Acta Scientific paediatrics (ISSN: 2581-883X)

Volume 7 Issue 12 December 2024

Research Article

Malaria Prevalence and Associated Risk Factors Among Children Aged 6 to 59 Months in Niger

Zaratou Ali Labo[1]*, Sahada Moussa Saley[1], Moustapha Mahamadou Yacouba[2], Habibatou Idé Amadou[3] and Mahamadou Doutchi[4]

[1]*Faculty of Health Sciences, Abdou Moumouni University of Niamey, Niger*

[2]*Public Health Emergency Operations Centre, Ministry of Public Health, Niger*

[3]*Medical and Health Research Center, Niamey, Niger*

[4]*Faculty of Medical Science, André Salifou University, Zinder, Niger*

***Corresponding Author:** Zaratou Ali Labo, Faculty of Health Sciences, Abdou Moumouni University of Niamey, Niger.

Received: November 14, 2024

Published: December 04, 2024

Abstract

The objective was to determine the prevalence of malaria and identify associated risk factors among children aged 6 to 59 months in Niger.

Data from the 2021 National Malaria Indicator Survey conducted by the National Institute of Statistics was used for this work. A total of 4724 children aged 6 to 59 months for whom the malaria rapid diagnostic test was performed were included. Pearson's chi-square tests at the 5% significance level were used to analyze differences between categorical variables. All variables that had a bilateral p-value <0.05 in the bivariate analysis were fed into the binary logistic regression model to identify factors associated with malaria in children

Of the 4724 children, 1121 (23.73%) were positive for the malaria rapid diagnostic test. Risk factors for malaria after logistic regression were: age range 24-59 months [Adjusted Odds Ratio (AOR): 3.86 Confidence Interval (CI) at 95%: (2.72-5.48)], rural residence [AOR: 1.92; 95% CI: (1.37-2.70)], and 24 months to more of net acquisition [AOR:1.33; 95% CI: (1.01-2.19)]. The birth order between 2 and 3 [ORA: 0.77; 95% CI (0.63-0.95)] was a protective factor for malaria in children.

Malaria remains a public health problem in Niger. Despite the prevention and care actions put in place. Emphasis must be placed on raising awareness and involving the community for vector eradication.

Keywords: Children; Prevalence; Malaria; Risk Factors; Niger

Abbreviations

CI: Confidence Interval; AOR: Adjusted Odds Ratio; DHS: Demographic Health Survey; ITNs: Insecticide-Treated Nets; WHO: World Health Organization; TDR: Rapid Diagnostic Test

Background

Malaria is one of the leading causes of morbidity and mortality in the world, especially in sub-Saharan Africa [1,2]. It is a disease caused by five pathogens [3] including *Plasmodium falciparum* which is the most responsible for severe cases of malaria and the most frequently encountered in West Africa [4]. Certain population groups are at higher risk of malaria and are more exposed to its consequences, including children under 5 years of age and pregnant women [5]. According to the World Malaria Report, an estimated 14 million more malaria cases in 2020 compared to 2019 (241 million compared to 227 million). Most of this increase originated in countries in the World Health Organization (WHO) African region. In 2020, the number of malaria deaths was estimated at 627,000 globally. The new estimates underscore the fact that the WHO African Region continues to bear the highest price for malaria, accounting for 96% of all malaria deaths. And that children under 5 years of age are the first victims of the disease (80% of all malaria deaths in the region are among children under 5 years of age) [6]. The frequency, severity and outcome of malaria are influenced by environmental, economic, cultural and behavioural sociodemographic factors [7]. In sub-Saharan Africa, prevention is essentially

based on the implementation of two strategies: protecting healthy subjects from Anopheles infesting bites through vector control and inhibiting the development of the parasite in already infested subjects through chemoprophylaxis and vaccination [8].

Niger, through the national malaria control program, has put in place various strategies for malaria control, including the free distribution campaign throughout the country of long-lasting insecticide-treated nets (LLINs) and the seasonal chemoprophylaxis campaign for children aged 6 to 59 months.

However, despite these measures, malaria still poses a public health problem and remains the main cause of morbidity and mortality in Niger among children under 5 years of age. Little data exist on the factors associated with malaria in children under 5 years of age in Niger. Hence the interest of our study, the objective of which was to determine the prevalence of malaria and to identify the associated risk factors among children aged 6 to 59 months in Niger.

Methods

Data source

The study used data from the 2021 Malaria Indicator Survey conducted in 2021 by the National Institute of Statistics in collaboration with the National Malaria Control Program of the Ministry of Public Health, Population and Social Affairs of Niger under technical assistance from the DHS Program which are available on the Measure DHS (https://dhsprogram.com) website upon request.

Setting and period of the study

The survey was conducted throughout the national territory in the 8 regions (Agadez, Diffa, Dosso, Maradi, Tahoua, Tillabéry, Zinder and Niamey). Data collection took place from August 12, 2021 to October 27, 2021, a period of 2.5 months which corresponds to the period of high malaria transmission in Niger (heavy rain in August and mid-September).

Study population

The population of our study consisted of all children eligible for malaria parasitaemia testing, i.e. all children aged 6–59 months (usual residents) who were in households at the time of the survey.

Sampling

A national sample of about 5,000 households was surveyed and of the 210 clusters sampled, 207 were actually visited. The sample of our study was a subpopulation composed mainly of 4724 children aged 6-59 months. For which the malaria test using an SD BIOLINE Malaria Ag P.f. (HRP-II) ™ rapid diagnostic test approved in Niger was performed. This qualitative test detects histidine-rich protein II antigen from Plasmodium falciparum in human whole blood. At the same time, hemoglobin analysis was performed on-site using a battery-operated portable device [HemoCue®201+]. Thus, anaemia was confirmed when, according to the World Health Organization, the haemoglobin level was < 11 g/dl, of which mild (10.0 -10.9 g/dl), moderate (7.0 - 9.9 g/dl) and severe (< 7 g/dl) anaemia [9].

In addition to the detailed information on the sample, the methodology of the survey is published in the report of the Survey on Malaria Indicators in Niger in 2021 at the address: https://dhsprogram.com/pubs/pdf/MF36/MF36.pdf

Study variables

The outcome variable was the Rapid Diagnostic Test (RDT) for malaria with its 2 positive and negative modalities. Explanatory variables included: age of children, region of origin, residence, order of birth of children, level of education of mothers, wealth index per household (scores based on the number and type of consumer goods owned, goods ranging from a television to a bicycle or bicycle, and on housing characteristics such as the source of drinking water, the type of toilet used, and the material of flooring), anaemia, Number of children under 5 slept mosquito bed net last night, Type of Mosquito Bed Net(s) person slept under last night, Months ago net obtained.

Statistical analysis

The data was analyzed using the Stata/SE 16.0 software. Frequency and percentage were calculated for qualitative variables. Quantitative variables were averaged with their standard deviations. Bivariate analysis using the Pearson Chi2 test at the 5% significance level was performed between the outcome variable (malaria RDT) and the explanatory variables. Variables that were significant (bilateral p-value <0.05) were introduced into the binary logistic regression model to identify factors associated with malaria in children. An adjusted odds ratio (AOR) with a 95% confidence interval was used to measure the strength and direction of the associations with a bilateral p-value < 0.05 indicating statistical significance.

Ethical approval

Ethical approval and consent from participants were not particularly necessary for this study, which was a secondary analysis of publicly available survey data from the DHS Program. the investi-

gation protocol, including the procedures for the biological tests, were reviewed and approved by the National Ethics Committee for Health Research (CNERS) of the Department of Public Health of Niger and the Institutional Review Board of DHS. However, approval for the reuse of the data was obtained by DHS program on request (REF of 20-08-2024). The procedures approved by the DHS program review committee for data for public use do not in any way allow respondents, households, or communities in the samples to be identified. In the data file made available to us, there was no household address or individual name. The geographic identifiers only go down to the regional level.

Results

A total of 4724 children aged 6-59 months were included in the study, of these, 1121 (23.73%) were positive for the SD BIOLINE Malaria Ag P.f RDT. The average age of the respondents was 32.46+-15.40 months, the age group 12-23 months represented 22.57% (n = 1066), 2402 children (50.84%) were male, 833 (17.63%) were from the Maradi region and the residence was rural for 3739 children (79.15%). In 59.60% (n = 2470) the birth order was 1, the wealth index was poor for 1945 (41.17%), the mothers of the uneducated respondents accounted for 72.44% (n = 3002). Children in 43.20% (n = 2040) had moderate anaemia. Among the children, 522 (11.15%) had not slept under a mosquito net the day before the survey, 3844 children (98.69%) had slept under a treated mosquito net the day before the survey and in 41.07% (n = 1573) the duration of obtaining the nets was from 0 to 11 months (Table 1).

Bivariate analysis results

In bivariate analysis, factors associated with malaria in children aged 6-59 months included: age (p = 0.0001), region of origin (p = 0.0001), residence (p = 0.0001), birth order (p < 0.001), wealth index (p = 0.0001), mothers' education level (p = 0.0001), anaemia (p = 0.0001), children under 5 slept under a mosquito net last night before the survey (p = 0.0001), Type of Mosquito Bed Net(s) person slept under last night before de survey (p = 0.0001) and Months ago net obtained (p = 0.032) (Table 2).

Multivariate analysis results

After logistic regression, risk factors for malaria in children aged 6 to 59 months in this study were: age range 24-59 months [AOR: 3.86; 95% CI (2.72-5.48)], rural residence [AOR: 1.92; 95% CI (1.37-2.70)], duration of net uptake from 24 months to more [AOR: 1.33: 95% CI (1.01-2.19)]. Birth order between 2 and 3 [AOR: 0.77; 95% CI (0.63-0.95)] was a protective factor for malaria in children (Table 3).

Table 1: Characteristics of the children surveyed and their mothers.

Variables	Frequency	Percentage
Age in months		
6-11	482	10.20
12-23	1066	22.57
24-59	3176	67.23
Sex		
Male	2402	50.84
Female	2322	49.16
Region		
Agadez	359	7.60
Diffa	537	11.36
Dosso	524	11.10
Maradi	833	17.63
Tahoua	636	13.46
Tillabéri	628	13.30
Zinder	816	17.28
Niamey	391	8.27
Residence		
Urban	985	20.85
Rural	3739	79.15
Birth order		
First	2470	59.60
2-3	1664	40.16
4-5	10	0.24
Wealth index		
Poorer	1945	41.17
Middle	877	18.57
Richer	1902	40.26
Mother's educational level		
No education	3002	72.44
Primary	651	15.71
Secondary	454	10.95
Higher	37	0.90
Anemia		
Not anemic	1259	26.66
Mild	1223	25.91
Moderate	2040	43.20
Severe	200	4.23
Number of children under 5 slept mosquito bed net last night		
No	522	11.15
All children	3522	75.25
Some children	636	13.60
Type of Mosquito Bed Net(s) person slept under last night		
Only treated nets	3844	98.69
Treated and untreated nets	3	0.07
Only untreated nets	48	1.23
Months ago net obtained		
0-11	1573	41.07
12-23	1340	34.98
24-36	565	14.75
More than 3 years ago	352	9.20

Table 2: Factors associated with malaria in children aged 6-59 months (bivariate analysis).

	Malaria RDT	Ag P.f	
Variables	**Negative n (%)**	**Positive n (%)**	**P-value**
Age in months 6-11 12-23 24-59	 429 (11.91) 898 (24.92) 2276 (63.17)	 53 (4.73) 168 (14.99) 900 (80.29)	0.0001
Sex Male Female	 1808 (50.18) 1795 (49.82)	 594 (52.89) 527 (47.01)	0.101
Region Agadez Diffa Dosso Maradi Tahoua Tillabéri Zinder Niamey	 352 (9.77) 516 (14.32) 353 (9.80) 614 (17.04) 467 (12.96 423 (11.74) 503 (13.96) 375 (10.41	 7 (0.60) 21 (1.87) 171(15.25) 219 (19.54) 169 (15.08) 205 (18.29) 313 (27.92) 16 (1.43)	0.0001
Residence Urban Rural	 911 (25.28) 2,692 (74.72)	 74 (6.60) 1047 (93.40)	0.0001
Birth order First 2-3 4-5	 1,860 (58.09) 1333 (41.53) 9 (0.29)	 610 (64.8) 331 (35.1) 1 (0.1)	<0.001
Wealth index Poorer Middle Richer	 1431 (39.51) 613 (16.92) 1559 (43.05)	 514 (45.85) 264 (23.55) 343 (30.59)	0.0001
Mother's educational level No education Primary Secondary Higher	 2245 (70.11) 519 (16.21) 402 (12.55) 36 (1.12	 757 (80.36) 132 (14.01) 52 (5.52) 1 (0.11)	0.0001
Anemia Not anemic Mild Moderate Severe	 1117 (31.02) 1009 (28.02) 1387 (38.52) 88 (2.44)	 142 (12.67) 214 (19.09) 653 (58.25) 112 (9.99)	0.0001
Children under 5 slept under mosquito bed net last night No All children Some children	 447 (12.52) 2651 (74.28) 471 (13.20)	 75 (6.75) 871 (78.40) 165 (14.85)	0.0001
Type of Mosquito Bed Net(s) person slept under last night Only treated nets Treated and untreated nets Only untreated nets	 2883 (98.39) 2 (0.06) 45 (1.53)	 961 (99.58) 1 (0.10) 3 (0.31)	0.0001
Months ago net obtained 0-11 12-23 24-36 More than 3 years ago	 1158 (40.18) 1005 (34.87) 435 (15.09) 284 (9.85)	 415 (43.77) 335 (35.33) 130 (13.71) 68 (7.17)	0.032

Table 3: Risk factors for malaria in children aged 6-59 months (multivariate analysis).

Variables	AOR (CI 95%)	P-value
Age (months)		
6-11	1	
12-23	1.29 (0.88- 1.88)	0.183
24-59	3.86 (2.72-5.48)	0.0001
Residence		
Urban	1	
Rural	1.92 (1.37-2.70)	0.0001
Birth order		
First	1	
2-3	0.77 (0.63-0.95)	0.017
4-5	0.35 (0.03-3.80)	0.395
Months ago net obtained		
0-11	1	
12-23	0.88 (0.71- 1.10)	0.28
≥24	1.33 (1.01- 2.19)	0.048

Discussion

The study found the prevalence of malaria by the SD BIOLINE Malaria Ag P.f rapid diagnostic test in children aged 6-59 months in Niger which was 23.73%. Studies conducted by El Moustapha., *et al.* [10] in 2023 in Mauritania, by Mengistu and Solomon [11] in Ethiopia in 2015 reported similar results of malaria-positive RDT prevalence which was 24.3% and 22.8% respectively in children under five years of age. On the other hand, the study by Rudasingwa and Cho [1] in Rwanda showed a prevalence of 5.45% by the rapid malaria test. This difference could be due to seasonal variation. Indeed, our study was carried out during the rainy season with high malaria transmission. On the other hand, our prevalence is low compared to those reported by studies conducted in India, which was 36.6% in children under 5 years of age, in malaria-endemic forest villages [12], and in Mauritania, by Lekweiry., *et al.* [13], which was 34.9%. A statistically significant relationship is observed between malaria and the age of children (p = 0.0001) in bivariate analysis in this study. Vander., *et al.* [14] also found an association between the age of children and malaria. Children in the 24-59 month age group were 3.86 times more likely to develop malaria than other children in this logistic regression study. Similar to studies conducted by Gahutu., *et al.* [15], Krefis., *et al.* [16] and Roberts and Matthews [17], an older child is associated with a higher risk of malaria. There was a significant association between the mothers' educational level (p = 0.0001) and RDT positivity in our series. Indeed, 80.36% of the children who tested positive for the RDT had mothers with no level of education. Educated women have more access to information on malaria prevention. The lack of knowledge about malaria is strongly dependent on the level of education (p = 0.01) [3]. Rural residence increased the risk of malaria nearly 2 times compared to children living in urban residence. Our result would be consistent with that of Liu., *et al.* [18] who found that living in rural areas (compared to urban areas) more than tripled malaria incidence rates. The prevalence of the malaria parasite was higher among children of rural residents (25.3%) than among urban residents of children (18.5%) [5]. Birth order between 2 and 3 with an ORA of 0.77, less than 1 protected children from malaria compared to children with rank 1 at birth. Mothers who have already brought up children have experience of the benefits of malaria prevention actions compared to primiparous mothers. The wealth index (p = 0.0001) was also associated with malaria in our series. The series of Rudasingwa and Cho [1] also reported that the lowest wealth category was associated with the incidence of malaria [AOR] = 1.54 as reported in previous studies in Africa [19,20]. Poverty is associated with malaria incidence in Uganda [21]. Information on the socio-economic conditions of malaria-affected populations is needed to control transmission.

Children under 5 slept under mosquito bed net last night before the survey (p = 0.0001) was associated with malaria. This finding was consistent with the study by Abossie., *et al.* [5], Ethiopia, who found that children who slept under insecticide-treated nets (ITNs) reduced the risk of malaria positivity by 9.65 times compared to those who did not sleep under ITNs. Children who slept under ITN were 55% and they were significantly protected against malaria

infection compared to children who did not sleep under IBD [22]. Children who did not use mosquito nets were more likely to be infected [23]. The use of ITN is a powerful vector control tool for the prevention of malaria transmission [24]. In sub-Saharan Africa; The proportion of children under 5 years of age sleeping under insecticide-treated nets increased from <2% in 2000 to about 68% in 2015 [25]. Non-use of ITN were significantly associated with the incidence of malaria AOR:2.93 [1]. The time it took to obtain the nets from 24 months to more increased the risk of malaria by 1.33 in children compared to those who used the nets who were over 2 years old. The longer the mosquito net lasts, the more its preventive action decreases due to the decrease in the effectiveness of the product, which needs to be renewed if the mosquito net is not changed.

Strengths and limitations

The study used nationally representative data from the 2021 Malaria Indicator Survey in Niger. The data were cross-sectional, however large enough to help make meaningful conclusions, and more so since the samples were selected nationwide. It provides information on factors associated with malaria in children aged 6-59 months. Few studies have explored this aspect in our practice setting.

Among the limitations were the self-reported nature of the variables that incurs the risks of recall and reporting biases, and lack of information on medication that could have influenced the strength of the association to certain degrees. We were also unable to account for several important determinants of malaria as the data were secondary.

Conclusion

The study determined the prevalence of malaria (positive RDT) and identified the risk factors associated with it among children aged 6-59 months in Niger. It was found that the child at risk of being positive on the malaria rapid diagnostic test is 24 to 59 months of rural origin, with a first birth order that sleeps under a mosquito net that is at least 24 months old. Malaria remains a major public health problem whose eradication must focus mainly on preventive actions.

Conflict of Interest

None.

Competing Interests

The authors declare no competing interests.

Author Contributions

- Zaratou Ali Labo and Sahada Moussa Saley: Conceptualization, Methodology, Software
- Zaratou Ali Labo, Moustapha Mahamadou Yacouba, Habibatou Idé Amadou and Mahamadou Doutchi: Writing- Original draft.
- All authors: Reviewing and Editing.

Bibliography

1. Rudasingwa G and Cho S. "Determinants of the persistence of malaria in Rwanda". *Malaria Journal* 19 (2020): 36-44.

2. Solomon A., *et al*. "Trend of malaria prevalence in Wolkite health center: an implication towards the elimination of malaria in Ethiopia by 2030". *Malaria Journal* 19.1 (2020): 112-119.

3. Doutoum AA., *et al*. "Perception of malaria risks and use of mosquito nets in Tchad". *International Journal of Biological and Chemical Sciences* 10.6 (2019): 2646-2654.

4. Bekono B., *et al*. "The potential of anti-malarial compounds derived from African medicinal plants: a review of pharmacological evaluations from 2013 to 2019". *Malaria Journal* 19.1 (2019): 183-217.

5. Abossie A., *et al*. "Prevalence of Malaria and Associated Risk Factors Among Febrile Children Under Five Years: A Cross-Sectional Study in Arba Minch Zuria District, South Ethiopia". *Infection and Drug Resistance* 13 (2020): 363-372.

6. WHO. World Malaria Report 2021, Key Messages (2021): 24.

7. Hasyim H., *et al*. "Social determinants of malaria in an endemic area of Indonesia". *Malaria Journal* 18.1 (2019): 134-144.

8. Sondo P., *et al*. "Malaria prevention in sub-Saharan Africa: current situation, challenges and perspectives". *Medicine and Infectious Diseases* 3.2 (2024): 73-77.

9. WHO. Haemoglobin concentrations for the diagnosis of anemia and assessment of severity. Vitamin and Mineral Nutrition Information System. 2011, Geneva (2011).

10. El Moustapha I., *et al*. "Malaria prevalence in Mauritania: a systematic review and meta-analysis". *Malaria Journal* 22.1 (2023): 146.

11. Mengistu H and Solomon G. "Analyse des tendances de la prévalence du paludisme au centre de santé d'Arsi Negele, dans le sud de l'Éthiopie". *Journal of Infectious Diseases and Immunity* 7.1 (2015): 1-6.

12. Qureshi I., *et al*. "Prevalence of malaria infection among tribal children under five years of age residing in malaria-endemic forest villages [version 1; peer review: peer review discontinued]". *F1000 Research* 3 (2014): 286.

13. Lekweiry KM., *et al*. "Malaria prevalence and morbidity among children reporting at health facilities in Nouakchott, Mauritania". *Transactions of the Royal Society of Tropical Medicine and Hygiene* 105.12 (2011): 727-733.

14. Vander Konradsen F., *et al*. "Risk factors for malaria: a microepidemiological study in a village in Sri Lanka". *Transactions of the Royal Society of Tropical Medicine and Hygiene* 92 (2011): 265 to 269.

15. Gahutu JB., *et al*. "Prevalence and risk factors of malaria among children in southern highland Rwanda". *Malaria Journal* 10 (2011): 134.

16. Krefis AC., *et al*. "Principal component analysis of socioeconomic factors and their association with malaria in children from the Ashanti Region, Ghana". *Malaria Journal* 9 (2010): 201.

17. Roberts D and Matthews G. "Risk factors of malaria in children under the age of five years old in Uganda". *Malaria Journal* 15 (2016): 246-256.

18. Liu JX., *et al*. "Is housing quality associated with malaria incidence among young children and mosquito vector numbers? Evidence from Korogwe, Tanzania". *PLoS One* 9.2 (2014): e87358.

19. Tusting LS., *et al*. "Socioeconomic development as a malaria intervention: a systematic review and meta-analysis". *Lancet* 382 (2013): 963-972.

20. Noor AM., *et al*. "The use of mosquito nets and the prevalence of Plasmodium falciparum infection in rural areas of south-central Somalia". *PLoS ONE* 3.5 (2008): E2081.

21. Tusting LS., *et al*. "Why is malaria associated with poverty? Results of a cohort study conducted in rural Uganda". *Infecting Poverty* 5 (2016): 78.

22. Shumbullo EL. "Variation in malaria transmission in southern Ethiopia, impact of prevention strategies and need for targeted intervention". Norway: University of Bergen (2013).

23. Delil RK., *et al*. "Magnitude of Malaria and Factors among Febrile Cases in Low Transmission Areas of Hadiya Zone, Ethiopia: A Facility Based Cross Sectional Study". *PLoS One* 11.5 (2016): e0154277.

24. World Health Organization. Global Vector Control Response 2017-2030. Geneva: (2017).

25. World Health Organization. World Malaria Report. Geneva (2015).