RESEARCH ARTICLE

KNOWLEDGE, ATTITUDES, AND PERCEPTIONS OF TRAVELLERS TOWARDS CROSS-BORDER MALARIA PREVENTION MEASURES IN KWAZULU-NATAL, SOUTH AFRICA

Ida Manyina Munsense[1] and Joyce M Tsoka-Gwegweni[1,2]

[1]Department of Public Health Medicine, School of Nursing and Public Health, College of Health Sciences, University of KwaZulu-Natal, Durban, South Africa
[2]Office of the Dean, Faculty of Health Sciences, University of the Free State, Bloemfontein, South Africa

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ABSTRACT

Background: Knowledge, attitudes, and perceptions of travellers could play a key role in preventing imported malaria in a country. It is believed that seeking pre-travel advice from health professionals could prevent diseases and improve travellers' health. It is also reported that when travellers have sufficient knowledge of malaria, they will take the necessary precautions and adhere to preventive measures when traveling to endemic countries, and so are likely to minimize the chances of infections.

This study aimed to investigate the knowledge, attitudes, and perceptions of travellers towards cross-border malaria prevention measures in the KwaZulu-Natal province, South Africa.

Methods: A cross-sectional survey of 396 participants was conducted in 2019. The participants included all adults en route to Mozambique, Eswatini, and Zimbabwe recruited from a major taxi rank in KwaZulu-Natal province, South Africa. A structured questionnaire about knowledge, attitudes, and perceptions towards cross-border malaria prevention measures was administered.

Results: More than 90.9% of participants demonstrated a high level of knowledge about malaria transmission and prevention in general. This knowledge was mainly acquired through healthcare facilities. However, only 13.6% of participants adhered to the required preventive measures. Similarly, 72.8 % of participants reported not being aware of any information about malaria preventive measures available at the borders.

Conclusion: The high level of knowledge about malaria transmission and prevention does not translate into positive attitudes and perceptions among cross-border travellers. Regular and active communication about the risk of malaria and the availability of cross-border malaria prevention measures is recommended. This approach will encourage travellers to use protection against malaria to prevent imported transmission.

1. Introduction

In 2022, the World Health Organization (WHO) estimated that there were 249 million cases of malaria worldwide. Of these, 233 million cases, or approximately 94%, occurred in the WHO African Region. An estimated 608,000 deaths were attributed to malaria globally. The African Region accounted for about 93.6% of all malaria cases and 95.4% of deaths worldwide, with 78.1% of the fatalities in this region being among children under 5 years old.[1] Although preventable, malaria is a major public health problem that exposes all categories of people at risk of being infected, including those who travel to high-risk areas without appropriate protection.[2] Cross-border movements from non-endemic malaria countries to endemic countries and high numbers of travellers, plus little use of malaria preventive measures, have contributed to the increased burden of imported malaria. [3-4]

It is estimated that an average of 3.5 million travellers from different countries move across the South African (SA) borders during the summer season for various reasons. Consequently, these cross-border movements have an impact on communicable diseases, especially malaria.[5] In SA, malaria is endemic in three provinces, namely KwaZulu-Natal (KZN), Mpumalanga, and Limpopo.[6]

South Africa is currently in a malaria elimination phase, intending to reach elimination by 2030.[7] However, the biggest challenge to elimination efforts in SA has been imported malaria.[8]

Although KZN has reassuringly shown a significant decline in the number of cases compared to the other two endemic provinces,[5] it has been found that the number of imported malaria cases is usually higher than local cases in KZN.[9]

It is reported that travellers' knowledge, attitudes, and perceptions play a key role in preventing imported malaria in a country. It is believed that travellers who have sufficient knowledge of malaria will take the necessary precautions and adhere to preventive measures when traveling to endemic countries so that they are likely to avoid infections.[10]

Evidence has shown that a high level of knowledge about the causes, transmission, and prevention of malaria was detected among the community members in Shewa Robit Town in Ethiopia. However, a considerable proportion of the community members had misconceptions about the causes and transmission of malaria, suggesting the necessity of health education to raise the community's awareness about the disease.[11] This study suggests that knowing about malaria and preventive measures is not enough and that one needs to make use of the information received to ensure well-being.

This was confirmed by previous studies conducted among travellers in Dubai,[2] Hong Kong,[12] Egypt,[13] Boston, USA,[14] and the UK,[15] which all suggest that there are educational needs for travellers heading to malaria-endemic countries[2] in terms of the uptake of preventive measures and current efforts to improve health-seeking behavior. A critical survey of data collected during the period 1999-2000 among the member sites of the TropNet Europe Network shows that only 60.4% of European travellers compared to 77.2% of immigrant travellers used malaria chemoprophylaxis, and that only a minority of patients took drugs or drug-combinations appropriate for the drug resistance situation of the malaria parasite at the respective destinations.[16]

A cross-sectional survey carried out with employees of 20 randomly selected companies in the Jebel Ali Free Zone, north of Dubai, revealed low awareness of pre-travel health advice as reflected by the low uptake of specialist travel medical advice on travel vaccinations and malaria prophylaxis. This survey highlighted an important educational need for Dubai travellers.[17] A study conducted at Johannesburg International Airport found that most travellers perceived they had been exposed to high-risk areas during their travel without carrying antimalarial medication, whilst some were carrying inappropriate medications.[18] This study also recommended the

need to improve the knowledge, attitudes, and practices of travellers.

While KZN and SA as a whole experience high volumes of travellers from malaria-endemic countries,[19-20] limited research has been done concerning the knowledge, attitudes, and perceptions of travellers towards cross-border malaria preventive measures. Therefore, the present study investigated the knowledge, attitudes, and perceptions of travellers crossing South African borders in the KZN province by land towards cross-border malaria preventive measures. The intention was to recommend evidence-based solutions that could inform policymakers in implementing strategies to prevent imported malaria.

2. Methods and Materials

2.1 STUDY DESIGN AND STUDY AREA
A descriptive cross-sectional survey was conducted in May 2019 at a major taxi rank for international travellers situated at the YMCA in the city of Durban, in the KZN province of SA.

2.2 STUDY POPULATION AND SAMPLE
The study population included all adults aged 18 years and above, both male and female, willing to sign written informed consent forms to participate in the study and travelling to either Mozambique, Eswatini, or Zimbabwe. All South African and non-South African travellers recruited at the taxi rank and heading to these neighboring countries crossing KZN ports of entry were included in the study.

All travellers crossing KZN ports of entry but not willing to provide written informed consent to participate in the study, and those who did not meet the above criteria, were excluded. The sample size was estimated to be 400 participants, proportionally allocated between the three countries, using simple random sampling.

2.3 DATA COLLECTION
The survey was conducted using questionnaires to establish travellers' knowledge, attitudes, and

perceptions concerning cross-border malaria preventive measures. A pilot study was conducted to test the data collection tool in March 2019. The test highlighted the necessity for a bilingual questionnaire due to the language barrier faced by Mozambican travellers. In the actual study, the data collection tool was translated into Portuguese to accommodate these travellers, while an English version was provided for those heading to Eswatini and Zimbabwe. The questionnaire was divided into four sections. The first section provided the demographic characteristics of the participants. The second section dealt with knowledge about malaria and preventive measures. The third section addressed the attitudes of travellers towards malaria prevention measures, and the fourth section focused on the perceptions of travellers towards cross-border malaria preventive measures. A Portuguese-speaking research assistant assisted with the data collection. Once the questionnaire was filled in, it was checked for completion and clarified when needed.

Ethical clearance for the study was obtained from the Biomedical Research Ethics Committee of the University of KZN (Reference No: BE382/18). Permission to access participants was sought from the taxi rank manager.

2.4 DATA ANALYSIS
Data was collected and entered into a Microsoft Excel Version 16 spreadsheet. The data was then processed and analyzed using R Statistical Computing Software, Version 3.6.3. Descriptive analysis was used to detail the demographic characteristics of the participants, their knowledge about cross-border malaria prevention measures, and their attitudes and perceptions towards those measures. The data is presented using frequency distribution tables. A Chi-squared test was used to examine the association between variables. Categorical explanatory variables were cross-tabulated against dichotomous outcome measures of knowledge, attitudes, and perceptions. The statistical significance level was set at $p < 0.05$.

3. Results

3.1 DESCRIPTION OF STUDY PARTICIPANTS

The demographic characteristics of the participants are shown in Table 1. In total, 396 participants were included, giving a response rate of 99%, with each country (Eswatini, Mozambique, and Zimbabwe) having a nearly equal proportion of travellers (130, 32.8%; 133, 33.6%; and 133, 33.6%, respectively). The majority of the participants were female (212, 53.5%) in the age ranges of 18-35 years (248, 62.6%), followed by 36-50 years (123, 31.1%). Very few participants were South African citizens (36, 9.1%), and the rest were equally divided between citizens of the above three countries, with a slightly higher number being citizens of Zimbabwe (136, 34.3%). A small proportion of the participants were citizens of other African countries or outside the African continent. Most participants (210, 53%) reported having achieved secondary and tertiary (146, 36.9%) levels of education. Similarly, a high proportion of the participants (182, 46%) said that they were employed, and the main reason for traveling was a visit (266, 67.2%) to the countries for less than one month.

Table 1: Demographic characteristics of the respondents (n=396)

Variable	Number	Percentage
Gender		
Male	184	46.5
Female	212	53.5
Age		
18-35	248	62.6
36-50	123	31.1
51-65	22	5.5
>65	3	0.8
Country of origin		
South Africa	36	9.1
Eswatini	104	26.3
Mozambique	106	26.8
Zimbabwe	136	34.3
Other African countries	10	2.5
Outside Africa	4	1.0
Country of destination		
Zimbabwe	133	33.6
Mozambique	133	33.6
Eswatini	130	32.8
Level of education		
No schooling	17	4.3
Primary level	23	5.8
Secondary level	210	53.0
Tertiary level	146	36.9
Occupation		
Employed	182	46.0
Unemployed	93	23.5
Housewife	41	10.3
Pensioner	8	2.0
Seasonal worker	35	8.8
Student	37	9.3

Variable	Number	Percentage
Reason for travelling to the current destination		
Visit	266	67.2
Medical	2	0.5
Work	97	24.5
Other	31	33.1
Duration of visit to the country destination		
< 7 days	133	33.6
7–14 days	80	20.2
14–28 days	39	9.8
> 28 day	144	36.4

Source: Primary data collected from the survey conducted at YMCA taxi rank in Durban (KZN) in May 2019

3.2 KNOWLEDGE OF TRAVELERS ABOUT CROSS-BORDER MALARIA PREVENTIVE MEASURES

Regarding the knowledge of travellers about cross-border malaria and its preventive measures, as presented in Table 2, a significant majority of participants (360, 90.9%) reported having heard about malaria before. The primary sources of information about malaria were health facilities, cited by 195 participants (49.2%), and community meetings, mentioned by 88 participants (22.2%). A small number of participants acquired information from alternative sources such as TV, radio, or church. When asked about their personal or familial history of malaria, a considerable proportion of participants (188, 47.5%) confirmed that they or their relatives had previously contracted malaria. Furthermore, a significant majority of participants (347, 87.6%) correctly recognized that malaria is transmitted through mosquito bites.

In terms of protective measures, nearly half of the participants (194, 49.0%) correctly identified mosquito repellent as an outdoor protection method. Similarly, a substantial number of participants (255, 64.4%) correctly identified a mosquito net as an indoor protection measure.

When asked about the level of malaria risk in their destination country, only a small proportion of participants demonstrated knowledge about the risk level, particularly those traveling to Zimbabwe, with only 20 participants (15%) having awareness of the risk level. Regarding the perceived most serious health threat in their destination country, the majority of participants identified malaria as the primary concern (174, 43.9%), followed by HIV (140, 35.4%).

3.3 ATTITUDES, AWARENESS, AND PERCEPTIONS OF TRAVELERS TOWARD CROSS-BORDER MALARIA PREVENTION

Regarding the attitudes of travellers towards malaria preventive measures, as depicted in Table 3, 265 (66.9%) reported not seeking pre-travel health advice. Interestingly, even though 314 participants (79.3%) acknowledged the necessity of taking antimalarial medication before traveling, the majority, 307 (77.5%), stated that they did not have any antimalarial regimen.

In terms of the availability of vector control products at home, 242 participants (61.1%) reported having mosquito nets in their homes, while 255 (64.4%) indicated the use of indoor residual spray. However, 91 (23%) reported not possessing any of these vector control products at home.

Regarding malaria awareness at the border post, most participants 240 (60.6%) stated that there were no measures in place to create awareness about malaria at the border. Furthermore, a significant number of participants, 239 (60.4%), reported the absence of malaria screening at the border. However, it is noteworthy that 206 participants (52%) expressed their belief that implementing malaria screening at the border would be beneficial.

Table 2: Travellers' knowledge about cross-border malaria and preventive measures (n=396)

Variable	Number	Percentage
Ever heard about malaria before		
Yes	360	90.9
No	36	9.1
Where have you heard about malaria		
Community meetings	88	22.2
Health care facility	195	49.2
Neighbour	14	3.5
Church	6	1.5
TV	48	12.1
Radio	27	6.8
Missing	18	4.5
You or relative had malaria before		
I do not know	20	5.1
No	185	46.7
Yes	188	47.5
Missing	3	0.8
Malaria contracted		
Mosquito bites	347	87.6
When touching a person infected with malaria	4	1.0
I do not know	45	11.4
Outdoor protection		
Cover arms and legs	71	17.9
Use perfume	11	2.8
Use deodorant	4	1.0
Use mosquito repellent	194	49.0
Others	15	3.8
No measure	101	25.5
Indoor protection		
Close windows/doors	67	16.9
Sleep under mosquito net	255	64.4
Turn on air conditioning	7	1.8
Vaporise/coils/insecticide	48	12.1
Others	7	1.8
No measure	12	3.0
*Travellers' knowledge of malaria risk level (prevalence) in the destination country**		
Mozambique (high risk) (n=133)	45	33.8
Eswatini (low risk) (n=130))	44	33.8
Zimbabwe (high risk) (n=130)	20	15.0
Total sample	109	27.5
Most serious health threat		
Malaria	174	43.9
HIV	140	35.4
Typhoid	37	9.3
Others	45	11.4

*Key: Mozambique is high risk, Eswatini is low risk, and Zimbabwe is high risk.
Source: Primary data collected from the survey conducted at YMCA taxi rank in Durban (KZN) in May 2019

Table 3: Attitudes, awareness and perceptions of travellers towards cross-border malaria prevention

Variable	Number	Percentage
Pre-travel malaria advice		
Yes	131	33.1
No	265	66.9
Antimalarial tablets necessary		
Yes	314	79.3
No	81	20.5
Missing	1	0.3
Chemoprophylaxis regimen		
Mefloquine	9	2.3
Doxycycline	9	2.3
Atovaquone-Proguanil	2	0.5
Chloroquine	27	6.8
Other(s)	42	10.6
None	307	77.5
Vector control product		
Mosquito net	242	61.1
In door residual spray	63	15.9
None	91	23.0
Border malaria awareness Billboards		
Border clinics	86	21.7
None	38	9.6
Pamphlets	240	60.6
Missing	31	7.8
	1	0.3
Availability of border malaria screening measures		
Yes	121	30.6
No	239	60.4
I do not know	36	9.1
Benefits of having border malaria screening		
Beneficial	206	52.0
Not beneficial	9	2.3
Time-consuming	10	2.5
Missing	171	43.2

Source: Primary data collected from the survey conducted at the YMCA taxi rank in Durban (KZN) in May 2019

3.4 FACTORS ASSOCIATED WITH KNOWLEDGE, ATTITUDES, AND PERCEPTIONS OF TRAVELERS ABOUT CROSS-BORDER MALARIA PREVENTION MEASURES

Table 4 presents the factors associated with the knowledge of travellers about cross-border malaria and preventive measures. Five factors were found to be statistically significantly associated with knowledge about malaria prevention measures: the participants' education level (p=0.028), the primary source of information regarding malaria (p=0.001), transmission methods of malaria (p=0.001), personal or familial history of malaria infection (p=0.001) and awareness of indoor protection against malaria (p=0.001). On the other hand, certain factors such as gender, age, country of origin, occupation, the reason for travel, duration of visit, outdoor protection measures, risk level, and the most serious health

threat in the destination country did not exhibit any statistically significant associations with knowledge about malaria.

Table 4: Factors associated with knowledge of travelers about cross-border malaria and preventive measures

Variable	Knowledge		p-value
	Know (N=360)	Don't know (N=36)	
Education level			0.028
No schooling/Primary	36 (10.0%)	4 (11.1%)	
Secondary	184 (51.1%)	26 (72.2%)	
Tertiary	140 (38.9%)	6 (16.7%)	
Where you heard about malaria			0.001
Health care facility	192 (53.3%)	3 (8.3%)	
Community meetings	102 (28.3%)	6 (16.7%)	
TV/Radio	66 (18.3%)	9 (25.0%)	
Missing	0 (0%)	18 (50.0%)	
You or relative had malaria before			0.001
No	177 (49.2%)	28 (77.8%)	
Yes	180 (50.0%)	8 (22.2%)	
Missing	3 (0.8%)	0 (0%)	
Malaria contracted			0.001
Mosquito bites	327 (90.8%)	20 (55.6%)	
Do not know/From infected person	33 (9.2%)	16 (44.4%)	
Indoor protection			0.001
Sleep under mosquito net	241 (66.9%)	14 (38.9%)	
Vaporise/Coils/Insecticide/Air conditioning	45 (12.5%)	10 (27.8%)	
Close windows/Doors	60 (16.7%)	7 (19.4%)	
No measure/Others	14 (3.9%)	5 (13.9%)	

The p-values are based on non-missing cases only (tableStack).

Source: Primary data collected from the survey conducted at YMCA cross-border taxi rank in Durban (KZN) in May 2019

Table 5 shows the results of the factors that were statistically associated with the attitudes of travellers towards cross-border malaria preventive measures. These factors included the destination country (p=0.033), seeking pre-travel malaria advice (p=0.004), adherence to a chemoprophylaxis regimen (p=0.035), and the use of a vector control product (p=0.014). Among participants, negative attitudes towards malaria preventive measures were observed in those who primarily travelled to Eswatini and Zimbabwe.

These individuals were less likely to seek pre-travel malaria advice and did not adhere to a chemoprophylaxis regimen. Conversely, participants who utilized a vector control product displayed notably positive attitudes towards malaria prevention. However, factors such as gender, age, education level, occupation, travel reason, and duration of the visit were not statistically significantly associated with attitudes towards cross-border malaria preventive measures.

Table 5: Factors associated with attitudes of travellers towards cross-border malaria preventative measures

Variable	Attitudes		p-value
	Positive (N=314)	Negative (N=81)	
Destination country			0.033
Eswatini	95 (30.3%)	34 (42.0%)	
Zimbabwe	104 (33.1%)	29 (35.8%)	
Mozambique	115 (36.6%)	18 (22.2%)	
Pre travel malaria advice			0.004
No	199 (63.4%)	65 (80.2%)	
Yes	115 (36.6%)	16 (19.8%)	
Chemoprophylaxis regimen			0.035
None	237 (75.5%)	70 (86.4%)	
Antimalarial tablets	77 (24.5%)	11 (13.6%)	
Vector control product			0.014
None	62 (19.7%)	28 (34.6%)	
Mosquito net	202 (64.3%)	40 (49.4%)	
Indoor residual spray	50 (15.9%)	13 (16.0%)	

The p-values are based on non-missing cases only (tableStack).
Source: Primary data collected from the survey conducted at a YMCA cross-border taxi rank in Durban (KZN) in May 2019

Table 6 presents the factors associated with the perceptions of travellers regarding cross-border malaria preventive measures: Perceptions, gender (p=0.019), country of destination (p=0.001), border malaria awareness (p=0.001), and perceived benefits of malaria screening (p=0.048). Males tended to display more positive perceptions, whereas females tended to have negative or neutral perceptions. Furthermore, negative or neutral perceptions were observed among participants aged 18-35 years, those traveling to Eswatini or Zimbabwe, those with a visit duration exceeding 28 days, and those lacking awareness of border malaria screening programs.

In contrast, participants who acknowledged the potential benefits of a border malaria screening program expressed highly positive perceptions. These results indicate that gender plays a role in shaping travellers' perceptions, with males exhibiting more positive attitudes. Additionally, specific characteristics such as age, destination country, duration of visit, and awareness of border malaria screening programs influence individuals' perceptions of cross-border malaria preventive measures. Furthermore, participants who recognized the advantages of implementing a border malaria screening program exhibited notably positive perceptions.

Table 6: Factors associated with perceptions of travellers towards cross-border malaria preventive measures

Variable	Perceptions			p-value
	Positive (N=121)	Negative (N=239)	Neutral (N=36)	
Gender				0.019
Male	67 (55.4%)	106 (44.4%)	11 (30.6%)	
Female	54 (44.6%)	133 (55.6%)	25 (69.4%)	
Age				0.047
18-35yrs	70 (57.9%)	149 (62.3%)	29 (80.6%)	
36+yrs	51 (42.1%)	90 (37.7%)	7 (19.4%)	
Duration				0.050
<7 days	48 (39.7%)	81 (33.9%)	4 (11.1%)	
8-14 days	27 (22.3%)	45 (18.8%)	8 (22.2%)	
15-28 days	11 (9.1%)	23 (9.6%)	5 (13.9%)	
>28 days	35 (28.9%)	90 (37.7%)	19 (52.8%)	
Destination Country				0.001
Eswatini	41 (33.9%)	84 (35.1%)	5 (13.9%)	
Zimbabwe	20 (16.5%)	88 (36.8%)	25 (69.4%)	
Mozambique	60 (49.6%)	67 (28.0%)	6 (16.7%)	
Border malaria awareness				0.001
None	44 (36.4%)	174 (72.8%)	22 (61.1%)	

Variable	Perceptions			
	Positive (N=121)	Negative (N=239)	Neutral (N=36)	p-value
Border clinics	24 (19.8%)	8 (3.3%)	6 (16.7%)	
Billboards	37 (30.6%)	42 (17.6%)	7 (19.4%)	
Pamphlets	16 (13.2%)	14 (5.9%)	1 (2.8%)	
Perceived benefits of border malaria screening				0.048
Not beneficial	5 (4.1%)	11 (4.6%)	3 (8.3%)	
Beneficial	112 (92.6%)	80 (33.5%)	14 (38.9%)	
Missing	4 (3.3%)	148 (61.9%)	19 (52.8%)	

The p-values are based on non-missing cases only (tableStack).

Source: Primary data collected from the survey conducted at the YMCA cross-border taxi rank in Durban (KZN) in May 2019.

4. Discussion

The results of the present study reveal that most of the travellers were employed; this agrees with the previous research that suggests that neighboring countries perceived SA as a land of work opportunities where they could go to work and visit their families back home regularly.[21-22] This situation underscores the importance of family traditions, shared memories, and values, demonstrating that distance cannot diminish these bonds. However, while this practice strengthens familial ties, it poses challenges for malaria control efforts in SA, especially considering the high prevalence of malaria in neighboring countries.[23]

The results on the knowledge of travellers regarding cross-border malaria preventive measures indicate a relatively high level of awareness about malaria, its transmission through mosquito bites, and the importance of using protective measures such as mosquito repellents and mosquito nets. However, there is a need to improve the knowledge regarding the risk levels of malaria in different destinations and to address other significant health threats in travellers' destination countries, such as HIV. The findings show that travellers generally had good knowledge about malaria, its transmission mode, and the protective measures for indoor protection. This concurs with the study conducted in Shewa Robit Town, North-Eastern Ethiopia, which found that most of the population had good knowledge about malaria, the mode of transmission, and preventive measures.[11] This is also similar to a study conducted in the UK among those traveling to malaria-endemic countries.[15]

The health facility was the most common source of information about malaria. These results also support studies conducted at the Dutch Schipol Airport[2] and Johannesburg Airport.[18] Very few participants identified television and radio as their primary sources of information. To address this gap, it is crucial to promote these traditional media channels for disseminating health-related information, as they have the potential to reach a wider audience. Most households are equipped with televisions and radios, making it common for people to tune in for daily news updates.[18] In contrast, a growing majority of the population now turns to the Internet and social media for information, which offers a vast array of content that significantly raises health awareness.[24] These digital platforms expose a larger number of individuals to health information compared to those who rely solely on the insights provided at health facilities or during community meetings. This reliance on social media creates an opportunity to reach diverse audiences beyond the more specialized gatherings, which often cater to a limited group of people.

Of greatest concern is the participants' poor knowledge about malaria risk levels in the country of destination, particularly among those who were bound for Zimbabwe, which is categorized among high-risk malaria areas.[25] In addition, not all travellers in the present study considered malaria as the most serious health threat. This finding could be linked to the fact that in some countries like SA, HIV/AIDS is regarded as a national health priority, ranked among the top causes of death, rather than malaria. As a result, most of the health promotion messages, research funding, and interventions are directed towards reducing the burden of HIV/AIDS.[26]

An analysis of the factors associated with knowledge about malaria preventive measures revealed that knowledge was associated with educational level, source of information about malaria, participants' or relatives' history of contracting malaria, knowledge about how malaria is contracted, and knowledge of indoor protection. These factors are similar to what was reported in other studies.[27]

The data presented in Table 3 provide insights into the attitudes and behaviors of travellers towards malaria preventive measures. The findings indicate a need for increased awareness and adherence to pre-travel health advice, antimalarial regimens, and the utilization of vector control products. The present study found that the participants had mostly negative attitudes concerning the uptake of malaria preventive measures and poor health-seeking behavior. This is demonstrated by the participants' acknowledgment of the necessity to take anti-malarial tablets while traveling to endemic countries, but not carrying any or seeking pre-travel medical advice. This finding agrees with studies among travellers in Dubai, which suggest a need for education concerning preventive measures for travellers,[17] but is contrary to a survey done in Schiphol airport, where health-seeking behavior was dependent on the category of travellers. In this study, most of the travellers traveling for business, leisure, and work sought medical advice before traveling, whilst those visiting family and friends did not.[2] Similar to the present study, inadequate pre-travel health preparations were found among Hong Kong travellers. The underestimation of malaria risks was a significant barrier to adequate pre-travel health preparations. The study suggested targeted health education and information about risk to improve the levels of travel health preparedness.[12] The reasons for non-adherence among travellers in Boston included forgetfulness, fear of side effects, peer advice, and not physically seeing mosquitoes.[14] In Johannesburg, some travellers claimed to know what to do, whilst others did not realize they should seek pre-travel advice.[18] The negative attitudes found in the present study could be linked to poor knowledge about the risk level of malaria in the country of destination and the seriousness of malaria as a health threat. The attitudes of participants towards malaria preventive measures were associated with the country of destination, seeking pre-travel malaria advice, chemoprophylaxis regimen, and use of vector control products. The attitudes of travellers in this study towards malaria preventive measures raise concerns. Most travellers at the taxi rank are from sub-Saharan Africa, where malaria is endemic. They have routinely been exposed to malaria infection as a result. However, they do not perceive it as a risk. Studies have found that natural immunity develops slowly after many years of exposure, but sterile protection is never achieved.[28] This means that even though the travellers have developed immunity due to exposure, it does not protect them against malaria infection when travelling to other endemic areas. They may be asymptomatic, but they are carriers of parasites in their blood that would almost certainly be deadly to non-immune travellers if not detected on time.[29] Travellers' acquired immunity creates reluctance and is perceived as protection against future exposure to malaria infection.[28] Instead, this should act as a wake-up call for them to embrace possible preventive measures against contracting malaria when travelling to an endemic country, because immunity does not mean exemption from malaria infection.

The results concerning malaria awareness and screening at the border underscore a critical gap that necessitates the implementation of effective measures aimed at enhancing malaria prevention strategies for travellers. This study reveals a significant lack of understanding surrounding cross-border malaria prevention among individuals crossing into neighboring regions. Many travellers expressed limited awareness regarding the existence or importance of a malaria screening program in the border areas of KZN. This is in contrast to the views of border authorities who reported that there are cross-border malaria prevention measures.[27] Despite this lack of awareness, participants were open to the idea that the introduction of a dedicated border malaria screening program could provide valuable benefits, suggesting a willingness to engage with such initiatives. The participants' perceptions were shaped by various factors, including age, gender, the country they were traveling to, the duration of their stay, their familiarity with any screening programs, and their views on the potential advantages of such measures. Notably, the data regarding age and gender support previous studies that indicate younger adults and males represent the most frequent cross-border travellers. This demographic trend underscores the importance of tailoring malaria prevention strategies to engage these groups effectively and raise their awareness about the risks of malaria when traveling across borders.[30-31]. The authors acknowledge that the study was conducted just before COVID-19 pandemic and that vigilance and strategies to prevent importation of infectious diseases may have intensified.[32] The authors believe that cross-border measures to prevent malaria might have been negatively impacted during the COVID-19 era as resources were shifted, health services reformed, and new priorities set to fight the pandemic. Current evidence indicates that redirecting resources towards reducing the burden of COVID-19 has resulted in the disruption of malaria control activities, with increased risk and burden of malaria in endemic countries of the Southern African community.[32-33] During COVID-19 pandemic, health education and awareness campaigns have increased significantly, far exceeding efforts for malaria. Communities have engaged more in sharing important information about preventing the virus, getting vaccinated, and practicing hygiene through social media and public workshops. This shows how important it is for the public to understand COVID-19. Meanwhile, malaria awareness efforts continue but do not receive as much attention, reflecting a change in public health priorities during the COVID-19 crisis.[34]

It is essential to raise health awareness about malaria, especially in areas near countries where malaria is common. We can learn from the COVID-19 pandemic, where effective communication about malaria prevention happened during that time in Rwanda and Cambodia.[32] Education campaigns should explain the life cycle of the malaria parasite, its symptoms, and the benefits of using insecticide-treated mosquito nets. Communities should be encouraged to seek medical help quickly if they experience symptoms like fever or chills. By using engaging stories and visuals, we can help people understand better and motivate them to take preventive measures, ultimately lowering the number of malaria cases in vulnerable border regions.

5. Study limitations

The first limitation of this study revolves around the decision to collect data from a single location, the bustling YMCA taxi rank in Durban. This choice was primarily driven by financial constraints, which restricted the researchers from including other potential sites such as bus stations and airports. Expanding the study to these diverse locations would have enriched the data by providing varied insights into travel destinations and creating a broader spectrum of travellers' profiles.

Despite this limitation, the YMCA taxi rank serves as an essential hub, recognized as the largest point of departure for travellers heading to Mozambique, Eswatini, and Zimbabwe. Its strategic location makes it highly accessible and convenient for most people departing from KZN province. However, the fast-paced nature of transportation at this site presents

challenges. Buses headed to these neighboring countries seldom linger at the rank, leaving little time for the researcher to administer their questionnaires effectively. Moreover, the environment at the bus station is far from conducive to conducting detailed research. The constant influx of travellers creates a lack of privacy, making it difficult for participants to engage openly in the study without distractions. Compounding this issue are the overwhelming noise levels generated by the buses and the countless conversations among travellers, which further complicate the ability to gather accurate and focused responses.

Another significant limitation is the exclusion of participants who utilize informal or illegal border crossings. These routes have been identified as major threats to malaria elimination efforts in KZN.[34] Recruiting participants from these areas poses unique challenges, as individuals crossing through illegal borders may fear the repercussions of revealing personal information, which include the risk of arrest or denial of entry into their desired province or country.

6. Conclusions and recommendations

Malaria remains a significant health threat in Africa, with many travellers exhibiting negative attitudes towards preventive measures. This non-compliance often leads to inadequate health-seeking behavior in the face of malaria risks. Knowledge of cross-border malaria prevention is alarmingly low, highlighting the urgent need for targeted education. Travellers should be informed about standard precautions, such as using insect repellent and sleeping under treated bed nets, and strategies specific to border crossings that can reduce transmission risk. A comprehensive risk management plan is essential to provide accessible information to travellers as they cross borders into and out of SA. Raising awareness about cross-border malaria measures requires collaboration among health, transport, port health, and communication ministries, using various media platforms for effective information dissemination. Awareness campaigns can include posters at taxi ranks, health workshops at transport hubs, and proactive screening initiatives. Enhancing public awareness and promoting universal health coverage can protect communities from imported malaria and prevent outbreaks in KZN and throughout SA. Further research on health education and malaria prevention at key border points is essential, along with improved communication among stakeholders to control the spread of the disease.

7. Conflict of interest

8. Authors' contributions

9. Acknowledgement

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