Research

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Factors associated with low knowledge about sexually transmitted infections in subnormal agglomerate, in the Brazilian Amazon

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Abstract

Background: Populations living in subnormal agglomerates in urban areas are more vulnerable to infections, including sexually transmitted infections (STIs). In these groups, inadequate knowledge about sexually transmitted infections can further increase the risk of contracting STIs. *Aim:* We investigated the factors associated with low knowledge about STIs in a peripheral population in the Brazilian Amazon. *Methods:* This cross-sectional study was conducted in Belém, in the Amazon region that has a high percentage of subnormal agglomerates in an urban area and a high incidence of STIs. Random sampling was adopted which resulted in a sample of 320 participants. To assess knowledge about STIs, the self-administered Sexually Transmitted Disease Knowledge Questionnaire was used. To assess aspects of vulnerability, a questionnaire was constructed which is linked to individual, social, and programmatic factors. The chi-square test, G test, and ordinal regression analyses were all performed. *Findings:* The sample of this study was composed of 320 participants. The mean age of the participants was 46.09 years. 37.5% (120), 50.6% (162), and 11.9% (38) showed low, medium, and high knowledge, respectively. Multiple analysis revealed that the factors associated with higher chance of having smaller knowledge about sexually transmitted infections were single/separated/divorced/widow(er) marital status (AOR: 1.80, CI: 1.15-2.84, $P = 0.01$); income equal to or less than one minimum wage (1.98, CI: 1.21-3.17, $P = 0.00$); equal to or over than 52 years old (AOR: 1.99, CI: 1.25-3.17, $P = 0.00$); lack of guidance by a health professional (AOR: 1.59, CI: 1.01-2.51, $P = 0.04$). Our results show that this community suffer from suboptimal levels of knowledge on STIs, which are linked to individual, social, and programmatic factors. Characterising the risk and vulnerabilies factors allows for carrying out appropriate interventions for populations living in subnormal agglomerates in urban area.

Introduction

Sexually transmitted infections (STIs) remain a worldwide public health problem that requires regional and global strategies for control and elimination. However, locoregional differences lead to inconsistent progress regarding health indicators associated with STI and human immunodeficiency virus (HIV)/acquired immunodeficiency syndrome (AIDS) (World Health Organization, 2016; World Health Organization, 2020). Such differences may occur because public health policies are implemented to varying degrees across regions and socioeconomic context varies among local populations, given that STIs disproportionately affect people with low income and education levels and that groups affected by social inequality also have limited knowledge about STIs/HIV (Liao *et al.*, 2015; Gomes *et al.*, 2017; Lyons *et al.*, 2017; von Rosen *et al.*, 2018; Guimaraes *et al.*, 2019; World Health Organization, 2020).

People living in subnormal agglomerates in urban areas are likely to have exposure to STIs that is above the national average and greater than that of residents of other areas. Similar to Africa (Steenkamp *et al.*, 2014; Kerubo *et al.*, 2015; Weimann and Oni, 2019), subnormal agglomerates are present in urban areas in Brazil and are characterised by an irregular urban pattern, lack of essential public services, and housing located in areas that are deemed inappropriate for occupation (Instituto Brasileiro de Geografia e Estatística, 2020).

Combined prevention of STIs/HIV, which includes behavioural, biomedical, and structural approaches, must consider context, which shapes a population's risk and vulnerability to these diseases (World Health Organization, 2016; World Health Organization, 2020). Adequate knowledge about STIs/HIV within the population should also be considered when

implementing combined prevention strategies, since it influences behaviour, practices, and attitude (Ibrahim *et al.*, 2014; Liao *et al.*, 2015; Dadi *et al.,* 2020; Logie *et al.*, 2020).

In this context, in which individual and social aspects interact with other factors related to health services access and thus influence knowledge about STIs, the theoretical concept of vulnerability has been adopted. It was initially proposed by Mann *et al.* (1992) at the beginning of the HIV/AIDS epidemic, when the concept of epidemiological risk factors was transmuted using causal reasoning into the operative concept of a risk group.

The concept of vulnerability implies that people's chances of exposure to illness depend on individual and collective sets. It is structured in three dimensions: cognitive, behavioural, and physical factors that increase the chances of infection. The focus of the social dimension is on cultural, moral, political, economic, and institutional factors that can determine the means of exposure determined at the previous analytical level. The programmatic dimension examines how policies, programmes, and services interfere in these social and individual situations (Ayres *et al.*, 2006; Shaurich and Freitas, 2011).

Although the concept of vulnerability has been investigated in numerous studies (Ayres *et al.*, 2006; Fagbamigbe *et al.*, 2017; Mahapatra *et al.*, 2018; Queiroz *et al.*, 2019), only one study has investigated the association between the three dimensions and level of knowledge about STIs (Gomes *et al.*, 2017). Moreover, no such investigation has been carried out in populations of subnormal agglomerates in urban areas in Brazil, particularly the Brazilian Amazon. Epidemiologically, this region is characterised by a growing incidence of HIV and AIDS-related mortality, despite advances in public policies regarding on HIV and STIs in Brazil (Brazil, 2019).

In Brazil, activities aimed at decreasing and controlling STIs and HIV/AIDS are included as a priority in the Unified Health System (UHF), and Primary Health Care (PHC) is the gateway of choice for accessing these activities. In this regard, the Family Health Strategy (FHS) allows intervention by healthcare workers, in the households of the families involved, the Basic Health Unit (BHU), and several social facilities. To allow interaction between education and health, the School Health Programme allows PHC professionals to work in public schools, guiding teachers, students, and the community (Sousa *et al.*, 2017; Melo *et al.*, 2018).

Thus, in the present study, we investigated the factors associated with low knowledge about STIs in a peripheral population in the Brazilian Amazon.

Methods

Study design

This observational, cross-sectional study was carried out in Belém, Pará state, northern Brazil. This state measures 1 059 466 square kilometres and has 1 433 981 inhabitants, of whom 38.47% live in subnormal agglomerates. Belém has the sixth lowest Municipal Human Development Index (MHDI) (0.746) among the state capitals of Brazil, and only 303 600 inhabitants (20.43%) are covered by the FHS (Instituto Brasileiro de Geografia e Estatística, 2020).

The site of the present study was a subnormal agglomerate in the Montese neighbourhood, which is covered by the FHS. Data collection took place from 13 October to 9 December 2019 and included people aged 18 years or over who resided in this agglomerate. Individuals with hearing impairment or any cognitive impairment that compromised adequate collection of information were excluded.

The sample size and power was calculated using Statcalc, Epi Info (Version 7.2.2.16) program, according to the following parameters: population size of 42 535 adults living in the area of Montese neighbourhood, an acceptable margin of error of five percentage points, a confidence interval of 95%, a design effect of 1.0 and an expected prevalence of low knowledge of STI/HIV of 30% based on previous studies showing that 46.2% of adolescents in Berlin had never heard of chlamydia (von Rosen *et al.*, 2018) and that the proportion of low knowledge was 25.5% among men who have sex with men (MSM) in a province of China (Liao *et al.*, 2015) and 26% among Brazilian MSM (Gomes *et al.*, 2017). Ultimately, 320 participants were required.

The four FHS teams provided the researchers with the registration details of families linked to each of the 28 community health agents (CHAs). The data (address, FHS team, and related CHA) of 2,387 houses were entered in a digital spreadsheet (each house was considered a family). The selection process of the participants was carried out in two stages. Firstly, stratified sampling was initially carried out proportional to a number of houses indexed for each CHA (28 strata) of the four FHS teams in the Montese BHU. In the second stage, simple random probability sampling was carried out using a computer-generated list in the Bioestat 5.3 program to select families within each stratum.

At the time of the visit, only one participant of each house/family was chosen. Specifically, the adult who self-referred as responsible for the family was chosen. In cases of loss and refusal, the house was replaced by the subsequent or previous house that was not contemplated in the random draw. The collection was performed by collectors accompanied by the CHA.

Data source

To assess knowledge about STIs, the self-administered Sexually Transmitted Disease Knowledge Questionnaire (STD-KQ) was used (Teixeira *et al.*, 2015). It consists of 28 knowledge statements with the following possible responses: 'true', 'false', or 'don't know'. This instrument was cross-culturally adapted and translated into Brazilian Portuguese. To assess factors of vulnerability, a formulary was constructed based on information from previous studies (Ayres *et al.*, 2006; Gomes *et al.*, 2017; Queiroz *et al.*, 2019). The instrument was sent to the macro-project researchers to check for content clarity and adequacy. After some corrections, the questionnaire was pretested in the context of the present study and its adequacy was established by surveying 15 randomly sampled participants who were not included in the study. After this pre-test, no adjustments in form or content were necessary. No tests were performed to assess the reliability and validity of the questionnaire.

Variables

The response variable was the level of knowledge about STI (low, medium, and high), as determined from the data obtained using the STD-KQ questionnaire. Each correct answer was awarded one point, with a total score of 28 if all the answers were correct. Each error or 'don't know' answer had a value of zero. The number of points was (correct answers) calculated, and the participants were grouped into three ordinal categories: Low level (1–13 points); medium level (14–19 points); high level (20–28 points). The independent variables were the dimensions of individual (Table 1), social (Table 2), and programmatic vulnerability (Table 3).

Table 1. Association between the level of knowledge about sexually transmitted infections (STI) and factors of individual vulnerability in individuals living in the subnormal agglomerate of Belém in 2019

Individual factors	Level of knowledge			χ^2/G[a]	*p*
	Low	Medium	High		
Sex					
Female	81	111	27	0.15	0.69
Male	39	51	11		
Age group (years)					
18 to 51	58	106	28	11.2	0.00
≥ 52	62	56	10		
Age at first sexual intercourse (years)					
≤18	79	123	29	3.07	0.07
> 18	41	39	9		
Sexual orientation					
Bisexual/Homosexual/other	6	5	2	0.75[a]	0.68
Heterosexual	114	157	36		
Number of sexual partners					
None	37	25	3	14.1[a]	0.00
≥ 1 partner	83	137	35		
Have you used places/services to find sexual partners?					
Yes	24	50	10	2.13	0.14
No	96	112	28		
Use of condoms during sexual intercourse					
Irregular	80	106	29	0.55	0.45
Always	40	56	9		
Frequency of alcohol consumption					
≥ 2 times a week	14	22	6	0.48	0.48
Never/Occasionally	106	140	32		
Chances of getting infected with HIV (Risk perception)					
Great/Moderate	12	25	8	3.42	0.06
Never/Low	108	137	30		
Alcohol abuse					
Yes	2	3	1	0.11[a]	0.94
No	118	159	37		
Have you forgotten to use a condom after using alcohol and/or illegal drugs?					
Yes	17	25	4	0.63[a]	0.72
No	103	137	34		
Sexual intercourse after using alcohol and/or illegal drugs?					
No	115	139	35	8.42[a]	0.01
Yes	5	23	3		
History of STI in the last 6 months?					
No	118	157	38	2.08[a]	0.35
Yes	2	5	0		
Have you felt sad or depressed in the last 6 months?					
Sometimes/Many times	73	89	24	0.05	0.81
A little/Never	47	73	14		

(Continued)

Table 1. (*Continued*)

Individual factors	Level of knowledge			χ^2/G[a]	*p*
	Low	Medium	High		
Do you have children?					
No	20	30	7	0.12	0.71
Yes	100	132	31		
Transfusion in the last 6 months					
Yes	3	7	0	2.96[a]	0.22
No	117	155	38		

[a]G Test *P* < 0.05.

Statistical analysis

A database was created using the EPI INFO 7.2.3 program, and descriptive statistics were derived to characterise the study population. For categorical variables, absolute and relative frequencies were calculated. For the continuous variables, measures of central tendency were calculated. The main hypothesis of the study was that the factors of social, individual, and programmatic vulnerability could predict the level of knowledge about STI. This hypothesis was tested using ordinal logistic regression.

Multicollinearity was examined. To analyse differences in the proportions of variables, univariate analysis was performed using the chi-square trend test or G test. All variables with p-values < 0.20 were entered into the intermediate model of the ordinal logistic multiple regression.

A variable coding scheme was determined using the Minitab® software standard. Initially, intermediate multiple ordinal logistic regression models were produced, one for each group of vulnerability dimensions. The final model was produced by inserting all variables that presented p-values < 0.05 in the intermediate models. Variables with higher p-values and no significant association with the response (*P* < 0.05) were removed one at a time until the final adjustment of the multiple ordinal logistic regression model was achieved.

Quality tests and associated measures were analysed at all stages of regression. To interpret the results, the coefficient value of the predictor was considered in the regression, Z-value, *p* values < 0.05 were considered statistically significant, confidence intervals and odds ratios, meeting the criteria of the Minitab® and Bioestat® programs.

Ethical aspects

The study was approved by the Research Ethics Committee of the Federal University of Pará under protocol No. 4 134 220 and followed the principles of the Declaration of Helsinki. All participants provided informed consent to participate.

Results

The study sample comprised three-hundred-and-twenty (320) participants with a mean age of 46.09 years (95% CI: 44.39–47.79; standard deviation: 15.46; minimum age: 18 years, maximum age: 87 years). There were 42 participants (13.1%) in the 18 to 27-year age group, 64 (20.0%) in the 28 to 37-year group, 61 (19.1%) in the 38 to 47-year group, 63 (19.7%) in the 48 to 57-year group, 59 (18.4%) in the 58 to 67-year group, and 31 (9.7%) in the >67-year group. Most participants were female (68.4%; 219), and 60.6% (194) had received high school or higher education. Most were married or in a stable union (51.6%; 165), and most were unemployed (56.9%; 182). Regarding level of knowledge about STIs, 120 (37.5%) had low knowledge levels, 162 (50.6%) had medium knowledge levels, and 38 (11.9%) had high knowledge levels.

Table 1 shows the association of knowledge levels with factors of individual vulnerability. Chi-square/G tests demonstrated that the level of knowledge about STIs/HIV was associated with age groups (*P* = 0.00), number of sexual partners (*P* = 0.00), and sexual intercourse after using alcohol and/or illegal drugs (*P* = 0.01). The following variables with p-values < 0.20 were included in the multiple ordinal logistic regression: age at first sexual intercourse (*P* = 0.07), use of facilities/services to find sexual partners (*P* = 0.14), and chance of getting infected with HIV (risk perception; *P* = 0.06).

With regard to social vulnerability (Table 2), univariate analysis revealed that the following variables were significantly associated with level of knowledge about STIs/HIV: with level of knowledge about STIs/HIV: education level (*P* < 0.00), marital status (*P* = 0.06), Brazilian economic classification criterion (*P* = 0.03), and individual income (*P* = 0.01). These variables were selected for multiple regression, as was the variable 'friends talk about prevention' (*P* = 0.17).

In terms of programmatic vulnerability, we identified a statistically significant association between level of knowledge about STIs and the following variables: receipt of guidance from professionals about STI prevention (*P* = 0.00) and receipt of free lubricant gel from public services (*P* = 0.01). The variable 'receipt of free condoms from public service' (*P* = 0.05) was selected for multiple ordinal logistic regression (Table 3).

The results of the univariate analysis identified factors that were then introduced into the ordinal regression model. Table 4 presents the regression results. The intermediate model showed the multiple analysis result for factors in each dimension, with factors presenting p-values < 0.05 being included in the final model.

After adjustment of the model (Table 4), participants aged 52 years or older had a 1.99-fold greater risk (*P* = 0.00) of low knowledge about STI/HIV; participants with single/separated/divorced/widowed status had a 1.80-fold greater risk of low knowledge (*P* = 0.01). The risk of low knowledge was 1.98-fold greater among participants with incomes equal to or less than one minimum salary (*P* = 0.00). The risk for participants who received no professional guidance on STIs/HIV was 1.59-fold higher.

Table 2. Association between the level of knowledge about sexually transmitted infections (STI) and factors of social vulnerability in individuals living in the subnormal agglomerate of Belém in 2019

Social factors	Level of knowledge			χ^2/G[a]	p
	Low	Medium	High		
Religion					
No	16	23	6	0.14	0.70
Yes	104	139	32		
Level of education					
Illiterate/Elementary	58	62	6	11.8	0.00
High school/Higher education	62	100	32		
Skin colour					
Black/indigenous/yellow	19	33	4	5.17[a]	0.27
Brown	80	98	30	0.27	
White	21	31	4		
Marital status					
Single/Separated/divorced/widow(er)	66	78	11	0.94[a]	0.06
Married/stable union	54	84	27		
Current job					
Unemployed	71	92	19	3.77[a]	0.43
Profession/occupation/Other activity	49	70	19		
Brazilian economic classification criteria					
A–B–C	66	102	28	4.59	0.03
D–E	54	60	10		
Monthly income (minimal wage)[b]					
Equal or less than 1 minimum wage	85	104	19	6.09	0.01
More than 1 minimum wage	25	48	15		
Did not answer[c]	10	10	4		
Friends talk about prevention					
Few/minority	90	105	26	1.85	0.17
All/majority	30	57	12		

[a]G test.[b] Brazilian monthly minimum wage in November 2019 – 998 Real per month.[c] Not considered for statistical calculation. $P < 0.05$.

Table 3. Association between the level of knowledge about sexually transmitted infections (STI) and factors of programmatic vulnerability in individuals living in the subnormal agglomerate of Belém in 2019

Programmatic factors	Level of knowledge			χ^2/G[a]	p
	Low	Medium	High		
Have you participated in any religious activity?					
No	58	78	23	0.96	0.32
Yes	62	84	15		
Have you participated in any educational activity?					
No	104	146	31	0.06	0.79
Yes	16	16	7		
Do you have access to health care services?					
No	13	21	4	0.36[a]	0.83
Yes	107	141	34		
Most used level of care					
Primary care	89	128	29	0.62	0.42
Secondary care/others	28	27	8		
No answer[b]	3	7	1		
Have you received guidance from professionals on STI prevention?					
No	72	74	15	7.23	0.00
Yes	48	88	23		
Did you take a rapid test for HIV and syphilis?					
No	64	67	19	1.26	0.26
Yes	56	95	19		
Have you received free condoms from public services?					
No	65	62	17	3.63	0.05
Yes	55	100	21		
Have you received free lubricant gel from public services?					
No	106	132	27	6.31	0.01
Yes	14	30	11		

[a]G test.[b] Not considered for statistical calculation. $P < 0.05$.

Discussion

In the present study, we showed that all dimensions of vulnerability are associated with the level of knowledge about STIs in a population living in subnormal agglomerate in a region in the Brazilian Amazon. In the final model, the number of factors was lower than that in each dimension of the intermediate model. The following factors were independently associated with low knowledge: age equal to or over than 52 years, single/separated/divorced/widowed status, a monthly income equal to or less than one minimum salary, and non-receipt of professional guidance.

A previous study focusing on vulnerability and HIV knowledge reported different results in the final regression model (Gomes et al., 2017). Among young people in Ethiopia, multivariable regression showed an association between lower HIV knowledge and low education, female sex, married status, and lack of access to TV, radio, and information (Dadi et al., 2020). Among women who have sex with women in Southern Africa, the final regression model showed that high STI/HIV knowledge was associated with higher education, regular income, and receipt of personalised information on STIs/HIV (Paschen-Wolff et al., 2020).

The key vulnerable populations from those previous studies had more risk factors than the current study population, perhaps because of specific differences in local access to health services, the level of public policy implementation, and human rights.

In a hyperendemic HIV area, the highest risk was observed in those who had never married and widowers, and the risk increased with age (Tlou, 2019). In Brazil, young adults have a higher HIV detection rate (Brazil, 2019). One previous spatial analysis study conducted in a state of the Amazon region between 2007 and 2018 showed an increasing HIV incidence in older people, with the city of Belém presenting a spatial-temporal risk for HIV/AIDS (Moraes et al., 2021). The results of the present study, which was conducted at an individual level, may indicate that lower

Table 4. Results of the multiple ordinal logistic regression analysis between factors of vulnerability and low knowledge about sexually transmitted infections in adults living in the subnormal agglomerate of Belém in 2019

Factors	Intermediate Model				Final Model	
	OR (95% CI)	p	Regression coefficient	Z	Adjusted OR (95% CI)	p
Individual factors						
Age (years) (<51 years as reference)						
≥ 52	1.66 (1.04–2.64)	0.035	0.68	2.9	1.99(1.25–3.17)	0.00
Age at first sexual intercourse (years) (> 18 as reference)						
≤18	0.89 (0.54–1.48)	0.65				
Number of sexual partners (none as reference)						
>1 partner	0.45(0.25–0.80)	0.007				
Have you used places/services to find sexual partners? (No as reference)						
Yes	0.85 (0.51–1.41)	0.53				
Chances of getting infected with HIV-Risk perception (Never/Low as reference)						
Great/Moderate	0.72 (0.34–1.53)	0.33				
Sexual intercourse after using alcohol and illegal drugs? (No as reference)						
Yes	0.72 (0.34–1.53)	0.39				
Social factors						
Level of education (High school/Higher education as reference)						
Illiterate/Elementary	1.84 (1.13–2.99)	0.01				
Marital status (Married/Stable union as reference)						
Single/Separated/divorced/widow(er)	1.84 (1.16–2.90)	0.00	0.58	2.55	1.80 (1.15–2.84)	0.01
Brazilian economic classification criteria (Class A to C as reference)						
Class D–E	1.19 (0.73–1.95)	0.47				
Monthly Income (R$) (More than 1 as reference)						
Equal to or less than 1 minimum wage	1.77 (1.07–2.94)	0.02	0.68	2.7	1.98 (1.21–3.17)	0.00
Friends talk about prevention (All/majority as reference)						
Few/minority	1.43 (0.88–2.33)	0.14				
Programmatic factors						
Received guidance from professionals on STI prevention (Yes as reference)						
No	1.61 (1.04–2.51)	0.03	0.46	2.01	1.59 (1.01–2.51)	0.04
Received free condoms from public services (Yes as reference)						
No	1.22 (0.76–1.95)	0.40				
Received free lubricant gel from public services (Yes as reference)						
No	1.65 (0.89–3.05)	0.11				

Ordinal logistic regression ($P < 0.05$). OR: Odds Ratio.

knowledge about STIs/HIV makes older people more susceptible to these infections, increasing the spatial-temporal risk.

Study participants aged over 50 years may not be adequately reached by mass dissemination campaigns or by the health education strategies of their respective FHS teams. It is important to rethink these strategies in this population since they have an active sexual life and are exposed to risks that increase their susceptibility to HIV (Queiroz et al., 2019).

Previous studies have shown that single, divorced, or separated people are more susceptible to HIV infection in subnormal settlements. Low income combined with other precarious social and economic indicators makes marriage unfeasible (Kerubo et al., 2015; Shisana et al., 2016). Thus, marital status alone was not a risk factor for low STI/HIV knowledge or infection; instead, it interacts with other factors (Ibrahim et al., 2014; Shisana et al., 2016).

The social context is related to the distribution of the most prevalent bacterial STIs and HIV (Rowley et al., 2019; World Health Organization, 2020). In populations with precarious social and economic indicators, health policies have not yet resulted in sufficient social response to reduce the incidence of HIV and mortality from AIDS (Probst et al., 2016; Rowley et al., 2019), indicating that the social context of a population contributes to STI vulnerability.

Regarding the programmatic aspects of vulnerability in this study, previous studies have confirmed the relationship between

knowledge about HIV and access to health campaigns and services (Paschen-Wolff *et al.*, 2020; Koschollek *et al.*, 2020). In this dimension, health professionals translate public health policies into concrete actions for the population under their responsibility. However, direct or indirect flaws in their professional performance can leave these groups prone to programmatic vulnerability (Shaurich and Freitas, 2011).

The populations of subnormal agglomerates have a greater need for public services, considering the marked social inequalities in these areas (Weimann and Oni, 2019; Instituto Brasileiro de Geografia e Estatística, 2020). The low availability of services in these areas affects knowledge about STIs and health services (Newton-Levinson *et al.*, 2016; Logie *et al.*, 2020). Identifying people without access to the health system is important to increase knowledge about HIV (Koschollek *et al.*, 2020). In this context, income transfer programmes can increase access to health services (Shei *et al.*, 2014).

The questions in the instrument used to assess knowledge about STIs/HIV may also affect the results (Teixeira *et al.*, 2015). This is relevant because there are differences in the population's knowledge about various STIs and are more suitable for HIV, gonorrhoea and syphilis (von Rosen *et al.*, 2018; Guimarãres *et al.*, 2019; Koschollek *et al.*, 2020), whereas it is of limited value for other STIs, such as genital warts, chlamydia, and herpes (von Rosen *et al.*, 2018; Koschollek *et al.*, 2020), as well as knowledge about the most current means of prevention, such as pre-exposure prophylaxis (PrEP) (Guimarães *et al.*, 2019).

The structure of the dimensions of vulnerability (Ayres *et al.*, 2006) indicates that lack of guidance by healthcare professionals can interfere with the social and individual situation of study participants, leading to less knowledge about STIs/HIV. The present study was limited because it only involved one urban agglomerate with access to PHC in Brazil. Further studies with populations with these characteristics may show whether the association with programmatic aspects is due to the work process of primary care in the city of the study.

Public health implications

For FHS teams, identifying factors related to vulnerability at the local level allows interventions directed towards the needs of these families. Therefore, the biomedical model of health education is refuted, implying that health professionals alone cannot solve all problems. Nonetheless, the data generated provide evidence for healthcare managers seeking solutions to structural issues related to social and economic policies that affect the way of life and behaviour of these groups.

Conclusion

The present results show that this community suffers from suboptimal levels of knowledge about STIs, which are linked to individual, social, and programmatic aspects. More factors related to the social dimensions of vulnerability were associated with lower levels of knowledge about STIs/HIV. Moreover, there was a complex interaction among the factors and that vulnerability was not limited to the individual context.

Living in a territory covered by the FHS does not guarantee adequate knowledge about STIs and HIV. Intersectoral public policies are essential in low-income populations and subnormal settlement residents. Health education and care actions must involve people at higher risk. Characterising risk and vulnerability allows

for the appropriate interventions in populations living in urban subnormal settlements, contributing towards the global goal of eliminating these infections by 2030.

Authors contributions. Glenda Roberta Oliveira Naiff Ferreira, Lucia Hisako Takase Gonçalves, Eliã Pinheiro Botelho conceived the idea for the study, conducted the analysis, drafted the manuscript and had full access to the study datasets. Ingrid Saraiva de Oliveira, Wanne Letícia Santos, Freitas, Aline Maria Pereira Cruz contributed interpretation of the findings and critically revised the manuscript. Renata Karina Reis, Ana Luisa Brandão C, Lira. Elucir Gir contributed to the study design, interpretation of the findings and critically revised the manuscript. All authors approved the final version of the paper. The authorship agreement is to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

References

Ayres JR, Paiva V, FrançaGravato IN Jr, Gravato N, Lacerda R, Della Negra M, Marques HH, Galano E, Lecussan P, Segurado AC and Silva MH (2006) Vulnerability, human rights, and comprehensive health care needs of young people living with HIV/AIDS. *Am J Public Health* **96**, 1001–1006.

Brazil (2019) Ministério da Saúde. Secretaria de Vigilância em Saúde. Boletim Epidemiológico HIV/Aids 2019. Número Especial. Available at http://www.aids.gov.br/pt-br/pub/2019/boletim-epidemiologico-de-hivaids-2019. (Accessed 10 March 2020). [In Portuguese]

Dadi TK, Feyasa MB and Gebre MN (2020) HIV knowledge and associated factors among young Ethiopians: application of multilevel order logistic regression using the 2016 EDHS. *BMC Infect Dis.* **20**, 714.

Fagbamigbe AF, Lawal AM and Idemudia ES (2017) Modelling self-assessed vulnerability to HIV and its associated factors in a HIV-burdened country. *SAHARA J* **14**, 140–152.

Gomes RRFM, Ceccato MGB, Kerr LRFS and Guimarães MDC (2017) Fatores associados ao baixo conhecimento sobre HIV/aids entre homens que fazem sexo com homens no Brasil. *Cadernos de Saúde Pública* **33**, e00125515. [In Portuguese].

Guimarães MDC, Magno L, Ceccato MDGB, Gomes RRFM, Leal AF, Knauth DR, Veras MASM, Dourado I, Brito AM, Kendall C, Kerr LRFS and Brazilian HIV/MSM Surveillance Group (2019) HIV/AIDS knowledge among MSM in Brazil: A challenge for public policies. *Rev Bras Epidemiol* **22**, e190005.

Ibrahim MTO, Arisegi SA, Awosan KJ and Erhiano EE (2014) Knowledge of HIV/AIDS, risk perception, sexual lifestyle and condom use among drivers in Sokoto, Nigeria. *J Infect Dis Immun* **6**, 19–25.

Instituto Brasileiro de Geografia e Estatística (IBGE) (2020) Dados demográficos e Dados sobre: Aglomerados subnormais.- Available at https://www.ibge.gov.br/ (Accessed on 30 June 2021). [In Portuguese]

Kerubo G, Khamadi S, Okoth V, Madise N, Ezeh A, Ziraba A and Mwau M (2015) Hepatitis B, hepatitis C, and HIV-1 coinfection in two informal urban settlements in Nairobi, Kenya. *PLoS One* **10**, e0129247.

Koschollek C, Kuehne A, Müllerschön J, Amoah S, Batemona-Abeke H, Dela Bursi T, Mayamba P, Thorlie A, Mputu Tshibadi C, Wangare Greiner V, Bremer V and Santos-Hövener C (2020) Knowledge, information needs and behavior regarding HIV and sexually transmitted infections among migrants from sub-Saharan Africa living in Germany: results of a participatory health research survey. *PLoS One* **15**, e0227178.

Liao M, Wang M, Shen X, Huang P, Yang X, Hao L, Cox C, Wu P, Tao X, Kang D and Jia Y (2015) Bisexual behaviors, HIV knowledge, and stigma-tizing/discriminatory attitudes among men who have sex with men. *PLoS One* **10**, e0130866.

Logie CH, Okumu M, Mwima S, Kyambadde P, Hakiza R, Kibathi IP and Kironde E (2020) Sexually transmitted infection testing awareness, uptake and diagnosis among urban refugee and displaced youth living in informal settlements in Kampala, Uganda: a cross-sectional study. *BMJ Sex Reprod Health* **46**, 192–199.

Lyons A, Heywood W, Fileborn B, Minichiello V, Barrett C, Brown G, Hinchliff S, Malta S and Crameri P (2017) Sexually active older Australian's knowledge of sexually transmitted infections and safer sexual practices. *Aust N Z J Public Health* **41**, 259–261.

Mahapatra B, Bhattacharya R, Atmavilas Y and Saggurti N (2018) Measuring vulnerability among female sex workers in India using a multidimensional framework. *PLoS One* **13**, e0204055.

Mann JM, Tarantola DJM and Netter TW (1992) *AIDS in the world: a global report.* Boston: Harvard University.

Melo EA, Maksud I and Agostini R (2018) HIV/AIDS management at the primary care level in Brazil: a challenge for the Unified Health System?. *Rev Panam Salud Publica* **42**, e151.

Moraes TM, Fernandes WAA, Paes CJO, Ferreira GRON, Gonçalves LHT and Botelho EP (2021) Spatiotemporal analysis of the HIV epidemic in older people in a Brazilian Amazon state. *Rev. Bras. Geriatr. Gerontol* **24**, e210007.

Newton-Levinson A, Leichliter JS and Chandra-Mouli V (2016) Sexually transmitted infection services for adolescents and youth in low- and middle-income countries: Perceived and experienced barriers to accessing care. *J Adolesc Health* **59**, 7–16.

Paschen-Wolff MM, Reddy V, Matebeni Z, Southey-Swartz I and Sandfort T (2020) HIV and sexually transmitted infection knowledge among women who have sex with women in four Southern African countries. *Cult Health Sex* **22**, 705–721.

Probst C, Parry CD and Rehm J (2016) Socio-economic differences in HIV/AIDS mortality in South Africa. *Trop Med Int Health* **21**, 846–855.

Queiroz AAFLN, Sousa AFL, Brignol S, Araújo TME and Reis RK (2019) Vulnerability to HIV among older men who have sex with men users of dating apps in Brazil. *Braz J Infect Dis* **23**, 298–306.

Rowley J, Vander Hoorn S, Korenromp E, Low N, Unemo M, Abu-Raddad LJ, Chico RM, Smolak A, Newman L, Gottlieb S, Thwin SS, Broutet N and Taylor MM (2019) Chlamydia, gonorrhoea, trichomoniasis and syphilis: global prevalence and incidence estimates, 2016. *Bull World Health Organ* **97**, 548–562.

Shaurich DF and Freitas HMB (2011) The HIV/AIDS vulnerability framework applied to families: A reflection. *Rev Esc Enferm USP* **45**, 989–995.

Shei A, Costa F, Reis MG and Ko AI (2014) The impact of Brazil's Bolsa Família conditional cash transfer program on children's health care utilization and health outcomes. *BMC Int Health Hum Rights* **1**, 10.

Shisana O, Risher K, Celentano DD, Zungu N, Rehle T, Ngcaweni B and Evans MG (2016) Does marital status matter in an HIV hyperendemic country? Findings from the 2012 South African National HIV Prevalence, Incidence and Behaviour Survey. *AIDS Care* **28**, 234–241.

Sousa MC, Esperidião MA and Medina MG (2017) Intersectorality in the 'Health in Schools' Program: an evaluation of the political-management process and working practices. *Cien Saude Colet.* **22**, 1781–1790.

Steenkamp L, Venter D, Walsh C and Dana P (2014) Socio-economic and demographic factors related to HIV status in urban informal settlements in the Eastern Cape, South Africa. *Afr J AIDS Res* **13**, 271–279.

Teixeira LO, Figueiredo VLM and Mendoza-Sassi RA (2015) Adaptação transcultural do Questionário sobre Conhecimento de Doenças Sexualmente Transmissíveis para o português brasileiro. *J Bras Psiquiatr* **64**, 247–256. [In Portuguese].

Tlou B (2019) The influence of marital status on HIV infection in an HIV hyperendemic area of rural South Africa, 2000–2017. *Afr J AIDS Res.* **18**, 65–71.

von Rosen FT, von Rosen AJ, Müller-Riemenschneider F, Damberg I and Tinnemann P (2018) STI knowledge in Berlin adolescents. *Int J Environ Res Public Health* **15**, 110.

Weimann A and Oni T (2019) A systematised review of the health impact of urban informal settlements and implications for upgrading interventions in South Africa, a rapidly urbanising middle-income country. *Int J Environ Res Public Health* **16**, 3608.

World Health Organization WHO (2020) Seizing the Moment: Tackling entrenched inequalities to end epidemics. Global Aids Update. UNAIDS 2020. Available at https://www.unaids.org/sites/default/files/media_asset/2020_global-aids-report_en.pdf (Accessed on 10 September 2020).

World Health Organization WHO (2016) Global health sector strategy on sexually transmitted infections 2016–2021. Available at http://apps.who.int/iris/bitstream/handle/10665/246296/WHO-RHR-16.09 (Accessed on 15 February 2019).