

Economic burden and prevalence of malaria in companies in Douala, Cameroon

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Abstract

Background: Malaria is a public health concern in Africa. At the socio-economic level, it represents a brake on the national growth through an increase of health spending, drop of productivity and high rate of absenteeism at the workplace. Some companies have implemented malaria control measures to improve their performance, but the vast majority are slow to follow this approach. Using the cost-of-illness approach, the objective of this study was to estimate the economic impact of malaria in two companies with 24-hour daily activity based in Douala, Cameroon: an agro-food industry nicknamed "AGRO" and a security company nicknamed "SECU".

Method: A retrospective analysis of medical and financial records of these companies was carried out to calculate the economic cost of absenteeism, prophylaxis, Internal Management of Malaria cases (IMM) and External Management of Malaria cases (EMM) to these companies. A malaria screening campaign was carried out also in each company in one day from 8 a.m. to 4 p.m. The clinical, anthropometric and socio-demographic data of the employees were collected before the collection of a drop of blood which was subsequently analyzed under the Cyscope fluorescence microscope (Partec-Sysmex, Münster, RFA).

Results: Analysis of retrospective data revealed that the prevalence of symptomatic malaria cases had decreased by 8.9% and 25.1% respectively at AGRO and SECU between 2010 and 2012. Regarding the prospective component, 372 employees of the two companies were included in the study. The prevalence of malaria was 26.83% and 26.44% respectively at AGRO in January 2013 and SECU in February 2013. Malaria-related absenteeism accounted for 5% and 17% of general absenteeism at AGRO and SECU respectively. The cost of an EMM accounted for 19.5% and 40.5% of the monthly income of AGRO and SECU workers respectively. Each year, malaria generates a shortfall of US\$ 26,426 and US\$ 136,824 respectively to AGRO and SECU.

Conclusion: Malaria have a negative impact on companies. However, early detection of suspected cases, campaigns to distribute insecticide-treated mosquito nets, Information, Education and Communication within the company could reduce this impact.

Background

Each year, 228 million cases of malaria are recorded worldwide with nearly 405.000 deaths [1]. Africa alone have a record above 90% of death cases [2]. Malaria remains a major public health issue in the world in resource-limited countries where it has a negative impact on their economy [3].

In Cameroon, malaria is the leading cause of morbidity and mortality[4], thus representing a significant brake on economic growth. In the business field, several studies have highlighted the impact of the disease on productivity [3,5–7]. The negative economic impact of malaria has encouraged a new control approach targeting companies. New diagnostic tools allow active case detection and prevalence measurements on relatively large samples [8,9]. Control initiatives in multilateral civil societies are carried out but usually insufficiently evaluated. Douala, the economic capital of Cameroon located 4 ° N 9 ° 44 E, and being endemic town for malaria is the site of our study which aims at enriching data on the economic impact of malaria, which is constantly evolving.

Methods

Study setting

A vast malaria control program has been carried out by an NGO CCA/SIDA (*Coalition de la Communauté des Affaires contre le SIDA, la tuberculose et le paludisme*) in several companies in Douala since January 3, 2013. This campaign

consisted of educating employees about malaria, performed systematic screening and treated all positive cases as it was described by Mbohou Mbohou *et al.* in 2019 [10]. Mosquito nets impregnated with Long-Lasting Insecticide-treated Nets (LLINs) were also distributed during these campaigns.

An agro-food industry (AGRO) and a security company (SECU), located in the city of Douala were chosen for the study. These two companies are in continuous activity over 24 hours every day. This study had a cross-sectional and retrospective component. Regarding the cross-sectional component of this study, the clinical, anthropometric and socio-demographic data of the employees were collected using a questionnaire before collection of blood, which was subsequently analyzed under the CyScope fluorescence microscope (Sysmex-Partec, Münster, RFA) [11]. It important to precise that Employees were free to answer or not to any question of questionnaire.

The retrospective component of this study focused on calculating the cost of malaria, based on available medical and financial records found in companies.

Daily salary = monthly salary / number of working days

Estimated annual economic cost of malaria

The number of working days per week in these two companies during our study period was six days, thus, 24 days per month. The Economic Cost (EC) of malaria includes the Direct Cost (DC) and the Indirect Cost (IC) [12]. The direct cost was represented by the cost of health care and prevention services; the indirect cost corresponds to the cost of the working days lost due to malaria illness [12].

$EC = DC + IC$

Indirect Cost Estimate (IC)

The method used to estimate the indirect cost of malaria is an adaptation of the approach proposed by Guiguemdé [13].

CI = Cumulative number of annual days of absence related to malaria * Daily salary

Report of the cost of the External Management of Malaria cases (EMM) and the monthly salary of the workers.

Annual health expenditure per capital is around US \$ 60.44 (MINSANTE, 2011). The minimum annual cost of an EMM per person represents 40% of this annual health expenditure. The company covers 80% of the employee's medical bill as well as that of their family.

Annual business loss related to employee EMM = number of employees * (60.44 * 0.4 * 0.8)

Annual business loss related to the employee's family members' EMM = (60.44 * 0.4 * 0.8) * Number of employees * Average number of children per employee

The average number of children per employee was 1.8 children at AGRO and 1.86 children at SECU.

Internal Management of Malaria cases (IMM) was done in the infirmary, inside the company.

External Management of Malaria cases (EMM) in a hospital approved by the company.

Data analysis:

Data were entered in an Excel sheet. A chi-square test was used to compare the proportions. Spearman's Z correlation was used to study continuous quantitative variables. The significance level was set at a P value <0.05. Statistical analysis were performed using Statview version 5.0 software (SAS Institute Inc., USA).

Results

Sociodemographic characteristics of the employees

Table 1 summarizes the sociodemographic characteristics of the study population. A total of 372 employees were enrolled in the study. More than three quarter of employees were men. Most employees were aged 30 to 45 years as shown in Table 1.

Table 1. Baseline characteristics of study population

Characteristics	Variables	AGRO	SECU	Total
Gender	Female	43 (26.22)	20 (09.62)	63 (16.93)
	Male	121 (73.78)	188 (80.38)	309 (83.07)
	Total	164 (100)	208 (100)	372 (100)
Age (Years)	Less than 30	32 (19.52)	76 (36.54)	108 (29.03)
	Between 30 and 45	105 (64.42)	112 (53.85)	217 (58.33)
	More than 45	27 (16.56)	20 (09.62)	47 (12.64)
	Total	164 (100)	208 (100)	372 (100)

Knowledge on Malaria

The majority of the employees knew at least two symptoms of malaria (96.74% in AGRO; 72.61% in SECU) like Table 2 is showing it.

Table 2. Participants' knowledge of the two symptoms.

Knowledge of two symptoms	AGRO n (%)	SECU n (%)	Total
Yes	89 (96.74)	114 (72.61)	203 (81.53)
No	3 (3.26)	43 (27.39)	46 (18.47)
Total	92 (100)	157 (100)	249 (100)

Only 37.30% of the employees was knowing malaria parasite as it is mentioned in table 3

Table 3. Knowledge of malaria parasite

Knowledge on malaria parasite.	AGRO n (%)	SECU n (%)	Total
Yes	49 (32.45)	67 (34.36)	116 (37.30)
No	67 (67.55)	128 (65.64)	195 (62.70)
Total	116 (100)	195 (100)	311 (100)

Table 4 shows that The name of malaria drug was known by 55.63% and 68.06% of participants from AGRO and SECU respectively.

Table 4. Knowledge of malaria drug

Knowledge of a malaria drug	AGRO n (%)	SECU n (%)	Total
Yes	84 (55.63)	130 (68.06)	214 (62.57)
No	67 (44.37) 61	61 (31.04)	128 (37.43)
Total	151 (100)	191 (100)	342 (100)

Almost half of AGRO participants (54.44%) suffered from malaria in the five months preceding the survey. At SECU, the last malaria attack (47.7%) of employees surveyed dates back to more than six months to the date of this survey, as shown in Table 5.

Table 5. Date of last malaria attack

Date of last malaria attack	AGRO n (%)	SECU n (%)	Total
Less than one month	40 (44.44)	32 (20.90)	72 (29.63)
Between 1 et 5 months	49 (54.44)	48 (31.40)	97 (39.92)
Between 6 et 12 months	1 (1.12)	20 (13.06)	21 (08.64)
More than one year	0 (0)	53 (34.64)	53 (21.81)
Total	90 (100)	153 (100)	243 (100)

Practices of participants in relation to prevention malaria

The utilization rate of LLINs was 55.49% (91/164) at AGRO and 51.92% (108/208) at SECU. The difference was not statistically significant ($\chi^2 = 0.468$; P-value = 0.4937).

Malaria prevalence

Evolution of symptomatic prevalence and absenteeism related to malaria from 2010 to 2012

Figure 1a illustrates the change in the prevalence of symptomatic malaria from 2010 to 2012. In three years, the prevalence fell by 8.9% at AGRO and by 25.1% at SECU. As for absenteeism, it fell by 2% and 1% respectively at AGRO and SECU.

General prevalence of malaria

In the company AGRO, 44 employees out of 164 screened (26.83%) were positive against 55 out of 208 (26.44%) at SECU. Table 6 summarizes the prevalence of malaria infection using CyScope fluorescence microscope for analysis of blood samples. Employees not using a LLIN were more infected than those using it but the difference was not significant ($\chi^2 = 0.212$; $p = 0.6448$).

Table 6. Distribution of patients according to parasitological results and use of the mosquito net

Use of ITNs	Infected (%)	Non-infected (%)	Total (%)	χ^2	P-value
Yes	51 (25,62)	148 (74,38)	199 (100)	0,212	0,6448
No	48 (27,75)	125 (72,25)	173 (100)		
Total	99 (26,61)	273 (73, 38)	372 (100)		

Report of the cost of the EMM and the monthly salary of the workers of AGRO and SECU

Depending on the severity of the malaria, the cost of an EMM varied between US \$ 10 and US \$ 49.4 in public hospitals. In private structures, it varied between US \$ 42 and US \$ 101. Table 7 shows the ratio between the cost of the EMM and the monthly income of AGRO and SECU employees. These workers would spend between 19.5% of their salary per month on malaria treatment if we consider that an African household would have one malaria episode per month [11]. The EMM represented 40.5% of the monthly income of the SECU workers.

Table 7. Ratio of the cost of the EMM and the monthly wages of the workers

	AGRO			SECU		
	Simple malaria	Complicate malaria	Average	Simple malaria	Complicate malaria	Average
Cost of EMM (US\$)	26	75.2	50.6	26	75.2	50.6
Average monthly salary (US\$)	260	260	260	125	125	125
Ratio	0.10	0.29	0.195	0.21	0.60	0.405

Estimation of the annual economic cost of malaria

The average number of children per employee was 1.8 at AGRO and 1.86 at SECU. The daily incomes of AGRO and SECU workers were respectively US \$ 10.40 and US \$ 5. Table 8 presents the annual economic cost of malaria to AGRO and SECU. Malaria causes a shortfall in AGRO at an approximate value of US \$ 24,660.3 per year; this for a workforce of 344 employees and 619 beneficiaries. A non-significant negative correlation was obtained between the cost of prevention and the prevalence ($z = -1.414$; $P = 0.1573$). A non-significant positive correlation ($z = 1.414$; $P = 0.1573$) was also observed on the one hand between the prevalence and the cost of IMM and on the other hand between the prevalence and the cost of absenteeism ($z = 1.414$; $P = 0.1573$). At SECU, malaria caused on average, an annual shortfall of US \$ 136,823.5 over 3 years. A correlation test was carried out between certain variables. A non-significant negative correlation ($z = -1.414$; $P = 0.1573$) was observed between the prevalence and the cost of IMM on the one hand and between the prevalence and the cost of prevention on the other.

Table 8. Estimate of the annual economic cost of malaria (in US \$)

	AGRO				SECU			
	2010	2011	2012	Average	2010	2011	2012	Average
IMM (US\$)	5600	5000	4600	5066.7	10120	10206	11321	10549
Prevention(US\$)	700	800	1000	833.3	2370	2466	2520	2451.6
Absenteeism (US\$)	1944.8	1934.4	1102.4	1660.5	12160	9840	10440	10815
Employee EMM (US\$)	6517.9	6962.7	6479.2	6653.4	38198.1	39745.3	40615.7	39513.3
EMM children(US\$)	11732.1	12532.8	11662.5	11975.8	71048.4	73926.3	75545.2	73494.7
Total (US\$)	26498.8	27234	20248.1	24660.3	133900.5	136187.7	140445.9	136823.5
Prevalence	54.9	54.2	46		62.2	44.9	39.4	

Discussion

The aim of our work was to study the impact of malaria in companies. It appears that the majority of employees surveyed knew at least two signs of the disease (96.74% and 72.61% respectively at AGRO and SECU) and also antimalarial drugs. This result can be explained by the effect of Information, Education and Communication (IEC) strategies undertaken by these companies but also by the government and civil society actors.

The utilization rate of LLIN was only about 50% in both facilities. These coverage rates was less than 77.23 % reported by Mbohou *et al.* [14] in Douala and lower than the national rate (65.6%) [15]. However, these rates are far from the 80% targeted by the Ministry of Public Health [4].

AGRO workers who had at least one malaria episode within a month at the start of the study was 44.44%. This result is similar to one reported by Onwujekwe [16] in Nigeria who obtained a rate of 57.6%. This household study on the budget spent on malaria treatment found that 50% of them had malaria within a year of the date of the survey. At SECU, this percentage was 20.90% and approaches the 17% obtained by Gazin [17]. Here the authors reported that 17% of workers were affected by this period of illness (people who had at least one malaria episode less than a month from the date of the survey). It should be noted that 34.64% of SECU participants had experienced their last malaria attack over a period of more than a year from the date of the interview; the reason may be that these employees are protected against the malaria vector by wearing gangs, long-sleeved clothing and the use of mosquito balms.

The mass screening in our study resulted in a malaria prevalence of over 26% in both companies. This high prevalence is explained by the fact that we are in an endemic area with perennial transmission. This parasite carriage is only the reflection of the balance established between the individual and the parasite following repeated malaria episodes as demonstrated by Rogier [18]. The level of prevalence observed would also be the result of preventive actions taken by

these companies such as IEC (Information-Education-Communication) strategies on the disease. This is confirmed by the average level of knowledge of the pathology by the employees.

Employees not using LLINs were more infected than those with LLINs. This corroborates the results of Bekele *et al.* [19]. Indeed, these authors have demonstrated the positive impact of the use of LLINs on the decrease in the prevalence of malaria, the difference was not significant. This could be explained by the fact that at workplace, the efficiency of the LLIN depends on the type of activity of the employees and the activity period of workers [14].

Malaria-related absenteeism is steadily declining at AGRO. This drop in the absenteeism rate would be the effect of the implementation of control measures. This result corroborates that of Girardin *et al.* [20] who carried out a study on the relation between malaria control measures, prevalence and absenteeism at the workplace.

The cost of EMM was higher in private hospitals than in public hospitals. The reason would be the fact that public hospitals would receive state subsidies [16,21].

EMM accounted for 19.5% and 40.5% of the monthly income of AGRO and SECU workers' respectively. These values are greater than the 14% obtained by Kouadio *et al.* [22]. Indeed these authors conducted a study on the value of EMM in the monthly salary of poor households in disadvantaged neighborhoods of Abidjan. Our ratio is higher than his because the cost of EMM in Cameroon is higher than in Ivory Coast. These values obtained in the two companies are lower than the 81.56% reported in a Ghanaian village [23].

A negative correlation was found between the prevalence and the cost of preventing the disease. The increase in the cost of prophylaxis would decrease the prevalence. This analysis corroborates the results obtained in three Zambian companies [11]; the latter had set up strategies to fight against malaria, thereby reducing the prevalence of more than 50%. A positive correlation was found between the prevalence and cost of IMM on the one hand, and between the prevalence and cost of absenteeism on the other. The increase of the cost of prevention indirectly leads to the drop of the cost of absenteeism and the cost of IMM.

Each year, SECU would lose approximately US \$ 136,823.5. A negative correlation was observed between the cost of IMM and prevalence. The increase of the cost of IMM would lead to the decrease of prevalence. This fact confirms the results reported by Besnard *et al.* [24]. These authors assessed the impact of the increased cost of IMM on the prevalence and cost of absenteeism. The rising cost of IMM has led to the reduction in the costs of absenteeism.

Conclusion

Malaria has a negative impact on companies in Douala, Cameroon. However, early detection of asymptomatic cases, campaigns to distribute insecticide-treated mosquito nets, Information, Education and Communication (IEC) within the company could reduce this impact.

List Of Abbreviations

CCA/SIDA : Coalition de la Communauté des Affaires contre le SIDA, la tuberculose et le paludisme

DC: Direct Cost of malaria

EC: Economic Cost of malaria

EMM: External Management of Malaria cases

IMM: Internal Management of Malaria cases

LLINs: Long-Lasting Insecticide-treated Nets

IC: Indirect Cost of malaria

IEC: Information, Education and Communication

Declarations

Ethics approval and consent to participate

The study was carried out in accordance with guidelines for human experimental models in clinical research as stated by the Cameroon Ministry of Public Health. Ethical clearance was obtained from the Institutional Review Board of the University of Douala (CEI218 DU/268/05/2019/T). A code was attributed to each employee to guarantee the respect for anonymity individual employee. All infected malaria cases were treated with artemisininbased combination therapy (artesunate-amodiaquine) as recommended in the national treatment guidelines from the Ministry of Public Health.

Consent for publication

All authors agree for the publication of the present paper

Availability of data and materials

All datasets on which the conclusions of the research rely are presented in this paper. However, data is available from the corresponding author on reasonable request

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

CMN participated in the data collection, laboratory analysis, analyzed and interpreted the data, and wrote the manuscript. HNN, CT, LK, LPKF, LKN, LNY, GMK, CNgB, ATDM, SWN, IMM, NN, BO, ZO, DN J, AM, PAN , LGL participated in the data collection and laboratory analysis. LGL participated in the study design, provided reagent, revision of the manuscript, and supervision of works at all stages. The authors read and approved the final manuscript.

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Figures

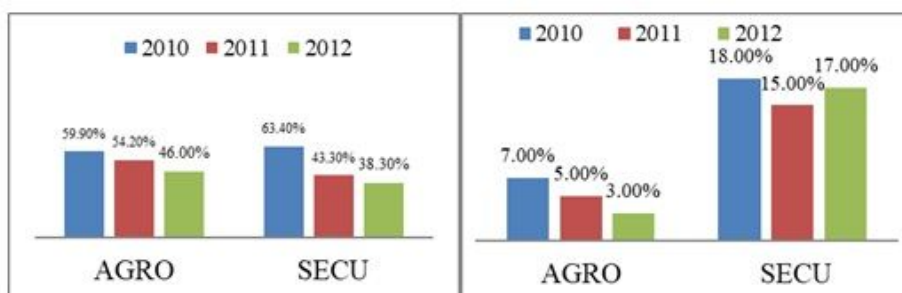


Figure 1

Evolution of the prevalence of symptomatic malaria (a) and absenteeism linked to malaria (b) from 2010 to 2012

Supplementary Files

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