflects the findings of Hanmer, Lensink and White and Costa et al., but not that of Macinko, Guanais, and Souza. Unlike Macinko, Guanais, and Souza, I found a negative relationship between the presence of nurses and the infant mortality rate supports the findings of Macinko, Guanais, and Souza, but not that of Flegg.

Except for percent change in fertility, the biological risk variables have a significant, moderate correlation with the infant mortality rate. The direction of the significant relationships supports my hypotheses and the findings in the literature, after accounting for the possible effect of confounding influence on average cesarean section rate.

Measured as average level, each environmental sanitation variable has a significant, moderate correlation with the infant mortality rate. The direction of these relationships is the same as those reported in the literature. The percent change versions of the environmental sanitation variables are not significant.

The significant regression variables are female illiteracy, fertility, and water supply. As a result of these findings and the bivariate relationships, targeting social structural factors, female illiteracy in particular, holds potential for substantial improvement of health across Brazilian states. Additionally, encouraging low fertility and continuing expansion of environmental sanitation services should also significantly improve health outcomes.

The fact that municipal health councils do not seem to have facilitated declines in state-level infant mortality rates in Brazil may reflect findings from the literature that suggest community participation in the municipal health counsels is generally compromised by the power of government representatives. Indeed, the councils were not specifically created to improve health across Brazil, but community participation in governance could improve health outcomes. Community participation in public health could result in better health by increasing the energy and information invested into public health initiatives, in addition to increasing the breadth, approval by citizens, and sustainability of public health initiatives. Lack of impact of the municipal health councils on health may reflect their disappointing achievement in fostering genuine community participation in public health.

The institutionalization of community participation in public health in Brazil is admiral, but the structure for and means of including community participation in public health may not be in the best interest of the populace. Perhaps community representatives on the municipal health councils need more health expertise, and therefore need health education in order to be optimally effective. Alternatively, the municipal health councils might better improve health outcomes if health practitioners had more power in public health decisionmaking, relative to community representatives and health administrators. The latter suggestion

is not to imply that community participation should have no place in public health decisionmaking, but perhaps one that is less prominent.

If Brazil continues to maintain the current representative structure of the municipal health councils and genuinely desires community participation in public health decisionmaking, it will have to ensure that council members believe in and are accepting of active community participation in public health. The ideal level of community participation in public health is probably "partnership" rather than the higher levels of active community participation, so as to avoid council domination by community representatives.4 Potential members of health councils should be screened for their commitment to and ability to uphold partnership in community participation. Perhaps supervision of community participation in municipal health councils needs to be established as an explicit role of state health councils. More rules and procedures that would foster higher levels of democracy, i.e. prohibition of voting by hands, might need to be standardized across health councils. Finally, there should perhaps be training to ensure understanding of general health knowledge among all council members.

Limitations of this research include lack of time, lack of ideal data for operationalization of certain variables, and lack of familiarity with quantitative research and the research software. Weaknesses of this research include possible inadequate operationalization of variables and small sample size. Future research should consider incorporation of a wider range of variables for community participation in public health, better operationalization of community participation in public health,

⁴ See Figure 4.

collection of qualitative data on the opinions and experiences of municipal health council members, and a unit of analysis that would allow a larger population size.

Appendix

Table 4. Model 1a Regression

Model		Unstanc Coeffi	lardized cients	Standardize d Coefficients	t	Sig.	
		В	Std. Error	Beta			
(Constant)	-8.14	14.54		-0.56	0.58	
\ و	WavMHCpcL g	-0.01	0.01	-0.13	-1.48	0.16	
a	avFmIlli	1.31	0.16	0.89	8.24	0	
ä	avUrb	-0.003	0.15	-0.002	-0.02	0.99	
a	avFert	5.59	2.12	0.26	2.64	0.02	
â	avH20Lg	0.07	0.09	0.08	0.71	0.49	

a. Dependent Variable: avIMR

Table 5. Model 1a Regression Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
dimension 1	0.94a	0.88	0.85	3.93

a. Predictors: (Constant), avH20Lg, WavMHCpcLg, avFert, avFmIlli, avUrb

Table 6. Model 1b Regression

Model		Unstanc Coeffi	lardized cients	Standardize d Coefficients	t	Sig.
		В	Std. Error	Beta	3eta	
	(Constant)	-6.16	14.89		-0.41	0.68
	WavMHCpcR g	-0.01	0.01	-0.08	-0.92	0.37
1	avFmIlli	1.31	0.17	0.89	7.97	0
	av∪rb	0.02	0.16	0.02	0.11	0.92
	avFert	4.96	2.11	0.23	2.35	0.03
	avH20Lg	0.03	0.09	0.04	0.35	0.73

a. Dependent Variable: avIMR

Table 7. Model 1b Regression Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
dimension0 1	0.93a	0.87	0.84	4.05

a. Predictors: (Constant), avH20Lg, WavMHCpcRg, avFert, avFmIlli, avUrb

Table 8. Model 2a Regression

Model		Unstanc Coeffi	lardized cients	Standardize d Coefficients	t	Sig.
		В	Std. Error	Beta		
	(Constant)	-18.29	21.07		-0.87	0.4
	WavMHCpcL g	0.01	0.01	0.09	0.51	0.61
1	avFmIlli	-0.93	0.23	-0.84	-4.03	0.001
	avUrb	0.09	0.22	0.11	0.40	0.69
	avFert	2.04	3.07	0.12	0.66	0.52
	avH20Lg	-0.22	0.13	-0.36	-1.63	0.12

a. Dependent Variable: perchIMR

Table 9. Model 2a Regression Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
dimension 1	.74a	0.55	0.43	5.69

a. Predictors: (Constant), avH20Lg, WavMHCpcLg, avFert, avFmIlli, avUrb

Table 10. Model 2b Regression

Model		Unstandardized Coefficients		Standardize d Coefficients	t	Sig.
		В	Std. Error	Beta		
	(Constant)	-18.09	20.71		-0.87	0.39
	WavMHCpcR g	0.01	0.01	0.13	0.82	0.42
1	avFmIlli	-0.94	0.23	-0.85	-4.11	0.001
	avUrb	0.08	0.22	0.09	0.35	0.73
	avFert	1.99	2.93	0.12	0.68	0.51
	avH20Lg	-0.21	0.13	-0.34	-1.62	0.12

a. Dependent Variable: perchIMR

Table 11. Model 2bRegression Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
dime nsio 1 n0	.75	0.56	0.45	5.64

a. Predictors: (Constant), avH20Lg, WavMHCpcRg, avFert, avFmIlli, avUrb

Table 12. Model 3a Regression

Model		Unstandardized Coefficients		Standardize d Coefficients	t	Sig.
		В	Std. Error	Beta		
	(Constant)	-51.56	8.59		-6.00	0
WperchMHCլ g	WperchMHCpcL g	-0.01	0.02	-0.08	-0.35	0.73
1	perchFmIlli	-0.46	0.19	-0.57	-2.47	0.02
	perchUrb	-0.01	0.25	-0.01	-0.03	0.98
	perchFert	-0.33	0.23	-0.32	-1.45	0.16
	perchH20Lg	-0.25	0.09	-0.70	-2.67	0.02

a. Dependent Variable: perchIMR

Table 13. Model 3a Regression Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	
dime nsion 1 0	.57a	0.33	0.16	6.93	

a. Predictors: (Constant), perchH20Lg, WperchMHCpcLg, perchFert, perchUrb, perchFmIlli

Table 14. Model 3b Regression

Model		Unstandardized Coefficients		Standardize d Coefficients	t	Sig.	
		В	Std. Error	Beta			
	(Constant)	-53.49	8.94		-5.98	0	
	WperchMHCpcR g	-0.07	0.22	-0.06	-0.33	0.74	
	perchFmIlli	-0.47	0.18	-0.59	-2.56	0.02	
	perchUrb	-0.02	0.24	-0.02	-0.10	0.93	
	perchFert	-0.31	0.21	-0.30	-1.44	0.17	
	perchH20Lg	-0.23	0.09	-0.66	-2.60	0.02	

a. Dependent Variable: perchIMR

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
dimension 1	.57a	0.33	0.16	6.93

Table 15. Model 3b Regression Summary.

a. Predictors: (Constant), perchH20Lg, perchFert, WperchMHCpcRg, perchUrb, perchFmIlli Figure 1. Bivariate correlation between the community participation variable closest to being significant and the infant mortality rate



Figure 2. Average infant mortality rate across Brazilian states (1997-2007)



Figure 3. Percent change in the infant mortality rate across Brazilian states (1997-2007)







Source: The Forestry Commission

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