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Vulnerability of adolescents and young student from public school to HIV in an administrative region of the Distrito Federal

Vulnerabilidade de adolescentes e jovens estudantes de escolas públicas ao HIV em uma região administrativa do Distrito Federal

Vulnerabilidad de adolescentes y jóvenes estudiantes de escuelas públicas al VIH en una región administrativa del Distrito Federal

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ABSTRACT

Objective: To analyze the vulnerability to HIV among adolescents and young high school students in public schools. **Method:** This descriptive, cross-sectional study was conducted in Ceilândia (Distrito Federal, Brazil). The study evaluated individuals of both sexes from 11 public high schools. To be included, volunteers needed to be aged 15 to 24 years old and enrolled in a public school. Those with cognitive impairments that hindered their understanding of the survey instrument were excluded. A self-administered questionnaire with 11 objective questions related to behaviors and knowledge about STIs/HIV was used. The findings were compared with regional data, using secondary data from the Brazilian Unified Health System on HIV/AIDS notifications. **Results:** Most individuals (n=3,706, 96.1%) were in the medium or high vulnerability categories, with a positive correlation between age and higher vulnerability (p<0.001). Males were the majority (n=896, 23.30%) within the high susceptibility group. Although most exposures were heterosexual (n=2,874), among homosexual relationships (n=121), the majority (n=71; 58.68%) were in the high vulnerability category. Nine schools had a higher frequency of individuals in the medium vulnerability category (n=1,945; 50.57%), while two schools had a higher frequency of individuals with high vulnerability (n=342; 8.9%). **Conclusion:** Data suggest adolescents and young adults face challenges in acquiring and applying knowledge about healthy sexual behaviors, indicating a need for better integration between health services, schools, and communities.

Descriptors: Adolescent; HIV infections; Health vulnerability; Health Risk Behaviors.

RESUMO

***Objetivo**: Analisar a vulnerabilidade ao HIV de adolescentes e jovens estudantes do ensino médio de escolas públicas. **Método:** Pesquisa descritiva, transversal, realizada em Ceilândia (Distrito Federal, Brasil). Foram avaliados indivíduos de ambos os sexos em 11 escolas públicas de ensino médio. Para ser incluídos, os voluntários deveriam ter entre 15-24 anos e estar matriculados*

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*na rede pública. Foram excluídos os que apresentavam problemas cognitivos que impedissem entendimento do instrumento. Utilizamos instrumento autoaplicável, com 11 questões objetivas, relacionadas aos comportamentos e conhecimento sobre IST/HIV. Foi feita também comparação com a realidade regional, usando dados secundários do Sistema Único de Saúde sobre as notificações de HIV/AIDS. **Resultados:** A maioria dos indivíduos (n= 3706, 96,1%) estava nas faixas de média ou alta vulnerabilidade, com associação positiva da idade com maior vulnerabilidade (p<0,001). O sexo masculino é a maioria (n=896, 23,30%) dentro da alta vulnerabilidade. Embora o maior número de exposições encontradas tenha sido heterossexual (n=2874), nas relações homossexuais (n=121), a maior parte (n=71; 58,68%) se encontrava dentro da alta vulnerabilidade. Nove escolas apresentaram indivíduos dentro da vulnerabilidade média com maior frequência (n=1945; 50,57%), sendo que duas apresentaram maior frequência de indivíduos com alta vulnerabilidade (n=342; 8,9%). **Conclusão:** Os dados sugerem que há uma dificuldade dos jovens e adolescentes em se apropriar do conhecimento disponível para ter comportamentos sexuais saudáveis, indicando que é necessária uma melhor integração dos serviços de saúde com escolas e comunidades.*

***Descritores:** Adolescente; Infecções por HIV; Vulnerabilidade em saúde; Comportamentos de risco à saúde.*

RESUMEN

***Objetivo:** Analizar la vulnerabilidad al VIH entre adolescentes y jóvenes estudiantes de secundaria en escuelas públicas. **Método:** Este estudio descriptivo y transversal se realizó en Ceilândia (Distrito Federal, Brasil). Se evaluó a individuos de ambos sexos de 11 escuelas secundarias públicas. Para ser incluidos, los voluntarios debían tener entre 15 y 24 años y estar matriculados en una escuela pública. Se excluyó a aquellos con discapacidades cognitivas que dificultaban su comprensión del instrumento de la encuesta. Se utilizó un cuestionario autoadministrado con 11 preguntas objetivas relacionadas con comportamientos y conocimientos sobre ITS/VIH. Los hallazgos se compararon con datos regionales, utilizando datos secundarios del Sistema Único de Salud de Brasil sobre notificaciones de VIH/SIDA. **Resultados:** La mayoría de los individuos (n=3,706, 96.1%) se encontraban en las categorías de vulnerabilidad media o alta, con una correlación positiva entre la edad y una mayor vulnerabilidad (p<0.001). Los hombres eran la mayoría (n=896, 23.30%) dentro del grupo de alta susceptibilidad. Aunque la mayoría de las exposiciones fueron heterosexuales (n=2,874), entre las relaciones homosexuales (n=121), la mayoría (n=71; 58.68%) se encontraba en la categoría de alta vulnerabilidad. Nueve escuelas presentaron una mayor frecuencia de individuos en la categoría de vulnerabilidad media (n=1,945; 50.57%), mientras que dos escuelas tuvieron una mayor frecuencia de individuos con alta vulnerabilidad (n=342; 8.9%). **Conclusión:** Los datos sugieren que los adolescentes y jóvenes enfrentan desafíos para adquirir y aplicar conocimientos sobre comportamientos sexuales saludables, lo que indica la necesidad de una mejor integración entre los servicios de salud, las escuelas y las comunidades.*

***Descriptores:** Adolescente; Infecciones por VIH; Vulnerabilidad en salud; Conductas de riesgo para la salud.*

INTRODUCTION

Human immunodeficiency virus (HIV) infection remains a significant public health problem, with approximately 38 million people living with HIV worldwide[1]. Acquired immunodeficiency syndrome (AIDS) remains the leading cause of death among people aged 15–49 years worldwide[2].

According to the Brazilian Ministry of Health[3], from 2007 to June 2023, a total of 489,594 HIV infections were reported in Brazil, with the number of HIV cases increasing by 17.2% between 2020 and 2022. From 1980 to June 2023, 1,124,063 AIDS cases were reported in Brazil. In all regions, sexual transmission was the main mode of transmission among men and women aged 13 years and older. Among men, the Southeast and Midwest regions showed a predominance of cases among men who have sex with men (MSM) (49.8% and 47.5%, respectively), while in other regions drug users were the main group affected. Although the AIDS detection rate in Brazil has been declining in recent years, with a downward trend in the Southeast and South regions, smaller annual fluctuations in the Midwest region, and an upward trend in the North region[3].

Although the highest concentration of AIDS cases in Brazil is found among people aged 25 to 39 years, 23.4% of cases occur among young people aged 15 to 24 years[3]. Between 2012 and 2022, 52,415 young people aged 15 to 24 of both sexes will progress from HIV infection to AIDS in Brazil, highlighting the significant impact of the disease in this age group[3].

The epidemiological bulletin of the Health Secretariat of the Distrito Federal shows that, between 2017 and 2021, the highest percentage of HIV (46.5%) and AIDS (32.9%) infections in the Distrito Federal (DF) was concentrated in the population aged 20 to 29 years[4].

Risk behaviors are thought to increase the vulnerability of adolescents to HIV infection[5,6]. Increasingly early initiation of sexual activity, coupled with low levels of information about sexuality, low risk perception, impulsivity, a

sense of invulnerability typical of this age group, and a desire for peer approval are some of the factors that warrant concern for this population[7]. The vulnerability of young people is influenced by their ability to assess whether they are at risk of exposure to HIV, which in turn is influenced by education, economic status, and access to health care[8,9].

There are several gaps in knowledge about young people's vulnerability to HIV infection, which vary according to geographical, social and economic contexts[10,11]. Many young people do not have adequate access to accurate information about HIV and AIDS, including prevention, transmission, and treatment. The stigma associated with HIV remains prevalent, which may discourage young people from seeking testing, treatment or support. In addition, young people may face social resistance or lack of support from family, schools, and health services in adopting preventive practices[7].

From a public health perspective, the high incidence of HIV infection among young people highlights inequalities in access to information and health services, which also places a financial burden on health systems and contributes to school dropout rates. The costs associated with HIV/AIDS treatment are substantial, putting pressure on public health systems and diverting resources that could be used for other preventive health measures[7]. There is a continuing need for research that examines young people's knowledge and experiences of HIV and AIDS across different social groups, genders, and races. Such research can inform the development of interventions tailored to their realities and sociocultural contexts, with the aim of reducing infection rates, lowering health care costs, promoting healthy sexual activity, and improving quality of life[6].

The aim of this study was to analyze the vulnerability to HIV among young and adolescent high school students in public schools.

METHOD

This study was conducted according to the STROBE guidelines. It is a descriptive, cross-sectional research conducted in Ceilândia, the most populous administrative region of the DF, with a population of 287,023[12]. According to the United Nations Development Programme (UNDP), in 2021 the DF had a Municipal Human Development Index (MHDI) of 0.814, while Ceilândia had an MHDI of 0.747, both considered high[13]. According to the websites of the Health Secretariat of the Distrito Federal and of the Education Secretariat of the Distrito Federal, Ceilândia has 15 primary health care units, 13 public high schools, 2 emergency care units, and 1 regional hospital. Data from the Security Secretariat of the Distrito Federal[14] show that in the first half of 2024, Ceilândia had the highest number of arrests in the DF, with 90% of those arrested being men, with an average age of 33 years, with incomplete primary education and earning up to a minimum wage (69%). The most common offense (33.6%) was related to domestic and family violence.

In this study, individuals of both sexes from 11 of the 13 public high schools in Ceilândia were evaluated, following the eligibility criteria of being between 15 and 24 years old and enrolled in the public education system. Individuals with cognitive impairments that prevented them from responding correctly to the evaluation instrument were excluded. Sample size was calculated by using SampSize for prevalence studies, with a 95% confidence interval (95% CI) and a 5% margin of error. As no similar analyses were found in the literature, a conservative prevalence of 50% was used. The total population of high school students enrolled in Ceilândia during the study period was approximately 12,850, and a minimum sample size of 374 students was estimated.

Data were collected during the academic year 2019. The study was conducted in accordance with Resolution No. 466/12 of the Brazilian Health National Council and was approved by the research ethics committee at Faculty of Health Sciences, University of Brasília (CAAE 44531615.0.0000.0030). Access to schools was authorized by the regional education coordination, which introduced the research team to the school principals. Meetings were held with each principal to define the strategies and optimal times for data collection.

Research was conducted by using a structured questionnaire developed by the Brazilian Ministry of Health in collaboration with the Ministry of Education and United Nations Children's Fund (UNICEF): "Do I have to take the HIV/AIDS test? National Mobilization of Adolescents and Young People for the Prevention of HIV and AIDS"[6,10,15]. Questionnaire was transferred to an online platform and data collection was performed by using tablets with internet access during students' free time in schools.

The vulnerability data collection instrument is validated[6] and includes 11 objective questions related to behavior and knowledge about sexually transmitted infections (STIs) and AIDS. Since it is self-administered, at the end the participant discovers their level of vulnerability based on the sum of the colors of their answers (green, yellow, or blue).

If all responses are green, the young person is considered to have a low vulnerability to HIV infection; if responses are green and yellow, it indicates a need for more in-depth information and protective measures, categorized as medium vulnerability. If there is at least one blue response, the individual is experiencing situations that result in high vulnerability to HIV infection. For data analysis, the colors were converted to numerical values as described in previous studies[6].

Additional questions were included about age, gender, and most frequent type of sexual exposure, with options for heterosexual, homosexual, bisexual, or not applicable if the youth had not yet initiated sexual activity.

Prior to completing the questionnaire, participants were presented with the Informed Consent Form (ICF), or the Assent Form if they were under 18 years of age (following the guidelines of the Child and Adolescent Statute, Law No. 8.069, of July 13, 1990). Once the volunteers accepted the terms and conditions available in the online survey link, the questionnaire was launched.

For a comparative analysis with the regional reality, secondary data from the Brazilian Unified Health System (SUS) on HIV/AIDS notifications were collected for the whole country, the Midwest macro-region and the DF, covering the target age group of the present study, from 2009 to 2019, by consulting the Department of Informatics of the Unified Health System (DATASUS).

Data sources for information on HIV/AIDS case reporting were the Information System on Diseases of Compulsory Declaration (SINAN) and the Brazilian Laboratory Test Control (SISCEL), with consolidated data up to June 30, 2019. These data were presented descriptively, with the aim of comparing the prevalence with sex, age group, type of sexual exposure, and level of education of the most vulnerable population in the present study.

Sociodemographic variables included sex, age in years (15 to 19; 20 to 24), and education level. Exposure categories were sexual exposure, injecting drug users, and vertical transmission, according to the hierarchical exposure criteria defined in the SINAN NET data dictionary — version 5.0[16], which reflect how individuals are exposed to the HIV. This provided the percentages of confirmed AIDS cases by exposure category in the population residing in a given location, in the year considered, by sex, and with a breakdown by different age groups.

All data were tabulated by using SPSS software (IBM, NY, USA) and analyzed by using analytical and descriptive statistics with a 95% CI. Absolute and relative frequencies were calculated for qualitative variables and mean and standard deviation for quantitative variables. Quantitative variables were analyzed by group of interest using the chi-square test to test the level of association between variables. The magnitude of associations was expressed by using odds ratios and their corresponding confidence intervals. Normality of data was tested by using the Kolmogorov-Smirnov and Shapiro-Wilk tests. Nonparametric tests such as Kruskal-Wallis, Wilcoxon, and Conover-Iman were used to compare two or more independent groups of different sizes without assuming any distribution.

RESULTS

A total of 3,856 individuals, both male and female, aged 15 to 24 years, who were regular high school students or enrolled in the Educação para Jovens e Adultos (EJA), a Brazilian educational program for youth, adults, and older adults who did not have access to school at the appropriate age, in Ceilândia were interviewed. Some data were lost because not all participants answered every question, which resulted in some analyses having a sample size smaller than the total, but still exceeding the minimum sample size determined by the sample size calculation.

Most of the individuals (3,706 [96.1%]) fell into the categories of medium or high vulnerability to HIV. Specifically, 150 individuals (3.9%) were classified as low vulnerability, 1,951 (50.57%) as medium vulnerability, and 1,755 (45.53%) as high vulnerability to STI/HIV infection.

Figure 1 and Table I show that the mean age across the different vulnerability groups is homogeneous, with all groups averaging around 16 years (16.35 ± 1.17). Median age for the high vulnerability group (17 years) stands out compared to the medians for the low and medium vulnerability groups. A peculiar pattern is observed between the lowest observed value and the first quartile in the medium and low vulnerability groups, both of which have identical values, indicating a concentration of 15-year-olds in the sample for these groups. In addition, these groups share the same third quartile and median. The differentiation between the groups occurs at the maximum values. Median and third quartile are identical for the high vulnerability group, which indicates a concentration of 17-year-olds in this group. Besides, this group includes older people between the ages of 19 and 24, as students enrolled in the EJA were included in the sample.

Table I. Descriptive analysis of ages of youth and adolescents by vulnerability to STIs/HIV/AIDS, Ceilândia, Distrito Federal, Brazil, 2019.

	Low	Mean	High
Mean	15.97	16.15	16.60
SD	1.11	1.10	1.21
Minimum	15	15	15
1st quartile	15	15	16
Median	16	16	17
3rd quartile	17	17	17
Maximum	21	22	24

SD = standard deviation; STI = sexually transmissible infections.
Source: Authors, 2024

Since data did not follow a normal distribution, the nonparametric Kruskal-Wallis test was used to determine if there were significant differences in age between the three susceptibility groups, which revealed a significant difference between the groups ($p<0.001$). The Conover-Iman test was then used for multiple pairwise comparisons between groups. Statistically significant differences were found between the ages of individuals in the low and high susceptibility groups, as well as between the intermediate and high susceptibility groups ($p<0.001$). The nonparametric Wilcoxon test was then used to determine which group had the higher age and showed that the age in the lowest susceptibility category was the lowest of the three groups. Again, statistically significant differences were observed between the ages of the low and high susceptibility groups and between the medium and high susceptibility groups ($p<0.001$). These results suggest an individual's vulnerability to HIV increases with age.

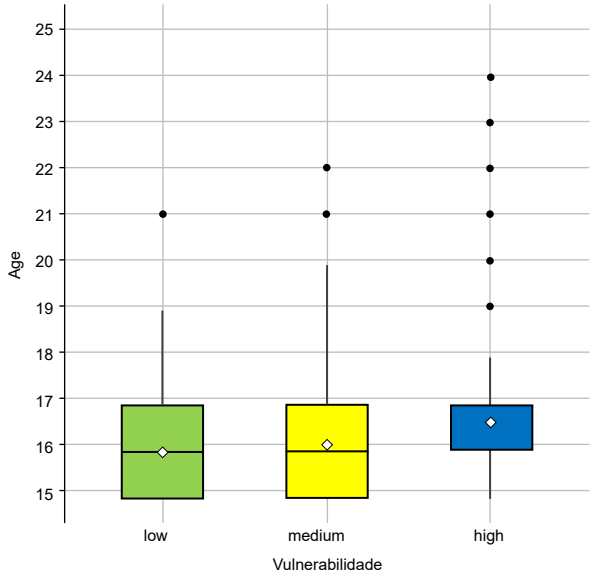

Figure 1. Classification of youth and adolescents by vulnerability to STIs/HIV/AIDS by age, Ceilândia, Distrito Federal, Brazil, 2019.

In analyzing the relationships between HIV vulnerability and gender, we found the sample included almost equal proportions of female and male participants (Table II). There were a few individuals with low HIV vulnerability, while the remainder were more evenly distributed between medium and high levels of vulnerability.

Within each vulnerability level, the analysis shows that females predominated in the low and medium vulnerability categories, accounting for 96 (2.5%) and 1,047 (27.2%) of the total in these levels, respectively, compared to 54 (1.4%) and 827 (23.3%) males. However, in the high vulnerability category, males were in the majority with 896 individuals representing 23.3% of the total in this level. Therefore, Pearson's chi-square test was used to determine if the sex of the individual had any influence on STI/HIV/AIDS vulnerability. There is a statistically significant relationship between a person's gender and their level of vulnerability ($p<0.001$).

Table II. Frequency analysis of youth and adolescent vulnerability to STIs/HIV/AIDS by sex, Ceilândia, Distrito Federal, Brazil, 2019.

Vulnerability level	Female n (%)	Male n (%)	Subtotal by category n (%)
Low	96 (2,5%)	54 (1,4%)	150 (3,9%)
Medium	1,047 (27,23%)	897 (23,33%)	1,944 (50,56%)
High	855 (22,24%)	896 (23,30%)	1,751 (45,54%)
Total	1,998 (51,97%)	1847 (48,03%)	3,845 (100%)

Source: Authors, 2024.

The most common type of sexual exposure found in the sample was heterosexual (n=2,874, 74.92%). Approximately 15.6% (n=600) of the sample had not yet initiated sexual activity and were categorized as “not applicable” in the results. Bisexual exposure accounted for 6.28% (n=241) of the sample, while homosexual exposure accounted for 3.15% (n=121) (Table III).

Regarding the analysis of vulnerability associated with the most common type of sexual exposure, most individuals in both heterosexual and homosexual relationships fell into the high vulnerability category, representing 37.2% (n=1,427) and 1.85% (n=71) of the total sample, respectively (Table III).

In contrast, medium vulnerability was most common among those with bisexual exposure and those who had not initiated sexual activity, with 3.26% (n=125) and 10.84% (n=416) of the sample, respectively. Therefore, the existence of an association between vulnerability and the most frequent type of sexual exposure was tested, which showed statistical evidence ($p<0.001$) of a positive association between vulnerability and the type of sexual relationship most frequently engaged in by the individual.

Table III. Analysis of youth and adolescent vulnerability to STIs/HIV/AIDS by most frequent type of sexual exposure, Ceilândia, Distrito Federal, Brazil, 2019.

Most frequent type of sexual exposure	Low n (%)	Medium n (%)	High n (%)	Subtotal by category n (%)
Homosexual	5 (0.13%)	45 (1.17%)	71 (1.85%)	121 (3.15%)
Heterosexual	96 (2.50%)	1,351 (35.22%)	1,427 (37.20%)	2,874 (74.92%)
Bisexual	7 (0.18%)	125 (3.26%)	109 (2.84%)	241 (6.28%)
Not applicable	41 (1.07%)	416 (10.84%)	143 (3.73%)	600 (15.64%)
Total	149 (3.88%)	1,937 (50.50%)	1,750 (45.62%)	3,836 (100%)

Source: Authors, 2024.

Analyzing the relative frequency data of HIV vulnerability by the high school studied, out of the 11 schools, nine had a higher frequency of medium vulnerability, while the other two schools had a higher proportion of individuals with high vulnerability (Table IV).

Table IV. Relative frequency analysis of youth and adolescent vulnerability to STIs/HIV/AIDS by high school, Ceilândia, Distrito Federal, Brazil, 2019.

High schools	Low n (%)	Medium n (%)	High n (%)	Subtotal by category n (%)
1	10 (0.26%)	**153 (3.98%)**	108 (2.81%)	271 (7.05%)
2	10 (0.26%)	**208 (5.41%)**	177 (4.60%)	395 (10.27%)
3	10 (0.26%)	**113 (2.94%)**	107 (2.78%)	230 (5.98%)
4	40 (1.04%)	**372 (9.67%)**	338 (8.79%)	750 (19.50%)
5	7 (0.18%)	**152 (3.95%)**	151 (3.93%)	310 (8.06%)
6	5 (0.13%)	**39 (1.01%)**	36 (0.94%)	80 (2.08%)
7	13 (0.34%)	**174 (4.52%)**	169 (4.39%)	356 (9.26%)
8	12 (0.31%)	**177 (4.60%)**	128 (3.33%)	317 (8.24%)
9	8 (0.21%)	135 (3.51%)	**143 (3.72%)**	286 (7.44%)
10	11 (0.29%)	171 (4.45%)	**199 (5.17%)**	381 (9.91%)
11	24 (0.62%)	**251 (6.53%)**	195 (5.07%)	470 (12.22%)
Total	150 (3.90%)	1945 (50.57%)	1751 (45.53%)	3846 (100%)

Source: Authors, 2024

In the last 10 years (2009-2019), the SINAN/SISCEL systems recorded 393,114 AIDS cases in Brazil, of which 27,882 (7%) originated from the Midwest macro-region. Within the Midwest region, 5,301 (19%) of these notifications came from the DF.

Focusing on the target age group, 760 AIDS cases were reported in the DF between 2009 and 2019. Among these adolescents and young adults, males represented 85% (n=646) of the cases. The frequency of male cases was significantly higher than that of females ($p<0.05$, Kruskal-Wallis).

When refining the data by educational level, 489 cases had this information in the system. Of these, 280 cases (36.8%) were individuals with a complete high school education and incomplete higher education. The remaining educational categories accounted for 27.5% (n=209), while 271 cases (35.6%) were recorded without a defined level of education.

Analyzing the exposure categories from 2009 to 2019, the data show that among the AIDS cases identified in the 15-24 age group in the DF, the largest percentage was among homosexual individuals (47.8%, n=363), while 9.3% (n=71) were bisexual and 17.8% (n=135) were heterosexual. Only 2% (n=15) of the cases in the DF were related to injecting drug users, and 23.2% (n=176) of the cases fell into the categories “ignored” or “other” (including vertical transmission, hemophiliacs, blood transfusions, and accidents involving biological material).

DISCUSSION

Vulnerability to HIV infection not only represents a significant public health challenge, but also underscores the need for efficient allocation of public financial resources. Public policies that prioritize the allocation of resources to interventions based on scientific evidence can help reduce the incidence of STIs/HIV while minimizing the costs associated with treating related diseases[17]. In this context, health information, education, and communication are also crucial aspects of breaking the transmission chain and improving the quality of life within communities[18].

The main finding of this study was the high prevalence of vulnerability to STI/HIV infection among adolescents and young adults aged 15-24 years in the largest administrative region of the DF. HIV vulnerability reflects a complex intersection of social, economic, and behavioral factors that influence the spread of the disease[9]. Vulnerable groups often face significant barriers to accessing health services, education, and prevention efforts, which may be related to a lack of sex education in schools, inadequate health education initiatives in public health services, and religious taboos in the family environment[19].

According to global estimates, more than 10 million people between the ages of 15 and 24 are infected with HIV, and the prevalence rate among young people is increasing, with many infections occurring during adolescence[1]. In Brazil, between 2009 and 2019, cases among people aged 15 to 24 will represent 12% of the total population affected by the virus[2]. Every 14 seconds, a young person between the ages of 15 and 24 becomes infected with HIV, and about half of all new infections occur in this age group. Worldwide, young people aged 15 to 24 are estimated to account for 45% of new HIV infections[1].

In this context, the present study shows that age is also associated with vulnerability to STI/HIV infection. The mean age of the individuals in this study is consistent with the average age of sexual initiation in Brazil, which is 14.9 years[20]. Approximately 15% of individuals had not yet initiated sexual activity, which is consistent with the Latin American average of 15 years[1].

Sample was 52% female, with the majority in the low and moderate HIV vulnerability categories. Literature suggests that women with higher levels of education tend to be more knowledgeable about HIV prevention and are better able to avoid high-risk situations[8,21]. n Brazil, women typically begin sexual activity later than men, with women with only primary education having their first sexual encounter between the ages of 16 and 19[8,22].

In contrast, the highest prevalence of males was found in the high vulnerability category. Male vulnerability is supported by socio-cultural factors shaped by the sex/gender system[23]. The need to demonstrate strength and virility may reduce the perception of vulnerability to HIV infection[24]. This social construct appears to be present among the young men in this study as well.

The results also showed a positive relationship between increasing age and increased vulnerability. In support of our findings, other studies have shown that as age increases, the number of experiences and potential exposures to risky behaviors increases over time[11,15]. Conversely, some studies suggest that vulnerability decreases with later initiation of sexual activity[25,26], and that lower age and educational attainment are associated with decreased likelihood of condom use[10,26]. These behaviors are often influenced by a combination of curiosity, social pressure, lack of comprehensive sex education in schools, and limited access to adolescent-specific health services. The influence of

the Internet and social media can also encourage risky behaviors that increase young people's vulnerability to HIV. While digital platforms provide access to information about sexuality, they can also expose young people to content that promotes unprotected sexual behavior. The spread of inaccurate or incomplete information about prevention methods and the encouragement of unsafe sexual practices are growing challenges. In addition, social media often perpetuate a culture of seeking approval and acceptance, where social pressure can lead to risky decisions about sexuality, drug use and alcohol consumption, further increasing vulnerability to HIV[5,27].

The positive correlation between age and vulnerability may also be related to the fact that this is a life stage marked by the onset of the human reproductive period, a time when individuals are more sexually active and potentially have a greater number of partners[24].

A considerable proportion of individuals who reported more frequent homosexual sexual exposure had high vulnerability to HIV infection, with evidence of a positive association between sexual exposure and vulnerability. A study of young people aged 13 to 24 found an association between drug use and a higher prevalence of HIV positivity among males, with the highest rates observed among homosexual and bisexual men[10]. Another study found a positive association between HIV positivity and initiation of sexual activity before age 15 among MSM[23,27]. Rates in this group have been increasing[2,3], which suggests a growing vulnerability among young people.

Although studies have shown that young MSM are knowledgeable about HIV and prevention methods[26], their behavior in practice often differs[28]. Unequal gender norms may limit their access to information and prevention methods, thereby increasing their risk of infection[23]. Another factor that may contribute to risky behavior is the age dynamic within these casual partnerships, where older men exert influence over younger ones[23], potentially facilitating the transmission of HIV to adolescents through the economic subordination of the younger individuals[29].

This study also showed that of the 11 schools analyzed, nine had a higher frequency of medium vulnerability, while two had a higher frequency of high vulnerability. These results are consistent with a previous study conducted among 136 high school evening students at a school in the interior of São Paulo, where 59.5% of the respondents were found to be vulnerable to HIV infection[30].

AIDS cases reported in SINAN from 2009 to 2019 in the study region among 15–24-year-olds showed a significantly higher number of men, especially homosexuals, with a high school education or incomplete higher education. This same vulnerability profile was identified in the present study, suggesting that infections likely occurred during high school and manifested in adulthood. Reducing the underreporting of cases would help to produce data that more accurately reflect regional realities, thereby supporting planning and investment in public policies aimed at combating HIV infection and promoting prevention.

All schools studied showed a higher frequency of individuals in the medium and high vulnerability categories, indicating the need for expanded studies to support the Brazilian guidelines for combined prevention of HIV/AIDS. This study contributes to the understanding of vulnerability to HIV infection in an age group that accounts for 45% of new infections worldwide[1].

The fact that 15% of the sample had not yet initiated sexual activity could be considered a limitation, as these participants were answering questions about behaviors, they had not yet experienced. However, only three questions were related to sexual activity, while the remaining questions focused on knowledge of the topic and access to health services. Other limitations could arise from the self-reported nature of the information; however, the questionnaires were completed individually and anonymously using tablets, which provided privacy and comfort for participants. In addition, due to the limitations of the instrument used, other socioeconomic, racial, and cultural factors (e.g., per capita income, environmental conditions, and housing) were not examined, but could be explored in future studies to demonstrate other associations.

CONCLUSION

Most of the young and adolescent population enrolled in public schools in the study region was found to be vulnerable to HIV, with a positive association between individual age and increased vulnerability. Females constituted the majority within the low and medium vulnerability categories, while a higher prevalence of high vulnerability was observed among males. The most common type of sexual exposure also influenced the vulnerability of these young people.

These findings highlight areas for future research to identify the reasons for underreporting and the gap between knowledge about HIV infection and risky behaviors among young people. Data suggest that adolescents and young adults face challenges in using available knowledge to engage in healthy sexual behaviors, indicating a need for better integration of health services with schools and communities.

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CONFLICTS OF INTEREST

We declare that we have no conflicts of interest related to the subject matter of this study.

AUTHOR CONTRIBUTIONS

Isabella Viana Silva, **Marina Costa Tolentino Ferreira**, **Ana Clara Alcântara Mendes Pereira**, **Yanna Thainá Soares Carvalho** e **Fernanda Helena Nunes Lacerda** made substantial contributions to data acquisition, analysis, interpretation, and drafting of the manuscript. **Jamila Reis de Oliveira** contributed to the study conceptualization, design, coordination, data interpretation, drafting, and critical revision of the manuscript. **Elaine Cristina Leite Pereira** contributed to the study conceptualization, design, coordination, financial resource management, data interpretation, writing, and critical review of the manuscript.

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