



OPEN Knowledge about the health impact of climate change and associated factors among women in Northeastern Ethiopia

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Globally, climate change (CC) is a major challenge to the health and lives of people especially in developing countries like Ethiopia. CC is an issue of great importance for public health and socioeconomic equity due to its diverse consequences. In developing nations, women still make up approximately half of the agricultural labor force. SDGs 13 and 5 would be achieved and CC mitigation efforts would rise if more women took part in it. Women should therefore be adequately informed about mitigating measures. However, there is no study regarding the issue among women. Therefore, this study attempted to fill this gap. A cross-sectional study was conducted from June 1 to 30, 2024 among systematically selected 401 women in Northeastern Ethiopia. Binary logistic regression models at 95% confidence interval (CI) were used to determine the factors affecting the knowledge about the health impacts of CC. From the bi-variable analysis, variables having a P -value < 0.25 were retained into the multivariable analysis. In multivariable analysis, variables with a p -value of less than 0.05 were considered statistically significant. Of the total women, 47.4% were between 18 and 30 years, with a mean age of 31 years. This study uses the mean to determine participants knowledge level; those who score the mean or higher are seen as having good knowledge, while those who score below the mean were regarded as having poor knowledge. In the research area, women had good knowledge prevalence about the health impact of CC at 34.4% (95% CI: 29.7–39.4). This research revealed that higher educational level (AOR = 3.46, 95%CI = 1.75–6.85) and using TV/radio as source of information (AOR = 2, 95%CI = 1.24–3.24) were significantly correlated with having good knowledge about the health impact of CC. In the current study, women's good knowledge about the health impact of CC was very low. This implies the need to support the women through intensive and continuous health information through radio and television.

Keywords Climate change, Knowledge, Health impact, Women, Ethiopia

Long-term alterations and statistical variability in weather patterns that last for a considerable amount of time usually for 10 years are referred to as climate change (CC)^{1,2}. CC can have a direct or indirect effect on human health through ecosystem-mediated effects³. Ocean acidification, melting glaciers, shrinking ice sheets, melting arctic sea ice, rising sea levels, and rising global temperatures are all the direct effects of CC⁴. Through vector, water, or foodborne illnesses brought on by changing precipitation or temperature patterns, CC can also have an indirect effect on human health^{3,5}.

Due to its many effects, CC poses a significant threat to human existence on a global scale⁶. CC endangers people's physical and mental well-being as well as their ability to access clean water, wholesome food, and shelter⁷. Malnutrition, malaria, diarrhea, and heat stress are predicted to cause an estimated 250,000 deaths annually due to CC between 2030 and 2050, with direct health care costs of between USD 2–4 billion annually by 2030⁸.

Due to its high rates of poverty, quick population growth, reliance on rain fed agriculture, severe environmental degradation, ongoing food insecurity, and regular cycles of natural drought, Ethiopia is particularly vulnerable to the effects of CC extremes^{9,10}. Consequently, there is an increase in CC-related health issues in Ethiopia, including respiratory diseases linked to air pollution, vector-borne infections, water-borne infections, meningitis, and mortality and morbidity from heat waves and floods¹⁰. Moreover, there is a high prevalence of climate-sensitive diseases in Ethiopia, and as the 2070s approach, there is a chance that vector-borne illnesses like dengue fever

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and malaria will become more common^{11,12}. Furthermore, projections indicate that by 2045, CC may lower Ethiopia's GDP by up to 10%, primarily due to effects on agricultural productivity brought on by drought¹³.

Thousands of people perished in the study area, in the Wollo zone of northeastern Ethiopia, as a result of a severe drought brought on by CC in the early 1973^{14–16}. Additionally, the region's extreme cold led to a heavy reliance on biomass fuels for heating, which increases the risk of CC. Furthermore, because of the region's hilly terrain and intense population pressure, there is a severe lack of land for agriculture and settlement, which leads to deforestation and ongoing cultivation¹⁷. These factors can make the area more susceptible to CC and other CC-related diseases, so the best defense against such impact is having good knowledge about the issue.

Although there are many publications on assessment of CC knowledge as well as its associated factors on farmers and the general population^{18–24}, previous studies have not examined women's knowledge of the health impacts of CC. Despite this, women still make up nearly half of the agricultural workforce in developing countries²⁵. Additionally, women are mainly responsible for conducting domestic activities in Ethiopia like other developing countries and CC has a great impact on women by increasing the number of hours spent for doing house works²⁶. By engaging more women in climate action, we can create a more sustainable and equitable future for everyone²⁷. Moreover, raising the participation rate of women would boost productivity and yield higher returns across all SDGs, including SDG 13 (action to combat CC) and SDG 5 (gender equality and women's empowerment)²⁸. Thus, this study evaluated the knowledge about the health impacts of CC and associated factors among women in Northeastern Ethiopia.

Methods and materials

Study setting

The study was carried out in the peri-urban areas of Dessie City, which is situated in Northeastern Ethiopia. Dessie City is the capital of the South Wollo Zone, located 401 km north of Addis Ababa, Ethiopia, in the Amhara Region. In 2014, the population of Dessie was 212,436. Of the total population 34,748 (16.4%) resided in peri-urban *kebeles*. Geographically, the City is divided into valleys (13%), plains (40%), and mountains (47%)²⁹. The City is divided administratively into sixteen *kebeles*, ten of which are urban and six of which are peri-urban, this study was conducted in this six peri-urban areas.

Study design, and period

A community-based cross-sectional study was conducted to evaluate knowledge about the health impact of CC and associated factors among women from June 1 to 30, 2024.

Source and study populations

All women in peri-urban areas of Northeastern Ethiopia were the source population, whereas the systematically selected women in peri-urban areas of Northeastern Ethiopia were the study population.

Inclusion and exclusion criteria

Only women who had resided in the study area for at least six months were included, whereas women with mental health disorders or other severe illnesses were excluded as they could have affected the study's results.

Sample size determination and sampling procedure

The sample size for this study was calculated using a single population proportion formula: $n = \frac{(z_{\alpha/2})^2 * p(1-p)}{d^2}$

³⁰ with the assumptions of 50% prevalence (P) of the health impact of CC knowledge among women, 5% margin of error (d), Z1 - /2 at 95% CI (confidence interval) = 1.96, and after considered a 10% non-response rate, the final sample size was set at 422.

Initially, the final sample size was proportionally distributed for the six peri-urban areas of Northeastern Ethiopia based on the number of households in each area. The lottery method was used to choose the first household. Then, using the kth value obtained by dividing the study household by the final sample size, the participant households from each peri-urban areas were chosen through systematic random sampling. The same day or the day after, households where study participants were unavailable during the initial visit were inspected again. A participant was regarded as a non-respondent if they were still unavailable. Furthermore, one woman was randomly selected from each of the selected houses when there were multiple women in a given houses.

Data collection and data quality assurance

Data were collected using an interviewer-administered structured questionnaire. The questionnaire was adapted after an extensive review of related literature and similar study tools^{3,31,32}. To guarantee consistency of the questions, an organized survey on the health impact of CC knowledge and related factors was created in English, translated into Amharic, and then back into English. The validity and reliability of the questionnaires were checked and were satisfactory for each section of the questionnaire. There were three sections to the questionnaire. Women socio-demographics factors were tested in the first section. Questions on preference of information source about CC and knowledge about the health impact of CC were asked in the second and third parts, respectively.

This study uses the mean to determine participants knowledge level; those who score the mean or higher out of 12 knowledge questions are seen as having good knowledge, while those who score below the mean of 12 knowledge questions were regarded as having poor knowledge. Mothers' awareness of the causes, mitigation strategies, direct effects of climate change on their area of residence, and indirect health effects were among the subjects covered by the knowledge questions.

The questionnaire was pretested in Kombolcha Town's peri-urban areas on participants who were similar to 10% of the sample size before the real data collection began. Several terms and misinterpretations were changed, the number of questions was reduced, and the unclear questions were corrected in light of the pretest analysis result. To gather data, three environmental health specialists were hired. A two-day training session covering study objectives, data collection instruments, work plan, and ethical considerations was provided to them.

Clear definitions of the variables to be recorded, data collector training, and feedback regarding discrepancies during daily supervision all contributed to ensuring inter-observer reliability. The overall supervision of the data collection process involved the principal investigator and two supervisors who had received training. Before any data was entered, every questionnaire was reviewed every day for consistency and completeness during the survey's administration. The same data collector re-asked the same questions on the same or the following day in response to incomplete or missing answers on a questionnaire. In order to verify the accuracy of the data entered, 10% of research participants were additionally randomly chosen and had their interviews conducted again by a different interviewer.

Data management and statistical analysis

After being verified and coded, the gathered data were imported into EpiData version 4.6 and exported to SPSS version 25.0 for further processing and analysis. For categorical variables, descriptive statistics (frequency distribution and cross-tabulations) were computed; for continuous variables, the mean with standard deviation was estimated.

The variable's normality, outliers and multicollinearity were checked before running bivariable and multivariable binary logistic regression analyses. The assumption of multicollinearity was tested using a variance inflation factor, and all variables had values less than five, indicating that there is no evidence of multicollinearity. The reliability of the questionnaire was tested using Cronbach's α , which was found to be 0.76. Utilizing logistic regression analysis with a 95% confidence interval (CI), bivariable (Crude Odds Ratio [COR]) and multivariable (Adjusted odds ratio [AOR]) analysis were conducted. Variables with $p < 0.25$ from the bivariable analysis were taken into account for the multivariable analysis. Factors that were deemed statistically significant and independently associated with women knowledge of the health impact of climate change were identified from the multivariable logistic regression analysis at a significance level of $p < 0.05$. The Hosmer Lemeshow goodness-of-fit test indicated that the model was well-fitting, with a p -value of 0.85.

Results

Socio-demographic characteristics

A total of 401 women in the study finished the questionnaire with a response rate of 95%. Of the total women, 47.4% were between 18 and 30 years, with a mean age ($\pm$ SD) of 31 ($\pm$ 6.59) years. In total, 50.1% of women had completed secondary education or higher, compared to 18.5% who are unable to read and write. Regarding the women's marital status, 54.6 were married and 16% were widowed. 363 women, or 90.5%, are the majority who lack CC training (Table 1).

Information source preference about CC

Regarding the information source, mass media accounted for 37.2% of the women's knowledge of the issues. The next participants' preference of CC related information source was schools, which accounts nearly one-fifth, and social Medias were the least from the sources of information (Table 2).

Knowledge about the health impact of CC

The impact of CC on health was assessed using a total of 9 questions. Women's knowledge scores had mean value of 2.06 ($\pm$ 2.86). In this study, 34.4% (95% CI: 29.7–39.4) of the participants were well-informed about how CC affects human health. Of those surveyed, 19.2% were aware that malaria and other vector borne diseases are the health impacts of CC. Additionally, 26.9%, 25.4% and 23.4% of respondents were aware that the health effects of CC include injuries, heat stroke, and diarrheal diseases and other waterborne diseases, respectively. Moreover, 24.9% and 25.2% of respondents were aware that skin cancer and pneumonia, respectively, can do so (Table 3).

Factors affecting women's CC knowledge

Educational level, monthly income, training regarding CC, and source of information regarding CC all showed a rough correlation with CC knowledge from the bivariable analysis and were included in the multivariable logistic regression analysis. The study's multivariable analysis resulted in a significant association between women good CC knowledge and educational level (AOR = 3.46, 95%CI = 1.75–6.85) and TV/radio as source of information (AOR = 2, 95%CI = 1.24–3.24). When it came to CC knowledge, women who had higher education were 3.46 times more likely to be knowledgeable about the topic than those who did not. Furthermore, women who got CC information from TV/radio were 2 times more likely to be well-informed about the health impact of CC than those who were not (Table 4).

Discussion

CC is the most challenging issue facing the world in the twenty-first century, especially for developing countries like Ethiopia^{33,34}. In nations with less capacity for adaptation, such as Ethiopia, CC can have the most detrimental effects on people's health and well-being^{33,35}. Developing nations will require highly strategic adaptation interventions to safeguard health. Having a thorough understanding of the problem is essential for implementing effective mitigation strategies. Therefore, the purpose of this community-based cross-sectional study was to evaluate women knowledge regarding the health impact of CC and related factors in Northeastern

Variables	Category	Frequency (<i>n</i>)	Percentage (%)
Age (in years)	18–30	190	47.4
	31–40	171	42.6
	≥ 41	40	10
Education status	Unable to read and write	74	18.5
	Primary level	126	31.4
	Secondary level and above	201	50.1
Marital status	Married	219	54.6
	Widowed	64	16
	Divorced	118	29.4
Occupational status	Housewife	70	17.5
	Merchant	96	23.9
	Governmental employee	40	10
	Daily labourer	67	16.7
	Farmer	70	17.5
Monthly income (ETB)	< 2000	153	38.2
	2001–4000	165	41.1
	4001–5000	42	10.5
	≥ 5001	41	10.2
Household size (in person)	≤ 5	181	45.1
	> 5	220	54.9
Training about CC	Yes	38	9.5
	No	363	90.5
Mean women age (in year) 31 (± 6.59SD)			

Table 1. Socio-demographic characteristics of women in peri-urban areas of Northeastern Ethiopia, 2024. Notes: *ETB* Ethiopian Birr, *SD* Standard deviation.

Variables	Category	Frequency(<i>n</i>)	Percentage (%)
Healthcare workers as a source of information about CC	Yes	78	19.5
	No	323	80.5
Social media as a source of information about CC	Yes	62	15.5
	No	339	84.5
TV/radio as a source of information about CC	Yes	149	37.2
	No	252	62.8
School as a source of information about CC	Yes	81	20.2
	No	320	79.8

Table 2. Source of information about CC among women in peri-urban areas of Dessie city, Northeastern Ethiopia, 2024.

Ethiopia. In this finding, women had a 34.4% knowledge prevalence of CC, and this knowledge was strongly correlated with their educational level, and source of information. The discovery has significant implications for using a multisector approach to address CC issues.

Despite the drastic changes in weather patterns, the majority of Africans lack knowledge about global CC³⁶. In support of this, only 34.4% (95% CI: 29.7–39.4) of women in the current study had good knowledge about the health impact of CC. The current study's findings demonstrated the pressing need for concerned parties to increase women's understanding of CC. The finding was also a far lower result than the studies among Ethiopian University students in the Amhara region (48.5%)³¹, Haramaya University health science students (77.5%)³², Nigeria (54%)³⁷, Bangladesh (54.2%)²³ and Nepal (51.3%)³⁸. The sociodemographic traits of the study participants may be the cause of the prevalence differences across various studies. Variations in the knowledge measurement tools may also be the cause of this. Furthermore, the current study's respondents tended to know more about CC and its immediate effects, like variations in temperature and precipitation, than they did about its effects on health, which may be related to the study lower knowledge score. In order to create a holistic global perspective on the health effects of CC, the current study emphasizes the necessity of integrated educational programs and further training for women. Thus, provision of strong health information emphasizing the negative health impact and prevention measures is urgently needed.

According to this study, women who had completed higher education were more likely to be knowledgeable about the health impact of CC. This might be the outcome of the correlation between higher educational

Variables	Category	Frequency(n)	Percentage (%)
Climate change causes malaria and other vector borne diseases	Yes	77	19.2
	No	324	80.8
Climate change causes injuries from extreme weather events	Yes	108	26.9
	No	293	73.1
Climate change causes heat stroke	Yes	102	25.4
	No	299	74.6
Climate change causes diarrheal diseases and other waterborne diseases	Yes	94	23.4
	No	307	76.6
Climate change causes skin cancer	Yes	100	24.9
	No	301	75.1
Climate change causes pneumonia	Yes	101	25.2
	No	301	74.8
Climate change causes anxiety and depression	Yes	73	18.2
	No	328	81.8
Climate change causes scabies and trachoma	Yes	76	19
	No	325	81
Climate change causes malnutrition	Yes	99	24.7
	No	302	75.3

Table 3. Knowledge about the health impact of climate change among women in peri-urban areas of Northeastern ethiopia, 2024.

Variables	Category	Knowledge about CC		COR(95%CI)	AOR(95%CI)	P-value
		Good (n)	Poor (n)			
Education status	Unable to read and write	13	61	Ref	Ref	
	Primary level	33	93	1.66 (0.81–3.41)	1.42 (0.67–3.02)	0.354
	Secondary level and above	92	109	3.96 (2.04–7.66)	3.46 (1.75–6.85)	0.000*
Monthly income (ETB)	<2000	43	110	Ref	Ref	
	2001–4000	65	100	1.66 (1.03–2.66)	1.72 (1.04–2.84)	0.032
	4001–5000	11	31	0.91 (0.41–1.96)	0.85 (0.38–1.92)	0.711
	≥ 5001	19	22	2.21 (1.08–4.48)	1.09 (0.48–2.49)	0.829
Training about CC	Yes	21	17	2.59(1.32–5.10)	1.92(0.87–4.24)	0.105
	No	117	246	Ref	Ref	
TV/radio as source of information	Yes	67	82	2.08(1.36–3.18)	2.00(1.24–3.24)	0.005*
	No	71	181	Ref	Ref	

Table 4. Factors affecting women’s knowledge about climate change in peri-urban areas of Northeastern Ethiopia, 2024. *Ref* reference category, *COR* crude odds ratio, *AOR* adjusted odds ratio, *CI* confidence interval; *significant at $p < 0.05$.

attainment and good knowledge scores among women. Studies carried out in Bangladesh²³, Philippines³⁹ and, Nepal⁴⁰ are in agreement with this finding. However, a study carried out in Ethiopia³¹ did not discover a statistically significant correlation between the educational level and CC knowledge. Variations may arise from difference in both the type of tool and the respondents’ educational level. Thus, it is important to address CC-related issues with great emphasis and concentrate health information about the health impact of CC on women with lower levels of education.

Women knowledge of the health impact of CC also significantly correlated with source of information. Compared to their counters, women who got CC information from TV/radio were two times more likely to be knowledgeable about the health impact of CC. This might be because this medias are trusted by the community as a result most of the women prefer to get CC related information. This result is in contrast to the two studies carried out in Ethiopia^{31,32}, and Bangladesh²³. This discrepancy could result from different source of information used and the difference in the delivery of health information on CC related issues. Consequently, CC information must be widely disseminated using this Medias.

The good CC knowledge in our study may be brought on by exposure to mass medias as most of the respondents stated as they get CC information from mass medias such as radios and TV. This suggests strong clues for concerned bodies to focus the information dissemination using this Medias. However, the relative

low CC knowledge of our study could also be due to decreasing monitoring and evaluation of CC mitigation measures at community level, and a lack of attention from concerned offices. Thus, CC related information must be disseminated through trusted Medias to further enhance women knowledge on the issue.

Based on the study's findings, women generally have lower levels of awareness regarding CC issues. This could be because concerned authorities have not paid as much attention to CC mitigation strategies. Therefore, it is imperative that concerned parties give the issue a lot of attention by using various media, like short SMS, and by bringing up CC issues in various public spaces. Given that women make up half of the population in developing nations, the primary focus of intervention measures should be on empowering them to create significant changes in mitigation measures. In addition to their large numbers, women are excellent change agents because they have the ability to positively impact many people indirectly through their children.

The study has certain limitations. There was a chance of response bias with over- or under-reporting because the data were gathered through self-reported questionnaires. The lack of literature on peri-urban areas was another study limitation; as a result, the discussion compared the results with studies on urban and rural communities. Notwithstanding these drawbacks, the study offers fresh perspective on how much women in peri-urban areas know about the health impact of CC. Furthermore, the results of this study have significant ramifications for policy development, planning at the local level, and the creation and execution of suitable adaptive measures by all relevant entities.

Conclusion

The current study provides insightful information about women knowledge on the health impact of CC and related issues. Only one-third of women had good knowledge of CC, indicating that women's understanding of the issue was generally very poor. Women good knowledge level was found to be significantly correlated with educational level and source of information. Consequently, addressing those factors may help women understanding of CC in a positive way. Thus, in order to increase women awareness of the health impact of CC, the Dessie City Health Department must foster good knowledge through ongoing training and oversight. Additionally, in order to reach a sizable portion of the community, radio and television must be used to disseminate information. Moreover, the numerous stakeholders' coordination and communication efforts regarding CC and health are desirable.

Data availability

The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

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Author contributions

T.N. performed each activity of the manuscript with the consultation of senior researchers in the field. Lastly, the author read and approved the final manuscript.

Declarations

Competing interests

The authors declare no competing interests.

Ethical considerations

The study was approved by the Wollo University Ethical Review Committee prior to the commencement of the data collection process. Furthermore, all methods were carried out in compliance with the applicable journal guidelines and regulations. After outlining the goals and benefits of the study, each participant gave their informed, voluntary, written and signed consent. They have also been told that they are chosen at random and that their responses are extremely helpful in resolving community issues related to CC. Throughout the data collection process, the study participants' culture was respected. By avoiding potential identifiers like the study participants' names, confidentiality of their information is further guaranteed.

Additional information

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