Malaria Journal

RESEARCH

Open Access

Perceived causes and solutions for malaria prevalence among seasonal migrant workers in Northwest Ethiopia: a qualitative study

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Abstract

Background Seasonal migrant workers are at increased risk of malaria and can play a substantial role in transmitting the disease to receptive areas. Assessments conducted among these workers showed a high prevalence of malaria. This qualitative study aimed to explore the contributing factors and challenges to the high malaria prevalence among seasonal migrant workers in agricultural farm areas. The study also sought to identify potential solutions.

Methods A descriptive phenomenological approach was employed to investigate the perceived causes, challenges, and solutions related to malaria prevalence among seasonal migrant workers in the development corridors of southwest Ethiopia. This approach emphasizes describing experiences as they are, without researcher interpretation. Data were gathered from 24 individuals purposefully selected for their close involvement with seasonal migrant workers and their experience with malaria issues in agricultural farm areas. Open-ended questions were used, and interviews were conducted in safe, quiet settings. Data management was performed using Open Code software version 4.03, and thematic analysis was applied to the contents.

Results The study findings identified origin from highland areas, low health-seeking behaviour, working at night, and lack of use of long-lasting insecticidal nets (LLINs) as the perceived causes of high malaria prevalence among seasonal migrant workers by the study participants. Limited collaboration among stakeholders, a lack of migrant-friendly malaria prevention strategies, and inconsistent support for medical supplies were challenges highlighted by the key informants. Therefore, seasonal migrant workers were faced with high risk of malaria due to factors such as lack of immunity, delayed treatment, exposure to mosquitoes, and limited prevention efforts. Addressing these challenges is crucial for reducing malaria prevalence among this vulnerable population.

Conclusion The study findings highlighted the need for targeted interventions to address the specific factors contributing to high malaria prevalence among seasonal migrant workers and to overcome the challenges in implementing effective malaria prevention strategies in this vulnerable population. Further study should be conducted to include the views and positions of seasonal migrant workers, owners of the farm areas, host communities, and political leaders.

Keywords Informant interview, Perceived causes, Challenges, Proposed solutions

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Background

Malaria remains a major public health problem in sub-Saharan African countries, including Ethiopia. The epidemiological distribution of malaria in the country varies from geographic area to area, from one community to another, and from season to season. Moreover, migration and mobility for political, economic, and social reasons also significantly contribute to malaria distribution variation in the country. Thousands of people migrate seasonally from areas with little or no malaria load to those with endemic malaria for agricultural activities, increasing their risk of contracting malaria and its complications [1].

Studies have shown that population movement is closely linked to malaria spread, resurgence, and outbreaks [2–4], and countries have found migration to be a key player in the reintroduction of malaria cases [5]. Migration has also posed challenges to the control and elimination of malaria [6, 7]. African countries were particularly affected by unrecognized migrants and were unable to continue with the malaria elimination programme. As a result, following the renewal of the malaria elimination paradigm in recent times, the population movement has gained recognition, especially in countries that eliminated malaria and those that are moving to eliminate malaria and sustain malaria elimination [7]. In Ethiopia, most of the migration is seasonal or cyclical [8]. Seasonal migration to mechanized farming areas occurs annually, involving around 500,000 migrant workers. These migrants typically come from highland regions with low malaria transmission to lowland or malarious areas during the farming season (June to December) for site clearing, land preparation, planting, weeding, and harvesting of cotton, sorghum, and sesame [9]. Seasonal migrant workers are key players, either as active transmitters or passive acquirers. As active transmitters, they harbour the parasite due to their low level of immunity to malaria, are at high risk of malaria infection, and transmit the disease to areas of low or sporadic transmission. As passive acquirers, they are exposed to malaria through movement from one environment to another [5, 6, 10]. Moreover, it has been shown that seasonal and short-term migrant workers are more at risk of malaria infection and play a central role in malaria transmission due to travelling to endemic areas with no immunity or partial immunity [2].

Health facility-based malaria studies conducted in Ethiopia revealed a high prevalence of malaria parasites among seasonal migrant workers from malaria-endemic areas [11, 12]. Therefore, seasonal migrant workers can reintroduce the parasite and initiate a resurgence and an outbreak of malaria when they return to their permanent living place, where it might be malaria-receptive [7]. In Ethiopia, malaria is one of the main public health and economic problems. The distribution varies from place to place depending on climate, rainfall patterns, and altitude [13–16]. It is a major concern in the country, and it is one of the leading causes of morbidity and mortality. In Ethiopia, 75% of the landscape areas below 200 m above sea level are affected by malaria cases [17]. Ethiopia has a population of over 100 million, of which approximately 68% are at risk of the disease [15]. About 2.9 million cases of malaria and 4,782,000 related deaths have been reported annually, and the rate of morbidity and mortality dramatically increases during epidemics [15]. Ethiopia is one of the countries that have implemented the revised strategies to control malaria. Among these, indoor residual spraying (IRS) and long-lasting insecticidal nets (LLINs) are the most important in malaria prevention and control strategies [18, 19]. Additionally, the introduction of rapid diagnostic tests at the community level and the adaptation of artemisinin-based combination therapy (ACT) are also practiced in Ethiopia [20]. Despite the massive efforts to implement these strategies, malaria continues to cause significant morbidities and mortalities in the endemic areas of Ethiopia. On the other hand, the developments of insecticide resistance in IRS and LLINs in different parts of the country have their own impact on controlling the main malaria vectors. In Ethiopia, the development of resistance in different insecticide groups on *Anopheles arabiensis* was reported by Yewhalaw et al. [21], Hadis et al. [22], and Massebo et al. [23]. Malaria causes much damage to the health and socioeconomic development of the country [15]. The disease is more severe in children and pregnant women [24]. Although several malaria prevalence studies in different parts of Ethiopia have focused on all age groups, only a few studies have indicated that adult malaria is still one of the major public health problems in the country. To date, however, the national estimate of adult malaria in the country is not known.

In Ethiopia, malaria prevention and control strategies are primarily designed for stable communities, with limited attention directed towards the specific needs of migrant workers. Seasonal migrant workers, who are often more vulnerable to malaria, receive fewer targeted interventions [25]. The most common practices for addressing malaria in this population include the temporary deployment of health workers for three to five months, awareness-raising campaigns, and environmental management efforts [9]. However, these approaches may fall short of fully addressing the unique challenges faced by migrant workers in preventing and controlling malaria. The study finding on malaria prevalence conducted [24] among seasonal migrant workers in the Metema district has shown high malaria prevalence. The study revealed that malaria prevalence rates were 13.5%

at transit, 18.7% at destination, and 17.5% at departure. The majority of seasonal migrant workers, 75.74% (2582), originated from rural areas, with a significant proportion coming from highland regions, accounting for 60.90% (2077). Among these workers, 44.62% (1521) were daily labourers, 42.74% (1457) were farmers, and 12.64% (431) were students [17, 26]. The study findings indicated a significant contribution of seasonal migrant workers to the transmission of malaria in the country.

Following the findings, a qualitative study was conducted to explore contributing factors, challenges, and the proposed solution for the high malaria prevalence among seasonal migrant workers in agricultural farm areas.

Methods

Study design

A descriptive phenomenological approach [27] was employed to investigate the perceived causes, challenges, and solutions related to malaria prevalence among seasonal migrant workers in the development corridors of southwest Ethiopia. This study design enabled to identify significant statements, cluster themes, and present key informant quotes as they were expressed.

In this study, owners and managers of farm areas, health extension workers, malaria focal points at cluster health centres, woreda, zones, regions, EPHI/PHEM, FMoH, and focal points from zone and regional social affairs and rural land administration participated. These study participants were selected based on their knowledge, experience, and involvement in the subject of interest and their closeness with seasonal migrant workers or having direct experience with malaria-related issues in agricultural settings. Selection bias and over-representation of certain views were potential biases in this study. Thus, the representation of various sectors and grassroots-level stakeholders was ensured to minimize biases. Moreover, triangulation with the study findings being conducted among seasonal migrant workers was done to validate the findings and reduce the impact of individual biases.

Data collection

A total of 24 participants were purposefully selected for key informant interviews from the various government sectors in charge of development corridors and malaria programme administration levels. Inclusion criteria included individuals with five or more years of experience in malaria prevention and control activities, including focal persons at all levels who were included in the study. This also encompassed farm owners, private clinic operators serving farm areas, healthcare workers supporting these sites, and stakeholders currently or previously involved in malaria prevention and control efforts within farm areas. Additionally, key informants with in-depth knowledge or experience related to the research topic who were willing to provide informed consent were included. Participants who have no direct responsibility for agricultural farm areas and seasonal migrant workers were excluded from the study. The principal investigator facilitated the interview. All the interviews were audio-recorded, and the confidentiality of the information was assured. The semi-structured interview guide was used for the key informant interview. The interview guide was developed based on previous literature and the high malaria prevalence result of a study conducted at transit and destination of seasonal migrant workers during harvest season on causes of an increased malaria problem in development corridors and malaria prevention and control strategies for migrant workers. The interview guide was tested and checked before the actual data collection. Participants approached for the interview from farm sites, health sectors (health posts, cluster health centres, Woreda Health Office, Zonal Health Department, Regional Public Health Institute, Federal Public Health Institute, Federal Ministry of Health), and other government sectors (social affairs and rural land administration at zonal and regional levels). The interviews were conducted from April to June 2021. The interviews were conducted in a safe and quiet place to prevent disturbances during discussion. The interviewers were one senior public health officer and one senior environmental health officer. None of the research team members were related to any of the study participants. An average of 40 min for each interview was used to collect the data.

The level of saturation was used to determine the adequacy of the data for each concept and to go to the next discussion point. The interviewer noted that repetitive patterns emerged, and participants provided no new information. During the coding process, no new codes were identified, confirming that all relevant aspects of the research question had been fully addressed. Thematic saturation was achieved, ensuring that the study's major themes were thoroughly developed and well understood. In reaching saturation, various criteria were considered, including sample size, sample diversity, the study's scope, the research methodology, and the overall quality of the data.

Debriefing was conducted after each interview using field notes to see the presence of new ideas and concepts and to formulate the next interview. The interview was conducted at all levels with farm camp owners/manager and health extension workers, malaria focal persons at the health centre, woreda malaria and other vector-borne disease prevention and control officers, zone malaria and other vector-borne disease prevention and control

officers, regional and federal malaria team leads, consultants, private clinic owners, and other stakeholders (social affairs office, rural land administration). Each interview was conducted by the principal investigator.

Data analysis

Data were gathered in the form of audio recordings and notes from the key informant interview, and Amharic recordings were transcribed daily after the fieldwork discussion by the research team, and the transcription was verbatim. The text was analysed thematically. Prior to analysis, all the collected data were translated into English by a senior communication officer who has a BA degree in Foreign Language and Literature and an MA degree in Educational Research and Development. The field notes were checked for accuracy and completeness. The transcribed data were read almost five times to understand the context. The transcripts were imported into Open Code 4.03 for analysis. Coding was conducted carefully, reading line by line several times, by two research investigators. The two researchers have a PhD in public health and qualitative research experience. A coding tree was constructed to understand the relationship between ideas and look for links between themes. The codes were grouped into categories and then analysed thematically.

Trustworthiness of the study

To ensure the trustworthiness, this research adopted Lincoln and Guba's criteria of credibility, dependability, confirmability, transferability, and authenticity [28]. This study established credibility through prolonged engagement, member checking, and peer debriefing. Participants validated the final codes, and experts reviewed the coding and analysis process. The research presents detailed coding methods and rich descriptions of participants' perspectives to establish dependability. Participants verified the interview-derived codes, and adjustments as needed to ensure accuracy. Transferability was achieved by ensuring the participant selection process, data collection, and analysis aligned with the objectives of this study. This allowed for the findings to be applied to similar contexts. Confirmability was reinforced by maintaining a clear audit trail of research decisions and processes, ensuring transparency and potential for replication.

Ethical considerations

Ethical clearance was granted by the University of Gondar's IRB, and further permission was obtained from the ARHB's Ethical Committee. Local administrations were informed to facilitate the study. Written consent was obtained from participants, who were told they could stop the interview if uncomfortable. Interviews were conducted at their workplaces without compensation. Confidentiality was maintained by using code numbers instead of names for the collected data.

Results

Sociodemographic characteristics

A total of 24 individuals participated in the key informant interview. The majority, 18 (75%), of the participants were male and found in the age group of 28–60 years. Representatives were selected from each sector office (investment camp, health post, health sector, woreda health office, zone health office, APHI, EPHI, FMoH, labour and social affairs, investment sector, and private clinic) (Table 1).

Table 1 Sociodemographic characteristics of study participants, April to June 2021

Participants	Sex	Age	Occupation	No. of participants
Investment camp	M	29–58	Farm manager/"Kobrare"	4
Health Post	F	30–35	Health extension workers	4
Health Centre	M	28–37	Malaria officers	3
Woreda health office	M	36	Malaria and other vector borne diseases	1
Zone health office	M	34–47	Malaria and other vector borne diseases	3
Amhara Public Health Institute (APHI)	F	31	Malaria case team lead	1
Ethiopian Public Health Institute (EPHI)	M	30	Malaria case team lead	1
Federal Ministry of Health (FMoH)	M	60	Consultant for malaria elimination	1
Labour & social affair	1F, 2 M	35–53	Focal officers for investment areas	3
Investment sector	M	31,37	Health of the investment department	2
Private clinic	M	45	Owner of the clinic	1
Total				24

Themes, subthemes, quotes, and interpretations

During the key informant interviews, participants were asked to describe the contributing factors to malaria in the development corridors, the common practices of malaria prevention and control activities, the challenges to malaria prevention and control practices, and the proposed solutions to protect seasonal migrant workers. The results were presented under four themes and seventeen subthemes. Participant quotes were organized by subthemes, and interpretations were provided for the quotes under each subtheme (Table 2).

Perceived causes for malaria in the development corridors

Migrants' origin

The geography of migrants' origin was described by participants as a risk factor for malaria exposure in the investment areas. Most of the seasonal migrant workers are from highland areas where the risk of malaria is zero or very low. So, migrants who are coming from highland areas to agricultural farm areas have no immunity to malaria, and their risk of malaria infection is significant (Table 2).

> *"Most workers travel to development corridors from high lands, especially during harvest time. Their immune system is weak, and their level of exposure is high." KI 8, 10,15,23*

Lack of knowledge

Participants views indicated that lack of knowledge on the nature of malaria disease among some of the seasonal migrant workers is another risk factor that exposes migrants to malaria infection. They also associated lack of knowledge of the nature of malaria disease with obstacles to early treatment, facilitated the spread of malaria among migrants, and increased the risk of severe malaria (Table 2).

> *"Some have no knowledge of the nature of the disease, which exposes them to malaria and causes them to look for treatment late. They give more focus to making money, and their health is not their priority, rather they want to come for treatment when they are severely sick because they don't understand that malaria is a fatal disease." KI 12, 14, 22*

Agricultural investment areas

All participants discussed agricultural investment areas as one of the risk factors due to their location in malaria-endemic areas. These areas are fertile and attracting hundreds of agricultural investors and seasonal migrant workers. The presence of stagnant waters due to agricultural activities in the areas created ideal breeding grounds for *Anopheles* mosquitoes. Seasonal migrant workers, who are sleeping in an open field or in the jungle and lack mosquito nets, especially during the harvest season, are highly exposed to malaria infection (Table 2).

> *" There are a lot of stagnant waters due to the numerous investments in the area, and seasonal migrant workers don't have many options to protect themselves, as they sleep outside and are not provided with mosquito nets. So, seasonal migrant workers are highly exposed to malaria." KI 3, 4, 5, 14*

Harvesting season

Participants described that major commercial farm activities are carried out during the malaria season. Migrants are employed in farm activities during land preparation, plantation, weeding, and harvest seasons in commercial farm areas. These farm activities are mostly done from May to December. In these months, malaria cases start to rise and peak during the harvest season, from September to December. Sleeping outside the shelter, working at night, nonuse of LLINs, and using torchlight were the common practices and risk factors for malaria (Table 2).

> *"As the woreda is an investment site, several seasonal migrant workers come from different places. Though there are efforts to implement malaria prevention methods, malaria is always present during land preparation, plantation, weeding, and harvesting. So, seasonal migrants are highly exposed to malaria disease." KI 1,2*
>
> *"Harvesting takes place in a season when mosquito breeding is significant and the temperature is hot, and migrants are working at night when mosquitoes are active and bite them easily; they are using torchlights. Some farm areas don't have shelter for migrant workers." KI 10, 12,14,17,23,24*

Lack of access to health care facilities

Access to health care facilities is very important to treat malaria cases coming from seasonal migrant workers and helps to prevent the risk of severe malaria and its consequences. Poor access to health facilities while they stay at farm sites. This resulted in a delay in treatment seeking and self-treatment, which might increase their exposure to malaria infection. Such risks were discussed by participants, particularly those who have participated from woreda health offices, cluster health centres, and health posts. Late health care-seeking by migrant workers was

Table 2 Summary of themes, subthemes, quotes, and interpretations, April to June 2021

Themes	Sub-themes	Quotes	Interpretations
Perceived causes for malaria in the development corridors	Migrants' origin	*"Most workers travel to development corridors from high lands, especially during harvest time. Their immune system is weak, and their level of exposure is high." KI 8, 10,15,23* *"The risk of malaria infection is higher for seasonal migrant workers compared to the host community because most of the migrants are coming to these commercial farm areas from highlands where malaria exposure is less and their experience with malaria bites is almost zero." KI 14, 21*	The geography of migrants' origin was described by participants as a risk factor for malaria exposure in the investment areas. Most of the seasonal migrant workers are from high-land areas where the risk of malaria is zero or very low. So, migrants who are coming from high-land areas to agricultural farm areas have no immunity to malaria, and their risk of malaria infection is significant
	Lack of knowledge	*"Some have no knowledge of the nature of the disease, which exposes them to malaria and causes them to look for treatment late. They give more focus to making money, and their health is not their priority, rather they want to come for treatment when they are severely sick because they don't understand that malaria is a fatal disease." KI 12, 14, 22* *"There is no awareness created for migrant workers before they depart for farm areas; awareness is usually given at the destination. But only a few are addressed by awareness-creation efforts on malaria prevention and control among migrant workers. Moreover, there is no mechanism to monitor the practice following the awareness created." -KI 21*	Participants views indicated that lack of knowledge on the nature of malaria disease among some of the seasonal migrant workers is another risk factor that exposes migrants to malaria infection. They also associated lack of knowledge of the nature of malaria disease with obstacles to early treatment, facilitate the spread of malaria among migrants, and increase the risk of severe malaria
	Agricultural investment areas	*" There are a lot of stagnant waters due to the numerous investments in the area, and seasonal migrant workers don't have many options to protect themselves, as they sleep outside and are not provided with mosquito nets. So, seasonal migrant workers are highly exposed to malaria." KI 3, 4, 5, 14*	All participants discussed agricultural investment areas as one of the risk factors due to their location in malaria-endemic areas. These areas are fertile, attracting hundreds of agricultural investors and seasonal migrant workers. The agricultural activities in the areas created fertile ground for stagnant water during the rainy season and the proliferation of Anopheles mosquitoes. Therefore, migrant workers who are sleeping in an open field or in the jungle, especially during the harvest season, are highly exposed to malaria infection

Table 2 (continued)

Themes	Sub-themes	Quotes	Interpretations
	Harvesting Season	*"As the woreda is an investment site, several seasonal migrant workers come from different places. Though there are efforts to implement malaria prevention methods, malaria is always present during land preparation, plantation, weeding, and harvesting. So, seasonal migrants are highly exposed to malaria disease." KI 1,2* *"Harvesting takes place in a season when mosquito breeding is significant and the temperature is hot, and migrants are working at night when mosquitoes are active and bite them easily; they are using torchlights. Some farm areas don't have shelter for migrant workers." KI 10, 12,14,17,23,24* *"Most of the workers don't have awareness and lack information to protect themselves from the disease and collect information prior to their arrival. Their income is low, and they are unable to buy a bed net and use it. The places they go to are so remote, and there is no infrastructure or shelter, so it is not possible for them to protect themselves. The investors don't provide them with the needed materials, such as mosquito nets and medicine. Few migrants who do have mosquito nets don't use them properly." KI 9, 14, 15, 18, 21* *" Though there are prevention activities in the areas, they are not suitable for seasonal migrant workers. The workers spend the night in the fields, and spray can't be used if there is no house. If we give them mosquito nets, it is not yet feasible as the work is done at night. The strategy of the country to prevent and control malaria doesn't work in the agricultural sites." KI 8, 10*	Participants described that major commercial farm activities are carried out during the malaria season. Migrants are employed in farm activities during land preparation, plantation, weeding, and harvest seasons in commercial farm areas. These farm activities are mostly done from May to December. In these months, malaria cases start to rise and peak during the harvest season, from September to December. In this season, sleeping outside the shelter, working at night, nonuse of LLINs, and using torch light were the common practices and risk factors for malaria Hot temperatures in the farm areas, harvesting activities at night, and the far location of the camp from the farm areas were listed as reasons to sleep in the open field Farming practices at night and outdoor sleeping by migrant workers during harvest time might contribute to the high malaria incidence in the farm areas. Harvesting is a common nighttime work activity, and sleeping in the field or at the farm in temporary shelters is a common practice among migrant workers in the farm areas Key informants pointed out that migrants are fixing torchlights on their foreheads to facilitate their harvesting activities at night, and that attracts anopheles' mosquitoes and increases their risk of bites and malaria infection Low income to purchase LLINs, lack of information, lack of infrastructure like shelter, and low suitability to use due to hot weather conditions and nighttime harvesting activities were mentioned as the main reasons for less use or nonuse of LLINs by seasonal migrant workers

Table 2 (continued)

Themes	Sub-themes	Quotes	Interpretations
	Lack of access to health care facilities	*"Some have no knowledge of the nature of the disease and come late for treatment when they are sick. They don't think about malaria prevention; they just want to come to treatment when they are severely sick." KI 12, 16, 23* *"Migrant workers don't care about the prevention of malaria and don't take malaria as a killer. They mostly think about their job. They only want to come to a health facility for treatment when they are severely sick." KI 16, 23* *"Although the area is malarious, migrants don't take malaria treatment medicine properly; they buy malaria drugs from private clinics and drug vendors, and taking them on their own is growing." KI 12,16,21*	Access to health care facilities is very important to treat malaria cases coming from seasonal migrant workers and helps to prevent the risk of severe malaria and its consequences. Poor access to health facilities while they stay at farm sites. This resulted in a delay in treatment seeking and self-treatment, which might increase their exposure to malaria infection. Such risks were discussed by participants, particularly those who have participated from woreda health offices, cluster health centers, and health posts. Late health care seeking by migrant workers was among the risk factors mentioned by most of the participants This study identified self-treatment as a contributing factor to the high malaria prevalence among seasonal migrant workers in commercial farm areas
The common practice of malaria prevention and control activities in commercial farm areas	Health education	*" Seasonal migrants are first to meet with investors, and then health education is given by contract health workers at some accessible farm sites. Otherwise, as malaria officers at the health center level, we have done nothing. In fact, when they come to the health center, we will give them health education." KI 1, 2*	Health education is given by health extension workers and temporarily deployed health workers at accessible farm sites. Health centers are also raising awareness among migrants who are coming to the health centers for treatment
	Environmental management	*"We put oil in the pocket of land that the tractor creates. When seasonal migrant workers become sick, we take them to the health center. We also make them clear their environment of mosquito-breeding vegetation and drain stagnant waters." KI 4*	In some farm areas, mosquito breeding sites are managed by adding burned oil and cleaning their environment. There is no provision of ITNs or LLINs to seasonal migrant workers by the government or investors, but distribution is made to migrants permanently living at agricultural farm sites. It was also mentioned that some investors are purchasing medicine by themselves to treat malaria cases

Table 2 (continued)

Themes	Sub-themes	Quotes	Interpretations
	Malaria case treatment	*" We collaborate with the Amhara Public Health Institute and work on seasonal malaria case management. Health professionals are selected and deployed to give treatment for about five months. Currently, we are working mainly on case management." KI 7, KI 8* *" The regional health bureau is allocated budget to deploy malaria workers to farm areas, and we assigned two health workers to cover large farm sites. However, it is difficult to cover all areas. There are big farm camps that are not accessible, and we covered the accessible ones." -KI 10*	West Gondar Zone, Amhara Regional Public Health Institute, and the Federal Ministry of Health are collaborating to deploy health professionals to agricultural investment areas temporarily for three to five months to provide treatment for malaria cases among seasonal migrant workers. However, the involvement of the Ethiopian Public Health Institute is minimal
Challenges to malaria prevention and control practice among seasonal migrant workers	Weak collaboration	*"Government sectors are expected to supervise the farm areas in a coordinated manner, but this time they are doing so rarely." KI 23*	Government sectors are expected to oversee and coordinate the supervision of farm areas in a consistent and organized manner. However, at present, their involvement has been infrequent and lacks the necessary coordination. This reduced presence and oversight have contributed to gaps in monitoring and addressing critical issues within these areas, such as the health and safety conditions of seasonal migrant workers. Strengthening government engagement and ensuring regular, collaborative supervision is essential to mitigating the challenges currently faced
	Lack of migrants'-friendly malaria prevention and control strategy	*"There are no malaria prevention and control strategies, policies, or guidelines being prepared for migrant workers. We are using the existing strategies that are prepared for the non-mobile population." KI 23*	Currently, there are no malaria prevention and control strategies, policies, or guidelines specifically tailored for migrant workers. Instead, we rely on existing strategies designed for the non-mobile population. This approach overlooks the unique vulnerabilities and challenges faced by migrant workers, who are often more susceptible to malaria due to their mobility, living conditions, and limited access to healthcare services. The absence of targeted strategies for this group highlights a significant gap in public health policy, underscoring the need for customized interventions that address the specific needs of migrant workers in order to effectively reduce malaria transmission among this high-risk population

Table 2 (continued)

Themes	Sub-themes	Quotes	Interpretations
	Inconsistent support of medical supplies and human resources	*"Government support of medical supplies, including antimalarial drugs, to prevent malaria among seasonal migrant workers is not adequate and doesn't consider the number of migrants coming to the farm areas. The support given to farm areas by the government is decreasing from time to time. KI 24* *"Despite the increase in malaria in commercial farm areas, the number of health workers who are temporarily employed by the regional government is decreasing year to year and covers a few of the farm areas; their deployment is seasonal, and the solution is temporary." KI 15, 18, 20, 23*	Government support for medical supplies, including antimalarial drugs, to prevent malaria among seasonal migrant workers is inadequate and the distribution of resources is not aligned with the growing demand, leaving many workers vulnerable to malaria infection. Despite the rising incidence of malaria in commercial farm areas, the number of health workers temporarily employed by the regional government has been steadily decreasing each year and would cover a limited number of farm areas. Moreover, the monitoring of health workers temporarily deployed to farm areas is remarkably weak
	Limited commitment of investors	*"No attention is given by the investors despite the agreement to build health facilities, hire health professionals, and provide health services for migrant workers while they stay in the commercial farm areas." KI 15, 23* *"They are expecting the government to distribute mosquito nets, to avail medical supplies, including antimalarial drugs, to deploy health workers, raise awareness about malaria, and destroy mosquito breeding sites, assuming their responsibility is to provide shelter and food to migrant workers." KI18*	Investors are expected to honor the agreements they made with the government when acquiring land for farming activities, which include providing basic services such as healthcare for the migrant workers they employ during seasonal farm operations. However, the majority of investors neglect these commitments, showing little interest in fulfilling their responsibilities. They often lack cooperation in implementing the agreed-upon measures and instead rely on the government to manage the prevention and control of malaria in farm areas, leaving a significant gap in addressing the health needs of the workers
Proposed solutions to protect seasonal migrant workers from being exposed to malaria disease	Adequate and proper information on malaria	*" The migrants need to get adequate and proper information on malaria. They need to take medications properly and use malaria nets responsibly. The health sector must give them health education, and migrants should listen and implement it." KI 1*	One key informant proposed that providing seasonal migrant workers with sufficient information on the proper use of malaria medication and the responsible use of long-lasting insecticidal nets (LLINs) should be the primary solution to protect them from the risk of malaria infection in commercial farm areas
	Strengthen collaboration among stakeholders	*" There should be a joint committee comprising rural land administration and the health office to make everyone responsible and accountable. …. Rural land administration should be able to take steps to the extent of taking away the land if the investor is not willing to accept health workers, is unable to make workers use LLINs appropriately, or takes it for its own personal use." KI 1*	Collaboration among government sectors to support malaria prevention and control activities in the farm areas. Rural land administration and health offices at regional, zonal, and woreda levels should be responsible or accountable to protect seasonal migrant workers from the risk of malaria infection. As a responsible sector, rural land administration should take steps to ensure the willingness of investors to welcome temporarily deployed health workers and the use of LLINs by migrant workers

Table 2 (continued)

Themes	Sub-themes	Quotes	Interpretations
	Mobilization of antimalaria drugs and human resources to farm areas	*" The health office should deploy an adequate number of health workers, allocate adequate budget, expand health services, establish a strong mobile team and vehicle to monitor and follow up on malaria situations on farm sites, form a malaria team to support them, and conduct robust monitoring and evaluation." Ki-1, 3, 8,11* *" There should be a permanent committee that does monitoring and evaluation during weeding and harvest time. It would also be good to establish a health committee that supervises malaria situations at agricultural sites. Investors who have 50 acres and above to come together to establish a health center, deploy health professionals, provide malaria LLINs, and medicine to treat malaria." KI 6* *" First, all stakeholders should come together to recognize the problem and realize the magnitude of the issue at hand. Then an appropriate assessment study should take place. Interventions will be set with their own implementing phase, budget, and proposals for project activities." KI 9*	Mobilization of an adequate number of health workers, expansion of health services, and establishment of a strong mobile team and vehicle to monitor the malaria situation in the farm areas. Form a malaria supervisory team to support and ensure robust monitoring and evaluation of malaria prevention and control activities in commercial farm areas
	Legal enforcement of investors' commitment	*"The investor should distribute LLINs and/or take the responsibility to distribute the LLINs in an organized manner, meet all the facilities (shelter, water, clinic) needed, and give attention to the environmental management (drainage, cleaning vegetation, putting burning oil in stagnant water, and destroying all means of mosquito breeding) in the farm areas." KI 11* *"Most migrants are coming from colder places or highlands where exposure to and knowledge of malaria are limited. Hence, awareness should be given about the places they are to go to and to let them be aware of how they can accustom to the new environment and how they can protect themselves from malaria, and LLINs should be provided to use while they stay at farm areas." KI 4*	The importance of investors' commitment to distribute LLINs, to avail facilities, including clinics, and to environmental management was mentioned by key informants. The study participants also pointed out the need for awareness creation among migrants from highland areas on the risk of malaria in the farm areas and how they can protect themselves from malaria. Provision of LLINs to migrants while they stay in farm areas was also the proposed solution to prevent malaria
	Develop migrants'-oriented malaria prevention and control methods	*"It is best to use migrants'-oriented malaria prevention and control methods, e.g., repellents." KI 22*	The development of migrants'-oriented malaria prevention and control strategies was proposed to prevent the risk of malaria infection among seasonal migrant workers in the commercial farm areas

among the risk factors mentioned by most of the participants (Table 2).

> *"Some have no knowledge of the nature of the disease and come late for treatment when they are sick. They don't think about malaria prevention; they just want to come to treatment when they are severely sick." KI 12, 16, 23*

The common practices of malaria prevention and control activities in commercial farm areas

Health education

Health education is given by health extension workers and temporarily deployed health workers at accessible farm sites. Health centres are also raising awareness among migrants who are coming to the health centres for treatment (Table 2).

> *" Seasonal migrants are first to meet with investors, and then health education is given by contract health workers at some accessible farm sites. Otherwise, as malaria officers at the health center level, we have done nothing. In fact, when they come to the health center, we will give them health education." KI 1, 2*

Environmental management

In some farm areas, mosquito breeding sites are managed by adding burned oil and cleaning their environment. There is no provision of ITNs or LLINs to seasonal migrant workers by the government or investors, but distribution is made to migrants permanently living at agricultural farm sites. It was also mentioned that some investors are purchasing medicine by themselves to treat malaria cases (Table 2).

> *"We put oil in the pocket of land that the tractor creates. When seasonal migrant workers become sick, we take them to the health center. We also make them clear their environment of mosquito-breeding vegetation and drain stagnant waters." KI 4*

Malaria case treatment

West Gondar Zone, Amhara Regional Public Health Institute, and the Federal Ministry of Health are collaborating to deploy health professionals to agricultural investment areas temporarily for three to five months to provide treatment for malaria cases among seasonal migrant workers. However, the involvement of the Ethiopian Public Health Institute is minimal (Table 2).

> *" We collaborate with the Amhara Public Health Institute and work on seasonal malaria case management. Health professionals are selected and deployed to give treatment for about five months. Currently, we are working mainly on case management." KI 7, KI 8*

Challenges to malaria prevention and control practice among seasonal migrant workers

Weak collaboration

Government sectors are expected to oversee and coordinate the supervision of farm areas in a consistent and organized manner. However, at present, their involvement has been infrequent and lacks the necessary coordination. This reduced presence and oversight have contributed to gaps in monitoring and addressing critical issues within these areas, such as the health and safety conditions of seasonal migrant workers. Strengthening government engagement and ensuring regular, collaborative supervision is essential to mitigating the challenges currently faced (Table 2).

> *"Government sectors are expected to supervise the farm areas in a coordinated manner, but this time they are doing so rarely." KI 23*

Lack of migrants'-friendly malaria prevention and control strategy

Currently, there are no malaria prevention and control strategies, policies, or guidelines specifically tailored for migrant workers. Instead, this research relies on existing strategies designed for the non-mobile population. This approach overlooks the unique vulnerabilities and challenges faced by migrant workers, who are often more susceptible to malaria due to their mobility, living conditions, and limited access to healthcare services. The absence of targeted strategies for this group highlights a significant gap in public health policy, underscoring the need for customized interventions that address the specific needs of migrant workers in order to effectively reduce malaria transmission among this high-risk population (Table 2).

> *"There are no malaria prevention and control strategies, policies, or guidelines being prepared for migrant workers. We are using the existing strategies that are prepared for the non-mobile population." KI 23*

Inconsistent support of medical supplies and human resources

Government support for medical supplies, including anti-malarial drugs, to prevent malaria among seasonal migrant workers is inadequate, and the distribution

of resources is not aligned with the growing demand, leaving many workers vulnerable to malaria infection. Despite the rising incidence of malaria in commercial farm areas, the number of health workers temporarily employed by the regional government has been steadily decreasing each year and would cover a limited number of farm areas. Moreover, the monitoring of health workers temporarily deployed to farm areas is remarkably weak.

> *"Government support of medical supplies, including antimalarial drugs, to prevent malaria among seasonal migrant workers is not adequate and doesn't consider the number of migrants coming to the farm areas. The support given to farm areas by the government is decreasing from time to time. KI 24.*

Limited commitment of investors

Investors are expected to honor the agreements they made with the government when acquiring land for farming activities, which include providing basic services such as healthcare for the migrant workers they employ during seasonal farm operations. However, the majority of investors neglect these commitments, showing little interest in fulfilling their responsibilities. They often lack cooperation in implementing the agreed-upon measures and instead rely on the government to manage the prevention and control of malaria in farm areas, leaving a significant gap in addressing the health needs of the workers. The challenges were illustrated as follows by key informant interviewees:

> *"No attention is given by the investors despite the agreement to build health facilities, hire health professionals, and provide health services for migrant workers while they stay in the commercial farm areas." KI 15, 23*

Proposed solutions to protect seasonal migrant workers from being exposed to malaria disease

Adequate and proper information on malaria

One key informant proposed that providing seasonal migrant workers with sufficient information on the proper use of malaria medication and the responsible use of long-lasting insecticidal nets (LLINs) should be the primary solution to protect them from the risk of malaria infection in commercial farm areas. It is illustrated as:

> *" The migrants need to get adequate and proper information on malaria. They need to take medications properly and use malaria nets responsibly. The health sector must give them health education, and migrants should listen and implement it." KI 1.*

Strengthen collaboration among stakeholders

Collaboration among government sectors to support malaria prevention and control activities in the farm areas. Rural land administration and health offices at regional, zonal, and woreda levels should be responsible or accountable for protecting seasonal migrant workers from the risk of malaria infection. As a responsible sector, rural land administration should take steps to ensure the willingness of investors to welcome temporarily deployed health workers and the use of LLINs by migrant workers (Table 2).

> *" There should be a joint committee comprising rural land administration and the health office to make everyone responsible and accountable. …. Rural land administration should be able to take steps to the extent of taking away the land if the investor is not willing to accept health workers, is unable to make workers use LLINs appropriately, or takes it for its own personal use." KI 1.*

Mobilization of antimalaria drugs and human resources to farm areas

Mobilization of an adequate number of health workers, expansion of health services, and establishment of a strong mobile team and vehicle to monitor the malaria situation in the farm areas. Form a malaria supervisory team to support and ensure robust monitoring and evaluation of malaria prevention and control activities in commercial farm areas (Table 2).

> *" The health office should deploy an adequate number of health workers, allocate adequate budget, expand health services, establish a strong mobile team and vehicle to monitor and follow up on malaria situations on farm sites, form a malaria team to support them, and conduct robust monitoring and evaluation." Ki-1, 3, 8,11.*
>
> *" There should be a permanent committee that does monitoring and evaluation during weeding and harvest time. It would also be good to establish a health committee that supervises malaria situations at agricultural sites. Investors who have 50 acres and above to come together to establish a health center, deploy health professionals, provide malaria LLINs, and medicine to treat malaria." KI 6.*

Legal enforcement of investors' commitment

The importance of investors' commitment to distributing LLINs, availing facilities, including clinics, and environmental management was mentioned by key informants. The study participants also pointed out the need for

awareness creation among migrants from highland areas on the risk of malaria in the farm areas and how they can protect themselves from malaria. Provision of LLINs to migrants while they stay in farm areas was also the proposed solution to prevent malaria (Table 2).

> *"The investor should distribute LLINs and/or take the responsibility to distribute the LLINs in an organized manner, meet all the facilities (shelter, water, clinic) needed, and give attention to the environmental management (drainage, cleaning vegetation, putting burning oil in stagnant water, and destroying all means of mosquito breeding) in the farm areas." KI 11.*

Develop migrants'-oriented malaria prevention and control methods

The development of migrants'-oriented malaria prevention and control strategies was proposed to prevent the risk of malaria infection among seasonal migrant workers in the commercial farm areas (Table 2).

> *"It is best to use migrants'-oriented malaria prevention and control methods, e.g., repellents." KI 22.*

Discussion

Most seasonal migrant workers in commercial farming areas come from highland regions and have low immunity to malaria. Their risk of infection is further heightened by working in malaria-endemic areas, sleeping in fields, and often working at night. This finding aligns with studies conducted in Northwest Ethiopia [17, 26]. Challenges identified include limited collaboration, a lack of targeted malaria prevention and control strategies for migrant workers, inconsistent provision of medical supplies and personnel, and weak commitment from investors. Similar studies have highlighted these challenges, attributing them to issues such as limited healthcare infrastructure, financial constraints, and inadequate support from investors, consistent with this study findings [25, 29, 30]. Key informants recommended actions to address these challenges, including providing comprehensive malaria information, strengthening collaboration, improving medical supplies and staffing, ensuring investor support, and developing targeted malaria prevention and control strategies for migrant workers.

This study identified limited knowledge of malaria as a key risk factor for malaria infection among seasonal migrant workers in commercial farming areas. Research indicates that poor understanding of malaria can hinder effective prevention and control practices. Malaria knowledge strongly influences both the ownership and use of LLINs [31], including health-seeking behaviour [31, 32]. Among seasonal migrant workers, low awareness was linked to delays in seeking treatment, even when experiencing severe symptoms. However, this finding contrasts with a study in two districts of Northwest Ethiopia, which reported high levels of malaria knowledge among seasonal migrant workers [33].

Most participants agreed that working at night increases migrant workers' exposure to *Anopheles* mosquitoes [34], thereby raising their risk of malaria infection. Nighttime farming practices during harvest contribute to the high incidence of malaria in farm areas [35]. Many migrant workers do not cover their bodies with long-sleeved clothing or use repellents, leaving them vulnerable to mosquito bites. Harvesting in commercial farm areas typically occurs during peak mosquito breeding seasons when mosquito activity is high. A qualitative study in southern Tanzania similarly found that outdoor evening activities increase the risk of mosquito bites and malaria [36, 37]. Key informants near commercial farm areas noted that migrant workers often use torchlights on their foreheads to facilitate nighttime harvesting, which attracts *Anopheles* mosquitoes, heightening the risk of bites and malaria. Additional studies have confirmed that nighttime lighting can draw insect vectors to humans, increasing the risk of disease transmission, while artificial light has also been shown to promote nighttime biting behaviour in *Aedes aegypti* mosquitoes [38, 39].

Delay in seeking health care was mentioned by study participants in commercial farm areas by seasonal farmworkers. Limited knowledge of the nature of the diseases was identified as a major reason for the delay. This leads to ignoring the consequences of malaria and looking for treatment when they are seriously sick, and they prefer to stay with the problem until they finish their contract. A study conducted in northwest Ethiopia has shown the impact of knowledge on the practice of malaria prevention among migrant workers [33]. Moreover, the seasonality of their work (which pushes them to move from one farm area to another for better payment) [40] and the inaccessibility of health care facilities could also cause delays in seeking health care [29].

This study identified self-treatment as a contributing factor to the high malaria prevalence among seasonal migrant workers in commercial farm areas. Improper use of the prescribed medication (sharing of drugs with friends and breaking medication when they feel okay) and self-purchasing of malaria drugs from private clinics or drug vendors were common practices among seasonal migrant workers, particularly those who have no access to government health facilities and health workers who were deployed temporarily at farm sites by the Regional Health Bureau/Public Health Institute. These practices might contribute to increased

malaria prevalence [29]. These findings are consistent with studies conducted elsewhere indicating elevated rates of self-medication among legal and illegal migrant workers. Risks linked to this trend include misdiagnoses, medication misuse, higher morbidity rates, and the potential for drug resistance. To address these issues, it is recommended to use social networks, enhance awareness, and improve access to healthcare facilities to encourage migrant workers to seek timely medical care [17, 41].

Malaria prevention in agricultural areas is limited and often incomplete. Health education efforts target accessible seasonal migrant workers [17], but many remain unreachable. This gap could affect health-seeking behaviours and increase malaria risk [42]. While environmental management practices like oil burning and cleaning living spaces are common, commercial farms often create additional breeding sites for malaria-carrying mosquitoes [43]. Case management, including drug distribution [25], is a common intervention, but limited staffing and inaccessibility leave many cases untreated [44].

The study revealed that the complex malaria situation in farm areas requires collaboration between various stakeholders involved in farming [29]. Initially, joint supervision by health, land, labour, and social affairs sectors addressed seasonal migrant workers' needs, including health services. However, budget constraints and the lack of a dedicated lead sector have fragmented these efforts. Despite these challenges, collaborative partnerships remain crucial for improving the health of migrant workers [45]. Given the complexities of malaria prevention in commercial farm areas, a collaborative approach among all relevant stakeholders is essential [29, 46].

A Federal Ministry of Health informant revealed that malaria prevention guidelines are being developed for commercial farm areas to address the needs of migrant workers. However, the use of long-lasting insecticidal nets (LLINs) and indoor residual spraying (IRS) [47] is less effective due to open shelters and the preference for outdoor sleeping [17, 48]. Moreover, government support for anti-malarial drugs and deployment of temporary health workers remains insufficient, leaving many migrant workers vulnerable to malaria.

National malaria strategies often neglect migrant workers [49], leaving them vulnerable to malaria in commercial farm areas [29, 33, 49]. This oversight has hindered prevention efforts and contributed to the spread of malaria to other regions [26] and it poses a significant challenge to the country's malaria elimination goals. Therefore, the current study underlines the urgent need for policymakers to integrate migrant workers' tailored malaria interventions into national malaria prevention and control strategies.

Limitation of the study

This research could not include seasonal migrant workers, who should be the primary source of information, due to security concerns and the inaccessibility of the farm areas. Key informants from the camps of the agricultural farm areas were included in the study but might not fully represent seasonal migrant workers. Furthermore, this study also missed owners of the commercial farms, political leaders, and the host community, who could provide important information and recommend valuable strategies to contain migrants' risk of malaria infection and the risk of further spread to other areas through them.

Conclusions and recommendations

The interconnected challenges of limited stakeholder collaboration, a lack of migrant-friendly strategies, inconsistent medical support, and weak investor commitment significantly undermine malaria control efforts for seasonal migrant workers. These issues are further exacerbated by factors such as migrants' origin, lack of knowledge, agricultural development, harvesting seasons, and restricted access to healthcare. Strengthening stakeholder collaboration ensures more coordinated and effective efforts, while improving investor commitment helps enhance living conditions and healthcare services. Additionally, ensuring adequate medical supplies and human resources during peak periods, such as the harvest season, and developing migrant-specific prevention strategies address both knowledge gaps and healthcare needs. Therefore, developing migrant-specific malaria prevention strategies and equipping migrants with the tools to protect themselves is recommended.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12936-024-05231-3.

Supplementary material 1

Acknowledgements

We are grateful to the Ethiopian Public Health Institute for funding, and our appreciation also goes to the Metema district health office, data collectors, and supervisors for their diligent work and study participants for their time and cooperation.

Author contributions

T.T. and K.A. designed the study. T.T., B.T., and K.A. implemented the study. T.T., WW.Y, and K.A. interpreted the data. T.T. wrote the first draft of the manuscript. T.T., B.T., WW.Y, and K.A. critically revised the manuscript for important content. All authors, 1–4, read and approved the final manuscript.

Funding

Funding of this study was provided by the Public Health Emergency Management Directorate, Ethiopian Public Health Institute, Addis Ababa.

Availability of data and materials
No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate
Ethical clearance was obtained from the institutional review board of the University of Gondar. Then, the Ethical Committee of the Amhara Regional Health Bureau (ARHB) was approached to get further permission. Local administrations were also informed for permission and facilitation of the study. During data collection, informed consent was sought from all the study participants, and they were informed and assured that interviews and use of audio recorder were completely voluntary.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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Received: 24 July 2024 Accepted: 20 December 2024
Published online: 17 February 2025

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