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Is the students' knowledge and preventive behaviors sufficient enough to combat the spread of COVID-19 in re-opened schools?

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Abstract

Purpose: In Ethiopia, more than 26 million students have been out of the classroom for nearly nine months. On September 18th, the Ethiopian Minister of Health advised the Parliament the possibility of reopening schools provided certain conditions were met. Schools are currently reopening in the country for the first time since March.

Objective: This study assessed the knowledge and preventive health behaviors toward COVID-19 among secondary school students.

Design, setting, participants, and outcome measures: An institution-based cross-sectional study was conducted from October to December, 2020 in Gondar city, Northwest Ethiopia. A total of 370 secondary school students were included. Bivariable and multivariable ordinary logistic regression model were fitted to identify the predictors of knowledge about COVID-19. Whereas, simple and multiple linear regression analysis were done to identify factors associated with preventive behavior. A p-value of less than 0.05 was used to declare statistical significance.

Results: Only one fourth (23.5%, 95%CI: 19.5, 28.1) of the participants had a good knowledge about COVID-19. The mean score of preventive behavior was 22.8 ± SD 6.2. Marital status, religion, father education, living arrangement, and sources of information were significantly associated with knowledge about COVID-19. Being female and using health professionals' as source of information increased the engagement in preventive behaviors. On the other hand, student whose father employed in non-governmental organization and other jobs had decreased engagement in preventive health behaviors.

Conclusion: Significant number of the students had inadequate knowledge about COVID-19 and poorly engaged in COVID-19 preventive behavior to tackle the spread of the disease. Thus, it is suggested to include and disseminate about COVID-19 in related academic sessions, using school clubs, and mini-medias. The sources of COVID-19 related information need to strengthen the dissemination of tailored, credible, and timely message to enhance the knowledge and engagement the student in preventive behaviors.

Strengths and limitations of this study

- We assessed the knowledge and preventive health behaviors toward COVID-19 in re-opened secondary schools.
- The study identified that the knowledge level as well preventive behavior towards COVID-19 of the students is not sufficient enough to combat the spread of the disease.
- The effectiveness of COVID-19 prevention measures needs to be well established among the students.
- School communities need to admit that at the time when access to a vaccine isn't confirmed, adhering to preventive behaviors is the only way of making schools COVID-safe.
- This study has certain limitations to be noted. This is cross sectional study, could not show a cause-and-effect relationship, and the findings represent the situation during the study period. The knowledge and preventive practices among the student may change rapidly. Besides, this study was based on self-report of the participant. There would be social desirability that can bias the findings.

BACKGROUND

The novel Coronavirus (SARS-CoV-2 or COVID-19) was first reported in December 2019, in Wuhan, Hubei Province, China [1]. The World Health Organization (WHO) declared the coronavirus disease as a global pandemic on March 11, 2020 [2]. The coronavirus COVID-19 is affecting 219 countries and nowadays, it is a public health emergency throughout the world [3]. The fast spread of the disease has taken so many lives and caused massive disruption to families, societies, and economies all over the world [4]. The latest statistics reveal that coronavirus has infected more than 101,457,202 people until 21 January, 2021, and led to the deaths of more than 2,184,619 people worldwide [3].

The Ethiopian Minister of Health announced the first confirmed the first case of COVID-19 in Ethiopia on March 13, 2020 [5, 6]. Then after the government of Ethiopia took different public health measures to prevent the spread of the disease. All primary, secondary and tertiary educational institutions across the country were closed and all public gatherings including sports were banned, impacting more than 26 million students. Hand washing and social distancing were the main preventive measures communicated to the general public [7, 8]. On April 8, 2020 Ethiopian government declared a State of emergency to intensify the control and prevention of the spread of the disease [5]. As of January 27, 2020, there were 134,569 confirmed cases of COVID-19 cases and 2,075 confirmed deaths from the disease [9].

On September 18th, the Ethiopian Minister of Health advised Parliament that it was possible to reopen schools provided certain conditions were met. The ministry adapted the global guidance for reopening school to make the schools safer and established structures to facilitate the process of reopening [10]. The knowledge on mode of disease transmission, basic hygiene principles and other public health measures are important for effective control measures [11]. The government of Ethiopia is using different strategies to enhance the knowledge, attitude and practices towards COVID-19 prevention measures and are not motivating the response to COVID-19 [5, 12].

During such pandemic the WHO advices everybody to take responsibility and adopt protective behaviors [13]. The lack of knowledge about the disease would be one of the most common driving factors for poor adoption of COVID-19 prevention measures and may increase the spread of the disease as well as the number of new cases [14, 15]. Studies conducted in Ethiopian reported contradicting findings regarding knowledge and practices towards COVID-19 preventive

measures among different population [16]. Some reported the existence of good knowledge about COVID-19 and level of prevention practice [17] while others reported poor knowledge and poor practice related to COVID-19 preventive practice [16-18]. Some studies suggest to consider individuals risk perception as a major factor to promote the adherence of preventive measures [5, 12, 19].

Secondary school students have poor knowledge and healthy preventive practices towards COVID-19. The exposure to education intervention had improved knowledge, attitude, and practice of the students [20]. On the other hand, high school students in Ghana had substantial level of knowledge and positive perception of COVID-19 [21]. A couple studies in Europe revealed secondary school present a good level of knowledge, shows appropriate practice, and positive attitude towards COVID-19 at the time of its outbreak [22, 23].

The Ethiopian government is using an adopted Risk Communication and Community Engagement (RCCE) strategic approach to empower people to adopt preventive and health-seeking behaviors contributing to a reduction in the spread of COVID-19 [5, 24]. The Ethiopian Ministry of Health and Ethiopian Public Health Institute are proactively working on disseminating prevention messages on radio and television, at federal and regional levels, reaching a potential audience of 30 million people [25]. In addition, volunteers conducted mobilization activities against COVID-19 in marketplaces, slums and congested public places [26]. However, the knowledge and practices towards COVID-19 among the public is not sufficient enough to tackle the rapidly transmitted disease and undermined the preparedness and responses in the country [5].

In Ethiopia Schools are reopening after several months of closure. As schools reopen, strict precautionary measures are in place to protect students, teachers, non-teaching staff within the school and community from COVID-19. In such case, the reopening of schools brings an opportunity to empower students as agents of change to adopt the recommended positive behaviors to prevent the spread of COVID-19 [27]. Therefore, this study aimed at assessing the knowledge about COVID-19 and adoption of preventive health behavior among students in the re-opened high schools.

METHODS

Study design and area

An institutional based cross-sectional study design was conducted in Gondar city from November to December 2020. Gondar city administration is located at about 727 km away from Addis Ababa, the capital city of Ethiopia, and 180 km away from Bahirdar the capital city of Amhara Regional State. In the city there are 12 government and 5 private high schools (Grade 9 to Grade 12) with more than 23,200 students [28].

Sample size and sampling procedure

The sample size was calculated using a single population proportion formula; considering 50% (since no previous study found) proportion of students who have good preventive health practice towards COVID-19, 95% confidence interval (CI), marginal error (d) of 5%, and 5% non-response rate. The final sample size was estimated to be 403 participants.

Stratified simple random sampling technique was used to select the study participants. First, stratification was done based on school ownership into private and governmental schools. Then, four governmental (Fasiledes, Fasiledes Third, Azezo, and Hidar 11) and two private secondary schools (Debreselam and Waliya) were selected on random basis. Finally, study participants were selected randomly based on their class roaster using Microsoft excel random number generator.

Study Variables

Preventive health behaviors: Refers to the participant's practice concerning, handwashing, physical distancing, facemask wearing, so as to prevent COVID-19 infection. It was measured by eight items having five-point response rate ranging from 1 (Never) to 5 (always). The composite score of the preventive behaviors ranged from 7 to 35. The higher score indicates compliance behavior.

Knowledge of COVID-19: Refers to participant's cognition of symptoms, nature and preventive measures of COVID-19. It was measured by 17 items having three response categories (1 = True, 2 = False and 3 = I don't know). A correct answer was coded as 1 point whereas, the incorrect and unknown answer was recoded as zero. The composite score ranged from 0-17 and categorized using Bloom's cut-off point, as low-level of knowledge (less than 60%; less than 12 score), moderate level of knowledge (60-80%; 13-14 score) and good level of knowledge (80-100%; 15 and above score) [29].

Data collection tools and procedures

The data were collected by using pre-tested self-administered questionnaire adapted from different literatures [15, 17]. The questionnaire was prepared in English, then translated to the local language, Amharic. Trained four BSc nurses and two Masters of public health professionals collected the data and supervised the data collection process, respectively. COVID-19 safety measures (physical distancing, wearing masks, and hand hygiene) were taken during the data collection process. The questionnaire had five sections including socio demographic, social support, constructs of Health Belief Model, knowledge, and preventive health behavior. Content validity and pretest was done with 5 experts panel discussion and 20 students. Data collectors and supervisors took one day training on the objective of the study, content of the questionnaire, and ethical issues need to be taken during the data collection process. Each questionnaire was reviewed for completeness and consistency on daily basis. The internal consistency of the items was checked by Cronbach's alpha.

Data processing and analysis

The collected data entered in to EpiData version 4.6 and exported into to STATA version 14 statistical software for analysis. Multicollinearity among the independent variables was assessed using variance inflation factors (VIF) and was in the acceptable range. Descriptive statistics was used to quantify the magnitude of preventive healthy behavior, knowledge and describe the characteristic of the participant. Bivariable and multivariable ordinary logistic regression model was fitted to identify the factors associated with knowledge of COVID-19. Those variables with a p-value of less than 0.25 in the bivariable model were fitted in the multivariable model. The assumptions of ordinary logistic regression were checked using chi-squared and parallel line tests (the model was well-fitted with the data). Normality and homogeneity of variances were checked for preventive health behavior (the variable was normally distributed). Simple linear regression analysis was computed and all independent variables with p-value less than 0.25 were entered in multiple linear regression. An unstandardized β coefficient was used to interpret the effect of predictors to preventive health behavior. Variables with p value less than 0.05 at 95% confidence interval were considered as statistically significant.

Ethical considerations

Ethical clearance was obtained from the Institutional Review Board of the University of Gondar. Letter of permission was obtained from Gondar city administrative education office. After the

purpose and objective of the study have been informed, written consent was obtained from each study participant. Any identifiers of the study participants were not recorded. Indeed, for the participants with age less than 18, family/guardian informed consent and an assent from themselves was taken. Finally, health information was provided for the study participants about the coronavirus and relative preventive measures.

Patient and public involvement

This research was done without involving patient on the design and implementation. But the participants and administrative officials were informed about study objectives. The results will be disseminated to Gondar City Education Office and through open access publication.

RESULTS

Socio demographic characteristics

A total of 370 respondents were participated with a response rate of 91.8%. The non-response was due to not replying to items on the questionnaire (4.0%), inconsistent responses (2.4%) and not volunteered without reason (1.8%). More than half of the participant (51.9%) were females. The higher proportion of the participant were affiliated with Orthodox religion (87.6%), single (84.6%), and live with their parents (64.1%). The mean age of participants 18.0±1.8 years with the minimum 15 and maximum 30 years (**Table 1**). With regard to sources of information, television (55.4%) was the most common source of information about COVID-19 (**Figure 1**).

Knowledge about COVID-19

The reliability test of the knowledge about COVID-19 items for Cronbach's alpha was 79.0% According to the Blooms cut-off point nearly half (47.8%) of the participant had low knowledge about COVID-19. Only one fourth of them (23.5%) had a good knowledge (**Figure 2**). **Table 2** also presents the details of knowledge about COVID-19.

Preventive health behavior

The reliability test of the preventive health behavior items for Cronbach's alpha was 78.7%. The mean of preventive health behavior was 22.8 with standard deviation of 6.2. Two hundred and four (55.1%, 95% CI: 50.0, 60.2) respondents scored above the mean score of preventive health behavior.

Predictors of knowledge about COVID-19

Of the variables satisfied the assumption of proportional odds model, age, marital status, religion, father's educational status, father's occupation, living arrangement, and sources of information for COVID-19 were associated with knowledge of COVID-19 with a p-value of less than 0.25. After controlling the confounding variables, marital status, religion, father's education, living arrangement, and sources of information were significantly associated with knowledge about COVID-19. The odds of having good knowledge (moderate and good) among engaged/married students were nearly half to the odds for single students (AOR=0.47, 95% CI: 0.25, 0.90). The odds of having good knowledge was nearly 7.71 times higher in students affiliated with other religion than those affiliated with Orthodox (AOR=1.78, 95%CI: 1.24, 2.55). Students with father's educational status of diploma and above were 2.56 times higher odds good knowledge than those with uneducated father (AOR=2.56, 95%CI: 1.07, 6.12). The odds of having good knowledge was nearly 0.32 times lower in students living alone than those who lived with their parents (AOR=0.32, 95%CI: 0.15, 0.69). Students who used television (AOR=6.68, 95%CI: 2.73, 16.36), radio (AOR=2.91, 95%CI: 1.04, 8.11), and health profession (AOR=4.15, 95%CI: 1.51, 11.40) as sources of information on COVID-19 were 6.68, 2.91-, and 4.15-times odds of good knowledge than those who used Facebook, respectively (**Table 3**).

Predictors of COVID-19 preventive health behaviors

In simple linear regression, sex, marital status, grade level, mother's educational status, father's educational status, mother's occupation and father's occupation, living arrangement, source of information about COVID-19, and social support were significant at with a p-value ≤ 0.25 and entered in to multiple linear regression. In the multiple linear regression analysis, sex (β:1.35 95% CI: 0.02, 2.68), having father employed in non-governmental organization (NGO) (β: -2.37, 95% CI: -4.71, -0.02), other jobs (β: -3.46, 95% CI: -6.49, -0.43) and health profession as source of information (β:3.00, 95% CI: 0.20, 5.80) were statistically significant at a p-value of less than 0.05. The standardized regression coefficient revealed that source of information was the most important predictor of adoption of COVID-19 preventive measures. The analysis of this study showed that female students were 1.35 times more frequently engaged in preventive health behavior than males. Compared to students with father employed in government institution, engagement in COVID-19 preventive behavior decreased by 2.37 and 3.46 times among those whose father was

employed in NGO and other jobs, respectively. Students who used health professionals as sources of information were three time more engaged in preventive health behavior than those who use Facebook as source of information provided that other variables are kept constant (**Table 4**).

DISCUSSION

This study assessed the COVID-19 related knowledge and preventive health behavior of the student subsequent to the reopening of schools in Ethiopia. Student's adherence to COVID-19 preventive behaviors (physical distancing, wearing a mask, and hand washing) are a key to sustain the education in the pandemic era. Previous studies addressed the knowledge, attitude, and practices of COVID-19 immediately after onset of the pandemics in Ethiopia [16-18]. These studies revealed lack of knowledge, attitude and preventive practice among different populations [16, 19]. Since the adherence of these behaviors reduce the spread of the disease among the students, teachers, and community, the current study focused the knowledge of the student and their level of engagement in preventive behavior.

A lack of adequate knowledge is probably the driving force for poor preventive practice as well as the spread of the disease. In this study only about half (52.2%) of the students had at least moderate knowledge about COVID-19. This study result is higher than studies done among health science student in Arbaminch [30] and secondary school student in Egypt (before intervention) [20]. On the other hands, this finding is lower than studied done among college student in Amhara region, undergraduate student in Debre Berhan University, undergraduate medical students in Egypt, high school students in Ghana, Iranian medical students, Libya, Jordan, and Portugal [21-23, 31-36]. The discrepancy is may be due difference in access and use of information sources. The result highlights the need to address the gap of knowledge timely using tailored and effective approaches. The authors recommended briefing sessions or including information about the disease is health related subjects/ lessons may enhance the knowledge of the students.

This study showed students had low preventive health behaviors against COVID-19 with 55.1% respondents scored above the mean score. Contrary to scientific recommendation social distancing, hand washing, and wearing of a mask were not highly prevalent practices among students. Similar finding is reported by studies done among university students in Debre Birhan university [32] and secondary school student in Egypt [20]. Contrary to this study among secondary school students in in Italy [23] and Portugal [22] reported that students are practicing appropriate preventive

behaviors. The difference may be due to difference in COVID-19 related information access, risk perception, and enforcement of COVID related measures in nations. In addition, college student in Amhara region, medical students in Egypt, Iran, Libya, Jordan, and University students in Birzeit (Palestine) [23, 31, 33, 35-37] implemented proper strategies to prevent its spread of the disease. This may be due too high-risk perception, advanced knowledge about the disease, and previous experience of infection prevention practice enabled them to properly implement COVID-19 preventive health behavior. School authorities with respected responsible health authorities need to identify, meet, and coordinate the implementation of preventive behaviors at schools. The promotion and awareness creation activities also need to be revised according to the situation evolution.

The analysis of predictors of knowledge about COVID-19 revealed that engaged/married and students living alone had lower level of knowledge. Similarly, study done among college student in Amhara region reported single students had good knowledge about COVID-19 [31]. The other study health science student in Arbaminch reported that married and student living with family members had good knowledge than their counterparts [30]. Whereas, On the other hand, being affiliated with other religions, having educated father, and using television, radio, and health professional as a source of information were positively associated with good knowledge. Health professionals and electronic medias were the reliable source of information and promote health awareness and engagement in preventive measures. Study done in Debre Berhan University reported that source of information about COVID-19 associated with the mean knowledge [32]. Elsewhere study done in Ghana reported that increased access of information from electronic media and the role of peers and family members in dissemination of COVID-19 related information [21].

The analysis on the predictor of preventive health behavior among the student showed that being female and health professionals' source of information increased the engagement in preventive behaviors. We found that females engaged more in preventive health behaviors than males. This is allied with a tendency of females to be more health-conscious and engaged in preventive behavior [38]. Moreover, the low preventive behavior in men may be due to their perceptions of masculinity which reduces their motivation to accept preventive health behavior [24, 39]. Similar findings were reported by studies done in Portugal, medical students in Egypt, university students

in Palestine, and China [22, 33, 37, 40]. Health messages and other health promotion initiatives at schools need to introduce gender-specific tailor preventive measures in order to enhance their efficiency. On the other hand, student whose father employed in non-governmental organization and other jobs had decreased engagement in preventive health behaviors. In this study the level of knowledge of the participant was not significant predictor for preventive health behavior. This may be due to knowledge is neither sufficient nor necessary to trigger a behavioral change (adopting preventive behaviors).

This study has certain limitations to be noted. This is cross sectional study, could not show a cause-and-effect relationship, and the findings represent the situation during the study period. The knowledge and preventive practices among the student may change rapidly. Besides, this study was based on self-report of the participant. There would be social desirability that can bias the findings.

CONCLUSIONS

In this study, substantial number of the students had inadequate knowledge about COVID-19 and poorly engaged in COVID-19 preventive health behavior. The research results indicated that engaged/married and students living alone had a lower level of knowledge. Being affiliated with other religions, having educated father, and using television, radio, and health professional as a source of information were all been associated with good knowledge. Sex, father occupation and source of information have all contributed to COVID-19 preventive behaviors. Therefore, the effectiveness of COVID-19 prevention measures needs to be well established among the students. Interventions that increase the awareness of the students and promote health behaviors need to be strengthen in secondary schools. It is suggested to introduce COVID-19 related message need to be disseminated in related academic sessions, using school clubs, and mini-medias. In addition, the main sources of COVID-19 related information (health professionals, television, and radio) need to strengthen the dissemination of tailored, credible, and timely message to enhance the knowledge and engagement the student in preventive health behaviors.

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Contributors

SH AA AK and KS conceived and designed the study. SH AA AK and KS participated in data processing and management. SH analyzed the data and drafted the manuscript. AK and KS participated in data analysis and interpretation. SH AA AK and KS reviewed the drafted manuscript. All authors read and approved the final manuscript.

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Competing interests

The author declare that he has no conflict of interest

Consent for publication

Not applicable

Data availability statement

Data will be available from the corresponding author upon reasonable request.

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Tables

Table 1: Socio-demographic characteristics of secondary school students in Gondar City, Northwest Ethiopia, 2021 (n=370).

Variables	Description	Knowledge about COVID-19			Total frequency (%)
		Poor n (%)	Moderate n (%)	Good n (%)	
Age	15-19	150 (84.7)	95 (89.6)	77 (88.5)	322 (87.0)
	20-30	27 (15.3)	11 (10.4)	10 (11.5)	48 (13.0)
Sex	Male	87 (49.2)	50 (47.2)	41 (47.1)	178 (48.1)
	Female	90 (50.8)	56 (52.8)	46 (52.9)	192 (51.9)
Marital status	Single	142 (80.2)	96 (90.6)	75 (86.2)	313 (84.6)
	Engaged/married	35 (19.8)	10 (9.4)	12 (13.8)	57 (15.4)
Grade	10th	80 (45.2)	39 (36.8)	38 (43.7)	157(42.7)
	11th	39 (22.0)	33 (31.1)	21 (24.1)	93 (25.2)
	12th	58 (32.8)	34 (32.1)	28 (32.2)	120 (32.1)
Religion	Orthodox	161 (90.9)	91 (85.8)	72 (82.8)	324 (87.6)
	Muslim	14 (7.9)	13 (12.3)	12 (13.8)	39 (10.5)
	Others	2 (1.2)	2 (1.9)	3 (3.4)	7 (1.9)
Mother's occupation	Housewife	126 (71.2)	75 (70.8)	61 (70.1)	262 (70.8)
	Govt employee	20 (11.3)	15 (14.2)	12 (13.8)	47 (12.7)
	Marchant	17 (9.6)	9 (8.5)	7 (8.1)	33 (8.9)
	NGO employee	5 (2.8)	4 (3.8)	4 (4.6)	13 (3.5)
	Farmer	4 (2.3)	1 (0.9)	2 (2.3)	7 (1. 9)
	Other	5 (2.8)	2 (1.9)	1 (1.2)	8 (2.2)
Father's occupation	Government Employee	34 (19.2)	28 (26.4)	30 (34.5)	92 (24.9)
	NGO employee	17 (9.6)	11 (10.4)	14 (16.1)	42 (11.4)
	Merchant	43 (24.3)	29 (27.4)	21 (24.1)	93 (25.1)
	Farmer	72 (40.7)	31 (29.3)	18 (20.7)	121 (32.7)
	other	11 (6.2)	7 (6.6)	4 (4.6)	22 (5.9)
Mother's	Unable to read and write	71 (40.1)	32 (30.2)	28 (32.2)	131 (35.4)

educational status	Able to read and write	41 (23.2)	32 (30.2)	16 (18.4)	89 (24.1)
	Primary education	31 (17.5)	12 (11. 3)	16 (18.4)	59 (15.9)
	Secondary education	24 (13.6)	18 (17.0)	17 (19.5)	59 (15.9)
	Diploma and above	10 (5.7)	12 (11.3)	10 (11.5)	32 (8.7)
Father's educational status	Unable to read and write	39 (22.0)	10 (9.4)	15 (17.2)	64 (17.3)
	Able to read and write	59 (33.3)	37 (34.9)	20 (23.0)	116 (31.4)
	Primary education	27 (15.2)	20 (18.9)	12 (13.8)	59 (15.9)
	Secondary education	34 (19.2)	23 (21.7)	13 (14.9)	70 (18.9)
	Diploma and above	18 (10.2)	16 (15.1)	27 (31.0)	61 (16.5)
Living arrangement	With mother/father	103 (58.2)	70 (66.0)	64 (73.6)	237 (64.1)
	With siblings	25 (14.1)	13 (12.3)	11 (12.6)	49 (13.2)
	With relatives	14 (7.9)	12 (11.3)	5 (5.8)	31 (8.4)
	Alone	31 (17.5)	8 (7.6)	4 (4.6)	43 (11.6)
	Other	4 (2.3)	3 (2.8)	3 (3.5)	10 (2.7)

Table 2: Knowledge about COVID-19 among secondary school students in Gondar City, Northwest Ethiopia, 2021 (N= 370).

S.no	Knowledge Items	Frequency (%)	
		Wrong	Correct
K1	Main clinical symptoms of COVID-19 are fever, cough, shortness of breath, and fatigue	45 (12.2)	325 (87.8)
K2	Unlike the common cold, stuffy nose, runny nose, and sneezing are less common in persons infected with the COVID-19 virus	221(59.7)	149 (40.3)
K3	COVID-19 symptoms appear within 2–14 days	120 (32.4)	250 (67.6)
K4	Currently, there is no effective treatment or vaccine for COVID-2019, but early symptomatic and supportive treatment can help most patients to recover from the infection.	160 (43.2)	210 (56.8)
K5	Not all persons with COVID-19 will develop severe cases. Those who are elderly, have chronic illnesses, and with suppressed immunity are more likely to be severe cases	184 (49.7)	186 (50.3)
K6	The corona virus can infect children and adolescents.	136 (36.8)	234 (63.2)
K7	Touching or shaking hands of an infected person would result in the infection by theCOVID-19 virus.	108 (29.2)	262 (70.8)
K8	Touching an object or surface with the virus on it, then touching your mouth, nose, or eyes with the unwashed hand would result in the infection by the COVID-19 virus	63 (17.0)	307 (83.0)
K9	The COVID-19 virus spreads via respiratory droplets of infected individuals through the air during sneezing or coughing of infected patients.	75 (20.3)	295 (79.7)
K10	Persons with COVID-19 cannot infect the virus to others if he has no any symptom of COVID-19	97 (26.2)	273 (73.8)
K11	Wearing masks when moving out of home is important to prevent the infection with COVID-19 virus	126 (34.1)	244 (65.9)
K12	Children and young adults do not need to take measures to prevent the infection by the COVID-19 virus	101 (27.3)	269 (72.7)
K13	To prevent the COVID-19 infection, individuals should avoid going to crowded places such as public transportations, religious places, Hospitals and Workplaces	100 (27.0)	270 (73.0)
K14	Washing hands frequently with soap and water for at least 20 seconds or use an alcohol-based hand sanitizer (60%) is important to prevent infection with COVD-19	123 (33.2)	247(66.8)
K15	Traveling to an infectious area or having contact with someone traveled to an area where the infection present is a risk for developing an infection	98 (26.5)	272 (73.5)

K16	Isolation and treatment of people who are infected with the COVID-19 virus are effective ways to reduce the spread of the virus	78 (21.1)	292 (78.9)
K17	People who have contact with someone infected with the COVID-19 virus should be immediately isolated in a proper place.	85 (23.0)	285 (77.0)

Table 3: Predictors of knowledge about COVID-19 among secondary school students in Gondar City, North West Ethiopia, 2021 (n=370)

Variable		Regression coefficient	Standard error	p-value	Adjusted Odds ratio	95% CI for AOR
Age	15-19 (ref.)					
	20-30	0.19	.34	0.58	1.21	0.62, 2.37
Marital status	Single (ref.)					
	Engaged/married	-0.75	0.33	0.02	0.47	0.25, 0.90
Religion	Orthodox (ref.)					
	Muslim	0.40	0.35	0.25	1.46	0.74, 2.89
	Other*	2.04	0.84	0.01	7.71	1.50, 39.66
Father 's educational status	Unable to read and write (ref.)					
	Able to read and write	0.28	0.33	0.39	1.33	0.69, 2. 55
	Completed primary school	0.22	0.39	0.57	1.24	0.58, 2.66
	Completed secondary school	0.06	0.39	0.89	1.06	0.49, 2.30
	Diploma and higher	0.94	0.44	0.03	2.56	1.07, 6.12
Father's occupation	Government Employee (ref.)					
	NGO employee	0.29	0.38	0.44	1.34	0.64, 2.80
	Merchant	-0.44	0.33	0.18	0.64	0.34, 1.23
	Farmer	-0.41	0.37	0.27	0.67	0.32, 1.38
	Other	-0.75	0.48	0.12	0.47	0.18, 1.20
Living arrangement	Parents (ref.)					
	Siblings	-0.26	0.33	0.44	0.77	0.41, 1.47
	Relatives	-0.30	0.38	0.44	0.74	0.35, 1.57
	Alone	-1.14	0.40	0.00	0.32	0.15, 0.69
	Others	-0.27	0.66	0.69	0.77	0.21, 2.77
Source of information about COVID-19	Facebook (ref.)					
	Telegram	0.81	0.59	0.17	2.24	0.70, 7.13
	Television	1.89	0.46	0.00	6.68	2.73, 16.36
	Radio	1.07	0.52	0.04	2.91	1.04, 8.11
	Health professionals	1.42	0.52	0.01	4.15	1.51, 11.40
Cut 1		1.21	0.60			0.04, 2.38
Cut 2		2.67	0.61			1.48, 3.86

*Other: Catholic and Protestant

Table 4: Predictors of COVID-19 preventive health behaviors among secondary school students in Gondar City, North West Ethiopia, 2021 (n=370)

Variable		Unstandardized B	Standardized β	95% CI for B
Sex	Male (ref.)			
	Female	1.35*	0.11	0.02, 2.68
Age	15-19 (ref.)			
	20-30	0.73	0.04	-1.37, 2.82
Marital status	Single (ref.)			
	Engaged/married	1.64	0.10	-0.18, 3.45
Grade	10^{th} (ref.)			
	11^{th}	-0.61	-0.04	-2.25, 1.02
	12^{th}	0.17	0.01	-1.42, 1.76
Mother's educational status	Unable to read and write (ref.)			
	Able to read and write	-1.16	-0.08	-2.84, 0.53
	Completed primary school	-0.98	-0.06	-3.01, 1.04
	Completed secondary school	-1.33	-0.08	-3.67, 1.01
	Diploma and higher	-1.82	-0.08	-5.06, 1.41
Father 's educational status	Unable to read and write (ref.)			
	Able to read and write	0.18	0.01	-1.76, 2.13
	Completed primary school	0.46	0.03	-1.89, 2.80
	Completed secondary school	-0.90	-0.06	-3.37, 1.55
	Diploma and higher	-1.20	-0.07	-4.22, 1.82
Mother's occupation	Housewife (ref.)			
	Govt employee	-0.72	-0.04	-3.08, 1.64
	Marchant	-1.17	-0.05	-3.57, 1.22
	NGO employee	2.14	0.06	-1.45, 5.72
	Farmer	0.52	0.01	-4.20, 5.25
	Other	1.07	0.03	-3.32, 5.46
Father's occupation	Government Employee (ref.)			
	NGO employee	-2.37*	-0.12	-4.71, -0.02
	Merchant	-0.25	-0.02	-2.36, 1.85
	Farmer	-0.59	-0.04	-2.84, 1.67
	Other	-3.46*	-0.13	-6.49, -0.43
Living arrangement	Parents (ref.)			
	Siblings	0.60	0.03	-1.38, 2.58
	Relatives	-0.53	-0.02	-3.00, 1.93
	Alone	0.02	0.01	-2.30, 2.26
	Others	2.42	0.06	-1.54, 6.39
Source of information about COVID-19	Facebook (ref.)			
	Telegram	-0.41	-0.02	-3.61, 2.78
	Television	0.92	0.07	-1.41, 3.26
	Radio	-0.12	-0.01	-2.83, 2.60
	Health professionals	3.00*	0.17	0.20, 5.80

Social support	10.32±2.30	0.29	0.11	-0.01, 0.58
Constant		19.84		15.16, 24.53

*p<0.05, ref. =reference

Figures legends

Figure 1: Source of information about COVID-19 among secondary school students in Gondar City, Northwest Ethiopia, 2021 (N=370).

Figure 2: Knowledge status about COVID-19 among secondary school students in Gondar City, Northwest Ethiopia, 2021 (N= 370).

Figures

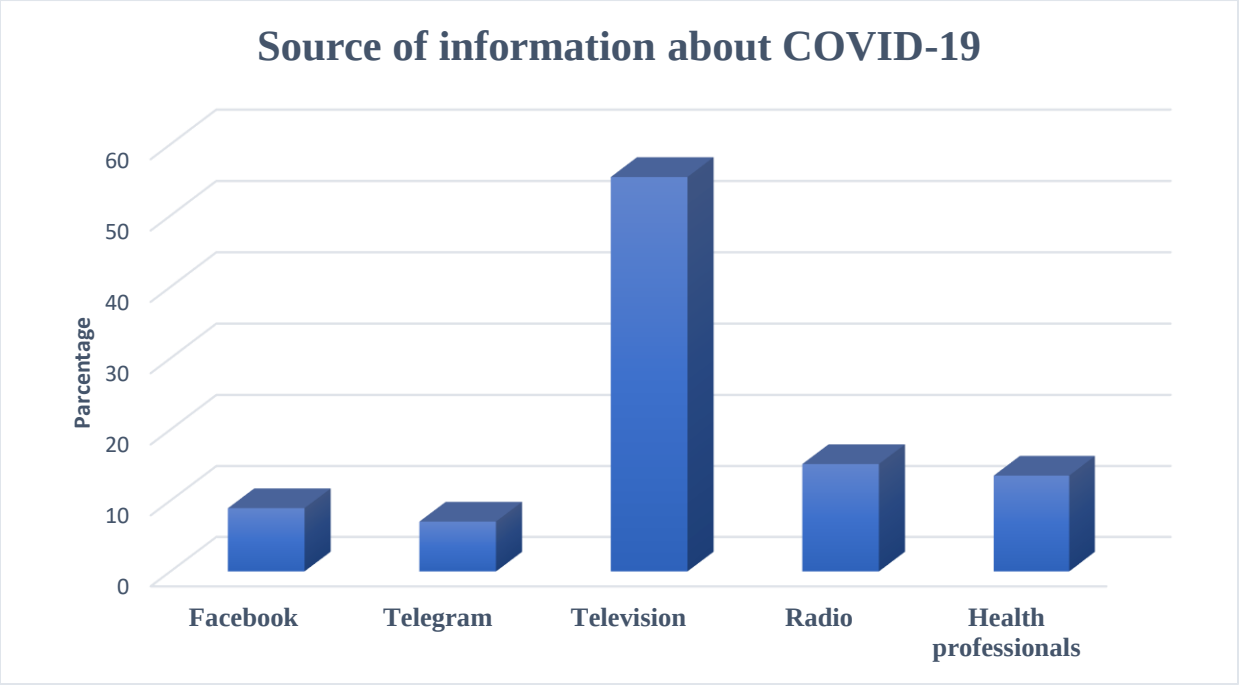

Figure 1: Source of information about COVID-19 among secondary school students in Gondar City, Northwest Ethiopia, 2021 (N=370).

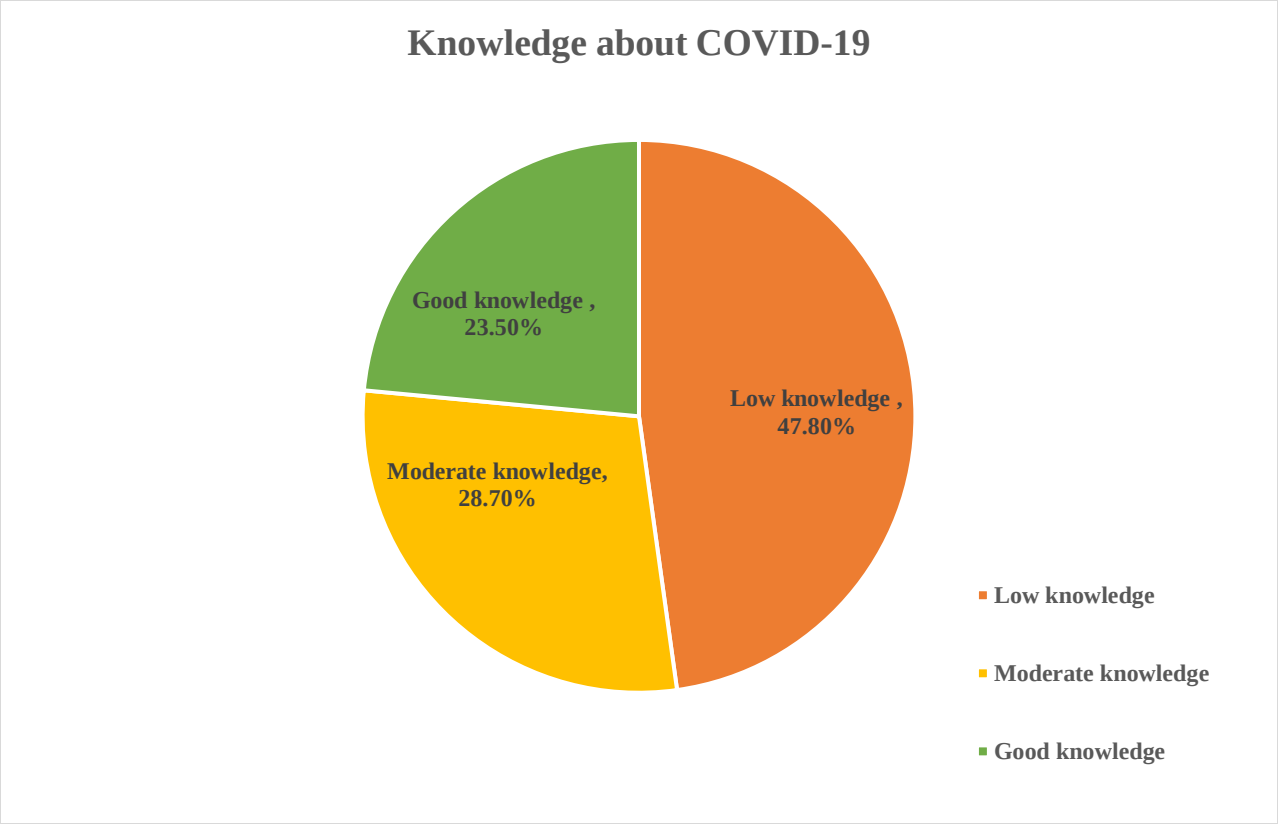

Figure 2: Knowledge status about COVID-19 among secondary school students in Gondar City, Northwest Ethiopia, 2021 (N= 370).

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No.	Recommendation	Page No.
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	4, 5
Objectives	3	State specific objectives, including any pre-specified hypotheses	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	6
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	6
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	6, 7
Bias	9	Describe any efforts to address potential sources of bias	7
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	7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7
		(*b*) Describe any methods used to examine subgroups and interactions	N/A
		(*c*) Explain how missing data were addressed	N/A
		(*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	8
		(b) Give reasons for non-participation at each stage	8
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8
		(b) Indicate number of participants with missing data for each variable of interest	N/A
Outcome data	15*	Report numbers of outcome events or summary measures	8

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9
		(*b*) Report category boundaries when continuous variables were categorized	8
		(*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	8, 9
Discussion			
Key results	18	Summarise key results with reference to study objectives	10
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	12
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	10, 11
Generalisability	21	Discuss the generalisability (external validity) of the study results	10, 11
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	13

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Determinants of COVID-19 related knowledge and preventive behaviors among students in re-opened secondary schools: cross-sectional study

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Determinants of COVID-19 related knowledge and preventive behaviors among students in re-opened secondary schools: cross-sectional study

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Abstract

Purpose: In Ethiopia, more than 26 million students have been out of the classroom for nearly nine months. On September 18th, the Ethiopian Minister of Health advised the Parliament the possibility of reopening schools provided certain conditions were met. Schools are currently reopening in the country for the first time since March, 2020.

Objective: This study assessed the knowledge and preventive health behaviors toward COVID-19 and associated factors among secondary school students.

Design, setting, participants, and outcome measures: An institution-based cross-sectional study was conducted from October to December, 2020 in Gondar city, Northwest Ethiopia. A total of 370 secondary school students were included. Bivariable and multivariable ordinal logistic regression model were fitted to identify the predictors of knowledge about COVID-19. Simple and multiple linear regression analysis were done to identify factors associated with preventive behavior. A p-value of less than 0.05 was used to declare statistical significance.

Results: Only one fourth (23.5%, 95%CI: 19.5, 28.1) of the participants had a good knowledge about COVID-19. The mean score of preventive behavior was 22.8 ± SD 6.2. Marital status, religion, father education, living arrangement, and sources of information were significantly associated with knowledge about COVID-19. Being female and using health professionals as source of information increased the engagement in preventive behaviors. On the other hand, student whose father employed in non-governmental organization and other jobs had decreased engagement in preventive health behaviors.

Conclusion: Significant number of the students had inadequate knowledge about COVID-19 and poorly engaged in COVID-19 preventive behavior. Thus, it is suggested to include and disseminate about COVID-19 in related academic sessions, using school clubs, and mini-medias. The sources of COVID-19 related information need to strengthen the dissemination of tailored, credible, and timely message to enhance the knowledge and engagement the student in preventive behaviors.

Strengths and limitations of this study

- This study assessed the knowledge and preventive health behaviors toward COVID-19 in re-opened secondary schools.
- We suggested that the effectiveness of COVID-19 prevention measures need to be established well-enough among the students.
- School communities need to admit that at the time when access to a vaccine isn't confirmed, adhering to preventive behaviors is the only way of making schools COVID-safe.
- Our study may be limited by social desirability bias due to self-report of the participants.
- Besides, the study could not show a cause-and-effect relationship, and the findings represent the situation during the study period.

BACKGROUND

The novel Coronavirus (SARS-CoV-2 or COVID-19) was first reported in December 2019, in Wuhan, Hubei Province, China [1]. The World Health Organization (WHO) declared the coronavirus disease as a global pandemic on March 11, 2020 [2]. The coronavirus COVID-19 is affecting 219 countries and nowadays, it is a public health emergency throughout the world [3]. The fast spread of the disease has taken so many lives and caused massive disruption to families, societies, and economies all over the world [4]. The latest statistics reveal that coronavirus has infected more than 101,457,202 people until 21 January, 2021, and led to the deaths of more than 2,184,619 people worldwide [3].

The Ethiopian Minister of Health announced the first confirmed the first case of COVID-19 in Ethiopia on March 13, 2020 [5, 6]. Then after the government of Ethiopia took different public health measures to prevent the spread of the disease. All primary, secondary and tertiary educational institutions across the country were closed and all public gatherings including sports were banned, impacting more than 26 million students. Hand washing and social distancing were the main preventive measures communicated to the general public [7, 8]. On April 8, 2020 Ethiopian government declared a State of emergency to intensify the control and prevention of the spread of the disease [5]. As of January 27, 2020, there were 134,569 confirmed cases of COVID-19 cases and 2,075 confirmed deaths from the disease [9].

On September 18th, the Ethiopian Minister of Health advised Parliament that it was possible to reopen schools provided certain conditions were met. The ministry adapted the global guidance for reopening school to make the schools safer and established structures to facilitate the process of reopening [10]. The knowledge on mode of disease transmission, basic hygiene principles and other public health measures are important for effective control measures [11]. The government of Ethiopia is using different strategies to enhance the knowledge, attitude and practices towards COVID-19 prevention measures and are not motivating the response to COVID-19 [5, 12].

During such pandemic the WHO advices everybody to take responsibility and adopt protective behaviors [13]. The lack of knowledge about the disease would be one of the most common driving factors for poor adoption of COVID-19 prevention measures and may increase the spread of the disease as well as the number of new cases [14, 15]. Studies conducted in Ethiopian reported contradicting findings regarding knowledge and practices towards COVID-19 preventive

measures among different population [16]. Some reported the existence of good knowledge about COVID-19 and level of prevention practice [17] while others reported poor knowledge and poor practice related to COVID-19 preventive practice [16-18]. Some studies suggest to consider individuals risk perception as a major factor to promote the adherence of preventive measures [5, 12, 19].

Secondary school students have poor knowledge and healthy preventive practices towards COVID-19. The exposure to education intervention had improved knowledge, attitude, and practice of the students [20]. On the other hand, high school students in Ghana had substantial level of knowledge and positive perception of COVID-19 [21]. A couple studies in Europe revealed secondary school present a good level of knowledge, shows appropriate practice, and positive attitude towards COVID-19 at the time of its outbreak [22, 23].

The Ethiopian government is using an adopted Risk Communication and Community Engagement (RCCE) strategic approach to empower people to adopt preventive and health-seeking behaviors contributing to a reduction in the spread of COVID-19 [5, 24]. The Ethiopian Ministry of Health and Ethiopian Public Health Institute are proactively working on disseminating prevention messages on radio and television, at federal and regional levels, reaching a potential audience of 30 million people [25]. In addition, volunteers conducted mobilization activities against COVID-19 in marketplaces, slums and congested public places [26]. However, the knowledge and practices towards COVID-19 among the public is not sufficient enough to tackle the rapidly transmitted disease and undermined the preparedness and responses in the country [5].

In Ethiopia Schools are reopening after several months of closure. As schools reopen, strict precautionary measures are in place to protect students, teachers, non-teaching staff within the school and community from COVID-19. In such case, the reopening of schools brings an opportunity to empower students as agents of change to adopt the recommended positive behaviors to prevent the spread of COVID-19 [27]. Improved awareness and adaption of preventive behaviors among students facilitate positive changes in the general population thru health messages and observation learning. Therefore, we need to understand the magnitude of COVID-19 related knowledge and preventive practice among students in the re-opened high schools. In addition, we also assessed whether socio demographic, social support, and source of COVID-19

related information were associated with the knowledge, and preventive health behavior towards COVID-19.

METHODS

Study design and area

An institutional based cross-sectional study design was conducted in Gondar city from November to December 2020. Gondar city administration is located at about 727 km away from Addis Ababa, the capital city of Ethiopia, and 180 km away from Bahirdar the capital city of Amhara Regional State. In the city there are 12 governments and 5 private high schools (Grade 9 to Grade 12) with more than 23,200 students [28].

Sample size and sampling procedure

The sample size was calculated using a single population proportion formula; considering 50% (since no previous study found) proportion of students who have good preventive health practice towards COVID-19, 95% confidence interval (CI), marginal error (d) of 5%, and 5% non-response rate. The final sample size was estimated to be 403 participants. The adequacy of the sample size for identifying the predictors of COVID-19 related knowledge preventive behavior was evaluated using post-hoc power analysis.

Stratified simple random sampling technique was used to select the study participants. First, stratification was done based on school ownership into private and governmental schools. Then, four governmental (Fasiledes, Fasiledes Third, Azezo, and Hidar 11) and two private secondary schools (Debreselam and Waliya) were selected on random basis. Finally, study participants were selected randomly based on their class roaster using Microsoft excel random number generator.

Study Variables

Preventive health behaviors: Refers to the participant's practice concerning, handwashing, physical distancing, facemask wearing, so as to prevent COVID-19 infection. It was measured by eight items having five-point response rate ranging from 1 (Never) to 5 (always). The composite score of the preventive behaviors ranged from 7 to 35. The higher score indicates compliance behavior.

Knowledge of COVID-19: Refers to participant's cognition of symptoms, nature and preventive measures of COVID-19. It was measured by 17 items having three response categories (1 = True, 2 = False and 3 = I don't know). A correct answer was coded as 1 point whereas, the incorrect and unknown answer was recoded as zero. The composite score ranged from 0-17 and categorized using Bloom's cut-off point, as low-level of knowledge (less than 60%; less than 12 score), moderate level of knowledge (60-80%; 13-14 score) and good level of knowledge (80-100%; 15 and above score) [29].

Data collection tools and procedures

The data were collected by using pre-tested self-administered questionnaire adapted from different literatures [15, 17]. The questionnaire was prepared in English, then translated to the local language, Amharic. Trained four BSc nurses and two Masters of public health professionals collected the data and supervised the data collection process, respectively. COVID-19 safety measures (physical distancing, wearing masks, and hand hygiene) were taken during the data collection process. The questionnaire had five sections including socio demographic, social support, source of COVID-19 related information, knowledge, and preventive health behavior. Content validity and pretest was done with 6 experts panel discussion and 20 students. It was determined by Item level Content Validity Index (I-CVI) of 0.78 or higher, Scale level Content Validity Index by Universal Agreement (S- CVI/UA) 0f 0.8 or higher and Scale level Content Validity Index by Average (S-CVI/Ave) 0.9 or higher. Data collectors and supervisors took one-day training on the objective of the study, content of the questionnaire, and ethical issues need to be taken during the data collection process (See the research tool at **Supplementary file**).

Data processing and analysis

Each questionnaire was reviewed for completeness and consistency on daily basis. The internal consistency of the items was checked by Cronbach's alpha. The collected data entered in to EpiData version 4.6 and exported into to STATA version 14 statistical software for analysis. Multicollinearity among the independent variables was assessed using variance inflation factors (VIF) and was in the acceptable range. Descriptive statistics was used to quantify the magnitude of preventive healthy behavior, knowledge and describe the characteristic of the participant. Bivariable and multivariable ordinal logistic regression model was fitted to identify the factors associated with knowledge of COVID-19. Those variables with a p-value of less than 0.25 in the

bivariable model were fitted in the multivariable model. The assumptions of ordinary logistic regression were checked using chi-squared and parallel line tests (the model was well-fitted with the data). Normality and homogeneity of variances were checked for preventive health behavior (the variable was normally distributed). Simple linear regression analysis was computed and all independent variables with p-value less than 0.25 were entered in multiple linear regression. An unstandardized β coefficient was used to interpret the effect of predictors to preventive health behavior. Variables with p value less than 0.05 at 95% confidence interval were considered as statistically significant.

Patient and public involvement

This research was done without involving patient on the design and implementation. But the participants and administrative officials were informed about study objectives. The results will be disseminated to Gondar City Education Office and through open access publication.

RESULTS

Socio demographic characteristics

A total of 370 respondents were participated with a response rate of 91.8%. The non-response was due to not replying to items on the questionnaire (4.0%), inconsistent responses (2.4%) and not volunteered without reason (1.8%). More than half of the participant (51.9%) were females. The higher proportion of the participant were affiliated with Orthodox religion (87.6%), single (84.6%), and live with their parents (64.1%). The mean age of participants 18.0±1.8 years with the minimum 15 and maximum 30 years (**Table 1**). With regard to sources of information, television (55.4%) was the most common source of information about COVID-19 (**Figure 1**).

Knowledge about COVID-19

The reliability test of the knowledge about COVID-19 items for Cronbach's alpha was 0.79 According to the Blooms cut-off point nearly half (47.8%) of the participant had low knowledge about COVID-19. Only one fourth of them (23.5%) had a good knowledge (**Figure 2**). **Table 2** also presents the details of knowledge about COVID-19.

Preventive health behavior

The reliability test of the preventive health behavior items for Cronbach's alpha was 0.79. The mean of preventive health behavior was 22.8 with standard deviation of 6.2. Two hundred and four (55.1%, 95% CI: 50.0, 60.2) respondents scored above the mean score of preventive health behavior (**Table 3**).

Predictors of knowledge about COVID-19

Of the variables satisfied the assumption of proportional odds model, age, marital status, religion, father's educational status, father's occupation, living arrangement, and sources of information for COVID-19 were associated with knowledge of COVID-19 with a p-value of less than 0.25. After controlling the confounding variables, marital status, religion, father's education, living arrangement, and sources of information were significantly associated with knowledge about COVID-19. The result of ordinal logistic regression analysis showed that the odds of having good knowledge (verses medium or poor knowledge) were 0.47 times lower for engaged/married students as compared to single students (AOR=0.47, 95% CI: 0.25, 0.90). The odds of having good knowledge was nearly 7.71 times higher for students affiliated with other religion as compared to those affiliated with Orthodox (AOR=1.78, 95%CI: 1.24, 2.55). Students belong to fathers with diploma and above education were 2.56 times higher odds of good knowledge than students belong to father with no education (AOR=2.56, 95%CI: 1.07, 6.12). The odds of having good knowledge was nearly 0.32 times lower for students living alone than those who lived with their parents (AOR=0.32, 95%CI: 0.15, 0.69). Students who used television (AOR=6.68, 95%CI: 2.73, 16.36), radio (AOR=2.91, 95%CI: 1.04, 8.11), and health profession (AOR=4.15, 95%CI: 1.51, 11.40) as sources of information on COVID-19 were 6.68, 2.91, and 4.15 times higher odds of good knowledge than those who used Facebook, respectively (**Table 4**).

Predictors of COVID-19 preventive health behaviors

In simple linear regression, sex, marital status, grade level, mother's educational status, father's educational status, mother's occupation and father's occupation, living arrangement, source of information about COVID-19, and social support were significant at with a p-value ≤ 0.25 and entered in to multiple linear regression. In the multiple linear regression analysis, sex (β:1.35 95% CI: 0.02, 2.68), having father employed in non-governmental organization (NGO) (β: -2.37, 95% CI: -4.71, -0.02), other jobs (β: -3.46, 95% CI: -6.49, -0.43) and health profession as source of information (β:3.00, 95% CI: 0.20, 5.80) were statistically significant at a p-value of less than 0.05.

The standardized regression coefficient revealed that source of information was the most important predictor of adoption of COVID-19 preventive measures. The analysis of this study showed that female students were 1.35 times more frequently engaged in preventive health behavior than males. Compared to students with father employed in government institution, engagement in COVID-19 preventive behavior decreased by 2.37 and 3.46 times among those whose father was employed in NGO and other jobs, respectively. Students who used health professionals as sources of information were three time more engaged in preventive health behavior than those who use Facebook as source of information provided that other variables are kept constant (**Table 5**).

DISCUSSION

This study assessed the COVID-19 related knowledge and preventive health behavior of the student and associated factors in the reopened schools, Northwest Ethiopia. Student's adherence to COVID-19 preventive behaviors (physical distancing, wearing a mask, and hand washing) are a key to sustain the education in the pandemic era. Previous studies addressed the knowledge, attitude, and practices of COVID-19 immediately after onset of the pandemics in Ethiopia [16-18]. These studies revealed lack of knowledge, attitude and preventive practice among different populations [16, 19]. Since the adherence of these behaviors reduce the spread of the disease among the students, teachers, and community, the current study focused the knowledge of the student and their level of engagement in preventive behavior.

A lack of adequate knowledge is probably the driving force for poor preventive practice as well as the spread of the disease. In this study only about half (52.2%) of the students had at least moderate knowledge about COVID-19. This study result is higher than studies done among health science student in Arbaminch [30] and secondary school student in Egypt (before intervention) [20]. On the other hands, this finding is lower than studied done among college student in Amhara region, undergraduate student in Debre Berhan University, undergraduate medical students in Egypt, high school students in Ghana, Iranian medical students, Libya, Jordan, and Portugal [21-23, 31-36]. The discrepancy is may be due difference in access and use of information sources. The result highlights the need to address the gap of knowledge timely using tailored and effective approaches. The authors recommended briefing sessions or including information about the disease is health related subjects/ lessons may enhance the knowledge of the students.

This study showed students had low preventive health behaviors against COVID-19 with 55.1% respondents scored above the mean score. Contrary to scientific recommendation social distancing, hand washing, and wearing of a mask were not highly prevalent practices among students. Similar finding is reported by studies done among university students in Debre Birhan university [32] and secondary school student in Egypt [20]. Contrary to this study among secondary school students in in Italy [23] and Portugal [22] reported that students are practicing appropriate preventive behaviors. The difference may be due to difference in COVID-19 related information access, risk perception, and enforcement of COVID related measures in nations. In addition, college student in Amhara region, medical students in Egypt, Iran, Libya, Jordan, and University students in Birzeit (Palestine) [23, 31, 33, 35-37] implemented proper strategies to prevent its spread of the disease. This may be due too high-risk perception, advanced knowledge about the disease, and previous experience of infection prevention practice enabled them to properly implement COVID-19 preventive health behavior. School authorities with respected responsible health authorities need to identify, meet, and coordinate the implementation of preventive behaviors at schools. The promotion and awareness creation activities also need to be revised according to the situation evolution.

The analysis of predictors of knowledge about COVID-19 revealed that engaged/married and students living alone had lower level of knowledge. Similarly, study done among college student in Amhara region reported single students had good knowledge about COVID-19 [31]. The other study health science student in Arbaminch reported that married and student living with family members had good knowledge than their counterparts [30]. Whereas, On the other hand, being affiliated with other religions, having educated father, and using television, radio, and health professional as a source of information were positively associated with good knowledge. Health professionals and electronic medias were the reliable source of information and promote health awareness and engagement in preventive measures. Study done in Debre Berhan University reported that source of information about COVID-19 associated with the mean knowledge [32]. Elsewhere study done in Ghana reported that increased access of information from electronic media and the role of peers and family members in dissemination of COVID-19 related information [21].

The analysis on the predictor of preventive health behavior among the student showed that being female and health professionals' source of information increased the engagement in preventive behaviors. Although those who had increased exposure to electronic medias seemed to be more aware of preventive measures to avoid COVID-19 spread, there is still the possibility that misinformation on the internet can have produced the opposite. We found that females engaged more in preventive health behaviors than males. This is allied with a tendency of females to be more health-conscious and engaged in preventive behavior [38]. Moreover, the low preventive behavior in men may be due to their perceptions of masculinity which reduces their motivation to accept preventive health behavior [24, 39]. Similar findings were reported by studies done in Portugal, medical students in Egypt, university students in Palestine, and China [22, 33, 37, 40]. Health messages and other health promotion initiatives at schools need to introduce gender-specific tailor preventive measures in order to enhance their efficiency. On the other hand, student whose father employed in non-governmental organization and other jobs had decreased engagement in preventive health behaviors. In this study the level of knowledge of the participant was not significant predictor for preventive health behavior. This may be due to knowledge is neither sufficient nor necessary to trigger a behavioral change (adopting preventive behaviors).

This study has certain limitations to be noted. This is cross sectional study, could not show a cause-and-effect relationship, and the findings represent the situation during the study period. The knowledge and preventive practices among the student may change rapidly. Besides, this study was based on self-report of the participant. There would be recall and social desirability that can bias the findings.

CONCLUSIONS

In this study, substantial number of the students had inadequate knowledge about COVID-19 and poorly engaged in COVID-19 preventive health behavior. The research results indicated that engaged/married and students living alone had a lower level of knowledge. Being affiliated with other religions, having educated father, and using television, radio, and health professional as a source of information were all been associated with good knowledge. Sex, father occupation and source of information have all contributed to COVID-19 preventive behaviors. Therefore, the effectiveness of COVID-19 prevention measures needs to be well established among the students. Interventions that increase the awareness of the students and promote health behaviors need to be

strengthen in secondary schools. It is suggested to introduce COVID-19 related message need to be disseminated in related academic sessions, using school clubs, and mini-medias. In addition, the main sources of COVID-19 related information (health professionals, television, and radio) need to strengthen the dissemination of tailored, credible, and timely message to enhance the knowledge and engagement the student in preventive health behaviors.

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Contributors

SH AA AK and KS conceived and designed the study. SH AA AK and KS participated in data processing and management. SH analyzed the data and drafted the manuscript. AK and KS participated in data analysis and interpretation. SH AA AK and KS reviewed the drafted manuscript. All authors read and approved the final manuscript.

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Competing interests

The author declare that he has no conflict of interest

Consent for publication

Not applicable

Data availability statement

Data will be available from the corresponding author upon reasonable request.

Ethics Statement

Ethical clearance was obtained from the Institutional Review Board of the University of Gondar with a reference number of V/P/RCS/05/588/2020. Letter of permission was obtained from Gondar city administrative education office. After the purpose and objective of the study have been informed, written consent was obtained from each study participant. Any identifiers of the study participants were not recorded. Indeed, for the participants with age less than 18, family/guardian

informed consent and an assent from themselves was taken. Finally, health information was provided for the study participants about the coronavirus and relative preventive measures.

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Tables

Table 1: Socio-demographic characteristics of secondary school students in Gondar City, Northwest Ethiopia, 2021 (n=370).

Variables	Description	Knowledge about COVID-19			p-value
		Poor n (%)	Moderate n (%)	Good n (%)	
Age	15-19	150 (84.7)	95 (89.6)	77 (88.5)	0.446
	20-30	27 (15.3)	11 (10.4)	10 (11.5)	
Sex	Male	86 (49.2)	51 (47.2)	41 (47.1)	0.0499
	Female	90 (50.8)	56 (52.8)	46 (52.9)	
Marital status	Single	142 (80.2)	96 (90.6)	75 (86.2)	0.059
	Engaged/married	35 (19.8)	10 (9.4)	12 (13.8)	
Grade	10th	80 (45.2)	39 (36.8)	38 (43.7)	0.495
	11th	39 (22.0)	33 (31.1)	21 (24.1)	
	12th	58 (32.8)	34 (32.1)	28 (32.2)	
Religion	Orthodox	161 (90.9)	91 (85.8)	72 (82.8)	0.344
	Muslim	14 (7.9)	13 (12.3)	12 (13.8)	
	Others	2 (1.2)	2 (1.9)	3 (3.4)	
Mother's occupation	Housewife	126 (71.2)	75 (70.8)	61 (70.1)	0.986
	Government employee	20 (11.3)	15 (14.2)	12 (13.8)	
	Marchant	17 (9.6)	9 (8.5)	7 (8.1)	
	NGO employee	5 (2.8)	4 (3.8)	4 (4.6)	
	Farmer	4 (2.3)	1 (0.9)	2 (2.3)	
	Other	5 (2.8)	2 (1.9)	1 (1.2)	
Father's occupation	Government Employee	34 (19.2)	28 (26.4)	30 (34.5)	0.039
	NGO employee	17 (9.6)	11 (10.4)	14 (16.1)	
	Merchant	43 (24.3)	29 (27.4)	21 (24.1)	
	Farmer	72 (40.7)	31 (29.3)	18 (20.7)	
	other	11 (6.2)	7 (6.6)	4 (4.6)	
Mother's educational	Unable to read and write	71 (40.1)	32 (30.2)	28 (32.2)	0.151
	Able to read and write	41 (23.2)	32 (30.2)	16 (18.4)	

status	Primary education	31 (17.5)	12 (11. 3)	16 (18.4)	
	Secondary education	24 (13.6)	18 (17.0)	17 (19.5)	
	Diploma and above	10 (5.7)	12 (11.3)	10 (11.5)	
Father's educational status	Unable to read and write	39 (22.0)	10 (9.4)	15 (17.2)	0.001
	Able to read and write	59 (33.3)	37 (34.9)	20 (23.0)	
	Primary education	27 (15.2)	20 (18.9)	12 (13.8)	
	Secondary education	34 (19.2)	23 (21.7)	13 (14.9)	
	Diploma and above	18 (10.2)	16 (15.1)	27 (31.0)	
Living arrangement	With mother/father	103 (58.2)	70 (66.0)	64 (73.6)	0.057
	With siblings	25 (14.1)	13 (12.3)	11 (12.6)	
	With relatives	14 (7.9)	12 (11.3)	5 (5.8)	
	Alone	31 (17.5)	8 (7.6)	4 (4.6)	
	Other	4 (2.3)	3 (2.8)	3 (3.5)	

Table 2: Knowledge about COVID-19 among secondary school students in Gondar City, Northwest Ethiopia, 2021 (N= 370).

S.no	Knowledge Items	Frequency (%)	
		Wrong	Correct
K1	Main clinical symptoms of COVID-19 are fever, cough, shortness of breath, and fatigue	45 (12.2)	325 (87.8)
K2	Unlike the common cold, stuffy nose, runny nose, and sneezing are less common in persons infected with the COVID-19 virus	221(59.7)	149 (40.3)
K3	COVID-19 symptoms appear within 2–14 days	120 (32.4)	250 (67.6)
K4	Currently, there is no effective treatment or vaccine for COVID-2019, but early symptomatic and supportive treatment can help most patients to recover from the infection.	160 (43.2)	210 (56.8)
K5	Not all persons with COVID-19 will develop severe cases. Those who are elderly, have chronic illnesses, and with suppressed immunity are more likely to be severe cases	184 (49.7)	186 (50.3)
K6	The corona virus can infect children and adolescents.	136 (36.8)	234 (63.2)
K7	Touching or shaking hands of an infected person would result in the infection by theCOVID-19 virus.	108 (29.2)	262 (70.8)
K8	Touching an object or surface with the virus on it, then touching your mouth, nose, or eyes with the unwashed hand would result in the infection by the COVID-19 virus	63 (17.0)	307 (83.0)
K9	The COVID-19 virus spreads via respiratory droplets of infected individuals through the air during sneezing or coughing of infected patients.	75 (20.3)	295 (79.7)
K10	Persons with COVID-19 cannot infect the virus to others if he has no any symptom of COVID-19	97 (26.2)	273 (73.8)
K11	Wearing masks when moving out of home is important to prevent the infection with COVID-19 virus	126 (34.1)	244 (65.9)
K12	Children and young adults do not need to take measures to prevent the infection by the COVID-19 virus	101 (27.3)	269 (72.7)
K13	To prevent the COVID-19 infection, individuals should avoid going to crowded places such as public transportations, religious places, Hospitals and Workplaces	100 (27.0)	270 (73.0)
K14	Washing hands frequently with soap and water for at least 20 seconds or use an alcohol-based hand sanitizer (60%) is important to prevent infection with COVD-19	123 (33.2)	247(66.8)
K15	Traveling to an infectious area or having contact with someone traveled to an area where the infection present is a risk for developing an infection	98 (26.5)	272 (73.5)

K16	Isolation and treatment of people who are infected with the COVID-19 virus are effective ways to reduce the spread of the virus	78 (21.1)	292 (78.9)
K17	People who have contact with someone infected with the COVID-19 virus should be immediately isolated in a proper place.	85 (23.0)	285 (77.0)

Table 3: COVID-19 preventive behaviors among secondary school students in Gondar city, Northwest Ethiopia, 2021 (n =370)

S. No	Items	Mean	Standard deviation
PH1	I keep a distance of at least two meters from others.	2.66	1.28
PH2	I place a tissue paper or bending elbow in front of my mouth and nose when coughing or sneezing.	3.26	1.33
PH3	I don't shake hands with others and don't kiss them.	2.92	1.30
PH4	I don't leave the house unless absolutely necessary	2.66	1.32
PH5	I wash my hands regularly with soap and water for at least 20 seconds every hour.	2.85	1.28
PH6	I do not touch my eyes, nose and mouth by hands.	2.76	1.32
PH7	I wash my hands with soap and water before touching anything while entering home.	2.98	1.44
PH8	I wear facemask consistently whenever I go out to my home.	2.69	1.39
	Overall preventive behavior standard score	2.85	0.77

Table 4: Predictors of knowledge about COVID-19 among secondary school students in Gondar City, North West Ethiopia, 2021 (n=370)

Variable		Regression coefficient	Standard error	p-value	Adjusted Odds ratio	95% CI for AOR
Age	15-19 (ref.)					
	20-30	0.19	.34	0.58	1.21	0.62, 2.37
Marital status	Single (ref.)					
	Engaged/married	-0.75	0.33	0.02	0.47	0.25, 0.90
Religion	Orthodox (ref.)					
	Muslim	0.40	0.35	0.25	1.46	0.74, 2.89
	Other*	2.04	0.84	0.01	7.71	1.50, 39.66
Father 's educational status	Unable to read and write (ref.)					
	Able to read and write	0.28	0.33	0.39	1.33	0.69, 2. 55
	Completed primary school	0.22	0.39	0.57	1.24	0.58, 2.66
	Completed secondary school	0.06	0.39	0.89	1.06	0.49, 2.30
	Diploma and higher	0.94	0.44	0.03	2.56	1.07, 6.12
Father's occupation	Government Employee (ref.)					
	NGO employee	0.29	0.38	0.44	1.34	0.64, 2.80
	Merchant	-0.44	0.33	0.18	0.64	0.34, 1.23
	Farmer	-0.41	0.37	0.27	0.67	0.32, 1.38
	Other	-0.75	0.48	0.12	0.47	0.18, 1.20
Living arrangement	Parents (ref.)					
	Siblings	-0.26	0.33	0.44	0.77	0.41, 1.47
	Relatives	-0.30	0.38	0.44	0.74	0.35, 1.57
	Alone	-1.14	0.40	0.00	0.32	0.15, 0.69
	Others	-0.27	0.66	0.69	0.77	0.21, 2.77
Source of information about COVID-19	Facebook (ref.)					
	Telegram	0.81	0.59	0.17	2.24	0.70, 7.13
	Television	1.89	0.46	0.00	6.68	2.73, 16.36
	Radio	1.07	0.52	0.04	2.91	1.04, 8.11
	Health professionals	1.42	0.52	0.01	4.15	1.51, 11.40
Cut 1		1.21	0.60			0.04, 2.38
Cut 2		2.67	0.61			1.48, 3.86

*Other: Catholic and Protestant

Table 5: Predictors of COVID-19 preventive health behaviors among secondary school students in Gondar City, North West Ethiopia, 2021 (n=370)

Variable		Unstandardized B	Standardized β	95% CI for B
Sex	Male (ref.)			
	Female	1.35*	0.11	0.02, 2.68
Age	15-19 (ref.)			
	20-30	0.73	0.04	-1.37, 2.82
Marital status	Single (ref.)			
	Engaged/married	1.64	0.10	-0.18, 3.45
Grade	10th (ref.)			
	11th	-0.61	-0.04	-2.25, 1.02
	12th	0.17	0.01	-1.42, 1.76
Mother's educational status	Unable to read and write (ref.)			
	Able to read and write	-1.16	-0.08	-2.84, 0.53
	Completed primary school	-0.98	-0.06	-3.01, 1.04
	Completed secondary school	-1.33	-0.08	-3.67, 1.01
	Diploma and higher	-1.82	-0.08	-5.06, 1.41
Father 's educational status	Unable to read and write (ref.)			
	Able to read and write	0.18	0.01	-1.76, 2.13
	Completed primary school	0.46	0.03	-1.89, 2.80
	Completed secondary school	-0.90	-0.06	-3.37, 1.55
	Diploma and higher	-1.20	-0.07	-4.22, 1.82
Mother's occupation	Housewife (ref.)			
	Government employee	-0.72	-0.04	-3.08, 1.64
	Marchant	-1.17	-0.05	-3.57, 1.22
	NGO employee	2.14	0.06	-1.45, 5.72
	Farmer	0.52	0.01	-4.20, 5.25
	Other	1.07	0.03	-3.32, 5.46
Father's occupation	Government Employee (ref.)			
	NGO employee	-2.37*	-0.12	-4.71, -0.02
	Merchant	-0.25	-0.02	-2.36, 1.85
	Farmer	-0.59	-0.04	-2.84, 1.67
	Other	-3.46*	-0.13	-6.49, -0.43
Living arrangement	Parents (ref.)			
	Siblings	0.60	0.03	-1.38, 2.58
	Relatives	-0.53	-0.02	-3.00, 1.93
	Alone	0.02	0.01	-2.30, 2.26
	Others	2.42	0.06	-1.54, 6.39
Source of information about COVID-19	Facebook (ref.)			
	Telegram	-0.41	-0.02	-3.61, 2.78
	Television	0.92	0.07	-1.41, 3.26
	Radio	-0.12	-0.01	-2.83, 2.60
	Health professionals	3.00*	0.17	0.20, 5.80

Social support	10.32±2.30	0.29	0.11	-0.01, 0.58
Constant		19.84		15.16, 24.53

*p<0.05, ref. =reference

Figure's legends

Figure 1: Source of information about COVID-19 among secondary school students in Gondar City, Northwest Ethiopia, 2021 (N=370).

Figure 2: Knowledge status about COVID-19 among secondary school students in Gondar City, Northwest Ethiopia, 2021 (N= 370).

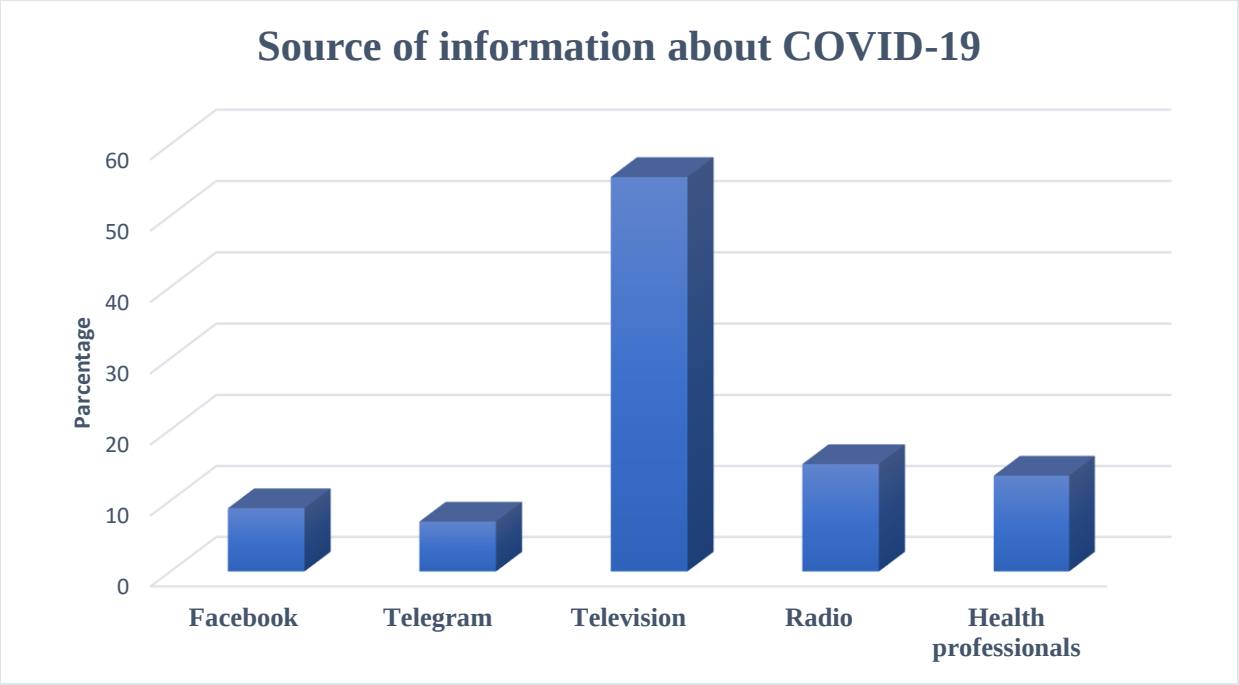

Figure 1: Source of information about COVID-19 among secondary school students in Gondar City, Northwest Ethiopia, 2021 (N=370).

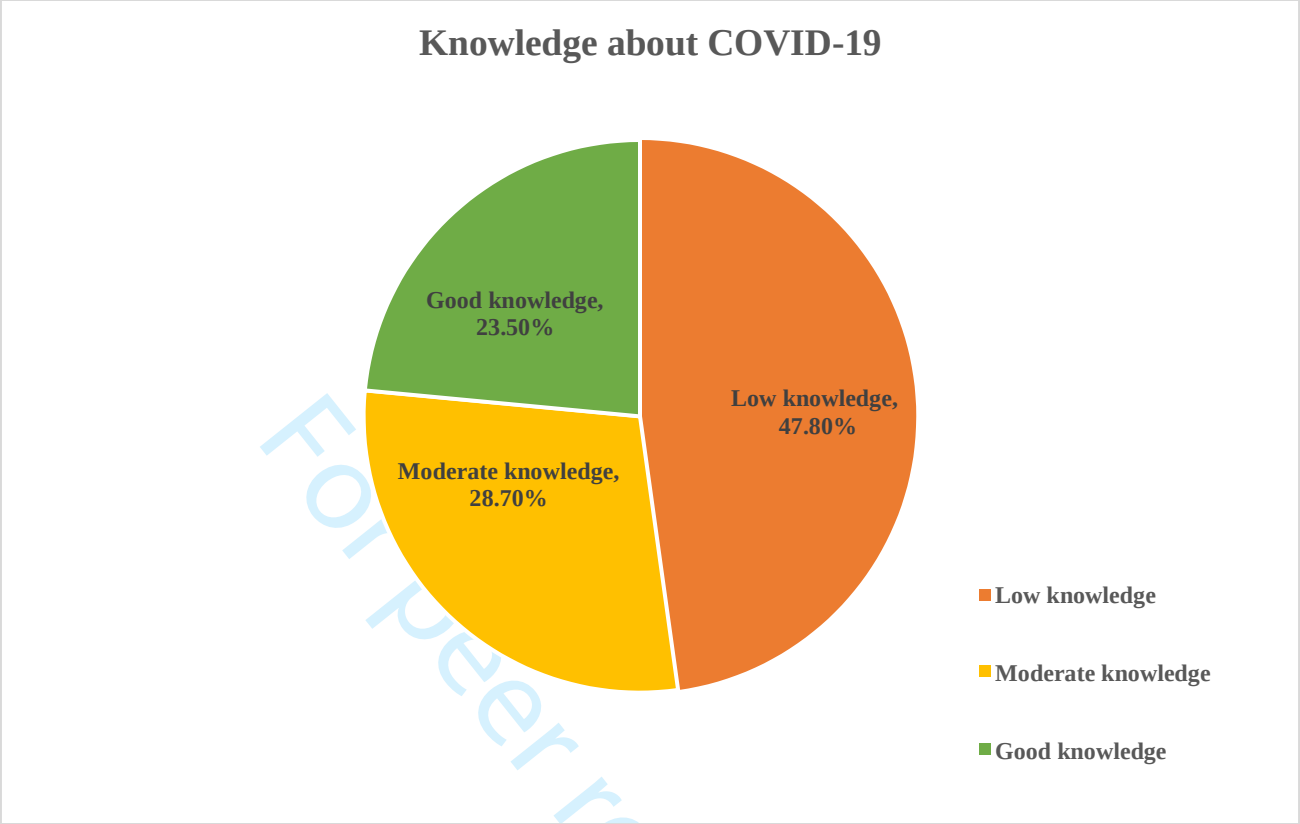

Figure 2: Knowledge status about COVID-19 among secondary school students in Gondar City, Northwest Ethiopia, 2021 (N= 370).

English Version Questionnaire

Title of the Research: COVID-19 related knowledge and preventive behaviors among students in re-opened secondary schools in Gondar City, Northwest Ethiopia: cross-sectional study

Name of the Organization: University of Gondar

Introduction

This information sheet is prepared for secondary school students of Gondar town, North West, Ethiopia. The aim of the form is to make the above concerned students clear about the purpose of research, data collection procedures and get consent to conduct the research

Purpose of the Research Project

The aim of this study is to assess knowledge and preventive health behaviors towards COVID-19 school students in Gondar city, Northwest Ethiopia 2020

Procedure

You are randomly selected to be one of the study participants. If you are willing to participate in this study, you will be requested to sign the consent form after you clearly understand the aim of this study. Finally, you are kindly requested to give your genuine response in the questionnaire.

Risk and /or Discomfort

By participating in this research project, there is no risk or discomfort otherwise you will take time about 30 minutes to fill the questionnaire.

Benefits of being in the study

There may not be direct benefits to you following your participation on this study but your participation is likely to help us in preventive health behaviors and associated factors. Ultimately this will help us to provide information for planners to consume to design and implement interventions.

Confidentiality and Privacy Protections:

You do not need to write your name to the questionnaire. All your responses and the results obtained will be kept confidentially by using coding system whereby no one will have access to your responses.

Incentives/Payments for Participating

You will not be provided any incentives or payment to take part in this project.

Right to Refusal or Withdraw

You have the full right to refuse from participating in this research if you feel discomfort with it. You have also the full right to withdraw from this study at any time if you wish.

Contacts and Questions:

If you have any questions about the study please ask now. If you have questions later, want additional information, or wish to withdraw call the researcher conducting the study.

Annex 2: English Version Consent form

I have been informed that the purpose of this study is to assess preventive health behaviors and its predictors of oral hygiene behavior among secondary school students. I have understood that participation in this study is entirely voluntarily. I have been told that my answers to the questions will not be given to anyone else and no reports of this study ever identify me in any way. I have also been informed that my participation or non-participation or my refusal to answer questions will have no effect on me. I understood that participation in this study does not involve risks.
Your signature below indicates that you have read or has been read to you the information provided above and have decided to participate in the study. If you later decide that you wish to withdraw from the study, simply tell me, you may discontinue your participation at any time.

Signature of the participant: _____ Date_____

Data collector's Name: _____ Signature: _____ Date_____

Supervisor's Name: _____ Signature: _____ Date_____

Part 1: Socio demographic characteristics of a patient

Code	Question	Response
1.	Age (in years)	_____
2.	Sex	1. male 2. female
3.	Marital status	1. Single 2. Married 3. Divorced 4. Widowed
4.	Religion	1. Orthodox 2. Muslim 3. protestant 4. other
5.	Place of residence	1.Rural 2.Urban
6.	Educational status	1. 10th 2. 11th 3. 12th
7.	Mothers' occupation	1. Government employee 2. NGO employee 3. Marchant 4. Farmer 5. If other specify_____
8.	Fathers' occupation	1. Government employee 2. NGO employee 3. Marchant 4. Farmer 5. If other specify_____

9.	Mothers' educational status	1. No formal education 2. Grade 1-8 3. Grade 9-12 4. Diploma & above
10.	Fathers' educational status	1. No formal education 2. Grade 1-8 3. Grade 9-12 4. Diploma & above
11.	Where do you usually get information about COVID-19? (Multiple selection is possible)	1. Facebook 2. Telegram 3. Television 4. Radio 5. Magazine 6. Newspaper 7. Other (specify)----------
Part 3: Social Support		
12.	How many people are so close to you that you can count on them if you have great personal problems?	1. None 2. 1–2 3. 3–5 4. 5+
13.	How much interest and concern do people show in what you do?	1. None 2. Little 3. Uncertain 4. Some 5. A lot
14.	How easy is it to get practical help from neighbors if you should need it?	1. Very difficult 2. Difficult 3. Possible 4. Easy 5. Very easy

Preventive Health Behaviors to COVID-19			
15.	I keep a distance of at least two meters from others.	1. Not at all 2. Rarely 3. Sometimes 4. Many times 5. Always	
16.	I place a tissue paper or bending elbow in front of my mouth and nose when coughing or sneezing.	1. Not at all 2. Rarely 3. Sometimes 4. Many times 5. Always	
17.	I don't shake hands with others and don't kiss them.	1. Not at all 2. Rarely 3. Sometimes 4. Many times 5. Always	
18.	I don't leave the house unless absolutely necessary	1. Not at all 2. Rarely 3. Sometimes 4. Many times 5. Always	
19.	I wash my hands regularly with soap and water for at least 20 seconds every hour.	1. Not at all 2. Rarely 3. Sometimes 4. Many times 5. Always	
20.	I do not touch my eyes, nose and mouth by hands.	1. Not at all 2. Rarely 3. Sometimes	

		4. Many times 5. Always	
21.	I wash my hands with soap and water without touching anything after entering home.	1. Not at all 2. Rarely 3. Sometimes 4. Many times 5. Always	
22.	I wear facemask consistently whenever I go out to my home.	1. Not at all 2. Rarely 3. Sometimes 4. Many times 5. Always	
Knowledge about COVID-19			
23.	Main clinical symptoms of COVID-19 are fever, cough, shortness of breath, and fatigue	1. True 2. False 3. I don't know	
24.	Unlike the common cold, stuffy nose, runny nose, and sneezing are less common in persons infected with the COVID-19 virus	1. True 2. False 3. I don't know	
25.	COVID-19 symptoms appear within 2–14 days	1. True 2. False 3. I don't know	
26.	Currently, there is no effective treatment or vaccine for COVID-2019, but early symptomatic and supportive treatment can help most patients to recover from the infection.	1. True 2. False 3. I don't know	
27.	Not all persons with COVID-19 will develop severe cases. Those who are elderly, have chronic	1. True 2. False 3. I don't know	

	illnesses, and with suppressed immunity are more likely to be severe cases	
28.	Touching or shaking hands of an infected person would result in the infection by theCOVID-19 virus.	1. True 2. False 3. I don't know
29.	Touching an object or surface with the virus on it, then touching your mouth, nose, or eyes with the unwashed hand would result in the infection by the COVID-19 virus	1. True 2. False 3. I don't know
30.	The COVID-19 virus spreads via respiratory droplets of infected individuals through the air during sneezing or coughing of infected patients.	1. True 2. False 3. I don't know
31.	Persons with COVID-19 cannot infect the virus to others if he has no any symptom of COVID-19	1. True 2. False 3. I don't know
32.	Wearing masks when moving out of home is important to prevent the infection with COVID-19 virus	1. True 2. False 3. I don't know
33.	Children and young adults do not need to take measures to prevent the infection by the COVID-19 virus	1. True 2. False 3. I don't know
34.	To prevent the COVID-19 infection, individuals should avoid going to crowded places such as public transportations, religious places, Hospitals and Workplaces	1. True 2. False 3. I don't know
35.	Washing hands frequently with soap and water for at least 20 seconds or use an alcohol-based hand	1. True 2. False 3. I don't know

	sanitizer (60%) is important to prevent infection with COVD-19	
36.	Traveling to an infectious area or having contact with someone traveled to an area where the infection present is a risk for developing an infection	1. True 2. False 3. I don't know
37.	Isolation and treatment of people who are infected with the COVID-19 virus are effective ways to reduce the spread of the virus	1. True 2. False 3. I don't know
38.	People who have contact with someone infected with the COVID-19 virus should be immediately isolated in a proper place.	1. True 2. False 3. I don't know

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No.	Recommendation	Page No.
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	4, 5
Objectives	3	State specific objectives, including any pre-specified hypotheses	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	6
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	6
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	6, 7
Bias	9	Describe any efforts to address potential sources of bias	7
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	7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7
		(*b*) Describe any methods used to examine subgroups and interactions	N/A
		(*c*) Explain how missing data were addressed	N/A
		(*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	8
		(b) Give reasons for non-participation at each stage	8
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8
		(b) Indicate number of participants with missing data for each variable of interest	N/A
Outcome data	15*	Report numbers of outcome events or summary measures	8

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9
		(*b*) Report category boundaries when continuous variables were categorized	8
		(*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	8, 9
Discussion			
Key results	18	Summarise key results with reference to study objectives	10
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	12
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	10, 11
Generalisability	21	Discuss the generalisability (external validity) of the study results	10, 11
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	13

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Determinants of COVID-19 related knowledge and preventive behaviors among students in re-opened secondary schools: cross-sectional study

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Determinants of COVID-19 related knowledge and preventive behaviors among students in re-opened secondary schools: cross-sectional study

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Abstract

Purpose: In Ethiopia, more than 26 million students have been out of the classroom for nearly nine months. On September 18th, the Ethiopian Minister of Health advised the Parliament the possibility of reopening schools provided certain conditions were met. Schools are currently reopening in the country for the first time since March, 2020.

Objective: This study assessed the knowledge and preventive health behaviors toward COVID-19 and associated factors among secondary school students.

Design, setting, participants, and outcome measures: An institution-based cross-sectional study was conducted from October to December, 2020 in Gondar city, Northwest Ethiopia. A total of 370 secondary school students were included. Bivariable and multivariable ordinal logistic regression model were fitted to identify the predictors of knowledge about COVID-19. Simple and multiple linear regression analysis were done to identify factors associated with preventive behavior. A p-value less than 0.05 was used to declare statistical significance.

Results: Only one fourth (23.5%, 95%CI: 19.5, 28.1) of the participants had a good knowledge about COVID-19. The mean score of preventive behavior was 22.8 ± SD 6.2. Marital status, religion, father education, living arrangement, and sources of information were significantly associated with knowledge about COVID-19. Being female and using health professionals as source of information increased the engagement in preventive behaviors. On the other hand, student whose father employed in non-governmental organization and other jobs had decreased engagement in preventive health behaviors.

Conclusion: Significant number of the students had inadequate knowledge about COVID-19 and poorly engaged in COVID-19 preventive behavior. Thus, it is suggested to include and disseminate about COVID-19 in related academic sessions, using school clubs, and mini-medias. The sources of COVID-19 related information need to strengthen the dissemination of tailored, credible, and timely message to enhance the knowledge and engagement of the students in preventive behaviors.

Strengths and limitations of this study

- Unlike other studies, this study used self-administered approach with COVID-19 safety precautions taken during questionnaire distribution.
- A standardized questionnaire with high validity and reliability was used in the study.
- Study provides an insight into students' knowledge and perspectives on COVID-19 preventive behaviors in re-opened schools.
- Our study may be limited by social desirability bias due to self-report of the participants.
- Besides, the study could not show a cause-and-effect relationship, and the findings represent the situation during the study period.

BACKGROUND

The novel Coronavirus (SARS-CoV-2 or COVID-19) was first reported in December 2019, in Wuhan, Hubei Province, China [1]. The World Health Organization (WHO) declared the coronavirus disease as a global pandemic on March 11, 2020 [2]. The coronavirus COVID-19 is affecting 219 countries and nowadays, it is a public health emergency throughout the world [3]. The fast spread of the disease has taken so many lives and caused massive disruption to families, societies, and economies all over the world [4]. The latest statistics reveal that coronavirus has infected more than 101,457,202 people until 21 January, 2021, and led to the deaths of more than 2,184,619 people worldwide [3].

The Ethiopian Minister of Health announced the first confirmed the first case of COVID-19 in Ethiopia on March 13, 2020 [5, 6]. Then after the government of Ethiopia took different public health measures to prevent the spread of the disease. All primary, secondary and tertiary educational institutions across the country were closed and all public gatherings were banned, impacting more than 26 million students. Hand washing and social distancing were the main preventive measures communicated to the general public [7, 8]. On April 8, 2020 Ethiopian government declared a State of emergency to intensify the control and prevention of the spread of the disease [5]. As of January 27, 2021, there were 134,569 confirmed COVID-19 cases and 2,075 deaths from the disease [9].

On September 18th, the Ethiopian Minister of Health advised Parliament that it was possible to reopen schools provided certain conditions were met. The ministry adapted the global guidance for reopening schools to make them safer and established structures to facilitate the process of reopening [10]. The knowledge on mode of disease transmission, basic hygiene principles and other public health measures are important for effective control measures [11]. The government of Ethiopia is using different strategies to enhance the knowledge, attitude and practices towards COVID-19 prevention measures and are not motivating the response to COVID-19 [5, 12].

During such pandemic the WHO advices everybody to take responsibility and adopt protective behaviors [13]. The lack of knowledge about the disease would be one of the most common driving factors for poor adoption of COVID-19 prevention measures and may increase the spread of the disease as well as the number of new cases [14, 15]. Studies conducted in Ethiopian reported contradicting findings regarding knowledge and practices towards COVID-19 preventive

measures among different population [16]. Some reported the existence of good knowledge about COVID-19 and level of prevention practice [17] while others reported poor knowledge and poor practice related to COVID-19 preventive practice [16-18]. Some studies suggested to consider individuals risk perception as a major factor to promote the adherence of preventive measures [5, 12, 19].

Secondary school students have poor knowledge and healthy preventive practices towards COVID-19. The exposure to education intervention had improved knowledge, attitude, and practice of the students [20]. On the other hand, high school students in Ghana had substantial level of knowledge and positive perception of COVID-19 [21]. A couple studies in Europe revealed secondary school present a good level of knowledge, shows appropriate practice, and positive attitude towards COVID-19 at the time of its outbreak [22, 23].

The Ethiopian government is using an adopted Risk Communication and Community Engagement (RCCE) strategic approach to empower people to adopt preventive and health-seeking behaviors contributing to a reduction in the spread of COVID-19 [5, 24]. The Ethiopian Ministry of Health and Ethiopian Public Health Institute are proactively working on disseminating prevention messages on radio and television, at federal and regional levels, reaching a potential audience of 30 million people [25]. In addition, volunteers conducted mobilization activities against COVID-19 in marketplaces, slums and congested public places [26]. However, the knowledge and practices towards COVID-19 among the public is not sufficient enough to tackle the rapidly transmitted disease and undermined the preparedness and responses in the country [5].

In Ethiopia Schools are reopening after several months of closure. As schools reopen, strict precautionary measures are in place to protect students, teachers, non-teaching staff within the school and community from COVID-19. In such case, the reopening of schools brings an opportunity to empower students as agents of change to adopt the recommended positive behaviors to prevent the spread of COVID-19 [27]. Improved awareness and adaption of preventive behaviors among students facilitate positive changes in the general population through health messages and observation learning. Therefore, we need to understand the magnitude of COVID-19 related knowledge and preventive practice among students in the re-opened high schools. In addition, we also assessed whether socio demographic, social support, and source of COVID-19

related information were associated with the knowledge, and preventive health behavior towards COVID-19.

METHODS

Study design and area

An institutional based cross-sectional study design was conducted in Gondar city from November to December 2020. Gondar city administration is located at about 727 km away from Addis Ababa, the capital city of Ethiopia, and 180 km away from Bahirdar the capital city of Amhara Regional State. In the city there are 12 governments and 5 private high schools (Grade 9 to Grade 12) with more than 23,200 students [28].

Sample size and sampling procedure

The sample size was calculated using a single population proportion formula; considering 50% (since no previous study found) proportion of students who have good preventive health practice towards COVID-19, 95% confidence interval (CI), marginal error (d) of 5%, and 5% non-response rate. The final sample size was estimated to be 403 participants. The adequacy of the sample size for identifying the predictors of COVID-19 related knowledge preventive behavior was evaluated using power analysis.

Stratified simple random sampling technique was used to select the study participants. First, stratification was done based on school ownership into private and governmental schools. Then, four governmental (Fasiledes, Fasiledes Third, Azezo, and Hidar 11) and two private secondary schools (Debreselam and Waliya) were selected on random basis. Finally, study participants were selected randomly based on their class roaster using Microsoft excel random number generator.

Study Variables

Preventive health behaviors: Refers to the participant's practice concerning, handwashing, physical distancing, facemask wearing, so as to prevent COVID-19 infection. It was measured by eight items having five-point response rate ranging from 1 (Never) to 5 (always). The composite score of the preventive behaviors ranged from 7 to 35. The higher score indicates compliance behavior.

Knowledge of COVID-19: Refers to participant's cognition of symptoms, nature and preventive measures of COVID-19. It was measured by 17 items having three response categories (1 = True, 2 = False and 3 = I don't know). A correct answer was coded as 1 point whereas, the incorrect and unknown answer was recoded as zero. The composite score ranged from 0-17 and categorized using Bloom's cut-off point, as low-level of knowledge (less than 60%; less than 12 score), moderate level of knowledge (60-80%; 13-14 score) and good level of knowledge (80-100%; 15 and above score) [29].

Data collection tools and procedures

The data were collected by using pre-tested self-administered questionnaire adapted from different literatures [15, 17]. The questionnaire was prepared in English, then translated to the local language, Amharic. Trained four BSc nurses and two Masters of public health professionals collected the data and supervised the data collection process, respectively. COVID-19 safety measures (physical distancing, wearing masks, and hand hygiene) were taken during the data collection process. The questionnaire had five sections including socio demographic, social support, source of COVID-19 related information, knowledge, and preventive health behavior. Content validity and pretest was done with 6 experts panel discussion and 20 students. It was determined by Item level Content Validity Index (I-CVI) of 0.78 or higher, Scale level Content Validity Index by Universal Agreement (S- CVI/UA) 0f 0.8 or higher and Scale level Content Validity Index by Average (S-CVI/Ave) 0.9 or higher. Data collectors and supervisors took one-day training on the objective of the study, content of the questionnaire, and ethical issues need to be taken during the data collection process (See the research tool at **Supplementary file**).

Data processing and analysis

Each questionnaire was reviewed for completeness and consistency on daily basis. The internal consistency of the items was checked by Cronbach's alpha. The collected data entered in to EpiData version 4.6 and exported into to STATA version 14 statistical software for analysis. Multicollinearity among the independent variables was assessed using variance inflation factors (VIF) and was in the acceptable range. Descriptive statistics was used to quantify the magnitude of preventive healthy behavior, knowledge and describe the characteristic of the participant. Bivariable and multivariable ordinal logistic regression model was fitted to identify the factors associated with knowledge of COVID-19. Those variables with a p-value of less than 0.25 in the

bivariable model were fitted in the multivariable model. The assumptions of ordinal logistic regression were checked using chi-squared and parallel line tests (the model was well-fitted with the data). Normality and homogeneity of variances were checked for preventive health behavior (the variable was normally distributed). Simple linear regression analysis was computed and all independent variables with p-value less than 0.25 were entered in multiple linear regression. An unstandardized β coefficient was used to interpret the effect of predictors to preventive health behavior. Variables with p value less than 0.05 at 95% confidence interval were considered as statistically significant.

Patient and public involvement

This research was done without involving patient on the design and implementation. But the participants and administrative officials were informed about study objectives. The results will be disseminated to Gondar City Education Office and through open access publication.

RESULTS

Socio demographic characteristics

A total of 370 respondents were participated with a response rate of 91.8%. The non-response was due to not replying to items on the questionnaire (4.0%), inconsistent responses (2.4%) and not volunteered without reason (1.8%). More than half of the participant (51.9%) were females. The higher proportion of the participant were affiliated with Orthodox religion (87.6%), single (84.6%), and live with their parents (64.1%). The mean age of participants 18.0±1.8 years with the minimum 15 and maximum 30 years (**Table 1**). With regard to sources of information, television (55.4%) was the most common source of information about COVID-19 (**Figure 1**).

Knowledge about COVID-19

The reliability test of the knowledge about COVID-19 items for Cronbach's alpha was 0.79 According to the Blooms cut-off point nearly half (47.8%) of the participant had low knowledge about COVID-19. Only one fourth of them (23.5%) had a good knowledge (**Figure 2**). **Table 2** also presents the details of knowledge about COVID-19.

Preventive health behavior

The reliability test of the preventive health behavior items for Cronbach's alpha was 0.79. The mean of preventive health behavior was 22.8 with standard deviation of 6.2. Two hundred and four (55.1%, 95% CI: 50.0, 60.2) respondents scored above the mean score of preventive health behavior (**Table 3**).

Predictors of knowledge about COVID-19

Of the variables satisfied the assumption of proportional odds model, age, marital status, religion, father's educational status, father's occupation, living arrangement, and sources of information for COVID-19 were associated with knowledge of COVID-19 with a p-value of less than 0.25. After controlling the confounding variables, marital status, religion, father's education, living arrangement, and sources of information were significantly associated with knowledge about COVID-19. The result of ordinal logistic regression analysis showed that the odds of having good knowledge (verses medium or poor knowledge) were 0.47 times lower for engaged/married students as compared to single students (AOR=0.47, 95% CI: 0.25, 0.90). The odds of having good knowledge was nearly 7.71 times higher for students affiliated with other religion as compared to those affiliated with Orthodox (AOR=1.78, 95%CI: 1.24, 2.55). Students belong to fathers with diploma and above education were 2.56 times higher odds of good knowledge than students belong to father with no education (AOR=2.56, 95%CI: 1.07, 6.12). The odds of having good knowledge was nearly 0.32 times lower for students living alone than those who lived with their parents (AOR=0.32, 95%CI: 0.15, 0.69). Students who used television (AOR=6.68, 95%CI: 2.73, 16.36), radio (AOR=2.91, 95%CI: 1.04, 8.11), and health profession (AOR=4.15, 95%CI: 1.51, 11.40) as sources of information on COVID-19 were 6.68, 2.91, and 4.15 times higher odds of good knowledge than those who used Facebook, respectively (**Table 4**).

Predictors of COVID-19 preventive health behaviors

In simple linear regression, sex, marital status, grade level, mother's educational status, father's educational status, mother's occupation and father's occupation, living arrangement, source of information about COVID-19, and social support were significant at with a p-value ≤ 0.25 and entered in to multiple linear regression. In the multiple linear regression analysis, sex (β:1.35 95% CI: 0.02, 2.68), having father employed in non-governmental organization (NGO) (β: -2.37, 95% CI: -4.71, -0.02), other jobs (β: -3.46, 95% CI: -6.49, -0.43) and health profession as source of information (β:3.00, 95% CI: 0.20, 5.80) were statistically significant at a p-value of less than 0.05.

The standardized regression coefficient revealed that source of information was the most important predictor of adoption of COVID-19 preventive measures. The analysis of this study showed that female students were 1.35 times more frequently engaged in preventive health behavior than males. Compared to students with father employed in government institution, engagement in COVID-19 preventive behavior decreased by 2.37 and 3.46 times among those whose father was employed in NGO and other jobs, respectively. Students who used health professionals as sources of information were three time more engaged in preventive health behavior than those who use Facebook as source of information provided that other variables are kept constant (**Table 5**).

DISCUSSION

This study assessed the COVID-19 related knowledge and preventive health behavior of the student and associated factors in the reopened schools, Northwest Ethiopia. Student's adherence to COVID-19 preventive behaviors (physical distancing, wearing a mask, and hand washing) are a key to sustain the education in the pandemic era. Previous studies addressed the knowledge, attitude, and practices of COVID-19 immediately after onset of the pandemics in Ethiopia [16-18]. These studies revealed lack of knowledge, attitude and preventive practice among different populations [16, 19]. Since the adherence of these behaviors reduce the spread of the disease among the students, teachers, and community, the current study focused the knowledge of the student and their level of engagement in preventive behavior.

A lack of adequate knowledge is probably the driving force for poor preventive practice as well as the spread of the disease. In this study only about half (52.2%) of the students had at least moderate knowledge about COVID-19. This study result is higher than studies done among health science student in Arbaminch [30] and secondary school student in Egypt (before intervention) [20]. On the other hands, this finding is lower than studied done among college student in Amhara region, undergraduate student in Debre Berhan University, undergraduate medical students in Egypt, high school students in Ghana, Iranian medical students, Libya, Jordan, and Portugal [21-23, 31-36]. The discrepancy is may be due difference in access and use of information sources. The result highlights the need to address the gap of knowledge timely using tailored and effective approaches. The authors recommended briefing sessions or including information about the disease is health related subjects/ lessons may enhance the knowledge of the students.

This study showed students had low preventive health behaviors against COVID-19 with 55.1% respondents scored above the mean score. Contrary to scientific recommendation social distancing, hand washing, and wearing of a mask were not highly prevalent practices among students. Similar finding is reported by studies done among university students in Debre Birhan university [32] and secondary school student in Egypt [20]. Contrary to this study among secondary school students in in Italy [23] and Portugal [22] reported that students are practicing appropriate preventive behaviors. The difference may be due to difference in COVID-19 related information access, risk perception, and enforcement of COVID related measures in nations. In addition, college student in Amhara region, medical students in Egypt, Iran, Libya, Jordan, and University students in Birzeit (Palestine) [23, 31, 33, 35-37] implemented proper strategies to prevent its spread of the disease. This may be due too high-risk perception, advanced knowledge about the disease, and previous experience of infection prevention practice enabled them to properly implement COVID-19 preventive health behavior. School authorities with respected responsible health authorities need to identify, meet, and coordinate the implementation of preventive behaviors at schools. The promotion and awareness creation activities also need to be revised according to the situation evolution.

The analysis of predictors of knowledge about COVID-19 revealed that engaged/married and students living alone had lower level of knowledge. Similarly, study done among college student in Amhara region reported single students had good knowledge about COVID-19 [31]. The other study health science student in Arbaminch reported that married and student living with family members had good knowledge than their counterparts [30]. Whereas, On the other hand, being affiliated with other religions, having educated father, and using television, radio, and health professional as a source of information were positively associated with good knowledge. Health professionals and electronic medias were the reliable source of information and promote health awareness and engagement in preventive measures. Study done in Debre Berhan University reported that source of information about COVID-19 associated with the mean knowledge [32]. Elsewhere study done in Ghana reported that increased access of information from electronic media and the role of peers and family members in dissemination of COVID-19 related information [21].

The analysis on the predictor of preventive health behavior among the student showed that being female and health professionals' source of information increased the engagement in preventive behaviors. Although those who had increased exposure to electronic medias seemed to be more aware of preventive measures to avoid COVID-19 spread, there is still the possibility that misinformation on the internet can have produced the opposite. We found that females engaged more in preventive health behaviors than males. This is allied with a tendency of females to be more health-conscious and engaged in preventive behavior [38]. Moreover, the low preventive behavior in men may be due to their perceptions of masculinity which reduces their motivation to accept preventive health behavior [24, 39]. Similar findings were reported by studies done in Portugal, medical students in Egypt, university students in Palestine, and China [22, 33, 37, 40]. Health messages and other health promotion initiatives at schools need to introduce gender-specific tailor preventive measures in order to enhance their efficiency. On the other hand, student whose father employed in non-governmental organization and other jobs had decreased engagement in preventive health behaviors. In this study the level of knowledge of the participant was not significant predictor for preventive health behavior. This may be due to knowledge is neither sufficient nor necessary to trigger a behavioral change (adopting preventive behaviors).

This study has certain limitations to be noted. This is cross sectional study, could not show a cause-and-effect relationship, and the findings represent the situation during the study period. The knowledge and preventive practices among the student may change rapidly. Besides, this study was based on self-report of the participant. There would be recall and social desirability that can bias the findings.

CONCLUSIONS

In this study, substantial number of the students had inadequate knowledge about COVID-19 and poorly engaged in COVID-19 preventive health behavior. The research results indicated that engaged/married and students living alone had a lower level of knowledge. Being affiliated with other religions, having educated father, and using television, radio, and health professional as a source of information were all associated with good knowledge. Sex, father occupation and source of information have all contributed to COVID-19 preventive behaviors. Therefore, the effectiveness of COVID-19 prevention measures needs to be well established among the students. Interventions that increase the awareness of the students and promote health behaviors need to be

strengthen in secondary schools. It is suggested to introduce COVID-19 related message need to be disseminated in related academic sessions, using school clubs, and mini-medias. In addition, the main sources of COVID-19 related information (health professionals, television, and radio) need to strengthen the dissemination of tailored, credible, and timely message to enhance the knowledge and engagement the student in preventive health behaviors.

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Contributors

SH AA AK and KS conceived and designed the study. SH AA AK and KS participated in data processing and management. SH analyzed the data and drafted the manuscript. AK and KS participated in data analysis and interpretation. SH AA AK and KS reviewed the drafted manuscript. All authors read and approved the final manuscript.

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Competing interests

The author declare that he has no conflict of interest

Consent for publication

Not applicable

Data availability statement

Data will be available from the corresponding author upon reasonable request.

Ethics Statement

Ethical clearance was obtained from the Institutional Review Board of the University of Gondar with a reference number of V/P/RCS/05/588/2020. Letter of permission was obtained from Gondar city administrative education office. After the purpose and objective of the study have been informed, written consent was obtained from each study participant. Any identifiers of the study participants were not recorded. Indeed, for the participants with age less than 18, family/guardian

informed consent and an assent from themselves was taken. Finally, health information was provided for the study participants about the coronavirus and relative preventive measures.

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Tables

Table 1: Socio-demographic characteristics of secondary school students in Gondar City, Northwest Ethiopia, 2021 (n=370).

Variables	Description	Knowledge about COVID-19			p-value
		Poor n (%)	Moderate n (%)	Good n (%)	
Age	15-19	150 (84.7)	95 (89.6)	77 (88.5)	0.446
	20-30	27 (15.3)	11 (10.4)	10 (11.5)	
Sex	Male	86 (49.2)	51 (47.2)	41 (47.1)	0.0499
	Female	90 (50.8)	56 (52.8)	46 (52.9)	
Marital status	Single	142 (80.2)	96 (90.6)	75 (86.2)	0.059
	Engaged/married	35 (19.8)	10 (9.4)	12 (13.8)	
Grade	10th	80 (45.2)	39 (36.8)	38 (43.7)	0.495
	11th	39 (22.0)	33 (31.1)	21 (24.1)	
	12th	58 (32.8)	34 (32.1)	28 (32.2)	
Religion	Orthodox	161 (90.9)	91 (85.8)	72 (82.8)	0.344
	Muslim	14 (7.9)	13 (12.3)	12 (13.8)	
	Others	2 (1.2)	2 (1.9)	3 (3.4)	
Mother's occupation	Housewife	126 (71.2)	75 (70.8)	61 (70.1)	0.986
	Government employee	20 (11.3)	15 (14.2)	12 (13.8)	
	Marchant	17 (9.6)	9 (8.5)	7 (8.1)	
	NGO employee	5 (2.8)	4 (3.8)	4 (4.6)	
	Farmer	4 (2.3)	1 (0.9)	2 (2.3)	
	Other	5 (2.8)	2 (1.9)	1 (1.2)	
Father's occupation	Government Employee	34 (19.2)	28 (26.4)	30 (34.5)	0.039
	NGO employee	17 (9.6)	11 (10.4)	14 (16.1)	
	Merchant	43 (24.3)	29 (27.4)	21 (24.1)	
	Farmer	72 (40.7)	31 (29.3)	18 (20.7)	
	other	11 (6.2)	7 (6.6)	4 (4.6)	
Mother's educational	Unable to read and write	71 (40.1)	32 (30.2)	28 (32.2)	0.151
	Able to read and write	41 (23.2)	32 (30.2)	16 (18.4)	

status	Primary education	31 (17.5)	12 (11. 3)	16 (18.4)	
	Secondary education	24 (13.6)	18 (17.0)	17 (19.5)	
	Diploma and above	10 (5.7)	12 (11.3)	10 (11.5)	
Father's educational status	Unable to read and write	39 (22.0)	10 (9.4)	15 (17.2)	0.001
	Able to read and write	59 (33.3)	37 (34.9)	20 (23.0)	
	Primary education	27 (15.2)	20 (18.9)	12 (13.8)	
	Secondary education	34 (19.2)	23 (21.7)	13 (14.9)	
	Diploma and above	18 (10.2)	16 (15.1)	27 (31.0)	
Living arrangement	With mother/father	103 (58.2)	70 (66.0)	64 (73.6)	0.057
	With siblings	25 (14.1)	13 (12.3)	11 (12.6)	
	With relatives	14 (7.9)	12 (11.3)	5 (5.8)	
	Alone	31 (17.5)	8 (7.6)	4 (4.6)	
	Other	4 (2.3)	3 (2.8)	3 (3.5)	

Table 2: Knowledge about COVID-19 among secondary school students in Gondar City, Northwest Ethiopia, 2021 (N= 370).

S.no	Knowledge Items	Frequency (%)	
		Wrong	Correct
K1	Main clinical symptoms of COVID-19 are fever, cough, shortness of breath, and fatigue	45 (12.2)	325 (87.8)
K2	Unlike the common cold, stuffy nose, runny nose, and sneezing are less common in persons infected with the COVID-19 virus	221(59.7)	149 (40.3)
K3	COVID-19 symptoms appear within 2–14 days	120 (32.4)	250 (67.6)
K4	Currently, there is no effective treatment or vaccine for COVID-2019, but early symptomatic and supportive treatment can help most patients to recover from the infection.	160 (43.2)	210 (56.8)
K5	Not all persons with COVID-19 will develop severe cases. Those who are elderly, have chronic illnesses, and with suppressed immunity are more likely to be severe cases	184 (49.7)	186 (50.3)
K6	The corona virus can infect children and adolescents.	136 (36.8)	234 (63.2)
K7	Touching or shaking hands of an infected person would result in the infection by theCOVID-19 virus.	108 (29.2)	262 (70.8)
K8	Touching an object or surface with the virus on it, then touching your mouth, nose, or eyes with the unwashed hand would result in the infection by the COVID-19 virus	63 (17.0)	307 (83.0)
K9	The COVID-19 virus spreads via respiratory droplets of infected individuals through the air during sneezing or coughing of infected patients.	75 (20.3)	295 (79.7)
K10	Persons with COVID-19 cannot infect the virus to others if he has no any symptom of COVID-19	97 (26.2)	273 (73.8)
K11	Wearing masks when moving out of home is important to prevent the infection with COVID-19 virus	126 (34.1)	244 (65.9)
K12	Children and young adults do not need to take measures to prevent the infection by the COVID-19 virus	101 (27.3)	269 (72.7)
K13	To prevent the COVID-19 infection, individuals should avoid going to crowded places such as public transportations, religious places, Hospitals and Workplaces	100 (27.0)	270 (73.0)
K14	Washing hands frequently with soap and water for at least 20 seconds or use an alcohol-based hand sanitizer (60%) is important to prevent infection with COVD-19	123 (33.2)	247(66.8)
K15	Traveling to an infectious area or having contact with someone traveled to an area where the infection present is a risk for developing an infection	98 (26.5)	272 (73.5)

K16	Isolation and treatment of people who are infected with the COVID-19 virus are effective ways to reduce the spread of the virus	78 (21.1)	292 (78.9)
K17	People who have contact with someone infected with the COVID-19 virus should be immediately isolated in a proper place.	85 (23.0)	285 (77.0)

Table 3: COVID-19 preventive behaviors among secondary school students in Gondar city, Northwest Ethiopia, 2021 (n =370)

S. No	Items	Mean	Standard deviation
PH1	I keep a distance of at least two meters from others.	2.66	1.28
PH2	I place a tissue paper or bending elbow in front of my mouth and nose when coughing or sneezing.	3.26	1.33
PH3	I don't shake hands with others and don't kiss them.	2.92	1.30
PH4	I don't leave the house unless absolutely necessary	2.66	1.32
PH5	I wash my hands regularly with soap and water for at least 20 seconds every hour.	2.85	1.28
PH6	I do not touch my eyes, nose and mouth by hands.	2.76	1.32
PH7	I wash my hands with soap and water before touching anything while entering home.	2.98	1.44
PH8	I wear facemask consistently whenever I go out to my home.	2.69	1.39
	Overall preventive behavior standard score	2.85	0.77

Table 4: Predictors of knowledge about COVID-19 among secondary school students in Gondar City, North West Ethiopia, 2021 (n=370)

Variable		Regression coefficient	Standard error	p-value	Adjusted Odds ratio	95% CI for AOR
Age	15-19 (ref.)					
	20-30	0.19	.34	0.58	1.21	0.62, 2.37
Marital status	Single (ref.)					
	Engaged/married	-0.75	0.33	0.02	0.47	0.25, 0.90
Religion	Orthodox (ref.)					
	Muslim	0.40	0.35	0.25	1.46	0.74, 2.89
	Other*	2.04	0.84	0.01	7.71	1.50, 39.66
Father 's educational status	Unable to read and write (ref.)					
	Able to read and write	0.28	0.33	0.39	1.33	0.69, 2. 55
	Completed primary school	0.22	0.39	0.57	1.24	0.58, 2.66
	Completed secondary school	0.06	0.39	0.89	1.06	0.49, 2.30
	Diploma and higher	0.94	0.44	0.03	2.56	1.07, 6.12
Father's occupation	Government Employee (ref.)					
	NGO employee	0.29	0.38	0.44	1.34	0.64, 2.80
	Merchant	-0.44	0.33	0.18	0.64	0.34, 1.23
	Farmer	-0.41	0.37	0.27	0.67	0.32, 1.38
	Other	-0.75	0.48	0.12	0.47	0.18, 1.20
Living arrangement	Parents (ref.)					
	Siblings	-0.26	0.33	0.44	0.77	0.41, 1.47
	Relatives	-0.30	0.38	0.44	0.74	0.35, 1.57
	Alone	-1.14	0.40	0.00	0.32	0.15, 0.69
	Others	-0.27	0.66	0.69	0.77	0.21, 2.77
Source of information about COVID-19	Facebook (ref.)					
	Telegram	0.81	0.59	0.17	2.24	0.70, 7.13
	Television	1.89	0.46	0.00	6.68	2.73, 16.36
	Radio	1.07	0.52	0.04	2.91	1.04, 8.11
	Health professionals	1.42	0.52	0.01	4.15	1.51, 11.40
Cut 1		1.21	0.60			0.04, 2.38
Cut 2		2.67	0.61			1.48, 3.86

*Other: Catholic and Protestant

Table 5: Predictors of COVID-19 preventive health behaviors among secondary school students in Gondar City, North West Ethiopia, 2021 (n=370)

Variable		Unstandardized B	Standardized β	95% CI for B
Sex	Male (ref.)			
	Female	1.35*	0.11	0.02, 2.68
Age	15-19 (ref.)			
	20-30	0.73	0.04	-1.37, 2.82
Marital status	Single (ref.)			
	Engaged/married	1.64	0.10	-0.18, 3.45
Grade	10th (ref.)			
	11th	-0.61	-0.04	-2.25, 1.02
	12th	0.17	0.01	-1.42, 1.76
Mother's educational status	Unable to read and write (ref.)			
	Able to read and write	-1.16	-0.08	-2.84, 0.53
	Completed primary school	-0.98	-0.06	-3.01, 1.04
	Completed secondary school	-1.33	-0.08	-3.67, 1.01
	Diploma and higher	-1.82	-0.08	-5.06, 1.41
Father 's educational status	Unable to read and write (ref.)			
	Able to read and write	0.18	0.01	-1.76, 2.13
	Completed primary school	0.46	0.03	-1.89, 2.80
	Completed secondary school	-0.90	-0.06	-3.37, 1.55
	Diploma and higher	-1.20	-0.07	-4.22, 1.82
Mother's occupation	Housewife (ref.)			
	Government employee	-0.72	-0.04	-3.08, 1.64
	Marchant	-1.17	-0.05	-3.57, 1.22
	NGO employee	2.14	0.06	-1.45, 5.72
	Farmer	0.52	0.01	-4.20, 5.25
	Other	1.07	0.03	-3.32, 5.46
Father's occupation	Government Employee (ref.)			
	NGO employee	-2.37*	-0.12	-4.71, -0.02
	Merchant	-0.25	-0.02	-2.36, 1.85
	Farmer	-0.59	-0.04	-2.84, 1.67
	Other	-3.46*	-0.13	-6.49, -0.43
Living arrangement	Parents (ref.)			
	Siblings	0.60	0.03	-1.38, 2.58
	Relatives	-0.53	-0.02	-3.00, 1.93
	Alone	0.02	0.01	-2.30, 2.26
	Others	2.42	0.06	-1.54, 6.39
Source of information about COVID-19	Facebook (ref.)			
	Telegram	-0.41	-0.02	-3.61, 2.78
	Television	0.92	0.07	-1.41, 3.26
	Radio	-0.12	-0.01	-2.83, 2.60
	Health professionals	3.00*	0.17	0.20, 5.80

Social support	10.32±2.30	0.29	0.11	-0.01, 0.58
Constant		19.84		15.16, 24.53

*p<0.05, ref. =reference

Figure's legends

Figure 1: Source of information about COVID-19 among secondary school students in Gondar City, Northwest Ethiopia, 2021 (N=370).

Figure 2: Knowledge status about COVID-19 among secondary school students in Gondar City, Northwest Ethiopia, 2021 (N= 370).

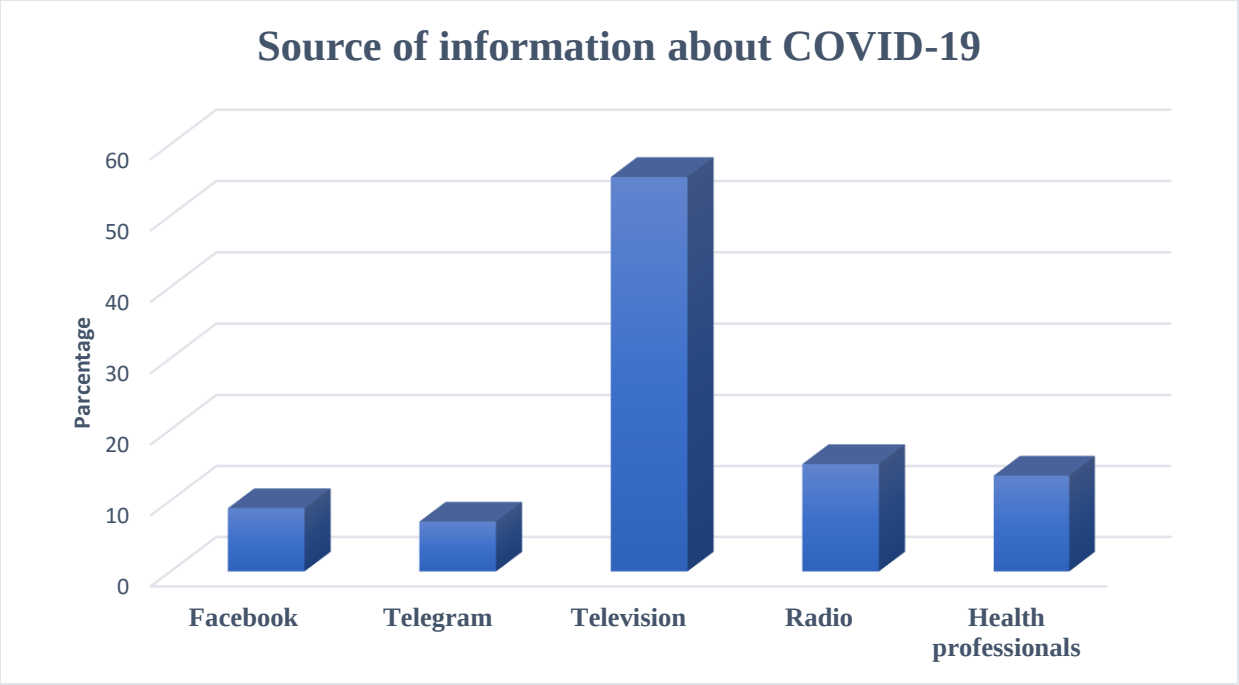

Figure 1: Source of information about COVID-19 among secondary school students in Gondar City, Northwest Ethiopia, 2021 (N=370).

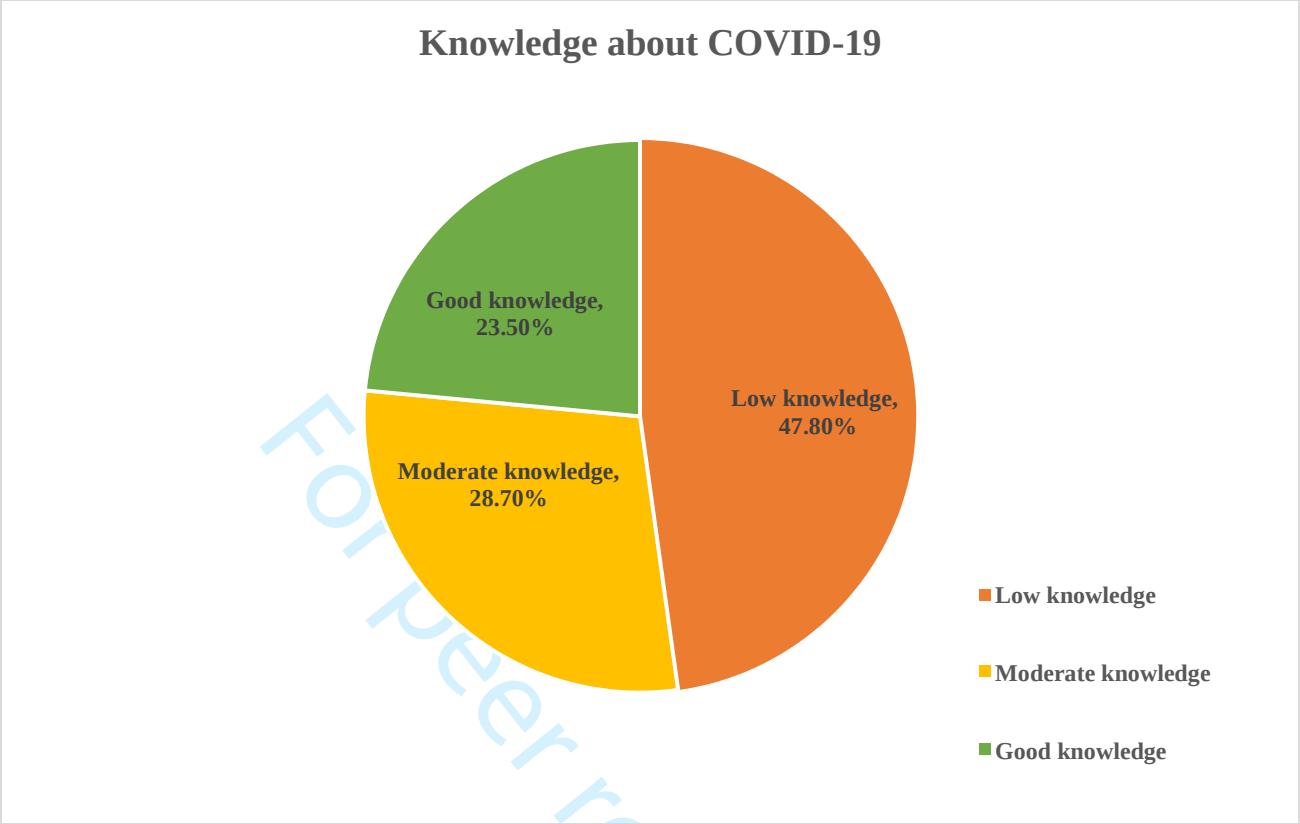

Figure 2: Knowledge status about COVID-19 among secondary school students in Gondar City, Northwest Ethiopia, 2021 (N= 370).

English Version Questionnaire

Title of the Research: COVID-19 related knowledge and preventive behaviors among students in re-opened secondary schools in Gondar City, Northwest Ethiopia: cross-sectional study

Name of the Organization: University of Gondar

Introduction

This information sheet is prepared for secondary school students of Gondar town, North West, Ethiopia. The aim of the form is to make the above concerned students clear about the purpose of research, data collection procedures and get consent to conduct the research

Purpose of the Research Project

The aim of this study is to assess knowledge and preventive health behaviors towards COVID-19 school students in Gondar city, Northwest Ethiopia 2020

Procedure

You are randomly selected to be one of the study participants. If you are willing to participate in this study, you will be requested to sign the consent form after you clearly understand the aim of this study. Finally, you are kindly requested to give your genuine response in the questionnaire.

Risk and /or Discomfort

By participating in this research project, there is no risk or discomfort otherwise you will take time about 30 minutes to fill the questionnaire.

Benefits of being in the study

There may not be direct benefits to you following your participation on this study but your participation is likely to help us in preventive health behaviors and associated factors. Ultimately this will help us to provide information for planners to consume to design and implement interventions.

Confidentiality and Privacy Protections:

You do not need to write your name to the questionnaire. All your responses and the results obtained will be kept confidentially by using coding system whereby no one will have access to your responses.

Incentives/Payments for Participating

You will not be provided any incentives or payment to take part in this project.

Right to Refusal or Withdraw

You have the full right to refuse from participating in this research if you feel discomfort with it. You have also the full right to withdraw from this study at any time if you wish.

Contacts and Questions:

If you have any questions about the study please ask now. If you have questions later, want additional information, or wish to withdraw call the researcher conducting the study.

Annex 2: English Version Consent form

I have been informed that the purpose of this study is to assess preventive health behaviors and its predictors of oral hygiene behavior among secondary school students. I have understood that participation in this study is entirely voluntarily. I have been told that my answers to the questions will not be given to anyone else and no reports of this study ever identify me in any way. I have also been informed that my participation or non-participation or my refusal to answer questions will have no effect on me. I understood that participation in this study does not involve risks.
Your signature below indicates that you have read or has been read to you the information provided above and have decided to participate in the study. If you later decide that you wish to withdraw from the study, simply tell me, you may discontinue your participation at any time.

Signature of the participant: _____ Date_____

Data collector's Name: _____ Signature: _____ Date_____

Supervisor's Name: _____ Signature: _____ Date_____

Part 1: Socio demographic characteristics of a patient

Code	Question	Response
1.	Age (in years)	_____
2.	Sex	1. male 2. female
3.	Marital status	1. Single 2. Married 3. Divorced 4. Widowed
4.	Religion	1. Orthodox 2. Muslim 3. protestant 4. other
5.	Place of residence	1.Rural 2.Urban
6.	Educational status	1. 10th 2. 11th 3. 12th
7.	Mothers' occupation	1. Government employee 2. NGO employee 3. Marchant 4. Farmer 5. If other specify_____
8.	Fathers' occupation	1. Government employee 2. NGO employee 3. Marchant 4. Farmer 5. If other specify_____

9.	Mothers' educational status	1. No formal education 2. Grade 1-8 3. Grade 9-12 4. Diploma & above
10.	Fathers' educational status	1. No formal education 2. Grade 1-8 3. Grade 9-12 4. Diploma & above
11.	Where do you usually get information about COVID-19? (Multiple selection is possible)	1. Facebook 2. Telegram 3. Television 4. Radio 5. Magazine 6. Newspaper 7. Other (specify)----------
Part 3: Social Support		
12.	How many people are so close to you that you can count on them if you have great personal problems?	1. None 2. 1–2 3. 3–5 4. 5+
13.	How much interest and concern do people show in what you do?	1. None 2. Little 3. Uncertain 4. Some 5. A lot
14.	How easy is it to get practical help from neighbors if you should need it?	1. Very difficult 2. Difficult 3. Possible 4. Easy 5. Very easy

Preventive Health Behaviors to COVID-19			
15.	I keep a distance of at least two meters from others.	1. Not at all 2. Rarely 3. Sometimes 4. Many times 5. Always	
16.	I place a tissue paper or bending elbow in front of my mouth and nose when coughing or sneezing.	1. Not at all 2. Rarely 3. Sometimes 4. Many times 5. Always	
17.	I don't shake hands with others and don't kiss them.	1. Not at all 2. Rarely 3. Sometimes 4. Many times 5. Always	
18.	I don't leave the house unless absolutely necessary	1. Not at all 2. Rarely 3. Sometimes 4. Many times 5. Always	
19.	I wash my hands regularly with soap and water for at least 20 seconds every hour.	1. Not at all 2. Rarely 3. Sometimes 4. Many times 5. Always	
20.	I do not touch my eyes, nose and mouth by hands.	1. Not at all 2. Rarely 3. Sometimes	

		4. Many times 5. Always	
21.	I wash my hands with soap and water without touching anything after entering home.	1. Not at all 2. Rarely 3. Sometimes 4. Many times 5. Always	
22.	I wear facemask consistently whenever I go out to my home.	1. Not at all 2. Rarely 3. Sometimes 4. Many times 5. Always	
Knowledge about COVID-19			
23.	Main clinical symptoms of COVID-19 are fever, cough, shortness of breath, and fatigue	1. True 2. False 3. I don't know	
24.	Unlike the common cold, stuffy nose, runny nose, and sneezing are less common in persons infected with the COVID-19 virus	1. True 2. False 3. I don't know	
25.	COVID-19 symptoms appear within 2–14 days	1. True 2. False 3. I don't know	
26.	Currently, there is no effective treatment or vaccine for COVID-2019, but early symptomatic and supportive treatment can help most patients to recover from the infection.	1. True 2. False 3. I don't know	
27.	Not all persons with COVID-19 will develop severe cases. Those who are elderly, have chronic	1. True 2. False 3. I don't know	

	illnesses, and with suppressed immunity are more likely to be severe cases	
28.	Touching or shaking hands of an infected person would result in the infection by theCOVID-19 virus.	1. True 2. False 3. I don't know
29.	Touching an object or surface with the virus on it, then touching your mouth, nose, or eyes with the unwashed hand would result in the infection by the COVID-19 virus	1. True 2. False 3. I don't know
30.	The COVID-19 virus spreads via respiratory droplets of infected individuals through the air during sneezing or coughing of infected patients.	1. True 2. False 3. I don't know
31.	Persons with COVID-19 cannot infect the virus to others if he has no any symptom of COVID-19	1. True 2. False 3. I don't know
32.	Wearing masks when moving out of home is important to prevent the infection with COVID-19 virus	1. True 2. False 3. I don't know
33.	Children and young adults do not need to take measures to prevent the infection by the COVID-19 virus	1. True 2. False 3. I don't know
34.	To prevent the COVID-19 infection, individuals should avoid going to crowded places such as public transportations, religious places, Hospitals and Workplaces	1. True 2. False 3. I don't know
35.	Washing hands frequently with soap and water for at least 20 seconds or use an alcohol-based hand	1. True 2. False 3. I don't know

	sanitizer (60%) is important to prevent infection with COVD-19	
36.	Traveling to an infectious area or having contact with someone traveled to an area where the infection present is a risk for developing an infection	1. True 2. False 3. I don't know
37.	Isolation and treatment of people who are infected with the COVID-19 virus are effective ways to reduce the spread of the virus	1. True 2. False 3. I don't know
38.	People who have contact with someone infected with the COVID-19 virus should be immediately isolated in a proper place.	1. True 2. False 3. I don't know

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No.	Recommendation	Page No.
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	4, 5
Objectives	3	State specific objectives, including any pre-specified hypotheses	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	6
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	6
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	6, 7
Bias	9	Describe any efforts to address potential sources of bias	7
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	7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7
		(*b*) Describe any methods used to examine subgroups and interactions	N/A
		(*c*) Explain how missing data were addressed	N/A
		(*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	8
		(b) Give reasons for non-participation at each stage	8
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8
		(b) Indicate number of participants with missing data for each variable of interest	N/A
Outcome data	15*	Report numbers of outcome events or summary measures	8

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9
		(*b*) Report category boundaries when continuous variables were categorized	8
		(*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	8, 9
Discussion			
Key results	18	Summarise key results with reference to study objectives	10
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	12
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	10, 11
Generalisability	21	Discuss the generalisability (external validity) of the study results	10, 11
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	13