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Seroprevalence and Patterns of HIV, Hepatitis B, and Hepatitis C Co-infection among Married Couples in Rural Western Tanzania: A Community-based Cross-sectional Study

Getera Isack Nyangi[1,*], Godfrey Nyandidi[2], Victoria Avelin Marunda[3]

[1]District Medical Officer and Public Health Researcher, Kakonko District Council, Tanzania
[2]Economist, Kakonko District Council, Tanzania
[3]Medical Officer and District Research Coordinator, Kakonko District Council, Tanzania
*Corresponding author: ngetera@gmail.com

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Abstract Human immunodeficiency virus (HIV), hepatitis B virus (HBV), and hepatitis C virus (HCV) remain major global public health challenges, contributing substantially to chronic liver disease and premature mortality. Married couples represent an important population for understanding long-term exposure and potential intra-household transmission; however, data on viral infections and co-infections among couples in rural Tanzania are limited. This study aimed to determine the seroprevalence and patterns of HIV, HBV, and HCV mono-infections and co-infections among married couples in Kakonko District, Kigoma Region, western Tanzania. A community-based cross-sectional study was conducted between August and October 2025 among 263 married couples (526 individuals). Finger-prick blood samples were tested for HIV using the national rapid diagnostic testing algorithm, HBV using hepatitis B surface antigen (HBsAg) rapid tests, and HCV using anti-HCV antibody rapid assays. Socio-demographic data were collected using structured questionnaires, and data were analyzed using Stata version 16. Among 526 participants, HIV prevalence was 0.4%, HBV prevalence was 4.5%, and HCV prevalence was 0.4%. HIV–HBV co-infection was identified in one participant (0.19%), while no HIV–HCV, HBV–HCV, or triple infections were detected. Serodiscordant infection was observed in two couples for HIV, eighteen couples for HBV, and two couples for HCV, while HBV seroconcordance was identified in two couples. In conclusion, HBV infection remains moderately prevalent among married couples in Kakonko District, whereas HIV and HCV prevalence are low and viral co-infections are rare. Strengthening HBV screening, adult vaccination, and couple-based education programs is recommended.

Keywords: *HIV, Hepatitis B, Hepatitis C, Co-infection, Married couples, Tanzania*

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1. Introduction

Human immunodeficiency virus (HIV), hepatitis B virus (HBV), and hepatitis C virus (HCV) remain major global public health challenges, contributing substantially to chronic liver disease, cirrhosis, hepatocellular carcinoma, and premature mortality [1,2]. Despite significant advances in prevention and treatment, these infections continue to impose a high disease burden, particularly in low- and middle-income countries.

Globally, HIV remains a leading cause of morbidity and mortality, with an estimated 40.8 million people living with the virus and more than 600,000 AIDS-related deaths annually, most of which occur in sub-Saharan Africa [3]. Viral hepatitis presents a similarly serious burden; approximately 254 million people live with chronic HBV infection and 50 million with chronic HCV infection worldwide, resulting in an estimated 1.3 million deaths each year, largely due to cirrhosis and hepatocellular carcinoma [4]. In 2022 alone, an estimated 2.2 million new hepatitis infections were reported globally, including 1.2 million new HBV infections and nearly 1.0 million new HCV infections [4].

Co-infection with HIV and viral hepatitis significantly worsens disease progression and prognosis by accelerating liver injury and increasing the risk of cirrhosis, hepatocellular carcinoma, and liver-related mortality, while also complicating clinical management [5,6]. Studies conducted in sub-Saharan Africa report variable prevalence of HIV–HBV and HIV–HCV co-infections,

reflecting differences in population characteristics and study settings. Reported prevalence estimates include 5.96% for HIV–HBV and 1.72% for HIV–HCV in Ethiopia, 5.8% and 4.2%, respectively, in Kenya, and evidence of substantial HBV exposure in the Democratic Republic of Congo [7,8].

In Tanzania, available evidence on HIV and viral hepatitis co-infections remains limited and is largely derived from facility-based studies conducted among people living with HIV in urban or tertiary healthcare settings. Reported HIV–HBV co-infection prevalence ranges widely from 0.1% to 17.3%, while HIV–HCV co-infection has been reported to be as high as 18.1% in some settings [9,10,11,12]. These estimates may not accurately reflect the burden of infection in rural communities, where access to screening services is limited, and a large proportion of infections remain undiagnosed.

Because many individuals infected with HIV, HBV, or HCV remain asymptomatic for prolonged periods, substantial transmission and disease progression can occur unnoticed at the community level. Investigating asymptomatic populations is therefore essential for identifying hidden infections, facilitating early diagnosis and treatment, and generating reliable data to inform effective public health planning, particularly in rural and underserved settings.

Married couples represent an important yet understudied population for understanding long-term exposure, intra-couple transmission, and patterns of infection concordance or discordance. In Tanzania, data on HIV, HBV, and HCV among married couples are scarce. This study aimed to determine the seroprevalence and patterns of HIV, HBV, and HCV mono-infections and co-infections, assess serodiscordance and seroconcordance within couples, and describe their distribution by selected socio-demographic and behavioral characteristics among married couples in Kakonko District, western Tanzania, between August and October 2025.

2 Materials and Methods

2.1. Study Design and Setting

A community-based cross-sectional study was conducted between August and October 2025 in Kakonko District, Kigoma Region, western Tanzania. Kakonko District is predominantly rural and is served by 37 public health facilities providing routine services, including HIV testing, immunization, and general outpatient care. The prevalence of HIV in Kigoma Region has been reported to be 1.7%, which is lower than the national average [13].

2.2. Study Population

The study population comprised heterosexual married or cohabiting couples aged 18 years and above who were permanent residents of Kakonko District. Eligibility required the presence of both partners at the time of the household visit and voluntary provision of written informed consent by each partner.

2.3. Inclusion and Exclusion Criteria

Couples were eligible for inclusion if both partners consented to participate and agreed to undergo couple-based HIV, HBV, and HCV testing. Couples were excluded if either partner declined testing, was severely ill at the time of data collection, or had incomplete laboratory results or questionnaire data.

2.4. Sample Size and Sampling Procedure

The sample size was calculated using a conservative estimated prevalence of 50% to maximize statistical power due to the absence of prior couple-based seroprevalence data in the study area. Using a 95% confidence level and a margin of error of 5%, the minimum required sample size was 384 households, corresponding to 768 individuals.

During field implementation, a total of 526 individuals (263 married couples) met the eligibility criteria and were included in the final analysis. The reduction from the initially planned sample size resulted from non-response and exclusions during data verification. Nevertheless, the achieved sample size was adequate for estimating the seroprevalence of HIV, HBV, and HCV and for describing infection patterns among married couples.

Households with eligible married couples were selected using a simple random sampling approach. From every three eligible households, two were randomly selected for participation. Sampling was conducted across all four cardinal directions (north, south, east, and west) within each village to ensure broad geographical representation. Written informed consent was obtained from all participants before data collection after providing detailed explanations of the study objectives, procedures, potential risks, and benefits.

2.5. Data Collection and Counselling Procedures

Data were collected through household visits by trained healthcare workers using a semi-structured questionnaire. The tool was developed in English, translated into Kiswahili, and back-translated to ensure semantic equivalence. Content validity was reviewed by three public health experts, and the questionnaire was pre-tested among 20 married individuals (10 couples) from a neighboring village; feedback was used to refine wording and flow, and pre-test data were excluded from analysis. Socio-demographic information was collected jointly from both partners, while sensitive questions on risk behaviors were collected individually to ensure privacy and minimize social desirability bias. Completed questionnaires were reviewed daily by field supervisors for completeness and accuracy, with inconsistencies addressed promptly. In addition to testing and counselling, participants received verbal, culturally appropriate health education on HIV, HBV, and HCV transmission, prevention, safe sexual practices, couple-based testing, and hepatitis B vaccination. Participants who tested negative were counselled on prevention, while those who

tested positive received tailored guidance on disease management, transmission prevention, and linkage to care

2.6. Detection of HIV, HBV, and HCV

Finger-prick blood samples were obtained from each participant. HIV testing was conducted according to the national rapid diagnostic testing algorithm, using SD Bioline for screening and Uni-Gold for confirmation. The SD Bioline rapid test has a reported sensitivity of 99% and specificity of 100% [14].

Hepatitis B virus infection was assessed using HBsAg rapid tests, while hepatitis C virus infection was determined using anti-HCV antibody rapid assays. Reported sensitivity and specificity for HBsAg rapid tests are 91.43% and 98.28%, respectively, while anti-HCV rapid tests have a sensitivity of 98% and specificity of 100% [15,16]. All laboratory procedures adhered to national quality assurance and biosafety guidelines. Participants who tested positive for any infection received post-test counselling and were referred to appropriate care and treatment services.

2.7. Data Management and Analysis

Data were entered into Microsoft Excel, checked for completeness and consistency, and analysed using Stata version 16 (Stata Corp, College Station, TX, USA). Married couples were recorded as paired observations to preserve spousal linkage and enable accurate assessment of intra-couple infection patterns. Descriptive statistics, including means, standard deviations, frequencies, and percentages, summarized participant characteristics. Prevalence estimates for HIV, HBV, and HCV mono-infections and co-infections (dual or triple) were calculated with 95% confidence intervals, and missing data were handled using case-wise deletion. Serodiscordant (one partner positive) and seroconcordant (both partners positive) infections were assessed for each virus to describe intra-couple transmission patterns. Due to the small number of positive cases, inferential statistical tests and multivariable analyses were not performed, and comparisons across groups were descriptive. Results were presented in both tabular and narrative formats.

3 Results

3.1. Participant Characteristics

A total of 526 participants, comprising 263 married couples, were included in the study. The overall mean age of the study participants was 39.9 ± 15.7 years (n = 526). Males had a higher mean age (43.1 ± 16.1 years, n = 263) compared to females (36.7 ± 14.6 years, n = 263), with a mean age difference of 6.5 years.

The majority of participants were peasants (93.7%). Regarding behavioral and medical history factors, 27.3% reported alcohol use, 9.1% reported cigarette smoking, and 3.8% had a history of blood transfusion. Most couples (84.6%) were in their first marriage. Detailed participant characteristics are presented in Table 1.

Table 1. Socio-demographic characteristics (N=526)

Variables	Mean ± SD	No (%)
Age(years)	39.9 ± 15.7	
Sex		
Male	43.1 ± 16.1	263(50)
Female	36.7 ± 14.6	263(50)
Age groups		
<25		99 (18.8)
25--34		153(29.1)
35--44		97(18.4)
45--54		67(12.7)
>55		110(21.0)
Occupation		
Peasant		493(93.7)
Non-peasant		33(6.3)
First marriage		
Yes		445(84.6)
No		81(15.4)
Alcohol use		
Yes		143(27.2)
No		383(72.8)
Smoke cigarette		
Yes		48(9.1)
No		478(90.9)
Ever received a blood transfusion		
Yes		20(3.8)
No		497(94.5)
Can't remember		9(1.7)

3.2. Seroprevalence of HIV, HBV, and HCV

HIV mono-infection was identified in 2 participants (0.38%), both of whom were male. Hepatitis B virus (HBV) infection was detected in 22 participants (4.2%), with a higher prevalence among males (5.7%) compared with females (2.7%). Hepatitis C virus (HCV) mono-infection was identified in 2 participants (0.38%), both of whom were female. The overall and sex-specific distribution of HIV, HBV, and HCV infections among study participants is presented in Table 2.

3.3. Seroprevalence of Co-infections

Among the study participants, one participant (0.19%) had HIV–HBV co-infection. No cases of HIV–HCV, HBV–HCV, or triple (HIV–HBV–HCV) co-infection were observed. The detailed distribution of co-infections is presented in Table 3.

3.4. Serodiscordant and Seroconcordance Infections

Among the married couples tested, serodiscordant couples were identified in two couples for HIV, eighteen couples for HBV, and two couples for HCV. Seroconcordance infections were observed only for HBV, affecting two couples.

Table 2. Seroprevalence of HIV, HBV, and HCV (N=526)

Variables	HIV positive n (%)	HBVpositive n (%)	HCV positive n (%)
Sex			
Male	2(0.8)	15(5.7)	0(0)
Female	0(0)	7(2.7)	2(0.8)
Age groups			
<25	0(0)	0(0)	1(1.0)
25--34	1(0.65)	9(5.9)	0(0)
35--44	0(0)	3(3.1)	0(0)
45--54	1(1.49)	4(6.0)	1(1.5)
>55	0(0)	6 (5.4)	0(0)
Occupation			
Peasant	2(0.4)	22(4.5)	1(0.2)
Non-peasant	0(0)	0(0)	1(3)
First marriage			
Yes	2(0.5)	18(4.0)	2(0.5)
No	0(0)	4(4.9)	0(0)
Alcohol use			
Yes	2(1.4)	12(8.4)	0(0)
No	0(0)	10(2.6)	2(0.5)
Smoke cigarette			
Yes	0(0)	6(12.5)	0(0)
No	2(0.4)	16(3.3)	2(0.4)
Ever received a blood transfusion			
Yes	0(0)	0(0)	0(0)
No	2(0.4)	22(4.4)	2(0.4)
Cannot remember	0(0)	0(0)	0(0)

Table 3. Seroprevalence of co-infections (N=526)

Variable	HIV+HBV n (%)	HIV+HCVn (%)	HBV+HCV n (%)	HIV+HBV+HCV n (%)
Sex				
Male	1(0.38)	0(0)	0(0)	0(0)
Female	0(0)	0(0)	0(0)	0(0)
Age group (years)				
<25	0(0)	0(0)	0(0)	0(0)
25–34	1(0.7)	0(0)	0(0)	0(0)
35–44	0	0(0)	0(0)	0(0)
45–54	0	0(0)	0(0)	0(0)
≥55	0	0(0)	0(0)	0(0)
Occupation				
Peasant	1(0.2)	0(0)	0(0)	0(0)
Non peasants	0(0)	0(0)	0(0)	0(0)
First marriage				
Yes	1(0.2)	0(0)	0(0)	0(0)
No	0(0)	0(0)	0(0)	0(0)
Alcohol use				
Yes	0(0)	0(0)	0(0)	0(0)
No	0(0)	0(0)	0(0)	0(0)
Smoke cigarette				
Yes	0(0)	0(0)	0(0)	0(0)
No	0(0)	0(0)	0(0)	0(0)
Ever received a blood transfusion				
Yes	0(0)	0(0)	0(0)	0(0)
No	0(0)	0(0)	0(0)	0(0)
Can't remember	0(0)	0(0)	0(0)	0(0)

4. Discussion

This study found a low prevalence of HIV and HCV and a moderate prevalence of HBV among married couples in rural western Tanzania. The low HIV prevalence is consistent with national estimates and likely reflects the impact of sustained community-based HIV prevention, testing, and treatment programs [13,17,18,19].

Similarly, the very low HCV prevalence observed aligns with previous studies in Tanzania [20,21,22] [23,24,25]. It may be attributed to improved blood safety practices and the limited circulation of the virus in rural communities. In our cohort, HCV seroprevalence was extremely low (0.4%), contrasting with the 8–18% prevalence reported among HIV-infected populations in Tanzania [10,11]. This discrepancy likely reflects the lower-risk profile of community-based married couples and the reduction of HCV transmission in recent years due to safer medical practices.

In contrast, the moderate HBV prevalence (4.2%) remains a public health concern and is consistent with previous reports from Tanzania and the broader East African region [26,27,28]. This pattern likely reflects early-life transmission and gaps in adult hepatitis B vaccination coverage. However, the lack of detailed behavioral risk data in our study limits further exploration of HBV transmission pathways. These findings underscore the need to strengthen HBV screening programs and expand vaccination strategies beyond routine childhood immunization.

Given the low prevalence of HIV and HCV and the moderate prevalence of HBV, the likelihood of viral co-infections in this population was expectedly low. In our current study, only one participant (out of 526) had an HIV–HBV co-infection, and no cases of HIV–HCV, HBV–HCV, or triple infections were detected. This contrasts with studies among people living with HIV and high-risk populations (e.g., people who inject drugs, prisoners, and men who have sex with men), which report higher rates of co-infection [10,27,29,30]. The observed differences likely reflect variations in exposure risk and transmission dynamics between high-risk groups and stable married couples in rural settings. Nonetheless, the extremely low prevalence of dual and triple infections in our study is consistent with findings from previous studies. [7,12,31,32,33].

The low seroconcordance observed among couples suggests limited intra-couple transmission, potentially resulting from the combination of a low background prevalence, stable long-term partnerships, and adherence to preventive measures such as safe sexual practices and vaccination, where applicable [34,35]. However, the presence of serodiscordant couples indicates that the risk of secondary transmission within households persists, emphasizing the critical role of couple-based testing, counseling, and targeted interventions to prevent infection spread [35].

Notably, most previous studies have focused on HIV-positive individuals and other high-risk populations, with limited data from HIV-negative couples in general communities, particularly in Tanzania [7,9,10,29,30,36]. To our knowledge, this study is among the first to assess HIV, HBV, and HCV co-infections among married couples using a couple-based testing approach, providing novel insights into infection patterns within a general population.

Limitations

This study has several limitations. First, the cross-sectional design precludes causal inference. Second, the use of rapid diagnostic tests, while practical for field-based studies, is subject to inherent sensitivity and specificity limitations, which may have led to misclassification of HIV, HBV, or HCV infections. Third, behavioral data were self-reported, making them susceptible to recall and social desirability bias. Finally, the small number of positive cases limited the ability to conduct advanced inferential analyses or to explore risk factors thoroughly.

Conclusion

Among married couples in Kakonko District, HIV and HCV prevalence were low, while HBV prevalence was moderate. Viral co-infections were rare, and seroconcordance was uncommon. Strengthening hepatitis B screening, adult vaccination, and couple-based preventive interventions is essential in rural settings.

Recommendations

Community-based health education targeting married couples should be strengthened. Routine hepatitis B screening and expanded adult vaccination should be integrated into primary healthcare services. Promotion of couple-based testing and counseling is essential for early detection and prevention. Further research is recommended to explore contextual risk factors for hepatitis B infection and to assess the long-term impact of preventive interventions.

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Authors' Contributions

Getera Isack Nyangi conceived the study, led data collection, performed data analysis, and drafted the manuscript.

Godfrey Nyandidi conducted statistical analysis and contributed to data interpretation.

Victoria Avelin Marunda supervised the study implementation and contributed to data analysis and critical review of the manuscript.

All authors read and approved the final manuscript.

Ethical Considerations

Ethical approval was granted by the National Health Research Ethics Committee of Tanzania (Certificate No. NIMR/HQ/R.8a/Vol.IX/4986).

Conflict of Interest

The authors declare that they have no competing interests.

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