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Access and usage of malaria control measures by women of reproductive age in Mopeia Mozambique

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Abstract

Background Malaria presents a disproportionate threat to pregnant women, making access to malaria prevention tools crucial for controlling the disease in this vulnerable population.

Methods This prospective descriptive study targeted women of reproductive age (13–49 years old) living in the Mopeia district, a high malaria endemic area in Zambezia province, Mozambique. As part of the BOHEMIA cluster randomized trial, the study included a simplified and full census to collect data on socio-demographic, socio-economic and household factors, health status, and malaria prevention tools from the target population.

Results Data from 7,099 women of reproductive age living in the BOHEMIA clinical trial study area was collected, including 497 (7.0%) self-referred as pregnant. Access to malaria vector control tools was high, with 89.9% of women self-referred as pregnant, 87.9% of women self-referred as not- pregnant living in a household with at least one long-lasting insecticidal net and 69.6% of women self-referred as pregnant and 73.4% of women self-referred as not-pregnant living in household that received indoor residual spraying in the past 12 months. Intermittent preventive treatment coverage was moderate-low, with 53.1% of women self-reported as pregnant having taken at least one dose.

Conclusions This study found that women of reproductive age in the highly-endemic Mopeia district have good access to malaria vector control tools. However, intermittent preventive treatment coverage remains below World Health Organization-recommended levels. Focused efforts are needed to improve this coverage, and continuous monitoring along with tailored interventions are essential for achieving optimal prevention outcomes among vulnerable populations.

Keywords Pregnancy, Malaria, Prevention, Long-lasting insecticidal nets, Indoor residual spraying, Intermittent preventive treatment of malaria in pregnancy, Mozambique, Mopeia, BOHEMIA

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Nicolas *et al. Malaria Journal*   (2025) 24:66

Page 2 of 11

Background

The World Health Organization (WHO) considers all women between 15 and 49 years of age to be of reproductive age (WRA). Approximately one quarter of the population consists of WRA [1]. This translates into 1.9 billion WRA worldwide in 2022, 290 million WRA in sub-Saharan Africa (SSA) [2] and 8.2 million WRA in Mozambique [1, 3]. Thus, maternal health is an integral component of the health status and well-being of a population. In SSA, maternal mortality remains high, with Mozambique witnessing 127 maternal deaths per 100,000 live births in 2020 which is ten-fold that of Europe and Central Asia at 13 per 100,000 live births [4, 5], but substantially below East and Southern Africa and the world´s average at 360 and 223 maternal deaths per 100,000 live births, respectively [6].

According to the 2023 World Malaria Report, there were 249 million malaria cases worldwide in 2022 [7]. The WHO Africa region accounted for 233 million cases, 94% of the global total [7]. Mozambique accounted for 4% of the global malaria cases in 2022 [7]. In 2022, within the 33 countries with moderate and high malaria transmission in the WHO African Region, there were approximately 35.4 million pregnancies [7]. Among these, around 12.7 million pregnancies were exposed to malaria infection [7]. Malaria infection during pregnancy carries significant risks for the mother, such as severe disease, anaemia, and risk of maternal death, as well as for the child, such as stillbirth and low birth weight [7]. Despite the remarkable investments of national resources as well as bilateral and multilateral efforts to provide free universal malaria care, the most vulnerable rural and impoverished populations still face important access barriers that further perpetuate poverty [8].

Long-lasting insecticidal nets (LLINs) are one of the key WHO recommendations for the prevention of malaria in pregnancy [9]. The proportion of pregnant women sleeping under LLINs in SSA has increased significantly in the past 20 years, from 3% in 2000 to 56% in 2022 [7]. In 2015, the proportion of pregnant women sleeping under a LLIN in Mozambique was 50–55% with a slightly higher uptake among those under 20 years of age [10]. In addition to LLINs, indoor residual spraying (IRS) is the second most widely implemented vector control intervention and has been previously shown to reduce malaria related adverse pregnancy outcomes [11]. In 2022, 47 countries implemented IRS to prevent malaria. However, the proportion of people in malaria endemic regions protected by IRS fell from 5.5% in 2010 to 1.8% in 2022 [7], this reduction entails lower proportional coverage for pregnant women as well [7, 12]. In Mozambique, around six million people, of which approximately 1.5 million are WRA, were protected by IRS in 2022.

Beyond timely diagnosis and treatment of malaria, WHO recommends that, starting the second trimester, all pregnant women living in areas of moderate-to-high malaria transmission receive at least three doses of intermittent preventive treatment (IPTp) with sulfadoxine-pyrimethamine (SP) as part of their antenatal care (ANC). While vector control tools try to maximize avoiding a mosquito bite, which can still happen when the person is outside of home and the vector control tools do not protect them, taking IPTp acts against malaria parasites directly so it protects the pregnant women in all situations. IPTp is one of the key measures to improve pregnancy outcomes in malaria endemic areas, significantly reducing anaemia and low birth weight [7].

In 2022, within the 33 countries with the highest burden of malaria in the WHO African Region, 78% of the pregnant women used ANC services at least once during their pregnancy. Of these, about 64% received one dose of IPTp, 54% received two doses and 42% received three doses [7]. The WHO estimates that IPTp has averted 393,000 low birthweights in 2022 [7].

Some of the current barriers to achieving the WHO goals for IPTp coverage include the availability of SP at the ANC clinic, the distance to the ANC clinic, particularly among women living more than 5 km away, the acceptability of IPTp, and attrition with repeated dosage [13].

In Mozambique IPTp coverage reported in 2022–23 was 65% of women aged 15–49 with live births receiving at least one dose, 47.6% receiving two or more doses and around 30.4% receiving three or more doses [14]. The coverage of IPTp with at least three doses is higher in urban areas (33.7%) than in the more endemic rural areas where it only reaches 22.1% [14].

This study describes the access and usage of malaria control measures by WRA as part of the BOHEMIA study, a cluster randomized controlled trial (cRCT) carried out in Mopeia, Mozambique, to assess the potential use of ivermectin to reduce malaria transmission [15]. The main socio-demographic and socio-economic characteristics affecting the coverage of malaria prevention in WRA are also described.

Methods

Setting

Mopeia district has a surface area of 7,671 km2 and is located in the southwest of the Zambezia province, in central Mozambique. There are two clearly defined areas in Mopeia, the highlands in the North, and the flood plains of the Zambeze river in the South (Fig. 1).
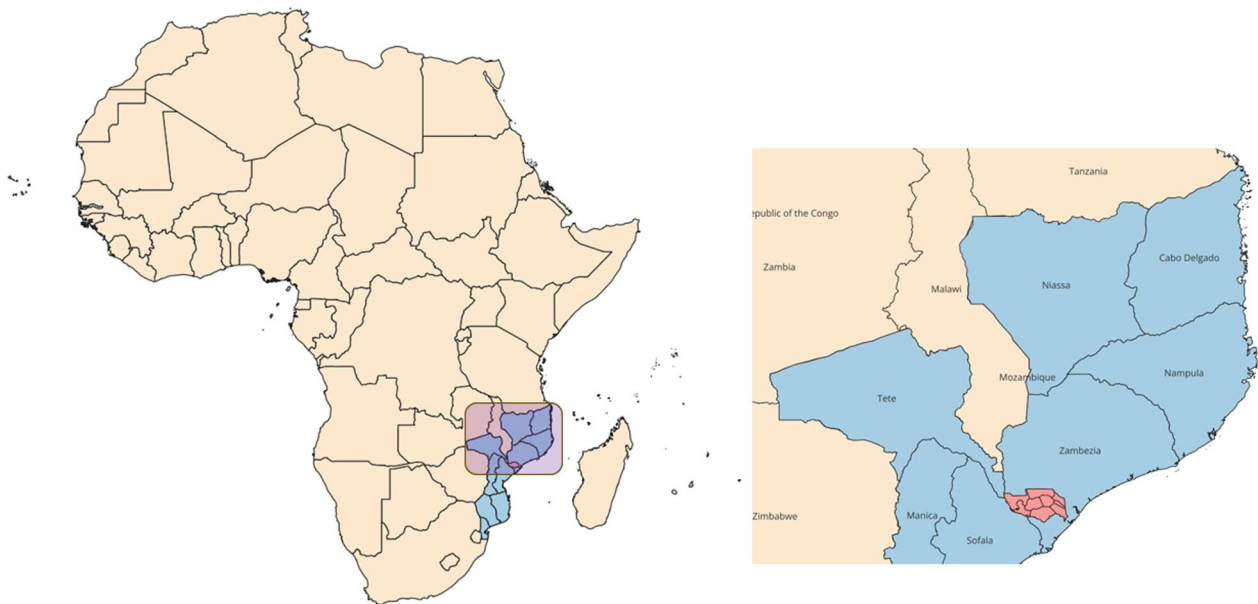
Fig. 1 Location of Mopeia district (red) in centre of Mozambique (left) and enlarged map of Mopeia district with the different localities (right)

The total population of Mopeia is estimated at 132,000 people in 2021 with almost 50% of the population below 15 years of age, and 18.3% under 5 years old [16]. This population is distributed in two administrative posts, eight localities, and almost 400 small villages ("bairros"). There is one district hospital and 13 health facilities. The road network in the district consists mainly of tertiary roads which pose serious difficulties for transport during the rainy season.

Study design and surveyed population

In preparation for BOHEMIA, a simplified census was conducted between October 2020 and March 2021 to map and capture household characteristics across the district [17]. In addition to this, between June and November 2021, a full census was performed in all the households selected for the BOHEMIA cRCT and individual data from all the household members was collected. This full census served as basis for a prospective descriptive study targeting WRA (considered between 13 and 49 years old) who lived in the study clusters. Eligibility criteria included the intention to remain in the area for at least 3 months, and agreement to participate in the study by signing the informed consent/assent from for the full census.

The data was collected during household visits by a team of fieldworkers, male and female, located across the study clusters using digital forms programmed in Open Data Kit (ODK, https://opendatakit.org) platform in Android tablets. Data was uploaded regularly based on the internet connection of the area.

The household questionnaire was administered to the head of household or substitute. Individual questionnaires were administered to adult and adolescent household members. All questions were asked in Portuguese or one of the two local languages of the district, Cisena or Echuwabo, depending on the participants' preference.

Household data, such as access to water, sanitation, and commodities and malaria prevention tools in place, was captured. At the individual level, data regarding health status, health-seeking behaviour, self-referred pregnancy, and use of malaria prevention tools was collected.

For questions related to pregnancy that could potentially cause distress to individuals within the family, particularly adolescent girls and unmarried respondents, fieldworkers were trained to ensure that the questionnaire was administered in an environment that maximized confidentiality, as much as field conditions allowed.

Data analysis

The analysis of this study involved examining individual socio-demographic, socio-economic, household factors, and health-related characteristics. Descriptive statistics, specifically individual socio-demographic, socio-economic, household factors and health related characteristics were presented as frequencies and percentages.

Age was classified in 3 ranges, 13–18 years old considered as adolescents, 18–35 years old considered as young

Nicolas *et al. Malaria Journal*   (2025) 24:66

Page 4 of 11

adults and 35–49 years old considered as mature. Water sources were classified as "improved", "unimproved", or "surface", and latrines were classified as "improved" or "unimproved", guided by the WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene [18]. Wealth index rank was divided into Rank 1 (Least Poor), Rank 2 (Poor), Rank 3 (Moderately Poor), Rank 4 (Poorer) and Rank 5 (Poorest) [19]. The linear distance from every household to the nearest health facility was calculated based on GPS data using ArcGIS [20].

Statistical analyses were conducted using R 4.1.2 [21]. The odds ratio (OR) (95% CI) has been calculated using MedCalc Software Ltd. Odds ratio [22].

Ethical considerations

All participants signed an informed consent. Consent was sought from parents of minors and assent from all adolescents 13–17. The study protocol was reviewed and approved by the Institutional Ethics Review Board for Health at CISM (CIBS-CISM) and the Research Ethics Review Committee (ERC) of the WHO, before data collection.

Results

A total of 25,550 households and 131,818 inhabitants were visited and registered during the simplified census in Mopeia [17]. From the district´s population surveyed in the simplified census, 31,898 (26%) were WRA, from this total, 24.7% were 13–18 years old, 53.6% were 18–35 years old and 21.6% were 35–49 years old.

Table 1 shows the individual key socio-demographic, household factors, economic and health-related characteristics among 7,099 WRA surveyed in the full census that took place in the BOHEMIA study after the simplified census. Age distribution follows the same trend observed in the simplified census. At the time of the full census, 497 (7.0%) WRA self-reported as pregnant, 6,468 (91.1%) as non-pregnant and 134 (1.9%) preferred not to answer or didn't know their pregnancy status.

In regard to the households where one or more WRA were living, 71.8% of WRA lived in male-headed households, and more than half of the household heads (68.5%) were between 25 and 50 years old. Most households (85.1%) had more than 4 members. The distribution between the different wealth index rank was reasonably uniform, the highest proportion of WRA belongs to the richest wealth quintile (24.4%) and the lowest proportion of WRA belongs to the poorest wealth quintile category (15.3%). 75.5% of WRA were living in a household with an improved main source of water, however only 41.8% of WRA whereas living in a household with an improved latrine.

Just 41.0% of WRA lived at a linear distance greater than 4.9 km to the nearest health facility, potentially conditioning their health access. In addition, 3.1% of WRA lived in a household that had reported at least one death in the previous 12 months.

Table 2 shows malaria protection tools at the household and individual level, as well as recent health status for WRA stratified by self-referred pregnancy status and displays the assessment of potential associations between these factors and self-referred pregnancy status.

The majority of individuals reported living in households that owned at least one LLIN, with 89.9% of pregnant women and 87.9% of non-pregnant women living in such households. There was no significant difference in LLIN ownership between the two groups.

Only 31.8% of women self-referred as pregnant and 30.2% self-referred as not-pregnant were living in a household that had at least one LLIN for every 2 individuals despite the fact that more than 78.0% of the study population reported having slept under a mosquito net the previous night, without significant differences associated with the self-referred pregnancy status.

In general, there was no difference in malaria control measures between self-referred pregnant and non-pregnant women in Mopeia. The only exception was a small difference in households that received IRS in the past 12 months favouring households with at least one pregnant woman (OR 1.22, p = 0.05) which, given multiple analyses, is likely a spurious finding.

Only 6.4% of women self-referred as pregnant and 5.8% self-referred as not-pregnant reported having a health problem (i.e., any diseases other than chronic diseases) or medical issues in the previous 15 days. There were no statistical differences between the groups. From those reporting health issues, 78.1% of women self-referred as pregnant and 82.4% self-referred as not-pregnant sought care in a health facility, community health worker, family or friends, or pharmacy among others without significant differences between groups.

Tables 3, 4 and 5 show the individual key socio-demographic, household factors, socio-economic and health related characteristics among self-referred pregnant women considering LLINs usage by the women the previous night, whether the household where the self-referred pregnant women were living received IRS in the last 12 months, and IPTp intake.

Table 3 shows no statistically significant differences in LLIN use by pregnant women based on their age, sex or age of the household head or the fact that they live in households with improved water sources or in households reporting at least one death in the previous 12 months. Linear distance to the health facility did not show significant results, however LLIN usage seems to be

Nicolas *et al. Malaria Journal*   (2025) 24:66

Page 5 of 11

Table 1 General characteristics of women in reproductive age

	Frequency (n = 7,099)	Percentage
Age groups (years)		
13–18	1,455	20.5
18–35	3,940	55.5
35–49	1,704	24.0
Self-referred pregnancy status		
No	6,468	91.1
Yes	497	7.0
Prefer not to answer	43	0.6
Doesn't know	91	1.3
Sex of household head		
Male	5,098	71.8
Female	2,001	28.2
Age of household head		
< 25	923	13.0
25–50	4,865	68.5
50–64	973	13.7
≥ 65	338	4.8
Number of household members		
1–3	1,060	14.9
4–6	3,009	42.4
7–10	2,564	36.1
> 10	466	6.6
Wealth index (101 missing values)		
Rank 1 (Least Poor)	1,710	24.4
Rank 2 (Poor)	1,516	21.7
Rank 3 (Moderately Poor)	1,478	21.1
Rank 4 (Poorer)	1,222	17.5
Rank 5 (Poorest)	1,072	15.3
Household main source of water (623 missing values)		
Improved	4,889	75.5
Unimproved	1,023	15.8
Surface	564	8.7
Individuals living in a household that owns an improved latrine		
Yes	2,966	41.8
No	4,133	58.2
Individuals linear distance to health facility (727 missing values)		
Rank 1 (closest) [0.035–0.762 km]	1,274	20.0
Rank 2 [0.762–1.916 km]	1,217	19.1
Rank 3 [1.916–4.980 km]	1,269	19.9
Rank 4 [4.980–9.241 km]	1,285	20.2
Rank 5 (farthest) [9.241–26.784 km]	1,327	20.8
Individuals living in a household that reports at least one death in the previous 12 months		
Yes	219	3.1
No	6,880	96.9

lower among those living further apart from the health facilities. Pregnant women living in a household with an older household head reported less usage of LLINs the previous night, but the only statistically significant difference was for age of the household head more than 65 years old.

Moreover, pregnant women living in larger households reported less usage of LLINs the previous night, but the

Nicolas *et al. Malaria Journal*   (2025) 24:66

Page 6 of 11

Table 2 Access to malaria control measures and health care by self-referred pregnancy status

	Self-referred as pregnant (n = 497)	Self-referred as not- pregnant (n = 6,468)	OR (95 CI %)	p-value
Individuals living in a household that owns at least one LLIN				
Yes	447 (89.9%)	5,683 (87.9%)	Ref.	
No	50 (10.1%)	785 (12.1%)	0.81 (0.60–1.09)	0.170
Universal coverage (Individuals living in a household owns at least one LLIN for every 2 individuals)				
Yes	158 (31.8%)	1,955 (30.2%)	Ref.	
No	339 (68.2%)	4,513 (69.8%)	0.93 (0.76–1.13)	0.465
Individuals living in a household that owns a LLIN obtained 1 year ago or less (841 missing values)				
Yes	393 (79.1%)	4,976 (76.9%)	Ref.	
No	54 (10.9%)	689 (10.7%)	0.99 (0.74–1.33)	0.959
Individuals that slept under a mosquito net the previous night				
Yes	402 (80.9%)	5,065 (78.3%)	Ref.	
No	95 (19.1%)	1,400 (21.7%)	0.86 (0.68–1.08)	0.184
Don't know	0 (0%)	3 (0.05%)	1.80 (0.09–34.87)	0.698
Individuals living in a household that received IRS in the last 12 months				
Yes	346 (69.6%)	4,745 (73.4%)	Ref.	
No	145 (29.2%)	1,628 (25.2%)	1.22 (1.00–1.49)	0.05
Don't know	6 (1.2%)	95 (1.5%)	0.87 (0.38–1.99)	0.735
Individuals with a medical issue in the last 15 days				
Yes	32 (6.4%)	374 (5.8%)	Ref.	
No	464 (93.4%)	6,085 (94.1%)	0.89 (0.61–1.29)	0.545
Prefer not to answer	1 (0.2%)	9 (0.1%)	1.30 (0.16–10.58)	0.807
Individuals that sought care for a medical issue in the last 15 days				
Yes	25 (78.1%)	308 (82.4%)	Ref.	
No	7 (21.9%)	66 (17.6%)	1.31 (0.54–3.15)	0.551

CI, confidence interval; OR, odds ratio

only statistically significant difference was for households with 7–10 members.

In addition, there was a significant association between owning an improved latrine and using LLINs the night before (p = 0.021). Poorest households reported less LLIN usage the previous night than wealthier ones, with significant results for those in the poorest wealth index rank.

Table 4 shows that there were no statistically significant differences between households that received IRS based on the age of the pregnant women, the sex of the household head, wealth index, linear distance to health facility, and households reporting at least one death in the previous 12 months. Households with older household heads, were more likely to have received IRS when compared with those whose head was < 25. However, the only statistically significant association was for those with heads 26–50 years old (p = 0.003). Larger households were more likely to have received IRS than smaller ones with statistical significance for those with 7–10 members and borderline significance for those with more than 10. Households with a surface main source of water (p = 0.024) and unimproved latrine (p = 0.004) were less likely to receive IRS compared to those with an improved source of water or an improved latrine respectively.

Table 5 shows that there were no statistically significant differences between pregnant women who received at least one dose of IPTp compared to the group that did not receive any dose based on the age of the pregnant women, the sex or the age of the household head, number of household members, household ownership of an improved latrine, wealth index, or one death reported in the previous 12 months. However, the pregnant women living in the farthest households reported less IPTp intake than the closest ones, with significant results for those in rank 5 linear distance to health facility.

In addition, only 53.1% of self-referred pregnant women had taken at least one dose of IPTp. From those, 23.5% took only one dose, 15.3% took two doses, 9.1% took three doses, and only 5.2% took more than three doses of IPTp. No differences between age ranges have been observed in the IPTp adherence. No inference about the potential coverage by gestational age can be made as during the full census no question was included in this regard.

Nicolas *et al. Malaria Journal*　　(2025) 24:66

Page 7 of 11

Table 3 Factors affecting access to LLINs usage during pregnancy (only self-referred as pregnant)

	Used LLIN the night before (n = 402)	Did not use LLIN the night before (n = 95)	OR (95% CI)	p-value
Age groups (years)				
13–18	23 (5.7%)	7 (7.4%)	Ref.	
18–35	326 (81.1%)	72 (75.8%)	1.38 (0.57–3.33)	0.477
35–49	53 (13.2%)	16 (16.8%)	1.01 (0.37–2.78)	0.988
Sex of household head				
Male	323 (80.3%)	73 (76.8%)	Ref.	
Female	79 (19.7%)	22 (23.2%)	0.81 (0.47–1.29)	0.446
Age of household head				
< 25	89 (22.1%)	14 (14.7%)	Ref.	
25–50	273 (67.9%)	64 (64.7%)	0.67 (0.36–1.25)	0.212
50–64	32 (8.0%)	10 (10.5%)	0.50 (0.20–1.25)	0.138
≥ 65	8 (2.0%)	7 (7.4%)	0.18 (0.06–0.57)	**0.004**
Number of household members				
1–3	94 (23.4%)	15 (15.8%)	Ref.	
4–6	192 (47.8%)	43 (45.3%)	0.71 (0.38–1.35)	0.297
7–10	99 (24.6%)	34 (35.8%)	0.46 (0.24–0.91)	**0.025**
> 10	17 (4.2%)	3 (3.2%)	0.90 (0.24–3.46)	0.883
Wealth index (4 missing values)				
Rank 1 (Least Poor)	75 (18.8%)	10 (10.5%)	Ref.	
Rank 2 (Poor)	82 (20.6%)	18 (18.9%)	0.61 (0.26–1.40)	0.241
Rank 3 (Moderately Poor)	83 (20.9%)	24 (25.3%)	0.46 (0.21–1.03)	0.058
Rank 4 (Poorer)	91 (22.9%)	20 (21.1%)	0.61 (0.27–1.38)	0.231
Rank 5 (Poorest)	67 (16.8%)	23 (24.2%)	0.39 (0.17–0.88)	**0.023**
Household main source of water (28 missing values)				
Improved	287 (76.7%)	68 (71.6%)	Ref.	
Unimproved	58 (15.5%)	20 (21.1%)	0.69 (0.39–1.22)	0.199
Surface	29 (7.8%)	7 (7.4%)	0.98 (0.41–2.34)	0.967
Individuals living in a household that owns an improved latrine				
Yes	162 (40.3%)	26 (27.4%)	Ref.	
No	240 (59.7%)	69 (72.6%)	0.56 (0.34–0.91)	**0.021**
Individuals linear distance to health facility (61 missing values)				
Rank 1 (closest) [0.035–0.762 km]	66 (18.5%)	10 (12.5%)	Ref.	
Rank 2 [0.762–1.916 km]	62 (17.4%)	17 (21.3%)	0.55 (0.24–1.30)	0.174
Rank 3 [1.916–4.980 km]	74 (20.8%)	19 (23.8%)	0.59 (0.26–1.36)	0.215
Rank 4 [4.980–9.241 km]	82 (23.0%)	11 (13.8%)	1.13 (0.45–2.82)	0.794
Rank 5 (farthest) [9.241–26.784 km]	72 (20.2%)	23 (28.8%)	0.47 (0.21–1.07)	0.073
Individuals living in a household that reports at least one death in the previous 12 months				
Yes	12 (3.0%)	5 (5.3%)	Ref.	
No	390 (97%)	90 (94.7%)	1.81 (0.62–5.25)	0.278

p < 0.05 are in bold

CI, confidence interval; OR, odds ratio

Discussion

The study examined the access and usage of malaria control measures, socio-demographic and economic household characteristics and health related characteristics among WRA and pregnant women in Mopeia.

Households where WRA live, follow the same trend in terms of LLIN ownership and access, 88.9% of the households have at least one LLINs and 78.0% of those have been obtained one year ago or less.

Nicolas *et al. Malaria Journal*   (2025) 24:66

Page 8 of 11

Table 4 Factors affecting access to IRS during pregnancy (only self-referred as pregnant)

	Pregnant women living in a HH that received IRS (n = 346)	Pregnant women living in a HH that did not receive IRS (n = 145)	OR (95% CI)	p-value
Age groups (years)				
13–18	20 (5.8%)	10 (6.9%)	Ref.	
18–35	272 (78.6%)	120 (82.8%)	1.13 (0.51–2.49)	0.756
35–49	54 (15.6%)	15 (10.3%	1.80 (0.70–4.66)	0.226
Sex of household head				
Male	279 (80.6%)	112 (77.2%)	Ref.	
Female	67 (19.4%)	33 (22.8%)	0.82 (0.51–1.31)	0.395
Age of household head				
< 25	60 (17.3%)	42 (29.0%)	Ref.	
25–50	247 (71.4%)	86 (59.3%)	2.01 (1.26–3.20)	**0.003**
50–64	29 (8.4%)	13 (9.0%)	1.56 (0.73–3.35)	0.253
≥ 65	10 (2.9%)	4 (2.8%)	1.75 (0.51–5.96)	0.371
Number of household members				
1–3	68 (19.7%)	40 (27.6%)	Ref.	
4–6	160 (46.2%)	70 (48.3%)	1.34 (0.83–2.18)	0.228
7–10	101 (29.2%)	32 (22.1%)	1.87 (1.06–3.24)	**0.030**
> 10	17 (4.9%)	3 (2.1%)	3.33 (0.92–12.09)	0.067
Wealth index (4 missing values)				
Rank 1 (Least Poor)	57 (16.6%)	27 (18.8%)	Ref.	
Rank 2 (Poor)	79 (23.0%)	20 (13.9%)	1.87 (0.96–3.66)	0.067
Rank 3 (Moderately Poor)	75 (21.9%)	30 (20.8%)	1.18 (0.63–2.21)	0.595
Rank 4 (Poorer)	79 (23.0%)	30 (20.8%)	1.25 (0.67–2.32)	0.486
Rank 5 (Poorest)	53 (15.5%)	37 (25.7%)	0.68 (0.36–1.26)	0.221
Household main source of water (27 missing values)				
Improved	258 (78.9%)	92 (67.2%)	Ref.	
Unimproved	49 (15.0%)	29 (21.2%)	0.60 (0.36–1.01)	0.055
Surface	20 (6.1%)	16 (11.7%)	0.45 (0.22–0.90)	**0.024**
Individuals living in a household that owns an improved latrine				
Yes	144 (41.6%)	40 (27.6%)	Ref.	
No	202 (58.4%)	105 (72.4%)	0.53 (0.25–0.82)	**0.004**
Individuals linear distance to health facility (60 missing values)				
Rank 1 (closest) [0.035–0.762 km]	57 (18.3%)	16 (13.4%)	Ref.	
Rank 2 [0.762–1.916 km]	56 (17.9%)	22 (18.5%)	0.71 (0.34–1.50)	0.375
Rank 3 [1.916–4.980 km]	61 (19.6%)	31 (26.1%)	0.55 (0.27–1.12)	0.098
Rank 4 [4.980–9.241 km]	71 (23.1%)	21 (17.6%)	0.96 (0.46–2.01)	0.919
Rank 5 (farthest) [9.241–26.784 km]	66 (21.2%)	29 (24.4%)	0.64 (0.32–1.29)	0.213
Individuals living in a household that reports at least one death in the previous 12 months				
Yes	11 (3.2%)	6 (4.1%)	Ref.	
No	335 (96.8%)	139 (95.9%)	1.31 (0.48–3.62)	0.597

p < 0.05 are in bold

CI, confidence interval; OR, odds ratio

Self-referred pregnant women in Mopeia have excellent access to LLINs as shown by self-reported ownership over 89.9%, which is 25% higher than the national average [14] and 80.9% slept under a LLIN the previous night. Despite the high usage of LLINs in Mopeia district among pregnant women, the national survey indicates that in Zambezia province only 37.5% of the pregnant women between 15 and 49 years old slept under a LLIN the previous night. Furthermore, at national level, there has been a significant decline of pregnant women that slept under a LLIN the previous night from 76% (2018) to 47% (2022–2023) [14].

Nicolas *et al. Malaria Journal*   (2025) 24:66

Page 9 of 11

Table 5 Factors affecting access to IPTp during pregnancy (only self-referred as pregnant)

	Received at least one IPTp dose (n = 264)	Did not receive IPTP (n = 211)	OR (95% CI)	p-value
Age groups (years)				
13–18	15 (5.7%)	14 (6.6%)	Ref.	
18–35	214 (81.1%)	165 (78.2%)	1.21 (0.57–2.58)	0.621
35–49	35 (13.3%)	32 (15.2%)	1.02 (0.43–2.44)	0.963
Sex of household head				
Male	209 (79.2%)	169 (80.1%)	Ref.	
Female	55 (20.8%)	42 (19.9%)	1.06 (0.68–1.66)	0.803
Age of household head				
< 25	56 (21.2%)	43 (20.4%)	Ref.	
25–50	183 (69.3%)	138 (65.4%)	1.02 (0.65–1.60)	0.938
50–64	18 (6.8%)	23 (10.9%)	0.60 (0.29–1.25)	0.174
≥ 65	7 (2.7%)	7 (3.3%)	0.77 (0.25–2.35)	0.644
Number of household members				
1–3	58 (22.0%)	45 (21.3%)	Ref.	
4–6	121 (45.8%)	103 (48.8%)	0.91 (0.57–1.46)	0.699
7–10	74 (28.0%)	54 (25.6%)	1.06 (0.63–1.80)	0.819
> 10	11 (4.2%)	9 (4.3%)	0.95 (0.36–2.48)	0.914
Wealth index (3 missing values)				
Rank 1 (Least Poor)	49 (18.6%)	34 (16.3%)	Ref.	
Rank 2 (Poor)	59 (22.4%)	39 (18.7%)	1.05 (0.58–1.90)	0.873
Rank 3 (Moderately Poor)	46 (17.5%)	52 (24.9%)	0.61 (0.34–1.11)	0.105
Rank 4 (Poorer)	62 (23.6%)	45 (21.5%)	0.96 (0.53–1.71)	0.880
Rank 5 (Poorest)	47 (17.9%)	39 (18.7%)	0.84 (0.45–1.54)	0.565
Household main source of water (26 missing values)				
Improved	194 (79.3%)	150 (73.5%)	Ref.	
Unimproved	33 (13.5%)	41 (20.1%)	0.62 (0.38–1.03)	0.066
Surface	18 (7.3%)	13 (6.4%)	1.07 (0.51–2.25)	0.858
Individuals living in a household that owns an improved latrine				
Yes	101 (28.3%)	83 (39.3%)	Ref.	
No	163 (61.7%)	128 (60.7%)	1.05 (0.72–1.52)	0.811
Individuals linear distance to health facility (58 missing values)				
Rank 1 (closest) [0.035–0.762 km]	48 (21.0%)	27 (14.4%)	Ref.	
Rank 2 [0.762–1.916 km]	41 (17.9%)	34 (18.1%)	0.68 (0.35–1.31)	0.245
Rank 3 [1.916–4.980 km]	51 (22.3%)	42 (22.3%)	0.68 (0.37–1.27)	0.231
Rank 4 [4.980–9.241 km]	48 (21.0%)	36 (19.1%)	0.75 (0.40–1.42)	0.378
Rank 5 (farthest) [9.241–26.784 km]	41 (17.9%)	49 (26.1%)	0.47 (0.25–0.88)	**0.019**
Individuals living in a household that reports at least one death in the previous 12 months				
Yes	10 (3.8%)	7 (3.3%)	Ref.	
No	254 (96.2%)	204 (96.7%)	0.87 (0.33–2.33)	0.784

p < 0.05 is in bold

CI, confidence interval; OR, odds ratio

Only 53.1% of pregnant women in Mopeia took at least one dose of IPTp. This is however 21% higher than the national average of 43.6% [14] highlighting an improved access of the WRA to the malaria control measures in Mopeia. The national survey for Zambezia province indicates that pregnant women's adherence for IPTp intake tends to decline after the first dose, 43.6% reported to have taken one or more doses, 36.3% reported to have taken two or more doses and only 20.0% reported to have taken three or more doses [14]. In addition, at national level, there has been a significant decline of women with a live birth in the 2 years prior to the survey who took 3

Nicolas *et al. Malaria Journal*   (2025) 24:66

Page 10 of 11

or more doses of SP during pregnancy from 41% (2018) to 25% (2022–2023) [14]. The low coverage and adherence to IPTp may be associated to stock-outs of SP and issues within the supply chain, as well as insufficient awareness of the risks and consequences of malaria during pregnancy, representing a significant obstacle to meeting WHO recommendations [23–26].

Additionally, the relative low coverage and adherence to IPTp in Mopeia district, can be attributed to the general low assistance to ANC visits. Following WHO recommendations pregnant women must have at least four ANC visits during pregnancy [27]. The national average for Mozambique was low, with only 41% of women having had four or more ANC visits in rural areas in the previous two years [14]. Zambezia province had the lowest statistics (26%) regarding the optimal number of ANC visits [14].

Moreover, the study revealed that the household wealth index significantly affects access to and use of malaria prevention tools. Pregnant women from the poorest households reported lower LLIN usage, which could be linked to several factors such as limited knowledge about the importance of malaria prevention during pregnancy, the poor attendance at ANC visits, where LLINs are distributed, due to barriers such as transportation difficulties, lack of awareness, or competing priorities.

A potential complementary strategy to improve LLIN usage across pregnant women and IPTp uptake and adherence could involve the delivery of LLIN and SP through Community Health workers aiming to reach populations residing farther from health facilities. This approach serves as an effective supplement to antenatal care clinics, capable of increasing LLIN and IPTp coverage in sub-Saharan Africa without adversely impacting antenatal care attendance [28].

Larger households faced challenges in achieving universal coverage with LLINs. Although in Mozambique, LLINs are distributed via national mass campaigns every 2.5 and 3 years, with ITNs rolled out in a few provinces at a time over a 12-month span [29], challenges may persist such as insufficient quantities to cover all household members, competing needs for limited household resources and usage of the LLIN for other activities, or a lack of awareness about proper usage and maintenance. To address these issues, interventions should focus on ensuring adequate LLIN distribution tailored to household size and reinforcing education on their use.

The study faced two main limitations. Firstly, it relied on self-reported data, which might not always be entirely accurate. Secondly, it lacked information regarding the gestational age of the women that allows to know if the pregnant women had received the appropriate number of doses.

Additionally, including data on the women's parity, education level, and occupation could have enhanced the analysis. This additional information would have allowed for an examination of any potential relationships between these factors and the frequency of ANC visits, as well as the use of LLINs [30].

Despite its limitations this study provides valuable empirical data on the access and usage to malaria preventive and management programmes by WRA in one of the districts with the highest burden of this disease in Mozambique.

Conclusion

The study reveals promising trends in access and utilization of malaria prevention tools among women of reproductive age in the Mopeia district, with relatively high LLIN and IRS coverage compared to national averages. However, the persistently low IPTp coverage and disparities in access among the most remote households from the health facilities suggests a need for targeted interventions to ensure comprehensive malaria control measures.

Addressing factors such as household wealth and composition as well as the proximity to health facilities could significantly enhance LLIN, IRS and IPTp utilization rates, thereby further reducing malaria burden in the region. These findings also underscore the importance of ongoing surveillance and tailored interventions to achieve optimal malaria prevention outcomes in vulnerable populations.

Author contributions
Conceptualisation: PN, CCh Data curation: PN, EE, PRC Formal analysis: PN, EE, AC, MR, NG Funding acquisition: CCh, RR Investigation: SI, PN, JM, HM, EJ Methodology: CCh, SI, PRC, CS Supervision: CS, FS, CCh Writing—original draft: PN, CCh Writing—review & editing: all authors contributed and approved the final version.

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

Declarations

Competing interests
The authors declare no competing interests.

Nicolas *et al. Malaria Journal*   (2025) 24:66

Page 11 of 11

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