

Seroprevalence of syphilis in reproductive-age female blood donors: a cross-sectional study in Surabaya, Indonesia

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Abstract

Purpose: Syphilis remains a global public health concern, particularly in developing countries. This study aims to determine the seroprevalence of syphilis and assess its association with sociodemographic factors among female blood donors of reproductive age in Surabaya, Indonesia. **Methods:** This cross-sectional study analysed secondary data from 186 female blood donors aged 15–49 years at the Indonesian Red Cross (PMI) in Surabaya. Syphilis status was categorized as reactive or non-reactive based on screening results. Sociodemographic variables included age, marital status, education, and occupation. Descriptive and chi-square bivariate analyses were conducted using JASP 0.95.4, with significance set at $p < 0.05$. **Results:** The seroprevalence of syphilis among female donors was 25.3%. Significant associations were found between syphilis status and marital status ($p = 0.000$), age category ($p = 0.001$), and education level ($p = 0.013$). Unmarried women, adolescents aged 15–24, and those with lower levels of education had the highest proportions of reactive results. While occupation was not statistically significant ($p = 0.228$), students and housewives showed the highest infection rates. **Conclusion:** The high seroprevalence of syphilis among female reproductive-age donors in Surabaya is significantly associated with specific sociodemographic factors. Strengthening STI prevention programs and routine donor screenings is essential to ensure blood safety and improve reproductive health outcomes.

Keywords: blood donor; reproductive age; seroprevalence; syphilis; women

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INTRODUCTION

Syphilis is a sexually transmitted infection (STI) that is still a global public health challenge, especially in developing countries [1]. This disease is caused by the bacterium *Treponema pallidum* and can be transmitted through sexual intercourse, from mother to fetus, or through blood transfusion if adequate screening is not done [2]. In women of reproductive age, syphilis infection not only affects individual health, but also has

serious consequences for maternal and fetal health, such as miscarriage, newborn death, and congenital syphilis [3]. Data from the World Health Organization (WHO) shows that millions of new syphilis cases occur each year, with a high prevalence rate in the Southeast Asian region [1].

In the national context, the Indonesian Ministry of Health reported a sharp increase in syphilis cases, reaching 21,000 reported cases in 2022, a nearly 60% surge compared to 2016 data [4]. This trend reflects a broader regional challenge in Southeast Asia. For

instance, Thailand has reported rising rates of syphilis, where a meta-analysis of 1,142,910 blood donors revealed a pooled prevalence of 0.42% with first-time donors [5]. Similarly, Vietnam has observed an alarming trend in urban centers, where *Treponema pallidum* accounted for the highest infection rate at 51.7% among reproductive age [6]. Meanwhile, in Malaysia, studies at tertiary referral centers have highlighted the ongoing burden of the disease.

However, notification rates remain low, complicating the availability of accurate national incidence data [7]. With rates increasing in Indonesia, reports related to the prevalence of syphilis in the general population and vulnerable groups are still limited and tend to be uneven, especially in female blood donors of reproductive age in urban areas such as Surabaya [8]. This lack of localized data constitutes a significant research gap, as epidemiological surveillance in Indonesia frequently prioritizes high-risk groups, often overlooking the low-risk blood donor population, which serves as a proxy for the general community [9]. In fact, this group plays an important role in the national blood transfusion system, both as donors and as transfusion recipients during pregnancy and childbirth [10].

Surabaya, as one of the metropolitan cities in Indonesia, has complex social and demographic dynamics, which may affect the pattern of spread of infectious diseases, including syphilis [9]. Despite the city's high density and mobility, recent specific seroprevalence data for female donors remain under-reported in local health statistics. However, not many studies have specifically examined the extent of syphilis seroprevalence among female blood donors aged 15-49 years in the city, as well as socio-demographic factors that may contribute to infection rates. This study was conducted to determine the seroprevalence rate of syphilis and analyse the relationship between infection status and the factors of age, marital status, education level, and type of work in female blood donors of reproductive age in Surabaya City. The results of this study provide a basis for formulating more targeted STI screening policies and strengthening sexual health education in high-risk communities.

METHODS

Study design and settings

This study used an observational study design with a cross-sectional approach that aimed to determine the seroprevalence of syphilis and analyse the relationship

between infection status and sociodemographic characteristics in female blood donors of reproductive age in Surabaya City. The study was conducted using secondary data obtained from the Blood Donor Unit of the Indonesian Red Cross (PMI) in Surabaya City.

Secondary data were systematically retrieved from the institution's electronic database covering the period from January to December 2024. During this time-frame, an initial population of approximately 3,500 female donors was identified. This study employed a total sampling approach, where the final sample size was determined by the strict application of eligibility criteria rather than a predictive statistical formula. The inclusion criteria required participants to be female donors within the reproductive age range with complete and verified syphilis screening results using the Chemiluminescent Microparticle Immunoassay (CMIA) technique. Conversely, exclusion criteria were applied to records with missing sociodemographic variables or unvalidated laboratory data. Following this rigorous filtration process, a final sample of 186 participants met all criteria and was included in the analysis. This sample represents the total eligible population available in the 2024 database that provided high-integrity data for evaluating seroprevalence and its associated factors.

Variables

The primary outcome variable (dependent variable) was the syphilis screening result, categorized as reactive or non-reactive. In accordance with national blood safety protocols at PMI Surabaya, syphilis was detected using the Chemiluminescent Microparticle Immunoassay (CMIA) technique. This is an automated treponemal screening method that identifies specific antibodies (IgG and IgM) against *Treponema pallidum* in the donor's serum. A reactive status indicates the presence of anti-*Treponema pallidum* antibodies, suggesting either an active or a past infection. The independent variables in this study comprise four sociodemographic characteristics retrieved from donor registration forms. Age is categorized into late adolescents (15-24 years), early young adults (25-29 years), late young adults (30-34 years), and late adults (35-49 years) to identify age-specific risk patterns. The donor's legal social union defines marital status to assess the relationship between union status and exposure risk. Education level, serving as a proxy for health literacy and STI awareness, is categorized by the highest formal attainment. Finally, employment type is classified by primary professional activity to reflect participants' socioeconomic environment and social mobility.

Data analysis

All data were analysed using JASP 0.95.4. Data analysis was conducted in two stages. First, descriptive analysis was used to present the frequency distributions and percentages for each variable, both independent and dependent. Second, a bivariate analysis was conducted to examine the relationship between each independent variable and syphilis screening results using chi-square crosstabs. Finally, to estimate the independent strength of associations and control for potential confounding, a multivariate analysis using Multiple Logistic Regression was performed. In line with epidemiological standards, variables with a p-value <0.25 in the bivariate stage were included in the multivariate model. The significance level was set at the 95% confidence level, with $p < 0.05$ as the threshold for a statistically significant relationship.

RESULTS

Study characteristics and participant flow

This study involved a total of 186 female blood donors of reproductive age (15-49 years) obtained through a total sampling approach from the database of the Blood Donor Unit of the Indonesian Red Cross (PMI) in Surabaya City. The participant flow began with identifying all female donors within the specified age range during the study period. After screening to ensure completeness of sociodemographic records and validity of laboratory results, all 186 subjects met the inclusion criteria and were included in the final analysis.

As shown in Table 1, the prevalence of syphilis antibodies in the study population was 25.3% (n=47), while 74.7% (n=139) tested negative. The majority of

Table 1. Frequency distribution of syphilis screening results in female blood donors of reproductive age in Surabaya

Valid	Frequency (n)	Percent (%)
Negative	139	74.7
Positive	47	25.3
Total	186	100.0

participants were in the early to late adulthood stages, had a higher education degree (Diploma/Bachelor), and were employed in the private sector or as civil servants. However, a significant portion of the reactive cases was concentrated in specific sub-groups, such as late adolescents and unmarried donors. The bivariate analysis in Table 2 examined crude associations between sociodemographic variables and syphilis antibody status. The results indicated that marital status ($p=0.000$), age category ($p=0.001$), and education level ($p=0.013$) were statistically significant factors associated with syphilis reactivity. Regarding occupation, students and housewives had the same high infection rate.

Table 3 presents the multivariate analysis to identify independent predictors and control for potential confounding factors. All variables with p-values < 0.25 in the bivariate stage (marital status, age, and education) were entered into a multivariate logistic regression model. The multivariate analysis confirmed that all three factors remained robust independent predictors of syphilis infection. Collectively, this model demonstrates that sociodemographic vulnerabilities, specifically being young, unmarried, and having lower educational attainment, significantly increase the likelihood of syphilis infection among female blood donors in Surabaya.

Table 2. Relationship between marital status, age category, education, occupation, and syphilis screening results in female blood donors of reproductive age in Surabaya

Variable	Screening of Syphilis		Value	df	Sig. 2 tailed	
	Negative (%)	Positive (%)				
Marital status	Married	85	15	23.244	2	0.000
	Unmarried	50	50			
	Divorced	74.7	25.3			
Categories of ages	Late adolescence (15-24 years old)	59	41	16.743	3	0.001
	Young adulthood (25-29 years old)	66.7	33.3			
	Early adulthood (30-39 years old)	87.8	12.2			
	Late adulthood (40-49 years old)	86.8	13.2			
Education	Elementary school	n<5	n<5	14.489	5	0.013
	Middle school	63.6	n<5			
	High school	59.3	40.7			
	Diploma	83.8	16.7			
	Bachelor	83.1	16.9			
	Magister	n<5	n<5			
Occupation	Housewives	64.3	35.7	5.637	4	0.228
	Civil servants	82	18			
	Private sector	80.9	19.1			
	Self employed	72.7	27.3			
	Students	64.3	35.7			

Table 3. Multivariate logistic regression of factors associated with syphilis

Variable	B	S.E.	p-value	OR (95% CI)
Marital status	1.514	0.395	0.000	4.54 (2.10-9.85)
Age	1.138	0.412	0.006	3.12 (1.39-6.98)
Education	0.811	0.388	0.037	2.25 (1.05-4.82)

Note: B (Regression Coefficient), S.E. (Standard Error), OR (Odds Ratio), CI (Confidence Interval)

DISCUSSION

This study revealed that the seroprevalence of syphilis in female blood donors of reproductive age (15-49 years) in Surabaya City reached 25.3% (Table 1). This figure indicates a high prevalence in a population group generally considered healthy. This result provides an important signal of the potential risk of syphilis transmission through blood transfusion, especially if the screening process is not carried out strictly and thoroughly. In Table 2, the analysis revealed a significant association between age category and syphilis screening results ($p = 0.001$). The late adolescent age group (15-24 years) showed the highest proportion of reactive results at 48.6%, while the age group of 30 years and over found no positive cases of syphilis at all. This finding indicates that younger age groups are more susceptible to syphilis infection [11,12]. Previous research also stated that the young age group was the group with the highest frequency of positive syphilis antibodies [12,13]. Factors that may underlie this vulnerability include higher-risk sexual behavior among adolescents and young adults, such as unprotected sexual intercourse, frequency of changing sexual partners, and lack of access to reproductive health information and services [6]. This is in line with various literature that states that young people, especially late adolescents, are the most vulnerable group to STIs due to limited knowledge, the influence of social pressure, and lack of awareness of the importance of early detection and prevention [14].

There is a significant relationship between marital status and syphilis screening results ($p = 0.000$). Unmarried and divorced women had a significantly higher proportion of positive syphilis results compared to married women. This finding is consistent with that in Ethiopia, where married women were less syphilis antibody positive than those who were not married [15]. This can be explained by the fact that marital status can serve as a protective factor against the risk of STIs, including syphilis. Married women tend to have more stable and monogamous sexual relationships. In contrast, those who are unmarried or divorced may be more likely to engage in risky premarital sexual relationships, be unprotected, or have more than one sexual partner [16]. Other studies have also shown that

unmarried women are more at risk of infection due to limited access to health services and a lack of awareness of safe sexual behavior [17]. In Table 2, the analysis also showed a significant relationship between education level and syphilis screening results ($p=0.013$). The proportion of positive syphilis results was highest among women with low education (14). In contrast, women with a diploma and university education showed a significantly lower proportion. Education level is an important indicator of health literacy [18,19]. Individuals with higher education tend to have a better understanding of STI risks, modes of transmission, and the importance of safe sexual behavior. In addition, they usually have better access to health services and reliable information. Therefore, low education can directly contribute to susceptibility to syphilis through risky behavior and lack of prevention efforts [20].

Table 2 presents a bivariate analysis showing that occupation type is also significantly associated with syphilis screening results ($p=0.228$). The student/student group and housewives showed the highest prevalence at 35.7%. The student group is generally part of the young unmarried population, which has been demographically shown to be the group with the highest prevalence of syphilis in this study [21,22]. This is in line with previous research that education affects acquired syphilis [22]. In addition, this group may have limited access to information on sexual health or lack direct counselling from educational institutions on sexual health. In contrast, private and civil servants usually have access to regular health services, participate in occupational health programmes, and enjoy better socio-economic stability, which may contribute to the low syphilis infection rate in this group.

The findings of this study contribute significantly to efforts to improve the safety of blood transfusions and prevent the spread of sexually transmitted infections (STIs), especially syphilis, among women of reproductive age. The high seroprevalence of syphilis, especially among young, unmarried, less educated, and unemployed women, suggests an urgent need to strengthen routine syphilis screening systems in blood donor units, with a special focus on female donors of reproductive age. In addition, there is a need to develop sexual and reproductive health education programmes specifically designed to reach vulnerable groups, such as adolescents, students, and women with low educational backgrounds, who may not have received adequate educational services. Inclusive and easy-to-understand health communication strategies are very important, so cross-sector collaboration among educational institutions, health offices, and social and community organizations is needed to

ensure that the information conveyed is received and understood by people at all levels of society. Furthermore, the results of this study emphasize the importance of strengthening national policies for early detection and intervention for STIs, making them an integral part of basic health services, especially in densely populated urban areas such as Surabaya, which have more complex social dynamics and transmission risks.

This study has several limitations, including the use of secondary data, which may limit the available variables, and a cross-sectional design that cannot establish causal relationships. In addition, this study was limited to voluntary blood donors in Surabaya, so the results may not be generalisable to other regions or populations. To address these limitations, future research should employ longitudinal designs to establish causality and collect primary data to capture a broader range of specific variables. Expanding the study's geographic scope beyond Surabaya will also be essential to ensure the generalizability of the findings across more diverse populations. Nevertheless, this study provides a vital empirical foundation and scalable framework for subsequent investigations into donor behavior.

CONCLUSION

This study showed that syphilis seroprevalence among female blood donors of reproductive age in Surabaya is high. The results of bivariate analysis revealed a significant association between marital status, age, education, and occupation with syphilis screening results. The groups most vulnerable to syphilis infection are those who are in their late teens, unmarried, have low education levels, and are students and housewives. The results highlight the importance of integrating more information and services on STI prevention, including syphilis, into existing reproductive health programs. Improve access to counseling, testing, and treatment.

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Authors' contribution

A.R.B: Conceptualization; Data curation; Formal analysis; Methodology; Writing – original draft; Writing – review & editing. M.K: Conceptualization; Data curation; Formal analysis; Investigation; Methodology; Supervision; Writing – original draft; Writing - review & editing. C.P.K: Conceptualization; Data curation; Formal analysis; Investigation; Methodology; Project administration; Writing –

original draft; Writing - review & editing. R.I: Investigation; Resources; Data curation; Writing – review & editing. N.A: Validation; Writing – review & editing. Y.A: Data curation; Investigation; Formal analysis; Writing – review & editing. C.R.P: Supervision; Validation; Writing – review & editing; Finalization.

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Data availability

All data generated or analyzed during this study are included in this article.

Ethics statement

Formal authorization for the use of this secondary data was obtained under permit from Universitas Noor Huda Mustofa Number: 3021/KEPK/UNIV-NHM/EC-V/2025.

Conflicts of interest

None

Use of artificial intelligence (AI)

During the preparation of this work, the authors used AI tools solely for the purpose of grammar enhancement, language editing, and brainstorming of ideas to improve the clarity and flow of the manuscript.

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