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Knowledge level and influencing factors towards prevention of COVID-19 epidemic among residents of Dessie and Kombolcha city administrations, northeast Ethiopia: A population-based cross-sectional study

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Abstract

Objective: The knowledge level which might be affected by several factors has not been well studied. This study is aimed to assess the level of knowledge and influencing factors towards the prevention of the COVID-19 epidemic among residents of Dessie and Kombolcha city administrations, northeast Ethiopia.

Design: Community-based cross-sectional study

Settings: Dessie and Kombolcha city administrations

Participants: Eligible participants were household heads and/or the age of above 18 years old, who have been living in the study area in the past two months ago and available during the study period (n=828). Then, they were interviewed at their houses using an interviewer administered structured questionnaire.

Methods: A binary logistic regression analysis was done. In the multivariable logistic regression analysis, a p-value of <0.05 and adjusted odds ratio (AOR) with 95% confidence interval were used to identify factors statistically associated with level of knowledge of the community.

Outcome: Knowledge level

Results: A total of 828 participants were involved with a response rate of 98%. Of the total participants; 54.11% (95% CI: 50.6, 57.6) had poor knowledge towards COVID-19 prevention. Significant associations reported among females (AOR=1.41; 95% CI: 1.03, 1.92); age ≥ 65years (AOR=2.72; 95% CI: 1.45, 5.11); rural residence (AOR=2.69; 95% CI: 1.78, 4.07); unable to read and write (AOR=1.60; 95% CI: 1.02, 2.51); information not heard from health care workers, mass media, and social media (AOR=1.95; 95% CI: 1.35, 2.82), (AOR=2.5; 95% CI: 1.58, 4.19) and (AOR=2.13; 95% CI: 1.33, 3.42) respectively with poor knowledge.

Conclusion: The findings revealed poor knowledge towards COVID-19 prevention. This study highlights the need for widespread awareness campaigns about COVID-19 prevention through mass media, healthcare professionals and social media as a source of information, house to house awareness creation might be important to address elders who are more vulnerable to the epidemic of COVID-19.

Keywords: Knowledge, Influencing factors, COVID-19, Dessie, Kombolcha, Ethiopia

Strengths and limitations of this study

- This is the first community level study in northeast Ethiopia which extracted information regarding participants' knowledge towards COVID-19 prevention
- The study addressed hotspot areas of COVID-19 where these are the corridor sites for many entries in northeast Ethiopia
- The quantitative study did not supported by qualitative study
- This study is limited due to its cross-sectional design/behavior which lacks cause and effect relationship.

INTRODUCTION

Coronavirus disease 2019 (COVID-19) was first detected in Wuhan, China, in December 2019 and on 30 January 2020. World Health Organization (WHO) declared that the current outbreak constituted a public health emergency of international concern based on growing case notification rates on Chinese and international locations when the virus cause a large burden of morbidity and mortality.[1] COVID-19 has threatened the world with a public health crisis. Globally, more than 15.5 million are infected and nearly 635,173 fatalities after being declared as a pandemic by the WHO. In Africa, there are about 679,962 confirmed cases and 11,340 deaths reported since July

25, 2020, 10:00 CEST.[2] International borders have been locked down, travel restricted, economies slashed and billions are isolated at their own homes, as a measure to contain the outbreak.

Effectiveness, applicability and feasibility are attributes which indicate that the interventions are going to be more appropriate in the community as the knowledge regarding any new infection improves the preparedness in both the healthcare professionals and the general public.[2, 3] The virus rapidly transmitted many countries across Africa and fatality related to COVID-19 has been an increase in the fastest time. The infection rate of the COVID-19 will increase due to failure to control the virus, and because of this continent has less detection rate, live in crowded place and weak health system.[1, 4]

Ethiopia is one of the countries threatened by COVID-19, a total of 12,693 confirmed cases, 200 deaths registered [2, 5] and 5,966 recovered.[6]. The country has not taken national wide lockdown, but the country declared state of emergency. In Ethiopia, many organizations, including government sector has implemented different measurement that plans to prevent the virus. In community still there is gap in using prevention mechanism despite many media and organization mobilizes the community and advocacy strategy to curb the pandemic. Most of the reason goes to inadequate knowledge of the disease of prevention technique.[4, 7] Community level knowledge concerning COVID-19 epidemic plays a crucial role both in choice of institutionally approved "top-down" medical policies and in grass-roots strategies adopted by communities. [8, 9]

In Ethiopia, the positivity rate of the COVID-19 epidemic is increased from time to time.[10] Findings showed that gender, age, residence, education, and occupation were associated with knowledge of the public. [3, 7, 9, 11] However, community level studies are lacking, particularly in the study areas towards COVID-19 prevention.

There is a huge gap in preventing viruses since it is new emerging little is known about the awareness of the disease communications by general public. [12] This all show the need for research in every aspect, but in developing countries the prioritize prevention is the only effective way to cut virus so to do this the community must know and prevent prevention mechanism. For the intervention need to have evidence that show levels of intervention and to continue it. Therefore, this research is aimed to assess the level of the knowledge and influencing factors towards COVID-19 prevention in Dessie and Kombolcha city administrations where these are the corridor sites for many entries in northeast Ethiopia.

METHODS

Study settings

The study was conducted from June 7-14, 2020, in Dessie and Kombolcha city administrations, Amhara National Regional State, North-East Ethiopia. Dessie is 401 kilometers and Kombolcha 376 away from Addis Ababa, the capital city of Ethiopia respectively. Dessie city has 26 *Kebeles* (*the lowest administrative level in Ethiopia) 18* urban 8 rural and Kombolcha has 11 *Kebeles* 5 urban and 6 rural a total of 37 *Kebeles* in the two city administrations. According to 2012 E.C population projection, in Dessie 91,870 households and in Kombolcha 34,097 households. A total of 125,967 households in the two city administrations. The total population of Dessie is 385,850 and Kombolcha 143,214. The two city administrations have 529,064 inhabitants, of which 262,157 males and 266,907 are females.[13]

Dessie is the 2nd populated metropolitan city and the corridor site of many entries in Amhara regional state, north-East, Ethiopia. Kombolcha as the twin city of Dessie which lies some 25 km to the northwest. Kombolcha is connected with Dessie through road transportation. This city shares Kombolcha Airport with neighboring Dessie. The city is served by a station on the Awash–

Weldiya Railway and neighbors with Afar region. It is a gate site where foreigners and migrants live that mainly came from Djibouti and Arab countries. [14]

Study design and period

Population-based cross-sectional study was conducted to assess KAP and factors about COVID-19 among the residents of Dessie and Kombolcha City administrations from July 01-07, 2020.

Population

The source of population was all the residents of Dessie and Kombolcha city administrations Amhara Regional State, Northeast Ethiopia. The study population was residents found in the selected *Kebeles* in Dessie and Kombolcha City administrations who had the chance to be included in the sample.

Inclusion and exclusion criteria

Household heads and/or the age of above 18 years old, who have been living in the study area in the past two months ago and available during the study period were included in the study. Whereas, participants to critically and mentally ill during the study period were excluded from the study.

Sample size determination and Sampling procedures

Since, COVID-19 is the new emerging disease and scientific information related COVID-19 is not available at national level. Therefore, using single population proportion formula, the estimation of the sample size was done by assuming a prevalence of 50%, 95% of confidence level and 5% of margin of error. The calculated sample size of this study was 768 participants with design effect of two. By adding tolerable non-response rate (10%), the total sample size was 845 participants.

$$n = \frac{(Z\alpha/2)^2 * p(1-p)}{w^2} * DE => n = \frac{(1.96)^2 * 0.5(1-0.5)}{(0.05)^2} * 2 = 768$$

By adding 10% non-response rate= 845

Where, prevalence (p) =50%; w=tolerable margin of error=5%; $Z^{\alpha/2}$ at 95%=1.96;

DE= Design effect

By using double population proportion formula, possible sample sizes were estimated using the assumptions of 80% power, and 95% confidence level as below (Table 1).

Table 1. Sample size determinations for fourth to sixth objectives for the study conducted on level KAP and factors towards COVID-19 prevention among residents of Dessie and Kombolcha city administrations, northeast Ethiopia

Variables name	Refe-rences	Percentage of unexposed	80% power	95% CI	Odds ratio	Sample size	Design effect	10% NRR	Final sample size
Sex	[15]	74	80	0.05	0.40	186	2	37	409
Education	[15]	51.7	80	0.05	6.30	62	2	12	136
Occupation	[16]	9.3	80	0.05	5.7	86	2	17	189

A two-stage sampling technique was employed to select the study participants. A total of 845 participants from their respective households were included in the study. Simple random sampling technique was applied to select *Kebeles* to eliminate selection bias. In the first stage, nine *Kebeles* were selected out of 37 *Kebeles* using a lottery method. In the second stage, data were collected from participants at households using systematic sampling technique (every 36th values were included). Then, based on their population size, the sample size was proportionally allocated to each sampled *Kebeles*. Dessie has 26 *Kebeles* (18 urban and 8 rural), and Kombolcha has 11 *Kebeles* (5 urban and 6 rural). The two city administrations have a total of 37 *Kebeles*.

Data collection

Data on socio-demographic variables, availability of household materials/related variables, source of information related variables, and knowledge related variables were collected through pretested and structured interviewer administered questionnaire. The questions were adapted from WHO COVID-19 guideline,[17] and similar study done in China.[18]

Measurement of COVID-19 - related Knowledge (Dependent variable)

The knowledge section of the questionnaire had 35 questions. The questions were intended to assess the participants' knowledge of COVID-19 plausibly influencing their health care seeking behavior. Yes/correct responses were labeled as "1", and incorrect/no/I don't know responses were labeled as "0". The scores were added up to create knowledge ranking for the aforementioned categories. The pooled scores of questions were classified into poor and good knowledge using median (50%) score values. Poor Knowledge was labeled as "1", and Good Knowledge was labeled as "0".

Operational definitions

The respondent was classified as having "**Poor Knowledge**" when he/she answered correctly below 50% of COVID-19 related knowledge questions. Whereas, the respondent was classified as having "**Good Knowledge**" when he/she answered correctly 50% and above of COVID-19 related knowledge questions.

Data quality assurance

Pre-test was conducted on 5% of the total sample size in Kalu district and the amendment was done according to the finding. Training on the objectives of the study was given to data collectors and supervisors before a day of data collection. Regular supervision, control as well as support data collectors by the supervisors were made daily and each completed questionnaire was checked and the necessary feedback

was offered to interviewers. The collected data were properly handled, reviewed and checked for completeness and consistency by the supervisors and before commencing analysis each day.

Data processing and analysis

The collected data were coded, edited, entered into Epi-Info version 7.2 and analyzed using the Statistical Package for the Social Sciences (SPSS) version 20. Internal consistency of the knowledge measures was tested using a reliability test where the Cronbach alpha coefficient aided in determining the reliability of the variables. The results showed that the Cronbach alpha for knowledge questions was 0.801. The result added credibility where, according to Griethuijsen, the range of Cronbach alpha within 0.6 to 0.7 is considered adequate and reliable.[19] It is proved that the items used to measure knowledge on COVID-19 are therefore acceptable. Descriptive summary statistics such as mean ± SD, median ± IQR, frequencies and proportions were presented as appropriate. Binary logistic regression analysis was done and all independent variables at $p<0.20$ were taken to multivariable logistic regression analysis to identify associated factors with outcome variables. The statistical significance of variables at final model was declared at $p<0.05$ and 95% confidence level for adjusted odds ratio. The Hosmer and Lemeshow statistics and deviance coefficient were used to check the goodness of fit of the model.

RESULTS

Socio-demographic characteristics of participants

By excluding incomplete and irrelevant questionnaires, the response rate was 828 (98%). Among the study participants, 541 (65.3%) reside in Dessie, and the rest of Kombolcha cities. Among the participants, 511 (61.7%) were females, 423 (51.1%) were Muslim followed by Orthodox Tewahido (385 (46.5%)) religion's followers. The mean (`SD) age of the study participants was 39 (±14) years. From all participants, 672 (81.2%) were living in urban settings, 576 (69.6%) married, 167 (20.2) were single headed participants. Of

the study participants, 218 (26.4%) had no formal education. Regarding their occupational status, 246 (29.7%) were housewives followed by government employees, 176 (21.3%) (Table 2).

Table 2. Socio-demographic characteristics of participants in Dessie and Kombolcha city Administrations, northeast Ethiopia, 2020 (n=828).

Demographic characteristics	Frequency	Percentage	Mean (±SD)
City name			
Dessie	541	65.3	
Kombolcha	287	34.7	
Sex			
Male	317	38.3	
Female	511	61.7	
Age group			39 (±14)
18-35	422	51.0	
36-64	341	41.2	
>=65	65	7.9	
Religion			
Orthodox Tewahedo	385	46.5	
Muslim	423	51.1	
Catholic	8	1.0	
Protestant	12	1.4	
Place of residence			
Urban	672	81.2	
Rural	156	18.8	
Marital status			
Single	167	20.2	
Married	576	69.6	
Divorced	47	5.7	
Widowed	38	4.6	
Education level			
Unable to read and write	153	18.5	
Able to read and write with informal education	65	7.9	
Primary school (grade 1-8)	158	19.1	
Secondary school (grade 9-12)	204	24.6	
Above 12 grades (University/College/TVET)	248	30.0	
Main occupation			
House wife	246	29.7	
Merchant	168	20.3	
Farmer	37	4.5	
Government employee	176	21.3	
NGO employee	63	7.6	
Labourer	82	9.9	
Student	56	6.8	

Household level and Media related characteristics

The median (±interquartile range) for family size of the participants was 4.42 (±1.8). The median (±IQR) income of the participants was 3,000 (±2500) ETB. Of the participants, 29 (3.5%) are using their water from spring water source (any type: protected or unprotected). Among them, 584 (70.5%) had lack adequacy of water (<20L/C/D) and, 789 (95.3%) access their source of water within less than 30 minutes (1km round trip). About 720 (87%) had a functional TV in the household, 78 (94.3%) had a cell phone (Table 3).

Table 3. House hold level and media related characteristics of participants in Dessie and Kombolcha city Administration, northeast Ethiopia, 2020

HH and media characteristics	Frequency	Percentage	Median (±IQR)
Family size			
1-3	251	30.3	4.42(±1.8)
4-6	476	57.5	
>6	101	12.2	
Monthly Income at household level			3000(±2500)
Type of water sources			
Piped water in dwelling	136	16.4	
Piped water at yard	585	70.7	
Communal "Bono"	78	9.4	
Spring (any type: protected or unprotected)	29	3.5	
Amount of water in Litter/Capita/Day			13.15(`12.00)
No access (<20L/C/D)	584	70.5	
Basic access (>=20L/C/D)	244	29.5	
Time to take water in minutes			2.00(±2.00)
<=30 minutes (1 km round trip)	789	95.3	
>30 minutes (>1 km round trip)	39	4.7	
Functional TV in the household			
No	108	13.0	
Yes	720	87.0	
Functional radio in the household			
No	347	41.9	
Yes	481	58.1	
Functional cell phone in the household			
No	47	5.7	
Yes	781	94.3	

Factors associated with Knowledge of participants towards COVID-19 epidemic

In the bivariate logistic regression (first model), seventeen independent variables were entered. In the multivariable logit regression (second model), only seven variables were significantly associated with poor knowledge of participants towards COVID-19.Variables associated with poor knowledge towards COVID-19 prevention were sex, age, residence, educational level, information from health care workers, mass media and social media.

Female participants were 41% more likely to have poor knowledge towards COVID-19 as compared to their counterparts (AOR=1.41, 95% CI; 1.03, 1.92). Participants whose age group >=65 years were 2.72 times more likely to have poor knowledge of COVID-19 as compared to the age groups of 18-35 years (AOR= 2.27, 95% CI; 1.45, 5.11). People who live in rural areas 2.70 times more likely to have poor knowledge when compare with urban dwellers. The participants who were unable to read and write were 60% times more likely to have poor knowledge compared to those who were attending high level education (AOR=1.60, 95% CI; 1.02, 2.51). Participants who did not receive information from health care workers towards COVID-19 were 95% times more likely to have poor knowledge as compared to those who received from health care workers (AOR=1.95, 95% CI; 1.35, 2.82). Among the participants who were not receiving information towards COVID-19 from mass media 2.6 times more likely to have poor knowledge compared to those who received information from mass media (AOR=2.57, 95% CI; 1.58, 4.19]. In addition to, participants who were not receiving information from social media were 2.13 times more likely to have poor knowledge towards COVID-19 as compared to those who received from social media (AOR= 2.13, 95% CI; 1.33, 3.42) (Table 4).

DISCUSSION

This finding showed that the proportion of poor knowledge towards COVID-19 prevention was 54.11% (95% CI: 50.6, 57.6), which is higher than studies conducted in Debre Birhan University, Ethiopia (26.2%),[20] Syrians (40%),[21] Iran (39.2%),[22] Bangladesh (51.7%),[23] Saudi Arabia (18.4%),[24] across the world (20.1%),[25] Malaysia (19.5%),[26] India (13.3%),[27] three Middle Eastern countries (Jordan, Saudi Arabia and Kuwait) (33.9%) [9] and Sudan (9.4%). [28] The differences in level of knowledge have been subjected to variation in the cut-values. In addition, the discrepancies might be due to differences in reach of community awareness creation through mass media and social media.

In this study, the odds of poor knowledge towards COVID-19 were 1.4 times higher among female participants compared to male participants. This finding is similar to studies conducted in Iran,[22] Bangladesh,[29, 30] Sudan.[28] In Ethiopia, most of home-based activities are left for females. Therefore, females may not get access for media because of their busy time in take care of the family members. Consequently, they are prone to poor knowledge of COVID 19 compared to males.

The study indicated that elderly people (i.e. 65 and above years of age) had 3-folds greater odds of poor knowledge towards COVID 19 compared to adults. This finding is similar to studies conducted at the Debre Birhan University, Ethiopia,[20] Iran,[22] Bangladesh, [23, 30] medical college in Uttarakhand, India.[27] In most of the cases, elderly People are not accessible to modern technologies in Ethiopia. Hence, they will have poor knowledge towards COVID 19 compared to adults due to shortage of information.

The odds of poor knowledge were 2.7 times higher among participants who were residing in rural areas compared to those who were living in urban dwellers. This finding is similar to studies conducted in Bangladesh, [29, 31] Sudan.[28] In Ethiopia, most of the people are living in rural areas

which is hard to reach for awareness creation using mass media or social media (telegram, Facebook, whatsup and Instagram). Thus, people in rural settings had poor knowledge of COVID-19 prevention and control measures compared to urban populations who are easily accessible to different source of media to acquire information regarding COVID-19.

Moreover, participants who were unable to read and write were 1.6 times more likely had poor knowledge of COVID-19 compared to those were attended tertiary level educations. This finding is similar to studies conducted in Syrians,[21] Iran,[22] rural residents in China,[32] Sudan,[28] Bangladesh,[29] Nepal.[33] In Ethiopia, most of the unable to read and write segment of the population are found in rural areas. Those unable to read and write people are not accessible to media which are the ultimate source of information to acquire basic knowledge regarding prevention and control modalities of COVID-19 infections. Thus, participants who were unable to read and write are less knowledgeable regarding COVID-19 compared to tertiary educated participants.

The study revealed that the odds of poor knowledge were twofold times higher among participants who were not receiving information regarding COVID-19 from health care workers compared to those were receiving from health care workers. Moreover, the odds of poor knowledge were 2.5 times higher among participants who were not receiving information regarding COVID-19 from mass media (TV/Radio) compared to their counterparts. Furthermore, the odds of poor knowledge were 2 times higher among participants who were not receiving information regarding COVID from social media compared to those were get receiving from social media. This finding is similar to a study conducted in eight referral hospitals, Ethiopia.[34] The community may get information regarding COVID-19 epidemic from different sources. These sources include health care workers, mass media (TV, radio, newspapers, and magazines), social media (telegram, Facebook, WhatsApp, Instagram, tweeters), and religious leaders. Thus, community members who are not

accessible to these sources are less knowledgeable regrading COVID-19 compared to those who are accessible to the listed sources of information.

This study extracted community level information regarding participants' knowledge towards COVID-19 prevention from the hotspot areas of COVID-19. However, this study is limited due to its cross-sectional design/behavior which lacks cause and effect relationship.

CONCLUSIONS

In this study, more than half of the study participants had poor knowledge towards COVID-19 prevention among residents of Dessie and Kombolcha city administrations, northeast Ethiopia. Findings from this study showed that sex, age, residence, educational level, information seeking from health care workers, mass media and social media were significantly associated with poor knowledge. The findings may have implications in the prevention campaign/program of the new corona virus epidemic particularly in the study settings. It helps other researchers as a baseline information for community level studies. This finding may enforce the local as well as national Anti-COVID-19 programmers to revise their campaign plans to strengthen the efforts against COVID-19 epidemics.

It is recommended to revise COVID-19 prevention plan to increase community awareness towards COVID-19. Strengthening the community to consider the health care workers and mass media as a source of COVID-19 related information might be encouraged. House to house awareness creation might be important to address elders who are more vulnerable to the epidemics. Females' empowerment in formal education shall be strengthened to increase their awareness and exposure to the latest information. The city administrations shall focus on their rural residents to access and have an appropriate information towards COVID-19 prevention.

List of abbreviations

AOR: adjusted odds ratio; CI: confidence interval; COVID-19: Coronavirus disease 2019; IQR: interquartile range; L/C/D: liter per capita per day; OR: odds ratio; SD: standard deviation

Declarations

Ethics approval and consent to participate

Ethical clearance was obtained from Ethical Review Committee [**Reference number: CMHS/311/036/12**] of College of Medicine and Health Sciences, Wollo University. Permission letter was obtained from Dessie and Kombolcha town administrations health department and offices, then from kebele administrations involved in the study. Informed verbal consent was obtained from each study participant. The information gathered from the participants was used for research purpose and confidentiality kept. Participation in the study was on a voluntary basis and participants who were unwilling to participate in the study and those who wish to quit from the study at any point in time informed to do so without any restriction.

Consent for publication

Not applicable.

Availability of data and materials

The data used to produce this manuscript are available in Epi-Info version 7.2 and SPSS version 20 databases and the authors are prepared to share their data on request recognizing the benefits of such transparency.

Competing interests

No competing interests for any authors.

Patient and public involvement

Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

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Contributors

Conception and design of the study: AMK. Conduct of the study: AMK, GGB, AMM, KAY, and AWT. Analysis and interpretation of data: AMK, GGB and AMM. Drafting the manuscript and revising it critically: AMK, GGB, AMM, KAY, and AWT.. All authors have given final approval for the manuscript to be published.

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Table 4. Bi-variable and multivariable logistic regression of knowledge towards COVID-19 epidemic among residents of Dessie and Kombolcha city administration, northeast Ethiopia, 2020 (n=828).

Variables	Knowledge level, n (%)		Crude odds ratio (COR)		Adjusted odds ratio (AOR)	
	Poor	Good	OR	95% CI	OR	95% CI
Sex						
Male	156(49.2)	161(50.8)	1		1	
Female	292(57.1)	219(42.9)	1.38	1.04, 1.82*	1.41	**1.03, 1.92***
Age						
18-35	215(50.9)	207(49.1)	1		1	
36-64	185(54.3)	156(45.7)	1.14	0.86, 1.52	1.14	0.83, 1.57
>=65	48(73.8)	17(26.2)	2.72	1.51, 4.88*	2.72	**1.45, 5.11***
Place of residence						
Urban	333(49.6)	339(50.4)	1		1	
Rural	115(73.7)	41(26.3)	2.86	1.94, 4.21*	2.69	**1.78, 4.07***
Marital status						
Single	92(55.1)	75(44.9)	1		1	
Married	307(53.3)	269(46.7)	0.93	0.66, 1.32	-	-
Divorced	27(57.4)	20(42.6)	1.10	0.57, 2.12	-	-

Widowed	22(57.9)	16(42.1)	1.12	0.55, 2.29	-	-
Education level						
Unable to read and write	94(61.4)	59(38.6)	2.48	1.64, 3.75*	1.60	**1.02, 2.51***
Able to read and write with informal education	46(70.8)	19(29.2)	3.77	2.09, 6.81*	2.29	**1.22, 4.30***
Primary school (grade 1-8)	98(62.0)	60(38.0)	2.54	1.69, 3.83*	1.67	**1.08, 2.60***
Secondary school (grade 9-12)	113(55.4)	91(44.6)	1.93	1.33, 2.82*	1.50	**1.01, 2.24***
Above 12 grade (University/College/TVET)	97(39.1)	151(60.9)	1		1	
Main occupation						
House wife	142(57.7)	104(42.3)	1.37	0.76, 2.44	0.73	0.38, 1.44
Merchant	84(50.0)	84(50.0)	1.00	0.55, 1.83	0.74	0.38, 1.44
Farmer	24(64.9)	13(35.1)	1.85	0.79, 4.34	0.67	0.25, 1.83
Government employee	83(47.2)	93(52.8)	0.89	0.49, 1.63	0.99	0.50, 1.95
NGO employee	31(49.2)	32(50.8)	0.97	0.47, 1.99	0.88	0.40, 1.92
Labourer	56(68.3)	26(31.7)	2.15	1.07,4.34*	1.37	0.63, 2.96
Student	28(50.0)	28(50.0)	1		1	
Family size						
1-3	137(54.6)	114(45.4)	1		1	
4-6	255(53.6)	221(46.4)	0.96	0.71, 1.31	-	-
>6	56(55.4)	45(44.6)	1.04	0.65, 1.65	-	-
Type of water sources						
Piped water in dwelling	64(47.1)	72(52.9)	1		1	
Piped water at yard	307(52.5)	278(47.5)	1.24	0.86, 1.81	1.08	0.72, 1.62
Communal "Bono"	53(67.9)	25(32.1)	2.39	1.33, 4.27*	1.08	0.54, 2.17
Spring (any type: protected or unprotected)	24(82.8	5(17.2)	5.40	1.95, 14.99*	2.58	0.77, 8.67
Amount of water in Litter/Capita/Day						
No access (<20L/C/D)	324(55.5)	260(44.5)	1.21	0.89, 1.63	-	-
Basic access (>=20L/C/D)	124(50.8)	120(49.2)	1		1	
Time to take/fetch water in minutes						
<=30 minutes (1 km round trip)	419(53.1)	370(46.9)	1		1	
>30 minutes (>1 km round trip)	29(74.4)	10(25.6)	2.56	1.23, 5.33*	0.69	0.25, 1.92
Functional TV/radio in the household						
No	73(67.6)	35(32.4)	1.92	1.25, 2.95*	0.97	0.58, 1.62
Yes	375(52.1)	345(47.9)	1		1	
Functional cell phone in the household						
No	31(66.0)	16(34.0)	1.69	0.91, 3.14*	0.96	0.47, 1.95
Yes	417(53.4)	364(46.6)	1		1	

COVID-19 Information heard from family members						
No	376(53.1)	332(46.9)	0.76	0.51, 1.12*	0.80	0.50, 1.28
Yes	72(60.0)	48(40.0)	1		1	
COVID-19 Information heard from health care workers						
No	355(57.5)	262(42.5)	1.72	1.25, 2.36*	1.95	**1.35, 2.82***
Yes	93(44.1)	118(55.9)	1		1	
COVID-19 Information heard from mass media (TV,…						
No	79(71.2)	32(28.8)	2.33	1.51, 3.60*	2.57	**1.58, 4.19***
Yes	369(51.5)	348(4835)	1		1	
COVID-19 Information heard from social mass (FB, …						
No	414(57.6)	305(42.4)	2.99	1.95, 4.61*	2.13	**1.33, 3.42***
Yes	34(36.2)	75(68.8)	1		1	
COVID-19 Information heard from religious leader's						
No	428(55.8)	339(44.2)	2.59	1.49, 4.50*	1.16	0.60, 2.28
Yes	20(32.8)	41(67.2)	1		1	

*for p<0.20 at bivariate analysis; *and bold for p<0.05 at multivariable analysis

Research checklist

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-5
Objectives	3	State specific objectives, including any prespecified hypotheses	2, 5
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	8
Bias	9	Describe any efforts to address potential sources of bias	1
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	n/a
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	9
		(*b*) Describe any methods used to examine subgroups and interactions	n/a
		(*c*) Explain how missing data were addressed	9
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	n/a
		(*e*) Describe any sensitivity analyses	n/a
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9
		(b) Give reasons for non-participation at each stage	9
		(c) Consider use of a flow diagram	9
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9-12
		(b) Indicate number of participants with missing data for each variable of interest	9-12
Outcome data	15*	Report numbers of outcome events or summary measures	12
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted	12

		estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	
		(*b*) Report category boundaries when continuous variables were categorized	12
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	n/a
Discussion			
Key results	18	Summarise key results with reference to study objectives	13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	2
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	13-14
Generalisability	21	Discuss the generalisability (external validity) of the study results	13-14
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	16

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Knowledge level and influencing factors towards prevention of COVID-19 pandemic among residents of Dessie and Kombolcha city administrations, northeast Ethiopia: A population-based cross-sectional study

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Abstract

Objective: In Ethiopia, community-level knowledge about the current COVID-19 pandemic has not been well-studied. This study is aimed to assess knowledge level and influencing factors towards the prevention of the COVID-19 pandemic among residents of Dessie and Kombolcha city administrations, Ethiopia.

Design: Community-based cross-sectional study

Settings: Dessie and Kombolcha city administrations

Participants: Participants were household heads or anyone from the house with age >18 years. They have been living in the study areas for the past two months preceding the survey (n=828).

Methods: A binary logistic regression was used for a single outcome and multiple response variables. In the multivariable regression model, a p-<0.05 and adjusted odds ratio (AOR) with 95% confidence interval were used to identify factors associated with knowledge level of the community. Epi-Info version 7.2 and SPSS version 20 software are used for data entry and analysis respectively.

Outcome: Knowledge level

Results: A total of 828 participants were involved with a response rate of 98%. Females were 61.7%. Participants' mean (±SD) age was 39 (±14) years. From the total participants; 54.11% (95% CI: 50.6, 57.6) had inadequate knowledge about COVID-19 prevention. Significant associations reported among females (AOR=1.41; 95% CI: 1.03, 1.92); age ≥65years (AOR=2.72; 95% CI: 1.45, 5.11); rural residence (AOR=2.69; 95% CI: 1.78, 4.07); unable to read and write (AOR=1.60; 95% CI: 1.02, 2.51); information not heard from healthcare workers, mass media,

and social media (AOR=1.95; 95% CI: 1.35, 2.82), (AOR=2.5; 95% CI: 1.58, 4.19) and (AOR=2.13; 95% CI: 1.33, 3.42) respectively with inadequate knowledge.

Conclusion: These findings revealed >50% of participants had inadequate knowledge about COVID-19. It highlights the need for widespread awareness campaigns about COVID-19 through mass media, healthcare professionals and social media as a source of information. House-to-house awareness creation is recommended to address older adults who are more vulnerable to the pandemic.

Keywords: Knowledge, Influencing factors, COVID-19, Dessie, Kombolcha, Ethiopia

Strengths and limitations of this study

- This is the first community-level study in northeast Ethiopia which extracted information regarding participants' knowledge towards COVID-19 prevention
- The study addressed hotspot areas of COVID-19 where these are the corridor sites for many entries in northeast Ethiopia
- The quantitative study did not supported by qualitative study
- This study is limited due to its cross-sectional design/behavior which lacks cause and effect relationship.

INTRODUCTION

Coronavirus disease 2019 (COVID-19) was first detected in Wuhan, China, in December 2019 and on 30 January 2020. When the virus causes a large burden of morbidity and mortality in China and international locations, the World Health Organization (WHO) declared the current outbreak a public health emergency of international concern.[1] Globally, more than 34,161,721 were infected and nearly 1,016,986 fatalities after being declared as a pandemic by the WHO. In Africa, there

are about 1,191,323 confirmed cases and 26,148 deaths reported as of 5:04 pm CEST, 2 October 2020.[2] International and national borders have been locked down, travel restricted, economies slashed and billions are isolated at their own homes, as a measure to contain the outbreak.

The COVID-19 prevention interventions are more appropriate in the community as the knowledge regarding the new infection improves the preparedness of both the healthcare professionals and the general public.[3,4] The virus was rapidly transmitted to many countries across Africa, and the fatality related to COVID-19 has been an increase in the fastest time. In the continent, the infection rate of the COVID-19 may be increased due to less detection rate, live in a crowded place and a weak health system.[1,5-7]

Ethiopia is one of the countries threatened by COVID-19, a total of 76,098 confirmed cases, 1,204 deaths registered.[2] Although the country has not instituted a nation-wide lockdown, a state of emergency has been declared since 14 April 2020.[8] In Ethiopia, many organizations, including the government sector, have been implementing different measures that plans to prevent the virus. Despite the advocacy strategies by the media and numerous organizations to curb the spread of the pandemic, there still exists a gap in adoption and adhering to preventive mechanisms within communities. Most of the reason goes to inadequate knowledge of the disease of prevention technique.[5,9] Community-level knowledge concerning the COVID-19 pandemic plays a crucial role both in the choice of institutionally approved "top-down" medical policies and in grass-roots strategies adopted by communities. [10,11]

In Ethiopia, the positivity rate of the COVID-19 pandemic is increased from time to time.[12] Findings showed that gender, age, residence, education, and occupation were associated with

knowledge of the community towards the pandemic.[4,9,11,13] However, community level studies are lacking, particularly in the study areas towards COVID-19 prevention.

There is a huge gap in preventing the pandemic since it is a new phenomenon, and little is known about the knowledge level of the disease by the general public.[14] This indicates the need for research in every aspect, but in developing countries, prioritizing prevention is the only effective way to curb the pandemic. So to do this, the community must know and implement prevention mechanisms. For the intervention to be successful, it is needed to have evidence that shows the level of the knowledge towards COVID-19 prevention strategies at the community level. Therefore, this research is aimed to assess the level of the knowledge and influencing factors towards COVID-19 prevention in Dessie and Kombolcha city administrations where these are the corridor sites for many entries in northeast Ethiopia.

METHODS

Study settings

The study was conducted from June 7-14, 2020, in Dessie and Kombolcha city administrations, Amhara National Regional State, North-East Ethiopia. Dessie is 401 kilometers and Kombolcha 376 kilometers away from Addis Ababa, the capital city of Ethiopia respectively. Dessie city has 26 *Kebeles* (*the lowest administrative level in Ethiopia) (18* urban and 8 rural), and Kombolcha has 11 *Kebeles* (5 urban and 6 rural), a total of 37 *Kebeles* in the two city administrations. *Kebeles* are *the lowest administrative level in Ethiopia.* According to 2012 E.C populations projection, in Dessie 91,870 households and in Kombolcha 34,097 households. A total of 125,967 households in the two city administrations. The total population of Dessie is 385,850 and Kombolcha 143,214.

The two city administrations have 529,064 inhabitants, of which 262,157 males and 266,907 are females.[15]

Dessie is the 2nd populated metropolitan city and the corridor site of many entries in Amhara regional state, north-East, Ethiopia. Kombolcha as the twin city of Dessie which lies some 25 km to the northwest. Kombolcha is connected with Dessie through road transportation. This city shares Kombolcha Airport with neighboring Dessie. The city is served by a station on the Awash–Weldiya Railway and neighbors with the Afar region. It is a gate site where foreigners and migrants live that mainly came from Djibouti and Arab countries. [16]

Study design and period

Population-based cross-sectional study was conducted to assess the knowledge level and influencing factors towards COVID-19 prevention strategies among the residents of Dessie and Kombolcha City administrations from July 01-07, 2020.

Population

The source of population was all the residents of Dessie and Kombolcha city administrations of Amhara Regional State, Northeast Ethiopia. The study population was residents found in the selected *Kebeles* in Dessie and Kombolcha City administrations who had the chance to be included in the sample.

Inclusion and exclusion criteria

Household heads or anyone from the house with the age of above 18 years were included in the study. They have been living in the study areas in the past two months preceding the survey. Whereas, participants who were critically and mentally ill during the study period were excluded from the study.

Sample size determination and Sampling procedures

This study has two objectives: namely; to assess knowledge level and to identify influencing factors for knowledge of the COVID-19 pandemic. Since COVID-19 is a new emerging disease and related evidence is not available at national level, a single population proportion formula was used to estimate the sample size (for knowledge level) by assuming a prevalence of 50%, 95% of confidence level and 5% of the margin of error. The calculated sample size of this study was 768 participants with a design effect of two. By adding a tolerable non-response rate (10%), the total sample size was 845 participants.

$$n = \frac{(Z\alpha/2)^2 * p(1-p)}{w^2} * DE => n = \frac{(1.96)^2 * 0.5(1-0.5)}{(0.05)^2} * 2 = 768$$

By adding 10% non-response rate= 845

Where, prevalence (p) =50%; w=tolerable margin of error=5%; $Z^{\alpha/2}$ at 95%=1.96;

DE= Design effect

For the second objective, a double population proportion formula was used to estimate and maximize possible sample sizes using the assumptions of 80% power, and 95% confidence level as below (Table 1).

Table 1. Sample size determinations for the second objective of the study are conducted to assess knowledge level and factors towards COVID-19 prevention among residents of Dessie and Kombolcha city administrations, northeast Ethiopia

Variables name	References	Percentage of unexposed	80% power	95% CI	Odds ratio	Sample size	Design effect	10% NRR	Final sample size
Sex	[17]	74	80	0.05	0.40	186	2	37	409
Education	[17]	51.7	80	0.05	6.30	62	2	12	136

Occupation	[18]	9.3	80	0.05	5.7	86	2	17	189

Finally, by comparing the optional sample size estimations above, the maximum sample size, 845, was taken as the final for this study.

A two-stage sampling technique was employed to select the study participants. A total of 845 participants from their respective households were included in the study. Simple random sampling technique was applied to select *Kebeles* to eliminate selection bias. In the first stage, 9 *Kebeles* were selected out of 37 *Kebeles* using a lottery method. In the second stage, data were collected from participants at households using systematic sampling technique (every 36th values were included). Then, based on their population size, the sample size was proportionally allocated to each sampled *Kebeles*. Dessie has 26 *Kebeles* (18 urban and 8 rural), and Kombolcha has 11 *Kebeles* (5 urban and 6 rural). The two city administrations have a total of 37 *Kebeles*.

Data collection

Data on socio-demographic variables, availability of household materials/related variables, source of information related to variables, and knowledge related variables were collected through a pretested and structured interviewer administered questionnaire. The questions were adapted from the WHO COVID-19 guideline,[19] and similar study done in China.[20]

Measurement of COVID-19 - related knowledge (Dependent variable)

The knowledge section of the questionnaire had 35 questions. The questions were intended to assess the participants' knowledge of COVID-19 plausibly influencing their health care seeking behavior. Yes/correct responses were labeled as "1", and incorrect/no/I don't know responses were labeled as "0". The scores were added up to create knowledge ranking for the aforementioned categories. The pooled scores of questions were classified into inadequate and adequate knowledge

using median (50%) score values. Inadequate Knowledge was labeled as "1", and Adequate Knowledge was labeled as "0".

Operational definitions

The respondent was classified as having "**Inadequate Knowledge**" when he/she answered correctly below 50% of COVID-19 related knowledge questions. Whereas, the respondent was classified as having "**Adequate Knowledge**" when he/she answered correctly 50% and above of COVID-19 related knowledge questions.

Data quality assurance

Pre-test was conducted on 5% of the total sample size in Kalu district, and the amendment was done according to the finding. Training on the objectives of the study was given to data collectors and supervisors before the day of the data collection. Regular supervision, control as well as support of data collectors by the supervisors were made daily, and each completed questionnaire was checked and the necessary feedback was offered to interviewers. The collected data were properly handled, reviewed and checked for completeness and consistency by the supervisors and before commencing analysis each day.

Data processing and analysis

The collected data were coded, edited, entered Epi-Info version 7.2 and analyzed using the Statistical Package for the Social Sciences (SPSS) version 20. Internal consistency of the knowledge measures was tested using a reliability test where the Cronbach alpha coefficient aided in determining the reliability of the variables. The results showed that the Cronbach alpha for knowledge questions was 0.801. The result added credibility where, according to Griethuijsen, the range of Cronbach alpha from 0.6 to 0.7 is considered adequate and reliable.[21] It is proved that the items used to measure knowledge on COVID-19 are therefore acceptable. Descriptive summary statistics such as mean ± SD, median ± IQR, frequencies and proportions were presented as

appropriate. Since the cross-sectional survey was conducted for a single outcome variable and multiple response variables, binary logistic regression analysis was done and all independent variables at p<0.20 were taken to a multivariable logistic regression analysis[22] to identify associated factors with outcome variables. The statistical significance of the variables at the final model was declared at p<0.05 and 95% confidence level for the adjusted odds ratio. The Hosmer and Lemeshow statistics and the deviance coefficient were used to check the goodness of the fit of the model.

RESULTS

Socio-demographic characteristics of participants

A total of 828 participants were involved with a response rate of 98%. Among the study participants, 541 (65.3%) are from Dessie city, and the rest are from Kombolcha city. Among the participants, 511 (61.7%) were females; 423 (51.1%) were Muslim followed by 385 (46.5%) Orthodox Tewahido religions' followers. The mean (`Standard Deviation) age of the study participants was 39 (±14) years. From all participants, 672 (81.2%) were living in urban settings; 576 (69.6%) were married, 167 (20.2) were single headed participants; 218 (26.4%) had no formal education. Regarding their occupational status, 246 (29.7%) were housewives followed by 176 (21.3%) government employees (Table 2).

Table 2. Socio-demographic characteristics of participants in Dessie and Kombolcha city Administrations, northeast Ethiopia, 2020 (n=828).

Demographic characteristics	Frequency	Percentage	Mean (±SD)
City name			
Dessie	541	65.3	
Kombolcha	287	34.7	
Sex			
Male	317	38.3	
Female	511	61.7	
Age group			39 (±14)
18-35	422	51.0	
36-64	341	41.2	
>=65	65	7.9	

Religion		
Orthodox Tewahedo	385	46.5
Muslim	423	51.1
Catholic	8	1.0
Protestant	12	1.4
Place of residence		
Urban	672	81.2
Rural	156	18.8
Marital status		
Single	167	20.2
Married	576	69.6
Divorced	47	5.7
Widowed	38	4.6
Education level		
Unable to read and write	153	18.5
Able to read and write with informal education	65	7.9
Primary school (grade 1-8)	158	19.1
Secondary school (grade 9-12)	204	24.6
Above 12 grades (University/College/TVET)	248	30.0
Main occupation		
House wife	246	29.7
Merchant	168	20.3
Farmer	37	4.5
Government employee	176	21.3
NGO employee	63	7.6
Labourer	82	9.9
Student	56	6.8

Household level and Media related characteristics

The median (±interquartile range) for family size of the participants was 4.42 (±1.8). The median (±IQR) income of the participants was 3,000 (±2500) ETB. Of the participants, 29 (3.5%) use their water from a spring water source (any type: protected or unprotected). Among them, 584 (70.5%) had lack adequacy of water (<20L/C/D) and, 789 (95.3%) access their source of water within less than 30 minutes (1km round trip). About 720 (87%) had a functional TV in the household, 78 (94.3%) had a cell phone (Table 3).

Table 3. Household level and media related characteristics of participants in Dessie and Kombolcha city Administration, northeast Ethiopia, 2020

HH and media characteristics	Frequency	Percentage	Median (±IQR)
Family size			
1-3	251	30.3	4.42(±1.8)
4-6	476	57.5	
>6	101	12.2	
Monthly Income at household level			3000(±2500)
Type of water sources			
Piped water in dwelling	136	16.4	
Piped water at yard	585	70.7	
Communal "Bono"	78	9.4	
Spring (any type: protected or unprotected)	29	3.5	
Amount of water in Litter/Capita/Day			13.15(`12.00)
No access (<20L/C/D)	584	70.5	
Basic access (>=20L/C/D)	244	29.5	
Time to take water in minutes			2.00(±2.00)
<=30 minutes (1 km round trip)	789	95.3	
>30 minutes (>1 km round trip)	39	4.7	
Functional TV in the household			
No	108	13.0	
Yes	720	87.0	
Functional radio in the household			
No	347	41.9	
Yes	481	58.1	
Functional cell phone in the household			
No	47	5.7	
Yes	781	94.3	

Factors associated with Knowledge of participants towards prevention of COVID-19 pandemic

In the bivariate logistic regression (first model), seventeen independent variables were entered. In the multivariable logistic regression (second model), only seven variables were significantly associated with inadequate knowledge of participants towards the prevention of the COVID-19 pandemic. Variables associated with inadequate knowledge towards COVID-19 prevention were sex, age, residence, educational level, information from health care workers, mass media and social media.

Female participants were 41% more likely to have inadequate knowledge towards COVID-19 as compared to their counterparts (AOR=1.41, 95% CI; 1.03, 1.92). Participants whose age group >=65 years were 2.72 times more likely to have inadequate knowledge of COVID-19 as compared to the age groups of 18-35 years (AOR= 2.27, 95% CI; 1.45, 5.11). People who live in rural areas are 2.70 times more likely to have inadequate knowledge as compared to urban dwellers. The participants who were unable to read and write were 60% times more likely to have inadequate knowledge compared to those who were attending high level education (AOR=1.60, 95% CI; 1.02, 2.51). Participants who did not receive information from health care workers towards COVID-19 were 95% times more likely to have inadequate knowledge as compared to those who received information from health care workers (AOR=1.95, 95% CI; 1.35, 2.82). Among the participants who were not receiving information about COVID-19 from mass media, they were 2.6 times more likely to have inadequate knowledge compared to those who received information from mass media (AOR=2.57, 95% CI; 1.58, 4.19]. In addition, participants who were not receiving information from social media were 2.13 times more likely to have inadequate knowledge about COVID-19 as compared to those who received it from social media (AOR= 2.13, 95% CI; 1.33, 3.42) (Table 4).

DISCUSSION

This finding showed that the proportion of inadequate knowledge towards COVID-19 prevention was 54.11% (95% CI: 50.6, 57.6), which is higher than studies conducted in Debre Birhan University, Ethiopia (26.2%),[23] Syrians (40%),[24] Iran (39.2%),[25] Bangladesh (51.7%),[26] Saudi Arabia (18.4%),[27] across the world (20.1%),[28] Malaysia (19.5%),[29] India (13.3%),[30] three Middle Eastern countries (Jordan, Saudi Arabia and Kuwait) (33.9%) [11] and Sudan (9.4%). [31] The differences in level of knowledge have been subjected to variation in the cut-values. In addition,

the discrepancies might be due to differences in the reach of community awareness creation through mass media and social media.

In this study, the odds of inadequate knowledge towards COVID-19 were 1.4 times higher among female participants compared to male participants. This finding is similar to studies conducted in Iran,[25] Bangladesh,[32,33] Sudan.[31] In Ethiopia, most of home-based activities such as food preparation and food serving, child feeding, cloth hygiene, and home-based sanitation are left for females. Therefore, females may not get access to media because of their busy time taking care of the family members. Consequently, they are prone to inadequate knowledge of COVID-19 compared to males.

The study indicated that older adults (i.e. 65 and above years of age) had 3-folds greater odds of inadequate knowledge towards COVID 19 compared to adults. This finding is similar to studies conducted at Debre Birhan University, Ethiopia,[23] Iran,[25] Bangladesh, [26,33] medical college in Uttarakhand, India.[30] In most of the cases, older adults are not accessible to modern technologies in Ethiopia. Hence, they will have inadequate knowledge towards COVID-19 compared to adults due to the shortage of information.

The odds of inadequate knowledge were 2.7 times higher among participants who were residing in rural areas compared to those who were living in urban dwellers. This finding is similar to studies conducted in Bangladesh, [32,34] Sudan.[31] In Ethiopia, most of the people are living in rural areas which is hard to reach for awareness creation using mass media or social media (telegram, Facebook, WhatsUp and Instagram). Thus, people in rural settings had inadequate knowledge of COVID-19 prevention and control measures compared to urban populations who are easily accessible to different sources of media to acquire information regarding COVID-19.

Moreover, participants who were unable to read and write were 1.6 times more likely to have inadequate knowledge of COVID-19 compared to those who attended tertiary level educations. This finding is similar to studies conducted in Syrians,[24] Iran,[25] rural residents in China,[35] Sudan,[31] Bangladesh,[32] Nepal.[36] In Ethiopia, most of the unable to read and write segment of the population are found in rural areas. Those unable to read and write people are not accessible to media which are the ultimate source of information to acquire basic knowledge regarding prevention and control modalities of COVID-19 infections. Thus, participants who were unable to read and write are less knowledgeable about COVID-19 compared to tertiary educated participants.

The study revealed that the odds of inadequate knowledge were twofold times higher among participants who were not receiving information regarding COVID-19 from health care workers compared to those who were receiving from health care workers. Moreover, the odds of inadequate knowledge were 2.5 times higher among participants who were not receiving information regarding COVID-19 from mass media (TV/Radio) compared to their counterparts. Furthermore, the odds of inadequate knowledge were 2 times higher among participants who were not receiving information regarding COVID-19 from social media compared to those who were received from social media. This finding is similar to a study conducted in eight referral hospitals, Ethiopia.[37] The community may get information regarding the COVID-19 pandemic from different sources. These sources include health care workers, mass media (TV, radio, newspapers, and magazines), social media (telegram, Facebook, WhatsApp, Instagram, tweeters), and religious leaders. Thus, community members who are not accessible to these sources are less knowledgeable about COVID-19 compared to those who are accessible to the listed sources of information.

The findings may have implications in the prevention campaign/program of the new corona virus pandemic, particularly in the study settings. This study helps other researchers as a baseline

information for community-level studies. This finding may enforce the local as well as national Anti-COVID-19 programmers to revise their campaign plans to strengthen the efforts against the COVID-19 pandemic. This study extracted community level information regarding participants' knowledge about COVID-19 prevention from the hotspot areas of COVID-19. However, this study is limited due to its cross-sectional design/behavior which could not show cause and effect relationship.

CONCLUSIONS

In this study, more than half of the study participants had inadequate knowledge about COVID-19 prevention among residents of Dessie and Kombolcha city administrations, northeast Ethiopia. Findings from this study showed that sex, age, residence, educational level, information seeking from health care workers, mass media and social media were significantly associated with inadequate knowledge.

This study recommends revising the COVID-19 prevention plan to increase community awareness towards the COVID-19 pandemic. Strengthening the community to consider health care workers and mass media as a source of COVID-19 related information might be encouraged. House to house awareness creation might be important to address older adults who are more vulnerable to the pandemic. Females' empowerment in formal education shall be strengthened to increase their awareness and exposure to the latest information. The city administrations shall focus on their rural residents to access and have an appropriate information towards COVID-19 prevention.

List of abbreviations

AOR: adjusted odds ratio; CI: confidence interval; COVID-19: Coronavirus disease 2019; IQR: interquartile range; L/C/D: liter per capita per day; OR: odds ratio; SD: standard deviation

Declarations

Ethics approval and consent to participate

Ethical clearance was obtained from Ethical Review Committee [**Reference number: CMHS/311/036/12**] of College of Medicine and Health Sciences, Wollo University. Permission letter was obtained from Dessie and Kombolcha town administrations health department and offices, then from kebele administrations involved in the study. Informed verbal consent was obtained from each study participant. The information gathered from the participants was used for research purpose and confidentiality kept. Participation in the study was on a voluntary basis and participants who were unwilling to participate in the study and those who wish to quit from the study at any point in time informed to do so without any restriction.

Consent for publication

Not applicable.

Data sharing statement

The data used to produce this manuscript are available in Epi-Info version 7.2 and SPSS version 20 databases and the authors are prepared to share their data on request recognizing the benefits of such transparency.

Competing interests

No competing interests for any authors.

Patient and public involvement

Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

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Contributors

Conception and design of the study: AMK. Conduct of the study: AMK, GGB, AMM, KAY, and AWT. Analysis and interpretation of data: AMK, GGB and AMM. Drafting the manuscript and revising it critically: AMK, GGB, AMM, KAY, and AWT. All authors have given final approval for the manuscript to be published.

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Additional information

The questionnaire used for this study was available here (**Supplementary file**).

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Table 4. Bi-variable and multivariable logistic regression of knowledge towards COVID-19 pandemic among residents of Dessie and Kombolcha city administration, northeast Ethiopia, 2020 (n=828).

Variables	Knowledge level, n (%)		Crude odds ratio (COR)		Adjusted odds ratio (AOR)	
	Inadequate	Adequate	OR	95% CI	OR	95% CI
Sex						
Male	156(49.2)	161(50.8)	1		1	
Female	292(57.1)	219(42.9)	1.38	1.04, 1.82*	1.41	**1.03, 1.92***
Age						
18-35	215(50.9)	207(49.1)	1		1	
36-64	185(54.3)	156(45.7)	1.14	0.86, 1.52	1.14	0.83, 1.57
>=65	48(73.8)	17(26.2)	2.72	1.51, 4.88*	2.72	**1.45, 5.11***
Place of residence						
Urban	333(49.6)	339(50.4)	1		1	
Rural	115(73.7)	41(26.3)	2.86	1.94, 4.21*	2.69	**1.78, 4.07***
Marital status						
Single	92(55.1)	75(44.9)	1		1	
Married	307(53.3)	269(46.7)	0.93	0.66, 1.32	-	-

Divorced	27(57.4)	20(42.6)	1.10	0.57, 2.12	-	-
Widowed	22(57.9)	16(42.1)	1.12	0.55, 2.29	-	-
Education level						
Unable to read and write	94(61.4)	59(38.6)	2.48	1.64, 3.75*	1.60	**1.02, 2.51***
Able to read and write with informal education	46(70.8)	19(29.2)	3.77	2.09, 6.81*	2.29	**1.22, 4.30***
Primary school (grade 1-8)	98(62.0)	60(38.0)	2.54	1.69, 3.83*	1.67	**1.08, 2.60***
Secondary school (grade 9-12)	113(55.4)	91(44.6)	1.93	1.33, 2.82*	1.50	**1.01, 2.24***
Above 12 grade (University/College/TVET)	97(39.1)	151(60.9)	1		1	
Main occupation						
House wife	142(57.7)	104(42.3)	1.37	0.76, 2.44	0.73	0.38, 1.44
Merchant	84(50.0)	84(50.0)	1.00	0.55, 1.83	0.74	0.38, 1.44
Farmer	24(64.9)	13(35.1)	1.85	0.79, 4.34	0.67	0.25, 1.83
Government employee	83(47.2)	93(52.8)	0.89	0.49, 1.63	0.99	0.50, 1.95
NGO employee	31(49.2)	32(50.8)	0.97	0.47, 1.99	0.88	0.40, 1.92
Labourer	56(68.3)	26(31.7)	2.15	1.07,4.34*	1.37	0.63, 2.96
Student	28(50.0)	28(50.0)	1		1	
Family size						
1-3	137(54.6)	114(45.4)	1		1	
4-6	255(53.6)	221(46.4)	0.96	0.71, 1.31	-	-
>6	56(55.4)	45(44.6)	1.04	0.65, 1.65	-	-
Type of water sources						
Piped water in dwelling	64(47.1)	72(52.9)	1		1	
Piped water at yard	307(52.5)	278(47.5)	1.24	0.86, 1.81	1.08	0.72, 1.62
Communal "Bono"	53(67.9)	25(32.1)	2.39	1.33, 4.27*	1.08	0.54, 2.17
Spring (any type: protected or unprotected)	24(82.8	5(17.2)	5.40	1.95, 14.99*	2.58	0.77, 8.67
Amount of water in Litter/Capita/Day						
No access (<20L/C/D)	324(55.5)	260(44.5)	1.21	0.89, 1.63	-	-
Basic access (>=20L/C/D)	124(50.8)	120(49.2)	1		1	
Time to take/fetch water in minutes						
<=30 minutes (1 km round trip)	419(53.1)	370(46.9)	1		1	
>30 minutes (>1 km round trip)	29(74.4)	10(25.6)	2.56	1.23, 5.33*	0.69	0.25, 1.92
Functional TV/radio in the household						
No	73(67.6)	35(32.4)	1.92	1.25, 2.95*	0.97	0.58, 1.62
Yes	375(52.1)	345(47.9)	1		1	
Functional cell phone in the household						
No	31(66.0)	16(34.0)	1.69	0.91, 3.14*	0.96	0.47, 1.95

Yes	417(53.4)	364(46.6)	1		1	
COVID-19 Information heard from family members						
No	376(53.1)	332(46.9)	0.76	0.51, 1.12*	0.80	0.50, 1.28
Yes	72(60.0)	48(40.0)	1		1	
COVID-19 Information heard from health care workers						
No	355(57.5)	262(42.5)	1.72	1.25, 2.36*	1.95	**1.35, 2.82***
Yes	93(44.1)	118(55.9)	1		1	
COVID-19 Information heard from mass media (TV,…						
No	79(71.2)	32(28.8)	2.33	1.51, 3.60*	2.57	**1.58, 4.19***
Yes	369(51.5)	348(4835)	1		1	
COVID-19 Information heard from social mass (FB, …						
No	414(57.6)	305(42.4)	2.99	1.95, 4.61*	2.13	**1.33, 3.42***
Yes	34(36.2)	75(68.8)	1		1	
COVID-19 Information heard from religious leader's						
No	428(55.8)	339(44.2)	2.59	1.49, 4.50*	1.16	0.60, 2.28
Yes	20(32.8)	41(67.2)	1		1	

*for p<0.20 at bivariate analysis; *and bold for p<0.05 at multivariable analysis

Annex II: Questionnaire

Part I: Socio-demographic and media related characteristics of the participants

Town/town/ name ---------- kebele_____

Code	Questions	Responses	Skip
101.	Sex of the participant	1.Female 2.Male	
102.	Age in years	------- years	
103.	Place of residence	1.Urban 2.Rural	
104.	Marital status	1. Single 2. Married 3. Widowed 4. Divorced	
105.	Religion	1. Orthodox 2. Muslim 3. Protestant 4. Catholic 5. Others: ----------	
106.	Level of Education /What is the highest education level you have attended?	1. Unable to read and write 2. Read and write with informal education 3. Primary education/1-8/ 4. Secondary education 1/9-12/ 5. 12 + Education level	
107.	What is your main occupation?	1. House wife 2. Merchant 3. Farmer 4. Health care worker 5. Government employee	

		6. NGO employee 7. Daily labor 8. Student 9. Others: ----------	
108.	Total family size	----------(put in number)	
109.	Average monthly income	----------(ETB)	
110.	Time to fetch water in minute from source	----------minutes	
111.	Availability of television	1. No 2. Yes	
112.	Availability of radio	1. No 2. Yes	
113.	Availability of mobile phone	1. No 2. Yes	
114.	Water source	1. Piped water in dwelling 2. Piped water at yard 3. Bono water 4. Spring water 5. River water 6. Ground water 7. Other----------	

Part II: Knowledge related questions

Code	Questions	Responses	Skip
201.	Have you heard about the new coronavirus disease?	0. No 1. Yes	
202.	What do you know about the new coronavirus disease? (Only one option)	Choose one best answer: **1.** I don't know anything **2.** It's a virus that can cause a disease **3.** It's a government's program **4.** It's a TV/radio campaign	

		5. Others: ----------	
203.	If yes Q201, from whom or from where did you hear about the new coronavirus disease? (*Multiple response possible*)	1. Family members 2. Health care workers 3. Mass media (TV/Radio) 4. Social media (Facebook/telegram/etc….) 5. Religious leaders 6. Others (Specify)--------	
204.	What kind of information have you received about the disease? (*Multiple response possible)*	1. How to protect yourself from the disease? 2. Symptoms of the new coronavirus disease 3. How it is transmitted 4. What to do if you have the symptoms 5. Risks and complications 6. Other:----------	
205.	Do you know coronavirus is highly contagious?	1. Yes 2. No 3. Don't know	
206.	How does the coronavirus spread? (Mark all the ways you think the disease spreads)	1. Blood transfusion 2. Droplets from infected people 3. Airborne 4. Direct contact with infected people. 5. Touching contaminated objects/surfaces 6. Sexual intercourse contact 7. Contact with contaminated animals 8. Mosquito bites 9. Others: ----------	

207.	What are the main symptoms?(Mark all the symptoms you think are caused by the new coronavirus)	1. Fever 2. Dry Cough 3. Shortness of breath and breathing difficulties 4. Muscle pain 5. Headache 6. Diarrhea 7. Don't know 8. Others:----------	
208.	Does coronavirus have cure treatment?	1. Yes 2. No 3. Don't know	
209.	Do you know how to prevent it? (One or more options possible)	**1.** Sleep under the mosquito net **2.** Wash your hands regularly using alcohol or soap and water **3.** Drink only treated water **4.** Cover your mouth and nose when coughing or sneezing **5.** Avoid close contact with anyone who has a fever and cough **6.** Keeping physical/social/distance **7.** Don't know **8.** Others: ----------	
210.	What more would you like to know about the disease?	1.How to protect yourself from the disease 2. Symptoms of the new coronavirus disease 3. How it is transmitted 4. What to do if you have the symptoms	

		5. Most at risk groups 6. Other----------	
213	Do you feel that people in your community know (enough) about the coronavirus disease? If yes for Q213 Why If No for Q213 why	1. Yes 2. No _____ ---------- ----------	

The interview is ended. Thank you.

Interviewer's name _____signature _____date_____

Supervisor name _____ signature _____ date_____

Research checklist

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-5
Objectives	3	State specific objectives, including any prespecified hypotheses	2, 5
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	8
Bias	9	Describe any efforts to address potential sources of bias	1
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	n/a
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	9
		(*b*) Describe any methods used to examine subgroups and interactions	n/a
		(*c*) Explain how missing data were addressed	9
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	n/a
		(*e*) Describe any sensitivity analyses	n/a
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9
		(b) Give reasons for non-participation at each stage	9
		(c) Consider use of a flow diagram	9
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9-12
		(b) Indicate number of participants with missing data for each variable of interest	9-12
Outcome data	15*	Report numbers of outcome events or summary measures	12
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted	12

		estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	
		(*b*) Report category boundaries when continuous variables were categorized	12
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	n/a
Discussion			
Key results	18	Summarise key results with reference to study objectives	13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	2
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	13-14
Generalisability	21	Discuss the generalisability (external validity) of the study results	13-14
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	16

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Knowledge level and factors influencing prevention of COVID-19 pandemic among residents of Dessie and Kombolcha city administrations, northeast Ethiopia: A population-based cross-sectional study

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Knowledge level and factors influencing prevention of COVID-19 pandemic among residents of Dessie and Kombolcha city administrations, northeast Ethiopia: A population-based cross-sectional study

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Abstract

Objective: In Ethiopia, community-level knowledge about the current COVID-19 pandemic has not been well-studied. This study is aimed to assess knowledge level and factors influencing the prevention of the COVID-19 pandemic among residents of Dessie and Kombolcha city administrations, Ethiopia.

Design: Community-based cross-sectional study

Settings: Dessie and Kombolcha city administrations

Participants: Participants were household heads or members (n=828, >18years) who have lived in the study area for at least two months preceding the survey.

Methods: A binary logistic regression was used for a single outcome and multiple response variables. In the multivariable regression model, a p-<0.05 and adjusted odds ratio (AOR) with 95% confidence interval were used to identify factors associated with knowledge level of the community. Epi-Info version 7.2 and SPSS version 20 software were used for data entry and analysis respectively.

Outcome: Knowledge level

Results: A total of 828 participants were involved with a response rate of 98%. Females were 61.7%. Participants' mean (±SD) age was 39 (±14) years. From the total participants; 54.11% (95% CI: 50.6, 57.6) had inadequate knowledge about COVID-19 prevention. Significant associations were reported among females (AOR=1.41; 95% CI: 1.03, 1.92); age ≥65years (AOR=2.72; 95% CI: 1.45, 5.11); rural residence (AOR=2.69; 95% CI: 1.78, 4.07); unable to read and write (AOR=1.60; 95% CI: 1.02, 2.51); information not heard from healthcare workers, mass

media, and social media (AOR=1.95; 95% CI: 1.35, 2.82), (AOR=2.5; 95% CI: 1.58, 4.19) and (AOR=2.13; 95% CI: 1.33, 3.42) respectively with inadequate knowledge.

Conclusion: These findings revealed >50% of participants had inadequate knowledge about COVID-19. It highlights the need for widespread awareness campaigns about COVID-19 through mass media, healthcare professionals and social media as a source of information. House-to-house awareness creation is recommended to address older adults who are more vulnerable to the pandemic.

Keywords: Knowledge, Factors, COVID-19, Dessie, Kombolcha, Ethiopia

Strengths and limitations of this study

- This is the first community-level study in northeast Ethiopia which extracted information regarding participants' knowledge about COVID-19 prevention.
- The study addressed hotspot areas of COVID-19 where these are the corridor sites for many entries in northeast Ethiopia
- This study is limited due to its cross-sectional design/behavior which lacks a cause and effect relationship.

INTRODUCTION

Coronavirus disease 2019 (COVID-19) was first detected in Wuhan, China, in December 2019 and on 30 January 2020. When the virus causes a large burden of morbidity and mortality in China and international locations, the World Health Organization (WHO) declared the current outbreak a public health emergency of international concern.[1] Globally, more than 34,161,721 were infected and nearly 1,016,986 fatalities after being declared as a pandemic by the WHO. In Africa, there are about 1,191,323 confirmed cases and 26,148 deaths reported as of 5:04 pm CEST, 2 October

2020.[2] International and national borders have been locked down, travel restricted, economies slashed and billions of people are isolated at their own homes as a measure to contain the outbreak.

The COVID-19 prevention interventions are more appropriate in the community as the knowledge regarding the new infection improves the preparedness of both the healthcare professionals and the general public.[3,4] The virus was rapidly transmitted to many countries across Africa, and the fatality related to COVID-19 has been an increase in the fastest time. In the continent, the infection rate of the COVID-19 may be increased due to less detection rate, live in a crowded place and a weak health system.[1,5-7]

Ethiopia is one of the countries threatened by COVID-19, a total of 76,098 confirmed cases, 1,204 deaths registered.[2] Although the country has not instituted a nation-wide lockdown, a state of emergency has been declared since 14 April 2020.[8] In Ethiopia, many organizations, including the government sector, have been implementing different measures that plans to prevent the virus. Despite the advocacy strategies by the media and numerous organizations to curb the spread of the pandemic, there still exists a gap in adoption and adhering to preventive mechanisms within communities. Most of the reason goes to lack of knowledge of the disease prevention technique.[5,9] Community-level knowledge concerning the COVID-19 pandemic plays a crucial role both in the choice of institutionally approved "top-down" medical policies and in grass-roots strategies adopted by communities. [10,11]

In Ethiopia, the positivity rate of the COVID-19 pandemic is increased from time to time.[12] Findings showed that gender, age, residence, education, and occupation were associated with knowledge of the community towards the pandemic.[4,9,11,13] However, community level studies are lacking, particularly in the study areas towards COVID-19 prevention.

There is a huge gap in preventing the pandemic since it is a new phenomenon, and little is known about the knowledge level of the disease by the general public.[14] This indicates the need for research in every aspect, but in developing countries, prioritizing prevention is the only effective way to curb the pandemic. So to do this, the community must know and implement prevention mechanisms. For the intervention to be successful, it is needed to have evidence that shows the level of the knowledge towards COVID-19 prevention strategies at the community level. Therefore, this research is aimed to assess the level of the knowledge and influencing factors towards COVID-19 prevention in Dessie and Kombolcha city administrations where these are the corridor sites for many entries in northeast Ethiopia.

METHODS

Study settings

The study was conducted from June 7-14, 2020, in Dessie and Kombolcha city administrations, Amhara National Regional State, North-East Ethiopia. Dessie is 401 kilometers and Kombolcha 376 kilometers away from Addis Ababa, the capital city of Ethiopia, respectively. Dessie city has 26 *Kebeles* (*the lowest administrative level in Ethiopia) (18* urban and 8 rural), and Kombolcha has 11 *Kebeles* (5 urban and 6 rural), a total of 37 *Kebeles* in the two city administrations. *Kebeles* are *the lowest administrative level in Ethiopia.* According to the 2012 E.C populations projection, in Dessie 91,870 households and in Kombolcha 34,097 households. A total of 125,967 households in the two city administrations. The total population of Dessie is 385,850 and Kombolcha 143,214. The two city administrations have 529,064 inhabitants, of which 262,157 males and 266,907 are females.[15]

Dessie is the 2nd populated metropolitan city and the corridor site of many entries in Amhara regional state, north-East, Ethiopia. Kombolcha is the twin city of Dessie which lies some 25 km

to the northwest. Kombolcha is connected with Dessie through road transportation. This city shares Kombolcha Airport with neighboring Dessie. The city is served by a station on the Awash–Weldiya Railway and neighbors with the Afar region. It is a gate site where foreigners and migrants live that mainly came from Djibouti and Arab countries. [16]

Study design and period

Population-based cross-sectional study was conducted to assess the knowledge level and factors influencing COVID-19 prevention strategies among the residents of Dessie and Kombolcha City administrations from July 01-07, 2020.

Population

The source of population was all the residents of Dessie and Kombolcha city administrations of Amhara Regional State, Northeast Ethiopia. The study population was residents found in the selected *Kebeles* in Dessie and Kombolcha City administrations who had the chance to be included in the sample.

Inclusion and exclusion criteria

Household heads or anyone from the house with the age of above 18 years were included in the study. They have been living in the study areas for the past two months preceding the survey. Whereas, participants who were critically and mentally ill during the study period were excluded from the study.

Sample size determination and Sampling procedures

This study has two objectives: namely; to assess knowledge level and to identify factors influencing the knowledge of the COVID-19 pandemic. Since COVID-19 is a new emerging disease and related evidence is not available at the national level, a single population proportion

formula was used to estimate the sample size (for knowledge level) by assuming a prevalence of 50%, 95% of the confidence level and 5% of the margin of error. The calculated sample size of this study was 768 participants with a design effect of two. By adding a tolerable non-response rate (10%), the total sample size was 845 participants.

$$n = \frac{(Z\alpha/2)^2 * p(1-p)}{w^2} * DE => n = \frac{(1.96)^2 * 0.5(1-0.5)}{(0.05)^2} * 2 = 768$$

By adding 10% non-response rate= 845

Where, prevalence (p) =50%; w=tolerable margin of error=5%; $Z^{\alpha/2}$ at 95%=1.96;

DE= Design effect

For the second objective, a double population proportion formula was used to estimate and maximize possible sample sizes using the assumptions of 80% power and 95% confidence level as below (Table 1).

Table 1. Sample size determinations for the second objective of the study are conducted to assess knowledge level and factors influencing COVID-19 prevention among residents of Dessie and Kombolcha city administrations, northeast Ethiopia

Variables name	References	Percentage of unexposed	80% power	95% CI	Odds ratio	Sample size	Design effect	10% NRR	Final sample size
Sex	[17]	74	80	0.05	0.40	186	2	37	409
Education	[17]	51.7	80	0.05	6.30	62	2	12	136
Occupation	[18]	9.3	80	0.05	5.7	86	2	17	189

Finally, by comparing the optional sample size estimations above, the maximum sample size, 845, was taken as the final for this study.

A two-stage sampling technique was employed to select the study participants. A total of 845 participants from their respective households were included in the study. Simple random sampling technique was applied to select *Kebeles* to eliminate selection bias. In the first stage, 9 *Kebeles* were selected out of 37 *Kebeles* using a lottery method. In the second stage, data were collected from participants at households using a systematic sampling technique (every 36th values were included). Then, based on their population size, the sample size was proportionally allocated to each of the sampled *Kebeles*. Dessie has 26 *Kebeles* (18 urban and 8 rural), and Kombolcha has 11 *Kebeles* (5 urban and 6 rural). The two city administrations have a total of 37 *Kebeles*.

Data collection

Data on socio-demographic variables, availability of household materials/related variables, source of information related to variables, and knowledge related variables were collected through a pretested and structured interviewer administered questionnaire. The questions were adapted from the WHO COVID-19 guideline,[19] and similar study done in China.[20]

Measurement of COVID-19 - related knowledge (Dependent variable)

The knowledge section of the questionnaire had 35 questions. The questions were intended to assess the participants' knowledge of COVID-19 plausibly influencing their health care seeking behavior. Yes/correct responses were labeled as "1", and incorrect/no/I don't know responses were labeled as "0". The scores were added up to create knowledge ranking for the aforementioned categories. The pooled scores of questions were classified into inadequate and adequate knowledge using median (50%) score values. Inadequate Knowledge was labeled as "1", and Adequate Knowledge was labeled as "0".

Operational definitions

The respondent was classified as having "**Inadequate Knowledge**" when he/she answered correctly below 50% of COVID-19 related knowledge questions. Whereas, the respondent was classified as having "**Adequate Knowledge**" when he/she answered correctly 50% and above of COVID-19 related knowledge questions.

Data quality assurance

Pre-test was conducted on 5% of the total sample size in Kalu district, and the amendment was done according to the finding. Training on the objectives of the study was given to data collectors and supervisors before the day of the data collection. Regular supervision, control as well as support of data collectors by the supervisors were made daily, and each completed questionnaire was checked and the necessary feedback was offered to interviewers. The collected data were properly handled, reviewed and checked for completeness and consistency by the supervisors and before the analysis was completedeach day.

Data processing and analysis

The collected data were coded, edited, entered Epi-Info version 7.2 and analyzed using the Statistical Package for the Social Sciences (SPSS) version 20. Internal consistency of the knowledge measures was tested using a reliability test where the Cronbach alpha coefficient aided in determining the reliability of the variables. The results showed that the Cronbach alpha for knowledge questions was 0.801. The result added credibility where, according to Griethuijsen, the range of Cronbach alpha from 0.6 to 0.7 is considered adequate and reliable.[21] It is proved that the items used to measure knowledge on COVID-19 are therefore acceptable. Descriptive summary statistics such as mean ± SD, median ± IQR, frequencies and proportions were presented as appropriate. Since the cross-sectional survey was conducted for a single outcome variable and multiple response variables, a binary logistic regression analysis was done and all independent variables at $p<0.20$ were taken to a multivariable logistic regression analysis[22] to identify

associated factors with outcome variables. The statistical significance of the variables at the final model was declared at p<0.05 and 95% confidence level for the adjusted odds ratio. The Hosmer and Lemeshow statistics and the deviance coefficient were used to check the goodness of the fit of the model.

RESULTS

Socio-demographic characteristics of participants

A total of 828 participants were involved with a response rate of 98%. Among the study participants, 541 (65.3%) are from Dessie city, and the rest are from Kombolcha city. Among the participants, 511 (61.7%) were females; 423 (51.1%) were Muslim followed by 385 (46.5%) Orthodox Tewahido religions' followers. The mean (`Standard Deviation) age of the study participants was 39 (±14) years. From all participants, 672 (81.2%) were living in urban settings; 576 (69.6%) were married, 167 (20.2) were single headed participants; 218 (26.4%) had no formal education. Regarding their occupational status, 246 (29.7%) were housewives followed by 176 (21.3%) government employees (Table 2).

Table 2. Socio-demographic characteristics of participants in Dessie and Kombolcha city Administrations, northeast Ethiopia, 2020 (n=828).

Demographic characteristics	Frequency	Percentage	Mean (±SD)
City name			
Dessie	541	65.3	
Kombolcha	287	34.7	
Sex			
Male	317	38.3	
Female	511	61.7	
Age group			39 (±14)
18-35	422	51.0	
36-64	341	41.2	
>=65	65	7.9	
Religion			
Orthodox Tewahedo	385	46.5	
Muslim	423	51.1	
Catholic	8	1.0	
Protestant	12	1.4	
Place of residence			

Urban	672	81.2
Rural	156	18.8
Marital status		
Single	167	20.2
Married	576	69.6
Divorced	47	5.7
Widowed	38	4.6
Education level		
Unable to read and write	153	18.5
Able to read and write with informal education	65	7.9
Primary school (grade 1-8)	158	19.1
Secondary school (grade 9-12)	204	24.6
Above 12 grades (University/College/TVET)	248	30.0
Main occupation		
House wife	246	29.7
Merchant	168	20.3
Farmer	37	4.5
Government employee	176	21.3
NGO employee	63	7.6
Labourer	82	9.9
Student	56	6.8

Household level and Media related characteristics

The median (±interquartile range) for family size of the participants was 4.42 (±1.8). The median (±IQR) income of the participants was 3,000 (±2500) ETB. Of the participants, 29 (3.5%) use their water from a spring water source (any type: protected or unprotected). Among them, 584 (70.5%) had lack adequacy of water (<20L/C/D) and, 789 (95.3%) access their source of water within less than 30 minutes (1km round trip). About 720 (87%) had a functional TV in the household, 78 (94.3%) had a cell phone (Table 3).

Table 3. Household level and media related characteristics of participants in Dessie and Kombolcha city Administration, northeast Ethiopia, 2020

HH and media characteristics	**Frequency**	**Percentage**	Median (±IQR)
Family size			
1-3	251	30.3	4.42(±1.8)
4-6	476	57.5	
>6	101	12.2	
Monthly Income at household level			3000(±2500)

Type of water sources			
Piped water in dwelling	136	16.4	
Piped water at yard	585	70.7	
Communal "Bono"	78	9.4	
Spring (any type: protected or unprotected)	29	3.5	
Amount of water in Litter/Capita/Day			13.15(`12.00)
No access (<20L/C/D)	584	70.5	
Basic access (>=20L/C/D)	244	29.5	
Time to take water in minutes			2.00(±2.00)
<=30 minutes (1 km round trip)	789	95.3	
>30 minutes (>1 km round trip)	39	4.7	
Functional TV in the household			
No	108	13.0	
Yes	720	87.0	
Functional radio in the household			
No	347	41.9	
Yes	481	58.1	
Functional cell phone in the household			
No	47	5.7	
Yes	781	94.3	

Factors associated with the Knowledge of participants towards prevention of the COVID-19 pandemic

In the bivariate logistic regression (first model), seventeen independent variables were entered. In the multivariable logistic regression (second model), only seven variables were significantly associated with inadequate knowledge of participants towards the prevention of the COVID-19 pandemic. Variables associated with inadequate knowledge towards COVID-19 prevention were sex, age, residence, educational level, information from health care workers, mass media and social media.

Female participants were 41% more likely to have inadequate knowledge towards COVID-19 as compared to their counterparts (AOR=1.41, 95% CI; 1.03, 1.92). Participants whose age group >=65 years were 2.72 times more likely to have inadequate knowledge of COVID-19 as compared to the age groups of 18-35 years (AOR= 2.27, 95% CI; 1.45, 5.11). People who live in rural areas

are 2.70 times more likely to have inadequate knowledge as compared to urban dwellers. The participants who were unable to read and write were 60% times more likely to have inadequate knowledge compared to those who were attending high level education (AOR=1.60, 95% CI; 1.02, 2.51). Participants who did not receive information from health care workers towards COVID-19 were 95% times more likely to have inadequate knowledge as compared to those who received information from health care workers (AOR=1.95, 95% CI; 1.35, 2.82). Among the participants who were not receiving information about COVID-19 from mass media, they were 2.6 times more likely to have inadequate knowledge compared to those who received information from mass media (AOR=2.57, 95% CI; 1.58, 4.19]. In addition, participants who were not receiving information from social media were 2.13 times more likely to have inadequate knowledge about COVID-19 as compared to those who received it from social media (AOR= 2.13, 95% CI; 1.33, 3.42) (Table 4).

DISCUSSION

This finding showed that the proportion of inadequate knowledge towards COVID-19 prevention was 54.11% (95% CI: 50.6, 57.6), which is higher than studies conducted in Debre Birhan University, Ethiopia (26.2%),[23] Syrians (40%),[24] Iran (39.2%),[25] Bangladesh (51.7%),[26] Saudi Arabia (18.4%),[27] across the world (20.1%),[28] Malaysia (19.5%),[29] India (13.3%),[30] three Middle Eastern countries (Jordan, Saudi Arabia and Kuwait) (33.9%) [11] and Sudan (9.4%). [31] The differences in level of knowledge have been subjected to variation in the cut-values. In addition, the discrepancies might be due to differences in the reach of community awareness creation through mass media and social media.

In this study, the odds of inadequate knowledge towards COVID-19 were 1.4 times higher among female participants compared to male participants. This finding is similar to studies conducted in

Iran,[25] Bangladesh,[32,33] Sudan.[31] In Ethiopia, most of home-based activities such as food preparation and food serving, child feeding, cloth hygiene, and home-based sanitation are left for females. Therefore, females may not get access to media because of their busy time taking care of the family members. Consequently, they are prone to inadequate knowledge of COVID-19 compared to males.

The study indicated that older adults (i.e. 65 and above years of age) had 3-folds greater odds of inadequate knowledge towards COVID 19 compared to adults. This finding is similar to studies conducted at Debre Birhan University, Ethiopia,[23] Iran,[25] Bangladesh, [26,33] medical college in Uttarakhand, India.[30] In most of the cases, older adults are not accessible to modern technologies in Ethiopia. Hence, they will have inadequate knowledge towards COVID-19 compared to adults due to the shortage of information.

The odds of inadequate knowledge were 2.7 times higher among participants who were residing in rural areas compared to those who were living in urban dwellers. This finding is similar to studies conducted in Bangladesh, [32,34] Sudan.[31] In Ethiopia, most of the people are living in rural areas which is hard to reach for awareness creation using mass media or social media (telegram, Facebook, WhatsUp and Instagram). Thus, people in rural settings had inadequate knowledge of COVID-19 prevention and control measures compared to urban populations who are easily accessible to different sources of media to acquire information regarding COVID-19.

Moreover, participants who were unable to read and write were 1.6 times more likely to have inadequate knowledge of COVID-19 compared to those who attended tertiary level educations. This finding is similar to studies conducted in Syrians,[24] Iran,[25] rural residents in China,[35] Sudan,[31] Bangladesh,[32] Nepal.[36] In Ethiopia, most of the unable to read and write segment of the population are found in rural areas. Those unable to read and write people are not accessible to media which

are the ultimate source of information to acquire basic knowledge regarding prevention and control modalities of COVID-19 infections. Thus, participants who were unable to read and write are less knowledgeable about COVID-19 compared to tertiary educated participants.

The study revealed that the odds of inadequate knowledge were twofold times higher among participants who were not receiving information regarding COVID-19 from health care workers compared to those who were receiving from health care workers. Moreover, the odds of inadequate knowledge were 2.5 times higher among participants who were not receiving information regarding COVID-19 from mass media (TV/Radio) compared to their counterparts. Furthermore, the odds of inadequate knowledge were 2 times higher among participants who were not receiving information regarding COVID-19 from social media compared to those who were receiving it from social media. This finding is similar to a study conducted in eight referral hospitals, Ethiopia.[37] The community may get information regarding the COVID-19 pandemic from different sources. These sources include health care workers, mass media (TV, radio, newspapers, and magazines), social media (telegram, Facebook, WhatsApp, Instagram, tweeters), and religious leaders. Thus, community members who are not accessible to these sources are less knowledgeable about COVID-19 compared to those who are accessible to the listed sources of information.

The findings may have implications in the prevention campaign/program of the new corona virus pandemic, particularly in the study settings. This study helps other researchers as a baseline information for community-level studies. This finding may enforce the local as well as national Anti-COVID-19 programmers to revise their campaign plans to strengthen the efforts against the COVID-19 pandemic. This study extracted community level information regarding participants' knowledge about COVID-19 prevention from the hotspot areas of COVID-19. However, this study

is limited due to its cross-sectional design/behavior which could not show a cause and effect relationship.

CONCLUSIONS

In this study, more than half of the study participants had inadequate knowledge about COVID-19 prevention among residents of Dessie and Kombolcha city administrations, northeast Ethiopia. Findings from this study showed that sex, age, residence, educational level, information seeking from health care workers, mass media and social media were significantly associated with inadequate knowledge.

This study recommends revising the COVID-19 prevention plan to increase community awareness towards the COVID-19 pandemic. Strengthening the community to consider health care workers and mass media as a source of COVID-19 related information might be encouraged. House to house awareness creation might be important to address older adults who are more vulnerable to the pandemic. Females' empowerment in formal education shall be strengthened to increase their awareness and exposure to the latest information. The city administrations shall focus on their rural residents to access and have an appropriate information towards COVID-19 prevention.

List of abbreviations

AOR: adjusted odds ratio; CI: confidence interval; COVID-19: Coronavirus disease 2019; IQR: interquartile range; L/C/D: liter per capita per day; OR: odds ratio; SD: standard deviation

Declarations

Ethics approval and consent to participate

Ethical clearance was obtained from Ethical Review Committee [**Reference number: CMHS/311/036/12**] of College of Medicine and Health Sciences, Wollo University. Permission

letter was obtained from Dessie and Kombolcha town administrations health department and offices, then from kebele administrations involved in the study. Informed verbal consent was obtained from each study participant. The information gathered from the participants was used for research purpose and confidentiality kept. Participation in the study was on a voluntary basis and participants who were unwilling to participate in the study and those who wish to quit from the study at any point in time informed to do so without any restriction.

Consent for publication

Not applicable.

Data availability

All data relevant to the study are included in the article or uploaded as supplementary information.

Competing interests

No competing interests for any authors.

Patient and public involvement

Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

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Contributors

Conception and design of the study: AMK. Conduct of the study: AMK, GGB, AMM, KAY, and AWT. Analysis and interpretation of data: AMK, GGB and AMM. Drafting the manuscript and

revising it critically: AMK, GGB, AMM, KAY, and AWT. All authors have given final approval for the manuscript to be published.

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Table 4. Bi-variable and multivariable logistic regression of knowledge towards COVID-19 pandemic among residents of Dessie and Kombolcha city administration, northeast Ethiopia, 2020 (n=828).

Variables	Knowledge level, n (%)		Crude odds ratio (COR)		Adjusted odds ratio (AOR)	
	Inadequate	Adequate	OR	95% CI	OR	95% CI
Sex						
Male	156(49.2)	161(50.8)	1		1	
Female	292(57.1)	219(42.9)	1.38	1.04, 1.82*	1.41	**1.03, 1.92***
Age						
18-35	215(50.9)	207(49.1)	1		1	
36-64	185(54.3)	156(45.7)	1.14	0.86, 1.52	1.14	0.83, 1.57
>=65	48(73.8)	17(26.2)	2.72	1.51, 4.88*	2.72	**1.45, 5.11***
Place of residence						
Urban	333(49.6)	339(50.4)	1		1	
Rural	115(73.7)	41(26.3)	2.86	1.94, 4.21*	2.69	**1.78, 4.07***
Marital status						
Single	92(55.1)	75(44.9)	1		1	
Married	307(53.3)	269(46.7)	0.93	0.66, 1.32	-	-
Divorced	27(57.4)	20(42.6)	1.10	0.57, 2.12	-	-
Widowed	22(57.9)	16(42.1)	1.12	0.55, 2.29	-	-
Education level						
Unable to read and write	94(61.4)	59(38.6)	2.48	1.64, 3.75*	1.60	**1.02, 2.51***
Able to read and write with informal education	46(70.8)	19(29.2)	3.77	2.09, 6.81*	2.29	**1.22, 4.30***
Primary school (grade 1-8)	98(62.0)	60(38.0)	2.54	1.69, 3.83*	1.67	**1.08, 2.60***
Secondary school (grade 9-12)	113(55.4)	91(44.6)	1.93	1.33, 2.82*	1.50	**1.01, 2.24***
Above 12 grade (University/College/TVET)	97(39.1)	151(60.9)	1		1	
Main occupation						

House wife	142(57.7)	104(42.3)	1.37	0.76, 2.44	0.73	0.38, 1.44
Merchant	84(50.0)	84(50.0)	1.00	0.55, 1.83	0.74	0.38, 1.44
Farmer	24(64.9)	13(35.1)	1.85	0.79, 4.34	0.67	0.25, 1.83
Government employee	83(47.2)	93(52.8)	0.89	0.49, 1.63	0.99	0.50, 1.95
NGO employee	31(49.2)	32(50.8)	0.97	0.47, 1.99	0.88	0.40, 1.92
Labourer	56(68.3)	26(31.7)	2.15	1.07,4.34*	1.37	0.63, 2.96
Student	28(50.0)	28(50.0)	1		1	
Family size						
1-3	137(54.6)	114(45.4)	1		1	
4-6	255(53.6)	221(46.4)	0.96	0.71, 1.31	-	-
>6	56(55.4)	45(44.6)	1.04	0.65, 1.65	-	-
Type of water sources						
Piped water in dwelling	64(47.1)	72(52.9)	1		1	
Piped water at yard	307(52.5)	278(47.5)	1.24	0.86, 1.81	1.08	0.72, 1.62
Communal "Bono"	53(67.9)	25(32.1)	2.39	1.33, 4.27*	1.08	0.54, 2.17
Spring (any type: protected or unprotected)	24(82.8	5(17.2)	5.40	1.95, 14.99*	2.58	0.77, 8.67
Amount of water in Litter/Capita/Day						
No access (<20L/C/D)	324(55.5)	260(44.5)	1.21	0.89, 1.63	-	-
Basic access (>=20L/C/D)	124(50.8)	120(49.2)	1		1	
Time to take/fetch water in minutes						
<=30 minutes (1 km round trip)	419(53.1)	370(46.9)	1		1	
>30 minutes (>1 km round trip)	29(74.4)	10(25.6)	2.56	1.23, 5.33*	0.69	0.25, 1.92
Functional TV/radio in the household						
No	73(67.6)	35(32.4)	1.92	1.25, 2.95*	0.97	0.58, 1.62
Yes	375(52.1)	345(47.9)	1		1	
Functional cell phone in the household						
No	31(66.0)	16(34.0)	1.69	0.91, 3.14*	0.96	0.47, 1.95
Yes	417(53.4)	364(46.6)	1		1	
COVID-19 Information heard from family members						
No	376(53.1)	332(46.9)	0.76	0.51, 1.12*	0.80	0.50, 1.28
Yes	72(60.0)	48(40.0)	1		1	
COVID-19 Information heard from health care workers						
No	355(57.5)	262(42.5)	1.72	1.25, 2.36*	1.95	**1.35, 2.82***
Yes	93(44.1)	118(55.9)	1		1	
COVID-19 Information heard from mass media (TV,...						
No	79(71.2)	32(28.8)	2.33	1.51, 3.60*	2.57	**1.58, 4.19***

Yes	369(51.5)	348(4835)	1		1	
COVID-19 Information heard from social mass (FB, …						
No	414(57.6)	305(42.4)	2.99	1.95, 4.61*	2.13	**1.33, 3.42***
Yes	34(36.2)	75(68.8)	1		1	
COVID-19 Information heard from religious leader's						
No	428(55.8)	339(44.2)	2.59	1.49, 4.50*	1.16	0.60, 2.28
Yes	20(32.8)	41(67.2)	1		1	

*for p<0.20 at bivariate analysis; *and bold for p<0.05 at multivariable analysis

Research checklist

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-5
Objectives	3	State specific objectives, including any prespecified hypotheses	2, 5
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	8
Bias	9	Describe any efforts to address potential sources of bias	1
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	n/a
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	9
		(*b*) Describe any methods used to examine subgroups and interactions	n/a
		(*c*) Explain how missing data were addressed	9
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	n/a
		(*e*) Describe any sensitivity analyses	n/a
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9
		(b) Give reasons for non-participation at each stage	9
		(c) Consider use of a flow diagram	9
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9-12
		(b) Indicate number of participants with missing data for each variable of interest	9-12
Outcome data	15*	Report numbers of outcome events or summary measures	12
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted	12

		estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	
		(*b*) Report category boundaries when continuous variables were categorized	12
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	n/a
Discussion			
Key results	18	Summarise key results with reference to study objectives	13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	2
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	13-14
Generalisability	21	Discuss the generalisability (external validity) of the study results	13-14
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	16

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.