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Sociodemographic associated factors with non-disclosure of HIV sero-status to sexual partners in Maputo, Mozambique

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The HIV prevalence in Maputo city is 16.2%. There is a lack of data describing associated factors with disclosure or non-disclosure of HIV-positive sero-status to sexual partners. This analysis describes associated factors of non-disclosure of HIV sero-status to sexual partners among people living with HIV (PLHIV) participating in a serostatus disclosure support program at three health facilities in Maputo, Mozambique. We used a cross-sectional design of PLHIV aged over 18 years. Datas were collected between December 2019 and September 2020. Univariate and multivariable logistic regression models were used to evaluate factors associated of non-disclosure of HIV sero-status. A total of 377 patients were enrolled in the HIV sero-status disclosure Program. Of these, nearly two-thirds (61.5%) were women, 52.9% had completed secondary school, 47.7% were 25–34 years old, 50.9% had informal employment with low income, and 73.2% were married. Univariate logistic regression model showed greater odds of non-disclosure among patients who had an employment contract with a maximum wage (Crude Odds Ratio [cOR] 2.02, 95% confidence interval [CI] 1.15–3.55, $p = 0.015$; were single (cOR 3.85, 95% CI 2.22–6.69, $p < 0.001$; were living with parents (cOR 2.30, 95% CI 1.07–4.93, $p = 0.033$; received financial support for their monthly household expenses from parents or a close relative (cOR 7.15, 95% CI 2.19–23.36, $p = 0.001$; or brought a parent/close relative and/or a friend as a confidant during HIV care(cOR 3.17, 95% CI 1.74–5.76, $p < 0.001$; and cOR 5.97, 95% CI 1.57–22.66, $p = 0.009$, respectively). Multivariable logistic regression model showed: from parents/close relative and from partner (Adjusted Odds Ratio [aOR] 8.19, 95% CI 1.44–46.46, $p = 0.018$; and aOR 4.34, 95% CI 1.05–17.17, $p = 0.043$, respectively); in those who brought a parent/close relative and/or a friend as a confidant during HIV care (aOR 8.86, 95% CI 2.16–36.31, $p = 0.002$; and 195 aOR 21.68, 95% CI 3.02–155.87, $p = 0.002$, respectively). Non-disclosure of serostatus is a critical issue for HIV care and treatment programs, given that non-disclosure of HIV serostatus increases risk of HIV transmission. Understanding the factors associated with non-disclosure is crucial for designing strategies to address these factors and end the HIV epidemic by 2030. Our findings suggest that HIV serostatus disclosure programs might target the sociodemographic factors strongly associated with non-disclosure.

Abbreviations

ART   Antiretroviral treatment
aOR   Adjusted Odds Ratio
CI   Confidence intervals
cOR   Crude Odds Ratio
PEPFAR   President's Emergency Plan for AIDS Relief

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PLHIV   People living with HIV
UNAIDS   United Nations Programme on HIV/AIDS
WHO   World Health Organization

The Mozambican national survey, INSIDA 2021, revealed that the annual incidence of HIV was 0.43% among adults over 15 years of age, with incidence higher among women (0.61%) compared to men (0.24%). The prevalence of HIV was 12.5% in adults, also higher among women than men (15 vs. 9.5%), and corresponding to approximately 2,097,000 people living with HIV (PLHIV)[1]. One of the important factors contributing to new infections annually can be attributed to the failure of PLHIV to disclose their zero status to partners. HIV disclosure is defined as the process of disclosing one's HIV positive serostatus to sexual partner(s), family members or other people in one's social circle and which usually occurs gradually over time[2].

Previous studies from other countries such as Tanzania revealed that barriers to timely disclosure included denial of one's status, fear of stigmatization, fear of separation or divorce, desire to protect loved ones and lack of adequate knowledge about HIV[3,4]. Between 2014 and 2018, the Ministry of Health of Mozambique in partnership with I-TECH Mozambique conducted a pilot to assess the acceptability, feasibility and effectiveness of supportive interventions for the disclosure of HIV sero-status to sexual partners[5]. I-TECH began working in Mozambique in 2005. Since then, its technical support to the Ministry of Health (MISAU) has been focused on addressing the shortage of health care providers in the country through clinical training and curriculum revision and development; improving the quality of HIV prevention, care and treatment services, including antiretroviral treatment (ART) and voluntary medical male circumcision (VMMC); ongoing monitoring and evaluation (M&E) activities, including technical assistance to MISAU, to measure the effectiveness of health care programs and provide quality data for decision-making and program improvement. In this successful pilot, 74% of PLHIV disclosed their positive HIV sero-status to their partners. Among partners of these index cases who were tested for HIV, seropositivity ranged between 57 and 95% of all new HIV cases identified were linked to HIV care and treatment[6].

Previous research suggests that, non-disclosure of one's HIV positive sero-status can be considered an emotional self-protection strategy, and may be influenced by the fear of overwhelming or triggering a severe emotional response in a partner, or becoming a target of discrimination[7]. In one qualitative study, PLHIV who chose to disclose positive serostatus to their partner reported that they were seeking to regain control over their lives, diminish the *stress* associated with non-disclosure and anxiety caused by sexual relations with a partner who is unaware of their serostatus[8]. In some cases, a change in the pattern of behavior may occur, reducing the number of sexual partners and consequently reducing the number of disclosures[9].

Support for PLHIV to disclose their HIV serostatus to partners and other people close to them is a practice that is becoming more common in many African countries because of multiple advantages[10–14]. For PLHIV, the disclosure of their serostatus with a close and trusted person fosters relief and closeness and is an important first step in creating a foundation of social support. For society as a whole, greater acceptance of disclosure contributes to raising awareness about the HIV epidemic, and adoption of preventive medications and behaviors that can reduce the transmission of infections, and the stigma and discrimination associated with HIV[15].

At the advent of the HIV in Mozambique, there was a generalized notion of treating HIV serostatus as a private matter, based on the assumption that disclosing information pertaining to one's HIV positive serostatus place the person in the receiving end of acts of stigmatization and discrimination, and therefore, would not be accepted by the patients[5]. This notion led to health systems not promoting health providers to assist patients to disclose their HIV positive serostatus to partners[5]. Disclosure of HIV positive serostatus has been encouraged and widely practiced through psychosocial support to a patient's "confident", a close person to the patient, who is generally a friend or close relative, but not to partners[5].

A pilot intervention conducted in 2016 that consisted in assisting patients to disclose their HIV positive sserostatus to partners trough counselling on the methodology and the benefits, resulted in high rates of disclosure of HIV positive sserostatus to partners and on a low occurrence of adverse events such violence and or relationship dissolutions[16]. As result of this intervention, assisted disclosure of HIV + partners and partners' notification were adopted by the Mozambican Ministry of health as an integral component of its response to the HIV epidemic[6]. But non-disclosure of HIV serostatus continues to be a problem in Mozambique, so it is critical to identify socio-demographic factors associated with non-disclosure to sexual partners among PLHIV. Not all studies from African countries have similar findings, however. Data from a survey of Kenya and Uganda who participated in a test and treatment trial (SEARCH, NCT#01,864,603), showed different results. That study found that among those who did not disclose (47.4% men vs. 15.0% women; $p = 0.005$)[17]. No studies have reported the main barriers to disclosure of HIV serostatus in Mozambique. This analysis aims to increase understanding of the sociodemographic factors that associated with non-disclosure and inform effective and feasible approaches to support that are relevant to the Mozambican context.

Methods
Setting or area
The analysis reviewed routine data collected from a serostatus disclosure support program ("*the support program for disclosing HIV sero-status and invitation for testing of sexual partners and children*") implemented at three high-volume urban/sub-urban health facilities in Maputo city. José Macamo (CSJM) is an urban health facility attached to a referral hospital with 7202 PLHIV in care and treatment [C&T], while Polana Caniço (HGPC) with 9933 PLHIV in C&T and Bagamoyo (CSB) with 6937 PLHIV in C&T, both are sub-urban primary level health facilities, between December 2019 and September 2020.

Evaluation design and population

This cross-sectional assessment of routine programmatic data was analyzed to inform future improvements to the program. Included data were collected as part of the Program from three health facilities between December 2019 and September 2020. Participants included people aged 18 or over who tested positive for HIV and initiated ART treatment.

Inclusion and exclusion criteria

The eligibility criteria consisted of: PLHIV over 18 years of age who were sexually active. Potential participants were identified from among HIV index case who received psychosocial support prior to starting ART, and who agreed to complete the questionnaire about disclosure of HIV serostatus to sexual partners. Participants included both patients who had already disclosed their serostatus to partners, as well as those who had not yet disclosed. Patients with mental illness, serious medical illness (e.g., life expectancy less than 6 months) and who did not give informed consent were excluded from the Program.

Sample size and sampling procedure

Potential Program participants were recruited from the annual PLHIV notification in 2018. Approximately 3316 PLHIV were included, distributed across the following 3 health units: 823 at the Bagamoio, 1182 at the José Macamo and 1311 at the Polana Caniço . With a confidence level of 95%, a margin of error of estimation of 4.5% and a population proportion of 50% of patients who revealed and expressed interest in revealing their HIV serological status, a sample of 415 patients, which constitutes 12.5% of the total population. The Program population consisted of all eligible patients who agreed to participate and completed the questionnaire. In this sense, the distribution of those selected by health unit was as follows: 103 at the CSB, 148 at the CSJM and 164 at the HGPC.

Data collection

The questionnaire form (prepared by the authors considering the sociodemographic situation of patients residing in the surrounding areas) included questions about: (1) gender; (2) age; (3) education; (4) profession/source of livelihood; (5) marital status; (6) household characteristics; (7) characteristics of partners.

Staging of data collection
The following steps were used for data collection. First, we coded and anonymized data from questionnaires forms for all Program participants for the period December 2019 and September 2020. Each patient was given an alphanumeric code. Patient names, birthdates, and home address were not extracted into the evaluation dataset. We then digitized the coded data in a data collection form in Excel. The dataset was then uploaded and synchronized on a cloud-based SQL server and then exported to SPSS for further analysis.

Data collection personnel and data security
Sources of data included a structured interviewer-administered questionnaire, collected by counselors trained in good research practices. Patient data was kept secure on forms and stored at I-TECH facilities, in a locked room and/or cabinet, in accordance with the national standards of the Ministry of Health. Primary questionnaire forms were reviewed, checked daily for completeness and consistency, then extracted into the assessment dataset by the I-TECH Monitoring and Evaluation (M&E) team. The evaluation dataset, which included only anonymized data, was password protected and only data collection team members received the password.

Operational or conceptual definition

According to the original articles on HIV disclosure[2,18], approaches implemented in other countries, the adopted operational or conceptual definition were as follows:

HIV disclosure
HIV disclosure is defined as the process of disclosing one's HIV positive serostatus to sexual partner(s), family members or other people in one's social circle and which usually occurs gradually over time[2].

HIV non-disclosure
HIV non-disclosure is defined as the process of non-disclosing one's HIV positive serostatus to sexual partner(s), family members or other people in one's social circle.

HIV index case
The index case is defined as a PLHIV who is aware of their serostatus and enrolled in care and treatment, who then identifies other individuals with whom they have had sexual contact[18]. These contacts might have had additional exposures to HIV (sexual contact with people who were not the index case, or perinatal exposure).

Outcome data and statistical analysis of data

The primary outcome was non-disclosure of HIV serological status to sexual partners.

Statistical analysis was performed using the statistical software IBM® Statistical Package for the Social Sciences (SPSS) version 25 (International Business Machines Corporation, IBM corp, Release 2017, https://www.ibm.com/legal/copytrade, USA).

First, to describe participants' baseline characteristics, we calculated frequencies and proportions for categorical data and means and standard deviations for continuous variables. We then compared these characteristics between the group of patients who reported disclosure of HIV serological status to sexual partners and the group who reported non-disclosure, using chi square or Fisher's exact tests. Next, we used univariate and multivariable logistic regression models to estimate odds of non-disclosure of HIV serostatus to sexual partners, reporting adjusted odds ratios (aOR) and 95% confidence (CI). Variables with p-value less than 0.5 in univariate analyzes were entered into the multivariable model.

Results

HIV Index case characteristics according to non-disclosures of HIV sero-status to sexual partners

A total of 377 patients were enrolled to HIV sero-status disclosure program in the three sites. Of these, nearly two-third 61.5% (95% CI 56.6–66.3) were women, more than half 52.9% (95% CI 47.9–57.9) had secondary school, 6.6% (95% CI 4.5–9.4) higher education, almost half 47.7% (95% CI 42.7–52.8) were aged between 25 and 34 years, half 50.9% (95% CI 45.9–56.0) had informal employment with low income, nearly three-quarter 73.2% (95% CI 68.5–77.5) were married (Table 1).

Overall, 70 (18.6%, 95% CI 14.9–22.7) of 377 HIV Index case patients did not disclose their HIV serostatus to their sexual partner (Fig. 1). The proportion of patients who did not disclose their HIV sero-status compared to those who did was significantly higher in women than in men (82.9% [95% CI 72.8–90.9] vs. 56.7% [95% CI 51.1–62.1], $p < 0.001$); PLHIV in care at the urban health facility (CSJM) (50.0% [95% CI 38.5–61.5] vs. 35.5% [95% CI 30.3–41.0], $p = 0.024$); in those who had an employment contract with maximum wage (47.1% [95% CI 35.8–58.5] vs. 32.6% [95% CI 27.5–38.0], $p = 0.049$); in those that lived with parents (18.5% [95% CI 10.5–29.1] vs 9.1% [95% CI 6.3–12.7], $p < 0.001$); in those that did not live in their own home (62.9% [95% CI 51.2–73.5] vs 45.9% [95% CI 40.4–51.5], $p = 0.011$); in those that received financial support for their monthly household expenses from parents/close relatives (10.0% [95% CI 4.6–18.6] vs 1.6% [95% CI 0.6–3.5], $p = 0.001$); (Table 1).

Associated factors of non-disclosure of HIV sero-status to sexual partner

Regarding the univariate logistic regression model, men had lower odds to non-disclosure their HIV serostatus to their sexual partner compared to women (cOR 0.27, 95% CI 0.14–0.52, $p < 0.001$); those receiving care in sub-urban health facilities (CSB & HGPC) had lower odds to non-disclosure their HIV sero-status compared to the urban health facility (CSJM) (cOR 0.55, 95% CI 0.33–0.9369, $p = 0.025$). Those who had an employment contract with a maximum wage had twice the odds of not disclosing their HIV sero-status compared to those who had informal employment with minimum and average wage (cOR 2.02, 95% CI 1.15–3.55, $p = 0.015$). Patients who were not married had nearly four-fold higher odds of not disclosing their HIV sero-status compared to married patients (cOR 3.85, 95% CI 2.22–6.69, $p < 0.001$). Those living with parents had twice the odds of not disclosing their HIV sero-status compared to those who lived with their own family (cOR 2.30, 95% CI 1.07–4.93, $p = 0.033$). Those who lived with a sexual partner in the same house had lower odds to not-disclosing their HIV sero-status compared to those who lived alone (cOR 0.26, 95% CI 0.15–0.45, $p < 0.001$).

Those who lived in their own house had lower odds of not disclosing their HIV sero-status to their sexual partner, compared to those who did not own and live in their own house (cOR 0.50, 95% CI 0.29–0.86, $p = 0.011$). Those who received financial support for their monthly household expenses from parents/close relatives had seven-fold higher odds of not disclosing compared to those who paid their own household expenses (cOR 7.15, 95% CI 2.19–23.36, $p = 0.001$); (Table 2).

According to the multivariable logistic regression model, men had lower odds of not disclosing their HIV sero-status to their sexual partner compared to women (aOR 0.38, 95% CI 0.16–0.95, $p = 0.038$). Those followed in sub-urban health facilities (CSB & HGPC) had 25% lower odds of to not disclosing their HIV sero-status compared to a urban health facility (CSJM) (aOR 0.75, 95% CI 0.18–0.32, $p < 0.001$), respectively. Those who received financial support for their monthly household expenses from parents/close relative and/or a partner had an eight-fold and more than four-fold higher odds of not disclosing their HIV sero-status compared to those who paid their own household expenses (aOR 8.19, 95% CI 1.44–46.46, $p = 0.018$; and aOR 4.34, 95% CI 1.05–17.17, $p = 0.043$), respectively.

Discussion

This is the first Mozambican cross-sectional assessment of routine programmatic data to identify sociodemographic factors associated with non-disclosure of HIV sero-status to sexual partners. In this Program, men had lower odds to non-disclosure their HIV Status to sexual partners compared to women, consistent with previous studies that suggest that women fail to reveal their HIV infection status due to fear of stigma, guilt, abuse, abandonment, and/ or violence[19]. Not all studies from African countries have similar findings, however. Data from a survey of Kenya and Uganda who participated in a test and treatment trial (SEARCH, NCT#01,864,603), showed different results. That study found that among those who did not disclose (47.4% men vs. 15.0% women; $p = 0.005$)[17]. Other cross-sectional and longitudinal analysis carried out at Manicaland, Zimbabwe showed that disclosure to anyone increased from 79 to 100% in men and from 63 to 98% in women from 2003 to 2008[20].

In our findings, those PLHIV registered in sub-urban health facilities (CSB & HGPC) had lower odds to non-disclosure their HIV sero-status to sexual partner compared to patients in the urban health facility (CSJM). These urban vs sub-urban differences demonstrated that PLHIV may be conducting an internal cost–benefit analysis of their potential disclosure of HIV status to their partner. Decisions about disclosing your HIV status will be influenced by the impact of stigma and the emotional security of being able to protect their current

N = 377		Total, N(%)	95% CI	Disclosure, N(%)	95% CI	Non-disclosure, N(%)	95% CI	p-value
P01.1. Health Facilities	CS José Macamo (CSJM)	144 (38.2)	(33.4–43.2)	109 (35.5)	(30.3–41.0)	35 (50.0)	(38.5–61.5)	0.008
	CS Bagamoyo (CSB)	111 (29.4)	(25.3–34.2)	88 (28.7)	(23.8–33.9)	23 (32.9)	(22.7–44.4)	
	HG Polana Caniço (HGPC)	122 (32.4)	(27.8–37.2)	110 (35.8)	(30.6–41.3)	12 (17.1)	(9.7–27.2)	
P01. 1 HF. aggregates	Urban: CJSM	144 (38.2)	(33.4 – 43.2)	109 (35.5)	(30.3–41.0)	35 (50.0)	(38.5–61.5)	0.024
	Sub-urban: CSB & HGPC	233 (61.8)	(56.8 – 66.6)	198 (64.5)	(59.0 – 67.9)	35 (50.0)	(38.5 – 61.5)	
P2.03. Gender	Women	232 (61.5)	(56.6–66.3)	174 (56.7)	(51.1–62.1)	58 (82.9)	(72.8–90.9)	0.000
	Men	145 (38.5)	(33.7–43.4)	133 (43.3)	(37.9–48.9)	12 (17.1)	(9.7–27.2)	
P2.01.C_Education grade	No School	28 (7.4)	(5.1–10.4)	25 (8.2)	(5.5–11.6)	3 (4.3)	(1.2–11.1)	0.544
	Primary	124 (33.0)	(28.4–37.8)	97 (31.7)	(26.7–37.1)	27 (38.6)	(27.8–50.5)	
	Secondary	199 (52.9)	(47.9–57.9)	164 (53.6)	(48.0–59.1)	35 (50.0)	(38.5–61.6)	
	Superior	25 (6.6)	(4.5–9.5)	20 (6.5)	(4.2–9.7)	5 (7.1)	(2.8–14.1)	
P2.04.1. Age_Band	15–24 yr	57 (15.1)	(11.8–19.0)	43 (14.0)	(10.5–18.2)	14 (20.0)	(12.0–30.3)	0.602
	25–34 yr	180 (47.7)	(42.7–52.8)	146 (47.6)	(42.0–53.1)	34 (48.6)	(37.1–60.6)	
	35–44 yr	105 (27.9)	(23.5–32.5)	90 (29.3)	(24.4–34.6)	15 (21.4)	(13.1–32.3)	
	45–54 yr	29 (7.7)	(5.3–10.7)	23 (7.5)	(4.9–10.8)	6 (8.6)	(3.7–16.1)	
	= > 55 yr	6 (1.6)	(0.7–3.3)	5 (1.6)	(0.6–3.5)	1 (1.4)	(0.2–6.6)	
P2. 05C Profession / source of livelihood	Informal employment with minimum and average wage	192 (50.9)	(45.9–56.0)	165 (53.7)	(48.2–59.3)	27 (38.6)	(27.8–50.5)	0.049
	Employment contract with maximum wage	133 (35.3)	(30.6–40.2)	100 (32.6)	(27.5–38.0)	33 (47.1)	(35.8–58.5)	
	Jobless with parents aid	52 (13.8)	(10.6–17.5)	42 (13.7)	(10.2–17.9)	10 (14.3)	(7.6–23.2)	
P2. 07. Civil Status band	Marital/marriage status	273 (73.2)	(68.5–77.5)	239 (78.6)	(73.8–82.9)	34 (49.3)	(37.7–60.6)	0.000
	Single	96 (25.7)	(21.5–30.3)	62 (20.4)	(16.2–25.2)	34 (49.3)	(37.7–60.6)	
	Divorced/separated	4 (1.1)	(0.4–2.5)	3 (1.0)	(0.3–2.6)	1 (1.4)	(0.2–6.6)	
Sec 2. 01. Who did you live with?	Own Family	229 (61.6)	(56.5–66.4)	193 (62.9)	(57.4–68.1)	36 (55.4)	(43.3–67.0)	0.000
	Parents	40 (10.8)	(7.9–14.2)	28 (9.1)	(6.3–12.7)	12 (18.5)	(10.5–29.1)	
	Own famly & parents	95 (25.5)	(21.3–30.1)	79 (25.7)	(21.1–30.8)	16 (24.6)	(15.4–36.0)	
	Friends	2 (0.5)	(0.1–1.7)	2 (0.7)	(0.1–2.1)	0 (0.0)	(0.0–0.0)	
	Alone	6 (1.6)	(0.7–3.3)	5 (1.6)	(0.6–3.5)	1 (1.5)	(0.2–7.0)	
Sec 2.02. How many people lived with you including you	< = 2 individuals	58 (15.4)	(12.0–19.3)	49 (16.0)	(12.2–20.4)	9 (12.9)	(6.6–22.1)	0.377
	3–4 individuals	159 (42.2)	(37.3–47.2)	127 (41.4)	(36.0–46.9)	32 (45.7)	(34.4–57.4)	
	5–6 individuals	98 (26.0)	(21.8–30.6)	84 (27.4)	(22.6–32.5)	14 (20.0)	(12.0–30.5)	
	= >7 individuals	62 (16.4)	(13.0–20.4)	47 (15.3)	(11.6–19.7)	15 (21.4)	(13.1–32.1)	
Sec 2.03. How many sons/daughters did you have when you enrolled in the program?	None	96 (25.5)	(21.3–30.0)	78 (25.4)	(20.8–30.5)	18 (25.7)	(16.6–36.3)	0.265
	1–2 Sons/daughters	182 (48.3)	(43.3–53.3)	142 (46.3)	(40.7–51.8)	40 (57.1)	(45.5–68.3)	
	3–4 Sons/daughters	85 (22.5)	(18.5–27.0)	75 (24.4)	(19.9–29.5)	10 (14.3)	(7.6–23.9)	
	5–6 Sons/daughters	9 (2.4)	(1.2–4.3)	7 (2.3)	(1.0–4.4)	2 (2.9)	(0.6–8.9)	
	= >7 Sons/daughters	5 (1.3)	(0.5–2.9)	5 (1.6)	(0.6–3.5)	0 (0.0)	(0.0–0.0)	
Sec 2.04. Of your children, how many were under 5 years old?	None	124 (32.9)	(28.3–37.8)	102 (33.2)	(28.1–38.6)	22 (31.4)	(21.5–42.9)	0.535
	1–2 Children	203 (53.8)	(48.8–58.8)	161 (52.4)	(46.9–58.0)	42 (60.0)	(48.3–70.9)	
	3–4 Children	49 (13.0)	(9.9–16.7)	43 (14.0)	(10.5–18.2)	6 (8.6)	(3.7–16.8)	
	5–6 Children	1 (0.3)	(0.0–1.2)	1 (0.3)	(0.0–1.5)	0 (0.0)	(0.0–0.0)	
	= >7 Children	0 (0.0)	(0.0–0.0)	0 (0.0)	(0.0–0.0)	0 (0.0)	(0.0–0.0)	
Sec 2.05. How many people depended on you, including people outside the house-hold?	0 individuals	58 (15.4)	(12.0–19.3)	44 (14.3)	(10.8–18.6)	14 (20.0)	(12.0–30.3)	0.354
	1–2 individuals	120 (31.8)	(27.3–36.7)	95 (30.9)	(26.0–36.3)	25 (35.7)	(25.2–47.3)	
	3–4 individuals	131 (34.7)	(30.1–39.7)	110 (35.8)	(30.6–41.3)	21 (30.0)	(20.2–41.4)	
	5–6 individuals	41 (10.9)	(8.0–14.3)	33 (10.7)	(7.7–14.6)	8 (11.4)	(5.6–20.4)	
	= >7 indivuduals	27 (7.2)	(4.9–10.1)	25 (8.1)	(5.5–11.6)	2 (2.9)	(0.6–8.9)	
Sec 2.06. When you enrolled in the program, did you live with your partner in the same house?	No	115 (30.5)	(26.0–35.3)	76 (24.8)	(20.2–29.8)	39 (55.7)	(44.0–66.9)	0.000
	Yes	262 (69.5)	(64.7–74.0)	231 (75.2)	(70.2–79.8)	31 (44.3)	(33.1–56.0)	
Sec 2.07. Was the partner you lived with the father or mother of your children?	No	25 (6.6)	(4.4–9.5)	22 (7.2)	(4.7–10.5)	3 (4.3)	(1.2–11.0)	0.000
	Yes	175 (46.4)	(41.4–51.5)	156 (50.8)	(45.2–56.4)	19 (27.1)	(17.8–38.3)	
	Missed	177 (46.9)	(42.0–52.0)	129 (42.0)	(36.6–47.6)	48 (68.6)	(57.1–78.5)	
Sec 2.08. When you enrolled in the program, were you living in your own home?	No	185 (49.1)	(44.0–54.1)	141 (45.9)	(40.4–51.5)	44 (62.9)	(51.2–73.5)	0.011
	Yes	192 (50.9)	(45.9–56.0)	166 (54.1)	(48.5–59.6)	26 (37.1)	(26.5–48.8)	
Continued								

N = 377		Total, N(%)	95% CI	Disclosure, N(%)	95% CI	Non-disclosure, N(%)	95% CI	p-value
Sec 2.09. If he wasn't in his own house, who paid the rent for the house where he lived?	Own	26 (6.9)	(4.7–9.8)	19 (6.2)	(3.9–9.3)	7 (10.0)	(4.6–18.6)	0.070
	Parents/close relative	44 (11.7)	(8.7–15.2)	35 (11.4)	(8.2–15.3)	9 (12.9)	(6.6–22.1)	
	Not paid	115 (30.5)	(26.0–35.3)	87 (28.3)	(23.5–33.6)	28 (40.0)	(29.1–51.7)	
	Missed	192 (50.9)	(45.9–56.0)	166 (54.1)	(48.5–59.6)	26 (37.1)	(26.5–48.8)	
Sec 2.11. Who paid for your household expenses? Did anyone help you with monthly expenses?	Own	336 (89.1)	(85.7–92.0)	281 (91.5)	(88.0–94.3)	55 (78.6)	(67.9–86.9)	0.001
	Parents/close relative	12 (3.2)	(1.8–5.3)	5 (1.6)	(0.6–3.5)	7 (10.0)	(4.6–18.6)	
	Partner	27 (7.2)	(4.9–10.1)	19 (6.2)	(3.9–9.3)	8 (11.4)	(5.6–20.4)	
	Parents & partner	2 (0.5)	(0.1–1.7)	2 (0.7)	(0.1–2.1)	0 (0.0)	(0.0–0.0)	
Sec 2.12.A. If your partner helped you with some expenses. Mention which expenses he or she helps with: Household expenses	Yes	219 (58.1)	(53.1–63.0)	185 (60.3)	(54.7–65.6)	34 (48.6)	(37.1–60.1)	0.074
	No	158 (41.9)	(37.0–46.9)	122 (39.7)	(34.4–45.3)	36 (51.4)	(39.9–62.9)	
Sec 2.12.B. If your partner helped you with some expenses. Mention what expenses he or she helps with: School: enrollment, transport, school supplies, etc	Yes	124 (32.9)	(28.3–37.8)	101 (32.9)	(27.8–38.3)	23 (32.9)	(22.7–44.4)	0.995
	No	253 (67.1)	(62.2–71.7)	206 (67.1)	(61.7–72.2)	47 (67.1)	(55.6–77.3)	
Sec 2.12.C. If your partner helped you with some expenses Mention which expenses he or she helps with: Personal expenses: gifts, clothes, travel. Cell phone and credits, etc.?	Yes	152 (40.3)	(35.5–45.3)	131 (42.7)	(37.2–48.3)	21 (30.0)	(20.2–41.4)	0.051
	No	225 (59.7)	(54.7–64.5)	176 (57.3)	(51.7–62.8)	49 (70.0)	(58.6–79.8)	
Sec 3.13. When you were enrolled in the program, did you have a confidant?	Yes	363 (96.3)	(94.0–97.9)	306 (99.7)	(98.5–100.0)	57 (81.4)	(71.2–89.2)	0.000
	No	14 (3.7)	(2.1–6.0)	1 (0.3)	(0.0–1.5)	13 (18.6)	(10.8–28.8)	
Sec 3.14. When you were enrolled in the program, did you have a confidant?	Partner	239 (63.4)	(58.4–68.1)	215 (70.0)	(64.7–75.0)	24 (34.3)	(24.0–45.9)	0.000
	Parent/close relative	111 (29.4)	(25.0–34.2)	82 (26.7)	(22.0–31.9)	29 (41.4)	(30.4–53.1)	
	Friend	10 (2.7)	(1.4–4.7)	6 (2.0)	(0.8–4.0)	4 (5.7)	(2.0–13.0)	
	Missed	17 (4.5)	(2.8–7.0)	4 (1.3)	(0.4–3.1)	13 (18.6)	(10.8–28.8)	
Sec 3.15. At the time he enrolled in the program he said he had [insert number of partners] in the last 2 years	< = 1 partner	324 (85.9)	(82.2–89.2)	259 (84.4)	(80.0–88.1)	65 (92.9)	(85.1–97.2)	0.065
	= > 2 partner	53 (14.1)	(10.8–17.8)	48 (15.6)	(11.9–20.0)	5 (7.1)	(2.8–14.1)	

Table 1. HIV Index case patients according with HIV sero-statusdisclosure. p-value based on Pearson chi-square or Fisher´s exact test. Own family = a household made up exclusively of a couple of partners together with their children. live with parents = live with their parents at home.

livelihoods. In cases where individuals tend to be unable to protect their livelihoods, there were lower odds of disclosing their HIV status[21].

Half of the people in the cohort had informal jobs with minimum and average wages (most of them were machine operators, guards, primary teachers, carpenters, barbers, taxi drivers, housekeepers). At the time of the Program the maximum rate of minimum wage for employees was 4,390 MZN/month (69USD/month) and minimum was 2,005 MZN/month (31USD/month)[22–24]. In our evaluation, those who had an employment contract with maximum wage had higher odds of not disclosing their HIV status. This finding differs from those of Tanzanian studies that reported that patients who were formally employed had higher odds to disclose their HIV sero-status to sexual partners[25]. In our Program, though, there were more women with jobs at the maximum wage rate, which could be explained by the fact that the men with high-end jobs do not usually seek health services from the public sector. When they become sick they will go to the pharmacy and emergency room. In contrast, women, regardless of their social and education level or job position tend to seek public health services, mainly maternal and child health, where everyone is tested for HIV[26].

Being unmarried was associated with higher odds of non-disclosure compared to being married. This was similar to an experimental survey on test and treat carried out in Kenya and Uganda, which showed among women, single women had higher odds to not disclosing their HIV status compared to married women (aOR 3.14, 95% CI 1.47–6.73, $p = 0.003$)[17].

A study conducted in Mozambique concluded that disclosure of seropositivity is more likely to occur in situations in which the PLHIV trusts the person to whom they are disclosing, as HIV/AIDS continues to be seen as a private matter and not a public matter[27]. However, even in situations where there is trust and reciprocity, there may not be disclosure, because HIV/AIDS is considered a private and confidential matter.

In this Program, patients who lived in the same house with a sexual partner had lower odds to not disclosing their HIV sero-status compared to those who lived alone, likely related to greater trust and closeness in the relationship. This finding is similar to the results of a prospective observational study of 328 PLHIV in Bangkok, which found that those living in their partner's house had lower odds of not disclosing their serostatus. (0.53;
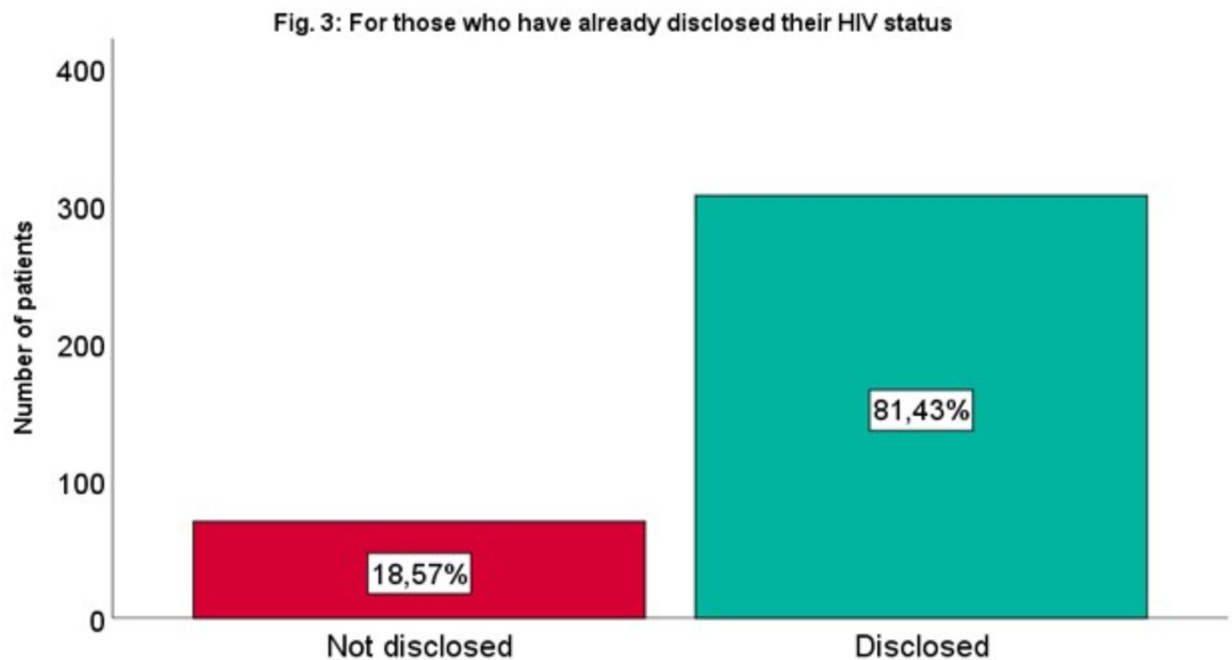
Fig. 1. For those have already disclosed their HIV status.

0.31–0.90; $P = 0.02$)[28]. Some authors have suggested that loneliness might partly explain the increased odds that PLWH fail to disclose, since loneliness is a predictor of low interest in health, poor health, self-esteem and early mortality in the general population —associations that are stronger among PLHIV[28]. Moreover, PLHIV are at increased risk of experiencing depression and anxiety disorders, and suicidal ideation, and consequently less willingness to disclose their HIV sero-status. Therefore, there is an urgent need for an interventions that target loneliness associated with experience of loss and stigma in the context of living with HIV[29].

The finding that patients who lived with their parents had higher odds of non-disclosure is interesting. It may be due to different reasons. For example, trusting that relationships are better maintained with the sexual partner than with the parents themselves[15]. Young PLHIV are more likely to live with their parents and are also less likely to disclose their HIV sero-status to partner[21]. In Mozambican society, parents rarely talk about sex and HIV with their children, so children are more likely to discuss these matters with their friends[30]. This perceived stigma might produce an environment of loneliness and secrecy, affecting people who live with parents more than those who do not. This secrecy risks undermining the social normalization of HIV, and represents a potential barrier to seeking treatment and adherence, which, in turn, can lead to morbidity, drug resistance and increased mortality among PLHIV[31].

We reported, those who received financial support for their monthly household expenses from parents/ close relative and/or a partner had highest odds of non-disclosure their HIV sero-status compared to those who paid their own household expenses. Although this finding is new, some researchers consider that the fear of suffering stigma, and losing benefits on the part of those who paid their fees, are some factors associated with non-disclosure of HIV sero-status[25,31].

In our findings, 29.7% of single women over 19.4% of single men, that contrasts with population statistics from Maputo, which reported a predominance of 55.4% of single men over 50.7% of single women[32]. Therefore, the proportion of women in this Program can be explained by a high prevalence of HIV among women in general, and specifically in the age groups in question, a fact that is attributable to social and biological factors[33]. Women also use health services more than men, which justifies the need and relevance of health programs such as "Male Engagement"[34]. When we talk about single women, this group mainly included divorced women (dissolution of relationships) highlighting that among people with HIV, the phenomenon of dissolution of relationships is very common, and greatly affects women, who are abandoned rather than men, for various reasons[35]. It is important to consider the fact that women constitute the largest proportion of people infected with HIV in Mozambique[33].

In our cohort, women were more likely to not pay the rent for the house where they live, since their partner pays all the monthly household expenses. Thus, men appear to be the responsible for paying women's expenses such as: gifts, travel, credits, cellphone. Furthermore, men took on more economic responsibilities in caring for the family, supporting a household with more than 5 people counting on them, including children under 5 years of age. Compared to what was observed in women, they provided economic care to families of 3 or fewer household members.

In our appraisal, men mentioned that they had more than two sexual partners, in contrast to women who reported had less than two. These findings are consistent with the notion that male tend to report higher number of sexual partners, as it is associated with success therefore socially accepted, while women tend to report lower number of sexual partners, which is more valued in society in general[36]. That's why women tend not to reveal the exact number of partners they had or have, to protect their reputation[29].

N = 377		cOR 95%CI	p-value	aOR 95%CI	p-value
P01.1. Health Facilities	Urban: CSJM	Ref		Ref	
	Sub-urban: CSB & HGPC	0.55 (0.33–0.93)	0.025	0.75 (0.18–0.316)	0.000
P2.03. Gender	Women	Ref		Ref	
	Men	0.27 (0.14–0.52)	0.000	0.38 (0.16–0.95)	0.038
P2.01.C_Education grade	No school	Ref			
	Primary	2.32 (0.65–8.27)	0.195		
	Secondary	1.78 (0.51–6.22)	0.367		
	Superior	2.08 (0.44–9.79)	0.353		
P2.04.1. Age_Band	15–24 yr	Ref			
	25–34 yr	0.72 (0.35–1.45)	0.354		
	35–44 yr	0.51 (0.23–1.16)	0.107		
	45–54 yr	0.80 (0.27–2.36)	0.688		
	= > 55 yr	0.61 (0.07–5.71)	0.668		
P2. 05.C Profession / Source of livelihood	informal employment with minimum and average wage	Ref		Ref	
	Employment contract with maximum wage	2.02 (1.15–3.55)	0.015	1.34 (0.61–2.94)	0.461
	Jobless with parents financial aid	1.46 (0.65–3.24)	0.359	0.64 (0.14–2.90)	0.563
P2. 07. Civil Status band	Marital/marriage status	Ref		Ref	
	Single	3.85 (2.22–6.69)	0.000	1.56 (0.42–5.80)	0.503
	Divorced/separated/widow	2.34 (0.24–23.17)	0.466	1.43 (0.10–21.43)	0.794
Sec 2. 01. Who did you live with?	Own family	Ref		Ref	
	Parents	2.30 (1.07–4.93)	0.033	0.56 (0.16–1.99)	0.373
	Own famly and parents	1.09 (0.57–2.07)	0.802	0.70 (0.26–1.89)	0.486
	Friends	0.00 (0.00–0.00)	0.999	0.00 (0.00–0.00)	0.999
	Alone	1.07 (0.12–9.45)	0.950	0.71 (0.06–8.51)	0.791
	Missed				
Sec 2.02. How many people lived with you including you	< = 2 individuals	Ref			
	3–4 individuals	1.37 (0.61–3.08)	0.444		
	5–6 individuals	0.91 (0.37–2.25)	0.834		
	= > 7 individuals	1.74 (0.69–4.35)	0.238		
Sec 2.03. How many sons/daughters did you have when you enrolled in the program?	None	Ref			
	1–2 Sons/daughters	1.22 (0.66–2.27)	0.529		
	3–4 Sons/daughters	0.58 (0.25–1.33)	0.198		
	5–6 Sons/daughters	1.24 (0.24–6.47)	0.800		
	= > 7 Sons/daughters	0.00 (0.00–0.00)	0.999		
Sec 2.04. Of your children, how many were under 5 years old?	None	Ref			
	1–2 Children	1.21 (0.68–2.14)	0.515		
	3–4 Children	0.65 (0.25–1.71)	0.379		
	5–6 Children	0.00 (0.00–0.00)	1.000		
	= > 7 Children				
Sec 2.05. How many people depended on you, including people outside the household?	0 individuals	Ref			
	1–2 individuals	0.83 (0.39–1.74)	0.618		
	3–4 individuals	0.60 (0.28–1.28)	0.188		
	5–6 individuals	0.76 (0.29–2.03)	0.586		
	= > 7 indivuduals	0.25 (0.05–1.20)	0.083		
Sec 2.06. When you enrolled in the program, did you live with your partner in the same house?	No	Ref		Ref	
	Yes	0.26 (0.15–0.45)	0.000	0.58 (0.18–1.82)	0.347
Sec 2.07. Was the partner you lived with the father or mother of your children?	No	Ref			
	Yes	0.89 (0.24–3.27)	0.864		
	Missed	2.73 (2.78–9.53)	0.116		
Sec 2.08. When you enrolled in the program, were you living in your own home?	No	Ref		Ref	
	Yes	0.50 (0.29–0.86)	0.011	0.59 (0.26–1.37)	0.222
Sec 2.09. If he wasn't in his own house, who paid the rent for the house where he lived?	Own	Ref			
	Parents/close relative	0.70 (0.22–2.17)	0.535		
	Not paid	0.87 (0.33–2.29)	0.784		
	Missed	0.43 (0.16–1.11)	0.081		
Continued					

N = 377		cOR 95%CI	p-value	aOR 95%CI	p-value
Sec 2.11. Who paid for your household expenses? Did anyone help you with monthly expenses?	Own	Ref		Ref	
	Parents/close relative	7.15 (2.19–23.36)	0.001	8.19 (1.44–46.46)	0.018
	Partner	2.15 (0.90–5.16)	0.086	4.34 (1.05–17.17)	0.043
	Parents and partner	0.00 (0.00–0.00)	0.999	0.00 (0.00–0.0)	1.000
Sec 2.12.A. If your partner helped you with some expenses. Mention which expenses he or she helps with: Household expenses	Yes	Ref			
	No	1.61 (0.95–2.70)	0.075		
Sec 2.12.B. If your partner helped you with some expenses. Mention what expenses he or she helps with: School: enrollment, transport, school supplies, etc	Yes	Ref			
	No	1.00 (0.58–1.74)	0.995		
Sec 2.12.C. If your partner helped you with some expenses Mention which expenses he or she helps with: Personal expenses: gifts, clothes, travel. Cell phone and credits, etc.?	Yes	Ref			
	No	1.74 (0.99–3.04)	0.053		
Sec 3.13. When you were enrolled in the program, did you have a confidant?	Yes	Ref		Ref	
	No	69.79 (8.95–544.02)	0.000	0.00 (0.00–0.00)	0.999
Sec 3.14. When you were enrolled in the program, did you have a confidant?	Partner	Ref		Ref	
	Parent/close relative	3.17 (1.74–5.76)	0.000	8.86 (2.16–36.31)	0.002
	Friend	5.97 (1.57–22.66)	0.009	21.68 (3.02–155.87)	0.002
	Missed	29.11 (8.79–96.41)	0.000	0.00 (0.00–0.00)	0.999
Sec 3.15. At the time he enrolled in the program he said he had [insert number of partners] in the last 2 years	< = 1 partner	Ref			
	= > 2 partner	0.42 (0.16–1.08)	0.073		

Table 2. Logistic regression to estimate the sociodemographic associated factors of non-disclosure the HIV sero-status among HIV Index cases to their sexual partner. aOR: adjusted Odds ratio. Own family = a household made up exclusively of a couple of partners together with their children. live with parents = live with their parents at home.

This is the first analysis of the factors associated with non-disclosure of HIV status to sexual partners among PLHIV in Mozambique. But some limitations should also be acknowledged. First, this analysis may have limited generalizability because Program participants were individuals enrolled in an HIV serostatus disclosure program at three facilities in Mozambique. In addition, the relatively small number of male participants in the Program also poses a challenge to generalizability.

Conclusion
Factors independently associated with non-disclosure of HIV serostatus were employment contract with maximum salary, single status, living with parents, receiving financial support for their monthly household expenses from parents/close relatives, brought a parent/close relative and/or a friend as a confidant during HIV care. These findings might inform the development of a social intervention strategy to improve HIV sero-status disclosure in PLHIV, which is urgently needed in Mozambique.

Knowledge about HIV sero-status among PLHIV is the foundation for adopting and promoting safer sexual practices disclosing to sexual partners, and increasing partner testing[18]. Marital status, age, level of education, fear of physical, verbal or economic violence, are some factors associated with disclosure of the serostatus[37,38]. To evaluate the success of HIV care and treatment programs in Mozambique over time, data on disclosure of HIV sero-status, one of the main indicators reportable by the WHO, should be periodically reported. Until now, data to quantify HIV disclosure and to identify barriers to disclosure have been limited.

Non-disclosure of serostatus is a critical issue for HIV care and treatment programs, given that non-disclosure of HIV serostatus increases risk of HIV transmission. Understanding the factors associated with non-disclosure is crucial for designing strategies to address these factors and end the HIV epidemic by 2030. Our findings suggest that HIV serostatus disclosure programs might target the sociodemographic factors strongly associated with non-disclosure.

Data availability
The datasets analyzed during the current study are available from the corresponding author on reasonable request.

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Author contributions

F.M. contribute on analysis design, data acquisition, analysis implementation, analysis and implementation of data, major contribution to writing, read, and approved final version. M.R., E.P., A.C., J.W. & A.I.M., contributed equally on analysis design, analysis implementation, writing, read and approved final version. Z.P., A.M., F.V., S.B., G.A. & R.U. contributed equally to data acquisition, analysis implementation, writing, read, and approved final version. M.M., L.C., & J.L. contributed to writing, reading, and approved the final version. E.N. contributes statistical analysis, figure/table preparation and interpretation of data, major contribution to writing, read, and approved final version. We performed analysis on routine administrative data; Written informed consent was obtained from all subjects who participated in the Program. All information obtained during the analysis was kept confidential. Analysis was performed on de-identified aggregated data. Written informed consent for publication was obtained from all subjects who participated.

Competing interests

The authors declare no competing interests.

Ethics approval and consent to participate

Ethical clearance was obtained from the Mozambican National Bioethics Committee for Health *(IRB0002657— Comité Nacional de Bioética para a Saúde, Ref: 107/CNBS/20)* and permission to perform the analysis was also obtained from the Maputo City Health Directorate (Direcção de Saúde da Cidade de Maputo, N/Ref. n.º 1201/DSCM-DPS/0501/2019). This analysis was given a Non-Research Determination from the University of Washington. Written informed consent was obtained from all subjects who participated in the Program. All information obtained during the analysis was kept confidential. Analysis was performed on de-identified aggregated data.

Additional information

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