

Research Article

Factors Associated with Indoor Residual Spraying Programme Effectiveness in Mutare City, Manicaland Province, Zimbabwe

Maxwell Moyoweshumba¹ , Maxwell Mhlanga^{2,*} 

¹Faculty of Health Sciences, Africa University, Mutare, Zimbabwe

²Centre of Gender Equity, University of Global Health Equity, Kigali, Rwanda

Abstract

Introduction: Malaria is a mosquito-borne disease causing fever, chills, and flu-like symptoms. If untreated, it can lead to severe complications and death (CDC, 2016). Recently, Mutare city recorded malaria cases after local transmission was confirmed in 2017. Indoor Residual Spraying (IRS) was implemented, but coverage decreased during the 2018/2019 IRS season, prompting a study in ten randomly selected locations. The study aimed to identify knowledge gaps, preferred alternatives to IRS, the influence of competing events, and household ownership on IRS. **Methods:** A descriptive cross-sectional study with 260 participants was conducted using proportional allocation for the study locations. Data were collected via interviewer-administered questionnaires, interviews with key informants, and focus group discussions. **Results:** Participants were mostly female (67%) and aged 31-60 years (50%), with vending being the top livelihood (52%). Only 38% always used bed nets, 24% owned houses, and 76% were tenants. IRS reservations included time consumption (11%), preference for other interventions (9%), landlord objections (22%), livelihood pressures (14%), labour intensity (15%), exposure of secrets and poverty (12%), distrust of the team (8%), and property damage (9%). Bed nets were preferred over IRS. **Conclusion:** Challenges in conducting IRS included knowledge gaps needing health education sessions, which faced attendance issues due to competing events. More strategic health education and bed net deployment were recommended.

Keywords

Malaria, In-Door Residual Spraying, Mosquito, Evaluation, Programme

1. Introduction

Malaria remains a significant global health burden, causing nearly a million deaths annually, primarily among children and pregnant women in sub-Saharan Africa. The disease consumes up to 40% of public health expenditure in these regions, leading to an annual loss of \$12 billion in Gross Domestic Product (GDP). Despite extensive intervention

efforts and resources, malaria continues to be a major public health challenge, particularly in sub-Saharan Africa [1]. Malaria is an acute febrile illness caused by Plasmodium parasites, transmitted by infected female Anopheles mosquitoes [2].

The indoor residual spraying (IRS) program for malaria

*Corresponding author: mmhlanga@ughe.org (Maxwell Mhlanga)

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control in Zimbabwe began in 1947, with large-scale spraying initiated in 1949 [3]. The goal of the National Malaria Control Program (NMCP) is to reduce morbidity and mortality through scaling up prevention and control strategies. One of the strategic objectives is to achieve universal access to malaria prevention and protection through effective vector control interventions, including IRS. The IRS program aims to maximize the reduction of target mosquitoes, extend the residual period, and reduce costs.

The use of dichlorodiphenyltrichloroethane (DDT) has been effective in reducing malaria incidence to around 150-200 cases per 1000 population [4]. However, after switching to shorter-acting pyrethroids, Zimbabwe saw a marked increase in malaria cases, leading to the reintroduction of DDT in 2004. In 2011, Zimbabwe's malaria program received support from major donors, including the President's Malaria Initiative (PMI), the Global Fund, UNICEF, and others.

IRS training in Zimbabwe occurs at three levels: for provincial managers, IRS district managers, and spray operators. The NMCP uses various training materials from the WHO and major insecticide manufacturers. Training includes hands-on spraying practice, malaria epidemiology and entomology presentations, health and safety issues, personal protective equipment (PPE) use, and pesticide handling [5].

Despite these efforts, IRS acceptance varies between rural and urban areas. Research in Mozambique revealed differences in IRS uptake, influenced by factors such as house ownership, landlord-tenant relationships, and socio-economic conditions [6]. Mutare City started IRS in 2017 after local malaria transmission was confirmed. However, the 2018 IRS campaign recorded low room coverage, falling below the national benchmark of 85%.

Mutare City has an estimated population of 201,155 people and 54,289 households, with 63.8% of the population aged 15 and above, indicating high mobility and livelihood engagements. The IRS period runs from September to December, using DDT as the primary chemical. However, the program faces challenges, including low acceptance, refusals, and locked rooms, questioning its feasibility and sustainability in the city.

Study Objectives

This study aimed to evaluate the IRS program in Mutare City for the 2018/2019 season, focusing on the locations of Hob House, Fair Bridge Extension, Florida, Mushamukadzi, Gimboki, Federation, Weirmouth, Fern Valley, Sanitation, and Remand. The study had the following objectives:

1. Determine knowledge gaps of IRS in Mutare City.
2. Identify preferred alternatives to IRS.
3. Assess the influence of competing events on IRS.

4. Evaluate the impact of household ownership on IRS.

2. Methods

2.1. Study Design

A descriptive cross sectional study was conducted.

2.2. Study Setting

Mutare City (Hob House Florida extension, Fair Bridge extension, Mushamukadzi, Gimboki; Federation; Weirmouth, Fern Valley, Sanitation, and Remand, Hob House, Fair Bridge extension, Florida, and Mushamukadzi.) in Zimbabwe.

2.3. Study Population

Household heads residing in Hob House Florida Extension, Fair Bridge Extension, Mushamukadzi, Gimboki, Federation, Weirmouth, Fern Valley, Sanitation, and Remand, as well as Hob House, Fair Bridge Extension, Florida, and Mushamukadzi, were the study population.

2.4. Inclusion Criteria

Adults 18 years and older located in Hob House, Fair Bridge Extension, Florida, Mushamukadzi, Gimboki, Federation, Weirmouth, Fern Valley, Sanitation, and Remand.

Households in Hob House, Fair Bridge Extension, Florida, Mushamukadzi, Gimboki, Federation, Weirmouth, Fern Valley, Sanitation, and Remand Prison.

2.5. Exclusion Criteria

Adults 18 years and older residing outside Hob House 1, 2, 3; Fair Bridge Extension, Florida, Mushamukadzi, Gimboki 1, 2, 3; Federation 1, 2, 3; Weirmouth, Fern Valley, Sanitation, and Remand.

Households outside Hob House; Fair Bridge Extension, Florida, Mushamukadzi, Gimboki, Federation; Weirmouth, Fern Valley, Sanitation, and Remand Prison.

2.6. Sample Size Calculation

Basing on the study by (Manguambe et al 2010), assuming that the response rate is 80% of the population size of 800, confidence level of 95%, margin of error of 5%; thus required sample size is 260.

Table 1. Sample size proportional allocation to study locations.

Location	Allocated sample size	% of the total required sample size
HobHouse	39	15%
Gimboki	81	31%
Federation	35	13%
Mushamukadzi	21	8%
Weirmouth	19	7%
FernValley	33	13%
Florida Extension	8	4%
FairBridge Extension	14	5%
Sanitation	5	2%
Remand	5	2%
Total	260	100%

2.7. Sampling Method

Ten locations sprayed for IRS in 2018 were selected for the study. The 260 participants of each of the ten locations sprayed were selected by simple random approach using random numbers. Each location shall be represented as shown by Figure 2 above. The Village Health Workers (VHWs), Community Malaria Committees (CMCs) and inherent community structures for IRS implementation were purposively selected. The 4 key informants (2 Environmental Health Officers (EHOs), 1 IRS coordinator and IRS supervisor) were purposively selected. The participants for the 2 Focus Group Discussion (FGDs) were conveniently selected from the 10 locations; central location for the two FGDs would be Hob House (catering for 5 locations) and Fern Valley (catering for the other 5 locations), with 10-15 participants each, respectively.

2.8. Data Collection Instruments

An interviewer-administered questionnaire was used to collect data from the 260 enrolled participants. Interview guide was used in facilitating interviews with the key informants at Mutare City. Focus Group Discussion guide was used in conducting discussions with the study community. Pretesting of the instruments was carried out in Hob House to check the instruments for validity and reliability.

2.9. Data Analysis

Data were captured, and analysed using Epi Info™ 7

(CDC) and qualitative data were analyzed manually.

2.10. Ethical Consideration

The study received ethical approval from the Africa University Research Ethics Committee. Written informed consent was obtained from study participants.

3. Results

3.1. Socio-Demographic Data

Of the 260 people who participated in this study, the majority, 175 (67%) were women. The age group 31-60 who were economically viable and were in the city to find livelihood constituted the greatest proportion (Table 2). The largest livelihood means among participants was vending 135 (52%). Most participants 159 (61%) had reached secondary education.

With regards to length of stay, the majority 189 (73%) had stayed in their locality for 1-2 years.

Most of the participants, 200 (77%) did not have housemaids who could facilitate the implementation of IRS when their hosts would be at work. With regards to house ownership, 198 (76%) of the participants were tenants. About 61 (62%) of the participants did not stay with their tenants who were said to be staying elsewhere in the country, 28% were staying with their landlords whereas 16% of the landlords were said to be leaving abroad.

Table 2. Socio demographic characteristics.

	Variable	n (%)
Age (years)	11-20	44 (17%)
	21-30	86 (33%)
	31-60	130 (50%)
Sex	Female	175 (67%)
	Male	85 (33%)
Marital status	Single	36 (14%)
	Married	97 (37%)
	Divorced	85 (33%)
	Widowed	42 (16%)
Level of education	None	2 (1%)
	Primary	42 (16%)
	Secondary	159 (61%)
	Tertiary	57 (22%)
	None	6 (2%)
Religion	Apostolic Church	98 (38%)
	Pentecostal church	149 (57%)
	Other	6 (3%)
Livelihood	Farming	39 (15%)
	Vending	139 (52%)
	Formal employment	67 (26%)
	Other	19 (7%)
Period of stay in location	Below 1 year	49 (19%)
	1 year to 2years	189 (73%)
	3 years and over	22 (8%)

3.2. Knowledge of Malaria

About 83 (32%) of the participants believed that malaria was caused by eating unripe fruits and 26 (6%) thought eating dirty fruits cause malaria (Figure 1).

Like the ignorance on malaria causation, the inability to

mention all the pertinent signs and symptoms of malaria would mean reduced understanding of the preventive interventions like IRS needed. 26 (10%) of the sampled 260 participants that is 16 (6%) participants and 10 (4%) participants mentioned kwashiorkor and stiffness of muscles respectively as the sign and symptom of malaria (Figure 2).

Causation of malaria

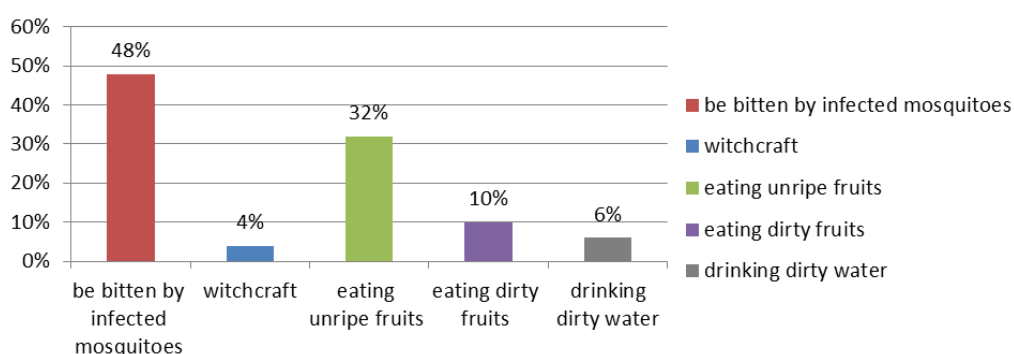


Figure 1. Knowledge of malaria.

Signs and Symptoms of malaria

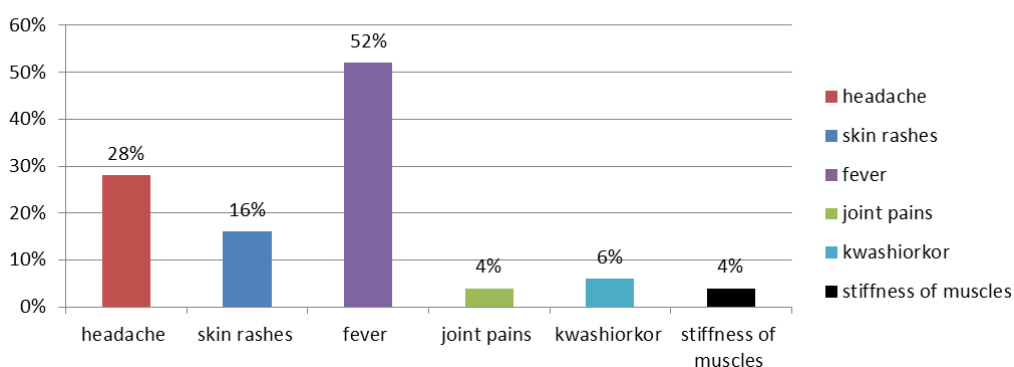


Figure 2. Signs and symptoms of malaria.

Of the enrolled participants 260, 133 (51%) appreciated that malaria was a problem in Mutare city, which help them remain ready to institute preventive interventions. The other fairly half 127 (49%) revealed that malaria was not problem which could thwart the propensity to institute and appreciate interventions like IRS.

Results showed that the residents do use several malaria interventions strategies other than Indoor residual Spraying. The preventive interventions include repellents 62 (24%), screening house 26 (10%) 31 (12%) and use of nets 21 (8%) (Figure 3).

Interventions to protect oneself

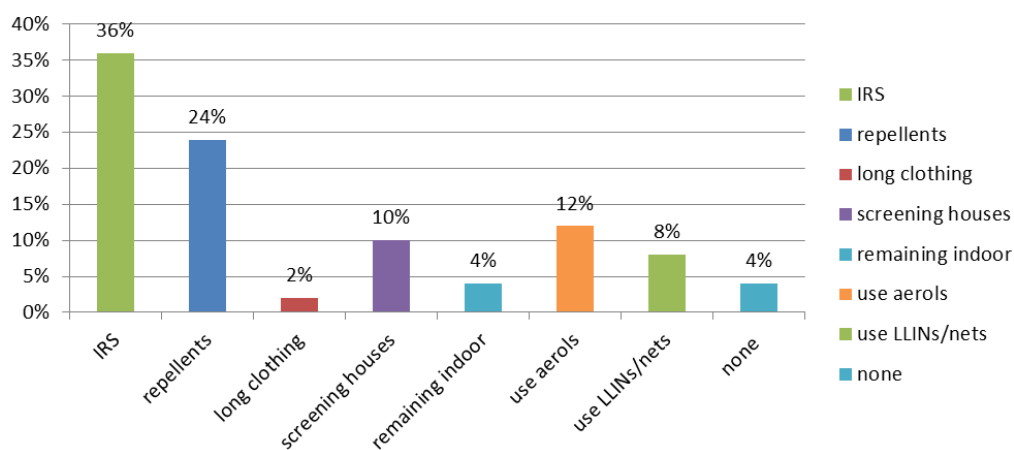


Figure 3. Interventions to protect oneself.

Of the sampled 260 participants 133 (51%) told that IRS was effective in controlling malaria while 127 (49%) told that it was not effective. The reduced uptake of IRS in the city could be due to the perspective that IRS was not effective.

Landlord objections 57 (22%) was cited as the major hiccup to let some houses sprayed (Figure 4). As noted the resi-

dents had reservations about IRS saying that it compromised them as it was time consuming, use of other interventions, livelihood pressure, IRS being labor intensive, exposure of residents poverty, lack of trust of the team and that in the process of implementing IRS there was property damage (Figure 4).

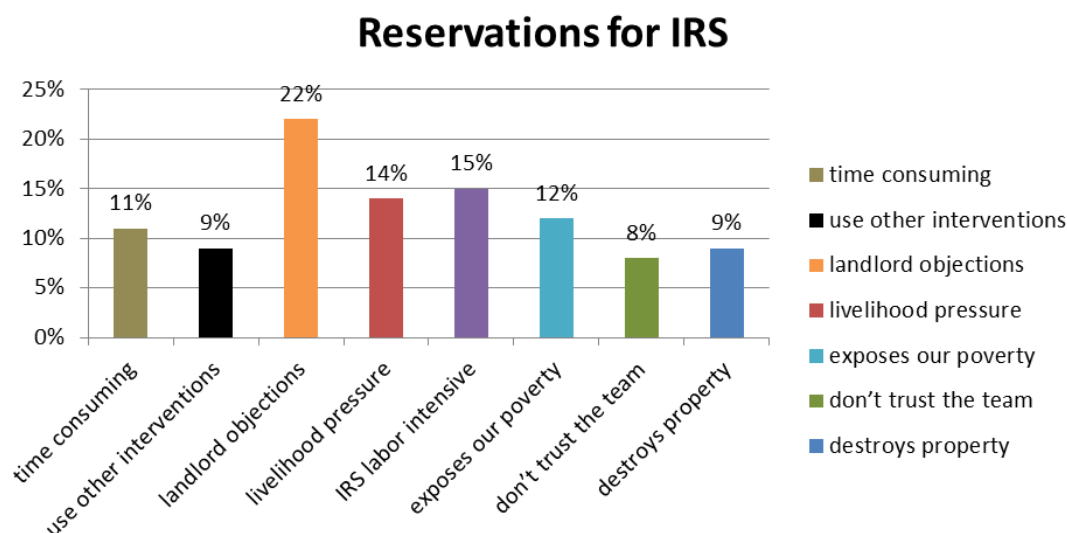


Figure 4. Reservation about IRS.

The participants who acknowledged receiving health education were 62 (24%) of the total enrolled 260 participants, leaving 198 (76%) without leaving general health education. The attendance of health education sessions was noted to be

of challenge as (81) (31%), they were always busy away, 83 (32%) indicated that they did not used to stay in the locations, while 52 (20%) told that they never had time to attend to the health education sessions (Figure 5).

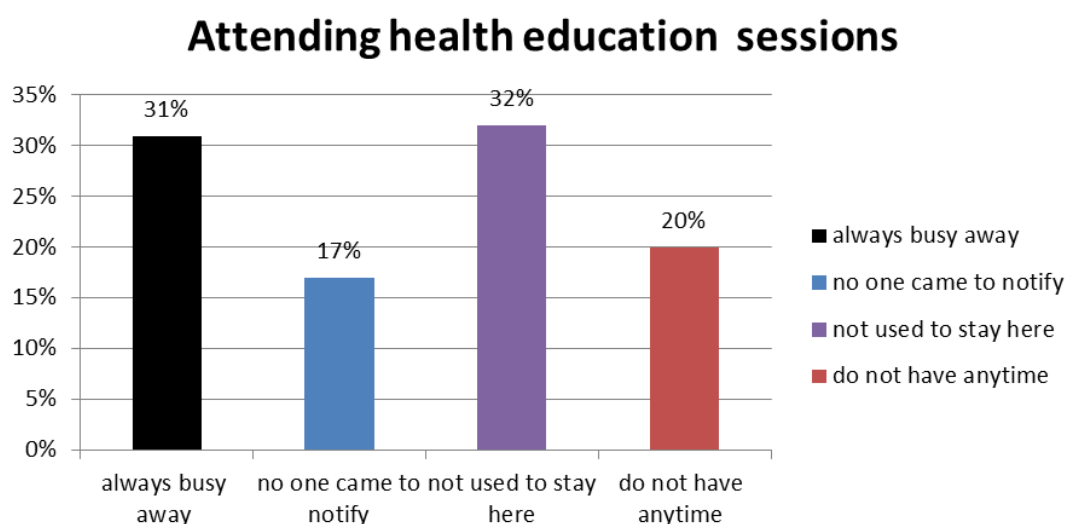


Figure 5. Attending health education sessions.

3.3. Practices

It is fairly observable 244 (94%) of the residents sleep under a bed net though inconsistently (Figure 6).

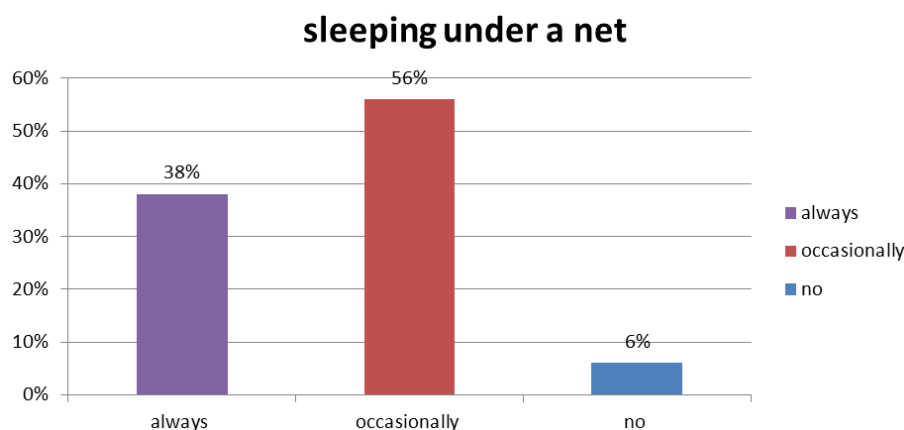


Figure 6. Sleeping under bed net.

Malaria illness and treatment

Only 24% (63 participants) of the sampled 260 participants suffered from malaria (Figure 7).

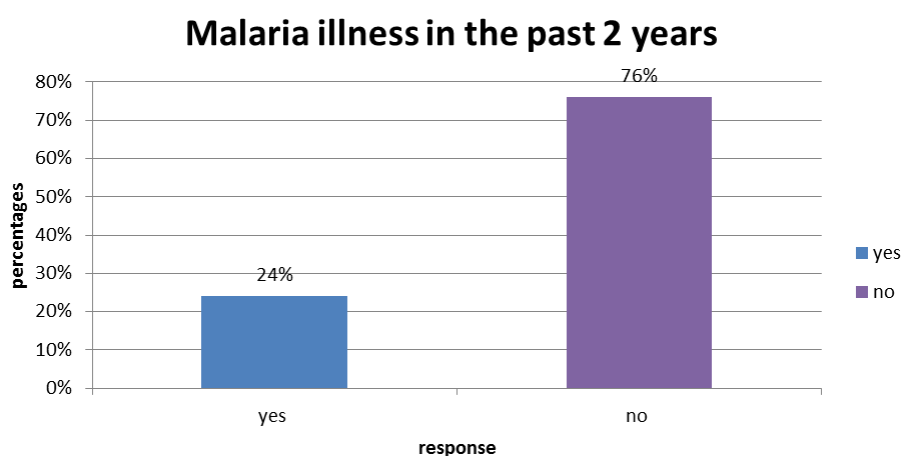


Figure 7. Malaria illness in the past 2 years.

3.4. Key Informants Responses

The Environmental Health Officers (EHOs) indicated that malaria was one of the top five diseases in the city. Key informants agreed that malaria was a problem, prompting interventions such as Indoor Residual Spraying (IRS) and larviciding.

The key informants highlighted the lack of budget for IRS, which relied on government funding. Consequently, critical periodic refresher training for the involved cadres was not conducted. They also noted that while rudimentary structures to support IRS existed, they were not active. The informants acknowledged the difficulty in navigating the IRS program in the city due to significant resistance.

It was agreed that the success of the IRS program depended on landlords' views, making it essential to actively engage and seek their support before implementation. Proper timing of the program was also deemed crucial. The inform-

ants highlighted the challenge of mobilizing urban residents for the IRS program. Residents were conflicted about the chemical DDT used for IRS, citing its limited spectrum and expressing a preference for bed nets over IRS. Proper timing and the use of a broad-spectrum chemical were noted as key to the program's success.

Key informant responses indicated a preference for treated nets and repellents over IRS, aligning with household questionnaire results where residents opposed IRS. Barriers to IRS uptake in the ten locations included community dynamics such as high mobility, livelihood pressures, landlord objections, the chemical's target-specific nature, and the prevalence of screened houses.

3.5. Focus Group Discussions

From the focus group discussion, the community felt that there was malaria in the city but significantly more cases were imported. They mentioned that cases were rare, but the

use of mosquito nets was preferred over IRS.

The community found IRS cumbersome and laborious, as it involved moving properties in and out for spraying, often resulting in damages. They complained about losing their belongings during the program and indicated they hardly had time for such a laborious task amidst livelihood pressures. The urbanites also expressed embarrassment about moving and removing their few possessions, exposing their poverty. They preferred to be sprayed by spray men they knew to avoid this shameful exposure.

The urbanites suggested that IRS was more suitable for the countryside, where livelihood stress was lower. They mentioned that in the countryside, unlike in towns, neighbours could help when one was not around.

4. Discussion

The age group 31-60 who were economically viable and were in the city to find livelihood constituted the greatest proportion. Thus as indicated by Munguambe and others that implementation of Indoor residual spraying in city is associated with myriads of issues including the quoted age group imbued in pressure of livelihood becoming potentially indifferent to program requirements like IRS [6].

The majority of the participants had at least a secondary education, 159 (61%), with the least being those who had never attended school. Adequate education helps individuals find solutions to challenges like the malaria problem in Mutare city. Education facilitates the use of effective alternatives to IRS, such as bed nets or repellents. Educated individuals are more discerning in choosing what suits them best and are skeptical about costly measures. Educated or elite workers do not simply follow the orders of the local government or the sprayers but are skeptical about IRS and its results. This concurs with Munguambe and others, who also acknowledged that participants who refused IRS were mainly from urban districts and were more educated compared to those in rural areas [6].

The sampled 260 participants indicated that they had various means of livelihood, with the greatest being vending 135 (52%), followed by formal employment. Thus, during the day, some participants were away, causing the IRS team to encounter deserted houses. In cities, unlike the countryside, residents are often available throughout the year, posing fewer challenges for the IRS program. However, in Mutare city, if the IRS program is not tailored to the times when most workers are available, it would be difficult to achieve adequate coverage.

The period of stay in the location showed that the greatest number of participants, 189 (73%), had been there for 1-2 years. The least was the 3 years and over category with 49 (19%) of the participants, while those below 1 year were 22 (8%). This indicates that residents were relatively mobile, moving from one location to another. Greater human mobility and dynamism hinder the implementation and coverage of the IRS program.

Most participants, 200 (77%), did not have housemaids to facilitate the implementation of IRS when the residents were at work. The IRS program in Mutare city could be suffering due to the unavailability of individuals who could stay behind to facilitate the spraying program. The majority of the participants were tenants. Being a tenant reduces autonomy in decision-making regarding the acceptance of IRS in the city. As confirmed by similar studies, tenants have to consult landlords and obtain permission for the use of the rooms they occupy [7, 8]. About 62 percent of the participants indicated that their landlords do not stay with them, implying that the decision-making process takes time. Even if landlords are willing to have their houses sprayed, distance and the cost of contacting them could hinder IRS coverage. Literature reviewed has shown no mention of the impact of landlords on IRS.

Results revealed gaps in the understanding of malaria causation, with 32% of the participants believing that malaria is caused by eating unripe fruits and a significant proportion of participants attributing it to eating dirty fruits. More health education is needed. Inadequate health education would impact the acceptance of the IRS program in the city. The inability of participants to mention all the pertinent signs and symptoms of malaria indicates a reduced understanding of the necessary preventive interventions like IRS. Twenty-six (10%) of the participants mentioned incorrect symptoms such as kwashiorkor and muscle stiffness as signs of malaria. A refined understanding assists in appreciating the necessary preventive interventions [9].

The residents used several malaria intervention strategies other than Indoor Residual Spraying. The adoption of various interventions could compromise the uptake of IRS as residents have alternatives. There is a need to explore other malaria interventions that could be more suitable for an urban setting. Of the sampled 260 participants, 127 (49%) believed that IRS was not effective in controlling malaria. The reduced uptake of IRS in the city could be due to the perception that it is not effective. More social mobilization campaigns targeting cities could change the status quo [10].

The attendance of health education sessions was a challenge: 81 participants (31%) were always busy, 83 (32%) did not stay in the locations regularly, and 52 (20%) never had time to attend health education sessions. Therefore, conducting health education sessions in the locations was a mammoth task.

It is notable that 244 (94%) of the residents sleep under a bed net, though inconsistently. This indicates that residents have some interest in bed nets, which could be at the expense of the IRS program, a reality that needs to be acknowledged [11].

Only 63 (24%) of the sampled 260 participants had suffered from malaria. This could mean that residents do not have a strong awareness of the disease's impact. Necessity propels residents to accept a program like IRS, but the opposite is true when they do not perceive any value in the intervention because they do not experience malaria [12].

The residents did not like IRS because it was cumbersome

to remove belongings from the rooms and then return them after spraying, which often led to breakages and reduced the shelf life of their possessions. The enrolled participants revealed knowledge gaps about malaria and IRS. Urban mobility and the rush for livelihood rendered consideration for IRS trivial. IRS in the city lacked grassroots support as critical support structures were either defunct or unavailable. Mutare city had no special budget for the IRS program. Bed nets were the most preferred by the residents. The urban community was highly dynamic and complex, complicating the smooth implementation and sustainability of IRS gains. It was noted that IRS required sound organization, which could be challenging in cities like Mutare. Landlords had a significant influence (88%) on the acceptance of houses to be sprayed. It was not sustainable to spray in the city without a budget and an established target database.

About half of the enrolled participants (51%) acknowledged that malaria was a problem in the city. Health education on malaria and IRS was inadequate, with only 24% of the 260 participants attending health education sessions on malaria and IRS. Reasons for not attending included being busy (31%), not being notified (17%), not having stayed in the location long enough (32%), and not having time (20%). There were missed opportunities due to a lack of proper timing [13]. Studies in Uganda and Tanzania have reflection on the importance of correct and consistent knowledge in addressing negative perceptions and attitudes towards IRS [14, 15].

5. Recommendations

This study recommends that City health management identify alternative interventions to IRs to be able to meet different preferences of clients. The study also recommends that The City Health management intensify community health education sessions on IRS and effectively engages the landlords in IRS planning (Table 3).

Table 3. Recommendations.

Recommendations	Who	When
Identify and explore alternative interventions to IRS (nets, use of repellents, larviciding)	City Health management	Ongoing
Effectively engage landlords in IRS planning strategies	City Health management	Ongoing
Intensify health education sessions on IRS	City Health management	Ongoing

6. Suggested Further Studies

To carry out Entomological spatial distribution of malaria vectors in the study settings.

7. Conclusion

The evaluated IRS program in Mutare city had major shortfalls, gaps, and realities. One reality was that the city's hyperactive community and dynamic population compromised the coherent implementation of IRS. Residents preferred alternatives like treated bed nets, as they disliked the periodic demands and potential damage to furniture caused by IRS. Noted knowledge gaps also affected the program's success. The Mutare City Council had no independent or special budget for IRS. The program lacked support and firm grassroots structures, such as health clubs, to anchor it. Additionally, landowners living in different areas had significant influence over whether houses were sprayed.

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Author Contributions

Maxwell Moyoweshumba: Development of the original draft

Maxwell Mhlanga: Review of the manuscript, data analysis and discussion.

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Conflicts of Interest

The authors declare no conflicts of interest.

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