The Relationship between Mental and Environmental Health in Urban Salvador Brazil: Development of a Research Protocol

ABSTRACT

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By

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Abstract:

This capstone was created to examine the association of environmental factors and measure of health including mental health in residents of four communities in Salvador, Brazil. Researchers collected data from self-reporting a standard form questionnaire to gain the perception of 1,128 Salvador residents on their living conditions and their daily mental and social well-being. Results indicate differences in physical and mental health across neighborhoods but not a significant association with access to environmental measures linked to water and sanitation via flooding and sewer problems. In addition to analysis, literature was reviewed and a proposed activity for further research is proposed.

The Relationship between Mental and Environmental Health in Urban Salvador Brazil: Development of a Research Protocol

by

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Author's Statement Page

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___Rashad Malik Parmer______________

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Introduction:

Brazil is a country with tremendous natural resources including one of the most expansive bodies of water in the world- The Amazon River. As a result, in many areas, the quantity of water in Brazil may not be an issue. However, the quality of water and the ability to drink the water continues to pose problems in both urban and rural settings in the country. In an article by Zini et al., 2021, based off the 77 parameters evaluated in drinking water, only 23 meet the standard of Brazilian drinking water from underground, surface, and rainwater (Zini 2021). The main sources of water pollutants were from soil components, mining, sewage, and agricultural activities (Zini 2021). Of particular interest is the areas in Brazil that house densely populated urban centers with disadvantaged residents often called favelas. In addition to understanding the factors that contribute to the contamination of the water, it is important to understand how these are related to both physical and mental health. In these high-density, low-income communities, there is a high incidence of disease due to poor sanitation, inadequate waste management, and inadequate environmental infrastructure. The presence of trash, open sewers, standing water, and rodents contribute to the incidence and transmission of illnesses such as leptospirosis. (Palma 2022).

While the absence of clean water jeopardizes physical health through many waterborne and vector-borne illnesses, there is a growing interest in the relationship between environmental conditions such as lack of access to safe water and sanitation and psychological well-being. We present the research question: Do factors related to water and sanitation, as examined through flooding and sewer problems show association with measures of mental health. This capstone will focus on examining data collected related to environmental conditions in Salvador, Bahia, Brazil and self-reported psychological well-being. In addition, it will identify steps to perform qualitative research to further understand the relationship between environmental conditions and psychological well-being in four communities of urban Salvador.

Review of Literature

Water and Sanitation and Mental Health

Access to water is vital to the growth and development of a population. The access to clean water is crucial to the prosperity of that said population. According to the (WHO and UNICEF 2015), approximately 663 million people do not have access to clean drinking water. According to the WHO and UNICEF, we can define clean water as not having access to water sources that do not have erected physical barriers to prevent fecal contamination. To add on, 2.5 billion individuals in the world do not have access to basic sanitation methods to hygienically isolate themselves from human excreta (WHO 2015). This can clearly show the pressing need for interventions of public health. For more than 20 years, water and sanitation initiatives have been improving and promoting human physical health through reduced contact with disease causing microorganisms. There has been substantial focus on reducing waterborne and vector borne illnesses like those linked to diarrhea and leptospirosis. On the contrary, there are not many studies to show the negative effects of inadequate water services on human mental health. Specifically, these studies focus on water insecurity and scarcity (Bisung and Elliott, 2017, Wutich et al, 2020, and Toivettula, 2023). We have yet to find a thorough assessment on lack of access to adequate water and sanitation and the mental health effects outside of previous studies related to water insecurity and water scarcity (Toivettula 2023).

Current research suggests that water scarcity does have a significant effect on human mental health. Water scarcity presents many stressors into a human's environment leading to feelings or introductions into full anxiety or depression. While these issues can be significant, few cases are reported. There are limited studies for reporting results in lower income areas with limited access to healthcare (Toivettula 2023). These outcomes and/or stressors can be due to social inequality, water price, fear of disease, time to fetch water, shame due to dependence on others, and more (Toivettula 2023). While research is limited in the effects of water sanitation and mental health, we can argue that water quality and quantity are not the only determinants of mental health. While lack of clean water is a key stressor, there are a multitude of determinants that build the barrier contributing to this disparity. Further research will help to understand specifically the effects of environmental health in the form of inadequate water and sanitation conditions and the effects on the mental health of individuals.

Mental Health and Environmental Conditions in Brazil

Brazil is a populous nation that contains many highly populated urban areas known as favelas. These dwellings have a dense number of individuals living in close quarters with non-optimal access to clean water. These neighborhoods are often on hillsides and are susceptible to flooding. In addition to waterborne disease, other illnesses related to flooding and lack of access to sanitation contribute to contamination of Brazil's portable water. Additionally, diseases related to environmental contamination include diseases such as leptospirosis, a vector borne disease that can be easily spread within the close quarters of the favelas.

Leptospirosis is a bacterial disease usually associated with rural workers. (Ko et al., 2019). There is a demographic shift occurring as this disease is spreading to urban highly dense populations (Ko et al., 2019). The usual mechanism for Leptospirosis is skin contact through water and soil exposed by rodents, the most common being rats (Ko et al., 2019). Leptospirosis is commonly seen in impoverished communities taking claim of 58,000 lives annually and infecting over 1 million individuals (about the population of Delaware). (Costa 2015). Brazil currently holds 40% of the annual 10000 human cases. (Schneider 2017). Salvador city is a major port city and capital of Bahia Brazil. Within Salvador are favelas that lack adequate infrastructure, and residents often face challenges to access clean water directly(Palma 2022). As a result, residents of favelas find themselves at higher risk of both waterborne and vector borne diseases such as leptospirosis making this an ideal city to examine.

Studies in Brazil are consistent in their focus on the effects of clean water on the physical health and the mitigation of leptospirosis (Cremenose et al 2023, Khalil 2021, Toivettula 2023). Evidence shows an association with presence of mental illness and the frequency and severity of chronic illnesses (Cremenose et al 2023, Khalil 2021, Toivettula 2022). An environmental aspect that has been identified as a risk factor for leptospirosis is flooding and sewage problems within Salvador (Cremenose et al., 2023). Research attests that water and sanitation issues through flooding and sewerage are the leading contributors to the leptospirosis spread. However, literature adds that water and sanitation are not the only factors as there are other determinants including social factors. (Khalil et al 2021 and Toivettula 2023). We need more research to understand the relationship more clearly between the effects of water and sanitation and the mental health of Brazilians. In a broad study of the link between water and mental health, we can argue that poor water quality is a psychological stressor. However, we can add that there are also various other inequalities that can be just as significant in determining the effects (Toivettula 2023). These inequalities include race, family income, neighborhood, marital status, and family demographics.

In Brazil, mental health conditions account for almost 33 % of chronic non communicable diseases in the entire nation (Araújo, T. M., & Torrenté, M. O. N. (2023)). As the study states, there are more cases and incidences of mental health conditions within Brazil. While the majority may or may not be in the Salvador region, these cases are in Brazil and warrant further study. While mental health disorders may not delve into a stage of depression, more research is needed to be done to factor in the middle ground such as anxiety, constant sadness, and lack of energy (Araújo, T. M., & Torrenté, M. O. N. (2023). The mental health governing bodies established within Brazil are facing a transitionary period where progress is impeded by the difficulty in building behavior models and protocols that do not have generational foundation in structural racism and patriarchy. (Araújo, T. M., & Torrenté, M. O. N. (2023) Also, the studies on mental health and mental health education have faced a drastic decline as the system has become oversaturated due to the mental effects of the COVID 19 Pandemic. (Araújo, T. M., & Torrenté, M. O. N. (2023).

Brazil is riddled with social inequities and oppression that is the opposite function of an effective physical care model leading to issues in the mental well-being of a population (Araújo, T. M., & Torrenté, M. O. N. (2023). Just as with general studies, access to water and sanitation is a leading disparity. However, it is also linked to many disparities and inequalities in this diverse population of people.

Methods and Analysis

In this preliminary investigation, data set was drawn from the SF12 questionnaire. Participants were surveyed in a larger project studying sanitation and leptospirosis in four communities in Salvador, Bahia, Brazil. This questionnaire was used to evaluate physical and emotional well-being. The data collection process involved datasets from each neighborhood, with recording of responses to the SF12 questionnaire. The SF-12 questionnaire survey, a shortened version of the SF-36 Health Survey, is a widely used tool in health research and healthcare evaluation. It is designed to assess the health-related quality of life of survey respondents across various dimensions. The SF-12 questionnaire includes questions related to general health, physical functioning, emotional well-being, and social functioning. Researchers and healthcare professionals use the survey to gather data on a broad range of health outcomes, allowing for the comparison of different patient populations or the evaluation of interventions.

All data used in this project was de-identified. The collected data was collected at individual and household levels. All data analysis was completed using R. Initially, a summary of the 12 key questions in the SF 12 questionnaire was generated and stratified by the respective neighborhood involved in the study. The neighborhoods included these four areas within the city of Salvador: Arenoso, Calabetão, Nova Sussuarana, Stol-Nacio/MataEscura. After initial summary of the SF12 questionnaire, we compared the neighborhood reported problems with flooding and sewage problems and bivariate associations with the SF12 variables. This comparative analysis aims to uncover patterns and variations in health and well-being across different city populations, shedding light on the broader implications of environmental factors on mental health within urban communities.

The initial analytical approach employed the chi-square test to test significant difference between SF12 variables. Next, the association of SF12 variables within each neighborhood was examined. Univariate analysis were conducted to assess the relationship between environmental factors- flooding and sewerage. After testing of significant differences, odds ratios were calculated for the environmental factors of sewer problems and flooding and the SF12 responses.

Results:

The self-reporting questionnaire was comprised of many variables. These two environmental factors, Flooding and sewage problems were strategically chosen as they center on our main concern of water sanitation and its effects on mental health. We aimed to investigate associations with environmental conditions, links with mental health, and how it is perceived by the Salvador Residents.

In table 1, we have formatted the responses for our questioning of flood recently in the neighborhood. As shown in the table, significant differences between the four neighborhoods and flooding were identified. This finding can suggest that flooding varies between the neighborhoods and with some individuals reporting greater problems with flooding in their neighborhood than others. However, as shown in Table 2, individual issues with sewer problems were not significantly different between the neighborhood level responses. No significant difference in responses shown can suggest sewage issues and water contamination in that aspect to be consistent between neighborhoods. This finding can allow us stronger confidence of comparison when investigating an association between these environmental factors and the mental health of the residents in our bivariate analysis.

In Tables 3 and 4 we examined the association of neighborhood flood and sewage problems, environmental factors, and its effects on the mental health through this self -reporting questionnaire. As shown in Table 3, two areas of SF 12 were associated with individuals who reported neighborhood floods. These include impacts of moderate activities and health interfering with social activities in the neighborhood of Calabetao. In table 4, we see significant differences in all neighborhoods except Nova Sussarana. In efforts to focus on mental and emotional health, we see a significant effect on emotional conditions related to work and home activities in the neighborhood of Arenoso thus suggesting sewage problems to be indicator of a determinant of mental health.

In tables 5 and 6, we calculated the odds ratios ratio for flooding vs self-reported well being and sewerage and self-reported well-being. In Nova Sussarana, residents are 4.91 times more likely to report feeling calm and peaceful when it is flooding than when it is not. This was the largest ratio seen. In Stol Nacio, there are more consistent odds ratio larger than 2. Here residents are 3.78 times more likely to report that emotions do not affect work obligations when their neighborhood has flooded. In Calabetao, residents are 0.005 times more likely to be energetic when their home their neighborhood has been flooded.

In table 6, we see a significant odds ratio in the first sf12 variable. Here the data tells us that those who experienced sewerage issues were more likely to report emotions to affect obligations at work. We see this as well as all cities that experience issues with sewerage were more likely to report difficulty completing moderate daily activities. The data exhibits, with 16 incidents, that were with double likely-hood (odds ratio >2) more significant values in table 6 as those experiencing sewerage issues are more likely to report of some type of emotion problem listed.

Flooding: Has your neighborhood flooded in the last 6 months?				
		No	Yes	
	Arenoso	62	46	
	Calabetao	100	21	
	Nova	84	39	
	Stol Nacio	58	57	
x-squared	258.68			
df	6			
Pvalue	2.2^ -16*			

Table 1: Neighborhood Flood Self Reported Responses

Sewerage: Has your neighborhood experienced any sewerage issues?				
		No	Yes	
	Arenoso	108	65	
	Calabetao	104	90	
	Nova	119	81	
	Stol Nacio	122	68	
x-squared	6.0902			
df	3			
Pvalue	0.1073			

Table 2: Sewerage Self Reported Responses

Chi-Squared test between Neighborhood Floods and Self Reported Wellness in Salvador Brazil				
Floods				
	Arenoso	Calabetao	Nova	Stol Nacio
	pvalue	pvalue	pvalue	pvalue
Health Rating	0.4944	0.251	0.7891	0.8816
Moderate Activities	0.3635	0.02686*	0.9987	0.7414
Current Health Difficulties	0.3884	0.4997	0.5186	0.5924
Less Activity due to Health	0.05228	0.2962	0.2141	0.3961
Health affecting Work	0.3416	0.3013	0.6638	0.9046
Activity Carefulness	0.5339	0.4037	0.7895	0.6349
Emotions affect Activities	0.3613	0.2524	0.5194	0.7041
Emotions affect work	0.3416	0.3013	0.6638	0.9046
Pain affects work	0.8283	0.0816	0.8261	0.8685
Calm/ Peaceful	0.6666	0.6122	0.7662	0.6348
Energetic	0.892	0.2436	0.3091	0.7208
Depression/Discouraged	0.7422	0.4558	0.896	0.4947
Health interferes with social activities	0.97778	0.008341*	0.9445	0.5087

Table 3: Neighborhood Floods vs Mental Health

Chi-Squared test between Sewerage and Self-Reported Wellness in Salvador Brazil				
Sewerage				
	pvalue	pvalue	pvalue	pvalue
	Arenoso	Calabetao	Nova	Stol Nacio
Health Rating	0.0045*	0.1643	0.8194	0.1105
Moderate Activities	0.02237*	0.05559*	0.8422	0.1084
Current Health Difficulties	3.59 e^-5*	0.9742	0.119	0.8042
Less Activity due to Health	0.2212	0.4398	0.6439	0.04784*
Health affecting Work	3.60E-05*	0.3919	0.06385	0.7889
Activity Carefulness	0.0045*	0.02477*	0.1446	0.3769
Emotions affect Activities	0.02237*	0.3074	0.07489	0.7321
Emotions affect work	0.00003598*	0.3919	0.06385	0.7889
Pain affects work	0.2212	0.6558	0.8922	0.439
Calm/ Peaceful	0.03893	0.1778	0.5789	0.006987*
Energetic	0.2877	0.5914	0.08347	0.01341*
Depression/Discouraged	0.2105	0.9486	0.7156	0.07759
Health interferes with social activities	0.1625	0.3447	0.2137	0.02073*

Table 4: Sewage Interference vs Mental Health

Flooding				
	Arenoso	Calabetao	Nova	Stol Nacio
Emotions affect work	2.34*	0.91	1.92	3.78*
Pain affects work	1.06	0.29	0.24	1.63
Moderate Activity	3.42*	0.85	1.97	4.03*
Health difficulties affect activities	1.70	0.51	1.36	2.69*
Less Activity due to Health	1.80	0.70	1.45	2.56*
Health affects work	2.01*	0.82	1.49	2.69*
Peaceful/calm	0.065	0.01	4.91*	0.032
Emotion Problems affect activity	2.01	0.66	1.33	2.67*
Energetic	0.031	0.005	0.012	0.048
Discouraged/Depressed	0.61	0.13	0.031	0.97
Health interferes with social activities	1.43	0.16	1.37	3.25*

Table 5: Odds Ratio between Neighborhood Flooding and Self Reported well-being

Sewerage				
	Arenoso	Calabetao	Nova	Stol Nacio
Emotions affect work	2.05*	3.70*	2.81*	2.34*
Pain affects work	0.93	1.24	1.26	0.93
Moderate Activity	3.00*	3.99*	3.19*	2.50*
Health difficulties affect activities	1.49	1.99	2.06	1.67
Less Activity due to Health	1.58	2.09*	2.11*	1.58
Health affects work	1.76	3.36*	2.17*	1.67
Peaceful/calm	0.06	0.04	0.03	0.02
Emotion Problems affect activity	1.76	2.72*	1.95	0.02
Energetic	0.03	0.02	0.01	0.03
Discouraged/Depressed	0.54	0.55	0.88	0.60
Health interferes with social activities	1.26	2.72*	2.01*	2.01*

Table 6: Odds Ratio between Sewerage Issues and Self Reported well-being

Discussion:

The results above are conducive to what we discovered examining the literature. While there is an effect of clean water on the mental health of citizens of Salvador. Clean water sanitation, as measured with flooding and sewerage, alone is not a significant determinant of the change in the mental health of the citizens of Salvador. The literature reveals that sewage and flooding to be the leading contaminators of the drinking water of Salvador. For this reason, we focused on the effects of these two factors and the SF12 questionnaire responses on how such environmental factors can affect their daily life. Just as the literature review reveals, a multitude of factors combined affect the citizens' mental health. Isolating one determinant is difficult in a demographic that has multiple variables. There is more research that needs to be done to address and investigate the mental well -being of the Salvador residents. Through the literature review, there exists focus to lower the spread of leptospirosis, which lowers the effect of an individual’s physical health. To see the effects of the environment on mental health, mental health should be isolated from physical health on clean water and water sanitation should be isolated to produce true results with a smaller risk of confounding variables. Currently, studies argue the mental health of Brazilians to include numerous factors including race, marital status. family dynamics, income, and region. Many factors are used to confound the effects of water sanitation on mental health in the Salvador region. As the mental health system and education rebuilds itself in the post pandemic years, there will be more opportunities for research and further investigation on the environmental effects on mental health in Brazil.

Protocol:

Recruitment

1. Recruit 5,000 Individuals aged 18 years and older to complete this study on water sanitation and mental health.

2. Provide a QR code that leads to the online survey or a mobile health app where participants can answer survey at their own leisure. Ask the individual to complete the individual demographic and the household demographic if they do not live alone.

3. Prior to completing the survey. Ask Participants to not disclose nor discuss their responses with others as this would hinder the efforts to obtain adequate research for the current health status in Salvador Brazil. Ensure not sharing their personal results will ensure accurate research to properly advocate for better water sanitation for the favelas.

4. Individuals will be giving an individual id number that will follow them throughout the study and will be asked to complete survey every three months. Subjects will be giving this ID number and asked to input with QR code or mobile health every time to submit answers to the self-reporting questionnaire. Personal information will be kept on an encrypted spread sheet with access limited to the current research team.

5. Questionnaire responses will be inputted in excel and data will be analyzed using R coding. We shall keep all four cities separate and we will track progress and difference in mental health responses throughout the year. The research team will be looking for indicators of significance, outliers, and contemplate confounding variables that may lead to bias in the data.

Data:

1. Once Data is collected, ensure data remains stratified by city.

2. Using only the individual reported responses, gather a data summary for each sf12 variable question response, the flooding variable, and the sewerage variable. This shall be used as a standard of comparison against environmental variables. Upon examining data summary ensure the number of participants in each group are at 1,000 participants at minimum for each city.

3. After the data summary, conduct a univariate analysis through a chi-squared test on sf12 responses, flooding variable, and sewerage variable. Here you will table and notate indicators of significant differences for each city. All tests conducted should be at a 95% confidence interval.

4. Next, conduct a bivariate analysis through odds ratio. Here we will test if those exposed to flooding and sewerage are affected in ways of their mental well-being. For all SF12 questions that are recording on a lichter scale, mark all responses that are not “No” to be counted as a “Yes". Table these results and notate all values greater than 2 to be significant.

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