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Research article

Health literacy and health information sources in relation to foodborne and waterborne diseases among adults in Gedeo zone, southern Ethiopia, 2022: A community-based cross-sectional study

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ABSTRACT

Introduction: Foodborne and waterborne illnesses affect billions of people each year and impose a significant burden on public health globally. To reduce the prevalence of foodborne and waterborne illness in resource-constrained settings like Ethiopia, it is essential to recognize and address the factors that influence health literacy and the sources of health information. We explored health literacy and health information sources regarding foodborne and waterborne illnesses among adults in the Gedeo zone.

Methods: A community-based quantitative study was undertaken between March and April 2022 in the Gedeo zone in southern Ethiopia. A semi-structured, pretested, and interviewer-administered questionnaire was used to collect data from 1,175 study participants selected through a systematic sampling technique. Data were entered in Epidata version 4.6 and analyzed in STATA version 14.2. Data were analyzed using descriptive statistics and the Chi-square test, and multivariate logistic regression analysis was used to assess the associations between variables at a significance level of 0.05. Further, a structural equation model or path analysis was also used in the data analysis.

Result: 1,107 (about 51% men) study participants were included in the analysis. About 25.5% of the participants had a foodborne or waterborne illness in the last six months before the survey. Family members and/or close friends were the most-used channel of health information (43.3%), and the internet or online sources were the least-used (14.5%). The result of path analysis shows that seeking health information, having adequate health literacy, and foodborne and waterborne literacy were significantly associated with lower incidences of foodborne or waterborne illness.

Conclusion: Our findings showed that individuals with a higher level of health literacy and foodborne and waterborne illness literacy had a lower incidence of foodborne and waterborne illness. Similarly, obtaining health information is positively associated with lowering the incidence of foodborne and waterborne illnesses. Importantly, our findings show mass media has the potential to reach a large audience when educating adults about foodborne and waterborne illnesses.

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1. Introduction

Each year, billions of people suffer from food-borne and water-borne illnesses, placing a heavy burden on global public health [1–7]. The burden of foodborne and waterborne illness was disproportionately high in developing or resource-limited settings, with significant financial consequences [6–8]. Although national estimates of foodborne and waterborne illness are lacking in Ethiopia, 9.3% of the annual incidence of cases were foodborne-related [9]. Furthermore, both of them continue to be major causes of preventable death [10–12]. 60 to 80% of communicable diseases are attributed to limited access to safe water and inadequate sanitation and hygiene services in Ethiopia [9,13]. This is also evident in the Gedeo zone in 2021; the zonal office report indicated that foodborne and waterborne illnesses were significant contributors to the majority of morbidity and mortality across the zone (See Supplementary File 1: Gedeo Zone Morbidity and Mortality Report).

Following the government-led WASH strategy [14], remarkable progress has been achieved in access to drinking water from 14% to 52% and access to sanitation from 3% to 52% in the last two decades [15,16]. However, access to water supply and sanitation in Ethiopia were among the lowest in sub-Saharan Africa and the entire world. According to UN-Water, in 2017, only 11% of the population used a safely managed drinking water service on their premises. Furthermore, the microbiological quality of water was regarded as very poor [17], posing a potential health risk [9]. Preventive healthcare takes a prominent role and is pivotal in the fight against the burden of food-borne and water-borne illnesses [18–21]. Therefore, this necessitated the development of health literacy among people.

Health literacy is an important factor that plays an important role in improving access to preventive care and reducing inequality [21–27]. It was also established that health literacy and health information are essential predictors of individual health status and can shape communities' and societies' health-related outcomes [28], including diseases, treatments, and prevention strategies [29–32]. Furthermore, health education that has been focused on foodborne and waterborne-related health information is an important concern [33]. Even though health literacy is a public health concern and an essential component of the healthcare system [26,29,31,34,35], it has gotten little attention in Ethiopian literature. Few health literacy studies were conducted among patients with non-communicable diseases [36–39] and reported overall insufficient or poor health literacy levels, ranging from 41.8% to 64.19%.

Further, having a reliable source of health information is critical for building a strong foundation of knowledge about health among the public [40–42]. However, failure to appropriately acquire or understand health-related information has negative impacts on individual health and can lead to health disparities. Therefore, understanding and addressing the drivers of health literacy and health information sources were pivotal to curbing the burden of foodborne and waterborne illness in resource-limited settings such as Ethiopia. Existing research shows variations in adults' health literacy levels were linked to several socioeconomic [43–52], demographic [45,46,51–55], behavio [42,43,45,46,49,56,57] and health information source factors [58–61]. Similarly, the determinants of utilizing health information sources were linked to sociodemographics [62–68] and socioeconomic characteristics [63–67,69,70].

This study aimed to explore health literacy and health information sources regarding foodborne and waterborne diseases among adults in the Gedeo zone. Furthermore, we examined the relationship between health information sources, health literacy, and foodborne and waterborne literacy and the effect of this relationship on the status of foodborne and waterborne illnesses.

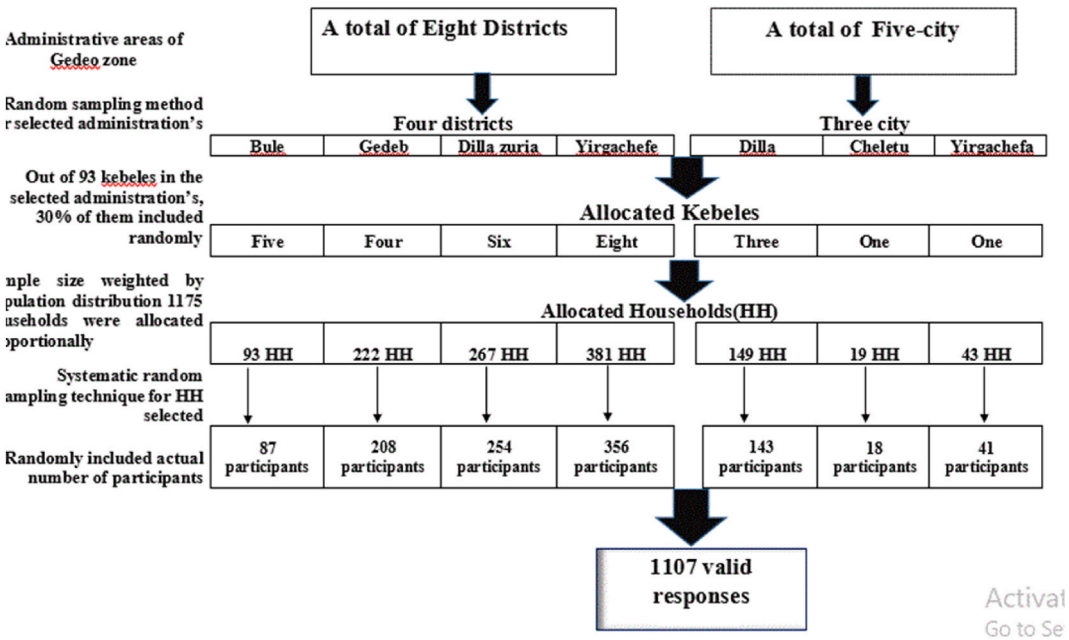

Fig. 1. Flowchart of sample allocation and data collection procedure used to select study participants in this study.

2. Methods and materials

2.1. Study design, setting, and period

A community-based cross-sectional study design with a quantitative approach was used to investigate health literacy and health information sources concerning foodborne and waterborne illness among adults in the Gedeo zone of the SNNPR, Ethiopia, in 2021–2022. The zone has eight woredas (Bule, Repe, Gedeb, Choriso, Wonago, Kochire, Dilla zuriya, Yirgacheeffe woredas) and five administrative towns (Dilla, Yirgachefe, Gedeb, Wonago, Cheleletu). Dilla is the zonal capital of Gedeo Zone, 360 km away from Addis Ababa in the south. The total population of the study area is 1,226,779, with an estimated crude population density of 774 persons per square kilometer. In 2021, there were a total of 250,363 households in the zone (source: Gedeo zone health department). This survey was executed through face-to-face interviews between March 2022 and April 2022 among adult participants in the Gedeo zone. All methods were carried out following relevant guidelines and regulations of the Helsinki Declaration, and the Institutional Review Boards (IRB) of Dilla University (duirb-004-22-07) granted ethical clearance.

2.2. Study population

To be included in this study, participants had to be 18 years of age or older and have lived in the selected areas of the Gedeo Zone, southern Ethiopia, for a minimum of six months. Exclusion criteria included the following: a hearing impairment, a speech impairment, a mental illness, and being unable to communicate with other serious illnesses. This was a cross-sectional study executed among selected districts from the Gedeo zone (see Fig. 1 for details).

3. Sample size determination and sampling technique

3.1. Sample size determination

Single population proportion formulas were employed to compute the sample size. Where n was the estimated sample size, Z was the standard normal value corresponding to the level of confidence (1.96), p was the estimated proportion of the study population with the variable of interest (study outcomes), and d was the degree of precision of the study. We took into account a 3% margin of error and a 95% confidence interval for this sample because there had never been any prior research done related to similar settings. Therefore, considering a 10% non-response rate, the final sample size was 1,175.

3.2. Sampling

A multistage sampling technique was employed to ascertain study subjects. Accordingly, among the eight districts and five city administrations of the Gedeo zone, four districts and three city administrations were selected using a simple random sampling method. Twenty-eight kebeles were then selected from each selected county using simple random sampling to obtain 30% of the kebeles in that county. Lists of kebeles and numbers of households were obtained from zone and district officials. After allocating 1175 households, they were allocated proportionally. The study households were selected using systematic random sampling, where the interval for selection was determined by dividing the approximate number of households in a given kebele by the required number of participants. Then an eligible individual within the selected household was included randomly in the study. In all, 1,175 adults were approached in the selected areas, and 1,107 completed the questionnaire. This represents a response rate of 94.4% (see Fig. 1 for details).

3.3. Data collection tools, procedures, and quality assurance

The development of the questionnaire survey was based on a literature review, and most of the items were adapted from items developed based on existing literature [22,43–45,49,51,54,56,57,68,71–74]. The questionnaire was originally prepared in English (see S1 Questionnaire), translated into Amharic (see S2 Questionnaire), and Gedofa (see S3 Questionnaire), and these were retranslated into English by an independent professional to validate consistency and ensure the accuracy of the translation. A paper-based version of the questionnaire was used to collect the data in this study. Intensive three-day training for data collectors and supervisors was given on the overall field survey techniques and skills, steps, and process of data collection. In addition, administered questionnaires were examined for completeness, accuracy, and consistency of responses to detect and eliminate errors. The collected data were cleaned, coded, and entered into Epi-Data version 4.6.

3.4. Pilot study

It was originally anticipated that the pilot testing would include a sample of 58 adult participants. However, to enable more thorough testing of the survey instrument in both local languages, the pilot sample was expanded by 30%. A pilot study was carried out by 4 trained data collectors, and 76 questionnaires were completed by using face-to-face interviews with adults, mainly Hasidela and Chechu Kebele residents of the Gedeo zone (see Supplementary Table 1 for details on the sample profile of the pilot study). In the pilot study, the minimum time to complete the survey was approximately eighteen to 20 min, and on occasions when there was an interruption, it may have taken up to thirty-five to 40 min. Thus, considering an average completion time of twenty-five to 30 min as an

acceptable response, formal recommendations about the survey content and process were not solicited from the pilot participants, although participants did provide suggestions on some sections of the instrument. Because of the pilot, a few items were identified for modification based on data collectors' and supervisors' feedback and the investigator's observation.

The body of the survey was revised to improve clarity and facilitate ease of completion by changing the order of questions to narrow the subsequent questions based on prior responses and relevance to the participant's specific circumstances (for example, a section on perceived barriers to achieving health literacy was added after the overall health literacy section) and permitting multiple answers when appropriate. In the Exposure to Foodborne and Waterborne Messages section, item 2 was changed from "If yes, with which foodborne and waterborne illness?" to " If yes, with which foodborne and waterborne illness? more than one answer is possible" On the other hand, in the perceived barriers to achieving health literacy questions, some participants indicated they have no personal barrier to achieving health literacy, considering the "NO BARRIER" option for the columns in barriers to accessing health information sources was used in the main study. Furthermore, to embed as much flexibility as possible in this section of the questionnaire, the following statement was amended in the instruction or bottom part of the Perceived Barriers to Achieving Health Literacy construct: "You may always go back to modify any answer if desired". Furthermore, the reliability of the pre-test instrument was assessed using Cronbach's alpha, and the findings were within the recommended range of 0.50 to 0.60[74–76] for the early stages of research (see Supplementary Table 2 for details on the results of the pilot study).

An interviewer-administered, semi-structured questionnaire was used to gather the data. The survey questionnaire was divided into five main sections. Section A of the questionnaire was concerned with sociodemographic and health status information. Section B was concerned with the participant's exposure to food- and water-borne illnesses and messages relating to their risk factors. Section C was about food- and water-borne literacy and health literacy, and Section D addressed health information sources, health information dissemination, and health information-seeking behavior (see the supplemental files for details of the questionnaire).

Foodborne and waterborne literacy: literacy towards foodborne and waterborne illness was measured using the Brief Health Literacy Screen (BHLS) [45,75,76]. The tool was created to be shorter than previous tools like the Rapid Estimate of Adult Literacy (REALM) and Short Test of Functional Health Literacy (STOFHLA) [58,77]. The BHLS instrument measures health literacy using three items; a 5-point Likert-type scale was used for scoring each of the items. The BHLS score, which ranges from 3 to 15, is determined by adding the three non-weighted items together. A higher score denotes greater health literacy. Finally, foodborne and waterborne literacy was classified as inadequate ($\leq$9) or adequate ($>$ 9).

Health literacy level was measured by using HLS-EU-Q16, which comprised 16 items [72,77,78]. The HLS-EU-Q16 is a 16-item self-report questionnaire that assesses "challenges in accessing, understanding, appraising, and applying the information to tasks associated with making decisions about healthcare, disease prevention, and health promotion." Items are rated on a four-point Likert scale: 1 = very difficult, 2 = difficult, 3 = easy, and 4 = very easy. To score the HLS-EU-Q16, the categories "very difficult" and "difficult" of each item were scored as 0, and the categories "easy" and "very easy" were scored as 1, yielding a simple sum score ranging between 0 and 16. A score of 0–8 was considered inadequate HL, a score between 9 and 12 was problematic, and 13 or more were sufficient.

Items that were adapted from the Health Information National Trends Survey (HINTS) [68,78] measured health information sources. Mass media and interpersonal sources were measured when determining the sources of health information. Participants were asked to report their exposure to health or medical topics on various media channels in the previous 12 months on a scale ranging from "yes" to "don't know." Mass media included the Internet, radio, TV, and print media (i.e., newspapers and magazines), while interpersonal platforms included healthcare providers and non-health professional social networks. Non-health professional interpersonal platforms were community organizations and friends and family. Participants who indicated "yes" when asked if they used a specific source of health information were referred to as "Users." Participants who mentioned missing items or said they "don't know" were classified as "non-users.".

The reliability of the instrument was analyzed using Cronbach's alpha (Table 1). All dimensions and the questionnaire as a whole show good internal consistency and reliability. The overall Cronbach's alpha value for the health literacy construct was 0.77, which was considered satisfactory. The alpha coefficients for the accessing, understanding, appraising, and applying dimensions were 0.64, 0.84, 0.71, and 0.66, respectively. Similarly, the coefficients of respondent exposure to foodborne and waterborne messages and perceived barriers to health literacy were 0.70 and 0.88, respectively. However, we observe that the reliability of the food and

Table 1
Reliability test for constructs used in this survey.

Constructs	Sub-scale	No of Items	Alpha detected	Cronbach's Alpha (α)
Health literacy	Accessing (Ability to find good health information)	4	0.64	0.77
	Understanding (Understanding health information well enough to know what to do)	5	0.84	
	Appraising (Appraisal of health information)	4	0.71	
	Applying information	3	0.66	
Literacy on food and waterborne diseases		3		0.63
Exposure to messages on foodborne and waterborne diseases		4		0.70
Perceived barriers to achieving health literacy		12		0.88

Table 2
Socio-demographic characteristics of respondents by status of foodborne and waterborne illness.

Characteristic	All participants	Participants who had foodborne and waterborne illness	Participants with adequate literacy on foodborne and waterborne illness		
	(N = 1107)), n (%)	(n = 282),n	% (95% CI)	(n = 257), n	% (95%CI)
Age					
18–30	497 (44.9)	132	26.5 (22.7–30.6)	112	22.5 (18.9–26.4)
31–40	262 (23.6)	63	24.0 (19.0–29.6)	64	24.4 (19.3–30.0)
41–50	190 (17.2)	54	28.4 (22.1–35.4)	38	2.0 (14.5–26.4)
51–60	142 (12.8)	28	19.7 (13.5–27.2)	39	27.0 (20.3–35.5)
>60	16 (1.4)	5	31.2 (11.0–58.6)	4	2.50 (0.7–5.2)
P-Value = 0.037					P-Value = 0.572
Gender					
Male	566 (51.13)	153	27.0 (23.4–30.9)	133	23.4 (20.0–27.2)
Female	541 (48.87)	129	23.8 (20.3–27.6)	124	22.9 (19.4–26.9)
P-Value = 0.224					P-Value = 0.889
Marital status					
Single	233 (21.1)	60	25.7 (20.2–31.8)	46	19.7 (14.8–25.4)
Married	740 (66.9)	185	25.0 (21.9–28.2	180	24.3 (21.2–27.5)
Divorced	61 (5.5)	16	26.2 (15.7–39.1)	14	22.9 (13.1–35.4)
Widowed	72 (6.5)	21	29.1 (19.0–41.1)	17	23.6 (14.4–35.1)
P-Value = 0.889					P-Value = 0.553
Family size					
<3	56 (5.1)	188	62.5 (48.5–75.1)	201	30.3 (18.7–44.0)
4–6	837 (75.6)	59	22.4 (19.6–25.4)	39	24.0 (21.1–27.0)
>6	214 (19.3)	35	27.5 (21.6–34.1)	17	18.2 (13.2–24.0)
P-Value = 0.000					P-Value = 0.087
Educational status					
Cannot read and write	383 (34.6)	93	24.2 (20.0–28.8)	103	26.8 (22.5–31.6)
Can read and write	83 (7.5)	16	19.3 (11.4–29.4)	19	22.8 (14.3–33.4)
Primary school (1–8)	442 (39.9)	95	21.4 (17.7–25.6)	89	20.1 (16.4–24.1)
High school (9–12)	185 (16.7)	12	35.6 (28.7–43.0)	3	23.2 (17.3–30.0)
College and above	14 (1.3)	66	15.7 (7.2–18.2)	43	2.1 (0.4–5.0)
P-Value = 0.000					P-Value = 0.259
Employment					
Daily labour	94 (8.5)	24	25.5 (17.1–35.5)	35	37.2 (27.4–47.8)
Governmental employee	103 (9.3)	36	34.9 (25.8–44.9)	25	24.2 (16.3–33.7)
Private employee	22 (1.9)	12	54.5 (32.2–75.6)	6	27.2 (10.7–50.2)
Merchant	255 (23.0)	65	25.4 (20.2–31.3)	57	22.3 (17.3–27.9)
Farmer	527 (47.6)	120	22.7 (19.2–26.5)	111	21.0 (17.6–24.7)
Homemaker/ housewife	20 (1.8)	4	2.0 (0.5–4.3)	5	2.5 (0.8–4.9)

(*continued on next page*)

Table 2 (*continued*)

Characteristic	All participants	Participants who had foodborne and waterborne illness	Participants with adequate literacy on foodborne and waterborne illness		
	(N = 1107)), n (%)	(n = 282),n	% (95% CI)	(n = 257), n	% (95%CI)
Student	68 (6.1)	11	16.1 (0.8–2.7)	14	20.5 (11.7–32.1)
Unemployed	18 (1.63)	10	55.5 (30.7–78.4)	4	2.2 (0.6–4.7)
P-Value = 0.000					P-Value = 0.001
Monthly household income(Ethiopian ETB)					
Less than 1000 birr	100 (9.08)	22	22.0 (14.3–31.3)	18	18.0 (11.0–26.9)
1001–2000	304 (27.6)	51	16.7 (12.7–21.5)	66	21.7 (17.2–26.7)
2001–3000	392 (35.6)	53	33.4 (28.7–38.3)	60	25.2 (21.0–29.8)
3001–4000	249 (22.6)	131	21.2 (16.3–26.8)	99	24.1 (18.9–29.9)
4001–5000	28 (2.5)	14	5.0 (30.6–69.3)	6	2.1 (0.8–4.0)
Above 5001 birr	28 (2.5)	9	11.1 (5.8–17.3)	7	2.5 (1.0–4.4)
P-Value = 0.000					P-Value = 0.695
Own Television					
Yes	347 (31.35)	70	20.2 (16.1–24.7)	61	17.6 (13.7–22.0)
No	760 (68.65)	212	27.8 (24.7–31.2)	196	25.8 (22.7–29.0)
P-Value = 0.006					P-Value = 0.003
Own Radio/tape recorder					
Yes	786 (71.00)	214	27.2 (24.1–30.4)	182	23.1 (20.2–26.3)
No	321 (29.00)	68	21.2 (16.8–26.1)	75	23.1 (20.2–26.2)
P-Value = 0.036					P-Value = 0.000
Self-rated health status					
good/very good	942 (85.09)	32	26.5 (23.7–29.5)	216	22.9 (20.2–25.7)
very poor/poor/fair	165 (14.91)	250	19.4 (13.6–26.2)	41	24.8 (18.4–32.2)
P-Value = 0.052					P-Value = 0.590
District/town					
Bule	87 (7.86)	20	22.9 (14.6–33.2)	12	13.7 (0.07–22.8)
Gedeb	208 (18.8)	4	27.8 (21.9–34.5)	1	0.05 (0.0–27.3)
Yirgachefe Woreda	356 (32.2)	27	23.0 (18.7–27.7)	21	14.7 (0.09–21.5)
Dillla Zuria	254 (22.9)	88	34.6 (28.8–40.8)	69	27.1 (21.7–30.0)
Cheletu	18 (1.6)	58	2.2 (0.6–4.7)	61	29.3 (23.2–36.0)
Dilla	143 (12.9)	82	18.8 (12.8–26.2)	90	25.2 (20.8–30.1)
Yirgachefe	41 (3.7)	3	0.7 (0.1–1.9)	3	0.07 (0.01–19.9)
P-Value = 0.001					P-Value = 0.000
Total		1,107	25.5 (22.9–28.1)	1,107	23.2 (20.7–25.8)

ETB currency exchange rate of 1 Ethiopian birr = US $0.16 is applicable.

waterborne illness literacy construct was 0.63, which is considered moderate or acceptable and would not affect the finding. Furthermore, this instrument has been validated by previous studies to test functional health literacy in adults; the area under the receiver operating characteristic curve was found to be between 0.76 and 0.87 for the three items [79].

3.5. Data management and analysis

STATA version 14.2 was employed to process the data analysis. Data were analyzed using appropriate descriptive statistics, which were expressed in absolute value or percentage, to determine the distribution. Next, using the chi-square test, we examined bivariate associations between demographic factors and foodborne and waterborne literacy, health literacy, and health information sources. Furthermore, to investigate the determinants of foodborne and waterborne literacy, a logistic regression model was employed. The results were expressed as crude and adjusted odds ratios together with corresponding 95% confidence intervals (CI).

The relationships between health information sources, health literacy, exposure to messages about foodborne and waterborne illness, and foodborne and waterborne literacy were also examined, as were the impacts of these relationships on the prevalence of foodborne and waterborne illness using structural equation modeling (SEM) with a maximum likelihood estimation. First, we made sure that the variables adhered to the multicollinearity and normal distribution assumptions. Further, the relative chi-square (x2/df), normed fit index (NFI), comparative fit index (CFI), and root-mean-squared error associated (RMSEA) fit indices were used to assess the model's goodness of fit (RMSEA). A better fit is indicated by smaller (x2/df) values, and insignificant (x2/df) is preferred. (x2/df) is supposed to be less sample size-dependent, and values higher than 1 and lower than 2 are regarded as a good fit. NFI and CFI have a range of 0–1, with values nearer 1 indicating a very good fit. A value of less than 0.08 indicates a good model fit. RMSEA measures how well a confirmatory structure resembles the data being modeled. At a two-sided p-value of 0.05, differences were deemed statistically significant.

3.6. Ethics approval and consent to participate

This study was conducted based on the Declaration of Helsinki and approved by the IRB of Dilla University (protocol code duirb-004-22-07). All the required information, such as consent, confidentiality, and the objectives of the survey, were described on the first page of the survey. In addition, all participants were informed that their participation was voluntary and they could withdraw their participation at any time; written informed consent was obtained from each study participant involved in the study. Further, to maintain confidentiality, the collected data did not provide any personal information about the participants and was only for research purposes.

4. Results

4.1. Descriptive statistics of the sample

The socioeconomic and demographic backgrounds of the study participants vary, as do the factors associated with foodborne and waterborne illnesses (Table 2). According to descriptive statistics, males made up 51.1% of the sample, and participants aged 18–30 years old made up 44.9% of the sample; 75.6% of the participants had a family size of four to six.

Fig. 2 shows percentages of exposure to foodborne and waterborne illnesses among participants in the last six months. Of the total study participants, 282 (25.5%) had been diagnosed with foodborne or waterborne illnesses. Typhoid (n = 129), acute watery diarrhea (n = 101), and helminthiasis (n = 14) were the most frequently reported foodborne and waterborne illnesses.

4.2. Sources of health information among participants

Various health information sources for participants are presented in Tables 3 and 4. In this study, the majority of participants obtained health information from mass media sources (watching TV, listening to the radio, and reading newspapers). Accordingly. Radio was the most common form of mass media to get health information, followed by TV (n = 345, 31.17%). In univariate analysis, age-perceived difficulty to obtain health information, willingness to access health information, ownership of a TV, and utilization of health professionals for health information were significant factors associated with participants' utilization of radio to get health information. For utilization of TV for health information, employment, perception towards accurate health information, health

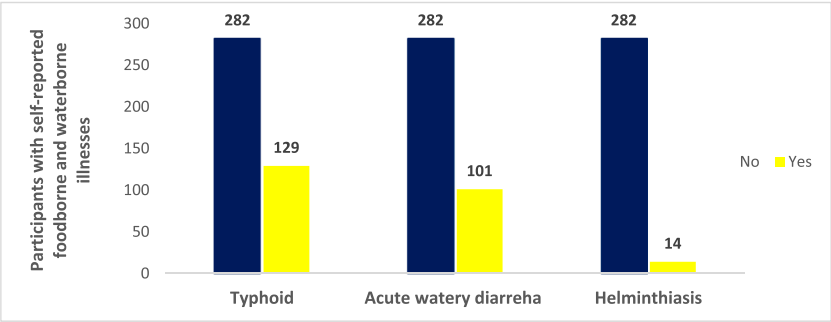

Fig. 2. Magnitude of self-reported foodborne and waterborne illnesses by adult participants at the selected areas of Gedeo Zone 2022.

Table 3
Bivariate associations between demographic variables and mass media sources for health information (n = 1107).

Variables	Mass media sources											
	Radio			TV			Print media			Internet		
	No n (%)	Yes n (%)	*X* [2]	No n (%)	Yes n (%)	*X* [2]	No n (%)	Yes n (%)	*X* [2]	No n (%)	Yes n (%)	*X* [2]
Gender												
Male	361 (63.78)	205 (36.22)		399 (70.49)	167 (29.51)		312 (83.20)	63 (16.80)		486 (85.87)	80 (14.13)	
Female	360 (66.67)	180 (33.33)	1.01	363 (67.10)	178 (32.90)	1.48	288 (81.36)	66 (18.64)	0.42	460 (85.03)	81 (14.97)	0.15
Age												
18–30	336(67.61)	161(32.39)	11.3*	355(71.43)	142(28.57)	4.47	331(82.54)	70(17.46)	1.84	419(84.31)	78(15.69)	9.18
31–40	175(66.79)	87(33.21)		180(68.70)	82(31.30)		137(81.07)	32(18.93)		228(87.02)	34(12.98)	
41–50	116(61.38)	73(38.62)		123(64.74)	67(35.23)		75(82.42)	16(17.58)		168(88.42)	22(11.58)	
51–60	89(62.68)	53(37.32)		95(66.90)	47(33.10)		50(86.21)	8(13.79)		121(85.21)	21(14.79)	
>60 years	5 (31.25)	11 (68.75)		9 (56.25)	7 (43.75)		7 (70.00)	3 (30.00)		10 (62.50)	6 (37.50)	
Marital status												
Single	149(63.95)	84(36.05)	1.42	159(68.24)	74(31.76)	1.77	177(84.69)	32(15.31)	1.39	197(84.55)	36(15.45)	1.10
Married	489(66.17)	250(33.83)		517(69.86)	223(30.14)		375(81.17)	87(18.83)		637(86.08)	103(13.92)	
Divorced	40(65.57)	21(34.43)		38(62.30)	23(37.70)		32(84.21)	6 (15.79)		52(85.25)	9(14.75)	
Widowed	43(59.72)	29(40.28)		48(66.67)	24(33.33)		16(80.00)	4 (20.00)		59(81.94)	13(18.06)	
Family size												
≤3	544(65.07)	292(34.93)	1.09	574(68.58)	263(31.42)	2.72	454(87.81)	63(12.19)	108.11**	736(87.93)	101(12.07)	33.49**
4–6	137(64.02)	77(35.98)		154(71.96)	60(28.04)		132(80.98)	31(19.02)		176(82.24)	38(17.76)	
>6	40 (71.43)	16 (28.57)		34 (60.71)	22 (39.29)		14 (28.57)	35(71.43)		34 (60.71)	22 (39.29)	
Education												
Cannot-read&write	235(61.52)	147(38.48)	4.79	260(67.89)	123(32.11)	7.94	4 (80.00)	1 (20.00)	57.23**	335(87.47)	48 (12.53)	22.92**
Can-read and write	58 (69.88)	25 (30.12)		49 (59.04)	34 (40.96)		67 (80.72)	16(19.28)		74 (89.16)	9 (10.84)	
1–8	296(78.57)	146(33.03)		312(70.59)	130(29.41)		377(85.29)	65(14.71)		375(84.84)	67(15.16)	
9–12	11(78.57)	3(21.43)		7(50.00)	7(50.00)		1(7.14)	13(92.86)		6(42.86)	8(57.14)	
College and above	121(65.41)	64 (34.59)		134(72.43)	51 (27.57)		151(81.62)	34(18.38)		156(84.32)	29 (15.68)	
Employment												
Daily labour	59(62.77)	35(37.23)	7.60	61(64.89)	33(35.11)	13.67*	43(84.31)	8 (15.69)	40.76**	74(78.72)	20(21.28)	36.60**
Governmental	71(68.93)	32(31.07)		76(73.79)	27(26.21)		79(8316)	16(16.84)		88(85.44)	15(14.56)	
Private	15(68.18)	7(31.82)		13(59.09)	9(40.91)		10(50.00)	10(50.00)		15(68.18)	7(31.82)	
Merchant	161(63.14)	94(36.86)		162(63.53)	93(36.47)		139(82.74)	29(17.26)		226(88.63)	29(11.37)	
Farmer	352(66.92)	174(33.08)		382(72.49)	145(27.51)		275(86.75)	42(13.25)		459(87.10)	68 (12.90)	
Housewife	15 (75.00)	5 (25.00)		16 (80.00)	4 (20.00)		8 (88.89)	1 (11.11)		18 (90.00)	2 (10.00)	
Student	40 (58.82)	28 (41.18)		42 (61.76)	26 (38.24)		39 (75.00)	13(25.00)		58 (85.29)	10 (14.71)	
Unemployed	8 (44.44)	10 (55.56)		10 (55.56)	8 (44.44)		7 (41.18)	10(58.82)		8 (44.4)	10 (55.56)	
Income												
<1000 birr	64(64.00)	36(36.00)	1.96	69(69.00)	31(31.00)	6.67	58(87.88)	8(12.12)	14.48*	82(82.00)	18(18.00)	16.31**
1001–2000	204(67.11)	100(32.89)		211(69.41)	93(30.59)		181(83.03)	37(16.97)		254(83.55)	50(16.45)	
2001–3000	158(63.45)	91(36.55)		165(66.27)	84(33.73)		139(79.89)	35(20.11)		208(83.55)	41(16.47)	
3001–4000	18(64.29)	10(35.71)		14(50.00)	14(50.00)		11(57.89)	8(42.11)		20(71.43)	8(28.57)	
4001–5000	16 (57.14)	12 (42.86)		18 (64.29)	10 (35.71)		14 (66.67)	7 (33.33)		22 (78.57)	6 (21.43)	
>5001 birr	260(66.50)	131(33.50)		279(71.17)	113(28.83)		192(84.96)	34(15.04)		355(90.56)	37 (9.44)	
Own TV												
Yes	108(72.48)	229(35.84)	3.71*	115(77.18)	34 (22.82)	4.70*	89(84.76)	16 (15.2)	1.10	132(84.59)	17 (11.41)	1.58
No	410(64.16)	41 (27.52)		436(68.13)	204(31.87)		363(80.31)	89(19.69)		541(84.53)	99 (15.47)	
Own Radio												
Yes	502(63.95)	102(31.78)	1.83	539(68.58)	247(31.42)	0.08	409(82.46)	87(17.54)	0.02	676(86.01)	110(13.99)	0.65
No	219(68.22)	283(36.05)		223(69.47)	98 (30.53)		191(81.97)	42(18.03)		270(84.11)	51 (15.59)	

(*continued on next page*)

Table 3 (*continued*)

Variables	Mass media sources											
	Radio			TV			Print media			Internet		
	No n (%)	Yes n (%)	*X* [2]	No n (%)	Yes n (%)	*X* [2]	No n (%)	Yes n (%)	*X* [2]	No n (%)	Yes n (%)	*X* [2]
Self-rated health status												
Good	621(65.92)	321(34.08)	1.50	657(69.75)	285(30.25)	2.44	510(81.86)	113(18.14)	0.57	804(85.35)	138(14.65)	0.05
Poor	100(60.98)	64 (39.02)		105(63.64)	60 (36.36)		90(84.91)	16 (15.09)		142(86.06)	23 (13.94)	
District/town												
Bule	64 (73.55)	23 (26.44)	8.93	63(72.41)	24 (27.59)	20.35**	41(95.35)	2 (4.65)	41.52**	86(98.85)	1 (1.15)	42.54**
Gedeb	131(20.00)	2 (11.11)		126(60.58)	82 (39.42)		123(94.62)	7 (5.38)		197(94.71)	11 (5.29)	
Yirgachefe	227(33.25)	55(38.46)		241(67.70)	115(32.30)		155(83.78)	30(16.22)		283(79.49)	73(20.51)	
Dillla Zuria	169(22.08)	85(33.46)		190(74.80)	64(25.20)		143(71.50)	57(28.50)		213(83.86)	41(16.14)	
Cheletu	16 (88.89)	77 (37.02)		16 (88.89)	2 (11.11)		17 (100.0)	0 (0.00)		17 (94.44)	1 (5.56)	
Dilla town	88 (61.54)	128(36.06)		104(72.73)	39 (27.27)		99 (80.49)	24 (19.51)		119(83.22)	24 (16.78)	
Yirgachefe town	26 (3.90)	15 (36.59)		22 (53.66)	19 (46.34)		22 (70.97)	9 (29.03)		31 (75.61)	10 (24.39)	
Had foodborne/waterborne illness												
Yes	191(67.73)	91 (32.27)	1.07	201(26.49)	81 (28.72)	1.05	144(75.39)	47 (24.61)	8.48**	240(85.11)	42 (14.89)	0.03
No	530(64.32)	294(35.68)		561(68.00)	264(32.00)		456(84.76)	82 (15.24)		706(85.58)	119(14.42)	
Importance of accurate health information					1.37							
Very-Important	187(65.61)	98(34.39)	2.69	187(65.38)	99(34.62)	8.98*	142(69.95)	61(30.05)	31.37**	249(87.06)	37(12.94)	10.46*
Somewhat-Important	459(64.29)	255(35.71)		501(70.17)	213(29.83)		397(86.30)	63(13.70)		602(84.31)	112(15.69)	
Not Important	35(76.09)	11(23.91)		38(82.61)	8 (17.39)		25(96.15)	1 (3.85)		46(100.0)	0 (0.00)	
I Don't Know	40(65.57)	21(34.43)		36(59.02)	25 (40.98)		36(90.00)	4 (10.00)		49(80.33)	12 (19.67)	
If there is public access to health information, how often would you look												
Frequently	145(57.31)	108(42.69)	35.52**	130(51.18)	124(48.82)	84.63**	137(80.24)	33(19.76)	49.37**	221(87.01)	33(12.99)	92.77**
Occasionally	264(59.46)	180(40.54)		288(64.86)	156(35.14)		229(72.93)	85(27.07)		328(73.87)	116(26.13)	
Not at all	312(76.28)	97 (23.72)		344(84.11)	65 (15.89)		237(95.56)	11 (4.44)		397(97.07)	12 (2.93)	
Preferred language to obtain health information												
Amharic	279(62.56)	167(37.44)	3.83	297(66.44)	150(33.56)	3.36	227(74.18)	79(25.82)	24.80	361(80.76)	86(19.24)	14.15*
Gedeofa	430(67.40)	208(32.60)		542(70.85)	186(29.15)		362(68.51)	47(11.49)		567(88.87)	71(11.13)	
Oromifa	12 (54.55)	10 (45.45)		13 (59.09)	9 (40.9)		11 (78.57)	3 (21.43)		18 (81.82)	4 (18.18)	
Foodborne and waterborne illness related literacy												
Adequate	163(63.42)	94 (36.58)	0.46	187(72.76)	70 (27.24)	2.40	126(81.29)	29 (18.71)	0.13	229(89.11)	28(210.89)	3.58*
Inadequate	558(65.72)	291(34.28)		575(67.65)	275(35.35)		474(82.58)	100(17.42)		717(84.35)	133(15.65)	
Health literacy				1.37								
Sufficient	55(64.80)	34(38.20)	1.37	52(58.43)	37(41.57)	287.35**	34(40.96)	49(59.04)	188.07**	57(64.04)	32(35.96)	105.9**
Inadequate	574(79.94)	144(20.06)		614(85.52)	104(14.48)		423(96.80)	14(3.20)		670(93.31)	48(6.69)	
Problematic	92 (30.77)	207(69.23)		96 (32.00)	204(68.00)		143(68.42)	66 (31.58)		219(73.00)	81 (27.00)	
Use family and friends for health information												
Yes	303(63.39)	175(36.61)	1.20	347(72.44)	132(27.56)	5.12*	248(82.39)	53 (17.61)	0.02	429(89.56)	111(17.68)	11.45
No	418(66.56)	210(33.44)		41(66.08)	213(33.92)		352(82.24)	76 (17.76)		517(82.32)	50 (10.44)	
Use health professionals for health information												
Yes	184(26.49)	41 (18.22)	34.24**	197(87.56)	28 (12.44)	46.13**	197(87.56)	28 (12.44)	46.13**	199(88.44)	26 (11.56)	2.02
No	537(73.51)	344(39.05)		565(64.06)	317(35.94)		565(64.06)	317(35.94)		747(84.69)	135(15.31)	
Use community organizations for health information												
Yes	125(66.49)	63 (33.51)	0.16	127(67.55)	61 (32.45)	0.17	104(73.76)	37 (26.24)	8.76**	157(83.51)	31 (16.49)	0.68
No	596(64.92)	322(35.08)		635(69.10)	284(30.90)		496(84.35)	92 (15.65)		789(85.85)	130(14.15)	

* indicates p-value significant (at less than 0.05).
*$p < 0.05$; **$p < 0.01$

literacy, utilization of family or friends for health information, ownership of TV, and willingness to access health information were found to be significant. Furthermore, education, income, family size, place of residence, health literacy, and willingness to access health information were found to be significant factors in accessing health information from print media and internet sources with *P*-values less than 0.05 (Table 3).

Table 4 also shows that interpersonal (i.e., family and friends, health professionals, and community organizations) sources of health information vary among participants. Family and friends (43.27%) and health professionals (20.33%) were the most commonly utilized sources to obtain health information. Further, the results of the univariate analysis indicated that family size, educational level, health literacy, place of residence, history of foodborne and waterborne illness, perception of accurate health information, and utilization of print media were significantly associated with the utilization of all interpersonal sources. Additionally, employment, income, and willingness to access health information were also significantly associated with interpersonal sources, except for family and friends. In addition, ownership of TV and the use of radio and TV for health information were significantly associated with accessing health information from family and friends and health professionals (Table 4).

4.3. Overall health literacy level

The results of participants' overall health literacy are shown in Table 5. From the total study participants, inadequate, problematic, and sufficient levels of health literacy were 64.8%, 27.1%, and 8.04%, respectively. Except for gender and radio ownership in the household, all of the independent variables were significantly associated with the participant's health literacy (Table 5). These included age, educational status, marital status, family size, income, employment, self-perceived health status, household ownership of TV, and place of residence.

4.4. Foodborne and waterborne illness-related literacy

Table 5 shows participants' literacy toward foodborne and waterborne illnesses. The study revealed that 23.2% (95% CI: 20.7–25.8) of the participants had an adequate level of foodborne and waterborne illness literacy.

As shown in Table 6, in the univariate logistic regression analysis, employment, those who own radio and TV, place of residence, self-rated health status, seeking foodborne and waterborne information, utilization of the internet, family and friends, and health professionals were associated with an adequate level of participants' literacy towards foodborne and waterborne illness. Furthermore, the proportion of participants who were knowledgeable about foodborne and waterborne illnesses was significantly related to household TV ownership and place of residence. The multivariate logistic regression model shows that an adequate level of foodborne and waterborne illness literacy shows a positive, statistically significant association with having good health status (aOR 1.3, 95% CI 1.01–1.8), radio ownership (aOR 1.53, 95% CI 1.46–1.61), and seeking information about foodborne and waterborne illnesses (aOR 1.1, 95% CI 1.0–1.6). On the other hand, a negative association was found between participants who are merchants, farmers, and students living in Cheletu town and the dependent variable.

4.5. Path analysis

The relationship between health information sources, health literacy, foodborne and waterborne literacy, and the status of foodborne and waterborne illness was investigated using SEM analysis. The results of the final model are shown in Fig. 3 and Table 7, respectively. Both health literacy and foodborne and waterborne literacy were associated with lower foodborne and waterborne illness incidences. Adequate foodborne and waterborne literacy, in particular, (−0.142, p 0.000), lowers the chances of having a foodborne or waterborne illness. In terms of the relationship between health literacy and having a foodborne or waterborne illness, participants with adequate health literacy (−0.179, p 0.001) show a lower incidence of foodborne or waterborne illness. Similarly, a lower incidence of foodborne or waterborne illness was significantly and directly associated with individuals who sought or obtained health information; the highest effect came from utilizing mass media sources, followed by interpersonal sources of health information (Fig. 3).

In terms of moderator analyses, mass media had a positive effect on foodborne and waterborne illness literacy (0.27, p 0.001). Further, there was a positive interaction between health literacy and both mass media and interpersonal sources of health information (0.49) and 0.22 (at the 99% confidence level). However, the role of foodborne and waterborne messages and interpersonal sources of health information on foodborne and waterborne illness literacy was not significant. The final model fit indices showed RMSEA = 0.020, CIF = 0.952, NFI = 0.677, and CMIN/df = 1.022, indicating relatively adequate model goodness of fit to the data (Table 7).

5. Discussion

Health literacy is critical and is regarded as one of the key foundations for individual and community health [29,75]. The burden of foodborne and waterborne illness is disproportionately high in developing or resource-limited settings [2]. However, research on health literacy and health information sources related to foodborne and waterborne illness is limited. The study aimed to evaluate whether health literacy and sources of health information constitute a pathway by which foodborne and waterborne illness literacy affects the status of foodborne and waterborne illnesses among adults in the Gedeo Zone, southern Ethiopia.

In this study, 25.5% (95% CI: 22.9–28.1%) of participants reported a diagnosed history of foodborne and waterborne illnesses. The results from this study showed that the level of literacy towards foodborne and waterborne illness was grossly inadequate; less than two-thirds of participants had an adequate level of literacy. On the contrary, a study conducted in Ghana reported a 40% adequate

Table 4
Bivariate associations between demographic variables and interpersonal sources for health information (n = 1107).

Variables	Interpersonal sources								
	Family and friends			Health professionals			Community organizations		
	No n (%)	Yes n (%)	*X* [2]	No n (%)	Yes n (%)	*X* [2]	No n (%)	Yes n (%)	*X* [2]
Gender									
Male	322(56.89)	235(43.44)	0.01	448(79.15)	118(20.85)	0.19	470 (83.04)	96 (16.96)	0.00
Female	306(56.56)	244(43.11)		434(80.22)	107(19.78)		449 (82.99)	92 (17.01)	
Age									
18–30	292(58.75	205(41.25)	3.65	387(77.87)	110(22.13)	7.41	417(83.90)	80(16.10)	4.74
31–40	144(54.96)	118(45.04)		208(79.39)	54(20.61)		208(79.39)	54(20.61)	
41–50	107(56.32)	83(43.68)		150(78.95)	40(21.05)		162(85.26)	28(14.74)	
51–60	79(55.63)	63(44.37)		125(88.03)	17(11.97)		117(82.39)	25(17.61)	
>60 years	6 (37.50)	10 (62.50)		12 (75.00)	4 (25.00)		15 (93.75)	1 (6.25)	
Marital status									
Single	134(57.51)	99(42.49)	2.40	177(75.97)	56(24.03)	2.91	193(82.83)	40(17.17)	4.62
Married	422(57.03)	318(42.97)		596(80.54)	144(64.00)		623(84.19)	117(15.81)	
Divorced	37(60.66)	24(39.34)		51(83.61)	10(16.99)		46(75.41)	15(24.59)	
Widowed	35(48.61)	37(51.39)		57(79.17)	15(20.83)		56(77.78)	16(22.22)	
Family size									
≤3	453(54.12)	384(45.88)	16.46**	704(84.11)	133(15.89)	91.47**	732(87.46)	105(12.54)	60.27**
4–6	130(60.75)	84(39.25)		160(74.77)	54(25.23)		157(73.36)	57(26.64)	
>6	45 (80.36)	11 (19.64)		18 (32.14)	38 (67.86)		30 (53.57)	26 (46.43)	
Education									
Cannot-read&write	235(61.52)	147(38.48)	4.79	313(81.72)	70 (18.28)	47.94**	335 (87.47)	48 (12.53)	45.63**
Can-read and write	58 (69.88)	25 (30.12)		70 (84.34)	13 (15.66)		64(77.11)	19 (22.89)	
1–8	296(78.57)	146(33.03)		364(82.35)	78(17.65)		380(85.97)	62(14.03)	
9–12	11(78.57)	3(21.43)		2(14.29)	12(85.71)		5(35.71)	9(64.29)	
College and above	121(65.41)	64 (34.59)		133(71.89)	52 (28.11)		135 (72.97)	50 (27.03)	
Employment									
Daily labour	59(9.09)	35 (9.09)	7.60	76(80.85)	18(19.15)	69.65**	81(86.17)	13 (13.83)	39.65**
Governmental	71(8.31)	32 (8.31)		80(77.67)	23(22.33)		80(77.67)	23 (22.33)	
Private	15(1.82)	7 (1.82)		11(50.00)	11(50.00)		12(54.55)	10(45.45)	
Merchant	161(24.42)	94 (24.42)		192(75.29)	63(24.71)		203(79.61)	52(20.39)	
Farmer	352(45.19)	174(45.19)		447(84.82)	80 (15.18)		462 (87.67)	65 (12.33)	
Housewife	15 (1.30)	5 (1.30)		15 (75.00)	5 (25.00)		16 (80.00)	4 (20.00)	
Student	40 (7.27)	28 (7.27)		58 (85.29)	10 (14.71)		56 (82.35)	12 (17.65)	
Unemployed	8 (2.60)	10 (2.60)		3 (16.67)	15 (83.33)		9 (50.00)	9 (50.00)	
Income									
<1000 birr	64(9.47)	36(9.47)	1.96	83(83.00)	17(17.00)	24.01**	83(90.00)	10(10.00)	50.68*
1001–2000	204(26.32)	100(26.32)		264(86.84)	40(13.16)		279(91.78)	25(8.22)	
2001–3000	158(23.95)	91(23.95)		203(81.53)	46(18.47)		212(85.14)	37(14.86)	
3001–4000	18(2.63)	10(2.63)		20(71.43)	8(28.57)		23(82.14)	5(17.86)	
4001–5000	16 (3.16)	12 (3.16)		20 (71.43)	8 (28.57)		17 (60.71)	11 (39.29)	
>5001 birr	260(34.47)	131(34.47)		286(72.96)	106(27.04)		292 (74.49)	100(25.51)	
Own TV									
Yes	108(84.81)	229(84.81)	3.71*	115(77.18)	34 (22.82)	4.70*	123(842.55)	26 (17.45)	0.09
No	410(15.19)	41 (15.19)		436(68.13)	204(31.87)		535(83.59)	105(16.41)	
Own Radio									
Yes	108(84.81)	229(84.81)	3.71*	638(81.17)	148(18.83)	3.74	229(84.81)	229(84.81)	1.37
No	410(15.19)	41 (15.19)		244(76.01)	77 (23.99)		41 (15.19)	41 (15.19)	
Self-rated health status									
Good	549(58.28)	393(41.72)	6.18*	115(77.18)	34 (22.82)	0.300	229 (84.81)	229(84.81)	1.37
Poor	79(47.88)	86 (52.12)		507(79.22)	133(20.78)		41 (15.19)	41 (15.19)	
District/town									
Bule	23(5.97)	23 (5.97)	6.18*	64(73.56)	23 (26.44)	51.31**	23(5.97)	23(5.97)	6.18*
Gedeb	2(0.52)	2 (0.52)		171(82.21)	37 (17.79)		2(0.52)	2(0.52)	
Yirgachefe	55(14.29)	55(14.29)		308(86.52)	48(13.48)		55(14.29)	55(14.29)	
Dillla Zuria	85(22.08)	85(22.08)		166(65.35)	88(34.65)		85(22.08)	85(22.08)	
Cheletu	77 (20.00)	77 (20.00)		15 (83.33)	3 (7.32)		77 (20.00)	77 (20.00)	
Dilla town	128(33.25)	128(33.25)		120(83.92)	23 (16.08)		128 (33.25)	128(33.25)	
Yirgachefe town	15 (3.90)	15 (3.90)		38 (92.68)	3 (16.67)		15 (3.90)	15 (3.90)	
Had foodborne/waterborne illness									
Yes	108(84.81)	229(84.81)	3.71*	195(69.15)	87 (30.85)	25.88**	211 (74.81)	71 (25.18)	18.02**
No	410(15.19)	41 (15.19)		687(83.27)	138(16.73)		708 (85.82)	117(14.18)	
Importance of accurate health information									
Very-Important	138(13.5)	148(51.75)	56.03**	174(60.84)	112(39.16)	86.48**	91(66.78)	95(33.32)	77.82**
Somewhat-Important	395(13.5)	319(44.68)		620(86.83)	94(13.17)		637(89.22)	77(10.78)	
Not Important	37(13.5)	9 (19.57)		36(78.26)	10 (21.74)		35(76.09)	11(23.91)	
I Don't Know	58(13.5)	3 (4.92)		52(85.25)	9 (14.75)		56(91.80)	5(8.20)	

(*continued on next page*)

Table 4 (*continued*)

Variables	Interpersonal sources								
	Family and friends			Health professionals			Community organizations		
	No n (%)	Yes n (%)	*X* [2]	No n (%)	Yes n (%)	*X* [2]	No n (%)	Yes n (%)	*X* [2]
If there is public access to health information, how often would you look									
Frequently	541(13.5)	117(26.17)	1.37	240(94.49)	14(5.51)	122.58**	193(75.98)	61(24.02)	14.20**
Occasionally	541(13.5)	105(16.46)		386(86.94)	58(13.06)		369(83.11)	75(16.89)	
Not at all	541 (13.5)	3 (13.64)		256(62.59)	153(37.41)		357 (87.29)	52 (12.71)	
Preferred language to obtain health information									
Amharic	330(73.83)	117(26.17)	1.37	330(73.83)	117(26.17)	15.940**	330(73.83)	117(26.17)	1.37
Gedeofa	533(83.54)	105(16.46)		533(83.54)	105(16.46)		533(83.54)	105(16.46)	
Oromifa	19 (86.36)	3 (13.64)		19 (86.36)	3 (13.64)		19 (86.36)	3 (13.64)	
foodborne and waterborne illness related literacy									
Adequate	108(84.81)	229(84.81)	3.71*	198(77.04)	59 (22.96)	1.431	229(84.81)	229(84.81)	1.37
Inadequate	410(15.19)	41 (15.19)		684(80.47)	166(19.53)		41 (15.19)	41 (15.19)	
Health literacy									
Sufficient	415(57.80)	303(42.20)	20.75**	565(78.69)	153(21.31)	179.59**	37(41.57)	52(58.43)	120.0**
Inadequate	146(48.67)	154(51.33)		289(96.33)	11(3.67)		630(87.74)	88(12.26)	
Problematic	67 (75.28)	22 (24.72)		28 (31.46)	61 (68.54)		252 (84.00)	48 (16.00)	
Exposure to foodborne and waterborne messages									
Use Radio for health information									
Yes	108(84.81)	229(84.81)	3.71*	115(77.18)	34 (22.82)	4.70*	229 (84.81)	229(84.81)	1.37
No	410(15.19)	41 (15.19)		436(68.13)	204(31.87)		41 (15.19)	41 (15.19)	
Use Print media for health information									
Yes	108(84.81)	229(84.81)	3.71*	89(68.99)	40 (31.01)	8.89*	92 (71.32)	37 (28.68)	8.76*
No	410(15.19)	41 (15.19)		485(80.83)	115(19.17)		496 (82.67)	104(17.33)	

* indicates p-value significant (at less than 0.05).*$p < 0.05$; **$p < 0.01$

level of literacy about foodborne and waterborne illness [45]. Similarly, our finding is lower than in a study conducted in China [35]. From our results, we found that the participants with sufficient health literacy (8.04%) were particularly lower when compared with the findings of some previous studies [35,52,54,58].

Regarding health information sources, research showed that participants were more likely to seek out or get health information from mass media sources (such as radio and television) than from interpersonal sources (family and friends, health professionals, and community organizations). However, family members and/or close friends were cited by more than 43% of research participants as the most often used source of health information, followed by radio (34.81%) and television (31.7%). The proportion of participants who sought or received information from family and/or close friends was comparable to studies conducted in rural areas of the United States of America [53,56,71], Latin America and Vietnam [59]. However, the proportion of participants in this study who talked about health-related topics with their family and friends was higher than that of the study carried out in Iran [46]. Internet or online resources, on the other hand, were the least often used source by research participants (14.54%). This is comparable to earlier research done in developing countries [56,71], but it is far less than research done in developed countries [49,53,57,70]. As previously stated, research showed that radio and television were the most popular media among adults for spreading health information. The majority picked radio and television as the platforms via which they would like to receive health information. Similarly, studies from Iran and Japan indicated that people turned to television programs first for health information before turning to books, public libraries, family members, or close friends [46,59]. This suggests that radio and television should be used to communicate health-related information.

During multivariate analysis, our results show that perceived good health status is positively associated with foodborne and waterborne illness literacy. Furthermore, we show that seeking health-related information among participants is associated with better foodborne and waterborne illness literacy. This finding is consistent with previous research on the role of health information-seeking behavior in ensuring that everyone has access to basic healthcare services, particularly in low-to middle-income countries. More precisely, the search for health-related information has a consistent impact on literacy in this situation [55,58,61,65]. Therefore, we assume that planning a strategy based on individual preferences and access to mass media and/or interpersonal sources has an important role in improving awareness of foodborne and waterborne illnesses.

Based on the findings of SEM, this study demonstrated a relationship between health literacy and foodborne and waterborne illnesses. This finding indicates that individuals with higher levels of health literacy had a lower incidence of foodborne or waterborne illness. Earlier HL frameworks also observed this pattern, with health literacy playing an important role in improving health outcomes [29]. Diabetes risk was enhanced by low health literacy [22], and chronic diseases were another health consequence [41]. Improving overall health literacy and literacy on foodborne and waterborne illnesses may be a productive way to reduce the burden of foodborne and waterborne illnesses among adults in this context.

Our findings also showed that seeking or obtaining health information among participants is associated with a lower incidence of foodborne and waterborne illnesses. Particularly, this result indicates that participants who obtain or seek health information from health professionals have a lower incidence of foodborne and waterborne illnesses. This result is in line with previous evidence on the impact of obtaining health information on access to basic healthcare services and health outcomes [26,29,39]. Furthermore, seeking or obtaining health information was associated with a higher level of health literacy, according to the SEM findings in this study. Effects were particularly striking among participants who obtain health information through interpersonal and media sources, according to

Table 5
Health literacy and foodborne and waterborne literacy of respondents according to predictors (n = 1,107).

Variables	All participants	Health literacy			Literacy on foodborne and waterborne illness	
	(N = 1107)), n (%)	Sufficient (%)	Inadequate (%)	Problematic (%)	Adequate (%)	Inadequate (%)
Age						
18–30	497 (44.9)	10.06	62.17	27.77	22.54	77.46
31–40	262 (23.6)	8.40	65.27	26.34	24.43	75.57
41–50	190 (17.2)	5.79	69.47	24.74	20.00	80.00
51–60	142 (12.8)	2.83	71.13	26.06	27.46	72.54
>60	16 (1.4)	12.50	31.25	56.25	25.00	75.00
		X **[2] = 19.409 *P*-Value = 0.013**			***X*** **[2] = 2.913 *P*-Value = 0.572**	
Gender						
Male	566 (51.1)	7.77	66.25	25.97	23.50	76.50
Female	541 (48.8)	8.32	63.40	20.20	22.92	77.08
		X **[2] = 0.993 *P*-Value 0.609**			***X*** **[2] = 0.052 *P*-Value = 0.820**	
Marital status						
Single	233 (21.1)	11.16	57.08	31.76	19.74	80.26
Married	740 (66.9)	8.11	66.08	25.81	24.32	75.68
Divorced	61 (5.5)	1.64	70.49	27.87	22.95	77.05
Widowed	72 (6.5)	2.78	73.61	23.61	23.61	76.39
		X **[2] = 14.554 *P*-Value = 0.024**			***X*** **[2] = 2.09 *P*-Value = 0.553**	
Family size						
≤3	56 (5.1)	2.15	70.25	27.60	24.01	75.99
4–6	837 (75.6)	17.76	57.01	25.23	18.22	81.78
>6	214 (19.3)	58.93	14.29	26.79	30.36	69.64
		X **[2] = 269.843 *P*-Value = 0.000**			***X*** **[2] = 4.892 *P*-Value = 0.087**	
Educational status						
Cannot read and write	383 (34.6)	1.57	73.63	24.80	26.89	73.11
Can read and write	83 (7.5)	8.43	69.88	21.69	22.89	77.11
Primary school (1–8)	442 (39.9)	4.52	66.52	28.96	20.14	79.86
High school (9–12)	185 (16.7)	85.71	0.00	14.29	21.43	78.57
College and above	14 (1.3)	23.78	45.41	30.81	23.24	76.76
		X **[2] = 217.788 *P*-Value = 0.000**			***X*** **[2] = 5.287 *P*-Value = 0.259**	
Employment						
Daily labour	94 (8.5)	9.57	67.02	23.40	37.23	62.77
Governmental employee	103 (9.3)	18.45	60.19	21.36	24.27	75.73
Private employee	22 (1.9)	40.91	31.82	27.27	27.27	72.73
Merchant	255 (23.0)	5.88	66.27	27.84	22.35	77.65
Farmer	527 (47.6)	3.04	68.69	28.27	21.06	78.94
Housewife	20 (1.8)	5.00	75.00	20.00	25.00	75.00
Student	68 (6.1)	5.88	58.82	35.29	20.59	79.41
Unemployed	18 (1.63)	88.89	0.00	11.11	22.22	77.78
		X **[2] = 232.134 *P*-Value = 0.000**			***X*** **[2] = 12.416 *P*-Value = 0.001**	
Household income(per month)						
Less than 1000 birr	100 (9.08)	5.00	72.00	23.00	18.00	82.00
1001–2000	304 (27.6)	3.62	65.46	30.92	21.71	78.29
2001–3000	392 (35.6)	6.83	60.64	32.53	24.10	75.90
3001–4000	249 (22.6)	9.95	68.37	21.68	25.26	74.74
4001–5000	28 (2.5)	32.14	42.86	25.00	21.43	78.57
Above 5001 birr	28 (2.5)	28.57	42.86	28.57	25.00	75.00
		X **[2] = 61.137 *P*-Value = 0.000**			***X*** **[2] = 3.031 *P*-Value = 0.695**	
Own Television						
Yes	347 (31.3)	7.49	57.06	35.45	25.79	74.21
No	760 (68.6)	8.29	68.42	23.29	17.58	82.42
		X **[2] = 17.921 *P*-Value = 0.000**			***X*** **[2] = 9.001 *P*-Value = 0.003**	
Own Radio						
Yes	786 (71.0)	7.25	65.90	26.84	23.16	76.84
No	321 (29.0)	9.97	52.31	27.83	23.36	76.64
		X **[2] = 2.613 *P*-Value = 0.271**			***X*** **[2] = 0.005 *P*-Value = 0.000**	
Self-rated health status						
good/very good	942 (85.0)	8.81	65.07	26.11	22.93	77.07
very poor/poor/fair	165 (14.9)	3.64	32.73	63.64	24.85	75.15
		X **[2] = 6.986 *P*-Value = 0.030**			***X*** **[2] = 0.289 *P*-Value = 0.889**	
District/town						
Bule	87 (7.86)	1.15	80.46	18.39	13.79	86.21
Gedeb	208 (18.8)	0.48	73.08	26.44	29.33	70.67
Yirgachefe Woreda	356 (32.2)	2.25	69.38	28.37	25.28	74.72
Dillla Zuria	254 (22.9)	26.77	52.76	20.47	27.17	72.83
Cheletu	18 (1.6)	0.00	83.33	16.67	5.56	94.44
Dilla	143 (12.9)	5.59	53.85	16.67	14.69	85.31
Yirgachefe	41 (3.7)	7.32	56.10	35.59	7.32	92.68

(*continued on next page*)

Table 5 (*continued*)

Variables	All participants	Health literacy			Literacy on foodborne and waterborne illness	
	(N = 1107)), n (%)	Sufficient (%)	Inadequate (%)	Problematic (%)	Adequate (%)	Inadequate (%)
		X **[2] = 183.006** ***P*****-Value = 0.000**			***X*** **[2] = 26.565** ***P*****-Value = 0.000**	
Seek information on foodborne and waterborne illness						
Yes	288 (71.0)	17.49	37.93	44.58	23.25	76.75
No	118 (29.0)	2.57	80.46	16.98	23.15	76.85
		X **[2] = 215.164** ***P*****-Value = 0.000**			***X*** **[2] = 0.0014** ***P*****-Value = 0.000**	
Read health segments of newspaper/general magazine						
Yes	129 (17.70)	37.98	10.85	51.16	21.00	79.00
No	600 (82.30)	5.67	70.50	23.83	22.48	77.52
		X **[2] = 188.072** ***P*****-Value = 0.000**			***X*** **[2] = 0.1390** ***P*****-Value = 0.709**	
Watched health segments on the local TV						
Yes	345 (31.17)	10.72	30.14	58.13	24.54	75.46
No	762 (68.83)	6.82	80.58	12.60	20.29	79.71
		X **[2] = 287.358** ***P*****-Value = 0.000**			***X*** **[2] = 2.407** ***P*****-Value = 0.121**	
Heard health segments on the local radio/FM						
Yes	385 (34.81)	8.83	37.40	53.77	22.61	77.39
No	721 (65.19)	7.63	79.61	12.76	24.42	75.58
		X **[2] = 225.437** ***P*****-Value = 0.000**			***X*** **[2] = 0.4600** ***P*****-Value = 0.498**	
Used Internet for your health information seeking						
Yes	161 (14.54)	19.88	29.81	50.31	24.21	75.79
No	946 (85.46)	6.03	70.82	23.15	17.39	82.61
		X **[2] = 105.957** ***P*****-Value = 0.000**			***X*** **[2] = 3.5856** ***P*****-Value = 0.008**	
Community organization provides health information						
Yes	188 (16.98)	27.66	46.81	25.53	22.85	77.15
No	919 (83.02)	4.03	68.55	17.42	25.00	75.00
		X **[2] = 120.009** ***P*****-Value = 0.000**			***X*** **[2] = 0.4044** ***P*****-Value = 0.525**	
Have friends/family members to talk about health						
Yes	479 (43.27)	4.59	63.26	32.15	23.89	76.11
No	628 (56.73)	10.67	66.08	23.25	22.34	77.66
		X **[2] = 20.757** ***P*****-Value = 0.000**			***X*** **[2] = 0.364** ***P*****-Value = 0.000**	
Looked for health information from healthcare providers						
Yes	255 (20.33)	27.11	68.00	4.89	22.45	77.55
No	882 (79.67)	3.17	64.06	32.77	26.22	73.78
		X **[2] = 179.594** ***P*****-Value = 0.000**			***X*** **[2] = 1.431** ***P*****-Value = 0.002**	
Are there any kinds of health information which might have helped you, but which you found difficult to obtain						
Yes	(71.0)	7.25	65.90	26.84	23.16	76.84
No	321 (29.0)	9.97	52.31	27.83	23.36	76.64
		X **[2] = 183.006** ***P*****-Value = 0.000**			***X*** **[2] = 26.565** ***P*****-Value = 0.000**	
How important do you believe that access to accurate and unbiased health information is for your own wellbeing as a citizen?						
Very Important	286 (25.84)	25.17	48.60	26.22	23.43	76.57
Somewhat Important	714 (64.50)	1.82	68.91	29.27	22.69	77.31
Not Important	46 (4.16)	2.17	91.30	6.52	23.91	76.09
I Don't Know	61 (5.51)	4.92	73.77	21.31	27.87	72.13
		X **[2] = 169.934** ***P*****-Value = 0.000**			***X*** **[2] = 0.8717** ***P*****-Value = 0.832**	
If public access to health information is widely available to the general public in your area, how often would you use them to look for information?						
Frequently	254 (22.94)	8.27	58.27	33.46	24.80	75.20
Occasionally	444 (40.11)	14.86	50.00	34.14	22.97	77.03
Not at all	409 (36.95)	0.49	85.09	14.43	22.49	77.51
		X **[2] = 135.978** ***P*****-Value = 0.000**			***X*** **[2] = 0.4933** ***P*****-Value = 0.781**	

*Percentages are given with respect to total sample size in respective column.

earlier studies that support similar findings [61,64]. This could be attributed to the fact that adults who seek or obtain health information could be proactive and capable of locating, analyzing critically, and providing feedback on health information from healthcare professionals.

This study makes several important contributions to the literature. Overall, our findings were drawn from large and representative samples using comprehensive evaluation methods such as SEM. First, it shows the need for enhancing foodborne and waterborne illness literacy and overall health literacy among adults in the Gedeo Zone, southern Ethiopia. Second, this research indicates that mass media can have a significant impact on reducing foodborne and waterborne illness mortality and morbidity in developing countries. For example, governmental and non-governmental organizations can use television, radio, and newspapers to spread information about foodborne and waterborne illnesses, as well as sanitation and hygiene in food preparation and consumption. However, this study has limitations. First, we only used a quantitative approach; therefore, future research studies should consider adding a qualitative approach to identify individual preferences towards the mass media and/or interpersonal sources of health information. Second, the reliability of the foodborne and waterborne illness literacy measurement was moderate, so further validation of this metric should be considered to have more strength in the findings.

Table 6
Univariate and multivariate logistic regression model for foodborne and waterborne illness related literacy (n = 1107)).

Variables	Crude OR (95%CI)	AOR (95%CI)
Own Radio		
Yes	1.1 [1.0–1.3]*	1.5 [1.16–1.61] *
No	1	1
Employment		
Daily labour	1	1
Governmental employee	0.5 [0.3–0.9] *	0.5 [0.2–0.8] *
Private employee	0.6 [0.2–1.7]	0.4 [0.1–1.2]
Merchant	0.5 [0.2–0.8] *	0.4 [0.3–0.7] *
Farmer	0.4 [0.2–0.7] *	0.5 [0.3–0.8] *
Housewife	0.6 [0.1–1.6]	0.5 [0.1–1.5]
Student	0.4 [0.2–0.9] *	0.4 [0.2–0.8] *
Unemployed	0.4 [0.1–1.5]	0.3 [0.1–1.1]
District/town		
Bule Woreda	1	1
Gedeb Woreda	2.1 [1.3–5.1]*	2.5 [1.3–5.1]
Yirgachefe Woreda	2.1 [1.1–4.0]*	2.0 [1.0–3.9]
Dillla Zuria Woreda	2.3 [1.1–4.5]*	2.1 [1.3–4.2]
Cheletu town	0.3 [0.04–0.6]*	0.3 [0.04–0.9] *
Dilla town	1.0 [0.5–2.3]*	1.1 [0.5–2.4]
Yirgachefe town	0.4 [0.1–1.8]*	0.4 [0.1–1.7]
Self-rated health status		
good/very good	1.5 [1.1–2.1]*	1.3 [1.1–1.8]**
very poor/poor/fair	1	1
Looked for health information from healthcare providers		
Yes	1.2 [1.0–1.7] *	1.1 [1.08–1.6]**
No	1	1

Note: *p-value≤0.05 for bivariable analysis.
** *P*-value <0.01 and *** *P*-value <0.001 for multivariable analysis, 1 = reference category.

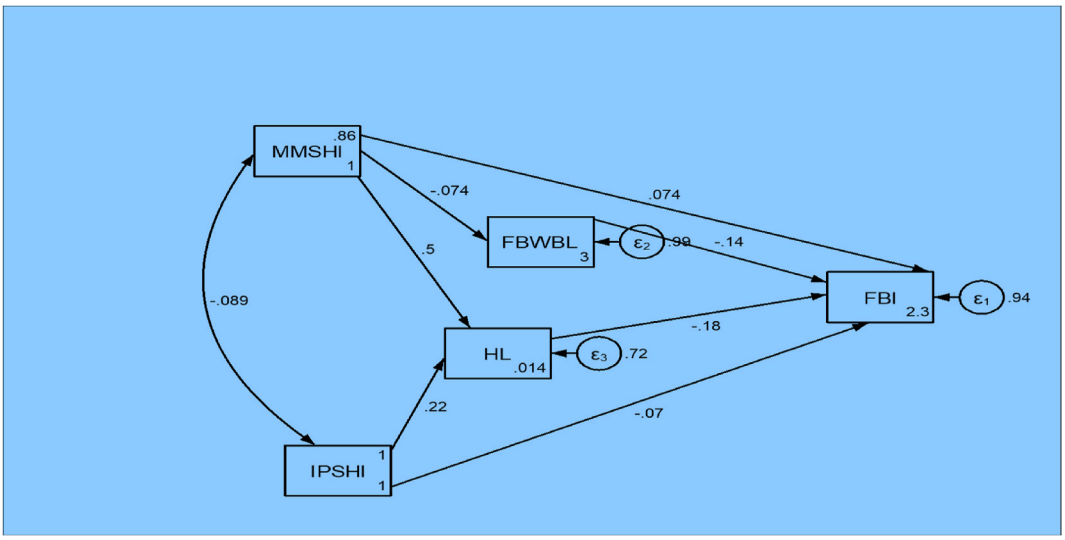

Fig. 3. Describe the association of the health information sources, foodborne and waterborne illness-related literacy, and health literacy with participants' status of foodborne and waterborne illness in the Gedeo Zone 2022.

6. Conclusion

Our findings show that foodborne and waterborne illnesses are significantly associated with low levels of health literacy and foodborne and waterborne literacy among adults in Ethiopia. From this study, it was understood that individuals with a higher level of health literacy and foodborne and waterborne illness literacy had a lower incidence of foodborne and waterborne illness. Similarly, obtaining health information is positively associated with lowering the incidence of foodborne and waterborne illnesses.

Importantly, our findings show mass media has the potential to reach a large audience when educating adults about foodborne and

Table 7
Path coefficients based on the final model.

Outcome variables	R2	Predictor variables	Unstandardized coefficient estimate	SE	p-value	Standardized coefficient estimate
Had foodborne and waterborne illness	**0.43**	Health literacy	−0.122	0.235	0.000	**−0.179**
		Foodborne and waterborne literacy	−0.023	0.004	0.000	**−0.142**
		mass media	−0.026	0.012	0.030	**0.073**
		Interpersonal	−0.039	0.017	0.021	**−0.070**
					0.000	
Foodborne and waterborne literacy	**0.005**	Mass-media	0.160	0.065	0.000	**0.274**
Health literacy	**0.27**	Mass-media	0.266	0.013	0.000	**0.499**
		Interpersonal	0.183	0.028	0.000	**0.223**

waterborne illnesses. Taking these results into consideration, healthcare professionals and institutions should be able to adapt their communication channels to improve health literacy and reduce the risks of foodborne and waterborne illness among adults.

Author contributions

Binyam Tariku Seboka & Mahlet Yigeremu: Conceived and designed the study; handled the data collection process; Analyzed and interpreted the data; Contributed analysis tools or data; Wrote the paper. Misrak Negashe & Delelegn Emwodew Yehualashet: handled the data collection process; Analyzed and interpreted the data; Contributed analysis tools or data. Chalachew Kassawe & Mulugeta Namaro: Analyzed and interpreted the data; Contributed analysis tools or data.

Data availability statement

Data included in article/supp. material/referenced in article.

Declaration of competing interest

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List of abbreviations

BHLS- Brief Health Literacy Screen, CFI-comparative fit index, CS-Confidence Intervals, HEPI-Health Professionals Education Partnership Initiatives, IRB- Institutional Review Boards, RMSEA-Root-mean-squared error associated, SSA-sub-Saharan Africa, SNNPR- Southern Nations, Nationalities, and Peoples' Region, SEM- Structural Equation Modeling.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.heliyon.2023.e15856.

References

[1] C. Fitzmaurice, D. Abate, N. Abbasi, H. Abbastabar, F. Abd-Allah, O. Abdel-Rahman, A. Abdelalim, A. Abdoli, I. Abdollahpour, A.S.M. Abdulle, et al., Global, regional, and national cancer incidence, mortality, years of life lost, years lived with disability, and disability-adjusted life-years for 29 cancer groups, 1990 to 2017: a systematic analysis for the global burden of disease study, JAMA Oncol. 5 (2019) 1749–1768, https://doi.org/10.1001/jamaoncol.2019.2996.

[2] M.D. Kirk, S.M. Pires, R.E. Black, M. Caipo, J.A. Crump, B. Devleesschauwer, D. Döpfer, A. Fazil, C.L. Fischer-Walker, T. Hald, et al., World health organization estimates of the global and regional disease burden of 22 foodborne bacterial, Protozoal, and viral diseases, 2010: a data synthesis, PLoS Med. 12 (2015), e1001921, https://doi.org/10.1371/journal.pmed.1001921.

[3] E. Abebe, G. Gugsa, M. Ahmed, Review on major food-borne zoonotic bacterial pathogens, J. Trop. Med. 2020 (2020), 4674235, https://doi.org/10.1155/2020/4674235.

[4] B. Devleesschauwer, M. Bouwknegt, P. Dorny, S. Gabriël, A.H. Havelaar, S. Quoilin, L.J. Robertson, N. Speybroeck, P.R. Torgerson, J.W.B. van der Giessen, C. Trevisan, Risk ranking of foodborne parasites: state of the art, Food Waterborne Parasitol. 8–9 (2017) 1–13, https://doi.org/10.1016/j.fawpar.2017.11.001.

[5] D. Dewey-Mattia, V.A. Roberts, A. Vieira, K.E. Fullerton, Foodborne (1973-2013) and waterborne (1971-2013) disease outbreaks - United States, MMWR. Morbidity and mortality weekly report 63 (2016) 79–84, https://doi.org/10.15585/mmwr.mm6355a8.

[6] M.D. Kirk, S.M. Pires, R.E. Black, M. Caipo, J.A. Crump, B. Devleesschauwer, D. Döpfer, A. Fazil, C.L. Fischer-Walker, T. Hald, et al., World health organization estimates of the global and regional disease burden of 22 foodborne bacterial, Protozoal, and viral diseases, 2010: a data synthesis, PLoS Med. 12 (2015), e1001921, https://doi.org/10.1371/journal.pmed.1001921.

[7] J. Jung, K. Skinner, Foodborne and waterborne illness among Canadian Indigenous populations: a scoping review, Canada communicable disease report = Releve des maladies transmissibles au Canada 43 (2017) 7–13, https://doi.org/10.14745/ccdr.v43i01a02.

[8] C. Wallace, S. Dickin, C. Metcalfe, Waterborne and Foodborne Diseases, Climate Change Impacts on Health, 2014, pp. 615–622, https://doi.org/10.1007/978-94-007-5784-4_102.

[9] A.H. Havelaar, A.C. Sapp, M.P. Amaya, G.F. Nane, K.M. Morgan, B. Devleesschauwer, D. Grace, T. Knight-Jones, B.B. Kowalcyk, (2022). Burden of foodborne disease due to bacterial hazards associated with beef, dairy, poultry meat, and vegetables in Ethiopia and Burkina Faso, Front. Sustain. Food Syst. 6 (2017), https://doi.org/10.3389/fsufs.2022.1024560.

[10] D. Belina, Y. Hailu, T. Gobena, T. Hald, P.M.K. Njage, Prevalence and epidemiological distribution of selected foodborne pathogens in human and different environmental samples in Ethiopia: a systematic review and meta-analysis, One Health Outlook 3 (2021) 19, https://doi.org/10.1186/s42522-021-00048-5.

[11] T. Bacha, E. Abebaw, A. Moges, A. Bekele, A. Tamiru, I. Shemsedin, D.S. Siraj, D. Jima, W. Amogne, Botulism outbreak in a rural Ethiopia: a case series, BMC Infect. Dis. 21 (2021) 1270, https://doi.org/10.1186/s12879-021-06969-w.

[12] S.A. Mekonnen, A. Gezehagn, A. Berju, B. Haile, H. Dejene, S. Nigatu, W. Molla, W.T. Jemberu, Health and economic burden of foodborne zoonotic diseases in Amhara region, Ethiopia, PLoS One 16 (2022), e0262032, https://doi.org/10.1371/journal.pone.0262032.

[13] UNICEF, Water, Sanitation and Hygiene (WASH), 2018. https://www.unicef.org/ethiopia/water-sanitation-and-hygiene-wash.

[14] S. Godfrey, M. Wambugu, P. Parikh, F. Tunhuma, Validation of the sustainable development goal 6 monitoring structures across east and southern Africa using fuzzy logic analysis, Water 14 (2022) 3065.

[15] United Nations, SDG 6 snapshot in Ethiopia. https://www.sdg6data.org/en/country-or-area/ethiopia.

[16] S.T. Gemeda, E. Springer, S.R. Gari, S.M. Birhan, H.T. Bedane, The importance of water quality in classifying basic water services: the case of Ethiopia, SDG6.1, and safe drinking water, PLoS One 16 (2021), e0248944, https://doi.org/10.1371/journal.pone.0248944.

[17] K. Amenu, M. Spengler, A. Markemann, A.V. Zárate, Microbial quality of water in rural households of Ethiopia: implications for milk safety and public health, J. Health Popul. Nutr. 32 (2014) 190–197.

[18] A.E. White, K.N. Garman, C. Hedberg, P. Pennell-Huth, K.E. Smith, E. Sillence, J. Baseman, E. Scallan Walter, Improving foodborne disease surveillance and outbreak detection and response using peer networks-the integrated food safety centers of excellence, J. Publ. Health Manag. Pract. : JPHMP 29 (2023) 287–296, https://doi.org/10.1097/phh.0000000000001607.

[19] L. Austin, Y. Jin, B.F. Liu, S. Kim, Coping with Outbreaks: toward an Infectious Disease Threat (IDT) Appraisal Model for Risk Communication, Health Commun. (2021) 1–13, https://doi.org/10.1080/10410236.2021.2006394.

[20] S. Almeria, L. Robertson, M. Santin, Why foodborne and waterborne parasites are important for veterinarians, Res. Vet. Sci. 136 (2021) 198–199, https://doi.org/10.1016/j.rvsc.2021.02.020.

[21] S. O'Brien, P. Garvey, K. Baker, M. Brennan, M. Cormican, J. Cuddihy, N. De Lappe, R. Ellard, Ú. Fallon, N. Irvine, et al., Investigation of a foodborne outbreak of Shigella sonnei in Ireland and Northern Ireland, December 2016: the benefits of cross-border collaboration and commercial sales data, Publ. Health 182 (2020) 19–25, https://doi.org/10.1016/j.puhe.2020.01.008.

[22] F. Zhang, P.P.L. Or, J.W.Y. Chung, How different health literacy dimensions influences health and well-being among men and women: the mediating role of health behaviours, Health Expect. Int. J. Public Participat. Health Care Health Policy 24 (2021) 617–627, https://doi.org/10.1111/hex.13208.

[23] C. Stormacq, J. Wosinski, E. Boillat, S. Van den Broucke, Effects of health literacy interventions on health-related outcomes in socioeconomically disadvantaged adults living in the community: a systematic review, JBI Evid. Synth. 18 (2020) 1389–1469, https://doi.org/10.11124/jbisrir-d-18-00023.

[24] H. Deek, L. Itani, P.M. Davidson, Literacy critical to heart failure management: a scoping review, Heart Fail. Rev. 26 (2021) 1413–1419, https://doi.org/10.1007/s10741-020-09964-6.

[25] T. Jansen, J. Rademakers, G. Waverijn, R. Verheij, R. Osborne, M. Heijmans, The role of health literacy in explaining the association between educational attainment and the use of out-of-hours primary care services in chronically ill people: a survey study, BMC Health Serv. Res. 18 (2018) 394, https://doi.org/10.1186/s12913-018-3197-4.

[26] C. Lorini, F. Ierardi, L. Bachini, M. Donzellini, F. Gemmi, G. Bonaccorsi, The antecedents and consequences of health literacy in an ecological perspective: results from an experimental analysis, Int. J. Environ. Res. Publ. Health 15 (2018), https://doi.org/10.3390/ijerph15040798.

[27] L. O'Meara, S.L. Williams, K. Ames, C. Lawson, S. Saluja, C. Vandelanotte, Low health literacy is associated with risk of developing type 2 diabetes in a nonclinical population, Diabetes Educat. 45 (2019) 431–441, https://doi.org/10.1177/0145721719857548.

[28] R.E. Rudd, Health literacy considerations for a new cancer prevention initiative, Gerontol. 59 (2019) S7–s16, https://doi.org/10.1093/geront/gnz032.

[29] D.A. Dewalt, N.D. Berkman, S. Sheridan, K.N. Lohr, M.P. Pignone, Literacy and health outcomes: a systematic review of the literature, J. Gen. Intern. Med. 19 (2004) 1228–1239, https://doi.org/10.1111/j.1525-1497.2004.40153.x.

[30] H. Ueno, H. Ishikawa, R. Suzuki, Y. Izumida, Y. Ohashi, T. Yamauchi, T. Kadowaki, T. Kiuchi, The association between health literacy levels and patient-reported outcomes in Japanese type 2 diabetic patients, SAGE Open Medicine 7 (2019), 2050312119865647, https://doi.org/10.1177/2050312119865647.

[31] Y. Huang, F. Qi, R. Wang, X. Jia, Y. Wang, P. Lin, M. Geng, S. Li, The effect of health literacy on health status among residents in Qingdao, China: a path analysis, Environ. Health Prev. Med. 26 (2021) 78, https://doi.org/10.1186/s12199-021-01001-8.

[32] M. Stellefson, S.R. Paige, J.M. Alber, B.H. Chaney, D. Chaney, A. Apperson, A. Mohan, Association between health literacy, electronic health literacy, disease-specific knowledge, and health-related quality of life among adults with chronic obstructive pulmonary disease: cross-sectional study, J. Med. Internet Res. 21 (2019), e12165, https://doi.org/10.2196/12165.

[33] M.D. Hohn, L. Rivera, The impact and outcomes of integrating health literacy education into adult basic education programs in Boston, Health Literacy Res. Pract. 3 (2019) S25–s32, https://doi.org/10.3928/24748307-20190325-01.

[34] D. Tilahun, A. Abera, G. Nemera, Communicative health literacy in patients with non-communicable diseases in Ethiopia: a cross-sectional study, Trop. Med. Health 49 (2021) 57, https://doi.org/10.1186/s41182-021-00345-9.

[35] D.F. Duan, M. Liu, Y. Chen, Y.Y. Huang, Y.Y. Shi, Food literacy and its associated factors in non-dialysis patients with chronic kidney disease in China: a cross-sectional study, Patient Prefer. Adherence 16 (2022) 439–447, https://doi.org/10.2147/ppa.s348227.

[36] H.M. Mogessie, M.A. Gebeyehu, M.G. Kenbaw, T.A. Tadesse, Diabetic health literacy and associated factors among diabetes mellitus patients on follow up at public hospitals, Bale Zone, South East Ethiopia, 2021, PLoS One 17 (2022), e0270161, https://doi.org/10.1371/journal.pone.0270161.

[37] Y. Gurmu Dugasa, Level of patient health literacy and associated factors among adult admitted patients at public hospitals of west shoa oromia, Ethiopia, Patient Prefer. Adherence 16 (2022) 853–859, https://doi.org/10.2147/ppa.s357741.

[38] W.F. Cohn, J. Lyman, D.K. Broshek, T.M. Guterbock, D. Hartman, M. Kinzie, D. Mick, A. Pannone, V. Sturz, J. Schubart, A.T. Garson, Tailored educational approaches for consumer health: a model to address health promotion in an era of personalized medicine, Am. J. Health Promot. : AJHP 32 (2018) 188–197, https://doi.org/10.1177/0890117116671082.

[39] E. Neter, E. Brainin, Association between health literacy, eHealth literacy, and health outcomes among patients with long-term conditions: a systematic review, Eur. Psychol. 24 (2019) 68–81, https://doi.org/10.1027/1016-9040/a000350.

[40] M. Erikson, P.D. Smith, S.W. Sparks, Best practices to advance health literacy in a Wisconsin adult literacy coalition, Health Literacy Res. Pract. 3 (2019) S8–s14, https://doi.org/10.3928/24748307-20190405-01.

[41] S.C. Lin, I.J. Chen, W.R. Yu, S.D. Lee, T.I. Tsai, Effect of a community-based participatory health literacy program on health behaviors and health empowerment among community-dwelling older adults: a quasi-experimental study, Geriatr. Nurs. 40 (2019) 494–501, https://doi.org/10.1016/j.gerinurse.2019.03.013.

[42] R.A. Tutu, S. Gupta, S. Elavarthi, J.D. Busingye, J.K. Boateng, Exploring the development of a household cholera-focused health literacy scale in James Town, Accra, J. Infect. Public Health 12 (2019) 62–69, https://doi.org/10.1016/j.jiph.2018.08.006.

[43] H.T.T. Dinh, N.T. Nguyen, A. Bonner, Health literacy profiles of adults with multiple chronic diseases: a cross-sectional study using the Health Literacy Questionnaire, Nurs. Health Sci. 22 (2020) 1153–1160, https://doi.org/10.1111/nhs.12785.

[44] A.S. França, C.M. Pirkle, T. Sentell, M.P. Velez, M.R. Domingues, D.G. Bassani, S.M.A. Câmara, Evaluating health literacy among adolescent and young adult pregnant women from a low-income area of northeast Brazil, Int. J. Environ. Res. Publ. Health 17 (2020), https://doi.org/10.3390/ijerph17238806.

[45] S. Gupta, R.A. Tutu, J. Boateng, J.D. Busingye, S. Elavarthi, Self-reported functional, communicative, and critical health literacy on foodborne diseases in Accra, Ghana, Trop. Med. Health 46 (2018) 15, https://doi.org/10.1186/s41182-018-0097-6.

[46] A.A. Haghdoost, M. Karamouzian, E. Jamshidi, H. Sharifi, F. Rakhshani, N. Mashayekhi, H. Rassafiani, F. Harofteh, M. Shiri, M. Aligol, et al., Health literacy among Iranian adults: findings from a nationwide population-based survey in 2015, Eastern Mediterr. Health J. = La revue de sante de la Mediterranee orientale = al-Majallah al-sihhiyah li-sharq al-mutawassit 25 (2019) 828–836, https://doi.org/10.26719/emhj.19.017.

[47] H. Heizomi, Z. Iraji, R. Vaezi, D. Bhalla, D.E. Morisky, H. Nadrian, Gender differences in the associations between health literacy and medication adherence in hypertension: a population-based survey in Heris county, Iran, Vasc. Health Risk Manag. 16 (2020) 157–166, https://doi.org/10.2147/vhrm.s245052.

[48] N. Hirvonen, H. Enwald, A.K. Mayer, R. Korpelainen, R. Pyky, T. Salonurmi, M.J. Savolainen, C. Nengomasha, R. Abankwah, W. Uutoni, et al., Screening everyday health information literacy among four populations, Health Inf. Libr. J. 37 (2020) 192–203, https://doi.org/10.1111/hir.12304.

[49] A.P. Rafferty, H. Luo, N.L. Winterbauer, R.A. Bell, N.R.G. Little, S. Imai, Health literacy among adults with multiple chronic health conditions, J. Publ. Health Manag. Pract. : JPHMP 28 (2022) E610–e614, https://doi.org/10.1097/phh.0000000000001352.

[50] H. Rheault, F. Coyer, A. Bonner, Chronic disease health literacy in First Nations people: a mixed methods study, J. Clin. Nurs. 30 (2021) 2683–2695, https://doi.org/10.1111/jocn.15757.

[51] C.H. Bouclaous, S. Salem, A. Ghanem, N. Saade, J. El Haddad, M. Bou Malham, S. Al Osta, K. Matar, E. Nassar, G. Yared, et al., Health literacy levels and predictors among Lebanese adults visiting outpatient clinics in Beirut, Health Literacy Res. Pract. 5 (2021) e295–e309, https://doi.org/10.3928/24748307-20211012-02.

[52] R.M. Simpson, E. Knowles, A. O'Cathain, Health literacy levels of British adults: a cross-sectional survey using two domains of the Health Literacy Questionnaire (HLQ), BMC Publ. Health 20 (2020) 1819, https://doi.org/10.1186/s12889-020-09727-w.

[53] E. Cepova, M. Cicvakova, P. Kolarcik, N. Markovska, A.M. Geckova, Associations of multidimensional health literacy with reported oral health promoting behaviour among Slovak adults: a cross-sectional study, BMC Oral Health 18 (2018) 44, https://doi.org/10.1186/s12903-018-0506-6.

[54] H. Joveini, A. Rohban, P. Askarian, M. Maheri, M. Hashemian, Health literacy and its associated demographic factors in 18-65-year-old, literate adults in Bardaskan, Iran, J. Educ. Health Promot. 8 (2019) 244, https://doi.org/10.4103/jehp.jehp_26_19.

[55] I.M. Blom, E.S. Cohen, L.V. Eshuis, A.J. Woudstra, M.B. Snijder, A.E. Kunst, M.P. Fransen, Ethnic differences in health literacy among young adults in Amsterdam, Health Literacy Res. Pract. 2 (2018) e192–e204, https://doi.org/10.3928/24748307-20180926-01.

[56] S. Chung, H.Y. Lee, M. Lee, S. Chung, Health literacy in Korean adults and Korean American immigrants: implications for achieving health equity, Int. Q Commun. Health Educ. 42 (2021) 29–36, https://doi.org/10.1177/0272684x20973511.

[57] C.C. Cutilli, L.C. Simko, A.M. Colbert, I.M. Bennett, Health literacy, health disparities, and sources of health information in U.S. Older adults, Orthop. Nurs. 37 (2018) 54–65, https://doi.org/10.1097/nor.0000000000000418.

[58] Z. Niu, J. Willoughby, R. Zhou, Associations of health literacy, social media use, and self-efficacy with health information-seeking intentions among social media users in China: cross-sectional survey, J. Med. Internet Res. 23 (2021), e19134, https://doi.org/10.2196/19134.

[59] M. Inoue, K. Shimoura, M. Nagai-Tanima, T. Aoyama, The relationship between information sources, health literacy, and COVID-19 knowledge in the COVID-19 infodemic: cross-sectional online study in Japan, J. Med. Internet Res. 24 (2022), e38332, https://doi.org/10.2196/38332.

[60] A. Tariq, S.R. Khan, A. Basharat, Internet use, eHealth literacy, and dietary supplement use among young adults in Pakistan: cross-sectional study, J. Med. Internet Res. 22 (2020), e17014, https://doi.org/10.2196/17014.

[61] P. Parandeh Afshar, F. Keshavarz, M. Salehi, R. Fakhri Moghadam, E. Khajoui, F. Nazari, M. Dehghan, Health literacy and media literacy: is there any relation? Commun. Health Equity Res. Policy 42 (2022) 195–201, https://doi.org/10.1177/0272684x20972642.

[62] M.M. Bujnowska-Fedak, J. Waligóra, A. Mastalerz-Migas, The internet as a source of health information and services, Adv. Exp. Med. Biol. 1211 (2019) 1–16, https://doi.org/10.1007/5584_2019_396.

[63] J.G. Myrick, M. Hendryx, Health information source use and trust among a vulnerable rural disparities population, J. Rural Health : Off. J. Am. Rural Health Assoc. Natl. Rural Health Care Assoc. 37 (2021) 537–544, https://doi.org/10.1111/jrh.12561.

[64] D. Nault, A. Beccia, H. Ito, S. Kashdan, A. Senders, Health information discrepancies between internet media and scientific papers reporting on omega-3 supplement research: comparative analysis, Interact. J. Med. Res. 7 (2018) e15, https://doi.org/10.2196/ijmr.8981.

[65] T. Yamashita, A.R. Bardo, D. Liu, P.A. Cummins, Literacy, numeracy, and health information seeking among middle-aged and older adults in the United States, J. Aging Health 32 (2020) 33–41, https://doi.org/10.1177/0898264318800918.

[66] J. Cudjoe, S. Delva, M. Cajita, H.R. Han, Empirically tested health literacy frameworks, Health Literacy Res. Pract. 4 (2020) e22–e44, https://doi.org/10.3928/24748307-20191025-01.

[67] S. Hopfer, H.T. Duong, S. Garcia, S.P. Tanjasiri, Health information source characteristics matter: adapting the dissemination of an HPV vaccine intervention to reach latina and Vietnamese women, J. Prim. Prev. 42 (2021) 511–529, https://doi.org/10.1007/s10935-021-00643-2.

[68] O. Asan, F. Cooper Ii, S. Nagavally, R.J. Walker, J.S. Williams, M.N. Ozieh, L.E. Egede, Preferences for health information technologies among US adults: analysis of the health information national Trends survey, J. Med. Internet Res. 20 (2018) e277, https://doi.org/10.2196/jmir.9436.

[69] T. Ozsoy-Unubol, E. Alanbay-Yagci, YouTube as a source of information on fibromyalgia, Int. J. Rheum. Dis. 24 (2021) 197–202, https://doi.org/10.1111/1756-185x.14043.

[70] T.M. Bollweg, O. Okan, P. Pinheiro, J. Bröder, D. Bruland, A.M. Freţian, O.M. Domanska, S. Jordan, U. Bauer, Adapting the European health literacy survey for fourth-grade students in Germany: questionnaire development and qualitative pretest, Health Literacy Res. Pract. 4 (2020) e119–e128, https://doi.org/10.3928/24748307-20200326-01.

[71] K. Hobbs, D.M. Muscat, D. Ceprnja, J.A. Gibson, C. Blumenthal, R. Milad, C. Burns, S. Dennis, T. Lau, V. Flood, Assessing health literacy among adult outpatients attending allied health clinics in western sydney: a cross-sectional survey using a multidimensional instrument, Health Promot. J. Aust. : Off. J. Aust. Assoc. Health Promot. Professionals 33 (2022) 83–90, https://doi.org/10.1002/hpja.456.

[72] M. Suka, T. Odajima, M. Kasai, A. Igarashi, H. Ishikawa, M. Kusama, T. Nakayama, M. Sumitani, H. Sugimori, The 14-item health literacy scale for Japanese adults (HLS-14), Environ. Health Prev. Med. 18 (2013) 407–415, https://doi.org/10.1007/s12199-013-0340-z.

[73] J. Pallant, SPSS Survival Manual: A Step by Step Guide to Data Analysis Using SPSS for Windows Version 15, 2007.

[74] R. Eisinga, M.t. Grotenhuis, B. Pelzer, The reliability of a two-item scale: pearson, Cronbach, or Spearman-Brown? Int. J. Publ. Health 58 (2013) 637–642, https://doi.org/10.1007/s00038-012-0416-3.

[75] J.P. Lima, D.P.G. Abreu, E.O. Bandeira, A.N. Brum, B.B. Garlet, N.F.F. Martins, Functional health literacy in older adults with hypertension in the Family Health Strategy, Rev. Bras. Enferm. 73 (Suppl 3) (2020), e20190848, https://doi.org/10.1590/0034-7167-2019-0848.

[76] J. Haun, S. Luther, V. Dodd, P. Donaldson, Measurement variation across health literacy assessments: implications for assessment selection in research and practice, J. Health Commun. 17 (Suppl 3) (2012) 141–159, https://doi.org/10.1080/10810730.2012.712615.

[77] J.P. Dsouza, S. Van den Broucke, S. Pattanshetty, Validity and reliability of the Indian version of the HLS-EU-Q16 questionnaire, Int. J. Environ. Res. Publ. Health 18 (2021), https://doi.org/10.3390/ijerph18020495.

[78] S. Winston, Health information national Trends survey (HINTS.gov), Med. Ref. Serv. Q. 40 (2021) 215–223, https://doi.org/10.1080/02763869.2021.1912575.

[79] L.D. Chew, K.A. Bradley, E.J. Boyko, Brief questions to identify patients with inadequate health literacy, Fam. Med. 36 (2004) 588–594.