

# + A Community Health Diagnosis of Rio das Pedras



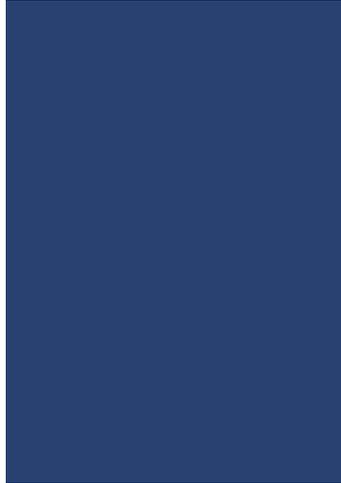
## Local conditions + opportunities

to support population health in a vibrant but vulnerable community



## Table of Contents

Overview + Orientation .....	5
Evidence-Based + Innovative Recommendations for Action .....	7
Opportunities for Innovative Data Collection Strategies .....	9
The Global Context of Urbanization + Informality .....	11
UN Sustainable Development Goals.....	12
Rio das Pedras .....	13
Coming into the World: Maternal + Perinatal Health .....	15
Overuse of Cesarean sections in Brazil.....	15
Growing up: Childhood Development + Adolescence.....	17
Recreation Space.....	17
2016 Olympic Games architecture.....	18
Education + Schools .....	18
Transmission Potential: Infectious + Vector Borne Diseases .....	19
Respiratory Diseases .....	19
Water-Borne Diseases .....	20
Vector-Borne Diseases .....	20
Health Habits: Chronic Diseases + Their Risk Factors .....	21
Alcohol Consumption .....	22
Smoking + Tobacco Use .....	22
Sedentary Lifestyles + Dietary Choices .....	22
Mobility: Physical Functioning + Disability .....	25
Longstanding Residents: How to Support an Aging Population .....	26
Infrastructure + Growth .....	27
The Social + Economic Role of Lajes.....	28
Health Care Services .....	29
2011 Rio Political Declaration .....	30
Family Clinics + Emergency Health Care.....	30
A Focus on Dental Health .....	30
References .....	31
Acknowledgements.....	35



# Orientation + Overview

## Investigative team, approach, and key findings

This report presents results of a community diagnosis and measurement feasibility study. The investigation included attention to human and street-level perspectives that could inform strategies to make the environment more health-supportive throughout the life course.

Our study was developed collaboratively among researchers at Mailman School of Public Health at Columbia University, the National School of Public Health (ENSP/Fiocruz), and the Center for Citizenship and Research in Rio das Pedras, with funding generously provided by Medtronic Philanthropy.

In this study we worked to understand the health drivers at play in rapidly urbanizing places such as Rio das Pedras. A systematic sample of 104 residents were asked to complete an interview, carry a GPS logger, and provide a saliva and household water samples to be tested for microbial presence and physical-chemical properties. Additionally, 14 residents were invited to participate in a longer interview. Finally, a mobile phone app was used to record street-level observations at 643 (86%) of the street segments throughout Rio das Pedras, allowing for the capture of more than 4,000 geotagged photos.

Este relatório apresenta os resultados de um estudo de diagnóstico da comunidade e viabilidade de medição. A investigação incluiu a atenção para perspectivas humanas e de nível de rua que poderia informar estratégias para tornar o ambiente de apoio à saúde durante toda a vida.

Nosso estudo foi desenvolvido em colaboração entre pesquisadores da Mailman Escola de Saúde Pública da Universidade de Columbia, na Escola Nacional de Saúde Pública (ENSP/Fiocruz), eo Centro de Cidadania e Pesquisa em Rio das Pedras, com financiamento generosamente fornecidos pela Medtronic Philanthropy.

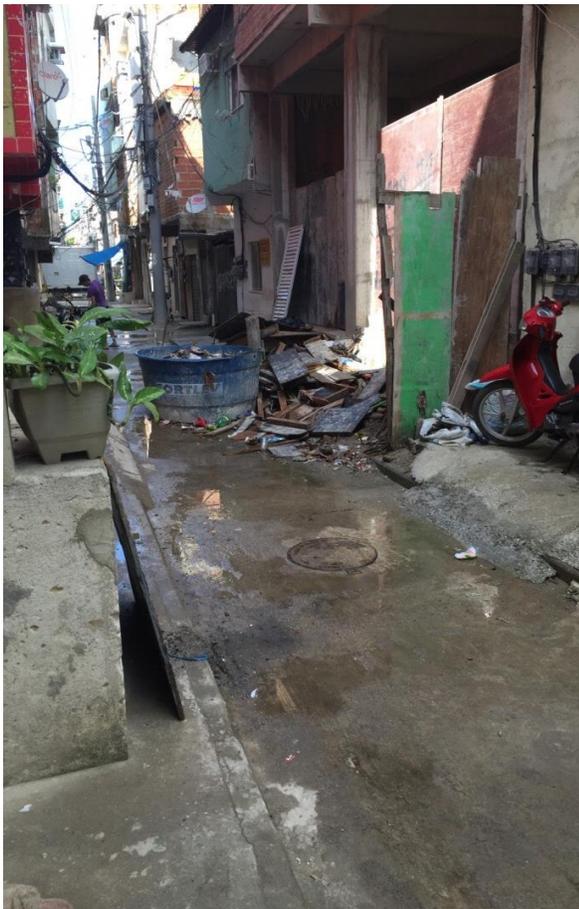
Neste estudo nós trabalhamos para entender as influências de saúde na urbanização rápida lugares como Rio das Pedras. Uma amostra sistemática de 104 moradores foram convidados a preencher uma entrevista, levar um logger GPS, e fornecer uma saliva e água para uso doméstico amostras a serem testadas para a presença microbiana e propriedades físico-químicas. Também, 14 moradores foram convidados a

Supplemental information has also been provided by city agencies or obtained through review of relevant research literature.

Through these approaches, we sought to understand how residents move around Rio das Pedras, and respond to impediments to health in their environment. Residents face challenges such as seasonal flooding, pedestrian exposure to traffic hazards, overcrowding, improvised construction methods, limited waste disposal, and limited access to municipal services and economic opportunities.

Together these data set the stage for a consideration of opportunities to improve health through local infrastructure. Top evidence-based recommendations focus on opportunities to improve sanitation infrastructure, transportation networks, and healthcare systems. Additional innovations with potential to improve health include ideas to enhance recreational spaces and food systems. Innovative ideas continue to emerge from an ongoing Columbia Engineering design challenge that looks to address water issues in Rio de Janeiro in partnership with the global center.

We conclude with ideas regarding potential investments to improve health and note that the processes of community outreach and engagement will be crucial for achieving and maintaining the hoped-for health benefits.



participar de uma entrevista mais longa. Finalmente, um aplicativo de telefone celular foi usado para gravar observações ao nível da rua em 643 (86%) dos segmentos de rua em todo Rio das Pedras, permitindo a captura de mais de 4.000 fotos com geotag. Informações suplementares também foi fornecido por agências municipais ou obtidos por meio de revisão da literatura de pesquisa relevantes.

Através destas abordagens, buscou-se compreender como os moradores se deslocar Rio das Pedras e responder aos impedimentos para a saúde em seu ambiente. Moradores enfrentam desafios como inundações sazonais, a exposição de pedestres a perigos de trânsito, a superlotação, os métodos de construção improvisados, eliminação de resíduos limitado, e acesso limitado aos serviços municipais e oportunidades económicas.

Juntos, estes dados contribuir para a definição de oportunidades para melhorar a saúde por meio da infraestrutura local. Principais recomendações baseadas em evidências se concentrar em oportunidades para melhorar a infraestrutura de saneamento, redes de transporte, e unidades de saúde. As inovações adicionais com potencial para melhorar a saúde incluem ideias para melhorar os espaços de lazer e sistemas alimentares, e resolução de problemas inovador como o desafio do projeto da Engenharia da Universidade de Columbia olha para abordar as questões da água no Rio de Janeiro em parceria com o centro global.

Concluimos com ideias sobre potenciais investimentos para melhorar a saúde e observe que os processos de sensibilização da comunidade e noivado será crucial para alcançar e manter os benefícios para a saúde desejados.



# Evidence-Based and Innovative Recommendations for Action to Address Health Needs in the Rio das Pedras Community

## I. Sanitation and Water

Public health gains from investing in water and sanitation have long been clear.

- Incorporate a resource reclamation plant which will serve Rio das Pedras and Barra<sup>26</sup>
- Improve traditional sewer system and integration with existing Alegria treatment plant city<sup>34</sup>
- Repair potable water mains and pipes<sup>44</sup>
- Resurface streets with allowance for drainage to limit standing water, which in turn contributes to mosquito-borne illness (e.g., Zika Virus, Dengue Fever) and skin infection (e.g., Impetigo)
- Community-based planning meetings, with participatory budgeting for infrastructure improvements or programs such as twice yearly cleanings of the rooftop water tanks



## II. Safe Streets and Recreational Spaces

Street design and transportation initiatives can support mobility, physical activity, and pedestrian safety, while limiting sources of urban air pollution.

- Enhance sidewalk continuity efforts along commercial streets, as part of a multi-faceted strategy to protect pedestrians<sup>47</sup>
- Create a bus-only lane during peak commuting hours<sup>53</sup>
- Build community centers and youth centers to support collective efficacy and social capital



## III. Health Care and Emergency Response

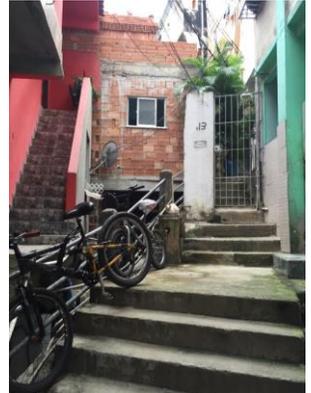
The failure to respond quickly and appropriately to a medical emergency often has fatal consequences. A preventive approach to emergency planning should explore ways to build reserve capacity into crucial but overextended health care and public safety systems.

- Provide a shuttle or “dial a ride” type transportation service to medical facilities outside of Rio das Pedras<sup>56</sup>
  - Coordinate with “Samu” ambulance service to improve response time
  - Address non-urgent transportation needs in collaboration with APE 4.0
  - Within Rio das Pedras use small electric carts to help people reach the family clinic, and help community health workers reach homes efficiently
- Expand access to health care by increasing the community health worker workforce, resources, and training<sup>59</sup>
- Use schools and other community locations as a new point of intervention for health check-ups– e.g. annual physicals and immunizations conducted in school to facilitate preventive care<sup>60</sup>
- Build an UPA – or urgent care center – that will serve as an immediate point of care for emergencies. Includes the resource of ambulances which currently don’t exist in Rio das Pedras.
- Incorporate telemedicine into Rio das Pedras health system to increase availability for consultation on weekends

#### IV. Housing and Economic Opportunity

Informal areas around the world are rapidly being reshaped by the arrival of new residents from other regions or from rural areas. These new migrants are typically people with deep ambition to work and invest to better their lives, to benefit from and contribute to the resources of the city. Yet without long-term planning, urban growth and housing wont effectively protect and promote their health and wellbeing.

- **Program to engage local residents in staircase repairs or other assistance with path maintenance by request, especially for elderly or disabled residents<sup>62</sup>**
- **Install a participatory model to fund and train RdP residents to assist with litter removal as well as with other infrastructure improvements**
- **Build a sustainable model to engage residents in cell phone based crowdsourced data collection (e.g., on standing water) and to share information regarding emerging problems and emergencies**
- **Replace “amiante” roofing with non carcinogenic materials (properly disposing of old materials)**



#### V. Food systems

Both malnutrition and obesity are striking threats to health in urban populations, increasing vulnerability to multiple acute and chronic conditions. Meanwhile, inefficiencies and waste keep the available nutrients from reaching the plates of those who most need them.

- **Reclaim trash-filled spaces as community gardens, and collaborate with produce-sellers at the market to build a sustainable funding model**
- **Infrastructure for resident-led cooking classes in a teaching kitchen, encouraging intragenerational sharing of food preparation skills**



While this list has been assembled as a set of independent possibilities, implementation would clearly benefit from coordination and integration. Further, the synergies across multiple investments will be maximized with coordination and a recognition of local expertise – that of the residents themselves. Finally, beyond the crucial goal of improving health, the action strategies listed here would also be relevant to other goals to improve equity, sustainability, and resilient, each of which are desirable for longer-term health-supportive environment.

One overarching consideration is the need for local buy-in and ownership across the majority of these suggestions. This will be crucial to maintenance of infrastructure and community use of new resources. From vector control to improving pedestrian safety, persistence will be required in order to, ultimately, positively transform resident health.

**Cities have the capability of providing something for everybody, only because, and only when, they are created by everybody.**

— Jane Jacobs, 1916 to 2006

# Opportunities for Innovative Data Collection Strategies

Actions to protect health in a given community have the potential to be more broadly implemented if health benefits can be shown through an empirical evaluation of the health impacts. Such efforts should be closely tailored to the pathways linking any particular action to health. Here we highlight an example of innovative mobile methodologies for measurement that could be used in such evaluation efforts.

## Using mobile phone apps to observe changing environments

For improvements to many systems systems, the built environment itself can be monitored using systematic street observation. We used mobile phones to collect data efficiently on hundreds of street segments, including thousands of photos linked to mapped locations. In the street observations, cell-phone images were captured to show various elements of the environment including local infrastructure, and building and street conditions. These images can be used to identify, measure, and characterize the conditions within the environment that affect health. With the increasing concerns about mosquito-borne diseases such as Dengue and Zika in this setting, mobile phone based data collection can be used to identify areas of the environment that serve as breeding sites for these vectors. Beyond using this methodology for characterizing the environment, possibilities exist to use it in leveraging community mobilization strategies for improving the environment. For example, crowd sourcing of images can also be useful in involving residents in ongoing data collection efforts to monitor changes in the environment, identify areas of improvement or areas that may require immediate attention to protect the health of the public. We found that 99% of participants had at least one cell phone, making crowdsourced data collection feasible as a complement to collection by the research team. While we collected data from a single snapshot in time, additional insights may be provided through repeated observations of the same street segments across times of day or seasons.



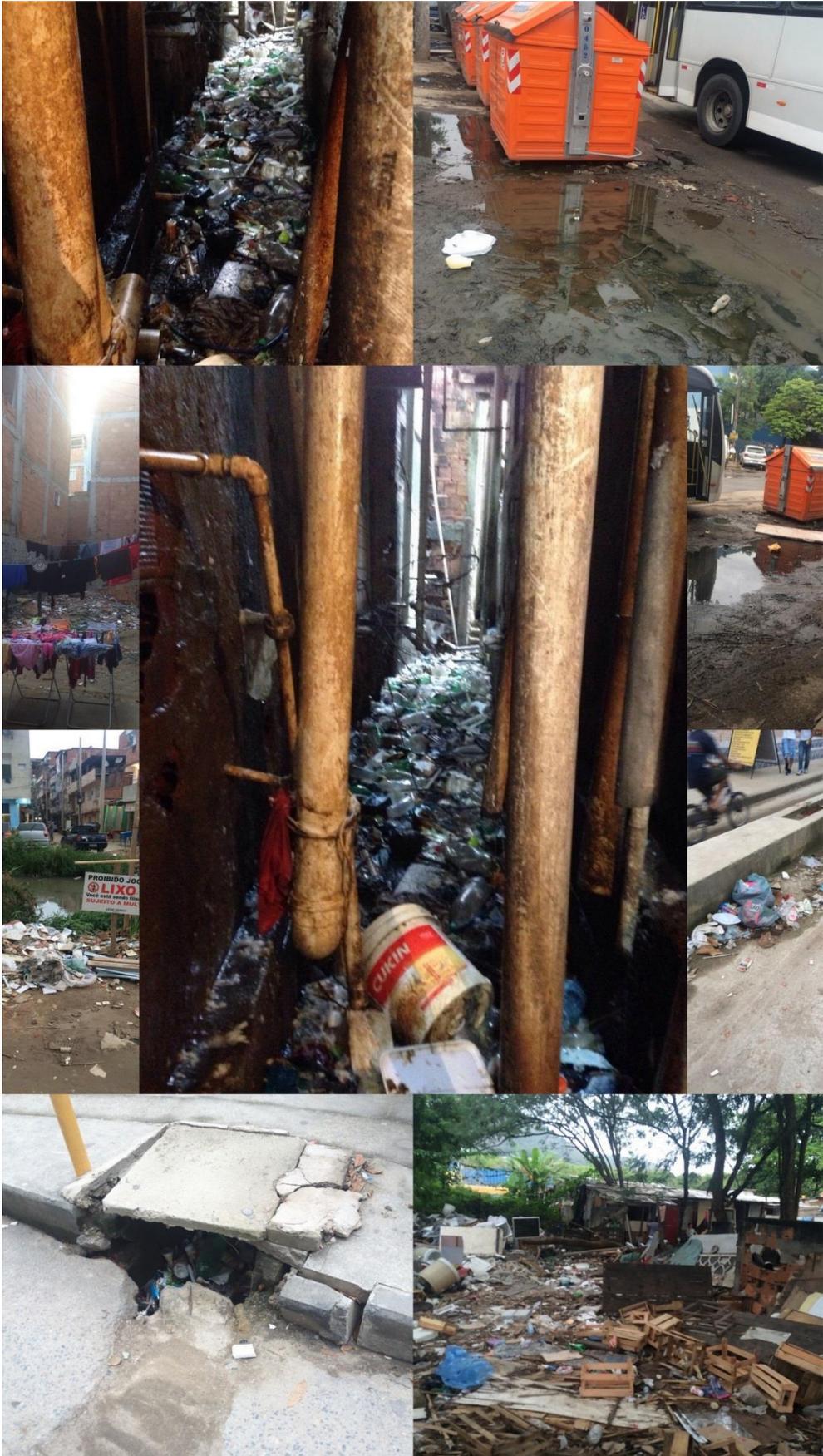
## Deploying devices to understand activity patterns

Further, the intersection of human activity and the environment can be evaluated with limited participant burden using device-based data collection. Mobility patterns detectable through GPS loggers can help to identify where people come into close proximity with local structures that affect their behaviors and place them at risk for disease and injury. Too many studies assume that the home environment captures relevant exposure to the resources and hazards in the local environment. In this setting, GPS technology was used to define patterns of movement among residents and quantify measures and parameters of mobility. Although urban street canyons may contribute to GPS error,<sup>68</sup> such devices provide new insights into daily and weekly travel patterns. Residents asked to wear GPS data loggers as they carried out their normal daily activities were often willing to do so, and 100% of the devices were returned to study staff. The maps showing GPS data points were then used in qualitative interviews, providing opportunities to better understand travel choices and identify opportunities to address barriers encountered by residents.

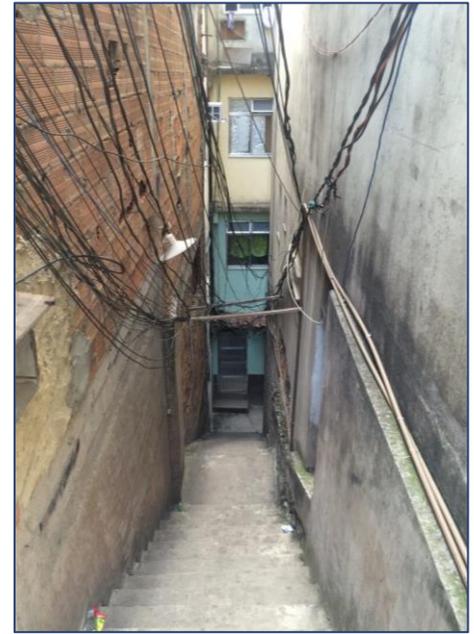


## Additional strategies to detect change with relevance to health

Using technology, including those above and others such as Google Street View,<sup>69</sup> has promise for tracking sustained environmental improvement and human movement. Combining the GPS technology with the systematic observational data collection method can show the extent to which structural environment and resources in the community contribute to patterns of human movement and health outcomes. In addition, for evaluation of sanitation and water system improvements, there are opportunities for measuring changes to the levels of contamination in drinking water, as well as shifts in the human microbiome. Given the possibilities highlighted in the measurement of among the sample of residents and in characterizing features of the neighborhood streets, opportunities exist to innovate and scale up data collection strategies to inform and evaluate investments in other informal communities.



# The Global Context of Urbanization + Informal Communities



## The population health implications of growing cities

Cities are rapidly growing. The majority of the world's population now lives in urban areas. The number is expected to rise to nearly 5 billion by the year 2030 as people are drawn to cities to pursue economic, educational, and cultural opportunities.<sup>9</sup> Our challenge in an era of urbanization is to make sure cities are living up to their full potential.

While urban areas are hubs for economic development and cultural expression, they also present a concentration of the physical and social hazards which can undermine health. Much of the migration to cities is among the poor, and the vulnerability of economically or socially marginalized populations is compounded by conditions that are overcrowded and under-resourced. Local conditions contribute to both infectious

and chronic diseases. Substandard, and sometimes makeshift, housing and transportation can also expose to residents to risk of injury.

Street design can create vibrant areas for physical and social activity, or yield unsafe road conditions for drivers and pedestrians alike while vehicles increase pollution and exposure to airborne toxins.<sup>28</sup> Businesses along those streets can provide fresh foods, or calorie-rich foods linked to unhealthy diets.

To create the conditions for healthy lives, therefore, the future of cities must be designed for health. Further, attention to co-benefits beyond health are needed: to provide opportunities for the old and the young, ensure access to services and the benefits of urban life, promote equity, and achieve environmental sustainability.

The potential for local conditions to better support health is particularly salient within informal communities such as Rio das Pedras, which house a growing portion of the world's population. Informal communities are settlements within or on the periphery larger cities worldwide. Commonly referred to as slums, informal communities are shaped in different ways across the globe, and often home to people with distinct social and political cultures. These communities are often wrought with poverty and suffer from poor infrastructure and a lack of formal engagement with city services. The physical and environmental deficiencies in neighborhood such as these provide opportunities for improvement that can benefit human health and disease prevention throughout the larger city.

# + UN Sustainable Development Goals

In September of 2015, world leaders pledged action on a broad sustainable development policy agenda before 2030. One of the 17 goals was devoted specifically to improving cities and urban environments.

Goal 11: Make cities inclusive, safe, resilient and sustainable.

- 1) Ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums
- 2) Provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety
- 3) Enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries
- 4) Strengthen efforts to protect and safeguard the world's cultural and natural heritage
- 5) Significantly reduce the number of deaths and the number of people affected by disasters
- 6) Reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management
- 7) Provide universal access to safe, inclusive and accessible, green and public spaces



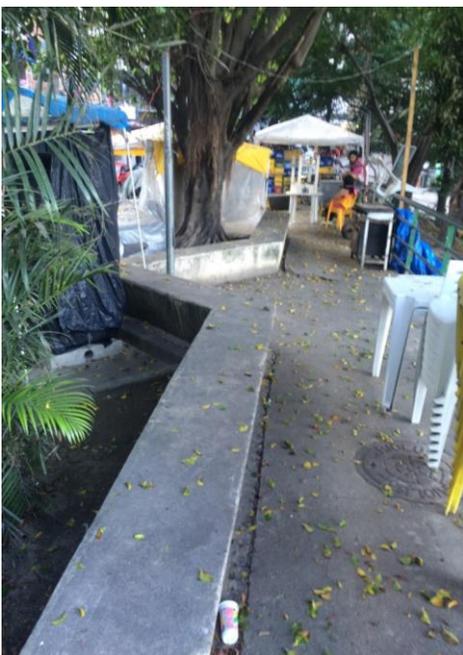
## A time for informed action building on past experience

Why are some populations healthy and others not? Clearly populations are, at their core, a sum of the people who live within them. Therefore, healthier people make for healthy populations. What makes people healthy, however, is not so easily defined. Populations are greater than the sum of their parts, and physical and institutional structures influence the health of the residents. The health of local residents is inexorably influenced by local factors over and above individual behavior or experience. For example, the presence of insufficient sanitation systems or crowding can set a 'ceiling' on whether individuals can act to stay healthy and limit their own risk of disease. Commensurately, having more resident interest in addressing health hazards in a particular residential area translates into local voices that call for infrastructural improvement, and that in turn influence the individuals' risk of threats ranging from dengue fever and tuberculosis to obesity and injury.

Creating population health then requires two central elements. First, the health care system must be attuned to local health needs and provide optimal care that reflects the needs of the population. Second, local conditions must be right to prevent disease and to promote health.

Many conditions which have profound impacts on population health fall outside of the purview of the health care system. As a result, creating population health requires that municipalities and local organizations invest in the right approaches across many sectors to create healthy and safe communities.

In order for cities to react to the multitude of factors at play and effectively invest in health, a clear understanding of local population health drivers is key. This requires initial investment in understanding the underlying context. Public health leadership should be able to provide the analysis of population health needs as a basis for targeting public health and clinical interventions, in synergy, and for tracking outcomes. The limited information on the health needs in rapidly expanding informal communities leaves stakeholders with little actionable information from which to shape and implement neighborhood-centered approaches to improve health and health disparities in urban slums. While pursuing the sustainable development goals globally, we propose that this is a key moment to bring breakthrough science and transformative action closer together, both within and across cities and sectors.





“A healthy city is one that is continually creating and improving those physical and social environments and expanding those community resources which enable people to mutually support each other in performing all the functions of life and developing to their maximum potential .”

-World Health Organization

According to the WHO, healthy cities aim to:

- create a health-supportive environment,
- achieve a good quality of life,
- provide basic sanitation & hygiene needs,
- supply access to health care.



## Rio das Pedras

The factors that determine health in informal communities such as Rio das Pedras come from multiple systems, ranging from transportation to sanitation. What they all have in common is that lack of resources or coordination contributes to unhealthy environments and to marginalization from the formal sector. Informal physical spaces concentrate and compound the ill effects of poverty, placing people in haphazard and polluted environments. As a result, many informal communities suffer from worse health outcomes than do individuals living in other parts of the city. Heightened levels of chronic and infectious diseases such as zika virus, pneumonia, gastroenteritis, hypertension, heart disease, and stroke are found in these settings, undermining quality of life and life expectancy.

Informal communities are operationally defined by the UN as communities that contain substandard structural quality of housing, overcrowding, insecure residential status, and inadequate access to safe water, or sanitation.<sup>45</sup> They are by definition incompletely integrated into existing city systems of surveillance and service provision. These complex communities have living conditions that matter for the health of the entire city, but are not well understood.

In particular, Rio de Janeiro has over 600 informal communities that vary tremendously in topography, local economy, and health needs. Located in west zone of the city, Rio das Pedras is home to over 63,000 inhabitants and is the third largest informal community or ‘favela’ in Rio de Janeiro. The community has been rapidly expanding since the 1970s and has reached its geographical boundaries with a lagoon to the south, marshland to the west and steep hills to the north. The community has also grown vertically, with multi-story buildings. This rapid urbanization has led to high population density, hectic vehicle traffic, and continuous construction that extends into areas with soil instability. Frequent relocation among residents has complicated efforts to understand daily realities and resident strategies for maintaining existing infrastructure. Even estimations of population size within the community are not agreed upon, as census figures for Rio das Pedras may underestimate the current population.

Further complicating the planning for improvements to health and infrastructure in this environment, the community suffers from seasonal flooding and informal connectivity to municipal services such as water and power. With limited integration with formal urban planning, and life has also been shaped by the local militia. Waste disposal and health services, though expanded in recent years, do not



“Informal or unplanned settlements are often regarded as synonymous with slums. Many definitions emphasize both informality of occupation and the non-compliance of settlements with land-use plans... ‘Slum’, at its simplest, is ‘a heavily populated urban area characterized by substandard housing and squalor.’”

-UN HABITAT

HOW INFORMAL COMMUNITIES COME BY MANY NAMES AND OFTEN PERTAIN TO A SPECIFIC CONTEXT

**Favela** *fa-ve-la* (n) \fə-'ve-lə\  
a settlement of jerry-built shacks lying on the outskirts of a Brazilian city

**Ghetto** *ghetto*, (n) \ˈge-(.)tō\  
1. a part of a city in which members of a particular group or race live usually in poor conditions  
2. the poorest part of a city

**Township** *town-ship* (n) \ˈtaɪn-ˌʃɪp\  
an area in the Republic of South Africa that was segregated under apartheid for occupation by persons of non-European descent

**Shantytown** *shan-ty-town* (n) \-,ˌtaɪn\  
a town or a part of a town where the people are poor and live in shanties



yet completely address the needs of the community. The end result is that residents of Rio das Pedras encounter barriers to health, despite the Brazilian Federal Constitution ensuring a right to health for all.

In this community health profile we outline what exposures residents of Rio das Pedras face throughout their life. We aim to bring together prior research from similar settings, health surveillance data collected by the federal and city government, street observations and survey data collected in 2015, and perspectives from community residents to inform recommendations on how to create resilient and sustainable conditions for health.



# Health challenges faced by residents of Rio das Pedras:



## Coming into the world: maternal + perinatal health

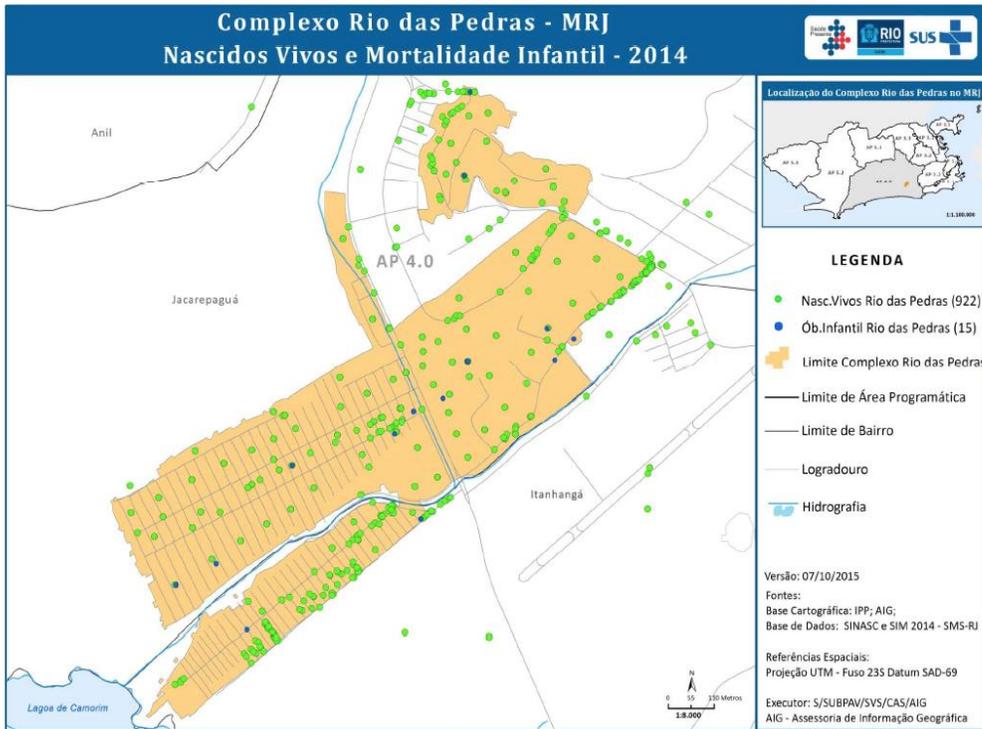
With limited access to perinatal and maternal health resources, children born in many informal communities enter the world at a disadvantage. However, in Brazil strong civil society and political advocacy around poverty reduction and primary health has sharply reduced infant deaths over the last three decades.<sup>21,22</sup> Through national interventions such as the National Women's Health Program (1984) and the National Program for Child Health (1984) there has been increased focus on child nutrition and women's health.<sup>6,22</sup> Vertically integrated health programs structured around immunization, breastfeeding, and oral rehydration became cornerstones of the health system in Brazil in the 1980s.<sup>6,21</sup> These programs were followed by the creation of a tax-funded national health service and the Family Health Program in 1994 that prioritized primary health care in the neediest areas of the country, including informal communities.<sup>20-22</sup>

Since then coverage for family clinics has been on the rise, reaching near universal coverage across the country.<sup>6,21,46</sup>

Large decreases in cause-specific infant mortality has been recorded in the country, with the largest single factors being attributed to deaths by diarrhea which decreased by 92% since 1990, followed by respiratory diseases which decreased by 82% during that same period.<sup>21</sup>

Unfortunately, in Rio das Pedras, infant deaths do still occur. As seen in the map above, in 2014 there were 15 infant deaths and 922 live births in the neighborhood. This infant mortality rate of 16.3 per 1,000 live births is markedly higher than the average rate of 11.3 reported across the city of Rio de Janeiro.

While less attention has been awarded to women's health than to child health, coverage of contraception, antenatal, and delivery care substantially improved in Brazil during these last few decades.<sup>6,54,55</sup> Nonetheless, where family health clinics assist with managing pregnancies and the monitoring of infants, gestating women face other health threats. With no ambulances based within Rio das Pedras,



## + Overuse of cesarean sections in Brazil:

In Brazil, where most maternal and child health indicators are improving, preterm deliveries are on the rise.<sup>6</sup> Many believe this to be due to the overmedicalization of childbirth in the country, where nearly half of all babies are delivered by cesarean section (C-section). Large differentials in C-section rates are seen between the public and private sector.<sup>6,30</sup> While approximately one third of children were born by C-section in the Unified Health System in 2007, four in every five births in the private sector were delivered through C-section.<sup>6,41</sup>

These rates are the highest found in the world, and significantly higher than the recommended upper limits set by the World Health Organization of 15%.<sup>6,30,43</sup> The result, in Brazil, is that prematurity has become the primary cause of death for infants, and has off-set most of the health gains achieved through reducing the incidence of low-birthweight babies in Brazil.<sup>20</sup>

What is driving the rise in unnecessary elective cesarean sections? In Brazil, many women choose to have cesarean deliveries believing it to be a quick and effective method of childbirth.<sup>49,50</sup> Their increasing popularity and frequency has spread the notion that cesareans are harmless.<sup>51,52</sup> Now increasingly, many poor women are following the trends of the rich and demanding that doctors deliver their babies through cesareans believing it to be reflective of a higher standard of care than for vaginal births.<sup>49,51</sup>

there are clear limits to connecting the available health resources to ensure women can access the help they need. In Rio das Pedras, the number one reason residents called the public municipal help line was to request transport for pregnant women seeking to reach the hospital to give birth or for emergency care.

Beyond primary care, high levels of unmet need continue to exist around reproductive health for impoverished women living in Rio das Pedras. Abortion-related complications are a primary cause of maternal morbidity and death in Brazil.<sup>6,57</sup> Far from abating, this is likely to be exacerbated given current concerns over the neurological consequences of zika virus infection during pregnancy, which has led to advice at the national level to delay pregnancy. Yet not all pregnancies are planned. Legal restrictions and uneven distribution in access to safe abortions leads to high numbers of pregnancies being terminated outside of health facilities.<sup>57,58</sup> In Rio das Pedras in 2014, one maternal death occurred, which is still one too many.

Further complicating this issue is the high number of teenage pregnancies.<sup>6,61</sup> It is estimated that more than 20% of all infants in Brazil are born to adolescent mothers.<sup>6,61</sup> In 2014, Rio de Janeiro reported that 16% of all births were to adolescent mothers. Young maternal age and social disadvantage,<sup>61,63</sup> which are prevalent risk factors in places like Rio das Pedras, are both associated with pre-term births. Adolescents are also at heightened risk of maternal deaths and adverse pregnancy outcomes due to a multiplicity of factors, including postpartum hemorrhage, puerperal sepsis, and anemia preterm.<sup>64-66</sup>

Focused attention on perinatal health is not enough to ensure a healthy start in life. To achieve this we must also focus on the physical, cultural, and psychosocial characteristics of the communities in which these children live.<sup>67</sup>



## Growing up: Childhood development + adolescence

Making it through childhood and adolescence in Rio das Pedras has no short list of challenges. Unhygienic settings and environmental hazards disproportionately affect young children.<sup>5</sup> Early childhood behaviors increase children’s exposure to outside pathogens and heighten their risk of infections.<sup>5,7,8</sup> Hand-to-mouth behaviors in early childhood, play and discovery, and underdeveloped immune and gastrointestinal systems make children more vulnerable to disease and heighten their susceptibility to diarrhea, intestinal helminthes, and water borne bacteria.<sup>5,7,8</sup> In 2014, 5% of all hospitalizations for children under 15 were due to infectious and parasitic diseases, and these accounted for 8% of all child deaths in Rio de Janeiro.

Diarrhea and gastrointestinal infections deplete a child’s nutrient stores making them more vulnerable to reinfection and illness throughout the life course. This makes child nutrition one of the strongest proximate determinants of child mortality.<sup>6,33</sup>

Products often used indoors such as insecticides, cooking fuel, and tobacco have been shown to be associated with respiratory problems and allergies in children.<sup>36</sup> In 2010, acute respiratory diseases were the leading cause of hospitalizations in Brazil for children under 14, accounting for 46% of all hospitalizations recorded by the Unified Health System (SUS).<sup>45</sup> Respiratory diseases caused 7% of child deaths in Rio de Janeiro in 2014.

Despite health benefits of active play, when children go outside, their exposures to hazards may increase. Injuries due to external causes such as vehicle accidents are a leading cause of death among children globally, and accounted for 34% of deaths in Rio de Janeiro in 2014 among children under 15. In Rio das Pedras, there is little outdoor space that is safe for play. Children face traffic just outside their doorstep, as one resident described:

***“You have to pay attention because you have cars, motorbikes, bicycles, other people... so if you are walking with children it is dangerous. It’s most problematic on the side streets where many people want to drive their cars or motorbikes as though they are on the main roads.”***



### Recreation space in Rio das Pedras

Physical activity and active play opportunities in the local environment support healthy development. The benefits, however, must be balanced against the potential for increased exposure to hazards during play. From traffic, to environmental contamination, to vector-borne illnesses to which children have not yet developed immunity, there are opportunities to more aggressively protect the spaces where children play.





## + 2016 Olympic Games architecture

The competition venues for the 2016 Olympic Games in the Barra Olympic Park are designed to be dismantled and recycled for public projects. Olympic Hall 4 will be repurposed to construct new schools in Rio de Janeiro. For the Barra area surrounding Rio das Pedras, this “nomadic architecture,” will create three new schools to teach a projected 1500 students.



## Education and schools

Education is critical tool to combatting the cycle of ill health and poverty seen in many informal communities. This has already been witnessed in Brazil, wherein improvements in maternal education over the last few decades has been associated with significant improvements in children’s nutritional status during that same period. This focus on maternal education has come in tandem with large expansions in Brazil’s education initiatives.

### Nursery school and Childcare

Enrollment of children in nursery schools has been on the rise. In Rio de Janeiro in the decade between 2000 and 2010, a 120% increase was seen in the percent of children under the age of three attending nursery schools from 18% to 40%, with over 63,000 of them being funded by the municipality.<sup>11</sup> During this same time the percentage of 4 and 5 year olds in preschools reached 88%.<sup>11</sup> While these advances are encouraging in light of the health benefits of early childhood education, thousands of children are still on waiting lists for nursery schools and others are missing this opportunity for an early start to their education.

### Primary School

The creation of the federal education law in 1988 allowed Rio de Janeiro to adopt a public school open enrollment system. This system provides parents with the option of electing a school outside of their neighborhood and guarantees every enrolled student access to free public transportation.<sup>39,40</sup> Through this arrangement, in the 2010 schoolyear, 34% of Rio de Janeiro’s school children traveled more than 1km to attend one of the 1070 schools in the city.<sup>39</sup> While children may leave Rio das Pedras, within the community six municipal and state schools exist, teaching over 7,000 students annually. Nonetheless, 8% of 8 and 9 year olds in Rio de Janeiro reported as illiterate in 2010.<sup>11</sup>

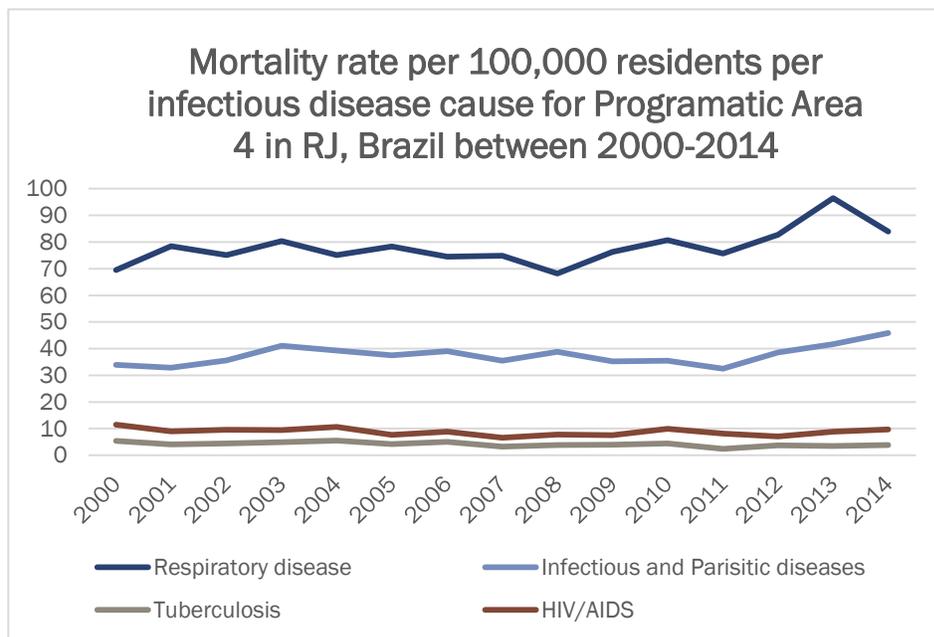


Among adults aged 25 or over, educational attainment varies in Rio das Pedras. The adult population consists of mostly migrants from the Northeast who come with varying levels of literacy from their home state. In the neighborhoods of Areal and Areinha, most adults had attained some secondary education (27%), another 20% had completed secondary school, and 6% had some tertiary education or above. However, 8% were illiterate or had under 1 year of schooling, another 16% had some primary education and 22% had only completed primary school. In other words 46% of the adults interviewed in the south-western zone of Rio das Pedras had below a 6<sup>th</sup> grade education.

# Transmission potential: infectious and vector-borne illnesses

Deaths due to communicable diseases have decreased considerably in Brazil over the past century. While previously infectious diseases caused over 50% of deaths in the country, in the last decade they accounted for 5% of all-cause mortality.<sup>10</sup> This marked decrease can be attributed to a multiplicity of factors in Brazil from sociopolitical forces like globalization and increasing urbanization to specific improvements in Brazil's health sector such as expanded vaccination coverage and health care access, and developments in other sectors that have improved access and quality of water, basic sanitation infrastructure, and adequate housing.

During the last three decades, Brazil has been able to eliminate polio (1989) and measles (1999) and control many parasitic and vector-borne diseases with long transmission cycles such as Chagas disease and Schistosomiasis.<sup>6,10,16,17</sup> Additionally, the incidence of cholera, mumps, diphtheria, typhoid and leptospirosis have considerably declined due to more hygienic environments and effective vaccines<sup>10</sup>. Nonetheless, despite these significant improvements, infectious diseases remain a public health problem in Brazil and absorb a considerable proportion (13%) of health care resources<sup>10,38</sup>.



Human migration to cities has allowed previously rural illnesses to infiltrate urban areas of Brazil, spreading the geographical reach of sexually transmitted illnesses, as well as introducing new pathogens from abroad such as the H1N1 influenza virus.

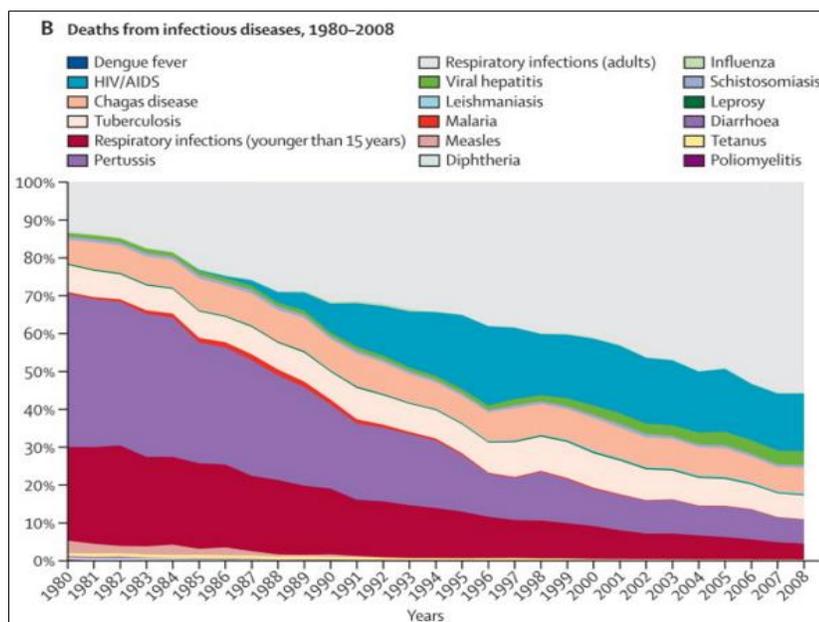
In cities like Rio de Janeiro, the reintroduction of the mosquito *Aedes Aegypti* has established a resilient vector that has fostered successive dengue epidemics and has now become a carrier

for emerging diseases like Chikungunya.<sup>10</sup>

Today in places like Rio das Pedras, a range of infectious diseases have room to thrive. Attending to the health needs of this population, and to conditions of urban environments that can amplify the spread of disease, has the potential to also reduce risk throughout the city.

## Respiratory Diseases:

While deaths due to infectious diseases in Brazil have been on the decline since the 1980's, the proportion of these deaths due to respiratory infections has been steadily increasing. This shift is one more commonly seen in high-income countries, where conditions like pneumonia is contracted in hospitals or starts more frequently affecting ageing populations. In the area around Rio das Pedras, respiratory diseases have killed more individuals than all other infectious and parasitic diseases, HIV, and Tuberculosis combined between 2000 and 2014. In other words, respiratory diseases have caused 60% of the disease burden due to infectious disease found in the area.



## Water-borne Diseases:

Piped water in Brazil has become near universal, increasing from 52% across Brazil in 1980 to nearly all households (99%) in Rio das Pedras reporting piped water in 2015. Paired with expanded use of oral rehydration therapy, diarrhea related morbidity has considerably been reduced and the incidence of stillbirths has declined by 95%. Nonetheless, contaminated water can be found in water reservoirs around Rio das Pedras, often showing the presence of total choliform bacteria (22%) or even *escheria coli* (*e.coli*) (3%). The presence of these pathogens is also exacerbated by unhygienic sewage disposal in the area.

## Vector-borne Diseases

The urbanization of mosquito borne diseases is a fairly recent phenomenon in Brazil. The physical environment that exists in favelas like Rio das Pedras allow for prime conditions for this type of disease transmission. In Rio das Pedras we see high population density and limited formal access to sanitation services. Specifically, problematic wastewater runoff, sewage overflow, and poor maintenance of the streets lead to constant pools of standing water.

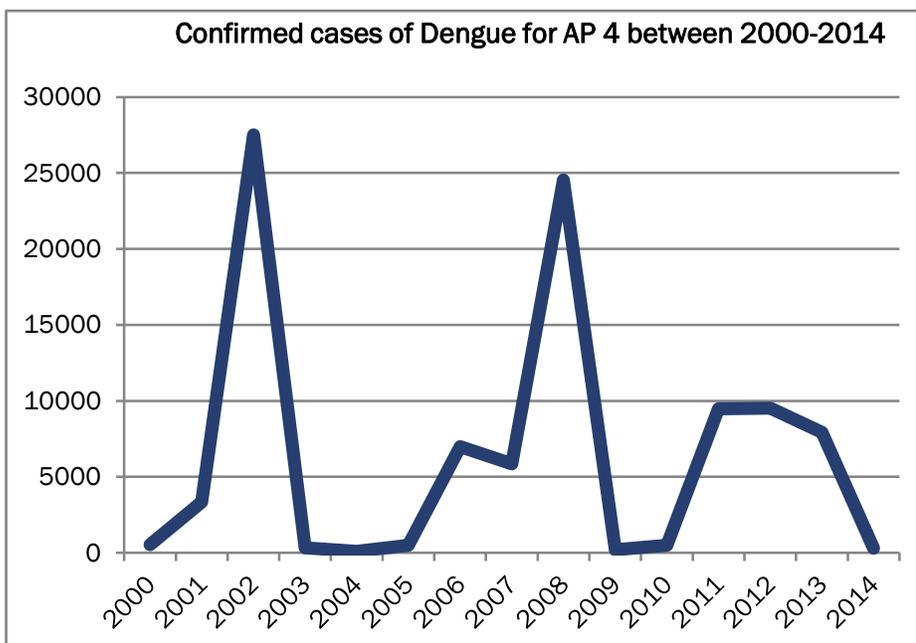
The most prominent mosquito-borne infection in Rio has been dengue until recently. In the last decade Rio de Janeiro has experiences severe dengue fever

the resilient *Aedes aegypti*. Scrambling to contain the epidemic, the short term strategy has been to control the vector with recommendations to delay pregnancy. Mosquito control though isn't easy, with different strains preferring different habitats.

The two most common mosquitoes in tropical urban areas are the *Culex sp* and the *Aedes aegypti*, with different breeding sites and feeding behavior. *Culex* is a nocturnal feeder that lays eggs on the surface of bodies of water, often targeting still or standing water, polluted water, soakaway pits, septic tanks, pitlatrines, blocked drains, canals and abandoned wells. *Aedes aegypti*, on the other

Hand, put the eggs above the water line, where they resist dessication for months, preferring clean water for breeding in storage tanks and jars, plant pots, roof gutters, and litter that can hold rain water such as jars, tin cans, and bottles.<sup>3</sup> However, elimination of mosquitos has relied historically on using substances with their own health implications, such as DDT.<sup>27</sup>

**Beyond recommending personal protections to avoid contact with mosquitos, vector control strategies should engage communities and be attentive to the ways urban contexts can become less hospitable to disease-carrying vectors.**





## Health Habits: Chronic Conditions + Their Risk Factors

Brazil's transition into an upper middle-income country was accompanied by significant increases in chronic disease around the nation. According to the Brazilian Ministry of Health, cardiovascular problems, such as heart attacks and strokes, are the leading cause of mortality among Brazilians. In 2007, approximately 72% of deaths in Brazil were attributed to non-communicable diseases (NCDs) such as respiratory conditions, diabetes, cancer, and cardiovascular disease.

These same mortality trends are apparent in the region Rio das Pedras is located in. In 2014, the region's mortality rate was about 353.4 per 100,000 individuals and 49.4% of mortality incidences were a result of NCDs. Of these approximately 3,502 NCD related deaths, 15.8% were a result of heart attacks, 12.5% from strokes, 38.3% from cancer, and 7.4% from diabetes.

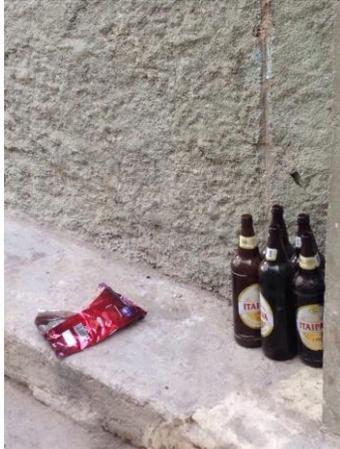
This rise in NCD related mortality has been the result of high NCD incidence in Rio de Janeiro. Municipal data from 2014 indicates that 28.1% of the city's population had a clinical diagnosis of hypertension; while 9.2% were clinically diagnosed with Diabetes and 20.4% were clinically diagnosed with high cholesterol levels. All three clinical diagnoses were highly prevalent in individuals 55 years or older, but all were present in individuals' aged 25-54 years olds. Specifically, 11.1% of individuals aged 25-34, 21.6% of individuals aged 35-44, and 32.5% of individuals aged 45-54 were hypertensive; thus signifying an expanded onset of NCDs in younger populations. Data collected from 104 individual interviews from adults in Rio das Pedras, illustrated that 15% reported being hypertensive, while 20% reported that someone in their family experienced a stroke.

In addition to increased NCD incidence and mortality in Rio de Janeiro and the surrounding region of Rio das Pedras, risk factors such as data show that 19.4% of the city's population was obese with a BMI

obesity is also considerably prevalent in the population. Obesity is a known risk factor for several NCDs, such as hypertension, stroke, and some forms of cancer. Rio de Janeiro 2014 data show that 19.4% of the city's population was obese with a BMI of 30 kg/m<sup>2</sup> or greater. Higher prevalence of obesity was observed in older individuals, with 25.8% of adults aged 35-44 years old and 23.7% of those aged 55-64 years old being obese. However, only 6.8% of individuals aged 18-24 were obese. About 22% of adults with zero to eight years of education and 19.6% of adults with 9-11 years of education were obese. Amongst those with 12 or more years of education, only 15.7% were obese. Based on the data, years of education do not appear to play as large of a role in obesity onset as age.

The behavioral risk factors such as alcohol intake, tobacco use, and obesogenic lifestyles are all potentially influenced by stores and other features the surrounding physical and social environment.





### Alcohol consumption

Similarly to obesity, excessive alcohol consumption can have profound effects on an individual's health and eventually lead to the onset of several NCDs. In Rio de Janeiro, 2014 data [2] illustrate fairly high prevalence of alcohol abuse in all age ranges from 18-54 years old, with a drop off after age 55. About 25.8% of adults aged 18-24 and 24.5% of those 25-34 reported to being alcohol abusers. Educational attainment appeared to be inversely related to alcohol abuse, with 22.1% of those with 9-11 years of education and 22.1% of those with 12 or more years of education reporting abuse, while only 11.4% of those with 8 or less years of education were alcohol abusers. According to the Rio das Pedras individual interviews, 75% of respondents reported to drinking at some point in their lives with 39% reporting current drinking. Amongst current drinkers, an average of 5 drinks per day was reported.



### Smoking + tobacco use

Conversely, risk factors such as tobacco consumption appear to be declining in the nation. With the enforcement of several tobacco related laws through the 1980s and into the early 2000s, Brazil became a world leader in tobacco control. From 1989-2003, data indicate that Brazil experienced a 0.8% reduction in tobacco consumption amongst its population. Higher relative reductions were noted in individuals 15-34 years old, with lower relative reductions in those with less than eight years of education [3]. These trends are observed in the 2014 Rio de Janeiro data [2]. Only 10.5% of the overall population reported being current smokers, with the same response from 8.8% of 18-24 year olds and 11.7% of 25-34 year olds. When considering educational attainment, 10.8% of individuals with less than nine years of education and 11.6% of those with 9-11 years of education reported being current smokers. A slight reduction was found in adults with 12 or more years of education, with only 8.4% being current smokers. In the data obtained from 104 individual interviews in Rio das Pedras, 36% of respondents reported ever smoking and 30.7% reported being current smokers. Of those who did smoke the mean number of cigarettes per day was about 2/3 of a pack (13.2 cigarettes).



### Sedentary lifestyles + dietary choices

Food production and distribution systems, which in turn shape the food environment and dietary intake of individuals, have been shown to affect malnutrition and obesity, both of which are striking threats to health in urban populations, increasing vulnerability to multiple acute and chronic conditions. Beyond the health of the population, management of the food supply and agricultural land has tremendous consequences for our resource consumption and air quality.

Secondary systems of sanitation and transportation potentially intersect with food production and distribution. In particular, sustainable sanitation systems involve resource recovery from food and human waste which in turn feeds back into food production (e.g., through water for irrigation, nitrogen for use in fertilizer), while transportation systems affect the travel patterns of both food commodities and people, constraining or expanding dietary choices available in one's daily life.







## Mobility: physical functioning + disability

The ability to move throughout a community is important for the health of urban residents. In particular, disabled and elderly residents are most at risk for decreased mobility due to environmental factors. Mobility can be supported by qualities like transportation systems, physical neighborhood conditions, green space, neighborhood safety, street connectivity, and community amenities. Socioeconomic status can also impact active behavior; Low income individuals may walk or cycle to work or school, sometimes very far distances, because paying more public transportation is not financially feasible. Nevertheless, those same individuals are less likely to participate in leisure activity.

The walkability of an urban neighborhood is an important determinant of resident mobility. Walkability in an informal

settlement can be influenced by a number of different factors. Traffic and crime are especially relevant when it comes to activity in children. Children are less likely to walk or participate in physical activity when there is a perceived lack of safety. In Rio das Pedras, heavy traffic is a significant issue. Poor road conditions and physical obstructions of sidewalks, including standing water and construction, pushes walkers into the streets. Walkers therefore must share streets with bicyclists, motorcycles, cars, and buses.

Mobility in adults, including the disabled and elderly, is often impacted by city design and transportation systems. The public transportation system in Rio das Pedras is a key strength, with bus routes traversing Rio das Pedras and connecting it to surrounding cities. Rio das Pedras has noted weaknesses, however, in street and housing

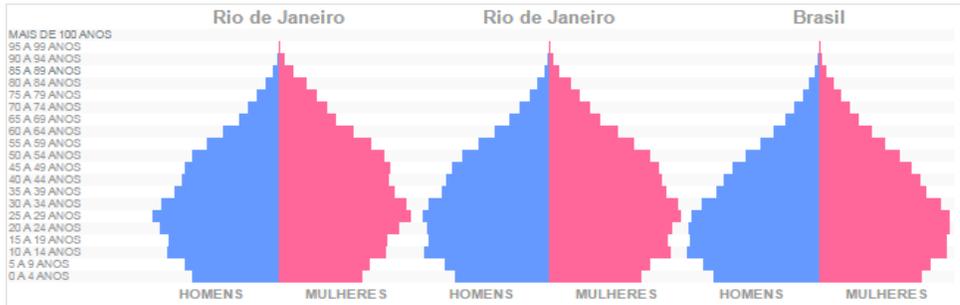
infrastructure. Holes in sidewalks and density of construction materials are fall hazards for the mobility impaired. Rio das Pedras also has many narrow stairways and steep inclines, making it difficult and dangerous for individuals to navigate through the community. Finally, as the population of Rio das Pedras has grown, the community has been growing vertically. Many buildings are multi-story and have unstable foundations, leading to buildings sinking over time and becoming unliveable. Living on a high floor also necessitates daily use of staircases, which reduces the likelihood that the mobility impaired will leave their homes and move around.

Rio de Janeiro is home to the International Longevity Center – Brazil, one of a global network of such centers across 17 countries. The World Health Organization has convened experts to articulate the infrastructure that would make a city age-friendly. Extending this idea to age friendly communities will be crucial as the urbanization and aging of the population continue to unprecedented levels.





# Longstanding residents: how to support an aging population



With the world’s rapid urbanization, there is increased attention being paid to ensuring cities are meeting the needs of an aging population. With about 85% of Brazil’s population already living in urban areas, cities will play a central role in filling the health needs of Brazil’s aging residents.

In Brazil, adults 60 years and older accounted for approximately 11% of Brazil’s total population in 2011. That percentage is projected to reach 29% by 2050. While the population of adults 60 years and over in the city of Rio de Janeiro is about 15% of the total population, Rio das Pedras is a young community. Many young adults migrate to Rio das Pedras to pursue work opportunities, and then return to their home city once they accumulate some wealth. Nonetheless, these trends are shifting with more individuals investing in the community by purchasing real estate. With Brazil’s population aging, there is

opportunity for Rio das Pedras to prepare for an increase in its population of older adults.

The main cause of morbidity and mortality among the elderly are non-communicable, diabetes, and cancer. Non-communicable diseases among Brazil’s older adults now surpass communicable diseases in infants and children as the leading cause of morbidity and mortality. The non-communicable diseases with the greatest death toll in Brazil include cardiovascular disease, cancer, and violence and injury. Throughout the world, there is a noted socioeconomic disparity in the prevalence of these diseases, and Brazil is no exception. Disadvantaged men and women in greater Rio de Janeiro, particularly in slums, experience poorer health than their counterparts in wealthier

areas of the city. At age 65, both males and females in Rio de Janeiro’s slums have a 5-6 year shorter life expectancy than those living in richer sectors.

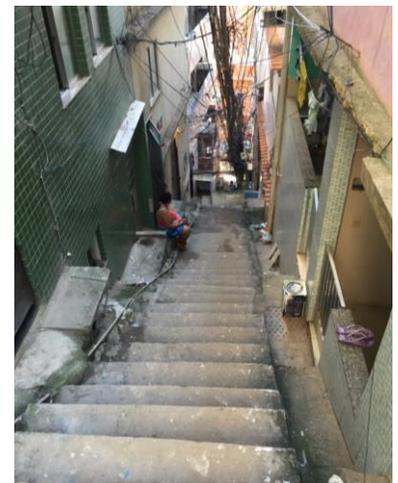
Though older individuals more readily see the effects of chronic diseases, the conditions begin earlier in adulthood and may worsen as one ages. Rio das Pedras may begin to see the impact of health behaviors as their young population ages. Drinking and smoking are fairly common in Rio das Pedras, with about 1/3 of the population reportedly participating in such activities. These behaviors are risk factors for non-communicable diseases later in life, like cancer and respiratory disease. It appears about half of Rio das Pedras’s residents participate in physical activity, which is important in preventing conditions like cardiovascular disease and obesity as one ages.

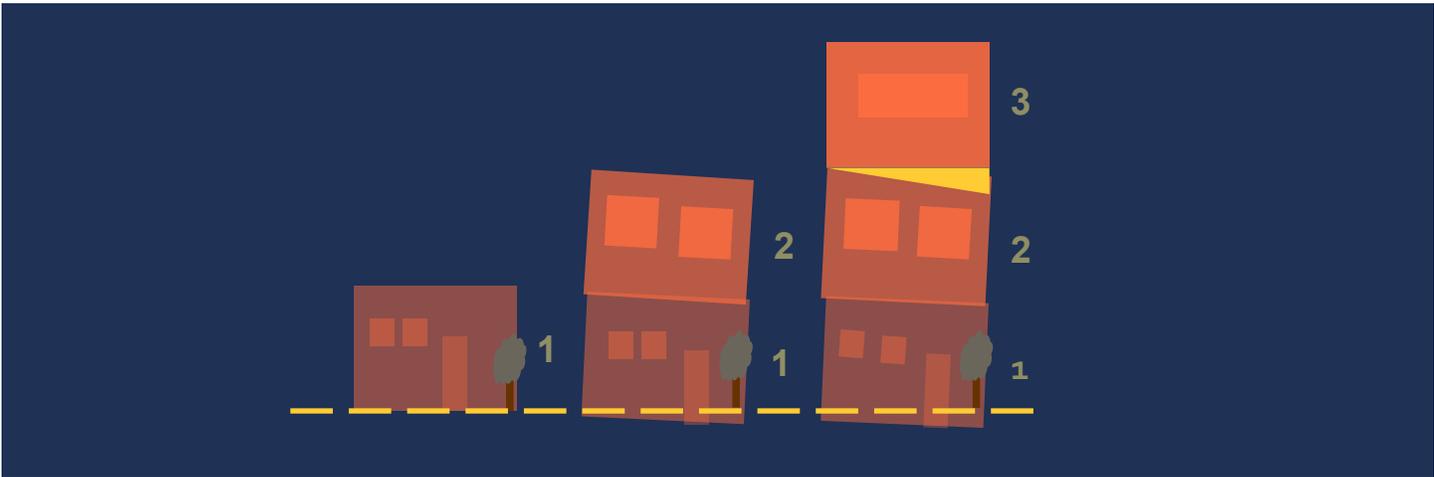
## Mobility and age-friendly environments

Many of the neighborhood conditions that support mobility are also important for healthy aging. Elements like clean and well-maintained roads and sidewalks, accessible transportation, and ramps and handrails help older individuals get around the community more easily.

Rio das Pedras displays many elements of an age-friendly environment, but there

are also areas for improvement. Rio das Pedras’s well-connected streets and robust public transportation systems enable seniors to move throughout the city. Though many of Rio das Pedras’s roadways have sidewalks, they are not very conducive to safe walking for seniors. Many roadways are in poor condition structurally and are fraught with standing water and litter.





## Infrastructure & Growth

Residents living in communities like Rio das Pedras lack many elements of formal urban infrastructure. While the community has schools, churches, and thousands of businesses, basic sanitation, plumbing, and electricity can be haphazard and improvised. The extremely rapid pace of urbanization seen in Brazil has led to fast and unplanned urban growth and difficulties in expanding public services.<sup>12,13</sup> Moreover, informal communities in Brazil often sit on land largely unsuitable for human occupation due to geological and ecological conditions.<sup>24</sup> In 1940 Brazil was mainly rural, today over 80% of the country's population lives in sprawling urban centers, and somewhere between 40-70% of these live in informal communities.<sup>12</sup>

Land subdivision is often irregular in communities like Rio das Pedras, leading to streets and alleys that narrow dramatically or end in stairways, making many thruways inaccessible to vehicle traffic. Meanwhile, the accessible road network supports a hazardous combination of users and functions. Roads service pedestrians, bicyclists, and motorists, leaving little to no designated room for foot traffic. Roads are also designated for traffic, for parking, for the loading and unloading of goods, or even to sell storefront goods and host markets – simultaneously serving as a transit point and a community gathering location. Lastly, streets are often poorly paved, leading to quick quality deterioration and obstacles for transit. Therefore, existing road networks inside informal communities like Rio das Pedras are problematic for their poor condition, conflicting functions, number of users, and inaccessibility to service vehicles<sup>14</sup>.

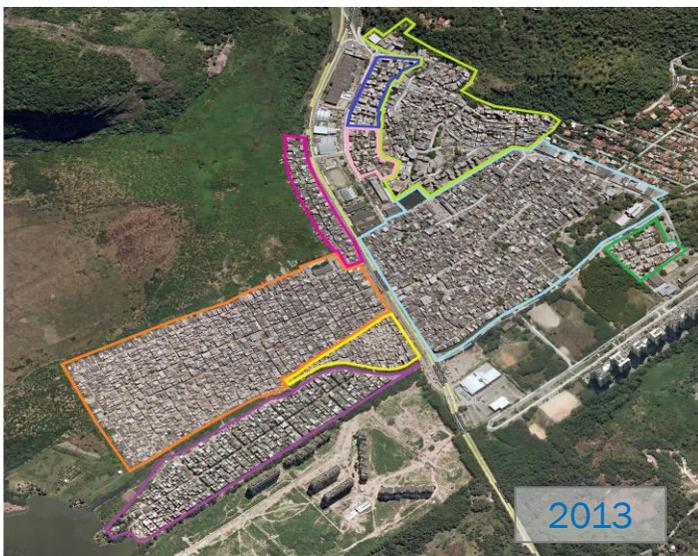
At the same time, Rio das Pedras is geographically positioned for high transport connectivity, centered in Rio de Janeiro's west zone between Barra da Tijuca and Rio de Janeiro's business city center and south tourist zone. As a result, heavy vehicle traffic intersects the community and while this connects the city's urban poor to badly needed city services, it also leads to daily roadside hazards and many pedestrian injuries. In 2014, 34% of traffic related deaths were among pedestrians in the city of Rio de Janeiro. In the area surrounding Rio das Pedras, 25% of injury related deaths were due to vehicular traffic, with 14.5 of every 100,000 residents dying due to traffic related accidents. Thus the chaotic and unplanned road infrastructure results in an unhealthy climate in which pedestrians and motorists commute, live, and play.





Busy streets aren't the only thing affecting healthy roads however. Poor lighting and unstable land also affect roads in Rio das Pedras. Narrow streets and growing buildings prevent sunlight from trickling down and entering homes while a paucity of street lamps keeps thruways dark. The constant expansion and vertical construction of the community has led to encroachment onto unstable land, leading to sinking or insecure residences. Houses in Rio das Pedras are made of brick and concrete and often grow one floor or *laje* at a time, first expanding the favela horizontally and later vertically.<sup>18,19</sup>

Most of these buildings don't abide by building code, instead adapting and growing haphazardly one floor at a time. These unplanned growths paired with poor land stability can create homes that are unfit for habitation. Nonetheless, informal communities like Rio das Pedras are transitioning away from being the poor shantytowns of the past. More and more, city and state authorities are servicing and adding legitimacy to the communities, recognizing areas as neighborhoods and expanding public amenities like trash collection and electricity connectivity. These changes have significant repercussions for residents, touching everything from tenants' rights and land titles, to accessing diverse social services.<sup>32</sup>

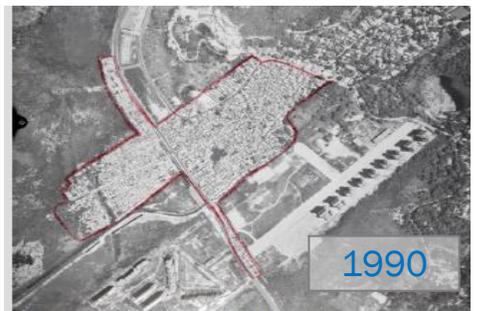


### The social and economic role of LAJES

It is estimated that Rio das Pedras's residents are distributed across approximately 25,000 homes, most of which are vertically integrated structures (small and medium-sized buildings). This intense verticalization of Rio das Pedras is in part due to its flat geography which is unlike other neighboring favelas in Rio de Janeiro that reside on steep hills.

The verticalization of informal communities came from an architectural phenomenon that was locally created and called the "ceiling slab law" which resulted in a disregard of planned construction. Through this phenomenon local residents are able to own the airspace above their home (area directly above ceiling), demarcated by the width and length of the property directly beneath. Residents could then sell this "space" and, with the use of reinforced concrete, expand the community vertically.

As a result it is common to find a "ceiling slab for sale" that provides prospective residents a location to build their new home – upward. This haphazard mode of construction has created a strong informal housing market but has also led to unstable and unsafe buildings that have tipped or sunk under the weight of newly constructed floors.





With rapid urbanization, the growth of certain neighborhoods has at times outpaced the expansion of clinics, as is the case in Rio das Pedras. In Rio das Pedras, currently approximately 40% of residents live within the catchment area of the Otto de Carvalho family clinic, which in 2015 was the only clinic in the community. In March 2015, a second clinic opened, the Helena Besserman Vianna family clinic, which offers hope to more completely connect the community to medical services

For those who are covered, family health teams provide basic primary care services focused around preventive care. Health teams are usually multidisciplinary and monitor resident health both at the clinic and through home visits.<sup>20</sup> These community health workers, physicians and other health professionals serve as a point of contact for addressing health needs and coordinating care between specialists and health services.<sup>20,23</sup> However, when emergencies do occur, all residents of Rio das Pedras must seek assistance elsewhere, traveling to urgent care centers or hospitals outside of Rio das Pedras.

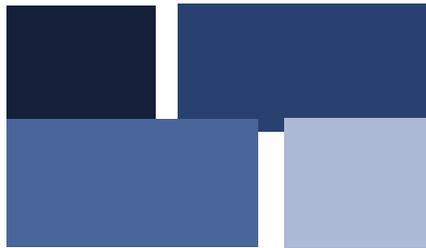


All for Equity

## + 2011 Rio Political Declaration

Convened by the World Health Organization, international leadership gathered in Rio de Janeiro to draft a statement on the social determinants of health.

Priorities and next steps were outlined, making clear that attending to the key determinants of health and health inequity would require investments beyond the health care system.



## Health care services: a focus on dental health

Untreated caries in permanent teeth was the most prevalent condition worldwide in 2010, affecting 2.4 billion people.<sup>1</sup> Brazil has a strong national oral health policy and the prevalence of dental caries has declined dramatically in recent decades.<sup>2</sup> The Brazilian national oral health policy “Smiling Brazil” (“Brasil Sorridente”) was launched in 2004, and oral health was designated as one of the four priority areas of the Unified Health System (“Sistema Único de Saúde” [SUS]). Prior to the enactment of this policy, oral care was mainly provided by the private sector and the Brazilian public service was limited to school children and very basic curative services. Large segments of the population were excluded from any form of dental care or prevention.<sup>31</sup>

Comparing the 2003 and 2010 Brazilian National Oral Health Survey (“Pesquisa Nacional de Saúde Bucal,” also known as SB Brasil) showed an overall reduction in caries

levels (as measured by the DMFT index) in 12-year olds of almost 70% between 1986 and 2010, and 25% between 2003 and 2010<sup>2</sup>. There was also a rise in the number of caries-free individuals.

Nonetheless, despite the improvement in caries status, income and education related inequalities in adolescents have not only persisted between 2003 and 2010 but have even worsened.<sup>25</sup> There were 3.5 more teeth affected by caries in 2010 at the lowest educational level compared to the highest educational level, about three times the 2003 value.<sup>25</sup> Brazilian adolescents also report a high negative impact of oral health on their quality of life.<sup>35</sup>

Regional differences in the caries experience and periodontal disease have also been observed by several authors, with the poorest areas of Brazil having more caries than the wealthier regions in the Southeast and

South.<sup>2</sup> In addition, racial and socioeconomic inequalities in oral health have been reported, with Brown and Black children and those from a lower income family having a higher prevalence of untreated caries,<sup>4</sup> or being more likely to have periodontal disease.<sup>29</sup> Gender and racial inequalities have also been reported for oral cancer mortality<sup>37</sup>

Lastly, while the Smiling Brazil initiative has improved access to oral health care, and 1 out of 4 dentists in Brazil have ties to the public health services, it is unclear whether the residents of Rio das Pedras favela have adequate access to the public dental clinics.<sup>42</sup> Lower income individuals have limited access to oral health services<sup>48</sup> and the majority of clinics are private dental clinics.

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