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Prevalence of sexually transmitted infections (HIV, hepatitis B virus, herpes simplex virus type 2, and syphilis) in pregnant women in Ethiopia: Trends over 10 years (2005–2014)

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ABSTRACT

Objectives: This study was performed to determine the trends in seroprevalence of four major sexually transmitted infections (STIs) (HIV, hepatitis B virus (HBV), herpes simplex virus type 2 (HSV-2), and syphilis) over a 10-year period (2005–2014) in pregnant women in Ethiopia.
Methods: Pregnant women (15–49 years old) who were enrolled in the antenatal care-based national HIV surveillance were included. Serological tests for HIV, HBV, HSV-2, and syphilis were done on serum/plasma samples.
Results: A total of 4887 pregnant women were included. Results showed a decline in prevalence of these STIs by 40–60% over the 10 years (2005–2014): HIV (10.5% to 5.5%), syphilis (2.5% to 1.1%), HBV (12.6% to 6.7%), and HSV-2 (47.5% to 28.5%). In 2014, 109/4887 (2.2%) women had triple infections. In 2005, 2007, and 2009, the prevalence of HSV-2 in the older age group (35–45 years) (47.1%, 47.4%, and 50.0%, respectively) was higher than that in the younger age group (15–24 years) (40.9%, 19.5%, and 20.2%, respectively). Age category (Chi-square = 22.4, $p < 0.001$), study sites/residence (Chi-square = 135.2, $p = 0.001$), and time/years (Chi-square = 58.9, $p = 0.001$) were associated with a positive HSV-2 test result.
Conclusions: A decline in HIV, HBV, HSV-2, and syphilis of >40% was seen over the years in Ethiopia. However, an intermediate endemicity level of HBV and higher prevalence of HIV and HSV-2 by 2014, suggest the need to strengthen prevention strategy for STIs.

Introduction

Diseases caused by sexually transmitted infections (STIs) are known to pose a significant public health burden. Due to the common routes of transmission and endemicity, there is an enormous burden of HIV and other STIs of public health importance, including hepatitis B virus (HBV), syphilis, and herpes simplex virus type 2 (HSV-2), globally (Jain, 2009; UNAIDS, 2010; Barth, et al., 2010; Melaku et al., 2015). Nonetheless, HIV is known to aggravate the progression of diseases caused by STIs and vice versa. Thus, HIV infection not only alters the spectrum of sexually transmitted diseases (STDs) (ulcerative (chancroid, HSV-2, syphilis) and non-ulcerative (chlamydia, gonorrhea)), but also exacerbates STI transmission, acquisition, and disease progression (Xiang-Sheng, 2007). On the other hand, STIs aggravate HIV disease progression towards AIDS and also facilitate the sexual spread of HIV infection (Hoffmann and Thio, 2007; Robinson et al., 1997; Grosskurth et al., 2000); the association is strong for genital ulcer diseases, with a 2–4-fold increased rate of HIV acquisition (Wald and Link, 2002).

Of particular note, STIs during pregnancy can have serious consequences for the mothers and the infants (Fuchs and Brockmeye, 2014). Therefore, this study was performed to assess the burden of four major STIs (HIV, HBV, HSV-2, and syphilis) in pregnant women in Ethiopia.

HBV, which can be transmitted through parenteral, perinatal, or sexual contact, is a serious infectious disease of the liver. HBV infection during pregnancy is associated with a high risk of

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maternal complications, high rate of vertical transmission causing fetal and neonatal hepatitis, and higher maternal mortality (Orony and Tenenbaum, 2006). In the presence of an acute maternal HBV infection, up to 90% of newborn infants and 30% of children under the age of 5 years develop chronic HBV infection, compared with only 1–5% of adults with an intact immune system (Hoffmann and Thio, 2007). Although data on the prevalence of HBV in pregnant women in Ethiopia are limited, a study done in Northwest Ethiopia reported intermediate endemicity (5.3%) of HBV among pregnant women (Walle et al., 2008). According to the recent studies conducted in different geographical locations in Ethiopia, the prevalence of HBV ranges from 4.7% to 9.5% (Tekalign, et al., 2017; Techalew et al., 2017; Melese and Tesfaye, 2016; Belay et al., 2010).

Syphilis, which is transmitted by sexual contact, blood transfusion, and via vertical transmission, is a serious health burden mainly in Sub-Saharan Africa. Syphilis in pregnant women causes severe congenital infection, which results in fetal/neonatal death (50%), prematurity (25%), and major long-term sequelae in surviving children (20%) (Charlier et al., 2015). The prevalence rates of active syphilis infection in Tanzania and Kenya were found to be 12.8% and 3.8%, respectively (Rahlenbeck et al., 1997), and syphilis infection among Ethiopian blood donors in 1995 was 12.8% (Rahlenbeck et al., 1997). According to the recent studies conducted in different geographical locations in Ethiopia, the prevalence of syphilis ranges from 0.6% to 5.1% (Melese and Tesfaye, 2016; Techalew et al., 2017; Belay et al., 2010; Anteneh et al., 2018).

HSV-2 is the most common cause of genital ulcer disease (GUD) (Hanibal, 1998). The prevalence of HSV-2 in Ethiopia ranges from 39% to 41% (Duncan et al., 1997; Kebede et al., 2004; Stephenson-Famy and Gardella, 2014). Genital herpes in pregnancy causes significant maternal morbidity, with an increasing number of infections due to oral–labial transmission. Near delivery, primary infections with HSV-1 or HSV-2 represent the highest risk of neonatal herpes infection, which is a rare but potentially devastating infection for newborns (Joseph et al., 2011). According to the recent studies conducted in different geographical locations in Ethiopia, the prevalence of HSV-2 is 32.1% (Antehun et al., 2016).

HIV, like the other STIs, has a severe effect in pregnant women. Studies have shown adverse pregnancy outcomes in HIV-infected women (Violari et al., 2008). It was reported in one study that intrauterine growth restriction (IUGR) (20.5% vs. 6.3%), pre-term birth (25.0% vs. 9.8%), and caesarean delivery (45.5% vs. 29.8%) were significantly more frequent among women with untreated HIV infections in pregnancy than in women who had received highly active antiretroviral therapy (HAART) from early pregnancy (Violari et al., 2008). Furthermore, in the absence of any intervention, transmission rates of HIV from mother to child range from 15% to 45%. On the other hand, HIV-infected and untreated children are at highest risk of mortality within the first 3 months of life, and up to 50% die within 2 years (EDHS, 2016).

According to the Ethiopia Demographic and Health Survey of 2016 (EDHS-2016), the HIV prevalence among women and men aged 15–49 years in Ethiopia was 0.9%, and the HIV prevalence was higher among women than men (1.2% vs. 0.6%) (EDHS, 2016). Other recent studies conducted in different geographical locations in Ethiopia have shown HIV prevalence of 3.2% and 3.8% (Belay et al., 2010; Melese and Tesfaye, 2016).

Ethiopia, like other developing countries, is highly affected by STIs (HIV, HBV, syphilis, and HSV-2). Thus, the country has developed national STI prevention, care and treatment strategies, programs, and guidelines to prevent and control infectious diseases. The syndromic approach to STI screening and treatment, which is one of the services offered to pregnant women during the four focused antenatal care (ANC) service visits, has been implemented since 2001 in Ethiopia (FMOH, 2016a,b). The Ethiopian government launched the country's Option A prevention of mother to child transmission (PMTCT) program in 2001 (FMOH, 2007) and Option B+ in early 2013. A serial HIV testing algorithm has been implemented since 2004 and a free antiretroviral therapy (ART) service was started in 2005 (FMOH, 2014). Furthermore, national guidelines for the prevention and control of viral hepatitis were developed in Ethiopia in 2016 (FMOH, 2016a,b).

Despite the implementation of national STI prevention, care and treatment strategies, programs and guidelines in Ethiopia, the evidence from reviews of the studies conducted in different geographical locations in Ethiopia have shown that STIs (HIV, HBV, syphilis, and HSV-2) remain public health challenges in the country.

Therefore, understanding the epidemiology and epidemiological synergy between HIV and STIs in pregnant women is of great importance to health program managers and health planners for comprehensive programmatic management of both HIV and other STIs and for initiating relevant vaccine and screening packages in the ANC clinics. Thus, this study was performed to determine the prevalence and trends of STIs (HIV, HBV, HSV-2, and syphilis) in pregnant women attending ANC clinics in the 12 major cities of Ethiopia over a 10-year period (2005–2014).

Materials and methods

Study design and period

This retrospective longitudinal study was conducted using stored data and serum, which had been collected for the purposes of ANC-based HIV sentinel surveillance over a 10-year period (2005, 2007, 2009, 2012, and 2014). The serum samples were stored at the National HIV Reference Laboratory, Ethiopian Public Health Institute (EPHI). In Ethiopia, ANC-based HIV sentinel surveillance has been implemented since 1989 to monitor the trends in the HIV epidemic and national responses to HIV.

In Ethiopia, a pregnant woman will attend ANC-based services four times during pregnancy: the first visit (8–12 weeks) is to confirm pregnancy and to determine whether the woman will receive basic antenatal care or more specialized care, with screening, treatment, and preventive measures given. At the second (24–26 weeks), third (32 weeks), and fourth (36–38 weeks) visits, maternal and fetal well-being are assessed, anemia is excluded, and preventive measures are given. EDHS-2016 results showed that 62% of women who gave birth in the 5 years preceding the survey had received antenatal care from a skilled provider at least once for their last birth.

Study population

The study population comprised pregnant women aged 15–49 years who were attending the ANC clinics and participated in the 2005, 2007, 2009, 2012, and 2014 national ANC-based HIV surveillance. For this study, a total of 4887 participants (all of the HIV-positive women ($n = 1703$) and a systematically selected sample of 10% of all of the HIV-negative women ($n = 3184$)) who had clinical data in the database and repository serum stored at −80 °C at EPHI were included. Data on demographic characteristics such as age, area of residence, parity status, and HIV and syphilis infection status were extracted from the database. The stored serum samples were used for serological testing for HBV (2005–2014) and HSV-2 (2005–2009) infections. HSV-2 serological tests were not done for 2010–2014 due to a shortage of ELISA kits.

Study sites

The study sites were 20 ANC clinics (health centers and hospitals) designated for the HIV sentinel surveillance, which are

located in the 12 major cities of Ethiopia. The distribution of the study participants across the 12 major cities and 18 sentinel sites/study sites is shown in Table 1.

Laboratory tests

During the national ANC-based HIV surveillance, blood samples were tested for HIV infection using the Vironostika HIV Ag/Ab ELISA as the screening test, and all HIV-reactive specimens were retested using the Murex HIV Ag/Ab ELISA as a confirmatory test. HIV testing was done at 20 regional HIV testing laboratories across all regions. All positive samples and 10% of the negative samples were retested at the HIV reference laboratory at EPHI for quality control purposes and the results were stored in the EPHI database. These samples were also tested for syphilis using the rapid plasma reagin (RPR) test during the ANC-based HIV surveillance. However, no further quantitative analysis or confirmatory testing was done for syphilis infection. Thus, for this study, HIV and syphilis infection status was extracted from the database. The stored serum was used to test for HSV-2 infection by HerpSelect 2 ELISA IgG kit (Focus Diagnostics, Cypress, CA, USA) and HBV infection (hepatitis B surface antigen, HBsAg) by Hepanostika ELISA kit (bioMérieux, Marcy l'Etoile, France).

Statistical analysis

Data were entered into Microsoft Office Access 2007. The statistical analysis was done using Stata version 11. Descriptive statistics were conducted to examine the prevalence of HIV, HBV, HSV-2, and syphilis infection over time. The median with interquartile range (IQR), or mean with standard deviation (SD) was calculated for continuous variables. Categorical variables were compared using the Chi-square test or Fisher's exact test when there were few observations. Stepwise logistic regression analysis was applied to identify risk factors. Age, residence, and time (year of enrolment) were included in the logistic regression analysis to identify risk factors for being HSV-2-positive, and these were reported with 95% confidence intervals (CI). A p-value of <0.05 was considered as statistically significant.

Results

Demographic characteristics of the study participants

A total of 4887 pregnant women (1703 HIV-positive and 3184 HIV-negative) were included in this study: 2005 ($n = 1068$), 2007 ($n = 946$), 2009 ($n = 775$), 2012 ($n = 1038$), and 2014 ($n = 1060$). The mean age of the study population was 24.5 ± 4.9 years.

Trends in prevalence of HIV, HBV, syphilis, and HSV-2 at the national level

The analysis was done by merging data from all 18 study sites (national level), irrespective of HIV status. As shown in Figure 1, there was a decline by >44% in the prevalence of these STIs from 2005 to 2014: HIV (10.5% to 5.5%), HBV (12.6% to 6.7%), and syphilis (2.5% to 1.1%). HSV-2 also declined by 61%% between 2005 (47.5%) and 2009 (14.5%). In 2014, 109/4887 (2.2%) of the women had triple infections.

Trends in HIV, HBV, syphilis, and HSV-2 prevalence by health facility

Although the declining trend was heterogeneous, there was a decline in HIV, HBV, and HSV-2 from 2005 to 2014 at all of the health facilities (Figure 1). The trend in HIV prevalence over time was higher in Gondar and Bahir Dar, while it was lowest at Hawassa health center (Figure 1A). The prevalence of HBV over time was highest in Gambela Hospital and it was lowest in Mekele Hospital (Figure 1B). Overall, HBV prevalence by 2014 in Ethiopia (in 10 major cities) was 6.7% (Figure 1B).

Trends in HBV and HSV-2 prevalence in pregnant women by HIV status

As shown in Figure 2A, the trend in HBV prevalence remained at the highest level over time (2005–2104) in HIV-positive pregnant women (HIV+HBV+) compared to HIV-negative pregnant women (HIV−HBV+). In addition, HBV prevalence in HIV-positive and HIV-negative women declined by 14.1% and 64%, respectively, from 2005 to 2014. The overall prevalence of HBV in pregnant women

Table 1
Total number of study participants ($N = 4887$) and list of study sites (health facilities) that were sentinel sites for the HIV surveillance in the years 2005, 2007, 2009, 2012, and 2014.

	Name of major cities	Name of study sites ($n = 18$)	Number of study participants		Total
			HIV-positive	HIV-negative	
1	Addis Ababa	Teklehaimanot HC	87	136	223
		Higher 23	115	222	337
		Kaza HC	124	203	327
		Gulele HC	130	173	303
		Akaki HC	94	218	312
2	Gondar	Gondar HC	214	210	424
3	Bahir Dar	Bahir Dar HC	141	164	305
		Bahir Dar Hospital	159	205	364
4	Jimma	Jimma HC	83	185	268
5	Harar	Hiwot Fana Hospital	67	200	267
6	Dire Dawa	Dire Dawa HC	31	164	195
		Dire Dawa Hospital	101	149	250
7	Mekele	Mekele HC	83	144	227
8	Jigjiga	Jigjiga Hospital	38	155	193
9	Gambela	Gambela Hospital	78	148	226
10	Asosa	Asosa Hospital	35	170	205
11	Adama	Adama HC	62	174	236
12	Hawassa	Hawassa HC	61	164	225
		Total	1703	3184	4887

HC, health center.

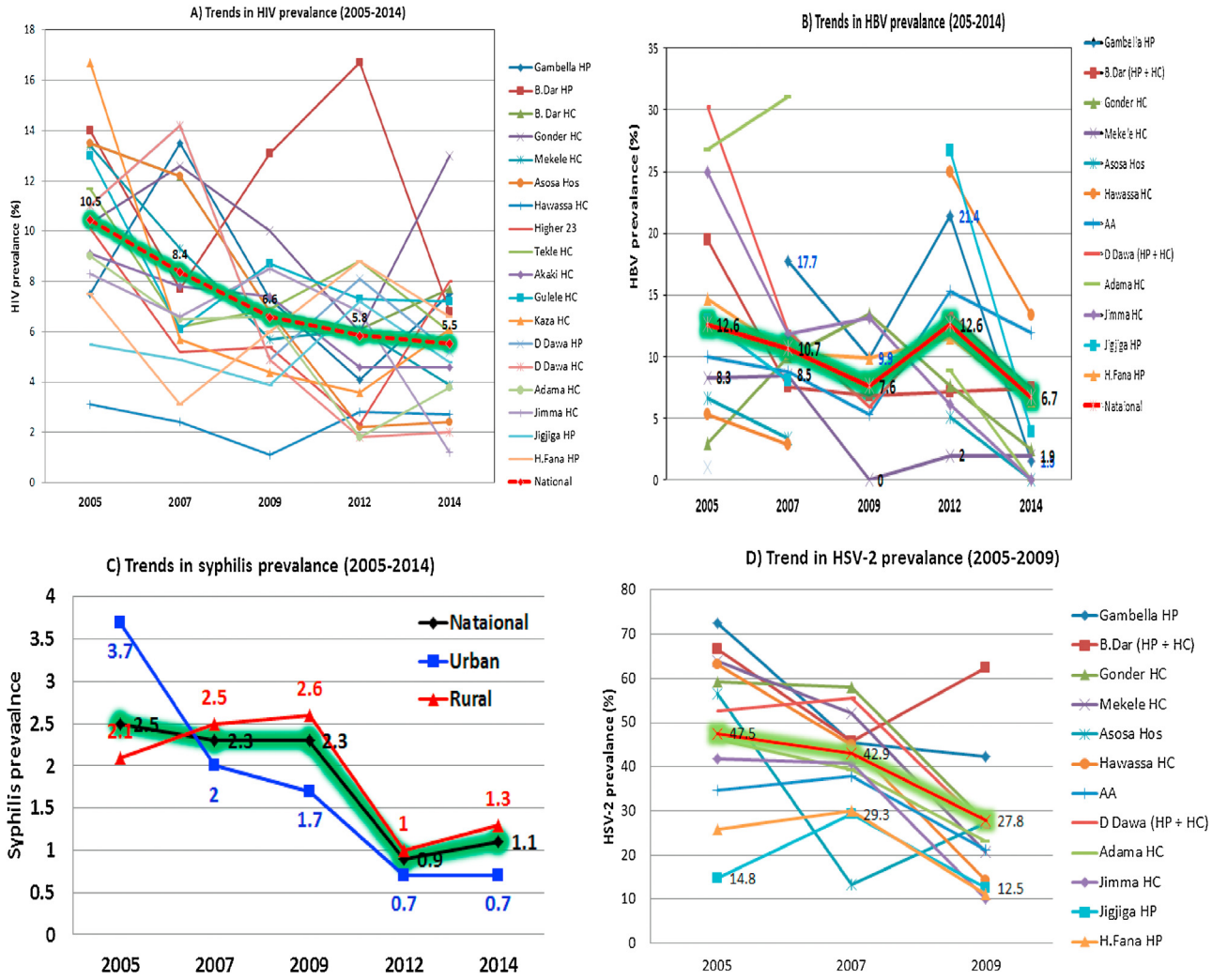

Figure 1. Trends in the prevalence of HIV (A), HBV (B), syphilis (C), and HSV-2 (D) in pregnant women attending antenatal clinics in 18 health facilities in Ethiopia from 2005 to 2014. HP: hospital; HC: health center.

(irrespective of HIV status) declined by 53.2% (12.6% in 2005 to 6.7% in 2014).

On the other hand, HSV-2 prevalence increased sharply from 62.7% in 2005 to 80.0% in 2009 in the HIV-positive women (HIV +/HSV−2+), while it remained at a constantly lower level in the HIV-negative women (HIV−/HSV−2+), which was 24.1% in 2005 and 22.7% in 2009 (Figure 2B). However, the overall prevalence of HSV-2 in pregnant women (irrespective of HIV status) declined by 58.5% (from 47.5% in 2005 to 27.8% in 2009).

Trends in prevalence of HBV and HSV-2 in pregnant women by age category

As shown in Figure 3, HBV prevalence in pregnant women (irrespective of HIV status) declined by more than 50% from 2005 to 2014 in the younger age group (15–24 years) as well as in the older age group (25–34 years). However, from 2007 to 2009, the HBV prevalence was higher in the younger age group than in the older age group.

HSV-2 prevalence was also investigated in the pregnant women (irrespective of HIV status) among the different age categories over time (2005–2009) (Figure 4). There was a consistently higher HSV-2 prevalence in the older age group (35–45 years), followed by the age groups of 25–34 years and 15–24 years. Interestingly, the prevalence of HSV-2 in the younger group (15–24 years) declined by 50% from 2005 (40.9%) to 2009 (20.2%), while it is increased over time in the age group of 35–45 years.

Analysis of association and risk factors for HSV-2 infection

As shown in Table 2, the statistical analysis indicated that age category (Chi-square = 22.4, $p < 0.001$), study sites/residence (Chi-square = 135.2, $p = 0.001$), and time/years (Chi-square = 58.9, $p = 0.001$) were associated with a positive HSV-2 test result.

In the stepwise logistic regression analysis, individuals in the older age range (25–34 years, 35–45 years) (adjusted odds ratio = 2.98), residences in some cities (Gambela and Hawassa) (adjusted odds ratio = 2.1), and time/years (2007 and 2009) (adjusted odds ratio = 2.9) had an increased risk of being HSV-2-positive (Table 3).

Discussion

The burden of the major STIs (HIV, HBV, syphilis, and HSV-2) that are known to cause serious consequences for women and infants during pregnancy was assessed in this study. A decline by >44% in the prevalence of these four STIs was shown in the pregnant women over the 8–10-year period in the major cities of

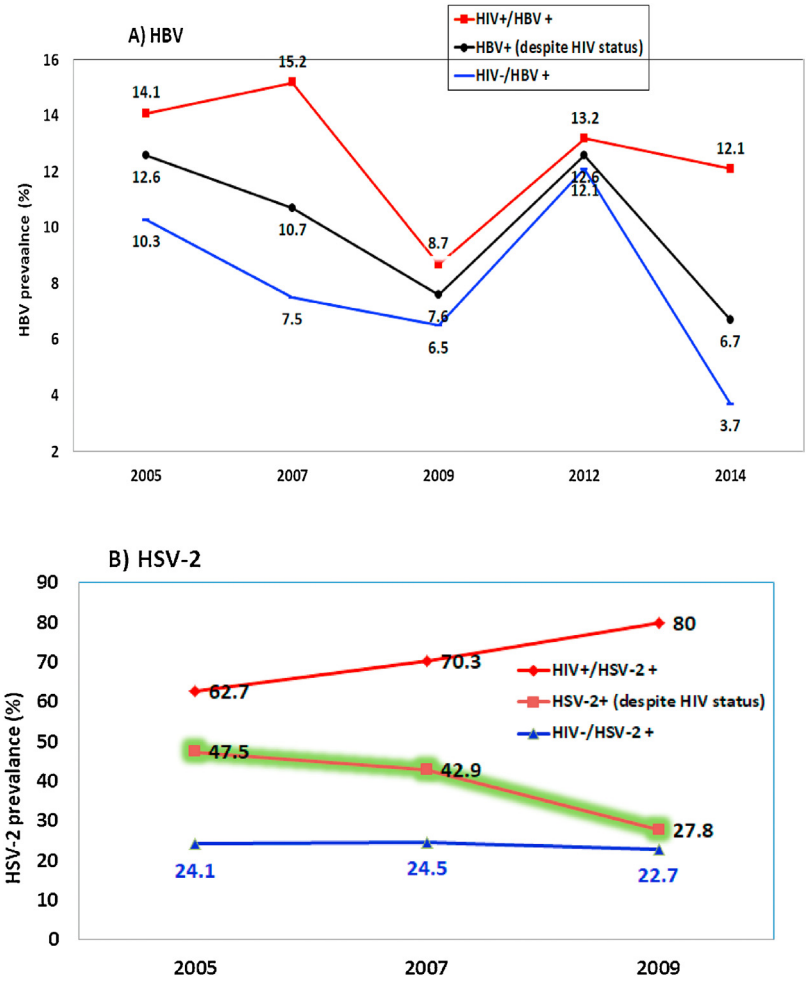

Figure 2. HBV (A) and HSV-2 (B) prevalence over time in HIV-positive and HIV-negative pregnant women in 18 heath facilities located in Ethiopia (2005–2014).

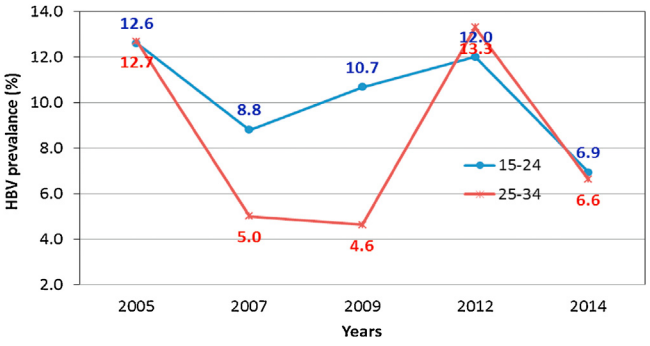

Figure 3. HBV prevalence in pregnant women (both HIV-positive and HIV-negative) in the younger age group (15–24 years, blue line) and older age group (25–35 years, red line) (2005–2014).

Ethiopia. This indicates the strength of the prevention and control strategy for infectious diseases in Ethiopia. However, despite this achievement, a high burden of HIV, HBV, and syphilis infection was observed (5.5%, 6.2%, and 1.1%, respectively) by 2014 and a high burden of HSV-2 by 2009, in the pregnant women. Furthermore, it was found that 109 women (2.2%) had triple infections. A heterogeneous prevalence of HIV, HBV, and HSV-2 was also found among the health facilities in Ethiopia (Figure 1). This could be due to multiple sex partners, or behavioral, cultural, or socioeconomic factors, as well as variations in the intervention and control programs. These findings therefore suggest the need to strengthen the prevention and control strategies for STIs in Ethiopia.

Viral hepatitis during pregnancy is associated with a high risk of maternal complications, higher maternal mortality, and a high rate of vertical transmission resulting in fetal and neonatal hepatitis (Orony and Tenenbaum, 2006). The present study data showed that 6.2% of pregnant women in urban cities in Ethiopia were

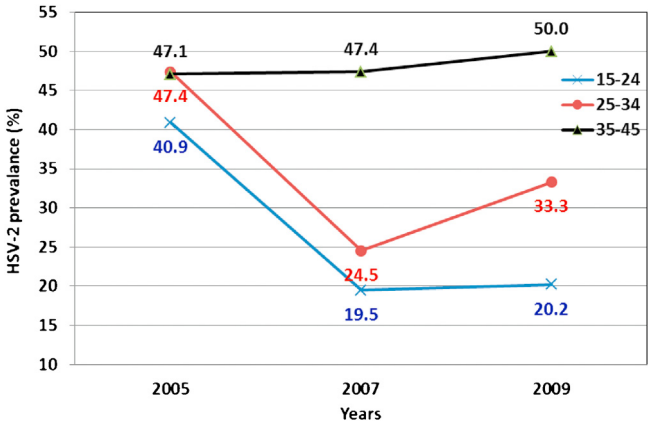

Figure 4. HSV-2 prevalence over time in HIV-positive and HIV-negative pregnant women in the age groups 15–24 years (blue line), 25–34 years (red line), and 35–45 years (black line) (2005–2009).

Table 2
Socio-demographic (age), study sites/residence, and time (years) variables potentially associated with HSV-2 test status among pregnant women in Ethiopia from 2005 to 2009.

Response variables		HSV-2 serostatus						
		Positive		Negative		Total		Chi-square, *p*-value
		n	%	*n*	%	*n*	%	
Age of the respondent (years)	15–24	317	47.7	759	58.1	1076	54.6	(23.530, 0.001*)
	25–34	310	46.6	508	38.9	818	41.5	
	35–45	38	5.7	39	3.0	77	3.9	
	Total	665	100.0	1306	100.0	1971	100.0	
Study sites/residence	Addis Ababa	265	25.2	544	36.8	809	32.0	(135. 2, 0.001*)
	Gambela	63	6.0	54	3.6	117	4.6	
	Asosa	39	3.7	70	4.7	109	4.3	
	Adama	52	4.9	89	6.0	141	5.6	
	Hawassa	60	5.7	72	4.9	132	5.2	
	Gondar	127	12.1	105	7.1	232	9.2	
	Bahir Dar	205	19.5	141	9.5	346	13.7	
	Jimma	41	3.9	81	5.5	122	4.8	
	Harar	25	2.4	86	5.8	111	4.4	
	Dire Dawa	93	8.8	105	7.1	198	7.8	
	Mekele	60	5.7	62	4.2	122	4.8	
	Jigjiga	22	2.1	71	4.8	93	3.7	
	Total	1052	100.0	1480	100.0	2532	100.0	
Time (year)	2005	500	47.5	552	37.3	1052	41.5	(58.9, 0.001*)
	2007	399	37.9	531	35.9	930	36.7	
	2009	153	14.5	397	26.8	550	21.7	
	Total	1052	100.0	1480	100.0	2532	100.0	

HSV-2, herpes simplex virus type 2.
* Pearson Chi-square statistic is significant at the 0.05 level.

Table 3
Multiple logistic regression analysis of socio-demographic (age), study sites/residence, and time (years) variables associated with HSV-2 prevalence among pregnant women in 12 cities in Ethiopia from 2005 to 2009.

Response variables		SE	*p*-Value	AOR	95% CI	
					Lower	Upper
Age of the respondent (years)	15–24 (Ref.)			1		
	25–34	0.26	0.00	2.98	1.80	4.92
	34–44	0.26	0.01	1.93	1.17	3.20
Region/geographic area/residence place	Addis Ababa (Ref.)		0.00	1.00		
	Gondar	0.24	0.00	0.28	0.18	0.45
	Bahir Dar	0.23	0.00	0.49	0.31	0.77
	Jimma	0.23	0.18	0.74	0.47	1.15
	Harar	0.23	0.00	0.46	0.29	0.72
	Dire Dawa	0.24	0.01	0.51	0.32	0.82
	Mekele	0.16	0.00	0.32	0.23	0.43
	Jigjiga	0.24	0.17	0.72	0.45	1.15
	Gambela	0.30	0.03	1.94	1.08	3.50
	Asosa	0.20	0.00	0.53	0.36	0.78
	Adama	0.23	0.00	0.49	0.31	0.77
	Hawassa	0.35	0.03	2.11	1.07	4.17
Year of enrolment	2005 (Ref.)		0.00	1.00		
	2007	0.13	0.00	2.90	2.24	3.76
	2009	0.12	0.00	2.41	1.89	3.08
	Constant	0.26	0.30	0.76		

HSV-2, herpes simplex virus type 2; SE, standard error; AOR, adjusted odds ratio; CI, confidence interval.

infected with HBV by 2014. Studies done in pregnant women in different geographical locations in Ethiopia (Tiruneh, 2008; Desalegn et al., 2016; Zenebe et al., 2014; WHO, 2015) have reported 3.8–7.3% seroprevalence of HBV infection. In particular, Duncan et al., in 1997, reported 40% of HBV prevalence in family planning clinic attendees in Addis Ababa. In summary, the results and the findings of other studies done in Ethiopia have shown a high intermediate endemicity level of HBV infection (5–7%) in Ethiopia, which is in line with the 2015 World Health Organization report (Endris et al., 2015).

HBV infection can be either acute or chronic, and may range from asymptomatic infection or mild disease to severe or rarely fulminant hepatitis. In this study, although no further laboratory or clinical investigations were done to categorize the study participants, a substantial HBV disease burden may result from acute and chronic infection acquired by older children, adolescents, and adults (Endris et al., 2015). Nonetheless, according to EDHS-2016, 38.5% of children (age 12–23 months) had received all basic vaccinations (EDHS, 2016). Therefore, although no testing for isolated hepatitis B surface antibodies (anti-HBs) was done, which is an indicator of vaccine-mediated immunity, the higher seroprevalence observed in this study could be attributed to previous HBV vaccination.

Concurrent or sequential infection with HBV and HIV usually results in more severe and progressive liver disease, and a higher incidence of cirrhosis, hepatocellular carcinoma, and mortality.

The national HBV and HIV co-infection observed in this study in 2014 (12.1%), was higher than that reported from Southern Ethiopia (0.6%) (Tiruneh, 2008), but lower than the prevalence in pregnant women reported from Northwest Ethiopia (19.0%) (WHO, 2015).

Syphilis in pregnant women causes severe congenital infection, which results in fetal/neonatal death (50%), prematurity (25%), and major long-term sequelae in surviving children (20%) (Charlier et al., 2015). In this study, the national syphilis prevalence in pregnant women in 2014 was 1.1% (1.3% rural and 0.7% urban). Other studies done in different geographical locations in Ethiopia have shown higher syphilis prevalence in pregnant women at 2.3% (Desalegn et al., 2016), 2.9% (Anjulo et al., 2016), and 39% (Kebede et al., 2004). Therefore, despite there being a continuous decline in syphilis infection in Ethiopia over time (Figure 1C), there remains a need to strengthen the ANC service delivery (diagnosis, care, and treatment of syphilis) to prevent and control the syphilis epidemic in Ethiopia.

Studies have reported adverse pregnancy outcomes such as IUGR, pre-term birth, and caesarean delivery in HIV-infected women (Violari et al., 2008). Thus, although the prevalence of HIV in pregnant women declined by 50% from 2005 (10.5%) to 2014 (5.5%) (Figure 1A), the study findings suggest the need for particular HIV service delivery to women in Ethiopia. Further studies are needed to determine the effect of HIV infection on pregnant women, child birth, and caesarean delivery in Ethiopia.

GUD in pregnancy, which is most commonly caused by HSV-2, causes significant maternal and neonatal morbidity. In this study, HSV-2 prevalence in pregnant women in the urban settings declined by >50% from 2005 to 2009 (Figure 1D). Other studies done in Ethiopia have reported 40.9% (Stephenson-Famy and Gardella, 2014) and 32.1% (Anjulo et al., 2016) seroprevalence of HSV-2. The heterogeneous but higher HSV-2 infection in pregnant women in Ethiopia suggests the need to strengthen the STI prevention and control mechanism in Ethiopia.

Limitations of the study

The fact that HSV-2 serological tests for HSV-2 were performed on stored samples from the years 2004–2009 but not from the years 2004–2014, even though testing was performed for these years for HIV, syphilis, and HBV, is a limitation of this study. This resulted from a shortage of HSV-2 test kits.

Conclusions and recommendations

Despite there being a significant decline in the prevalence of the four major STIs (HIV, HSV-2, HBV, and syphilis) in Ethiopia, the heterogeneity and the higher level in the prevalence of the major STIs by 2014 across the health facilities in the major cities of Ethiopia, suggest the need to strengthen the screening of and targeted interventions for STIs in pregnant women. There was higher prevalence of HSV-2 in the older age group (35–45 years), and age category, study sites/residence, and time/years were associated with a positive HSV-2 test result. Further investigations are required to identify factors associated with the epidemiology (higher prevalence of the STIs), synergetic interaction of the STIs that might aggravate disease progression of one by the other, and clinical implications of combined infections (HIV, HBV, HSV-2, and syphilis) in pregnant women.

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Ethical approval

The study was approved by the Scientific and Ethics Review Office (SERO) of the Ethiopian Public Health Institute (EPHI).

Conflict of interest

The authors have no conflicts of interest to disclose.

Author contributions

DK conducted the primary analysis and authored the manuscript draft; GG, AA, GM, YB, MD, and AG performed laboratory tests; YA supervised and supported the data analysis and manuscript writing; all authors reviewed and approved the manuscript.

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