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FACTORS ASSOCIATED WITH SELF-REPORTED ARBOVIRUSES IN AN AREA OF EXTREME SOCIAL VULNERABILITY IN BRASILIA, BRAZIL

FATORES ASSOCIADOS A ARBOVIROSES AUTORREFERIDAS EM ÁREA DE EXTREMA VULNERABILIDADE SOCIAL EM BRASÍLIA, BRASIL

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ABSTRACT

This study investigated the association of environmental, demographic, and socioeconomic factors in the poorest area in Brasilia, the capital of Brazil, with the occurrence of self-reported arboviruses. It is a cross-sectional study with a quantitative approach including sociodemographic variables, access to water and sanitation, sewage disposal and living habits. A survey created in Google Forms was sent via mobile phone to the heads of households who lived in the Estrutural area, which hosted the largest open dump in Latin America for almost 60 years. There were 2,176 responses, of which 1,934 (88.9%) were from women, 1,432 (65.8%) from those who had no partners, 961 (44.16%) were illiterate or had incomplete elementary school, and 1,155 (53.08%) reported having already had arboviruses. After the adjusted analysis, storing water in the residence (Odds Ratio - OR 1.58; CI 1.30-1.92), having knowledge on how to prevent arboviruses (OR 2.22; CI 1.61-3.06) and being a waste picker (OR 1.84; CI 1.46-2.31) showed a positive association with self-reported arbovirus, while waste collection was a protective factor (OR- 0.71; CI 0.63-0.92). The influence of occupational and environmental factors were observed with arboviruses. Effective intersectoral measures focused on this vulnerable population are needed in all sectors, including training them to face these diseases.

Keywords: Dengue. Arboviruses. Neglected Diseases. Social Vulnerability. Basic sanitation. Solid Waste.

RESUMO

Este estudo investigou a associação entre fatores ambientais, demográficos e socioeconômicos na área mais pobre de Brasília, capital do Brasil, e a ocorrência de arboviroses autorreferidas. Trata-se de um estudo transversal com abordagem quantitativa

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incluindo variáveis sociodemográficas, acesso à água e saneamento, esgotamento sanitário e hábitos de vida. Um questionário criado no aplicativo Google Forms foi enviado via celular aos chefes de família que moravam na área Estrutural, que abrigou o maior lixão a céu aberto da América Latina em quase 60 anos. Houve 2.176 respostas, sendo 1.934 (88,9%) mulheres, 1.432 (65,8%) não tinham companheiro, 961 (44,16%) eram sem instrução ou tinham ensino fundamental incompleto e 1.021 (46,92%) relataram ter tido alguma arbovirose. Após a análise ajustada, armazenar água na residência (*Odds Ratio* - OR 1,58; IC 1,30-1,92), ter conhecimento sobre prevenção de arboviroses (OR 2,22; IC 1,61-3,06) e ser catador de material reciclável (OR 1,84; IC 1,46-2,31) tiveram associação positiva com arbovirose autorreferida, enquanto a coleta de lixo foi fator de proteção (OR - 0,71; IC 0,63-0,92). Observou-se influência de fatores ocupacionais e ambientais nas arboviroses. São necessárias medidas intersetoriais efetivas direcionadas a essa população vulnerável, incluindo capacitação para enfrentamento dessas doenças.

Palavras-Chave: Dengue. Arbovírus. Doenças Negligenciadas. Vulnerabilidade Social. Saneamento básico. Resíduos sólidos.

INTRODUCTION

The increase in urban population is a growing and complex phenomenon with economic, social, and environmental impacts. According to the United Nations (UN), 55% of the world's population lives in urban areas, and this proportion is expected to increase to 70% by 2050 (UN-HABITAT, 2022). In Brazil, more than 85% of the population lives in cities; and about 20% live in favelas or in irregular occupations, and tenements, places where water supply and regular garbage collection are precarious (VALLE; PIMENTA; CUNHA, 2015). Disorderly growth, poverty, and social inequality are persistent problems in developing countries such as Brazil. Poor sanitation can be considered one of the main aggravating factors of this inequity (BRASIL, 2014). A consequence of this discrepancy is the increase in the number of cases of waterborne diseases and arboviruses among the poorest population, which reflects the need to invest in more comprehensive public policies that could potentially solve some issues (PAIVA; SOUZA, 2018).

To ensure the availability and sustainable management of water and basic sanitation for all, 196 countries agreed upon 6 of the 17 Sustainable Development Goals (SDGs) as a target by 2030, while SDG 11 is aimed to make cities and human settlements inclusive, safe, resilient, and sustainable (UN, 2015). In Brazil, this right is provided by the Federal Constitution (BRASIL, 1988). However, in 2017, about 39.7% of the Brazilian municipalities did not have a sewer service, according to the National Basic Sanitation Survey (IBGE, 2020). Most unassisted people live in poor neighborhoods and/or in places called irregular areas, which are areas of permanent protection (APPs), wellsprings, risk areas, among other places.

From the perspective of the social determinants of health, basic sanitation is one of the main factors related to the health of a population, as it comprises fundamental services, such as water supply, sewage, urban cleaning, and solid waste management (BRASIL, 2007). Among the services offered, the lack of garbage collection and sewer service contributes to the reproduction of vector mosquitoes such as *Aedes aegypti*, as they make several artificial breeding sites available due to inadequate waste disposal and proper sewage (ALMEIDA; COTA; RODRIGUES, 2020). The lack of treated water is also a risk factor, as the community has to store water in containers such as drums and water tanks, which are considered potential breeding sites for mosquitoes, as well as incorrect solid waste disposal, as described by Cruvinel et al. (2020). People living near open dump areas are more vulnerable to being infected by the viruses that cause these diseases, as shown by this research group in previous studies (ZOLNIKOV et al., 2018; CRUVINEL et al., 2019).

Arboviruses transmitted by the *Aedes aegypti* mosquito, such as dengue, Zika, Chikungunya, and Urban Yellow Fever have been considered one of the main public health issues in worldwide (WALLAU, 2023; WEAVER et al., 2018). Annually, dengue infects 390 million people in the 130 countries where it is endemic, which can cause hemorrhagic fever and death. In the Americas, dengue is the arbovirus that causes the largest number of cases, with epidemics occurring cyclically every 3 and 5 years. In 2022, 3,110,442 cases of arboviruses were reported. Of the total cases, 2,803,096

(90.1%) were dengue cases, 271,006 (8.7%) were chikungunya cases, and 36,340 (1.2%) were Zika cases (PAHO/WHO, 2023).

In Brazil, in 2022, there were 1,450,270 probable cases of dengue (incidence rate of 679.9 cases per 100,000 inhabitants). Compared to the previous year, there was an increase of 162.5%. The Central-West Region had the highest dengue incidence rate, with 2,086.9 cases/100,000 inhabitants. Regarding probable cases, the Federal District presented the highest incidence in relation to Brazilian cities, with 70,672 cases, which corresponds to a rate of 2,282.9 cases/100,000 inhabitants (MINISTÉRIO DA SAÚDE, 2023).

Brasília, the capital of Brazil is located in the Federal District, has the highest per capita income in the country and shows the highest income inequality, revealing the social gap among the 35 Administrative Regions (AR) (NERI, 2023; FERNANDEZ; OLIVEIRA, 2020). This social inequality is territorialized, with a vulnerable population residing in peripheral areas, with little infrastructure, low income, and low educational background (INESC, 2023). Lago Sul is among the richest regions of the capital, with a per capita income equivalent to 16 times the value of Estrutural, the poorest AR in the Federal District (DF), whose population is mostly black and has a low educational background. About 5% of the population in Estrutural has an undergraduate level, whereas the percentage climbs to 87% in Lago Sul.

This inequality can also be seen in relation to basic sanitation. The 2022 Census revealed an expansion in sanitation in the country, particularly in water distribution and waste collection. The Federal District is one of the few Brazilian states with more than 90% of the population with access to basic sanitation (IBGE, 2023). On the other hand, there are areas in Estrutural where less than 15% of households have access to the DF general network of the sanitation company, with open sewage in 20% of households (CODEPLAN, 2022b).

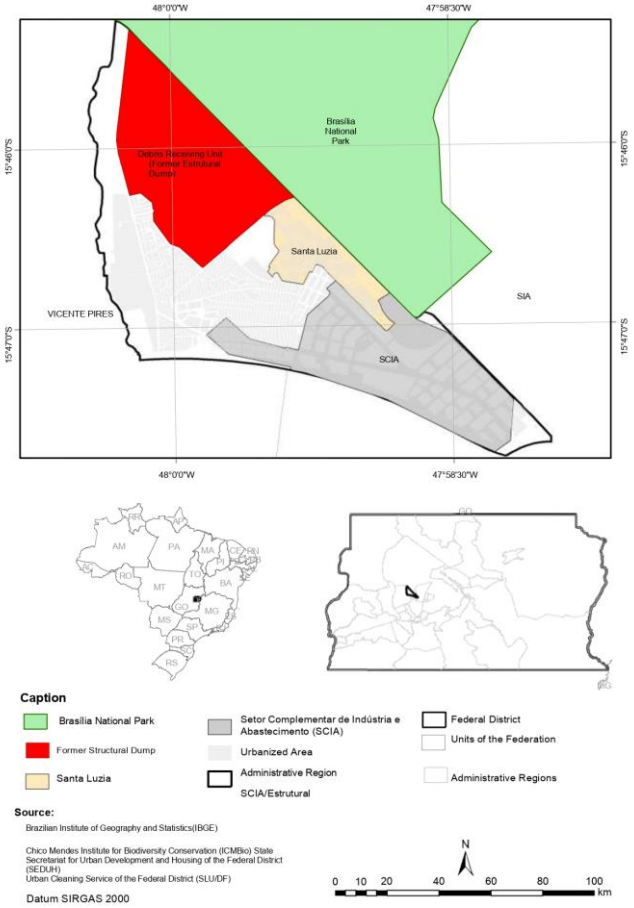
Estrutural also has one of the worst environmental and health indicators in the DF, Brazil (CODEPLAN, 2022a; INESC, 2023). On-site studies demonstrate that the socio-environmental profile may affect the spread of the virus, with cosmopolitan evidence of *Aedes sp*. and human mobility in the Federal District (RUFALCO-MOUTINHO et al., 2021). Having this background, this study aimed to investigate the environmental, demographic, and socioeconomic factors associated with the occurrence of self-reported arbovirus in the AR of Estrutural in Brasilia, Brazil.

METHODOLOGY

A cross-sectional exploratory study was conducted, with secondary data collected in a survey carried out by a unit of the Rotary Club, to identify socially vulnerable families within the region of Estrutural that needed to receive donations of clay filters through an international subsidy.

In 1960, after the inauguration of Brasília, the capital of Brazil, the area was destined to receive all the garbage produced in the capital. It was inhabited by people who invaded the region to work in the open dump that operated for almost 60 years and became the largest open dump in Latin America and the second largest in the world (CRUVINEL et al., 2019). After 21 years of struggle, the land started to be regularized. There were several conflicts for the site's regularization, considering that it could affect the Brasília National Park, which is very close to the region. The site has areas with precarious infrastructure, poor sanitation, such as the sector with small farms in Santa Luzia. The AR of Estrutural has 37,527 inhabitants and 10.640 residences and the Santa Luzia Sector, which is still irregular, has 10,273 inhabitants e 2.544 residences, approximately, predominantly young people with a low level of education (CODEPLAN, 2022A; CODEPLAN, 2022b; REZENDE et al., 2020). Figure 1 shows a map of RA of Estrutural including the neighborhood of Santa Luzia, the open dump area, National Park of Brasília, and its localization in Brazil.

Figure 1 – Map of the AR of SCIA/Estrutural (DF), including Chácara Santa Luzia



Source: Prepared by the authors, 2023.

The Chácara Santa Luzia Sector emerged in 1996, classified as a Subnormal Agglomerate or Favela. The place was not considered appropriate for housing due to the lack of access to basic rights. Because of the absence of public services, the population makes clandestine water pipelines and electricity and uses cesspits as a sanitary sewage. Several attempts were made to remove the population from the site, but local leadership groups, social projects, and urban study groups advocate the regularization of the area so that the residents should have access to infrastructure (Figure 2). Part of the territory is located in the 300-meter buffer zone of the National Park Conservation Unit and faces an imminent risk of removing 15,000 families (CODEPLAN, 2022b).

Figure 2 – Sewage and household water storage at Chácara Santa Luzia

Source: Picture taken by the authors, 2023.

A total of 2,176 families from Estrutural, including the Chácaras Santa Luzia Sector, participated in the study.

An electronic self-completion form was prepared with semi-structured questions on sociodemographic data, access to water, garbage storage and disposal, life habits, and arboviruses history and sent to the head residents. They were contacted with the support of Community Health Agents, leaders, coordinators of social daycare centers, and presidents of the waste picker cooperatives of Estrutural and Santa Luzia. In cases where the reference person in the household was illiterate, the questionnaire was filled in with the help of another family member. The instrument was prepared by professors and students from the University of Brasília, who participated in the extension project entitled “Pare, Pense e Descarte” (Stop, Think and Dispose), and consists of 16 questions.

To identify the factors associated with the occurrence of self-reported arboviruses, crude and adjusted odds ratios (OR) were estimated with the corresponding 95% confidence intervals. Binary logistic regression was carried out, with the dependent variable being self-reported arboviruses (yes and no), considering the question: "Have you or anyone in your household ever had any of these diseases: dengue, chikungunya, zika or yellow fever?"

The explanatory variables studied were: level of education (no formal education and incomplete elementary school; complete elementary school and incomplete high school; high school and over), marital status (with or without a partner), place of residence (Estrutural and Chácara Santa Luzia), water storage (yes and no), household water tank (yes and no), public sewage system (yes and no), garbage collection (yes and no), cesspit (yes and no), storage of recyclable material (yes and no), knowledge on how to prevent arboviruses (yes and no), existence of breeding sites at work (yes and no), presence of mosquitoes at work (yes and no), being a recyclable material picker (yes and no) and age (18 to 29 years; 29 to 39 years; 40 to 50 years; 51 years or older).

The explanatory variables with a p-value of <0.20 in the univariate analysis were included in the model. The stepwise strategy was used, from the simplest to the most complex model (forward selection). Variables with a p-value of <0.05 remained in the model. The residual variables were examined to check the quality of the model's fit to the observed data using the Hosmer and Lemeshow

test. Therefore, it is an appropriate test to check the quality of fit of the final model. The statistical software Stata was used.

The study was approved by the Research Ethics Committee of the Ceilândia Campus of the University of Brasília (CAAE No. 70411223.5.0000.8093). It complied with all appropriate rules and regulations as established by the ethics committee.

RESULTS AND DISCUSSION

Of the 2,176 respondents, 1,934 (88.9%) were women. Mean age was 35.2 years. Regarding marital status, 1,432 (65.8%) had no partners. As for the level of education, 961 (44.2%) declared having no formal education or incomplete elementary school. In relation to the place of residence, 1,180 (54.2%) lived in the Estrutural area, which has basic sanitation, and 996 (45.8%) lived in Santa Luzia, an area with no sanitation. Regarding profession, 431 (19.8%) were waste pickers, which highlights the issue of the job profile of the residents of this region. After the dump closed, they were relocated to a Waste Recovery Facility located on the margins of the Administrative Region of Estrutural (SLU, 2018), but are still living in the same area as before.

Almost all respondents were female (n=1,934; 88.9%), although in both Estrutural and Santa Luzia men are the majority (CODEPLAN, 2022a; CODEPLAN, 2002b).Most respondents declared that they did not have a partner (n=1,432; 65.8%) and, with regard to education, 44.16% (n=961) had no education or had not completed elementary school.

Another study conducted in the same region with waste pickers showed that most of the interviewees were female, most were single (61.8%) with 3 or more children and 47.29% had not completed elementary school (MARQUES et al., 2020). It is noteworthy that inequalities are even more notorious in women, operating in an intersectional way, in which most single-parent families, whose women are the household heads, are also in lower-income cities and most are black, as in Estrutural. Black and vulnerable women are most of the unemployed population (INESC, 2023). The findings show occupational inequalities, since the waste pickers women have a double shift taking care of the kids and other domestic responsibilities after return from work (COELHO, 2018).

The closure of the dump in Estrutural in 2018 allowed waste pickers to have a new working reality. On the other hand, not all workers are legally constituted in organizations – associations and cooperatives, either due to the lack of opportunities or the adaptation of this work methodology. Thus, reaching this population with useful information about prevention measures is fundamental to protect the health of these workers and their families.

Almost half of the respondents (n=1,021; 46.92%) said they had had arbovirus at some point, with the majority living in Estrutural (n=601; 58.86%), aged under 40 (n=704; 68.95%) and with no education or incomplete primary education (n=459; 44.96%) (Table 1).

Understanding the urban context that involves the risks caused by poor sanitation shows how to face these diseases, to guarantee better health indicators and guide health policies for other territories. Poor sanitation is a factor that favors the proliferation of the *Aedes aegypti* mosquito and the spread of urban arboviruses (FARIA et al., 2023; GOMES; BELÉM, 2022).

Of the interviewees, 1,498 (68.8%) usually store water at home for consumption (Table 2). Of these, 869 (58.0%) were residents of Santa Luzia, and the others lived in Estrutural. During the visits to the area, the ways of storing water were inadequate because they keep water in the containers without a lid or any type of seal, which can contribute to the proliferation of *Aedes aegypti* vectors. In this study, it was observed that inadequate water storage was a risk factor for arboviruses OR=1.58 (CI 1.30-1.92) (Table 3). Studies show that water tanks can be sources of embryonic development of *Aedes aegypti* and that metal containers and plastic containers were the most frequent to produce pupae with 32.9% and 21.5%, respectively (FORATTINI, 2003; ARDUINO, 2015).

Table 1 – Descriptive Statistics of Sociodemographic Variables**.** Estrutural, DF, 2021

Variable	Category	Arbovirus		TOTAL	p*
		Yes N (%)	No n (%)	n (%)	
Level of Education	No formal education and incomplete elementary school	459 (47.76)	502 (52.24)	961 (100.00)	0.250
	Elementary school and incomplete high school	254 (48.75)	267 (51.25)	521 (100.00)	
	Complete high school and more	308 (44.38)	386 (55.62)	694 (100.00)	
Marital status	With a partner	326 (43.82)	418 (56.18)	744 (100.00)	0.037
	Without a partner	695 (48.53)	737 (51.47)	1,432 (100.00)	
Place	Estrutural	601 (50.93)	579 (49.07)	1,180 (100.00)	<0.001
	Santa Luzia	420 (42.17)	576 (57.83)	996 (100.00)	
Age	18 to 29	320 (48.93)	334 (51.07)	654 (100.00)	0.496
	29 to 39	384 (45.23)	465 (54.77)	849 (100.00)	
	40 to 50	223 (47.85)	243 (52.15)	466 (100.00)	
	51 or more	94 (45.41)	113 (54.59)	207 (100.00)	
TOTAL		1,021 (46.92)	1,155 (53.08)	2,176 (100.00)	

* Chi-square (uncorrected)
** In years
Source: Prepared by the authors, 2023.

The association between housing conditions and living habits in relation to self-reported arboviruses is shown in Table 2. Perception of the mosquitoes at the workplace and knowledge to prevent these diseases are demonstrated too.

According to the Planning Company of DF, currently Research and Statistics Institute of DF, sewage and garbage collection services are made available to 90% of Estrutural's population (CODEPLAN, 2002a). On the other hand, irregular areas such as Chácara Santa Luzia, where many interviewees live, cannot count on these services because of the lack of land regularization. Inadequate waste disposal is one of the social factors that may be associated with the increase in *Aedes aegypti* (SOBRAL; SOBRAL, 2019). In the present study, the garbage collection carried out by the Urban Cleaning Service of the Federal District was a protective factor for arboviruses. Residents who had garbage collected at their door were less exposed OR=0.76 (CI 0.63-0.92), as shown in Table 3. This result highlights the importance of the Urban Cleaning Service providing waste management service and defends its role in public health.

Table 2 – Housing conditions and living habits in relation to self-reported Arboviruses. Estrutural, DF, 2021

Variable	Category	Arbovirus		TOTAL	p*
		Yes n (%)	No n (%)	n (%)	
Stores water	Yes	633 (42.26)	865 (57.74)	1,498 (100.00)	<0.001
	No	388 (57.23)	290 (42.77)	678 (100.00)	
Water tank	Yes	674 (44.81)	830 (55.19)	1,504 (100.00)	0.003
	No	347 (51.64)	325 (48.36)	672 (100.00)	
Public Sewer System	Yes	528 (51.41)	499 (48.59)	1,027 (100.00)	<0.001
	No	493 (42.91)	656 (57.09)	1,149 (100.00)	
Garbage Collection	Yes	703 (51.02)	675 (48.98)	1,378 (100.00)	<0.001
	No	318 (39.85)	480 (60.15)	798 (100.00)	
Cesspit	Yes	604 (44.38)	757 (55.62)	1,361 (100.00)	0.002
	No	417 (51.17)	398 (48.83)	815 (100.00)	
Stores Recyclable Material	Yes	157 (43.98)	200 (56.02)	357 (100.00)	0.223
	No	864 (47.50)	955 (52.50)	1,819 (100.00)	
Knows how to prevent	Yes	907 (45.44)	1,089 (54.56)	1,996 (100.00)	<0.001
	No	114 (63.33)	66 (36.67)	180 (100.00)	
Breeding Sites at Work	Yes	117 (40.07)	175 (59.93)	292 (100.00)	0.012
	No	904 (47.98)	980 (52.02)	1,884 (100.00)	
Mosquitoes at Work	Yes	185 (46.60)	212 (53.40)	397 (100.00)	0.887
	No	836 (46.99)	943 (56.01)	1,779 (100.00)	
TOTAL		1,021 (46.92)	1,155 (53.08)	2,176 (100.00)	

* Chi-square (uncorrected)
Source: Prepared by the authors, 2023.

Table 3 – Crude and adjusted analyses of the association between independent variables and arboviruses. Estrutural, DF, 2021

Variable	Gross Analysis		Adjusted Analysis	
	OR	CI 95%	OR	CI 95%
Marital status				
With a partner	1	-	1	-
Without a partner	0.83	0.69-0.99	0.87	0.73-1.05
Place				
Estrutural	1	-	1	-
Santa Luzia	1.42	1.20-1.69	0.94	0.74-1.19
*Water storage**				
No	1	-	1	-
Yes	1.83	1.52-2.20	1.58	1.30-1.92
Water tank in the household				
No	1	-	1	-
Yes	1.31	1.10-1.58	0.97	0.79-1.19
Public Sewer System				
No	1	-	1	-
Yes	0.71	0.60-0.84	1.04	0.83-1.31
*Garbage collection**				
No	1	-	1	-
Yes	0.64	0.53-0.76	0.76	0.63-0.92
Cesspit				
No	1	-	1	-
Yes	1.31	1.10-1.56	0.97	0.79-1.18
*Knows how to prevent**				
No	1	-	1	-
Yes	2.07	1.51-2.84	2.22	1.61-3.06
*Waste collector**				
No	1	-	1	-
Yes	1.77	1.43-2.19	1.84	1.46-2.31

* Statistically significant variables in the adjusted analysis and that remained in the final model.
Source: Prepared by the authors, 2023.

Most residents of Estrutural do not have health insurance, and when they need care, they seek it at the Basic Health Unit (CODEPLAN, 2022a). In this study, knowledge of preventive measures was positively associated with self-reported arboviruses (OR 2.22; CI 1.61-3.06). It could be explained by the hypothesis that those who had the disease, became more interested in knowing about the outcomes, risk factor and preventive measures. The study showed that most interviewees state they learned about prevention measures during the health agents visit in their houses. These agents work in two Basic Health Units in Estrutural, demonstrating the importance of the professional in the community and the need to strengthen primary care policies to prevent arboviruses. The study conducted by Bender and Bianchi (2016) showed positive results regarding knowing how to prevent and risk factors for arboviruses with the visit of community agents in Belo Horizonte.

Being a waste picker was a risk factor for arboviruses OR 1.84 (CI 1.46-2.31). The potential risk related to the working conditions that these people face is highlighted, with low use of personal protective equipment and waste handling, which can serve as breeding sites for the vectors.

One study carried out by Cruvinel et al. (2020) with waste pickers who worked in the Estrutural dump showed that 28.60% of the waste pickers interviewed reported having had at least one of these diseases before (dengue, zika, or chikungunya). However, in another study, blood samples were collected in this same population and the frequency of positive results was more than 70%, suggesting

the lack of knowledge of these workers regarding their previous illness due to arboviruses (Cassemiro et al., 2020).

In the Federal District, 263,412 dengue cases were reported, of which 245,065 were probable. Of the probable cases, 98.0% were residents of the Federal District (n=239,983). During this period, there was a 1,440.3% increase in the number of probable dengue cases in residents of the Federal District compared to the same period in 2023, when 15,580 probable cases of the disease were recorded (DISTRITO FEDERAL, 2024). In this study, 46.92% of participants reported having had some form of arbovirus, which reinforces the need to tackle arboviruses in vulnerable areas of the Federal District.

STUDY LIMITATIONS

The measurement of arboviruses was self-reported and not based on clinical/medical diagnoses, which may compromise the interviewees' understanding of what is meant by arboviruses. As mentioned before, this research was conducted with data collected by the Rotary Club. Thus, this analysis was restricted to the variables in the questionnaire prepared by the aforementioned association. To minimize these biases, the analysis was carried out by the researchers leading the study. Thus, the methods used provide some lessons for researchers interested in similar studies on poor urban communities around the world.

CONCLUSION

Poor living conditions, lack of sanitation and waste collection were associated with arboviruses, and other factors related to social and occupational inequality such as being waste pickers can increase the risk of these diseases. The high prevalence of self-reported diseases indicates it was an important predictor in determining the risks of arboviruses in this territory.

Government actions to address territorial issues should involve community members from the beginning so that they can participate in decision-making and outcomes. Engaging community members requires a deep understanding of how they perceive the risks related to the issues under discussion. Understanding the risk perceived by arboviruses in this territory helps to propose the measures that will be implemented to protect vulnerable communities. Households with a higher perceived risk are more likely to develop positive attitudes towards the prevention of these diseases.

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