

Malaria Prevention Practices and Care Seeking among Night Workers in the Greater Accra Region of Ghana

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Abstract

Background

Night workers may experience occupational exposure to malaria vectors because their work can coincide with peak biting periods. However, malaria prevention and care seeking in this occupational group are poorly described in Ghana. This study assessed malaria prevention practices, care seeking behaviours, and factors associated with adequate prevention, prompt care seeking, malaria testing, and appropriate care seeking among night workers in the Greater Accra Region of Ghana.

Methods

A multicentre cross-sectional study included 420 night workers from 14 urban and periurban districts. Data were collected using a structured questionnaire. Adequate prevention was a prespecified composite defined as at least five of eight assessed practices. Prompt care seeking meant seeking external care within 24 hours of fever onset. Appropriate care seeking required prompt care, initial use of a formal provider, malaria testing, and no self medication before testing. Modified Poisson regression estimated adjusted prevalence ratios and 95% confidence intervals.

Results

Overall, 189 (45.0%) workers were mostly outdoors between 10 p.m. and 4 a.m., 111 (26.4%) had adequate malaria knowledge, and 103 (24.5%) met the definition of adequate prevention. Among 134 (31.9%) workers reporting fever, 95 (70.9%) sought care within 24 hours, 116 (86.6%) received a malaria test, and 52 (38.8%) met all criteria for appropriate care seeking. Adequate prevention was associated with senior high or tertiary education (aPR 1.53, 95% CI 1.02 to 2.29), employer provided prevention (aPR 2.17, 95% CI 1.40 to 3.35), and adequate malaria knowledge (aPR 2.11, 95% CI 1.61 to 2.78). Health insurance was associated with prompt care seeking (aPR 1.83, 95% CI 1.37 to 2.46) and appropriate care seeking (aPR 3.57, 95% CI 1.42 to 8.98).

Conclusions

Only one quarter of participants met the study definition of adequate malaria prevention, although most workers who reported fever received a malaria test. Workplace prevention, targeted education, employer engagement, and improved access to insured care may strengthen malaria control for occupations involving routine night work.

Background

Malaria remains a major global public health problem. In 2024, an estimated 282 million malaria cases and 610,000 malaria deaths occurred worldwide. The World Health Organization African Region accounted for approximately 94% of cases and 95% of deaths [1]. Ghana contributed an estimated 6.74 million cases, representing 2.4% of the global malaria burden, and 1.9% of malaria deaths [1]. Although malaria parasite prevalence in Greater Accra is lower than in many other regions of Ghana, transmission persists in a rapidly urbanising environment characterised by heterogeneous drainage, construction, population mobility, and local mosquito breeding sites [2–4]. Greater Accra is also the country's main commercial centre, with a substantial workforce engaged in activities that continue through the night.

Night work includes employment performed entirely or partly during usual sleeping hours [5]. In the United States, approximately 14% of employed adults undertake some form of night or overnight work [6]. Ghanaian labour force data indicate that a smaller proportion of employed people currently work at night, but this proportion may increase as the country expands economic activity across a 24 hour cycle [7, 8]. Night workers may therefore spend prolonged periods outdoors or in incompletely protected workplaces when *Anopheles* mosquitoes are active [9].

Core malaria vector control interventions, particularly insecticide treated nets and indoor residual spraying, primarily protect people indoors [2, 10]. Their protection may be reduced for workers who remain outdoors for substantial periods at night. Effective malaria case management also depends on timely care seeking, parasitological confirmation, and prompt treatment [11]. Irregular shifts, fatigue, restricted access to services after work, concern about income loss, and self medication may interfere with this pathway [12, 13]. Delayed diagnosis and treatment may increase the risk of complications and sustain transmission.

Evidence on malaria prevention and care seeking among night workers in Ghana is limited. Previous studies have largely examined households, travellers, caregivers, and other community populations, with less attention to occupations involving routine night exposure [12–15]. Evidence specific to night workers is needed to inform occupational health measures and malaria control as night time economic activity expands. This

study therefore assessed malaria prevention practices and care seeking behaviours among night workers in Greater Accra and examined factors associated with adequate prevention, prompt care seeking, malaria testing, and appropriate care seeking.

Methods

Study design and setting

A multicentre cross-sectional study was conducted among night workers in 14 urban and periurban districts of the Greater Accra Region of Ghana. District names are not reported because district specific estimates were not produced and the study was designed to describe the regional occupational population. Greater Accra contains the national capital, major commercial and industrial centres, transport terminals, markets, hospitality establishments, health facilities, and security posts that operate throughout the night. Data were collected at recognised night work locations, including security posts, transport terminals, markets, hotels and food service outlets, factories, health facilities, and sanitation service locations.

Study population

The source population comprised adults engaged in regular night work within the selected districts. The study population consisted of night workers in security services, transport, market trading, hospitality and food services, factory or industrial work, health and emergency services, sanitation and waste management, and other occupations requiring routine work during night hours. The individual night worker was the unit of observation.

Eligibility criteria

Workers were eligible if they were aged 18 to 64 years, had worked in the selected district for at least one month, normally worked at least three night shifts per week and had a usual shift that included work between 10 p.m. and 4 a.m. Workers who performed night duties only occasionally or on an irregular on-call basis, were temporary visitors to the worksite or were unable to complete the interview were excluded.

Sample size and sampling procedure

The minimum sample size was estimated with Cochran's formula for a single population proportion. Because no prior estimate of adequate malaria prevention among night workers in the region was available, a prevalence of 50%, 95% confidence level, and 5% margin of error were used. The resulting minimum was 384 participants. This was increased by approximately 9% to allow for incomplete responses and improve precision, producing a target of 420. Thirty completed interviews were obtained from each of the 14 districts. Districts were first grouped into urban and periurban strata, after which 14 were selected by simple random sampling. Lists of locations operating routinely at night were compiled with assistance from district authorities, employers, and occupational associations. Locations were grouped by occupational sector, and worksites were selected to reflect the estimated distribution of eligible workers. At each worksite, a roster of eligible workers present was prepared. Participants were selected systematically after a random start, with occupational allocation proportional to the estimated workforce within each district. If a selected worker was ineligible or declined, the next eligible person on the roster was approached.

Data collection

Data were collected with a structured interviewer administered questionnaire. The instrument covered sociodemographic characteristics, occupation and employment conditions, duration and frequency of night work, shift length, work environment, outdoor exposure between 10 p.m. and 4 a.m., workplace mosquito nuisance, nearby stagnant water and open drains, employer provided prevention, workplace malaria education, and sick leave arrangements. It also assessed malaria knowledge, prevention practices at work and home, perceived risk, barriers to care, fever during the preceding three months, first response to fever, time and source of care, self medication, malaria testing, treatment, artemisinin based combination therapy completion, and workdays missed.

Outcome definitions and scoring

Malaria knowledge was assessed with 10 questions. Each correct answer received one point, and a score of at least eight was classified as adequate knowledge. Prevention was assessed with eight indicators: long sleeved clothing, mosquito repellent, mosquito coils or vapour, aerosol or insecticide spray, use of an insecticide treated net while resting at work, use of an insecticide treated net at home after a night shift, workplace environmental cleaning, and avoidance of stagnant water or open drains. A prespecified study score of at least five practices was classified as adequate prevention. This composite was used as an operational measure of the breadth of prevention behaviours and should not be interpreted as a clinical effectiveness scale. Prompt care seeking was defined as seeking the first external source of care within 24 hours of fever onset.

Malaria testing referred to rapid diagnostic testing or microscopy for the most recent fever episode. Appropriate care seeking required care within 24 hours, initial attendance at a formal health provider, malaria testing, and no self medication before testing. A six item barrier score covered cost, work schedule, income loss, distance, self medication, and anticipated waiting time.

Statistical analysis

Categorical variables were summarised with frequencies and percentages. Continuous variables were summarised with means and standard deviations or medians and interquartile ranges, as appropriate. Prevention analyses included all participants, whereas care seeking analyses were restricted to workers reporting fever during the preceding three months. Modified Poisson regression with a log link and district clustered robust standard errors was used to estimate adjusted prevalence ratios and 95% confidence intervals because the principal outcomes were common. The prevention model included age, sex, education, income, health insurance, nights worked per week, outdoor exposure, mosquito nuisance, employer prevention, workplace malaria education, malaria knowledge, prevention attitude, and district setting. Care seeking models included age, sex, education, health insurance, sick leave, malaria knowledge, care seeking barriers, fever characteristics, and district setting. Associations were assessed with two sided tests at a significance level of 0.05. The models estimate associations and do not establish causation.

Results

Characteristics and night-work exposure

The analysis included 420 night workers from 14 districts. The mean age was 36.0 years (standard deviation 10.5), and 260 participants (61.9%) were male. Participants had worked night shifts for a mean of 12.7 years (standard deviation 10.2), and their shifts lasted a mean of 10.0 hours (standard deviation 1.9). Median monthly income was GHS 2,351 (interquartile range 1,787 to 2,959). Overall, 189 workers (45.0%) worked mostly outdoors between 10 p.m. and 4 a.m (Table 1).

Table 1
Characteristics and occupational exposure of night workers (N = 420)

Characteristic	Category/statistic	n (%) or value
Age, years	Mean (SD)	36.0 (10.5)
Years working night shifts	Mean (SD)	12.7 (10.2)
Shift duration, hours	Mean (SD)	10.0 (1.9)
Monthly income, GHS	Median (IQR)	2351 (1787 to 2959)
Distance to health facility, km	Median (IQR)	4.3 (2.7 to 6.0)
Sex	Male	260 (61.9)
	Female	160 (38.1)
Occupation	Security services	98 (23.3)
	Transport services	85 (20.2)
	Market trading	65 (15.5)
	Hospitality and food services	49 (11.7)
	Factory or industrial work	52 (12.4)
	Health and emergency services	30 (7.1)
	Sanitation and waste services	26 (6.2)
	Other night work	15 (3.6)
Mostly outdoors between 10 pm and 4 am	Yes	189 (45.0)
Employer provides malaria prevention	Yes	196 (46.7)
Received workplace malaria education	Yes	182 (43.3)
Employer allows sick leave	Yes	215 (51.2)
Covered by health insurance	Yes	297 (70.7)

Malaria knowledge and prevention practices

The mean knowledge score was 5.94 (SD = 2.17) out of 10, and 111 workers (26.4%) had adequate malaria knowledge. The mean prevention score was 3.43 (SD = 1.52) out of eight. Overall, 103 workers (24.5%) had adequate prevention practices, while 136 (32.4%) had a positive prevention attitude (Table 2).

Table 2
Malaria prevention practices among night workers

Indicator	n	%
Uses long-sleeved clothing	202	48.1
Uses mosquito repellent	159	37.9
Uses mosquito coils or vapour	214	51.0
Uses aerosol or insecticide spray	162	38.6
Rests under an ITN during shift	54	12.9
Uses an ITN at home after night shift	290	69.0
Workplace environmental cleanup	195	46.4
Avoids stagnant water or open drains	166	39.5
Adequate malaria knowledge	111	26.4
Adequate prevention practices	103	24.5
Positive prevention attitude	136	32.4

Fever, care seeking and malaria testing

Fever during the preceding three months was reported by 134 workers (31.9%). Among them, 95 (70.9%) sought care within 24 hours, 99 (73.9%) first attended a formal health provider, and 116 (86.6%) received a malaria test. Self medication before testing was reported by 43 workers (32.1%). Overall, 52 workers (38.8%) met all four criteria for appropriate care seeking. Malaria was reported as confirmed in 51 of the 134 workers with fever (38.1%). Fifty six workers received an artemisinin based combination therapy, indicating that treatment was not limited to participants reporting a confirmed positive result. Among those treated, 45 (80.4%) obtained the medicine from a formal provider and 46 (82.1%) completed the full course (Table 3).

Table 3
Care seeking, malaria testing and treatment

Indicator	n	Denominator	%
Fever in previous 3 months	134	420	31.9
Prompt care within 24 hours	95	134	70.9
Formal provider used first	99	134	73.9
Self-medicated before testing	43	134	32.1
Tested for malaria	116	134	86.6
Tested within 24 hours	79	134	59.0
Confirmed malaria	51	134	38.1
Appropriate care seeking	52	134	38.8
Sought additional care	21	134	15.7
Hospitalised	3	134	2.2
ACT obtained from formal provider	45	56	80.4
Completed full ACT course	46	56	82.1

Barriers to prompt formal care

Among the 58 workers with a recorded main reason for delayed or informal care, the most frequently reported reasons were inability to leave work (14/58, 24.1%), preference for self medication (13/58, 22.4%), fear of losing income (10/58, 17.2%), perception that symptoms were mild (7/58, 12.1%), and inability to afford care (6/58, 10.3%) (Table 4).

Table 4
Reported barriers and reasons for delayed or informal care

Barrier or reason	n	Denominator	%
Cost of care	30	134	22.4
Work schedule	43	134	32.1
Fear of income loss	56	134	41.8
Distance to facility	19	134	14.2
Preference for self-medication	41	134	30.6
Expected facility waiting time	37	134	27.6
Main reason: Work schedule did not allow	14	58	24.1
Main reason: Preferred self medication	13	58	22.4
Main reason: Fear of losing income	10	58	17.2
Main reason: Symptoms seemed mild	7	58	12.1
Main reason: Could not afford care	6	58	10.3
Main reason: Facility was too far	5	58	8.6
Main reason: Expected long waiting time	3	58	5.2

Factors associated with adequate malaria prevention

Senior high or tertiary education was associated with a higher prevalence of adequate prevention than lower education (aPR 1.53, 95% CI 1.02 to 2.29). Employer provided malaria prevention was associated with more than twice the prevalence of adequate prevention (aPR 2.17, 95% CI 1.40 to 3.35). Adequate malaria knowledge was also associated with adequate prevention (aPR 2.11, 95% CI 1.61 to 2.78) (Table 5).

Table 5
Adjusted associations with adequate malaria prevention

Factor	aPR	95% CI	p value
Female sex (ref: male)	1.03	0.74 to 1.43	0.867
Senior high or tertiary education	1.53	1.02 to 2.29	0.038
Middle income tertile (ref: low)	1.19	0.88 to 1.61	0.258
High income tertile (ref: low)	1.05	0.68 to 1.62	0.819
Mostly outdoors between 10 pm and 4 am	0.89	0.64 to 1.24	0.502
High mosquito nuisance at work	1.19	0.86 to 1.63	0.293
Employer provides malaria prevention	2.17	1.40 to 3.35	< 0.001
Received workplace malaria education	1.15	0.80 to 1.65	0.451
Adequate malaria knowledge	2.11	1.61 to 2.78	< 0.001
Positive prevention attitude	0.96	0.71 to 1.30	0.794
Peri urban district setting (ref: urban)	1.00	0.71 to 1.40	0.991

Factors associated with care seeking and malaria testing

Health insurance coverage was associated with a higher prevalence of prompt care seeking (aPR 1.83, 95% CI 1.37 to 2.46). No variable in the adjusted malaria testing model met the prespecified significance threshold. Health insurance was also associated with appropriate care seeking (aPR 3.57, 95% CI 1.42 to 8.98), although the wide confidence interval indicated limited precision. Adequate malaria knowledge was associated with appropriate care seeking (aPR 1.86, 95% CI 1.30 to 2.66) (Table 6).

Table 6
Adjusted associations with care seeking and malaria testing

Outcome and factor	aPR	95% CI	p value
Prompt care: Female sex (ref: male)	0.86	0.64 to 1.16	0.323
Prompt care: Senior high or tertiary education	1.11	0.81 to 1.51	0.520
Prompt care: Covered by health insurance	1.83	1.37 to 2.46	< 0.001
Prompt care: Employer allows sick leave	1.15	0.95 to 1.38	0.144
Prompt care: Adequate malaria knowledge	1.05	0.83 to 1.33	0.668
Prompt care: Each one-point increase in care-seeking barrier score	0.90	0.77 to 1.05	0.188
Prompt care: Each additional day of fever	1.04	0.95 to 1.13	0.454
Prompt care: Fever with chills or sweating	1.25	0.98 to 1.60	0.075
Prompt care: Peri urban district setting (ref: urban)	0.73	0.46 to 1.16	0.181
Testing: Female sex (ref: male)	0.96	0.81 to 1.14	0.627
Testing: Senior high or tertiary education	0.96	0.82 to 1.11	0.554
Testing: Covered by health insurance	1.10	0.91 to 1.34	0.317
Testing: Employer allows sick leave	1.12	0.99 to 1.27	0.066
Testing: Adequate malaria knowledge	1.08	0.97 to 1.21	0.177
Testing: Each one-point increase in care-seeking barrier score	1.00	0.97 to 1.03	0.938
Testing: Formal health provider used first	1.16	0.83 to 1.63	0.385
Testing: Self-medicated before testing	0.93	0.77 to 1.12	0.430
Testing: Prompt care within 24 hours	0.94	0.75 to 1.16	0.548
Testing: Peri urban district setting (ref: urban)	0.96	0.83 to 1.11	0.544
Appropriate care: Female sex (ref: male)	1.23	0.69 to 2.18	0.481
Appropriate care: Senior high or tertiary education	0.98	0.62 to 1.53	0.922
Appropriate care: Covered by health insurance	3.57	1.42 to 8.98	0.007
Appropriate care: Employer allows sick leave	1.06	0.82 to 1.37	0.659
Appropriate care: Adequate malaria knowledge	1.86	1.30 to 2.66	< 0.001
Appropriate care: Each one-point increase in care-seeking barrier score	0.89	0.73 to 1.09	0.253
Appropriate care: Fever with chills or sweating	1.09	0.56 to 2.12	0.808
Appropriate care: Fever with weakness or body pain	1.35	0.80 to 2.29	0.266
Appropriate care: Mostly outdoors between 10 pm and 4 am	1.21	0.76 to 1.93	0.416
Appropriate care: Peri urban district setting (ref: urban)	0.85	0.48 to 1.52	0.590

Discussion

This study found that only 24.5% of night workers met the study definition of adequate malaria prevention, despite 45.0% working mostly outdoors between 10 p.m. and 4 a.m. Among participants reporting fever, prompt care seeking and malaria testing were common, but only 38.8% completed the full pathway defined as appropriate care seeking. Higher education, employer provided prevention, and adequate malaria knowledge were associated with adequate prevention. Health insurance was associated with prompt and appropriate care seeking, while adequate malaria knowledge was also associated with appropriate care seeking. These findings identify behavioural and workplace gaps but do not demonstrate that night work itself causes increased malaria infection.

Only 26.4% of participants met the study threshold for adequate malaria knowledge. Direct numeric comparison with community studies is difficult because knowledge instruments and classification thresholds differ. Nevertheless, research from Ghana and other African settings has documented important gaps between awareness of malaria and consistent use of effective prevention [15, 16]. In the present study, adequate

knowledge was associated with more than twice the prevalence of adequate prevention. Health education interventions have improved malaria knowledge and insecticide treated net use in sub-Saharan African populations, although effects vary by intervention and context [17]. Education for night workers may therefore be more effective when delivered at workplaces and linked to prevention resources relevant to outdoor and occupational exposure.

Most workers reporting fever sought care within 24 hours and received a malaria test, but fewer than half met all criteria for appropriate care seeking. This difference arose because the composite outcome also required initial use of a formal provider and no self medication before testing. Ghanaian policy recommends parasitological confirmation before antimalarial treatment [11]. Work schedules, fear of income loss, and preference for self medication were prominent barriers in this study, consistent with evidence that financial and occupational constraints can shape malaria care seeking [12, 13]. The finding that 56 workers received an artemisinin based combination therapy whereas 51 reported confirmed malaria also suggests some treatment outside the reported test positive group. Because testing and treatment were self reported and not verified against clinical records, this difference should be interpreted cautiously.

Malaria prevention among night workers was associated with both individual and workplace characteristics. Workers with senior high or tertiary education had a higher prevalence of adequate prevention, which may reflect greater access to and understanding of health information. Employer provided prevention showed a stronger association, supporting the workplace as a practical setting for malaria control. Occupational reviews have highlighted the need to adapt vector protection to the location and timing of exposure [14]. Potential measures include repellents, suitable protective clothing, environmental management, and protected resting areas. The effectiveness and feasibility of these measures should be evaluated rather than assumed from the present cross-sectional findings.

Health insurance coverage was associated with prompt and appropriate care seeking. This agrees with Ghanaian evidence that insurance can influence the use of formal malaria care, although insured individuals may still use informal sources [18]. The association with appropriate care had a wide confidence interval, and its magnitude should therefore be interpreted cautiously. Adequate malaria knowledge was also associated with appropriate care seeking. These findings support combined approaches that address knowledge, financial access, and work-related barriers rather than relying on education alone.

This study is among the few Ghanaian studies focused specifically on malaria prevention and care seeking among night workers. Recruitment across multiple districts and occupational groups broadened the range of work settings represented. Several limitations should be considered. The cross-sectional design does not establish temporal or causal relationships. Prevention, fever, testing, and treatment were self reported and may be affected by recall and social desirability bias. The study specific thresholds for adequate knowledge and prevention have not been established as clinical effectiveness thresholds, and some prevention indicators may not be applicable to every work setting. The fever analysis included 134 participants, resulting in limited precision for some adjusted estimates. District clustered estimates were based on 14 clusters and should therefore be interpreted cautiously. Because participants were recruited in Greater Accra, the findings may not apply to rural areas or regions with different malaria transmission patterns. Malaria episodes, test results, and treatment were not verified using clinical records.

Conclusion

Only one quarter of participants met the study definition of adequate malaria prevention. Although most workers reporting fever received a malaria test, fewer than half completed the full appropriate care pathway. Employer provided prevention, malaria knowledge, and health insurance were associated with favourable prevention or care seeking outcomes. Malaria programmes and employers should consider workplace education, access to context appropriate prevention, and arrangements that enable workers to seek timely formal care. Prospective studies with verified malaria outcomes are needed to determine whether these strategies reduce malaria infection among night workers.

Abbreviations

ACT, artemisinin based combination therapy; aPR, adjusted prevalence ratio; CI, confidence interval; GHS, Ghana Health Service; IQR, interquartile range; ITN, insecticide treated net; RDT, rapid diagnostic test; SD, standard deviation; WHO, World Health Organization.

Declarations

Ethics approval and consent to participate

Ethical approval was obtained from the Ghana Health Service Ethics Review Committee. Written informed consent was obtained from all participants before enrolment. The study was conducted in accordance with the Declaration of Helsinki. Participation was voluntary, questionnaires used study codes rather than names, and study data were accessible only to the research team.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Author Contribution

AGM and JND conceptualised the study and collected the data. AGM and MA analysed the data and drafted the manuscript. JND, CLN, and RNN critically reviewed the manuscript. All authors read and approved the final manuscript.

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Data Availability

All data supporting the findings of this study are available within the paper and its Supplementary Information.

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