Ethiopian Journal of Medical and Health Sciences
2021, Volume 1, Issue 1
https://journals.hu.edu.et/hu-journals/index.php/ejmhs

Open Access

Original Article

Health work force risk of exposure and factors associated with COVID-19 exposure in Addis Ababa, Ethiopia: A facility-based survey

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Abstract

Background: Health Work Force (HWF) risk of exposure to COVID-19 is expected to be higher than the general population. This study investigated the risk of exposure and associated factors among HWF in Addis Ababa, Ethiopia.

Method: A facility-based cross-sectional study was conducted at COVID-19 diagnostic and treatment centers found in Addis Ababa from September 20 – Oct. 10, 2020. Seven hundred thirty two HWF were included in the study. The samples were taken from each facility based on proportional allocation to the number of staff directly engaged in managing cases. Data were collected using questionnaire adapted from WHO and CDC tools. Descriptive statistics and logistic regression were conducted using SPSS version 24. Categorization of COVID-19 exposure risk was done based on WHO classification, into "High exposure risk" and "Low exposure risk" level.

Result: Four hundred forty (62.1%) of the health work force have high exposure risk level to COVID-19. The age group of 25 – 34 years had a higher risk of exposure (AOR: 1.697 [95% CI: 1.055, 2.729]) compared to age group 18-24, while working in outpatient department showed a decreased exposure risk (AOR; 0.385 [95% CI: 0.195, 0.760]).

Conclusion: Exposure risk to COVID-19 is high among HWF whereas non-adherence to infection prevention and control was observed. Infection prevention and control awareness creations are required from stakeholders.

Key words: COVID-19, health work force, exposure risk, infection prevention & control, adherence, Ethiopia

Introduction

Coronavirus disease 2019 (COVID-19) was reported in Wuhan, Hubei Province, China in December 31, 2019. The causative agent of the outbreak is known as Severe Acute Respiratory Syndrome-coronavirus$_2$ (SARS-CoV$_2$) (1). The virus is highly contagious with no drugs to date. Severity of the diseases ranges from asymptomatic to severe pneumonia and death(2).

The risk of accidental contamination among Health Work Force (HWF) can be minimized by following appropriate procedures for putting on (donning) and removing (doffing) personal protective equipment (PPE), and respiratory protection measures through appropriate use of PPE and strict follow up of infection prevention and control (IPC) measures (3–6). Appropriate PPE for HWF includes a medical mask, single use gloves, disposable gown, eye protection (visor or goggles), heavy duty gloves and boots or closed work shoes based on specific activities that will be performed (4–6).

Studies have indicated COVID-19 exposure was related to increased fears of COVID-19 and depression; depressive feelings increased with fear of COVID-19 (7). In Winnebago County, Wisconsin, perceived low severity of disease outcome; perceived responsibility to others; peer pressure; and exposure to misinformation, conflicting messages, or opposing views regarding masks were identified as factors associated with increased exposure risk among young adults in a study conducted Winnebago County, Wisconsin, March–July 2020 (8). Identifying factors that affect risk for COVID-19 exposure and framing education to target those factors could help the public to adhere to public health guidelines that prevent the spread of COVID-19.

COVID-19 spreads easily through person-to-person contact via droplet infections. Behavioral factors, wearing masks, social distancing, and avoiding large gatherings, are effective in preventing COVID-19. It is found that persons aged 18–24 years reported lower agreement with and adherence to public health guidance (e.g., wearing masks) compared to those aged ≥25 years (2).

In Ethiopia due to weak health system, the risk of HWF COVID-19 exposure is expected to be higher than in developed nations(9). Exposure risk level assessment is required to provide additional precautions, in terms of early detection and highly effective infection control and prevent transmission in the healthcare setting (5,6,10). There is limited data in resource-limited settings. To minimize the risk, there is a need for COVID-19 risk assessment and mitigation measures which will be used to develop or revise guidelines. This study assesses the level of risk of exposure of HWF categorized as high risk exposure and the determinants of risk of exposure.

Materials and Methods

Study design, setting and population

A facility-based cross-sectional study was conducted at Addis Ababa, the capital city of Ethiopia, COVID-19 treatment and diagnostic centers where confirmed COVID-19 cases were diagnosed treated and admitted. Previously a total of 29 treatment and 11 diagnostic centers had been providing a direct care for confirmed COVID 19 cases, while due to school re-opening, 8 facilities were closed during the data collection period. The study was among HWF working at the centers during the study period, from September 20 – Oct. 10, 2020. A total of 732 HWF from 32 facilities (22 COVID 19 treatment and 10 diagnostic centers) were involved in the study.

The source populations were HWF working at COVID-19 centers engaged in treating/managing and providing support to COVID-19 confirmed patients during the study period. Participants were selected based on the pre-set eligibility criteria: HWF working on or caring for COVID-19 patients, who had direct contact with laboratory specimen and materials/dispensing medication to COVID-19 patients.

Measurement

The instrument to guide this survey was questionnaire developed according to WHO's/CDC's guidelines to measure risk of exposure to COVID-19: family and travel exposure history, background information of the HWF (age, sex, sub-city, facility type, profession and department), date of first exposure, first exposure facility, first exposure type of facility, number of patient in first exposure facility, activities of HWF performed on COVID-19 patient/facility exposure history (provision of direct care to confirmed patient/specimen, face to face contact with patient, type of procedure, direct contact with patients environment and involvement in health care interaction.

The risk classification was done based on WHO classification into "high" or "low" (8). The exposure risk level for the HWF was considered as a "high risk" for COVID-19 virus infection if he/she did not respond "always, as recommended" during healthcare interaction with a confirmed COVID-19 patient to any of the following IPC measures (9 items): wearing of single-use gloves, medical masks, face shield or goggles/protective glasses, disposable gown, removing and replacing PPE according to protocol, performing hand hygiene (before and after touching a COVID-19 patient, after exposure to body fluids, after touching patient surroundings (bed, door handle, etc.) and decontaminating high touch surfaces at least 3 times daily. Otherwise, the risk of exposure was considered "low".

Sample size and sampling procedures

The source population of this study was health work force from those centers providing COVID-19 diagnostics and treatment in Addis Ababa. Among these, the study population was selected using systematic sampling based on the list of HWF obtained from the human resource departments of each facility. Every third person in the list list (k=3) was included in the survey. Proportional allocation of HWF to each facility, treatment and diagnostic centers was done. Proportional allocation of the sample size was done to select the required sample from each listed treatment and diagnosis center.

The sample size for the survey had been calculated based on the proportion taken from a study conducted in US in collaboration with CDC (CDC, 2020) in which the prevalence (P) in high exposure risk group was 67%. By using a single population proportion formula with assumption of proportion of 67%, 95% confidence interval (Margin of error=0.05) and 10% non-response, a sample size of 374 was calculated. We used samples from different sites; it was therefore adjusted for design effect of 2.0. Finally data were collected from **732** respondents.

Data collection tools and procedures

Data collection tool was questionnaire developed using various guidelines(WHO's/CDC's (11)) and adapted from previous studies (5,12). The questionnaire included: provision of direct care to a confirmed COVID-19 patient, face-to-face contact (within 1 meter) with a confirmed case. Health professionals (physician, nurses, midwives, health officers, or other medical professionals) were recruited and trained on appropriate data collection procedures. The training was conducted for two days on how to collect quality data aided by tablet (e-data collection) and how to fill in responses during

the interview process. Data processing teams (IT specialists and supervisors) were also engaged in the training.

The data collection instrument was prepared, reviewed, and pre-tested. The completeness and logical consistency of the data was checked and corrected at the spot during data collection. Several quality safeguards were incorporated into the data entry program: automatic skips where appropriate, range checks, coding checks, and others. After data is transferred to appropriate software, all questionnaires were reviewed again to ensure that the data entry is accurate.

Data collection template was developed using the open data kit (ODK) software and it was configured in Android tablet/smart phones for data collection. The collected data was sent to the Ethiopian Public Health Institute (EPHI) server on a daily basis and the quality was assured through supervision and monitoring each activity of the team during fieldwork and online monitoring.

Statistical analysis

Data analysis was done using SPSS, version 24. Descriptive statistics were done and results were presented in tables and graphs using summary measures such as percentages for all variables. Logistic regression was used to assess factors associated to the dependent variable. Binary logistic regression was done for each variable at 95% confidence level. Variables significantly associated with the dependent variables ($P<0.05$) were included in the final model multiple logistic regressions to obtain determinant factors of risk of exposure to COVID-19.

Results

Exposure history and background information of the HWF

Seven hundred thirty two participants working in 32 health facilities (COVID 19 treatment and diagnostic centers) were involved in this study. Of these, 23(3.1%) who showed community exposure either due to travel or from family were excluded from further analysis. Family exposures accounted for 15 (2%), while 14 (1.9%) had a history of traveling unprotected in close proximity (within 1 meter) in potentially infectious environment.

Majority of the study participants were from treatment centers (85.3%). Almost equal number of males and females participated in the study: males (50.6%) versus females (49.4%). Majority (70.1%) participants were in the age group of 25 – 34 years with age range of 18 to 57 (Table 1).

Nearly half of the HWF (51%) didn't remember their date of first exposure and most were exposed in treatment centers (83.4%). Majorities (77.9%) provide direct care to a confirmed COVID-19 patient or have contact with patient's laboratory specimen, whereas 20.7% had no direct contact with a confirmed patient. Most of the respondents (81.2%) had direct contact with the environment of patients like bed, linen, TV stand and so on. HWF not involved in other health care facility during the study period accounted for 77.4%, whereas involvement in other health care facility (public or private), ambulance, other diagnostic center, and home care comprised of 17.9, 3.1, 2 and 0.3 percent, respectively.

During interactions with COVID-19 patient or with patient's laboratory specimen, almost all (98.7%) of the HWF wore PPE regardless of frequency of use. The detailed HWF adherence to PPE and IPC is provided on Table 2.

Table 1: Background information of the Health Work Force (n=709)

Variable	Category	Number	Percent (%)
Type of current working health care facility	Treatment center	605	85.3
	Diagnostic center	104	14.7
Sex	Male	359	50.6
	Female	350	49.4
Age	18 – 24	101	14.2
	25 – 34	497	70.1
	35 – 44	98	13.8
	45 – 59	13	1.8
Type of health care facility *(more than one department possible)*	Outpatient	45	6.1
	Emergency	21	3
	Inpatient	361	50.7
	ICU	53	7.4
	Cleaning service	74	10.1
	Laboratory	127	17.3
	Pharmacy	19	2.6
	Ambulance	17	2.3
	Record room	4	0.5
Type of Profession	Medical doctors	77	10.9
	Specialist doctors	6	0.8
	Nurses (or equivalent)	225	31.7
	Health Officers	38	5.4
	Radiology /X-ray technician	9	1.3
	Respiratory therapist/ Anesthetist	5	0.7
	Physical therapist	10	1.4
	Midwife	18	2.5
	Pharmacy professional	33	4.7
	Laboratory personnel	122	17.2
	Patient transporter/ Ambulance driver	19	2.7
	Catering staff/ food preparation	8	1.1
	Cleaner/laundry	108	15.2
	Morgue Staff	7	1.0
	Others	24	3.4

Table 2: Frequency of IPC adherence of Health Work Force (n=709)

Variable	Category	Number	Percent (%)
Wear PPE During a health care interaction with a patient/laboratory specimen	Yes	700	98.7
	No	9	1.3
Frequency of PPE use (n=700):			
Single use glove	Always, as recommended	625	89.3
	Most of the time	32	4.6
	Occasionally	19	2.7
	Rarely	24	3.4
Medical mask	Always, as recommended	676	96.6
	Most of the time	17	2.4
	Occasionally	3	0.4
	Rarely	4	0.6
Face shield goggle or glass	Always, as recommended	595	85
	Most of the time	49	7
	Occasionally	19	2.7
	Rarely	37	5.3
Disposable gown	Always, as recommended	500	71.4
	Most of the time	29	4.1
	Occasionally	33	4.7
	Rarely	138	19.8
Remove and replace PPE according to protocol during a health care interaction with patient/laboratory specimen	Always, as recommended	607	85.6
	Most of the time	69	9.7
	Occasionally	15	2.1
	Rarely	18	2.5
Perform hand hygiene before and after touching patient/ laboratory specimen	Always, as recommended	550	77.6
	Most of the time	115	16.2
	Occasionally	25	3.5
	Rarely	19	2.7
Perform hand hygiene after body fluid exposure during a health care interaction with patient/specimen	Always, as recommended	594	83.8
	Most of the time	68	9.6
	Occasionally	17	2.4
	Rarely	30	4.2
Perform hand hygiene after touching patients' surrounding (bed, door handle-) regardless of wearing gloves during a health care interaction with patient/specimen	Always, as recommended	568	80.1
	Most of the time	89	12.6
	Occasionally	34	4.8
	Rarely	18	2.5
Decontaminating high-touch surfaces frequently (at least three times daily) during a health care interaction with the COVID-19 patient	Always, as recommended	481	67.8
	Most of the time	147	20.7
	Occasionally	48	6.8
	Rarely	33	4.7

Accidental contamination

In the course of a health care interaction with a COVID-19 patient or patient's laboratory specimen, 70(9.9%) of the study participants had accidental contamination with body fluid/respiratory secretions (see details in Figure 1).

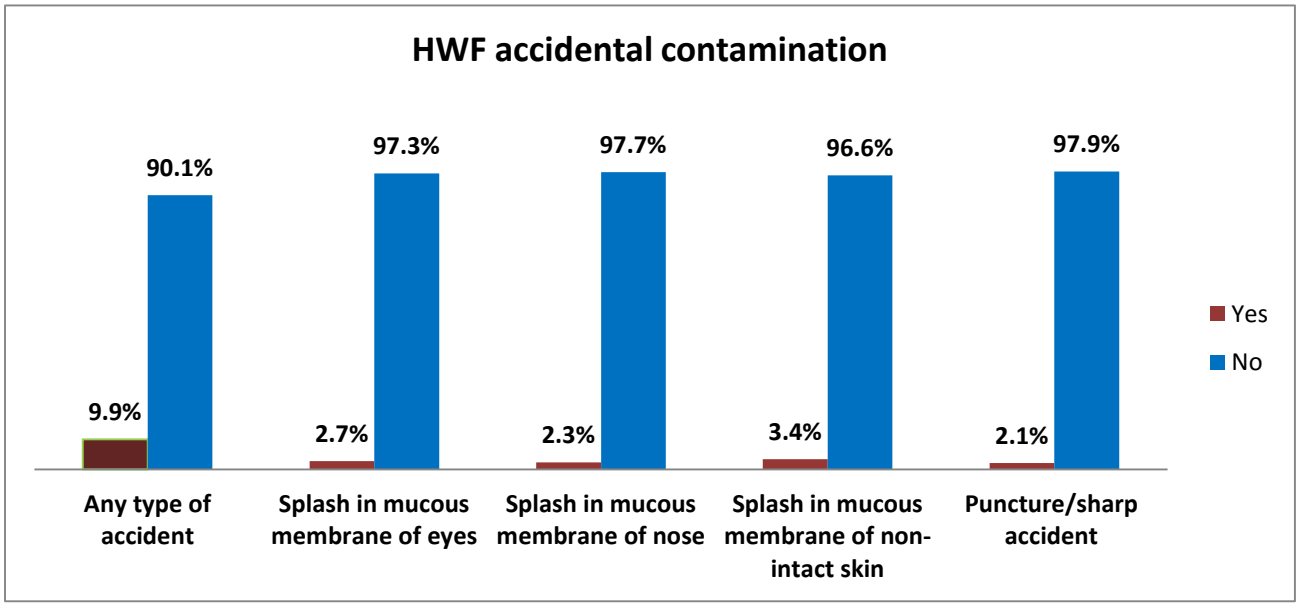

Figure 1**:** Accidental contamination on Health Work Force

Exposure status

Among a total of seven hundred nine HWF, 62.1% had "high exposure risk level" to COVID-19 while 37.9% had "low risk exposure". In multivariate logistic regression, two variables (age and department) showed significant association with the risk level to COVID-19. The age group of 25 – 34 years had shown a 1.7 times increased odds of high exposure (AOR, 1.697 [95% CI: 1.055, 2.729]), while working in outpatient department decreased the odds of exposure by 61% (AOR; 0.385 [95% CI: 0.195, 0.760]) (Table 3).

Discussion

This study addressed an imperative public health issue associated with the highly infectious COVID-19 and the safety of HWF, who are vital to healthcare provision. It responded to the immediate needs of more scientific evidence to protect HWF when providing care. To the best of our knowledge, this is the first of its kind to generate evidence on COVID-19 exposure risk in Ethiopia. The evidence will have paramount importance to stakeholders to improve the HWF working environment and reduce the risk of exposure. It has provided baseline information for researchers interested to generate new insights in the field of IPC efforts.

A considerable proportion of the HWF (62.1%) have high exposure risk level to COVID-19 as a result of poor adherence to IPC. This could be expected given their direct and persistent interaction with the amassed number of cases at the frontline and are facing a substantial risk of infection (13,14). This is much higher compared to the exposure risk reported from Ghana

Table 3: Determinants of Health Work Force COVID-19 exposure risk

Variables	High exposure risk n (%)	Low exposure risk n (%)	COR (95% CI)	AOR (95% CI)
Facility Type				
Treatment Center	384 (63.5)	221 (36.5)	1	
Diagnosis center	56 (53.8)	48 (46.2)	0.671 (0.441 , 1.021)	-
Sex of HWF				
Male	232 (64.6)	127 (35.4)	1	
Female	208 (59.4)	142 (40.6)	0.802 (0.592 , 1.087)	-
Age				
18 – 24	49 (48.5)	52 (51.5)	1	1
25 – 34	323 (65)	174 (35)	**1.970 (1.279 , 3.033)**	**1.697(1.055, 2.729)**
35 – 44	62 (63.3)	36 (36.7)	**1.828 (1.037 , 3.221)**	1.773 (0.970, 3.238)
45 – 59	6 (46.2)	7 (53.8)	0.910 (0.286 , 2.896)	0.871 (0.255, 2.983)
Profession				
Medical doctors	45 (58.4)	32 (41.6)	1	1
Specialist doctors	2 (33.3)	4 (66.7)	0.356 (0.061, 2.060)	0.277 (0.047, 1.647)
Nurses (or equivalent)	150 (66.7)	75 (33.3)	1.422 (0.836, 2.419)	1.436 (0.835, 2.470)
Health Officers	25 (65.8)	13 (34.2)	1.368 (0.609, 3.071)	1.467 (0.638, 3.374)
Radiology /X-ray technician	6 (66.7)	3 (33.3)	1.422 (0.331, 6.113)	1.459 (0.336, 6.347)
Respiratory therapist/ Anesthetist	4 (80)	1 (20)	2.844 (0.304,26.657)	2.872 (0.296, 27.846)
Physical therapist	14 (77.8)	4 (22.2)	1.067 (0.278, 4.089)	0.965 (0.248, 3.756)
Midwife	6 (60)	4 (40)	**7.111 (1.996,25.332)**	3.611 (0.741, 17.597)
Pharmacy professional	30 (90.9)	3 (9.1)	0.785 (0.441, 1.396)	0.514 (0.167, 1.581)
Laboratory personnel	64 (52.5)	58 (47.5)	1.219 (0.432, 3.437)	1.552 (0.524, 4.596)
Patient transporter/ Ambulance driver	12 (63.2)	7 (36.8)	2.133 (0.404,11.256)	2.276 (0.404, 12.822)
Catering staff/ food preparation	6 (75)	2 (25)	0.738 (0.409, 1.331)	1.150 (0.507, 2.605)
Cleaner/laundry	55 (50.9)	53 (49.1)	0.948 (0.198, 4.530)	0.727 (0.149, 3.555)
Morgue Staff	4 (57.1)	3 (42.9)	1.727 (0.642, 4.648)	1.685 (0.606, 4.683)
Others	17 (70.8)	7 (29.2)	2.489 (0.750, 8.264)	2.516 (0.744, 8.510)
Department				
All departments other than outpatient	423 (63.7)	241 (36.3)	1	1
Outpatient	17 (37.8)	28 (62.2)	**0.346 (0.186, 0.645)**	**0.385 (0.195, 0.760)**
All departments other than emergency	426 (61.9)	262 (38.1)	1	
Emergency	14 (66.7)	7 (33.3)	1.230 (0.490, 3.087)	-
All departments other than inpatient	219 (63.5)	126 (36.5)	1	
Inpatient	221 (60.7)	143 (39.3)	0.889 (0.656, 1.205)	-
All departments other than ICU	404 (61.6)	252 (38.4)	1	
ICU	36 (67.9)	17 (32.1)	1.321 (0.726, 2.402)	-

Table 3 continued

Variables	High exposure risk n (%)	Low exposure risk n (%)	COR (95% CI)	AOR (95% CI)
All departments other than cleaning service	406 (63.9)	229 (36.1)	1	1
Cleaning service	34 (45.9)	40 (54.1)	**0.479 (0.295, 0.779)**	0.695 (0.313, 1.543)
All departments other than laboratory	372 (63.9)	210 (36.1)	1	1
Laboratory	68 (53.5)	59 (46.5)	**0.651 (0.442, 0.959)**	1.715 (0.600, 4.901)
All departments other than pharmacy	422 (61.2)	268 (38.8)	1	1
Pharmacy	18 (94.7)	1 (5.3)	**11.431 (1.517, 86.128)**	3.247 (0.261, 40.420)
All departments other than ambulance	432 (62.4)	260 (37.6)	1	1
Ambulance	8 (47.1)	9 (52.9)	0.535 (0.204, 1.404)	-
All departments other than record room	439 (62.3)	266 (37.7)	1	
Record room	1 (25)	3 (75)	0.202 (0.021, 1.952)	-
Staff category				
Health professional	346 (63.7)	197 (36.3)	1	
Support staff	94 (56.6)	72 (43.4)	0.743 (0.522 , 1.058)	-
Date of first exposure				
Not known	226 (62.4)	136 (37.6)	1	
Known	214 (61.7)	133 (38.3)	1.968 (0.715 , 1.312)	-
First exposure facility type				
Treatment Center	377 (63.8)	214 (36.2)	1	1
Diagnosis center	63 (53.4)	55 (46.6)	**0.650 (0.436 , 0.969)**	0.830 (0.464, 1.486)
Multiple COVID-19 patients in the facility of first exposure				
No	109 (62.6)	65 (37.4)	1	
Yes	331 (61.9)	204 (38.1)	0.968 (0.680 , 1.378)	-
Involvement in other health facilities (other than where the health worker is based)				
Other options	349 (60)	233 (40)	1	1
Other health care facility (public or private)	91 (71.7)	36 (28.3)	**1.688 (1.109, 2.569)**	1.137 (0.480, 2.693)
Other options	433 (62.3)	262 (37.7)	1	
Other laboratory diagnosis center	7 (50)	7 (50)	0.605 (0.210, 1.744)	-
Other options	426 (62)	261 (38)	1	
Ambulance	14 (63.6)	8 (36.4)	1.072 (0.444, 2.591)	-
Other options	112 (70)	48 (30)	1	1
Not involved in other health care facility	328 (59.7)	221 (40.3)	**0.019 (0.636, 0.436)**	0.797 (0.371, 1.711)

Note: “Other options” refers to the sum total of all options other than the one under consideration.

(14.0%) (15). Health care workers are generally disproportionately affected by pandemics (16,17). Frontline worker nurses' are at increased risk for exposure in recent studies globally (17,18).

An increase in exposure risk in the age group of 25 – 34 years could potentially be attributed to negligence in this age group. The decrease in the risk of exposure in outpatient department could be due to simplicity of procedure performed at this department. To the best of our knowledge, no previous studies have obtained similar findings in this regard.

The high exposure risk requires immediate action by stakeholders and healthcare organizations to provide adequate precautions to curtail dangers(19). Organizational strategies that incorporate rigorous actions to alleviate any risk for exposure must be adopted at clinical facilities. It is imperative that healthcare institutions follow the recommended flowchart for the management of HWF exposed to COVID-19 which includes clinical judgment, close monitoring and surveillance, risk identification, and determining the requirement for any work constraints(19,20).

Recall bias was expected, which might have resulted in misclassification exposure risk. The survey might have also been affected by small size to multiple facilities and lack of qualitative component in order to assess factors for non-adherence.

Conclusion

This study revealed HWF COVID-19 exposure risk is high. Non-adherence to IPC is a critical issue among the HWF. Managing the work load in outpatient department could reduce the risk of infection.

Acknowledgment

We extend our gratitude to all COVID-19 treatment and diagnostic centers management bodies for their unreserved support.

Ethical considerations

The study protocol was reviewed and approved by Institutional Review Board (IRB) of EPHI. Permission had been taken from all COVID-19 treatment/diagnostic centers administrative bodies. Informed consent had been obtained from every respondent before proceeding to the interview. Privacy is maintained by using coded ID without mentioning individual names. The EPHI server is also accessed only by authorized person.

Conflicts of interest

The authors declared no conflicts of interest exist.

Funding

This research was funded by Ethiopian Public Health Institute.

Data Availability statement

The dataset supporting the conclusions of this article are is available on Ethiopian Public Health Institute data repositories.

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