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# Trends of HIV testing among sexually active young females in Ethiopia: a multivariable decomposition analysis of 2005-2016 EDHS

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## Abstract

**Introduction:** Even though HIV testing and care is highly targeted in different strategies in Ethiopia, most sexually active young females do not know their HIV status. Moreover, prior trend analysis has not been conducted among sexually active young females in Ethiopia. Therefore, this study aimed to assess the trend and determinants of HIV testing change among sexually active young females in Ethiopia.

**Material and methods:** The current study utilized three consecutive Ethiopia Demographic and Health Survey (EDHS) datasets. A total of 1,201.9, 3,094, and 2,864.7 sexually active female youths were included in 2005, 2011, and 2016 EDHS surveys, respectively. Data were analyzed using Stata version 14.0. Logit-based decomposition analysis was performed to identify contributing factors for HIV testing change, and statistical significance was determined with p-value.

**Results:** The trend of HIV testing increased from 7% in 2005 to 52.5% in 2016 EDHS. The analysis revealed that 19% of the overall change in HIV testing was due to the change in female youths composition. Changes in the composition of young females according to region, age, economic status, age of sexual initiation, and comprehensive HIV/ AIDS knowledge were the major sources of the change. Greater than 80% of the increase in HIV testing was due to differences in coefficient. The change in behaviors of married youths and early starting of sex life were the contributing factors to change of HIV testing over the last decade.

**Conclusions:** Change of HIV testing among sexually active female youths increased in the last 10 years in Ethiopia. However, in order to achieve the HIV-related targets in the country, programmatic interventions targeting uneducated women is needed.

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**Key words:** Ethiopia, HIV testing, trend, female youths, decomposition.

## Introduction

Human immunodeficiency virus (HIV)/acquired immunodeficiency syndrome (AIDS) is a significant public health concern throughout the world [1-3], and developing countries are disproportionally affected by the epidemic [4]. The prevalence of the virus has declined in the last 10 years, but the change is insignificant among young individuals in high-burden countries, especially for adolescent girls and young women [5]. Globally, youths between 15 and 24 years still account for over 30% of HIV new infections each year [6, 7].

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Young people are exposed to HIV due to mother-to-child transmission during childhood, as a result of their sexual behaviors, and gender disparities during adolescence [8-10]. Young women and girls aged 15 to 24 years are mostly affected by HIV because of economic, cultural, and social disparities in the society [11-14].

In Ethiopia, the nationwide HIV prevalence in 2017 was 1.16% [15], and there were an estimated 613,000 people living with HIV, of whom 62 percent were females [16]. The incidence of HIV infections is high among Ethiopian youth, but only 76.9% of HIV-positive females in reproductive age group know their HIV status [15]. In Ethiopia, youths are among the key populations disproportionately affected by HIV/AIDS [17, 18]. In Ethiopia, adolescents represent more than 50% of the population [16], but most of them are unaware of their HIV status [19].

HIV testing is critical, and is the first step in identifying and linking HIV-infected people into the treatment and care cascade. It is essential to provide behavioral change communication for HIV-negative individuals to prevent further infections [20]. It is also important to achieve the 2014 Joint United Nations Program on HIV/AIDS estimates [2].

In Ethiopia, the prevalence of HIV testing among adolescent is low (range, 25-48%) [21-25]. Studies indicated that youths in the richest household wealth quintile [21, 22, 26], being educated or in school [18, 22, 25, 26], being urban dweller [18, 22, 25, 26], being in late youth [23, 25], visiting health facility [23, 25], taking alcohol [23, 25], being married or sexually active [22, 23, 25], and using Internet [23] were important factors associated with HIV testing among young females in Ethiopia. However, the above-mentioned studies were done in local areas with small sample sizes, irrespective of participants' sexual status, and none of them addressed the change of HIV testing status of sexually active youths in Ethiopia. In particular, prior trend analysis has not been conducted in Ethiopia. Therefore, the current study aimed to assess the trend and determinants of HIV testing change among sexually active youths in Ethiopia by using the 2005 and 2016 Ethiopian Demographic and Health Survey data. Identifying the contributing factors to the changes in HIV testing among sexually active adolescents would help to improve youth's acceptance of HIV testing to reduce vertical HIV transmission. The increasing trend in acceptance of HIV testing could be due to the current changes in population composition, including age structure, access to health facility, urbanization, educational status, and other development activities as well as changes in HIV test acceptance behavior. Therefore, recognition of the source of change is important to achieve different national and international HIV-related policies and goals.

## Material and methods

### Data source and study area

Data for this study were accessed from the DHS program official database. DHS collects data through nationally representative cross-sectional surveys in over 40 developing countries. The survey is usually conducted once a year in a country. Ethiopia has undertaken four consecutive DHS surveys, in 2000, 2005, 2011, and 2016, and Ethiopian DHS was planned to obtain estimates from 11 regional states (9 regions and 2 city administrations). In the present study, data were restricted to sexually active youths aged 15-24 years. Based on these criteria, sample sizes from three Ethiopian Demographic and Health Surveys (EDHS) were 1,201.9 (weighted cases) youths in 2005, 3,094 (weighted cases) in 2011, and 2,864.7 (weighted cases) in 2016 (Figure 1).

### Variable measurement

Dependent variable HIV testing was classified dichotomously as 'yes/ no'. Female youths level less than 11 g/dl after

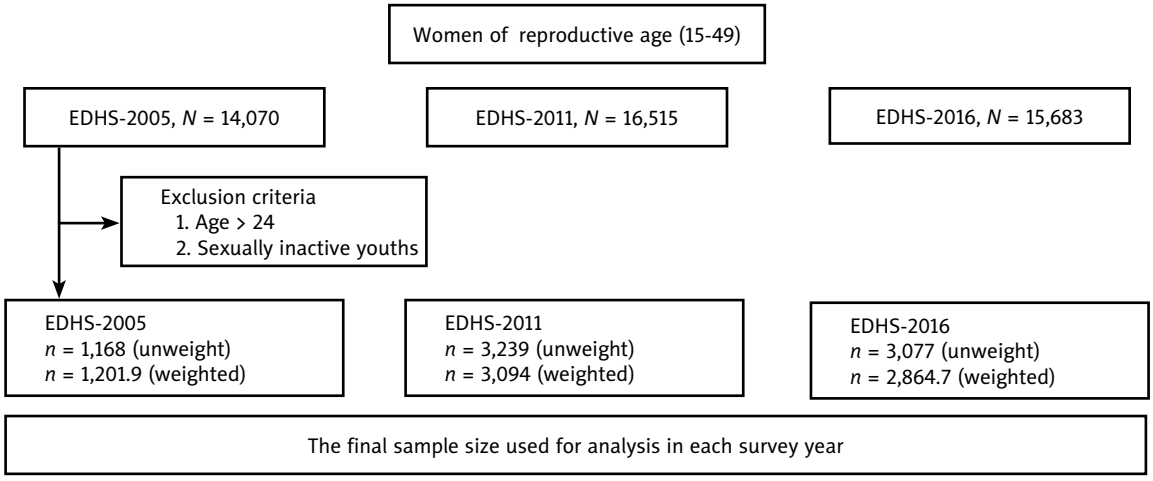


**Figure 1.** Exclusion procedures to identify the final sample size in 2005, 2011, and 2016 DHSs

adjusted for sea level were categorized as those who had ever taken HIV testing as 'yes', otherwise as 'no'. Independent variables were socio-demographics, reproductive history, and HIV-related knowledge.

## Statistical analysis

The study employed trend analysis of taking HIV test among youths and decomposition of changes in HIV testing. The trend was examined separately for the periods of 2005-2011, 2011-2016, and 2005-2016. Multivariable decomposition analysis of change in HIV testing was applied to answer the major research question of the present study. The analysis was a regression decomposition of the difference in taking HIV test between two surveys (the 2005 and 2016 EDHS data). Both changes in population composition and population behavior related to taking HIV test (effect) were important. The technique used output from logit regression model to divide the observed difference in HIV testing in two components. This difference could be attributed to compositional changes between surveys (i.e., differences in characteristics), and to changes in effects of the selected explanatory variables (i.e., differences in coefficients due to changes in population behavior). Therefore, the observed difference in taking HIV test between different surveys was additively divided into a characteristic (or endowments) component and a coefficient (or effects of characteristics) component. Stata version 14 was employed for data management and analyses, and Stata commands were applied during the process of analysis. All calculations presented in this paper were weighted for the sampling probabilities and non-response using the weighting factor included in EDHS data. During testing of statistical significance or associations (95% confidence interval calculations), complex sampling procedures were considered. The process was done by using svy Stata's command to control the clustering effect of complex sampling (stratification and multistage sampling procedures).

## Ethical considerations

Data were accessed from CSA by sending a request through a web site www.measuredhs.com. Then, authorization letter was received from CSA to download EDHS datasets. Data were used only for this study, and it was not shared with other researchers. All data were treated as confidential, and no personal or household identifications were used in the survey. The detailed information on ethical issues was published within the EDHS report [17].

## Characteristics of the study population

Table 1 present characteristics of the respondents (sexually active females aged 15-24 years) over the three EDHSs periods. Among the respondents, about seven out of ten in all three surveys were aged 20-24 years. In terms of residence,

**Table 1.** Percentage distribution of socio-demographic characteristics decomposition in 2005, 2011, and 2016 Ethiopia Demographic and Health Surveys

| Factor | 2005 (%) | 2011 (%) | 2016 (%) |
|---|---|---|---|
| Age (years) | | | |
| 15-19 | 33.97 | 31.37 | 29.04 |
| 20-24 | 66.03 | 68.63 | 70.96 |
| Place of residence | | | |
| Urban | 16.23 | 20.98 | 17.40 |
| Rural | 83.77 | 79.02 | 82.60 |
| Wealth index | | | |
| Poorest | 16.88 | 19.60 | 20.79 |
| Poorer | 21.79 | 19.51 | 21.10 |
| Middle | 21.00 | 18.89 | 19.35 |
| Richer | 16.25 | 17.52 | 17.09 |
| Richest | 24.08 | 24.48 | 21.67 |
| Education level | | | |
| No education | 64.07 | 45.00 | 31.42 |
| Primary | 25.48 | 42.03 | 50.59 |
| Secondary | 9.61 | 7.41 | 12.57 |
| Higher | 0.84 | 5.57 | 5.42 |
| Marital status | | | |
| Single | 5.23 | 7.30 | 8.03 |
| Married | 82.37 | 81.04 | 80.06 |
| Widowed | 12.40 | 11.66 | 11.91 |
| Number of sexual partners | | | |
| 1 | 83.95 | 85.73 | 86.16 |
| 2 and above | 16.05 | 14.27 | 13.84 |
| Region of residence | | | |
| Developing | 3.25 | 5.42 | 6.23 |
| Developed | 96.75 | 94.58 | 93.77 |
| Listening radio | | | |
| No | 53.36 | 42.26 | 67.64 |
| Yes | 46.64 | 57.74 | 32.36 |
| Watching television | | | |
| No | 81.84 | 58.20 | 74.67 |
| Yes | 18.16 | 41.80 | 25.33 |
| Age of sexual initiation | | | |
| ≤ 18 | 85.27 | 79.50 | 82.17 |
| > 18 | 14.73 | 20.50 | 17.83 |
| Visiting health facility | | | |
| No | 69.94 | 61.20 | 49.35 |
| Yes | 30.06 | 38.79 | 50.65 |
| History of abortion | | | |
| No | 94.07 | 94.58 | 94.67 |
| Yes | 5.93 | 5.42 | 5.33 |
| HIV comprehensive knowledge | | | |
| No | 76.11 | 72.71 | 72.39 |
| Yes | 23.89 | 27.29 | 27.61 |

16.23% of the respondents in 2005, 20.98% in 2011, and 17.40% in 2016 were resided in urban areas. With regard to educational status, 64.07% of the respondents in 2005, 45.0% in 2011, and 31.42% in 2016 were not educated. The proportion with primary education increased from 25.48% in 2005 to 50.59% in 2016. About eight from ten of the respondents were married in the three EDHSs.

The proportion of the participants from developing regions were double in the last 15 years. The proportion of female youths listing radio increased from 46.64% in 2005 EDHS to 57.74% in 2011 EDHS, and decrease to 32.36% in 2016 EDHS. More than 80% of the respondents started sex before they celebrated their 18th birthday in all EDHSs. Termination of abortion was about 5% in three data sets. Almost one quarter of the respondents had HIV/AIDS comprehensive knowledge over the three EDHS periods.

## Trend of HIV testing among female youths

The trend of HIV testing among sexually active youths in Ethiopia increased significantly from 7.23% in 2005 to 46.21% in 2016, and to 52.5% in 2016. Overall, HIV testing among sexually active young females in Ethiopia increased by 45.27% in the last 15 years (Figure 2).

As shown in Table 2, the trend was divided into two phases, 2005 to 2011 and 2011 to 2016, with the overall phase from 2005 to 2016. Higher change was observed in phase one (2005-2011) with 39% when compared with 6.3% change in the second phase (2011-2016).

The trend increased significantly (more than 26%) in all socio-demographic and reproductive history characteristics from 2005 to 2011. The trend of HIV testing among youth females increased by 56.15% in urban residence in phase 1. The trend increased in all age groups by 41.21% and 34% among 20-24 and 15-19 years youths, respectively. Similarly, the trend increased in all wealth index groups. There was 58.35% change in the richest wealth index group; the change was 44.84% among singles and 46.01% among youths having more than one sexual partner. Also, the change was high among youths in developing regions (30.22%), visiting health facility with one year of survey (53.75%), starting sexual life at later age (46.95%), and having comprehensive HIV/AIDS knowledge (56.97%).

The change was positive in most of the respondents characteristics in the second phase (2011-2016). However, the change was negative in some variables, including single status, starting sex life in late age, and attending primary school and above. In this phase, high changes were observed in developed nations (35.14%), having more than one sexual partner (17.49%), and no listing to the radio (13.18%). There was a significant change in HIV testing among sexually active young females in the last 15 years. The highest and lowest changes were seen among developed region (74.69%) and poorest wealth index (27.41%), respectively.

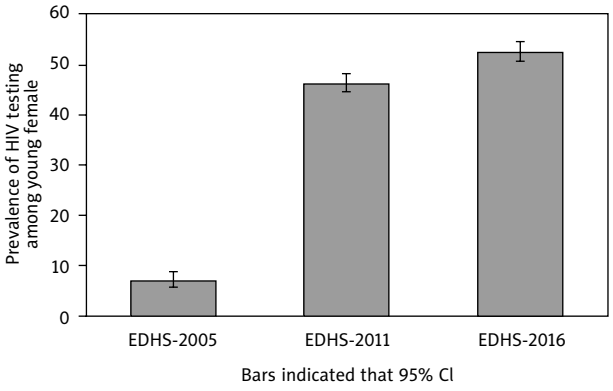


**Figure 2.** Trends in HIV testing among sexually active young females in Ethiopia in the past 10 years, Ethiopia Demographic and Health Surveys 2005-2016

## Decomposition analysis

In the decomposition analysis model, the differences in characteristics (compositional factors) and the differences due to the effect of characteristics were considered. As shown in Table 3, the analysis revealed that about 19% of the overall percentage change in HIV testing among sexually active youths was due to differences in characteristics (compositional factors). Among the compositional factors, a significant contribution to the positive change in HIV testing was associated with youths' education. A decrease in the composition of not educated youths over the survey period showed a significant contribution to the change in HIV testing among the study participants. In other words, increasing the composition of youths in primary and above education contributed to change in HIV testing. Similarly, decreasing the proportion of females youth, who were not visiting health facility (increasing the proportion of youths who were visiting health facility) had positive change in taking HIV test among these population. Even though the compositional change was small, having HIV/AIDS comprehensive knowledge contributed for change in HIV testing. A decreasing proportion of youths, who resided in the richest, poorer, and middle households showed a significant negative impact on HIV testing. On the other hand, an increasing proportion of youths resided in richer household of the sample was associated with a significant contribution to the increase of percentage in HIV testing. Although compositional changes were too small, a decreasing in the composition of married youths demonstrated a statistically significant negative impact on HIV testing change.

After controlling for the role of compositional changes, about 81% of the increase in HIV testing among sexually active young females was due to the difference in the effects of characteristics. Factors, including age of sexual initiation and marital status showed a significant effect for the observed positive change in HIV testing. In other things, such as being equal, about one-fourth of the increase in HIV testing in the past decade was due to a change in taking HIV testing behavior of youths who initiated sex before 18 years

**Table 2.** Trend in HIV testing among sexually active young Ethiopian females according to selected characteristics in 2005, 2011, and 2016 Ethiopia Demographic and Health Surveys

| Factor | 2005 | 2011 | 2016 | Phase I (2005-2011) | Phase II (2011-2016) | Overall phase (2005-2016) |
|---|---|---|---|---|---|---|
| Age (years) | | | | | | |
| 15-19 | 6.49 | 40.49 | 44.71 | 34.00 | 4.22 | 38.22 |
| 20-24 | 7.61 | 48.82 | 55.69 | 41.21 | 6.87 | 48.08 |
| Place of residence | | | | | | |
| Urban | 25.02 | 81.17 | 82.03 | 56.15 | 0.86 | 57.01 |
| Rural | 3.79 | 36.93 | 46.28 | 33.14 | 9.35 | 42.49 |
| Wealth index | | | | | | |
| Poorest | 0.03 | 25.31 | 27.44 | 25.28 | 2.13 | 27.41 |
| Poorer | 2.86 | 31.11 | 44.94 | 28.25 | 13.83 | 42.08 |
| Middle | 2.43 | 35.29 | 48.12 | 32.86 | 12.83 | 45.69 |
| Richer | 6.91 | 52.41 | 61.27 | 45.50 | 8.86 | 54.36 |
| Richest | 20.63 | 78.98 | 80.89 | 58.35 | 1.91 | 60.26 |
| Education level | | | | | | |
| No education | 2.32 | 24.34 | 31.18 | 22.02 | 6.84 | 28.86 |
| Primary | 9.31 | 57.37 | 55.30 | 48.06 | -2.07 | 45.99 |
| Secondary | 30.68 | 82.50 | 80.51 | 51.82 | -1.99 | 49.83 |
| Higher | 50.08 | 90.54 | 85.00 | 40.46 | -5.54 | 34.92 |
| Marital status | | | | | | |
| Single | 29.47 | 74.31 | 61.40 | 44.84 | -12.91 | 31.93 |
| Married | 6.05 | 43.58 | 51.39 | 37.53 | 7.81 | 45.34 |
| Widowed | 5.67 | 46.88 | 53.95 | 41.21 | 7.07 | 48.28 |
| Number of sexual partners | | | | | | |
| 1 | 7.52 | 45.29 | 49.81 | 37.77 | 4.52 | 42.29 |
| 2 and above | 5.74 | 51.75 | 69.24 | 46.01 | 17.49 | 63.50 |
| Region of residence | | | | | | |
| Developing | 4.09 | 34.31 | 46.28 | 30.22 | 11.97 | 42.19 |
| Developed | 7.34 | 46.89 | 82.03 | 39.55 | 35.14 | 74.69 |
| Listening to radio | | | | | | |
| No | 3.11 | 32.28 | 45.46 | 29.17 | 13.18 | 42.35 |
| Yes | 11.95 | 56.41 | 67.21 | 44.46 | 10.80 | 55.26 |
| Watching television | | | | | | |
| No | 3.50 | 31.70 | 44.22 | 28.20 | 12.52 | 40.72 |
| Yes | 24.02 | 66.43 | 76.91 | 42.41 | 10.48 | 52.89 |
| Age of sexual initiation | | | | | | |
| ≤ 18 | 5.64 | 41.78 | 50.94 | 36.14 | 9.16 | 45.30 |
| > 18 | 16.45 | 63.40 | 59.68 | 46.95 | -3.72 | 43.23 |
| Visiting health facility within the last 12 month | | | | | | |
| No | 6.01 | 35.06 | 41.09 | 29.05 | 6.03 | 35.08 |
| Yes | 10.06 | 63.81 | 63.62 | 53.75 | -0.19 | 53.56 |
| History of abortion | | | | | | |
| No | 7.25 | 46.86 | 53.17 | 39.61 | 6.31 | 45.92 |
| Yes | 6.99 | 34.89 | 40.50 | 27.90 | 5.61 | 33.51 |
| HIV comprehensive knowledge | | | | | | |
| No | 5.61 | 37.52 | 45.08 | 31.91 | 7.56 | 39.47 |
| Yes | 12.41 | 69.38 | 71.96 | 56.97 | 2.58 | 59.55 |

**Table 3.** Characteristics of change in taking HIV test among sexually active young females in Ethiopia in 2005 to 2016

| Factor | Difference due to characteristics (E) | | | Difference due to coefficients (C) | | |
|---|---|---|---|---|---|---|
| | Coefficient | Percentage | *p*-value | Coefficient | Percentage | *p*-value |
| Age (years) | | | | | | |
| 15-19 | 0.0042838 | 0.94631 | 0.007 | –0.027915 | -6.1665 | 0.034 |
| 20-24 | 1 | | | | | |
| Place of residence | | | | | | |
| Urban | 0.0006169 | 0.13627 | 0.409 | –0.0014641 | –0.32343 | 0.868 |
| Rural | 1 | | | | | |
| Wealth index | | | | | | |
| Poorest | 1 | | | | | |
| Poorer | –0.00072796 | –0.16081 | 0.012 | –0.092886 | –20.519 | 0.000 |
| Middle | –0.0018682 | –0.41269 | 0.007 | –0.084034 | –18.563 | 0.000 |
| Richer | 0.0015339 | 0.33884 | 0.000 | –0.0741 | –16.369 | 0.000 |
| Richest | –0.0056572 | –1.2497 | 0.000 | –0.10375 | –22.919 | 0.000 |
| Education level | | | | | | |
| No education | 0.094905 | 20.965 | 0.001 | 0.04576 | 10.108 | 0.467 |
| Primary | –0.0356 | –7.8641 | 0.085 | 0.0099394 | 2.1956 | 0.655 |
| Secondary | 0.00043047 | 0.095091 | 0.874 | 0.0065913 | 1.456 | 0.426 |
| Higher | 1 | | | | | |
| Marital status | | | | | | |
| Single | 1 | | | | | |
| Married | –0.0026163 | –0.57794 | 0.046 | 0.088001 | 19.440 | 0.038 |
| Widowed | –0.00066532 | –0.14697 | 0.040 | 0.015898 | 3.5118 | 0.047 |
| Lifetime sexual partners | | | | | | |
| 1 | –0.0039006 | –0.86166 | 0.000 | –0.061899 | –13.674 | 0.132 |
| 2 and above | | | | | | |
| Region of residence | | | | | | |
| Developing | –0.0023857 | –0.52701 | 0.004 | 0.00056318 | 0.12441 | 0.713 |
| Developed | 1 | | | | | |
| Listening to radio | | | | | | |
| No | –0.004007 | –0.88516 | 0.391 | –0.026578 | –5.8712 | 0.319 |
| Yes | 1 | | | | | |
| Watching television | | | | | | |
| No | 0.0071994 | 1.5903 | 0.011 | 0.021855 | 4.8279 | 0.589 |
| Yes | 1 | | | | | |
| Age of sexual initiation | | | | | | |
| ≤ 18 | –0.0022894 | –0.50574 | 0.065 | 0.10802 | 23.863 | 0.002 |
| > 18 | | | | | | |
| Visiting health facility | | | | | | |
| No | 0.031029 | 6.8544 | 0.000 | –0.020243 | –4.4718 | 0.402 |
| Yes | 1 | | | | | |
| History of abortion | | | | | | |
| No | 0.00083355 | 0.18413 | 0.023 | 0.11137 | 24.603 | 0.193 |
| Yes | | | | | | |
| HIV comprehensive knowledge | | | | | | |
| No | 0.0049311 | 1.0893 | 0.000 | –0.054757 | –12.096 | 0.053 |
| Yes | 1 | | | | | |
| Overall | 0.086045 | 19.007 | 0.000 | 0.36665 | 80.993 | 0.000 |

old. Similarly, about one-fifth of increasing HIV testing during the last ten years was due to the change in behavior of married youths towards HIV testing.

Factors, including wealth of the household and age of the respondent demonstrated a significant contribution to the observed negative change in HIV testing. As compared with poorer household residents, other household residents, especially the richest ones, showed a significant negative contribution to the observed percentage change in HIV testing among sexually active young females over the decade.

## Discussion

The aim of the current study was to examine the trends and major factors positively or negatively contributing to the changes in HIV testing among young Ethiopian females in the past 10 years. HIV testing and counseling is important for teenagers, because of their risky sexual behaviors [27-30]. Moreover, HIV testing is the first step to take further preventive activities, or having HIV/ AIDS treatment and care in line with test result [31, 32].

HIV testing among young females increased substantially over the last decade, particularly in the first survey period of 2005–2011. This may be attributed to rigorous HIV testing and counseling programs implemented by the government and NGOs, through the improvement in healthcare infrastructure and governments' attention to meeting MDG goals with health sector development strategies [33]. The Ethiopian government has launched adolescent reproductive health policy during this phase. Youth-friendly services are expanded in governmental health facilities and non-governmental organizations, such as family guidance association of Ethiopia across the country [34, 35]. About a fourth of the overall change in HIV testing by sexually active female youths was due to the difference in characteristics. Population structure change in terms of education, wealth, and residence, which affects uptake of HIV/AIDS [36, 37]. This implies that a significant contribution of the change arises when the composition of the population changes according to important variables. An increase in the composition of young females achievement of primary and above education showed a significant positive effect on HIV testing. Universal education is of priority in Ethiopia, including education among females. Education is important for obtaining HIV/AIDS information, early diagnosis, and treatment as well as for further prevention [38, 39]. Therefore, the proportion of educated teen females is expected to rise and to continue having an impact on HIV/AIDS testing in the future, in line with the 90-90-90 HIV/AIDS program [40, 41].

Compositional changes by categories of household wealth index were associated negatively and positively with the trend of HIV/AIDS testing. A decreased proportion of youths, who resided in richest, poorer, and middle households (those taking HIV testing more often than youths residing in poorest household) negatively affected the trends in HIV testing prevalence, and an increasing proportion of youths residing in rich households, who take HIV testing more often than youths living in poorest households, had a positive effect on the trend of HIV testing among female youths. The finding implies changing in the structure of the population in terms of wealth enhancing the utilization of HIV testing among young females [42, 43].

A decreased proportion of youths, who were married negatively affected the trends in HIV testing prevalence. This might be due to HIV testing done for couples before marriage. Decreasing the proportion of having multiple sexual partners negatively affected the trend of HIV testing. It might justify that high-risk population take regular HIV testing [44-47].

An increased proportion of youths, who are watching television have a positive effect on HIV testing. Accessing information through different mass media, including television, is important to take preventive measures on HIV/ AIDS [48-50]. Similarly, increasing the proportion of youths, who have comprehensive HIV/ AIDS knowledge and visiting health facilities within 12 month of the survey, increased the uptake of HIV testing in the last decade. When youths visit health facilities, they might get information about the importance of HIV testing from health professionals and take the test [25, 47, 51]. Comprehensive knowledge has positive effect on HIV testing [39, 52, 53].

After controlling the effect of compositional factors, about four-fifth of the change in HIV testing uptake among sexually active young females over the past decade was due to difference in the effects of characteristics (coefficients). This finding is in line with a study in South Africa, where most of the increase in HIV testing was found to be due to change in coefficients [54].

The most important finding from the analysis was the effect of time of sexual initiation. Although, the prevalence of HIV testing was high (60%) in those who started sex life late than those who started sex life early (51%); about a fourth of the increase in HIV testing among sexually active youths in the past decade was due to changes in HIV testing behaviors of youths, who started sex life before or at the age of 18 years. Accesses for HIV testing might be improved for such communities by governmental and non-governmental organizations through time, and friendly sexual reproductive health services are expanding in the country [35, 55-57].

The behavioral change of youths, who resided in better wealth index households decreased the overall change of HIV testing. This needs further analysis, especially that studies evaluating the effect of wealth status on behavioral change of HIV testing in youth age groups are lacking.

Changing the behavior of married women towards HIV testing contribute to about 20% of HIV testing in the last decade. Married women might get the opportunity for initiating testing and counseling during marriage, pregnancy, delivery, post-partum, and contraception usage times.

Behavioral changes of youths negatively affected the trend of HIV testing. This might be due to accessing of ART and other interventions, since HIV-related misconceptions are prevalent in the country [58, 59]. The level of

change in comprehensive knowledge was low in young females in the last decade.

Even though the present study utilized large datasets and considered sampling weighing, it was not without limitation. As the three surveys were not conducted among the same participants, it was not real-time series analysis. In addition, the analysis included only variables recorded in all the surveys and included factors were not the only factors that could affect uptake of HIV testing among young sexually active females in Ethiopia.

## Conclusions

The trend of HIV testing significantly increased among sexually active young females over the last decade in Ethiopia. Both compositional factors and behavioral change contributed to the change of up taking HIV testing. Change in the composition of characteristics of the respondents according to region, economic status, age group, marital status, age of sexual initiation, educational status, and number of lifetime sexual partners as well as comprehensive HIV/AIDS knowledge, region, and watching television were the major sources of the change. The majority of increasing HIV testing was due to differences in the coefficient. Mostly, the change of behaviors of married women and those who started sex life early were the sources of the positive change. However, behavioral changes of household wealth index affected the trend negatively, and programmatic interventions targeting richer households, singles, and uneducated youths are still needed to increase HIV testing and to achieve the 90-90-90 targets in the country.

## Conflict of interest

The authors declare no conflict of interest.

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