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Exploring Pathways from HIV Program Exposure to HIV Status Among Male Clients of Female Sex Workers in Indonesia: A Cross-Sectional Structural Equation Model

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Abstract

Background

Male clients of female sex workers (FSWs) in Indonesia face heightened HIV risk but are frequently excluded from national prevention efforts. HIV testing and consistent condom use remain suboptimal within this group.

Objective

To examine associations between HIV program exposure, behavioural and biological factors, and HIV status among male clients of FSWs in Indonesia, and to explore structural pathways consistent with the proximate determinants framework.

Methods

We analysed cross-sectional 2018 IBBS data from 6,592 male FSW clients (aged ≥ 15 years, having paid for sex in the past 3 months) across 24 districts in Indonesia, recruited using time-location sampling. Generalized structural equation modelling (GSEM) was used to estimate direct and indirect associations between exposure to HIV programs (education, testing promotion, condom distribution) and HIV status, with condom use and syphilis specified as proximate determinants.

Results

HIV and syphilis prevalence were 1.0% and 1.9%, respectively. Fewer than 17% had ever tested for HIV; only 18.2% used a condom at last sex. Higher HIV prevalence was observed among older, less educated, unmarried/divorced clients, those who initiated FSW contact before age 25, or who visited FSWs frequently. In the GSEM, HIV program exposure showed positive associations with condom use behaviour but no direct association with HIV status. Condom non-use and syphilis were significantly associated with HIV. However, no significant indirect association was found from program exposure to HIV through syphilis.

Conclusion

This study identifies behavioural and biological factors—particularly condom non-use and syphilis—that are associated with HIV risk among male clients of FSWs. Due to the cross-sectional design, causal interpretations are not supported. Nevertheless, targeting this population with improved condom promotion, STI management, and explicit inclusion in national HIV strategies remains essential to reduce transmission.

1. Introduction

Clients of female sex workers (FSWs) represent a population with significant yet under-addressed HIV risk, particularly in Indonesia. While most programs have focused on sex workers, less attention has been paid to the individuals who engage their services. This gap is especially concerning given the persistence of HIV transmission among heterosexual men in national surveillance data, and mounting evidence that FSW clients contribute to broader sexual network transmission. Rather than labelling them as a “bridge population” a term increasingly viewed as outdated and potentially stigmatizing this study emphasizes their distinct behavioural and structural vulnerabilities. Current global discourse encourages recognizing clients as individuals with specific prevention and care needs.[1]

International studies support these concerns. In China, Tucker et al. found that male clients lacked access to voluntary counselling and testing (VCT) and were highly mobile, making them difficult to reach through conventional health programs. [2] WHO SEARO reports have highlighted the role of clients in sustaining heterosexual transmission dynamics across Southeast Asia. In Cambodia and Vietnam, targeted programs including peer outreach and mobile testing—have shown promise in increasing service uptake (WHO, 2019). [3] In Indonesia, Choi et al. documented how stigma continues to limit clients’ access to HIV services.[4]

According to the Indonesian Ministry of Health, HIV prevalence among clients of FSWs has remained stable but concerning over the past decade, typically around 1.0–1.5%. However, prevention coverage particularly HIV testing and consistent condom use remains low in this group.[5] IBBS (Integrated Biological and Behavioural Surveillance) reports from 2011 and 2015 consistently reported that fewer than 30% of clients had ever tested for HIV, and only 30–40% used condoms at last sex. These patterns reflect persistent behavioural vulnerabilities and limited program reach. [6,7]

Despite these trends, clients are still not explicitly included in Indonesia’s National AIDS Strategy. This reflects a misalignment between epidemiological evidence and the scope of current policy responses. Most existing research in Indonesia has focused on FSWs themselves, leaving data on client behaviours fragmented. An analysis of IBBS data (Ministry of Health, 2017) found that higher educational attainment among clients did not necessarily translate into safer sexual practices, indicating behavioural gaps that go beyond knowledge.[5] As shown in Table 1, previous IBBS rounds have consistently reported low testing uptake and inconsistent condom use among FSW clients in Indonesia

Globally, clients of sex workers continue to face structural and perceptual barriers to accessing HIV services including stigma, fear of disclosure, limited-service accessibility, and geographic mobility. These barriers further compound their exclusion from routine prevention efforts.

This study uses data from the 2018–2019 IBBS to assess the behavioural, demographic, and programmatic correlates of HIV among male clients of FSWs in Indonesia. Following the proximate determinants framework (Boerma & Weir, 2005), we include syphilis as a biological marker of unprotected sex and a proximate determinant of HIV status. It applies generalized structural equation

modelling (GSEM) to explore both direct and indirect associations between program exposure, proximate determinants, and HIV status. The findings are contextualized with existing literature from Indonesia and other Asian countries to underscore the urgency of including FSW clients in national prevention strategies.

Table 1
Summary of Previous Findings on Clients of Female Sex Workers (FSWs)

Study / Source	Location	Key Findings
IBBS 2015 (MOH Indonesia)	National	38% of FSW clients reported condom use at last sex; HIV prevalence: 1.4%
IBBS 2011 (MOH Indonesia)	National	Low HIV knowledge; testing uptake below 30%; inconsistent condom use
Choi et al., 2020 (Lancet Regional)	Indonesia (urban)	High stigma faced by clients; 47% had never tested for HIV
WHO SEARO 2019 Report	Southeast Asia	Clients contribute significantly to general population transmission dynamics
Tucker et al., 2012 (China)	China	Clients lacked access to VCT; mobility and anonymity were key challenges

2. Methods

2.1 Study design

We conducted a secondary analysis of the 2018–2019 Integrated Biological-Behavioural Surveillance (IBBS) dataset, a cross-sectional survey involving 6,592 male clients of female sex workers (FSWs) recruited across 24 districts in Indonesia. Eligible participants were men aged 15 or older who had engaged in paid sex with an FSW within the past three months.[5]

Participants were selected using time-location sampling (TLS), a method widely used to recruit hard-to-reach populations. In TLS, the primary sampling unit is defined by a specific location and time slot. Sampling frames were built by mapping areas where FSWs and their clients typically congregate (e.g., streets, parks, brothels, hotels, karaoke venues) along with estimated client counts at those times. Simple random sampling was then applied to select eligible clients present during defined time periods. [8,9]

Data were collected from 24 districts across 13 of Indonesia's 34 provinces, including South Sumatra, Bangka Belitung, Riau Islands, Jakarta, West Java, Central Java, Yogyakarta, East Java, Bali, East Kalimantan, North Sulawesi, South Sulawesi, and North Maluku.

2.2 Ethical Consideration

The 2018–2019 IBBS was conducted in accordance with the Indonesian Ministry of Health ethical standards for biomedical and behavioural research involving human subjects, which are consistent with the principles of the Declaration of Helsinki. Ethical approval was obtained from the Ethics Committee of the Faculty of Public Health, Universitas Indonesia (Approval No. 727/UN2.F10/PPM.00.02/2018). During the survey, informed consent was obtained from every respondent based on the principle that a competent individual is entitled to freely choose to participate or not participate in the study. Informed consent realizes an individual's freedom to make a choice and respects the individual's autonomy. In this survey, informed consent was obtained through the following process:

a. Explaining about the study starting with an introduction of the interviewer, the survey objective, and the institution the interviewer represented;
b. Provide information about the approximate time needed for the interview;
c. Provide information about the topics of questions that would be asked;
d. Explain that participation in the study is voluntary, and respondents can choose to not respond to some or all of the questions, and can stop the interview at any moment without pressure or force;
e. Inform respondents that their personal identity and any information provided will be kept confidential;
f. Provide information that participation in the survey is not linked with any type of service or favour from any party;

Before starting the interview, the interviewer provided time for the respondent to ask questions or request clarification. Consent was documented as respondent's signature on the questionnaire.

2.3 Conceptual Framework

This study applied the conceptual framework of HIV determinants by Boerma and Weir (2005), which distinguishes between background determinants, proximate determinants (e.g., condom use, STI status), and HIV outcome. This framework guided our specification of structural relationships in the GSEM, organizing variables conceptually without implying causal ordering given the cross-sectional design. The Boerma and Weir framework is well-established in HIV research and Programs modelling.[10]

2.4 Measurements

HIV status was the dependent variable, measured through laboratory-confirmed testing. [11] Independent variables included age, education, marital status, age at first sex with an FSW, frequency of sex with FSWs, HIV knowledge, prior HIV testing, and carrying condoms. Proximate determinants (specified as intermediate variables in the structural model) included condom use at last sex and syphilis infection status.

2.5 Description of MoH Programs

The MoH programs had analysed in this study reflect national HIV prevention efforts implemented between 2016 and 2019. These include free condom distribution, peer-led HIV education, and voluntary counselling and testing campaigns for key populations. Participants were asked whether they had ever

received information about HIV, had been recommended for testing, and whether they consistently brought or used condoms during sexual encounters. These variables are used as indirect measures of exposure to intervention programs.

2.6 Mediation Analysis

We applied Generalized Structural Equation Modelling (GSEM) to examine the structural relationships between HIV program exposure, proximate determinants, and HIV status among male clients of female sex workers in Indonesia. GSEM is appropriate for modelling binary, ordinal, or non-normally distributed outcomes and uses quasi-maximum likelihood or Bayesian estimation methods, enabling robust modelling of categorical and complex data structures.

The conceptual framework was guided by the proximate determinants framework proposed by Boerma and Weir (2005), which distinguishes between background determinants, proximate determinants (condom use, STI status), and HIV outcome. The models estimated direct and indirect statistical associations between program exposure variables and HIV status, with condom use at last sex and syphilis status specified as proximate (intermediate) variables.

Important methodological note

Due to the cross-sectional nature of the IBBS data, all estimated parameters represent statistical associations, not causal effects. Temporal ordering between program exposure, proximate determinants, and HIV status cannot be established. Therefore, the terms "direct association" and "indirect association" are used throughout, rather than "direct effect" or "indirect effect," and no claims of causal mediation are made. The analysis is exploratory and hypothesis-generating.

We tested three sequential model specifications to assess the stability of the estimated associations:

- **Model 1** included only program exposure variables (HIV knowledge, recommendation for testing, condom carrying habit) as predictors of HIV status.
- **Model 2** added the proximate determinant variables (condom use at last sex and syphilis status) as intermediate variables in the pathway to HIV.
- **Model 3** further incorporated demographic and behavioural background variables (age, education, marital status, age at first sex with FSW, frequency of sex with FSWs).

All analyses were conducted using STATA version 17 (StataCorp, College Station, TX, USA). [14]

Model Setup

- **Response variable**: HIV_cat (binary outcome HIV infection status)
- **Mediators**:

1. **Condom use at last sex** (condom_last ~ x)
2. **Syphilis status** (sifilisnew)

- **Predictors (exposures from MoH program)**:
    - catknowledge (categorized HIV knowledge)
    - recomendation (received recommendation to test)
    - bring_condom (habit of bringing condom)

3. Results

According to the IBBS 2018–2019 technical report, the overall refusal rate for eligible CSW clients across all sites was approximately 16%. Of the 8084 CSW clients, data completeness was checked, and 6592 clients were successfully analysed and reached final analysis. The prevalence of HIV and syphilis in this group was 1.09% and 1.94%, respectively (Table 2).

Table 2
Prevalence of HIV and Syphilis Among Male Clients of FSWs (n = 6,592)

Diseases		**N**	**%**
HIV	No	6520	98.91
	Reactive	72	**1.09**
Syphilis	No	6464	98.06
	Reactive	128	**1.94**

Table 2. **Prevalence of HIV and Syphilis Among Male Clients of FSWs (n = 6,592)**

3.1.1 Demographics, Sexual Behaviours, MoH Programs and HIV Status Among Clients
Table 3 presents the associations between demographic characteristics, sexual behaviours, Ministry of Health (MoH) program exposure, and HIV status among male clients of female sex workers (FSWs). Statistically significant associations were observed for two demographic variables: education and marital status. Clients with senior high school education or higher had significantly lower odds of HIV infection (OR: 0.59; 95% CI: 0.37–0.94), and married clients had a reduced likelihood of HIV compared to unmarried or divorced individuals (OR: 0.39; 95% CI: 0.21–0.73).

Table 3
Demographic Characteristics, Sexual Behaviours, MoH Program Exposure, and HIV Status Among Male Clients of FSWs (n = 6,592)

Demographic characteristics Variables		**HIV**	**%**	**OR**	**OR (CI 95%)**
Formal Education	<= Yunior high school (N = 2213)	33	1.49	**Ref**	
	>=Senior high school (N = 4379)	39	0.89	0.59	0.37–0.94
Age Group	15–24 Years (N = 1246)	12	0.96	**Ref**	
	24–34 Years (N = 2230)	26	1.17	1.591	0.75–3.37
	35–49 Years (N = 2364)	26	1.10	1.988	0.84–4.71
	> 50 Years (N = 752)	8	1.06	1.71	0.57–5.09
Marriage	Not Marriage (N = 2132)	30	1.41	**Ref**	
	Marriage Status (N = 3955)	31	0.78	0.392	0.21–0.73
	Divorce (N = 505)	11	2.18	1.082	0.48–2.43
Sexual behavior Variables					
Age of first sex with FSW	< 20 Years (N = 2920)	35	1.20	**Ref**	
	20–25 Years (N = 2038)	25	1.23	0.991	0.57–1.70
	> 25 Years (N = 1634)	12	0.73	0.594	0.29–1.20
Sex frequencies with FSW	<=2 times in three months (N = 801)	9	1.12	**Ref**	
	> 6 times in three months (N = 1775)	36	2.03	1.966	0.94–4.11
	3–6 times in three months (N = 4016)	27	0.67	0.679	0.32–1.46
MoH Program					
HIV Knowledge	All Correct answers (N = 312)	3	0.96	**Ref**	
	Not (N = 6280)	69	1.10	0.87	0.27–2.79

Demographic characteristics Variables		HIV	%	OR	OR (CI 95%)
Have ever been recommendation for HIV testing	Ever (N = 1098)	15	1.37	**Ref**	
	Never (N = 5494)	57	1.04	0.57	0.43–1.34
The person who recommended HIV testing	Health worker (N = 850)	13	1.52	**Ref**	
	Not a health worker (N = 248)	2	0.80	0.52	0.12–2.34
Always bring condom	Yes (N = 863)	15	1.74	**Ref**	
	No (N = 5729)	57	0.99	0.57	0.32–1.02

In contrast, no statistically significant associations were found for age group, age at first sex with an FSW, or frequency of sexual encounters in the past three months. Although clients aged 35–49 and those reporting more than six recent encounters had elevated odds ratios (ORs: 1.99 and 1.97, respectively), but the 95% CI shown were not significant. These trends may suggest increased risk but should be interpreted cautiously due to wide variability and potential confounding.

The MoH program exposure variable shows the low coverage of HIV testing among FSW clients, as shown in the table, which only reports that 13.7% reported ever being tested for HIV, with 7.7% undergoing testing on their own initiative, 1.8% through referral, and 4.2% through both. For significant associations with HIV status, results show that clients who answered all questions about HIV knowledge correctly, had been advised to be tested, or reported always carrying condoms, did not show lower HIV prevalence. In fact, those who always carried condoms had a higher HIV prevalence (1.74%) than those who did not (0.99%), although the difference was not statistically significant (OR: 0.57; 95% CI: 0.32–1.02). This counterintuitive finding may reflect reverse causality or targeted outreach efforts directed at individuals already considered at higher risk.

Together, these findings highlight persistent gaps between program exposure and actual HIV risk reduction. Given the mixed results observed in the bivariate analysis, further investigation is warranted to assess whether background and programmatic factors influence HIV outcomes indirectly. To explore these complex relationships, we conducted a mediation analysis using Generalized Structural Equation Modelling (GSEM), with condom use at last sex and syphilis status specified as proximate mediators. This approach enables a more nuanced understanding of how MoH Programs may affect HIV risk through both direct and indirect pathways.

Table 3. **Demographic Characteristics, Sexual Behaviours, MoH Program Exposure, and HIV Status Among Male Clients of FSWs (n = 6,592)**

3.1.2 The Mediators

Table 4 shows interesting features such as the high HIV prevalence in the group who used condoms at last sex and the high HIV prevalence in the group with a diagnosis of syphilis.

Table 4
HIV Prevalence by Proximate Determinants (Condom Use at Last Sex and Syphilis Status)

Variables		HIV (N)	%	OR	OR (CI 95%)
Used condoms last sex	Yes (N = 1,275)	21	1.65	Ref	
	No (N = 5,317)	51	0.96	0.57	0.34–0.96
Syphilis	No (N = 6464)	62	1	Ref	
	Yes (N = 128)	10	7.8	8.75	4.38–17.48

Table 4. **HIV Prevalence by Proximate Determinants (Condom Use at Last Sex and Syphilis Status)**

3.2 HIV Transmission among Clients FSWs Model

3.2.1 Direct Associations Between MoH Program Variables and HIV Status (Model 1)

Figure 1 illustrates Model 1, which included only program exposure variables as predictors of HIV status. Table 5 presents the estimated direct associations from this model. HIV-related knowledge was not significantly associated with HIV status (OR = 1.18; 95% CI: 0.37–3.76; p = 0.785). The wide confidence interval indicates considerable statistical imprecision. Receiving a recommendation for HIV testing also showed no statistically significant association with HIV status (OR = 0.79; 95% CI: 0.45–1.41; p = 0.428). Consistently bringing a condom was marginally associated with HIV status (OR = 0.58; 95% CI: 0.33–1.12; p = 0.065), suggesting a possible protective association that warrants further investigation in larger or longitudinal samples. The intercept (_cons = − 4.02; p < 0.001) represents the log-odds of HIV infection when all predictors are at their reference levels, indicating low baseline HIV prevalence in this population.

Table 5
Direct Associations Between MoH Program Exposure Variables and HIV Status (Model 1)

HIV_cat	Coefficient	Std. Err	z	P>|z|	[95% conf. interval]
catknowledge	**.1621569**	**.5932239**	**0.27**	**0.785**	**− 1.000541–1.324854**
recomendation	− .2328538	.2940054	− 0.79	0.428	− 0.809093 − .3433861
bring_condom	− .5434232	.2941697	− 1.85	0.065	− 1.119985 − .0331388
_cons	-4.018627	.6507122	− 6.18	0.0001	− 5.2940 − 2.743255

Overall, in Model 1, none of the MoH program variables reached conventional statistical significance (p < 0.05) in their direct association with HIV status. The marginally protective association for consistent

condom carrying, while not conclusive, points to a behavioural factor that may be relevant for prevention programming.

Figure 1. **Structural Model 1 (Direct Associations Model)**

Table 5. **Direct Associations Between MoH Program Exposure Variables and HIV Status (Model 1)**

3.2.2 Direct and Indirect Associations with HIV Status Including Proximate Determinants (Model 2)

Model 2 added condom use at last sex and syphilis status as proximate (intermediate) variables. The structural relationships tested in this model are illustrated in Fig. 2, and Table 6 presents the estimated coefficients.

Table 6
Direct and Indirect Associations Between MoH Program Exposure, Proximate Determinants (Condom Use, Syphilis), and HIV Status (Model 2)

		Coefficient	Std. Err	z	P>|z|	[95% conf. interval]
HIV_cat	**catknowledge**	**.1676062**	**.5972305**	**0.28**	**0.779**	**-1.002944–1.338156**
	recomendation	− .2806049	.2957019	-0.95	0.343	− .8601699 − .2989601
	bring_condom	− .5801853	.2987362	-1.94	0.052	-1.165697 − .0053268
	condom_last ~ x	− .576036	.2655013	-2.17	0.030	-1.096403 - (-.055657)
	sifilisnew	2.125563	5.355	5.97	0.0001	1.428261–2.82286
	_cons	-3.644086	.6943034	-5.25	0.0001	-5.004896 - (-2.283276)
condom_last ~ x	catknowledge	− .2123745	.1584291	-1.34	0.180	− .5228899 − .0981409
	recomendation	− .2301821	.0899278	-2.56	0.010	− .4064374 - (-.0539268)
	bring_condom	− .868829	.1196273	-7.26	0.0001	-1.103294 - (-.6343637)
	_cons	2.606.357	.2006898	12.99	0.0001	2.213012–2.999702
sifilisnew	catknowledge	− .0022846	.4226378	-0.01	0.996	− .8306394 − .8260702
	recomendation	.2956716	.2636891	1.12	0.262	− .2211495 − .8124927
	bring_condom	− .2954194	.242428	-1.22	0.223	− .7705696 − .1797308
	_cons	-3.919167	.4978011	-7.87	0.0001	-4.89484 - (-2.943495)

Direct Associations with HIV Status

HIV-related knowledge (OR = 0.97; 95% CI: 0.30–3.12; p = 0.956) and receiving a recommendation to test (OR = 0.81; 95% CI: 0.45–1.44; p = 0.466) were not significantly associated with HIV status. The habit of bringing a condom showed a marginally significant direct association with HIV status (OR = 0.56; 95% CI: 0.32–1.01; p = 0.052). Condom use at last sex was significantly associated with HIV status (OR = 0.56; 95% CI: 0.33–0.95; p = 0.030), indicating a protective association. Syphilis status was strongly

associated with HIV status (OR = 5.21; 95% CI: 2.76–9.83; p < 0.001), consistent with the well-established biological link between STI co-infection and HIV.

Associations with Condom Use at Last Sex (Pathway via Proximate Determinant 1)

HIV knowledge was not significantly associated with condom use at last sex (OR = 0.94; 95% CI: 0.56–1.58; p = 0.820). Receiving a recommendation for testing showed a negative association with condom use (OR = 0.68; 95% CI: 0.51–0.91; p = 0.010)—a counterintuitive finding that may reflect unmeasured confounding, reverse causation, or program targeting of higher-risk individuals. Bringing a condom was positively associated with condom use at last sex (OR = 3.21; 95% CI: 2.41–4.28; p < 0.001), suggesting that carrying condoms is a strong predictor of actual use.

Associations with Syphilis Status (Pathway via Proximate Determinant 2)

None of the MoH program variables (HIV knowledge, testing recommendation, or condom carrying) showed statistically significant associations with syphilis status. The estimated odds ratios were close to 1.0 with wide confidence intervals, indicating no clear evidence of association. Consequently, no substantial indirect association from program exposure to HIV status through syphilis was detected.

Summary of Model 2

In this model, condom use at last sex and syphilis status were both significantly associated with HIV status, consistent with their role as proximate determinants. However, indirect associations from program exposure variables to HIV through these proximate determinants were limited. The negative association between receiving a testing recommendation and subsequent condom use is unexpected and warrants further investigation in longitudinal studies to understand its direction and underlying mechanisms.

Figure 2. **Structural Model 2 (Proximate Determinants Model)**

Table 6. **Direct and Indirect Associations Between MoH Program Exposure, Proximate Determinants (Condom Use, Syphilis), and HIV Status (Model 2)**

3.2.3 Associations Including Demographic and Behavioural Background Variables (Model 3)

Model 3 incorporated demographic and behavioural background variables alongside the proximate determinants. The structural relationships are illustrated in Fig. 3, and Table 7 presents the estimated coefficients for all pathways. The model includes five interrelated equations predicting (1) HIV-related knowledge, (2) condom carrying behaviour, (3) receiving a recommendation for HIV testing, (4) condom use at last sex, and (5) HIV status.

Predictors of HIV-Related Knowledge

HIV-related knowledge was positively associated with receiving a testing recommendation (Coef. = 0.430, p = 0.002) and with moderate sexual activity (freqsex1: Coef. = 0.577, p = 0.005). Education showed a marginally negative association (Coef. = -0.230, p = 0.075). Higher sexual frequency (freqsex2) was not significantly associated with knowledge. These patterns suggest that program engagement and moderate sexual behaviour are associated with greater HIV awareness, while higher education alone did not guarantee better knowledge in this sample.

Predictors of Condom Carrying Behaviour

Condom carrying was positively associated with receiving a testing recommendation (Coef. = 0.615, $p < 0.001$), marital status, and sexual frequency. Higher education was negatively associated with condom carrying (Coef. = -0.253, p = 0.003), a counterintuitive finding that may reflect differential risk perception or social desirability bias. Married individuals and those with more frequent sexual encounters were more likely to report carrying condoms.

Predictors of Receiving a Testing Recommendation

Receiving a recommendation for HIV testing was associated with lower education (Coef. = -0.471, $p < 0.001$) and older age (agef1 and agef2). Married status was negatively associated with receiving a recommendation. These patterns suggest that outreach efforts may be disproportionately directed toward older, less-educated, and unmarried clients, possibly reflecting targeted program strategies.

Predictors of Condom Use at Last Sex

Condom use at last sex was strongly associated with condom carrying (Coef. = -0.870, $p < 0.001$; note that this negative coefficient reflects reverse coding in the original variable). However, receiving a testing recommendation showed a negative association with condom use (Coef. = -0.235, p = 0.009). This unexpected finding—where program engagement (recommendation) is positively associated with condom carrying but negatively associated with actual condom use—warrants further investigation. Possible explanations include unmeasured confounding, social desirability bias in self-reported behaviours, or that recommendations reach individuals who are already at higher risk.

Associations with HIV Status

In Model 3, condom carrying (Coef. = -0.60, p = 0.042), condom use at last sex (Coef. = -0.57, p = 0.031), and syphilis status (Coef. = 2.116, $p < 0.001$) were each significantly associated with HIV status. The protective associations for condom-related behaviours and the strong positive association for syphilis are consistent with the proximate determinants framework.

Summary of Model 3

Overall, Model 3 shows that demographic and behavioural background variables are associated with both program engagement and HIV-related behaviours. Receiving a testing recommendation was

associated with better HIV knowledge and increased condom carrying, but counterintuitively with lower reported condom use. While this pattern may suggest that communication strategies do not fully translate into practice, an alternative explanation is equally plausible: programs may selectively target testing recommendations toward men already perceived to be at higher risk (e.g., those who report inconsistent condom use). In a cross-sectional design, this selection bias would produce a negative association between recommendation and condom use even if the recommendation itself has no adverse effect.

These patterns highlight the complexity of behavioural responses to program messaging and underscore the need for longitudinal research to clarify causal directions. Nevertheless, the model demonstrates that program engagement is associated with HIV-related knowledge and behaviour, and that demographic factors education, age, and marital status significantly shape both program exposure and health behaviour.

The Key findings from the GSEM result include:

- Direct effects from behavioural variables (condom carrying and condom use) to HIV were not statistically significant.
- Syphilis was positively associated with HIV status but did not function as a mediating variable in the model.
- HIV education and recommendation for testing were positively associated with improved condom behaviour, suggesting that program inputs may still play a role in shifting proximate behaviours.

Given the cross-sectional nature of the IBBS, these results are exploratory and do not imply causal pathways. However, the modelling framework highlights potential leverage points for targeted MoH Programs among male clients of sex workers in Indonesia.

Figure 3. **Structural Model 3 (Full Model with Background Variables)**

Table 7. **Structural Equation Model Results: Associations Between MoH Program Exposure, Proximate Determinants (Condom Use, Syphilis), Demographic Background Variables, and HIV Status Among Male Clients of FSWs (Model 3)**

4. Discussion

This study contributes to the growing body of research on male clients of FSWs, a population often overlooked in HIV prevention planning. Programs targeting this group are essential to curb HIV transmission, yet national strategies continue to under-prioritize them. While clients of FSWs are epidemiologically recognized as potential bridge populations, this study cannot confirm onward transmission to spouses or partners due to a lack of data on household or spousal dynamics in the IBBS survey. Future research should include such linkage data to better understand inter-population

transmission. But we still emphasize referring to this population not as a “bridge population,” which has stigmatizing implications, but as a group at direct and independent risk. [15]

Despite moderate-to-high levels of education among respondents, HIV knowledge remains low and condom use inconsistent, suggesting that education alone is insufficient without supportive environments and repeated exposure to tailored messages. Consistent with studies from Southeast Asia and China, structural factors including stigma, geographic mobility, and limited health outreach emerge as major barriers for this group. [16] Our findings also support earlier research from Indonesia indicating that higher education does not necessarily translate to safer practices.

The results highlight extremely low HIV testing coverage and suboptimal condom use among FSW clients findings that are consistent with previous IBBS rounds. Notably, only 13.7% of respondents reported ever receiving an HIV test, and just 13% reported consistently carrying condoms. This concurrence of low testing and low condom use underscores a critical gap in the HIV prevention cascade. Such dual vulnerability increases the risk of undiagnosed infections and ongoing transmission. Strengthening HIV outreach efforts must prioritize repeated, accessible testing campaigns, combined with stigma-free condom promotion strategies tailored to mobile and hard-to-reach populations such as clients of sex workers.

However, the use of generalized structural equation modelling (GSEM) in this study despite limited statistical significance reveals important patterns: HIV-related outreach and testing promotion were positively associated with improved condom-related behaviours.

Notably, the co-infection between syphilis and HIV was statistically significant, although we refrain from interpreting this as causal due to the cross-sectional nature of the data. This association is well-established in the literature, supporting syndemic frameworks where multiple infections interact and amplify risk. [17,18] Syphilis did not appear as a mediator in the GSEM model.

While education and risk perception are often considered influential factors in HIV prevention, they are insufficient on their own to ensure consistent protective behaviours. Evidence shows that structural, interpersonal, and behavioural barriers frequently override the effects of education or knowledge in shaping HIV-related practices. For example, Fauk et al. (2018) identified low education levels and limited sexual health literacy as key societal determinants of HIV vulnerability among clients of female sex workers (FSWs) in Indonesia [19].

Although higher education is often assumed to enhance prevention behaviours, our findings and those of others suggest this effect may be limited in contexts lacking culturally resonant messaging and accessible services. Internalized stigma and sociocultural constraints may also explain clients’ reluctance to undergo HIV testing or consistently use condoms, even when aware of their benefits [20].

Finally, the persistently low levels of HIV knowledge observed among this population point to broader systemic gaps in public health outreach. Clients of FSWs may face compounded barriers geographic,

financial, and sociocultural which must be explicitly addressed through targeted, inclusive, and accessible programming.

This study also found that clients of FSWs are still excluded from Indonesia's National AIDS Program (NAP). We recommend their explicit inclusion in future strategies. Moreover, integrating client-targeted approaches such as peer-based outreach, mobile testing, and community-based condom distribution can enhance engagement. These approaches have shown promise in other countries and may be adapted to the Indonesian context. [21,22, 23] and may be adapted to the Indonesian context. In parallel, empowering FSWs to negotiate and uphold consistent condom use through supportive policies, peer education, and structural protections will reinforce prevention efforts and protect both women and their clients.

We conclude with a call for policy and societal action. Indonesia's HIV prevention efforts must expand to include this high-risk, underserved population. Priorities should include integrating FSW clients into national prevention strategies, ensuring condom availability, empowering FSWs, and expanding testing services to reach men in informal and community-based settings. Innovative approaches could include peer-led outreach, mobile testing at hotspot venues, and digital risk communication through messaging platforms. NGOs already engaged with FSWs may extend services to clients, particularly through trust-based interventions in known hotspots. Piloting such models in high-burden districts may provide scalable solutions tailored to the Indonesian context.

Conclusion

This study highlights the persistent vulnerability of male clients of female sex workers in Indonesia to HIV infection, in part due to gaps in condom use, HIV testing, and programmatic reach. While direct effects of program exposure on HIV outcomes were not statistically significant, the structural modelling suggested meaningful pathways from education and outreach to behavioural improvements.

Given these findings, future HIV prevention strategies should explicitly include this population within national frameworks. Programmatic responses must go beyond information dissemination and ensure consistent availability of condoms, accessible and stigma-free HIV testing, and engagement of both clients and sex workers in shared risk reduction strategies.

More research is needed to understand the long-term behavioural trajectories of clients and the frequency of their engagement with FSWs. Meanwhile, structural barriers such as stigma, mobility, and exclusion from services should be prioritized in public health responses.

In summary, clients of FSWs are a critical yet underserved group in Indonesia's HIV epidemic. Strengthening programs to reach them more effectively is essential for reducing transmission and achieving broader prevention goals. The government must take concrete steps to ensure stigma-free condom distribution and routine HIV testing are accessible in venues where clients are likely to be

reached. At the same time, the public should demand access to these essential services, and normalize condom use as a cornerstone of HIV prevention, not just family planning.

Declarations

5. Acknowledgments

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7. Clinical trial number: not applicable

8. Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

9. Limitations

This study has several limitations that should be considered when interpreting the findings.

First, the cross-sectional design of the IBBS dataset precludes any causal inference. Although we used Generalized Structural Equation Modelling (GSEM) to estimate direct and indirect associations, temporal ordering between program exposure, proximate determinants (condom use and syphilis), and HIV status cannot be established. Therefore, the terms "direct association" and "indirect association" are used throughout, and no claims of causal mediation are made. Alternative temporal sequences such as HIV infection occurring prior to program exposure, or reverse causation where HIV status influences subsequent behaviour cannot be ruled out. The structural pathways presented should be interpreted as exploratory and hypothesis-generating, not as evidence of causal mechanisms. **Second**, the relatively low HIV prevalence in this sample (1.0%) limits statistical power, particularly for detecting smaller indirect associations or subgroup differences. The wide confidence intervals observed for several estimates (e.g., HIV knowledge in Model 1) reflect this limited precision. **Third**, data on behaviours (including condom use, HIV testing history, and sexual practices) were self-reported and thus subject to social desirability and recall biases. Underreporting of stigmatized behaviours (e.g., inconsistent condom use) or overreporting of socially desirable behaviours (e.g., HIV testing) may have influenced the estimated associations. **Fourth**, the study focused exclusively on male clients of female sex workers and did not include clients of other key populations such as transgender sex workers (waria) or male sex workers. Findings may not generalize to clients of these populations. Finally, the MoH program exposure

variables were measured through self-reported recall of ever having received information, recommendations, or condoms. The intensity, frequency, and quality of program exposure were not captured, which may have attenuated observed associations.

Author Contribution

IT drafted the main text of the manuscript, while IT and IA prepared Figures 1–3 and Tables 1–7. BU provided several suggestions regarding methodological improvements. RR and AN provided several suggestions regarding the content of the discussion section, particularly concerning the Ministry of Health's evaluation program.

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Table 7

Table 7 is available in the Supplementary Files section.

Figures

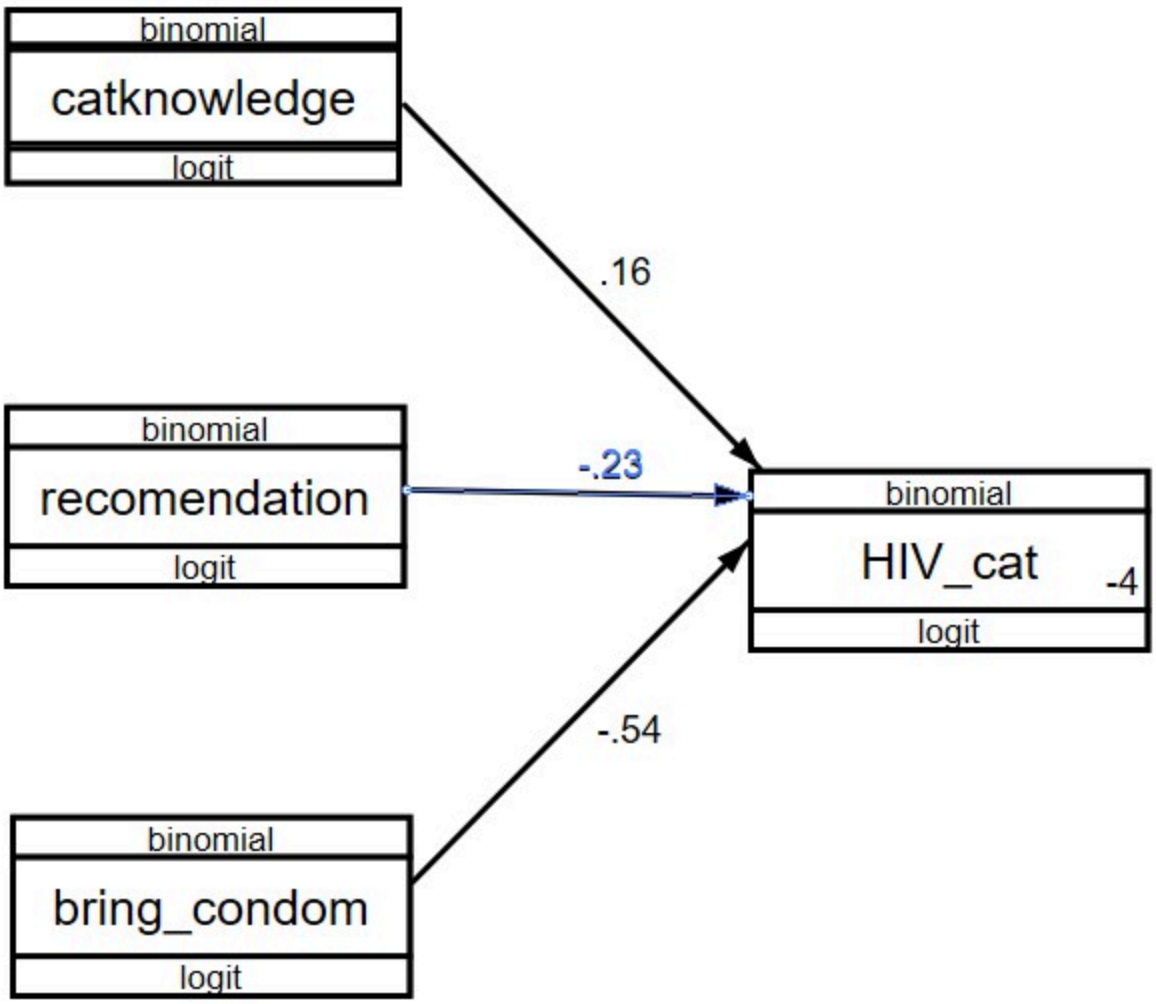


Figure 1

Structural Model 1 (Direct Associations Model)

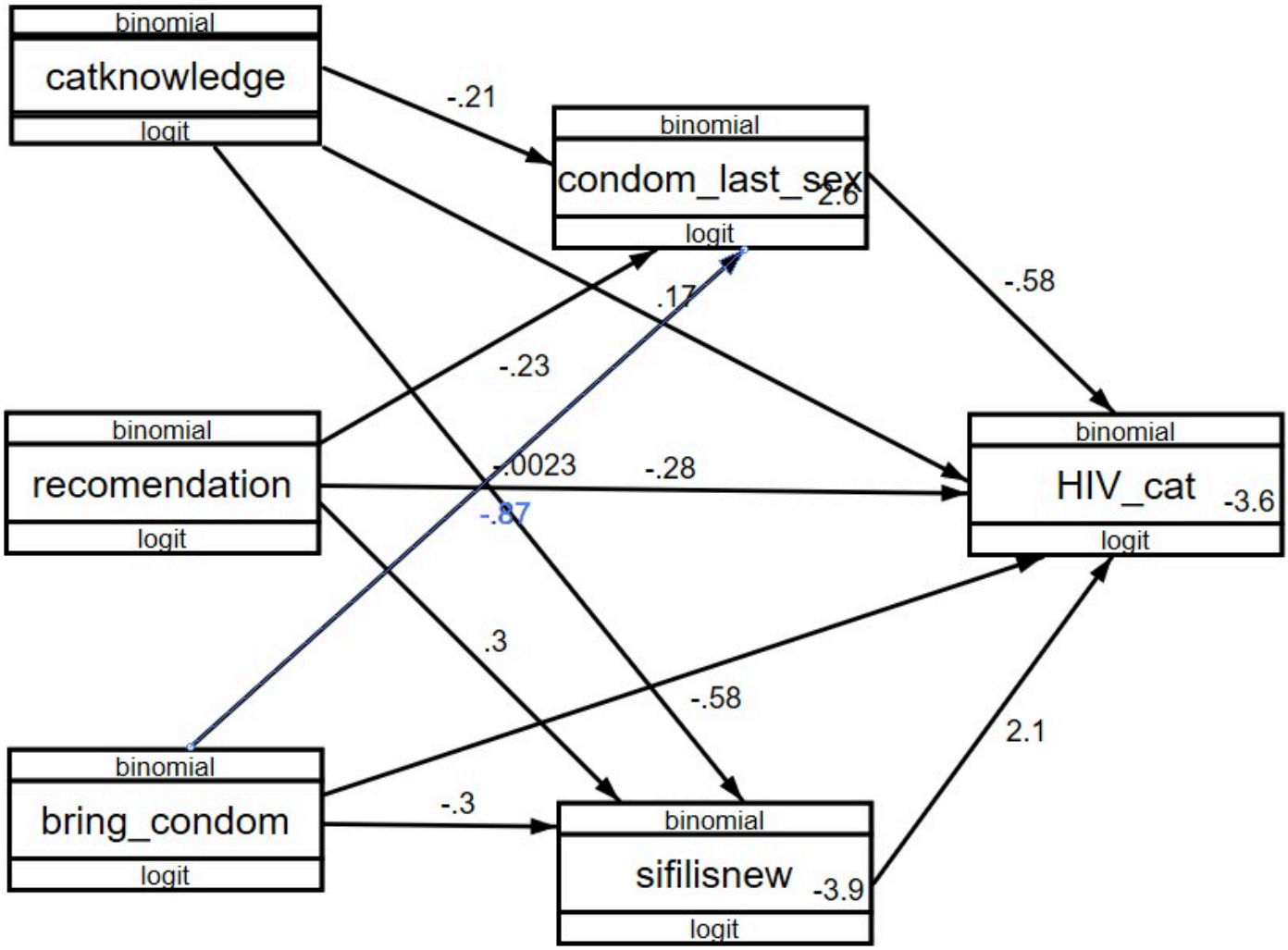


Figure 2

Structural Model 2 (Proximate Determinants Model)

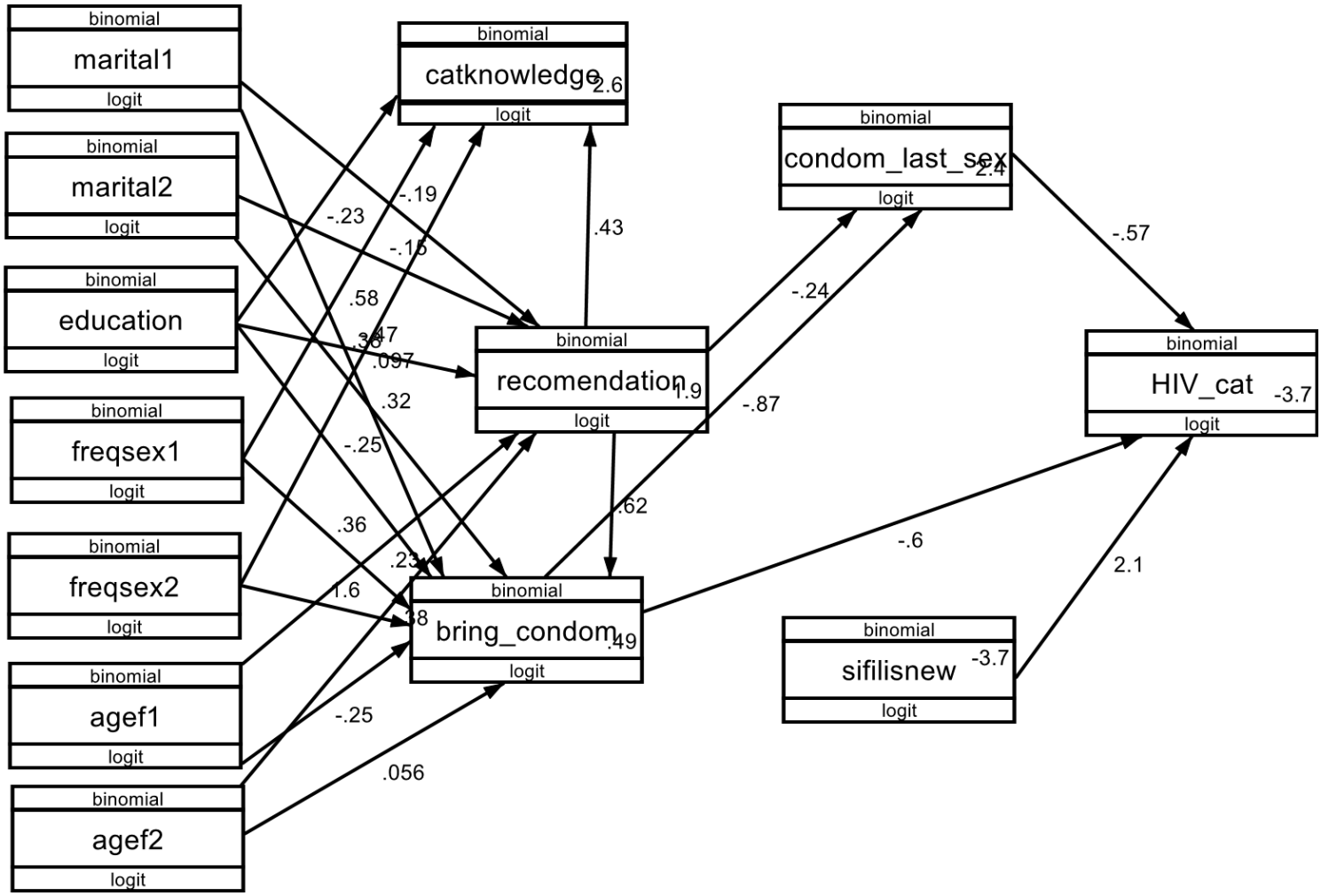


Figure 3

Structural Model 3 (Full Model with Background Variables)

Supplementary Files

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- Tables.docx