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Comparison of Malaria Control Interventions in Southern Africa

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Abstract **Background:** There is a need of more evidence on which of the two malaria prevention methods, mosquito bednets and indoor residual spraying, is more effective than the other. **Objective**: To compare the effectiveness of mosquito bednets and indoor residual spraying in the prevention of malaria in Southern Africa. Based on the Health Belief Model, the research questions tested whether there is any relationship between the use of mosquito bednet or the use of indoor residual spraying and reporting fever. **Materials and Methods:** Using a quantitative research design, secondary data from the 2010 - 2011 Zimbabwe demographic and health survey, 2013 Namibia demographic health survey, and 2013 - 2014 Zambia demographic and health survey were analyzed using IBM/SPSS version 26. Chi-square for association, logistic regression, and multinomial logistic regression tests were conducted with significance level set at p value of $\leq .05$. **Results:** From 2044 children who slept under mosquito bednet the night before data collection 21.8% (n = 446) reported fever during the previous two weeks prior to data collection compared to 22.1% (n = 606) of 2748 children who did not sleep under mosquito bednet. There was no statistically significant association between the use of mosquito bednet and reporting fever during the previous two weeks, x^2 (1) = 0.037, p = .848, odds = .987, 95% CI [.859, 1.133]. From 2748 children who lived in dwellings that were not sprayed against mosquito 22.1% (n = 606) reported fever compared to 20.8% (n = 288) of 1387 children who lived in sprayed dwellings. There was no statistically significant association between the use of indoor residual spraying and reporting fever, x^2 (1) = 0.903, p = .342, odds = .926, 95% CI [.791, 1.085]. **Conclusion:** The absence of significant association between mosquito bednet use or indoor residual spraying and having fever in this study could be due to the fact that fever can also manifest in conditions other than malaria. Thus, effort should be made to conduct malaria blood test before concluding whether one has malaria or not based on presence or absence of fever. Furthermore, studies focusing on malaria prevalence should consider collecting data on other variables such as malaria blood test results.

Keywords: *malaria, mosquito bednet, indoor residual spraying*

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1. Introduction

Malaria affects close to half of the world’s population [1]. While the number of deaths due to malaria seems to decrease, from half a million death in 2013 [2], 438000 in 2015 [1], 435000 in 2017 [3] to 405000 in 2018 [4] the number of malaria cases have been increasing, from 198 million cases in 2013 [2], 214 million cases in 2015 [1], 219 million cases in 2017 [3] to 228 million cases in 2018 [4].

In 2018, 93% of all malaria cases and 94% of all malaria deaths were reported from the African region with only six countries in sub-Saharan Africa reporting more than 50% of all malaria cases [5].

The two highly recommended malaria prevention methods are insecticide-treated mosquito nets and indoor residual spraying [1]. In 2018, 50% of the population used mosquito bednets while 2% used indoor residual spraying [5]. While some studies show no difference in malaria prevention when these two methods are used in combination or separately [6,7], some other studies show that indoor residual spraying offers better malaria protection than mosquito bednets [8,9,10,11,12,13,14].

There is a need of more evidence on which of the two malaria prevention methods is more effective in order to ensure efficiency in breaking the malaria chain of infection and therefore reducing the impact of malaria to individuals in particular and to the community in general. Therefore, this study is a follow up on another study that was conducted using similar data and variables in Angola.

2. Materials and Methods

2.1. Study Design

This was a cross-sectional quantitative study that used secondary data of the 2010 - 2011 Zimbabwe demographic and health survey, 2013 Namibia demographic health survey, and 2013 - 2014 Zambia demographic and health survey from Demographic and Health Surveys (DHS) Program.

2.2. Population

The target population for this study comprised of all households in Zimbabwe, Namibia, and Zambia. The estimated number of privately owned households was 3,059,016 in Zimbabwe [15], 21,283 in Namibia [16], and 2,815,897 in Zambia [17].

2.3. Sampling Procedure

In Zimbabwe, the 2002 population census enumeration areas constituted a sampling frame and clusters were selected in two stages using a stratified design whereby two strata, one rural and one urban, were identified. In first stage, 169 urban and 237 rural enumeration areas were selected from the sampling frame. In the second stage, a complete list and map of all private households was obtained and used to select a representative sample of households. In total, 10,828 households were selected of which 9,756 were interviewed. All women aged from 15 to 49 and all men aged from 15 to 59 who were present in the selected households the night before the survey were eligible for inclusion in the survey. Field work started in September 2010 and ended in March 2011 [18].

In Namibia, clusters were selected in two stages using a stratified design whereby two strata, one rural and one urban, were identified per each of the 13 regions resulting in 13 rural and 13 urban strata. In first stage, using the preliminary frame of the 2011 Namibia population and housing survey, 269 urban and 285 rural enumeration areas were selected from the sampling frame using a stratified probability proportional to the number of households in the enumeration area. From each enumeration area, a predetermined number of samples were selected independently in every stratum and a complete household listing and mapping in all selected clusters was obtained. In the second stage, an equal probability systematic sampling was used to select a fixed number of 20 households from every rural and urban cluster. In total, 11,004 households were selected of which 9,849 were interviewed. Field work started in May 2013 and ended in September 2013 [19].

In Zambia, clusters were selected in two stages using a stratified design whereby two strata, one rural and one urban, were identified per each of the 10 provinces resulting in 10 rural and 10 urban strata. In first stage, using a sampling frame from the 2010 population and housing census, 305 urban and 417 rural enumeration areas were selected from the sampling frame using a stratified probability proportional to the number of households in the enumeration area. In the second stage, geographic coordinates for each sampled cluster were recorded using Global Positioning System receivers and a complete list and map of all private households was obtained and used to select an average of 25 households from each enumeration area. In total, 18,052 households were selected of which 15,920 were interviewed. All women aged from 15 to 49 and all men aged from 15 to 59 who were present in the selected households the night before the survey were eligible for inclusion in the survey. Field work started in August 2013 and ended in April 2014 [17].

2.4. Sample Size

The sample size for this research was determined using G*Power 3.0.10 software which is freely accessible online. For this research the test family was x^2 tests, the statistical test was goodness-of-fit tests: Contingency tables, and the types of power analysis was A priori: Compute required sample size - given α, power, and effect size. The effect size was set to small. Alfa and power were set at .5 and .95 respectively. Type I error was unlikely to occur as the effect in malaria prevention exists when mosquito nets are used [20], or indoors are sprayed [12,14] or a combination of both [21], and thus one can set the power higher to minimize the chances of the only highly possible type II error [22]. The highest expected degree of freedom df = 12. Using these data G*Power calculated a total sample size of 2,586.

2.5. Archival Data

For this research the researcher used secondary data from Demographic and Health Surveys database which stores and provides on request data from nationally-representative household surveys from several countries in areas such as population, health, and nutrition [23]. Permission to access the needed data was granted on November 23, 2015.

2.6. Variables and Data Manipulation

The original data set consisted of hundreds of variables of which only seven variables were relevant for this study. The dataset was filtered using as inclusion criteria the availability of information on the child had fever or not in the two weeks prior to data collection, whether the child slept under mosquito bednet or not, and whether the household was sprayed or not. All cases with missing value on any of these variables were deleted listwise. This left a sample size of 4,792 participants for research question (RQ) 1 and 4,135 participants for RQ 2.

2.7. Data Analysis Plan

To analyze data in this study, the researcher used a statistical application developed by IBM, the Statistical Program for the Social Sciences (SPSS) version 26. The researcher computed summary statistics for the variables being analyzed and used Chi-square with cross-tabulation to test the association between the independent variable use of bednet in RQ 1 and the use of indoor residual spraying in RQ 2 and the dependent variable, reporting fever in two weeks prior to data collection. The researcher further used logistic regression to test the predictive effect of the independent variables on the dependent variable and computed the odds ratio in order to facilitate the interpretation of the logistic regression values. All statistical tests were conducted at 5% significance level, 95% Confidence Interval, and a *p*- value of .05.

2.8. Threat to Validity

In this study, threats to internal validity might not have been an issue since the study was not about establishing a causal relationship. Furthermore, considering that the study was cross sectional and that the aim was to provide a correlational and predictive relationship among variables, threat to external validity might not have been an issue either. This study used secondary data. Therefore construct validity was established through hypothesis testing. However, threats to validity could include human error that might have occurred during the data collection, the recording of results, as well as the demographic and other information. There could be also the possibility of information bias.

3. Results

The first RQ was "What is the relationship between the use of mosquito bednet and contracting malaria?" To answer this question all cases for variable *had fever in the last two weeks* with values other than *0 = No* or *1 = Yes* as well as all cases for variable *children under 5 slept under bednet last night* with values other than *0 = No* or *1 = All children* were deleted. Furthermore all cases for variable *someone sprayed interior walls* with values other than *0 = No* were deleted, leaving an a sample size of 4792 subjects, which is more than enough to run statistical tests since G*Power 3.0.10 estimates a sample size of 2586 at an effect size of .10 with a degree of freedom equal to 12. Variable *Number of household members* was recoded to variable *Number of household members CAT*, with categories *1 = Low* for household with 1 to 4 members, *2 = Medium* for households with 5 to 7 members, and *3 = High* for households with 8 or more members.

The sample comprised of under-fives whose fever status in two week prior to data collection was known. There was no specification of particular subjects' age or sex. A chi-square test for association between children sleeping under a mosquito bednet and having fever was performed using a sample size of n = 4792. No cell had expected count less than 5. As shown in Table 1, there was no statistically significant association between children sleeping under a mosquito bednet and having fever, x^2 (1) = .037, p = .848, odds = .987, 95% CI [.859, 1.133]. The measure of effect between children sleeping under a mosquito bednet and having fever further shows the lack of statistically significant association, V = .003, p = .848.

There were 2748 children who did not sleep under mosquito bednet while 2044 did sleep under mosquito bednet the night prior to data collection. From those who did not sleep under a mosquito bednet 606 (22.1%) had fever in two week prior to data collection compared to 446 (21.8%) from those who slept under bednet, a difference of 0.3%.

Table 1. Chi-Square Results for Sleeping under Mosquito Net and Having Fever

	Value	*P*	95%CI	
			Lower	Upper
Pearson x^2	.037	.848		
Df	1			
V	.003	.848		
Odds Ratio	.987		.859	1.133

The first model in the logistic regression included variable *Children under 5 slept under bednet last night Yes No*, as a predictor. This model was not statistically significant, $x^2(1)$ = .046, p = .830. The model could not explain any of the variances in having fever (Nagelkerke R^2 = .000). Overall, the model could correctly classify 78.1% of cases. As shown in Table 2, the Wald statistics, Wald = .046, p = .830, also support these results showing that sleeping under a mosquito bednet the previous night does not predict having fever.

The second model, which included variable *Types of place of residence*, as predictor was also not statistically significant, $x^2(2)$ = .136, p =.934. The model could not explain any of the variances in having fever (Nagelkerke R2 = .000). Overall, the model could correctly classify 78.1% of cases. As shown in Table 3, the Wald statistics, Wald = .090, p = .764, also support these results showing that the place of residence does predict having fever.

The third model, which included variable *wealth index* as predictor was also not statistically significant, $x^2(6)$ = 7.827, p = .251. The model could explain 0.3% (Nagelkerke R^2) of the variances in having fever. Overall, the model could correctly classify 78.1% of cases. As shown by the Wald statistics in Table 4, only the middle category of the wealth index predicts having fever, Wald = 7.840, p = .006.

The fourth model included variable *Highest educational level attained*. This model was also not statistically significant, $x^2(9)$ = 8.578, p = .477.The model could explain 0.3% (Nagelkerke R^2) of the variances in having fever. Overall, the model could correctly classify 78.1% of cases. As shown by the Wald statistics in Table 5, none of the categories in highest educational level attained predicts having fever.

The fifth model included *Number of household members*. This model too was not statistically significant, $x^2(11)$ = 8.653, p = .654. The model could explain 0.3% (Nagelkerke R^2) of the variances in having fever. Overall, the model could correctly classify 78.1% of cases. As shown by the Wald statistics in Table 6, none of the categories in the number of household members predicts having fever.

These logistic regression results indicate that only the middle category of the wealth index is a significant confounder while the place of residence, wealth index in general, highest educational level attained, and number of household members are not significant confounders.

The second RQ was "What is the relationship between the use indoor residual spraying and contracting malaria?" To answer this question all cases for variable *Someone sprayed interior walls*, with values other than *0 = No* or *1 = Yes* were deleted while all cases with values other than *0 = No* for variable *children under 5 slept under bednet last night*, were deleted. Variable *Number of household members* was recoded as for RQ 1.

The sample comprised of under-five children. There was no specific age or sex for subjects. A chi-square test for association between the use of indoor residual spraying and having fever was performed using a sample size of n = 4135. No cell had expected count less than 5. As shown in Table 7, there was no statistically significant association between the use of indoor residual spraying and having fever, x^2 (1) = .903, p = .342, odds = .926, 95% CI [.791, 1.085]. The measure of effect between the use of indoor residual spraying and having fever also shows no statistically significant association, *V* = .015, *p* = .342. Furthermore, 2748 children lived in dwellings that were not sprayed against mosquitoes while 1387 children lived in sprayed dwellings. From those who lived in non-sprayed dwellings, 606 (22.1%) had fever compared to 288 (20.8%) from those who lived in sprayed dwellings.

As for RQ 1, a regression test was conducted to control for confounding factors such as area of residence, wealth index, level of education, and number of household members. The first model in the logistic regression included variable *Someone sprayed interior walls*, as a predictor. This model was not statistically significant, x^2 (1) = .833, *p* = .361. The model could not explain any of the variances (Nagelkerke R^2 = .000) in having fever. Overall, the model could correctly classify 78.4% of cases. As shown in Table 8, the Wald statistics, Wald = .829, *p* = .363, also support these results showing that living in a dwelling that was sprayed does not predicted having fever.

Variable *Type of place of residence* was added as predictor in the second model. This model was not statistically significant, x^2 (2) = .870, *p* = .647. The model could not explain any (Nagelkerke R^2 = .000) of the variances in having fever. Overall, the model could correctly classify 78.4% of cases. As shown in Table 9, the Wald statistics, Wald = .037, *p* = .848, also supports these results that the place of residence does not predict having fever.

Variable *Wealth index* was added as predictor in the third model. This model was also not statistically significant, x^2 (6) = 7.636, *p* = .266. The model could explain 0.3% (Nagelkerke R^2) of the variances in having fever. Overall, the model could correctly classify 78.4% of cases. However, as shown in Table 10, only the Wald statistics for the poorer category of wealth index was statistically significant.

Table 2. Predicting Having Fever based on Bednet Use

	B	S.E.	Wald	Df	Sig.	Exp(B)	95% C.I. for Exp(B)	
							Lower	Upper
Slept under bednet last night Yes No(1)	-.015	.071	.046	1	.830	.985	.857	1.132
Constant	-1.265	.046	752.866	1	.000	.282		

Table 3. Predicting Having Fever based on Place of Residence and bednet use

	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for Exp(B)	
							Lower	Upper
Slept under bednet last night Yes No (1)	-.014	.071	.041	1	.840	.986	.858	1.133
Place of residence (1)	.023	.075	.090	1	.764	1.023	.882	1.186
Constant	-1.273	.052	588.810	1	.000	.280		

Table 4. Predicting Having Fever based on Wealth Index, Place of Residence, and Bednet Use

	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for Exp(B)	
							Lower	Upper
Slept under bednet last night Yes No (1)	-.019	.071	.072	1	.788	.981	.854	1.128
Place of residence(1)	-.079	.102	.598	1	.439	.924	.756	1.129
Wealth index			7.727	4	.102			
Poorest(1)	-.271	.150	3.247	1	.072	.763	.568	1.024
Poorer(2)	-.265	.146	3.281	1	.070	.767	.576	1.022
Middle(3)	-.378	.138	7.480	1	.006	.685	.523	.898
Richer(4)	-.247	.131	3.557	1	.059	.781	.604	1.010
Constant	-.984	.138	50.486	1	.000	.374		

Table 5. Predicting Having Fever based on Educational Level, Wealth Index, Place of Residence, and Bednet Use

	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for Exp(B)	
							Lower	Upper
Slept under bednet last night Yes No (1)	-.020	.071	.081	1	.776	.980	.852	1.127
Place of residence(1)	-.083	.102	.660	1	.417	.920	.753	1.125
Wealth index			6.534	4	.163			
Poorest(1)	-.258	.157	2.702	1	.100	.772	.568	1.051
Poorer(2)	-.249	.152	2.673	1	.102	.779	.578	1.051
Middle(3)	-.360	.144	6.283	1	.012	.698	.526	.924
Richer(4)	-.232	.135	2.944	1	.086	.793	.608	1.034
Highest educational level attained			.752	3	.861			
Primary (1)	-.081	.255	.102	1	.749	.922	.560	1.518
Secondary (2)	-.139	.254	.300	1	.584	.870	.528	1.432
Higher (3)	-.099	.257	.149	1	.699	.906	.548	1.498
Constant	-.888	.256	12.011	1	.001	.412		

Table 6. Predicting Having Fever based on Number of Household Members, Educational Level, Wealth, Place of Residence, and Bednet Use

	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for Exp(B)	
							Lower	Upper
Slept under bednet last night Yes No (1)	-.020	.071	.078	1	.780	.980	.852	1.128
Place of residence(1)	-.082	.103	.625	1	.429	.921	.752	1.129
Wealth index			6.488	4	.166			
Poorest (1)	-.256	.160	2.574	1	.109	.774	.566	1.058
Poorer (2)	-.248	.154	2.600	1	.107	.780	.577	1.055
Middle (3)	-.359	.144	6.204	1	.013	.698	.526	.926
Richer (4)	-.231	.136	2.908	1	.088	.794	.608	1.035
Highest educational level attained			.743	3	.863			
Primary (1)	-.082	.255	.104	1	.747	.921	.559	1.518
Secondary (2)	-.140	.255	.302	1	.583	.870	.528	1.432
Higher (3)	-.101	.257	.156	1	.693	.904	.546	1.495
Number of household members CAT			.075	2	.963			
Low(1)	.005	.107	.002	1	.966	1.005	.815	1.238
Medium(2)	-.018	.078	.051	1	.821	.982	.843	1.145
Constant	-.881	.258	11.642	1	.001	.414		

Table 7. Chi-Square Results for Using Indoor Residual Spraying and Having Fever

	Value	P	95% CI	
			Lower	Upper
Pearson x^2	.833	.361		
Df	1			
V	.015	.342		
Odds Ratio	.926		.791	1.085

Table 8. Predicting Fever based on Sprayed Dwelling

	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for Exp(B)	
							Lower	Upper
Dwelling sprayed (1)	-.074	.081	.829	1	.363	.929	.793	1.089
Constant	-1.265	.046	752.866	1	.000	.282		

Table 9. Predicting Fever based on Place of Residence and Sprayed Dwelling

	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for Exp(B)	
							Lower	Upper
Dwelling sprayed (1)	-.071	.082	.748	1	.387	.931	.793	1.094
Type of place of residence(1)	.015	.079	.037	1	.848	1.015	.870	1.185
Constant	-1.275	.070	328.294	1	.000	.279		

Table 10. Predicting Fever based on Wealth Index, Place of Residence, and Dwelling Sprayed

	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for Exp(B)	
							Lower	Upper
Dwelling sprayed (1)	-.054	.082	.429	1	.513	.947	.806	1.114
Place of residence(1)	.025	.103	.059	1	.807	1.025	.838	1.255
Wealth index			6.635	4	.157			
Poorest(1)	-.021	.114	.035	1	.852	.979	.783	1.224
Poorer(2)	-.237	.118	4.037	1	.045	.789	.626	.994
Middle(3)	-.061	.137	.200	1	.655	.941	.719	1.230
Richer(4)	.040	.159	.065	1	.799	1.041	.762	1.422
Constant	-1.220	.130	87.928	1	.000	.295		

Variable *educational level* was added as predictor in the fourth model. This model was not statistically significant, x^2 (9) = 10.149, p = .339. The model could explain 0.4% (Nagelkerke R^2) of the variances in having fever. Overall, the model could correctly classify 78.4% of cases. Furthermore, as shown in Table 11, the Wald statistics for the different categories in educational level were not statistically significant. This indicates that the highest educational level attained is not a statistically significant predictor of having fever.

The fifth model included *number of household members*. This model too was not statistically significant, x^2 (11) = 14.383, p = .213. The model could explain 0.5% (Nagelkerke R^2) of the variances in having fever. Overall, the model could correctly classify 78.4% of cases. Furthermore, as shown in Table 12, only the Wald statistics for the medium number of household members, 5 to 7 members, is statistically significant.

Table 11. Predicting Having Fever based on Educational Level, Wealth Index, Place of Residence, and Dwelling Sprayed

	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for Exp(B)	
							Lower	Upper
Dwelling sprayed (1)	-.056	.083	.455	1	.500	.946	.804	1.112
Place of residence(1)	.026	.103	.064	1	.801	1.026	.838	1.257
Wealth index			7.376	4	.117			
Poorest(1)	-.024	.114	.043	1	.836	.977	.781	1.221
Poorer(2)	-.240	.119	4.103	1	.043	.786	.623	.992
Middle(3)	-.063	.138	.205	1	.651	.939	.717	1.231
Richer(4)	.074	.166	.200	1	.655	1.077	.778	1.490
Highest educational level attained			2.278	3	.517			
Primary (1)	.011	.085	.016	1	.900	1.011	.856	1.194
Secondary (2)	.034	.113	.091	1	.763	1.035	.829	1.292
Higher (3)	-.508	.360	1.983	1	.159	.602	.297	1.220
Constant	-1.227	.135	82.156	1	.000	.293		

Table 12. Predicting Having Fever based on Number of Household Members, Educational Level, Wealth, Place of Residence, and Dwelling Sprayed

	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for Exp(B)	
							Lower	Upper
Dwelling sprayed (1)	-.049	.083	.349	1	.555	.952	.810	1.120
Place of residence(1)	.051	.104	.242	1	.623	1.053	.858	1.291
Wealth index			6.731	4	.151			
Poorest (1)	-.019	.114	.028	1	.868	.981	.784	1.227
Poorer (2)	-.203	.120	2.860	1	.091	.816	.645	1.033
Middle (3)	-.029	.139	.043	1	.836	.972	.739	1.277
Richer (4)	.129	.168	.594	1	.441	1.138	.819	1.582
Highest educational level attained			2.280	3	.516			
Primary (1)	.022	.085	.069	1	.793	1.023	.865	1.209
Secondary (2)	.032	.113	.081	1	.776	1.033	.827	1.289
Higher (3)	-.503	.361	1.947	1	.163	.605	.298	1.226
Number of household members CAT			4.274	2	.118			
Low(1)	-.140	.115	1.484	1	.223	.869	.694	1.089
Medium(2)	-.240	.118	4.093	1	.043	.787	.624	.993
Constant	-1.111	.157	49.997	1	.000	.329		

These logistic regression results, as was in *RQ 1*, indicate that type of place of residence, wealth index, highest educational level attained, and number of household members are not significant confounders.

4. Discussion

The chi-square test for association and the logistic regression test results in this research indicate that there is no statistically significant association between sleeping under a mosquito bednet or living in a sprayed household and reporting fever. While some researchers have reported that the risk of having malaria is the same for children who sleep under a mosquito bednet and those who do not [24], other researchers have reported that bednet users are less likely to have malaria than non-users [25]. Furthermore, some studies indicate that spraying households was found to be more effective than using bednets [8,14] while other studies indicate low malaria prevalence in sprayed compared to non-sprayed areas [9,10,11,12,13].

One factor that could have contributed to the findings of this study could be the way some of the original variables were constructed. One of the independent variables was: Children under 5 slept under bednet last night; while the dependent variable was: Had fever during two weeks prior to data collection. A negative response to sleeping under mosquito bednet last night may not mean that one did not sleep under a net other nights before while an affirmative response could mean just for that night and not other previous nights [14]. Considering that malaria incubation period can be up to 14 days [2,26] it could be possible that some children get infected long before the fever can manifest and therefore can be wrongly classified as net users or not. Furthermore, there are many other conditions that can make one have fever and thus fever may not be a definitive indicator for malaria. This could justify the lack of statistically significant association between having fever and indoor residual spraying while there was a statistically significant association between malaria and indoor residual spraying in the neighboring Angola [14].

Limitations of the Study: This study used secondary data. Thus, the manipulation of some variables could have led to errors. The data used in this study were collected in 2010/2011 in Zimbabwe, 2013 in Namibia, and 2013/2014 in Zambia. While these were the latest available data, the current malaria prevalence could have changed. One of the variables was *Children under 5 slept under mosquito bed net last night*. This variable leaves a possibility of misclassifying a case as bednet user or non-user. The other variable was *had fever in two weeks prior to data collection*. One may also have fever due to conditions other than fever.

5. Conclusions

Malaria remains a challenge in Southern Africa as well as in other parts of the world. Mosquito bednets and indoor residual spraying are the two highly recommended malaria prevention methods. This study aimed at comparing these two methods. The results of this study indicate no significant association between mosquito bednet use or indoor residual spraying and having fever while a study in Angola indicated a significant association between indoor residual spraying and having positive blood test for malaria. This could be due to the fact that fever can also manifest in conditions other than malaria. Thus, effort should be made to conduct malaria blood test before concluding whether one has malaria or not based on presence or absence of fever. Furthermore, studies focusing on malaria prevalence should consider collecting data on other variables such as malaria blood test results.

Ethical Consideration

In this study the researcher used secondary data from Demographic and Health Surveys (DHS). An online request to use data from some specific countries was submitted to the DHS and a written authorization to use the requested dataset was given on November 23, 2015. There were no identifiers of the study subjects in the data sets obtained. The Institutional Review Board at Walden University reviewed and approved this study proposal.

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Conflict of Interest Statement

The author has no competing interests.

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