Self-medication practices in the management of malaria in the city of Bukavu in Eastern of Democratic Republic of Congo

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Abstract
Self-medication for malaria management is very common in Democratic Republic of Congo (DRC). This study was conducted to determine the extent, characteristics and factors associated with this practice in medical area in the city of Bukavu. This cross-sectional descriptive study was carried out by direct interview between January and June 2018, in the internal medicine department of the General Referral Hospital (GRH) of Bukavu. Graph Pad software was used to analyze the data collected. Seven hundred eighty-five patients were consulted, among them 57.8% (average age 38.7 ± 8 years; average income: 95 ± 12 USD; gender male / female ratio: 0.47) practice self-medication with antimalarials. They used it for the first time at an average age of 6 ± 2 years. Quinine (91.4%) and Artemether- Lumezantrine (60.4%) are the most used antimalarial. Ascorbic acid (98.7%) and Paracetamol (89.2%) are the most medicines associates to antimalarial in self-medication. Several risks are incurred during this practice when the most cited are worsening side effects (53%), incomplete treatment (37%) and the occurrence of side effects (37%). Age (31-46 and > 61 years old), low income (50-150 USD), membership in a health sector and the pretension of knowledge of antimalarials, predispose subjects to self-medication. Self-medication with antimalarials is very common in Bukavu. It concerns both biomedicine and traditional medicine. There is an urgent need to regulate this practice to avoid its harmful consequences.

Graphical Abstract

Keywords: Self-prescription; GRH: General Referral Hospital; South Kivu; Antimalarials
1. Introduction

Malaria is a haemoparasitic disease caused by obligate intracellular protozoan parasite of plasmodium species which are transmitted by infected female anopheline mosquito [1]. It is one of the most important public health problems worldwide [2,3]. In fact, each year, more than one third of the world's population is exposed to this parasitosis [4] and, more than 200 million people are affected [5,6] and more than 200 thousand die of it [7]. In 2019, 228 million cases were recorded has worldwide including 95% in sub-Saharan Africa and 405,000 deaths reported [8]. In DRC, 97% of the population is exposed to this disease and thousands of deaths are due to it each year [9]. There is not a social security system supporting the health care which is supported by patients and their families. The majority of the population living below the poverty line and there is not enough resources for many families to pay medical consultations [10,11]. In Bukavu, although the city is in the low risk zone, this pathologies is the leading cause of consultation and mortality. Access to primary health care is twice as low as in other parts of the country due to a permanent war which paralyzed the entire provincial economy and further deteriorated the health structure which was already in deficit [12]. Faced with this health scourge, which in most of these cases concerned countries with very modest income and where the health structure is not very efficient, the self-prescription is a very emerging phenomenon, particularly in the management of malaria.

Self-medication consists in the fact that an individual resorts to a drug, on his own initiative or that of a relative, in order to treat a disease or a symptom that he himself has identified, without consulting a health professional [13]. This practice concerns both developing countries [14, 15] as well as developed countries [16,17], the Mediterranean countries [18] and the tropical countries [19]. Several damages linked to this practice have previously been described such as the failure to control the indications, contraindications, dosages, administration rates and duration of treatment, but despite these damages the practice remains [20]. Several reasons may justify the persistence of this phenomenon the high cost of caring for patients in health facilities, low purchasing power, insufficient infrastructure and health personnel, the trivialization of certain diseases, the complicity of certain pharmacy salespeople not respecting the rules for dispensing drugs and lack of information and awareness on the risks associated with the misuse of drugs [14, 21–23]. However, the frequency of self-medication as well as its characteristics are experienced differently from one country to another, from one pathology to another and the control of this phenomenon is an important factor in the control of health policy.

Self-medication with antimalarials is widely used, while antimalarials are among the drugs that are supposed to be available only on medical prescription. This phenomenon is widespread in countries endemic to malaria which are in most cases countries with very low income. In Africa, cases of self-medication with antimalarials have been reported in several countries such as Nigeria [24], Cameroon [25], Benin [26], Tanzania [27,28], Kenya [29] and, Ethiopia [30]. In DR Congo, very little work has been done on self-medication in the treatment of malaria [31]. However, in the few studies that have addressed the issue of self-medication [20,32–34], or the treatment of malaria [11,35–37], the practice of self-medication with antimalarials clearly appears. The city of Bukavu shares the same reality as at the national level where the practice of self-medication with antimalarial drugs is only indirectly reported [38–40].

This study focuses on the description of the practice of self-medication during the treatment of malaria by the population of Bukavu encountered in the reference hospitals of the said city. It also presents the frequency of this practice.

2. Material and methods

2.1. Area of study

Bukavu is in the Eastern part of Democratic Republic of Congo (S 2°26'-33°, E 28°49'-253°), on the Eastern valley Graben. It is one of the highest parts of the country with an average altitude of 1600 m and has a tropical mountain climate with two seasons; a wet season from September to April and the dry season from October to march. This average temperature is 20 °C. His bio-indicator vegetation is marked by the presence in some places of relict species of seasonal deciduous forests and its population estimated at around 800,000 living in 3 municipalities making a total of 32 health areas including 5 GRH, Bagira, Bukavu, Ciriri, Kadutu and Panzi [41–43].

2.2. Patients and methods

This cross-sectional descriptive study was carried out by a direct interview using a guide questionnaire, with all patients, aged over 15 year old, met in the internal medical services of these 5 health facilities in good condition speaking and having provided informed consent. The questionnaire included 20 items related to antimalarials self-medication.
practices as well as socio-demographic characteristics of respondents. The sample size precalculated with Schwartz's formula \( n = z^2 \times p \times (1-p) / m^2 \) where \( z \) = confidence level, set at 95\%, \( p \) = prevalence of self-medication in Bukavu set at 50\%, \( m \) = margin of error fixed at 5\%) was 368 patients. We have nevertheless taken all the patients who met the inclusion criteria to improve the accuracy.

2.3. Ethical Considerations

Ethical approval was granted from the Department of Pharmacology in the Faculty of Pharmaceutical Sciences at the University of Lubumbashi (UNILU/FSP/DPCOL/PT/003/2017) and all participants were asked for their consent to participate in the study before being given the survey. The responses were anonymous and confidential, and the participants were informed that before start answering the questionnaire.

2.4. Statistical data analysis

Graph Pad prism version 6 software was used to analyze the data statistically. The chi-square test and odd ratio established the factors associated. A probability level \( p < 0.05 \) was considered significant.

3. Results and discussion

3.1. Socio-demographic characteristics of respondents

Between January and June 2018, 785 patients attended the internal medicine departments of 5 public hospitals in the city of Bukavu. Only 454 (57.8\%) admit having already practiced self-medication against malaria and most of them are women (male-female sex ratio: 0.47), with an average age of 38.7 ± 8 years (extremes: 16 and 67). The respondents were from the 3 municipalities of the city of Bukavu and belonged to many professional categories; most represented by traders (39\%) followed by farmer (20\%). Most respondents of this study were of secondary school education level (40.5\%), have an average monthly income of 95 ± 12 USD (extremes: 50 and 450 USD) and are in their majority (60\%) Catholic (Table 1).

| Table 1 | Socio-demographic features of respondents |
|---------|------------------------------------------|
| Variable                  | Ni  | Fi (%) |
| Gender                      |     |       |
| Male                       | 145 | 32    |
| Feminine                    | 308 | 68    |
| Marital status              |     |       |
| Single                      | 145 | 32    |
| Divorced                    | 9   | 2     |
| Married                     | 281 | 62    |
| Widower                     | 18  | 4     |
| Age class                   |     |       |
| [16 – 31]                   | 70  | 15.5  |
| [31 – 46]                   | 247 | 54.5  |
| [46– 61]                    | 104 | 22.8  |
| >61                         | 33  | 7.2   |
| District of residence        |     |       |
| Bagira                      | 127 | 28    |
| Ibanda                      | 145 | 32    |
| Idjwi                       | 5   | 1     |
| Kabare                      | 9   | 2     |
| Kadutu                      | 163 | 36    |
| Variable               | Ni | Fi (%) |
|------------------------|----|--------|
| Walungu                | 5  | 1      |
| Any                    | 114| 25     |
| Trader                 | 177| 39     |
| Farmer                 | 91 | 20     |
| Teacher                | 9  | 2      |
| Public employee        | 36 | 8      |
| Service provider       | 27 | 6      |
| Any                    | 84 | 18.5   |
| Primary                | 116| 25.5   |
| Secondary              | 184| 40.5   |
| Higher School-University| 70 | 15.5   |
| Another sector         | 403| 88.8   |
| Health sector          | 51 | 13.2   |
| ≤50                    | 100| 22     |
| [50 – 100]             | 191| 42     |
| [100 – 150]            | 95 | 21     |
| [150 – 200]            | 36 | 8      |
| [200 – 300]            | 23 | 5      |
| > 300                  | 9  | 2      |
| Brananist              | 1  | 0.3    |
| Catholic               | 272| 60     |
| Kimbanguist            | 1  | 0.2    |
| Jehovah's Witness      | 2  | 0.5    |
| Muslim                 | 14 | 3      |
| Non-practicing         | 5  | 1      |
| Protestant             | 123| 27     |
| Revival Church         | 36 | 8      |

Ni = effective, Fi: frequency; N=454

3.2. Diagnosis of malaria by respondents

The surveyed people associate several signs to diagnose malaria. The first two groups of which consist of fever and vertigo (37%) followed by bitterness and fever (29%). Fever is the most common sign in each of the symptom groups (Figure 1).
3.3. Frequency of self-medication

The frequency of self-medication varies considerably between 19.3% (GRH Panzi) and 99.7% (Ciriri). It is higher in subjects who attended GRH Ciriri (97.8%) followed by GRH Bagira (93.2%) (Table 2).

Table 2 Distribution of subjects according to the GRH where they were met

| GRH    | N  | Ni  | Fr (%) | Fa (%) |
|--------|----|-----|--------|--------|
| Bagira | 148| 138 | 93.2   | 17.6   |
| Bukavu | 214| 154 | 71.9   | 19.6   |
| Ciriri | 92 | 90  | 97.8   | 11.5   |
| Kadutu | 61 | 20  | 32.8   | 2.5    |
| Panzi  | 270| 52  | 19.3   | 6.6    |
| Total  | 785| 454 | NA     | 57.8   |

N: total number of subjects encountered in the GRH; Ni: number of subjects who practiced self-medication in the GRH; Fr (relative frequency of self-medication in the medium concerned (= Ni * 100 / N); Fa (absolute frequency of self-medication in the medium concerned (= Ni * 100 / 785). NA: Not applicable. N=785.

3.4. Reasons for patients to practice self-medication and their knowledge of the risks incurred during this practice

Several reasons have pushed interviewed subjects to practice self-medication among which, search for time saving (32%) and the difficult to confide in a health professional (18%), are the most mentioned alongside a claim knowledge of effective remedies (8.5%), less mentioned (figure 2a). Although they resort to self-medication, the subjects nevertheless recognized certain risks incurred, the most cited of which were worsening side effects (22%) and inadequate treatment respectively (figure 2b).
3.5. Cost of malaria treatment in modern health care and traditional medicine in Bukavu

The average cost of treating malaria over three days in the health facilities in which this study was carried out is 56 ± 15.5 USD for 7 days or 8 ± 2.2 USD per day. The highest cost is observed in two GRHs, Bukavu (80 USD) and Panzi (57 USD) and the lowest cost is observed in GRH, Ciriri (40USD). In traditional medicine, treatment for malaria is ≤ USD 5 and in most cases (47%), it is free (Figure 3).

3.6. Age, instigator of first self-medicaiton, main sources, reasons for changing medication and frequency of self-medication depending on the subjects

Almost 40% of subjects resort to self-medication whenever the need arises, and more than a third (40%) started it as a teenager between 13 and 17 years old (4a) although a large fraction do not know the exact age. The instigator of the 1st most incriminated self-medication is the parents (37%) and the main sources of information during this practice are providers in the health services (39%) and the internet (23%). People sometimes change medications for several reasons, the most mentioned of which are the lack of healing (39%) and the occurrence of unbearable effects (28%) (Figure 4).
3.7. Antimalarial drugs used in self-medication in Lubumbashi

Eight molecules are used in self-medication, including 3 used alone and 6 combined in pairs. Quinine (91.4%) and the combination Artemether & Lumefantrine (60.4%) are the two most widely used drugs (Table 3).

Table 3 Antimalarial drug used in self-medication in Bukavu city

| Active substance                          | Aberrant dosage | Ei | Fi (%) |
|-------------------------------------------|-----------------|----|--------|
| α-β Arteether                             |                 | 20 | 4.4    |
| Artemether & Lumefantrine                 | 2x2 Tab/D W 7D  | 274| 60.4   |
| α-β Aartemether                           |                 | 30 | 6.6    |
| Amodiaquine & Artesunate                  |                 | 10 | 2.2    |
| Sulfadoxine & Pyrimethamine               |                 | 178| 39.2   |
| Quinine                                   | 2x2 Tab/D W 5D  | 415| 91.4   |

Tab: tablet, D: day, W: while Ei= population, Fi = frequency, n=454

3.8. Medicines associated with antimalarials during self-medication

Thirteen drugs belonging to 9 pharmacological classes are associated with antimalarials during self-medication. Among these drugs, ascorbic acid (98.7%) followed by paracetamol (89.2%) are the most used (Table 4).

Table 4 Medicines associated with antimalarial drugs by Informants

| Active substance                     | Class                        | Ei | Fi (%) |
|--------------------------------------|------------------------------|----|--------|
| Aluminium Hydroxide-Magnesium        | Antacid                      | 10 | 2.2    |
| Hydroxide-Simethicone                |                              |    |        |
| Amoxicillin                          | β-Lactam                     | 105| 23.1   |
| Ampicillin                           | β-Lactam                     | 126| 27.8   |
| Ascorbic Acid                        | Vitamin                      | 448| 98.7   |
| Azithromycin                         | Macrolide                    | 198| 43.6   |
| Ciprofloxacin                        | Fluoroquinolon               | 228| 50.2   |
| Dextrometorphan (D-Amphetamin)       | Stimulant                    | 45 | 9.9    |
| Diclofenac                           | Nonsteroidal Anti-Inflammatory | 198| 43.6   |
| Gentamicin                           | Aminoglycoside               | 54 | 11.9   |
| Mebendazole                          | Antiparasitic                | 36 | 7.9    |
| Norfloxacin-Metronidazole            | Fluoroquinolon-Antiprotozoal | 89 | 19.6   |
| Paracetamol                          | Analgesic-Antipyretic        | 405| 89.2   |
| Vitamin B (Complex)                  | Vitamin                      | 129| 28.4   |

Ei: population; Fi: frequency, n=454
3.9. Factors associated with self-medication during this study

Six factors are associated with self-medication with antimalarials in this study. These are age (31-46 years and over 61), monthly income (US$ 50 - 150 USD), religion (Catholic), profession (Trader), Belong to a health science, prior use of traditional medicine and the pretension of knowledge of antimalarials (Table 5).

Table 5 Factors associated with anti-malarial self-medication in Bukavu.

| Gender | Factor                      | Self-medication | OR (IC 95 %)     | \( \chi^2 \) test | \( \text{aP value} \) | \( \text{bP value} \) |
|--------|-----------------------------|-----------------|------------------|------------------|------------------|------------------|
| Male   | Yes                         | 146             | 165              | 1.816 (1.27 - 2.59) | 0.2114           | 0.2114           |
| Female | No                          | 308             | 164              |                  |                  |                  |
|       | [16 - 31]                   | 70              | 91               | 0.92 (0.62 - 1.40) | 0.7565           |                  |
|       | [31 - 46]                   | 247             | 60               | 0.19 (0.12 - 0.28)| < 0.0001         |                  |
|       | [35 - 61]                   | 104             | 125              | 0.92 (0.62 - 1.40)| 0.7565           |                  |
| Monthly income | >61                   | 33              | 36               | 0.91 (0.53 - 1.60)| 0.7834           |                  |
|       | [50 - 150]                  | 291             | 19               | 24 (13 - 45)     | < 0.0001         | < 0.0001         |
|       | [150 - 200]                 | 36              | 57               | 1.86 (0.58 - 3.13)| 0.195            |                  |
|       | [200 - 250]                 | 45              | 25               | 0.35 (0.18 - 0.67)| 0.4293           |                  |
|       | > 300                       | 9               | 37               | 7.4 (3.10 - 18.00)| < 0.0001         |                  |
| Religion | Bramanist               | 1               | 1                | 0.73 (0.05 - 12.00)| 1                | 0.0205           |
|         | Catholic                   | 272             | 108              | 3.10 (2.30 - 4.20)| < 0.0001         |                  |
|         | Kimbanguist                | 1               | 1                | 0.73 (0.05 - 12.00)| 1                |                  |
|         | Jehovah’s Witness          | 14              | 5                | 2.08 (0.74 - 5.82)| 0.2389           |                  |
|         | Muslim                     | 5               | 2                | 1.80 (0.35 - 9.50)| 0.7051           |                  |
|         | Non-practicing             | 5               | 1                | 3.70 (0.43 - 32.00)| 0.4097           |                  |
|         | Protestant                 | 123             | 88               | 1.00 (0.75 - 1.40)| 0.9351           |                  |
|         | Revival Church             | 36              | 30               | 0.86 (0.52 - 1.43)| 0.6036           |                  |
| Profession | Trader                | 114             | 10               | 10.76 (5.54 - 20.91)| < 0.0001         | < 0.0001         |
|         | Farmer                     | 81              | 90               | 0.74 (0.53 - 1.01)| 0.0624           |                  |
|         | Teacher                    | 9               | 6                | 1.10 (0.39 - 3.11)| 1                |                  |
|         | State worker               | 36              | 26               | 1.01 (0.60 - 1.71)| 1                |                  |
|         | Service provider           | 27              | 19               | 1.04 (0.57 - 1.90)| 1                |                  |
|         | No                         | 114             | 10               | 10.76 (5.54 - 20.91)| < 0.0001         |                  |
| Marital status | Single          | 145             | 105              | 1.010 (0.75 - 1.37)| 1                | 0.9976           |
|         | Divorced                   | 9               | 6                | 1.10 (0.39 - 3.11)| 1                |                  |
|         | Married                    | 281             | 207              | 0.97 (0.73 - 1.30)| 0.8817           |                  |
|         | Widower                    | 18              | 13               | 1.77 (0.85 - 3.68)| 0.1394           |                  |
|         | Belong to a health science | Yes             | 200              | 6                | 0.42 (0.20 - 0.90)| 0.0291           | < 0.0001         |
|         | No                         | 54              | 325              |                  |                  |                  |
|         | Having used traditional medicine | Yes    | 390              | 1                | 410.5 (52.27 - 3224)| < 0.0001         | < 0.0001         |
|         | No                         | 19              | 20               |                  |                  |                  |
|         | Knowledge of antimalarials | Yes             | 408              | 10               | 255 (74.67 - 870.80)| < 0.0001         | < 0.0001         |
|         | No                         | 4               | 25               |                  |                  |                  |

\( a \): bivariate analysis; \( b \): multivariate analysis
4. Discussion

This study completes the extent, associated factors, and characteristics of self-medication during the management of malaria in people attending 5 public hospitals in the city of Bukavu between January and June 2018. The results show that the city is experiencing self-medication using both conventional and traditional medicine.

Despite respondents are informed about self-medication risks (Figure 2), many of them resort to it with a higher frequency (57.8%) than that observed in other regions such as the Middle East: 43% [44], Mbeya in Tanzania: 19% [27], Antananarivo: 22 % [45] but less than that observed from Saudi Arabia 98% [23], Jordan 100% [46] or Bangladesh 100% [47].

Fever associated to one or more other symptoms (Figure 1) was the major sign conducting people to self-diagnosed malaria; as fever is known to be a major symptom of malaria according to World Health Organization: WHO, and many other accepted guidelines for the management of malaria [48]. Self-medication with antimalarials products would be favored by the low level of education (Table 1) and the easy access to antimalarials drugs, which are supposed to be dispensed only on medical prescription. Furthermore, the various signs of self-diagnosis of malaria mentioned by interviewed (Figure 1) suggest that, the kind of malaria generally treated in self-medication concerns the simple malaria. In this context, the high use of quinine by self-medicated people (91.4%) would be considered as an irrational use of medication, as is observed in most cases of self-treatment [49–51] especially since quinine is normally used in 2nd or 3rd intention or in case of severe malaria [8,52,53].

People resorting to self-medication have given several reasons motivating them such as time saving and the law cost of self-treatment as mentioned in other previous studies [54–56]. A possible approximation can be established between the average monthly income of respondents (100 ± 8 USD) and the average cost of malaria care in biomedicine (56 ± 15.5 USD) suggesting that very likely, the use of self-medication would be very related to financial reasons which is also one of the factors associated with self-medication during this study.

The first instigator of self-medication is the parent as in some previous studies [20,23]. In a country where almost, the entire population does not have health insurance, it seems very likely that the practice of self-medication will start in the family. This familiarity is also observed in the transmission of self-medication information (Figure 4c) where the subjects mainly use the knowledge that underpins the health sciences.

The use of the Artemether-Lumefantrine (Table 3) combination is in accordance with the treatment regimens proposed by the WHO for the management of uncomplicated malaria, visibly managed by self-medication by the patients interviewed. However, cases of irrational use with non-adherence to dosage were encountered during the interview. Indeed, some informants use this combination for a period of 7 days while in the hypothesis of simple malaria, the treatment is 3 days. The same is true of quinine, the rational use of which requires administration every 8 hours [48,57].

Regarding drugs associated with antimalarials (Table 4), the high use of ascorbic acid and paracetamol can be explained respectively for the immunomodulatory and anti-free radical effects of ascorbic acid and on the other hand, by the symptomatic management of fever and headache from paracetamol during malaria infection. However, the use of the other different antibiotics (Table 4) cannot be explained except in the case of co-infection. Otherwise, it would simply be irrational use. This practice could lead to cases of high resistance against most of these different molecules which do not have an antiplasmodial spectrum.

The use of medicinal plants as the first line approach is a practice recognized by 80% of the world population for the primary health care [58–60]. In this study, we observed a high rate (390/454: 86%) of malaria self-medication with medicinal plants suggesting that the use of medicinal plants in Bukavu is popular knowledge.

Six factors are associated with antimalarials self-medication in this study: age, monthly income, religion, membership in a health science, previous use of traditional medicine and the claim of knowledge of antimalarials unlike two studies where the associated factor was education [61,62], and in accordance with the works for which the age [25,63] and previous self-medication [63,64] were associated factors.
5. Conclusion
The malaria self-treatment is a very common practice in Bukavu in both modern and traditional medicine. Several drugs reported in self-medication against malaria are used irrationally. This practice deserves special attention in the fight against malaria in DR Congo.

Compliance with ethical standards

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Disclosure of conflict of interest
The authors declare no conflict of interests.

Statement of ethical approval
Ethical approval was granted from the Department of Pharmacology in the Faculty of Pharmaceutical Sciences at the University of Lubumbashi (UNILU/FSP/DPCOL/PT/003/2017).

Statement of informed consent
"Informed consent was obtained from all individual participants included in the study."

References
[1] Dufera M, Dabsu R, Tiruneh G. Assessment of malaria as a public health problem in and around Arjo Didhessa sugar cane plantation area, Western Ethiopia. BMC Public Health. 2020; 20(1): 1–10.
[2] Gebretsadik D, Feleke DG, Fiseha M. Eight-year trend analysis of malaria prevalence in Kombolcha, South Wollo, north-central Ethiopia: A retrospective study. Parasites and Vectors. 2018; 11(1): 1–6.
[3] Kuesap J, Na-Bangchang K. The effect of ABO blood groups, hemoglobinopathy, and heme oxygenase-1 polymorphisms on malaria susceptibility and severity. Korean J Parasitol. 2018; 56(2): 167–173.
[4] Kumar H, Tolia NH. Getting in: The structural biology of malaria invasion. PLoS Pathog. 2019; 15(9): 1–10.
[5] Kogan F. Malaria Burden. In: Remote Sensing for Malaria. Springer Remote Sensing/Photogrammetry. Springer, Cham: Cham, Switzerland, 2020: 320.
[6] Yanow SK, Good MF. Nonessential research in the new normal: The impact of COVID-19. Am J Trop Med Hyg. 2020; 102(6): 1164–1165.
[7] WHO. World malaria report 2018. WHO Press: Geneva, 2018.
[8] WHO. World Malaria Report 2019. WHO Press: Geneva, 2019.
[9] WHO. World Malaria Report 2017. WHO Press: Geneva, 2017.
[10] Cibangu KR, Bilonda MA, Kabengele ME, Mulewu NH, Ciamala MP, Kanyiki KM, et al. Mutual Health Insurance and Access to Care in the Health Zone of Kabinda, Kasai-Oriental, Democratic Republic of Congo (DRC). OALib. 2017; 4(4): 1–11.
[11] Guillaume KMA, Christophe BTJ, Christine KB, Henock MKJ, Anaclet MM, Valentin KB, et al. Factors Associated with Inequalities in Access to Health Care to Mbujimayi (Kasai Oriental/DR Congo). OALib. 2019; 6(10): 1–17.
[12] Van Lenthe M, Van Der Meulen R, Lassovski M, Ouabo A, Bakula E, Badio C, et al. Markers of sulfadoxine-pyrimethamine resistance in Eastern Democratic Republic of Congo; Implications for malaria chemoprevention. Malar J. 2019; 18(1): 1–9.
[13] Helal RM, Abou-Elwafa HS. Self-medication in university students from the city of mansoura, Egypt. J Environ Public Health. 2017; 9145193.
[14] Gbagbo FY, Nkrumah J. Self-medication among pregnant women in two municipalities in the Central Region of Ghana. Health Care Women Int. 2020; 1–16.

[15] Rodrigues CF. Self-medication with antibiotics in Maputo, Mozambique: practices, rationales and relationships. Palgrave Commun. 2020; 6(1): 1–12.

[16] De Sanctis V, Soliman AT, Daar S, Di Maio S, Elalaily R, Fiscina B, et al. Prevalence, attitude and practice of self-medication among adolescents and the paradigm of dysmenorrhea self-care management in different countries. Acta Biomed. 2020; 91(1): 182–192.

[17] Gras M, Champel V, Masmoudi K, Liabeuf S. Self-medication practices and their characteristics among French university students. Therapies. 2020; 75 (1): 165-167.

[18] Zyoud SH, Sawalmeh SN, Khadrah HA. Parental Knowledge, Attitudes, and Practices Towards Self-Medication for Their Children: a Cross-Sectional Study from Palestine. J Asia Pacific Fam Med. 2019; 18(1): 1–9.

[19] Potchoo Y, Awizoba A. Socio-Demographic Factors of Parental Self-Medication among Children under 15 Years, at the Teaching Hospitals of Lomé, Togo. J Adv Med Pharm Sci, 2018; 18(1): 1–6.

[20] Bashige CV, Manya MH, Bakari AS, Sangwa KG, Kahumba BJ, Pierre D, et al. Prévalence et caractéristiques de l’automédication chez les étudiants de 18 à 35 ans résidant au campus de la Kasapa de l’Université de Lubumbashi. Pan Afr Med J. 2015; 21: 107.

[21] Karimy M, Rezaee-Montaz M, Tavousi M, Montazeri A, Araban M. Risk factors associated with self-medication among women in Iran. BMC Public Health. 2019; 19(1): 1–7.

[22] Tuyishimire J, Okoya F, Adebayo AY, Humura F, Lucero-Prisno DE. Assessment of self-medication practices with antibiotics among undergraduate university students in Rwanda. Pan Afr Med J, 2019; 33: 1–7.

[23] Alshahrani SM, Alavudeen SS, Alakhal KM, Al-Worafi YM, Bahamand AK, Vigneshwaran E. Self-medication among king khalid university students, Saudi Arabia. Risk Manag Healthc Policy. 2019; 12: 243–249.

[24] Tuyishimire J, Okoya F, Adebayo AY, Humura F, Lucero-Prisno DE. Assessment of self-medication practices with antibiotics among undergraduate university students in Rwanda. Pan Afr Med J, 2019; 33: 1–7.

[25] Iwuafor AA, Udoh UA, Ita OI, Ekeng BE, Irokanulo U, Abraka BA. Awareness of the National Antimalarial Treatment Policy and Malaria Self-care Practices among Medical Students and the Staff of the University of Calabar, Nigeria. Saudi J Pathol Microbiol. 2019; 4(11): 803–812.

[26] Atinsounon CA, Sissinto Y, Avokpahoe E, Alassani A, Sanni M, Zannou M. Self-Medication Practice against Malaria and Associated Factors in the City of Parakou in Northern Benin: Results of a Population Survey in 2017. Adv Infect Dis. 2019; 9(03): 263–275.

[27] Kajeguka DC, Moses EA. Self-medication practices and predictors for self-medication with antibiotics and antimalarials among community in Mbeya City, Tanzania J Health Res. 2017; 19(4): 1–10.

[28] Hertz JT, Madut DB, Tesha RA, William G, Simmons RA, Galson SW, et al. Self-medication with non-prescribed pharmaceutical agents in an area of low malaria transmission in northern Tanzania: A community-based survey. Trans R Soc Trop Med Hyg. 2019; 113(4): 183–188.

[29] Kimoloi S, Nicky O, Onidgo BM, Langat BK. Choice and sources of antimalarial drugs used for self-medication in Kisumu, Western Kenya. Afr J Pharm Ther. 2013; 2(4): 124–129.

[30] Mossa DA, Wabe NT, Angamo MT. Güney Etiyopya silte zone toplumunda antibiyotikler ve antimalaryallerle kendi kendini tedavi. TAF Prev Med Bull. 2012; 11(5): 529–536.

[31] Kamitalu KR, Aloni MN. High School Students Are a Target Group for Fight-Self-Medication with Antimalarial Drugs: A Pilot Study in University of Kinshasa, Democratic Republic of Congo. J Trop Med. 2016; 30–32.

[32] Ilunga-Ilunga F, Levêque A, Dramai M. Influence de l’âge et du niveau de transmission sur l’expression clinique et biologique du paludisme grave de l’enfant. Arch Pediatr. 2016; 23(5): 455–460.

[33] Mukomena SE, Philippe CM, Désiré MK, Pascal LT, Ali MM, Oscar LN. Parasitémie asymptomatique chez les enfants de moins de 5 ans, enfants en âge scolaire et prise en charge des épisodes fébriles dans les ménages de Lubumbashi, république démocratique du Congo. Pan Afr Med J. 2016; 24: 1–7.
[34] Bunduki G, Mumbere M, Mbahweka F. Assessment of Antibiotic Self-medication Pattern among University Students in Eastern Democratic Republic of the Congo. J Pharm Res Int, 2017;18(1): 1–7.

[35] Mavoko HM, Kalabuanga M, Delgado-Ratto C, Maketa V, Mukele R, Fungula B, et al. Uncomplicated clinical malaria features, the efficacy of artesunate-amodiaquine and their relation with multiplicity of infection in the Democratic Republic of Congo. PLoS One, 2016; 11(6): 1–5.

[36] Mandoko PN, Sinou V, Mbongi DM, Mumba DN, Mesia GK, Likwela JL, et al. Access to artemisinin-based combination therapies and other anti-malarial drugs in Kinshasa. Med Mal Infect. 2018; 48(4): 1–9.

[37] Ngatu NR, Kanbara S, Renzaho A, Wumba R, Mbelambela EP, Muchanga SMJ, et al. Environmental and sociodemographic factors associated with household malaria burden in the Congo. Malar J. 2019; 18(53): 1–9.

[38] Mbarangara PM, Songa PB, Wansubi LM, Mututa PM, Minga BBK. Self-medication practice among pregnant women attending antenatal care at health centers in Bukavu, Eastern DR Congo. Int J InnoV Appl Stud 2016; 16(1): 38–45.

[39] Salama B, Bavurhe BZ, Kadima JN. Management of Acute Respiratory Infections in Children under Five by Self-medication and Prescription of Antibiotics in Bukavu. Int J Trop Dis Heal, 2020; 40(4): 1–10.

[40] Malembaka EB, Karemere H, Bisimwa Balaluka G, Altare C, Odikro MA, Lwamushi SM, et al. Are people most in need utilising health facilities in post-conflict environments? A cross-sectional study from South Kivu, eastern DR Congo. Glob Health Action. 2020; 13(1).

[41] Nobile A, Dille A, Monsieurs E, Basimike J, Bibentyo TM, d’Oreye N, et al. Multi-temporal dinsar to characterise landslide ground deformations in a tropical urban environment: Focus on Bukavu (DR Congo). Remote Sens. 2020; 12(4): 1–18.

[42] Bisimwa NP. Evidence of African Swine Fever Virus in Pigs Slaughtered at Muhanzu Municipal Abattoir in Bukavu City, Eastern of Democratic Republic of Congo. Int J Microbiol Biotechnol. 2019; 4(1): 1.

[43] Mboni HM, Keymeulen F, Ngezahayo J, Amuri SB, Mutombo BK, Byanga JK, et al. Antimalarial herbal remedies of Bukavu and Uvira areas in DR Congo: An ethnobotanical survey. J Ethnopharmacol. 2019; 249(1): 112422.

[44] Khalifeh MM, Moore ND, Salameh PR. Self-medication misuse in the Middle East: a systematic literature review. Pharmacol Res Perspect. 2017; 5(4): 1–13.

[45] Sendrasoa FA, Razanakoto NH, Ranavo IM, Andrianasolo RL, Jean M, Randria DD, et al. Antibiotic and medication practice observed by community pharmacists in Jordan. Saudi Pharm J. 2020; 28(3): 233–237.

[46] Gogazeh E. Dispensing errors and self-medication practice observed by community pharmacists in Jordan. Saudi Pharm J. 2020; 28(3): 233–237.

[47] Sarker R, Moonajilin MS. Knowledge, Attitude & Practice of Self-Medication with Painkillers among Young Adults, Bangladesh. Int J Public Heal Res. 2020; 10(1): 1174–1182.

[48] WHO. Guidelines for the treatment of Malaria-3rd edition. WHO Press. WHO Press: Geneva, 2015.

[49] Sunny T, Jacob R, KK Varghese S. Self-medication: Is a serious challenge to control antibiotic resistance? Natl J Physiol Pharm Pharmacol. 2015; 9(9): 821–827.

[50] Arshiya A, Shaji AK, Sunny T, Cherian RS, Vishwanath BA. A Study on Self-Medication Practice among Nursing Pharmacy and B. Arch Students in a Private Institution. J Drug Deliv Ther. 2020; 10(3S): 82–85.

[51] Fekadu G, Dugassa D, Negera GZ, Woyessa TB, Turi E, Tolossa T, et al. Self-medication practices and associated factors among health-care professionals in selected hospitals of western ethiopia. Patient Prefer Adherence. 2020; 14: 353–361.

[52] Bruneel F, Raffetin A, Corne P, Ltitjos JF, Mourvillier B, Argaud L, et al. Management of severe imported malaria in adults. Med Mal Infect. 2020; 50(2): 213–225.

[53] Leblanc C, Vasse C, Minodier P, Mormand P, Naudin J, Quinet B, et al. Management and prevention of imported malaria in children. Update of the French guidelines. Med Mal Infect. 2020; 50(2): 127–140.

[54] Abdi A, Faraji A, Dehghan F, Khatory A. Prevalence of self-medication practice among health sciences students in Kermanshah, Iran. BMC Pharmacol Toxicol. 2018; 19(1): 1–7.

[55] Lei X, Jiang H, Liu C, Ferrier A, Mugavin J. Self-medication practice and associated factors among residents in Wuhan, China. Int J Environ Res Public Heal. 2018; 15(68): 1–10.
[56] Majid N, Vatankhah S. Prevalence and Cause of Self-Medication in Iran: A Systematic Review and Meta-Analysis on Health Center Based Studies. J Biochem Tech. 2019; 1(2): 90–105.

[57] Hanboonkunupakarn B, White NJ. The threat of antimalarial drug resistance. Trop Dis Travel Med Vaccines. 2015; 2(1): 1–5.

[58] Jamshidi-Kia F, Lorigooini Z, Amini-Khoei H. Medicinal plants: Past history and future perspective. J HerbMed Pharmacol. 2018; 7(1): 1–7.

[59] Singh S, Singh DB, Singh S, Shukla R, Ramteke PW, Misra K. Exploring Medicinal Plant Legacy for Drug Discovery in Post-genomic Era. Proc Natl Acad Sci India Sect B - Biol Sci. 2019; 89(4): 1141–1151.

[60] Wang W, Xu J, Fang H, Li Z, Li M. Advances and challenges in medicinal plant breeding. Plant Sci, 2020; 298(9): 110573.

[61] Mwita S, Meja O, Katabalo D, Richard C. Magnitude and factors associated with anti-malarial self-medication practice among residents of Kasulu Town Council, Kigoma-Tanzania. Afr Health Sci. 2019; 19(3): 2457–2461.

[62] Oche OM, Godwin GJ, Yahaya M, Gambo AA, Abdulkarim A. Prevalence and Factors Associated with Self Medication Among People Living in Urban Slums of Sokoto Metropolis, Sokoto State, Nigeria. Cent African J Public Heal. 2019; 5(6): 302–309.

[63] Douine M, Lazrek Y, Blanchet D, Pelleau S, Chanlin R, Corlin F, et al. Predictors of antimalarial self-medication in illegal gold miners in French Guiana: A pathway towards artemisinin resistance. J Antimicrob Chemother. 2018; 73(1): 231–239.

[64] Kassie AD, Bifftu BB, Mekonnen HS. Self-medication practice and associated factors among adult household members in Meket district, Northeast Ethiopia, 2017. BMC Pharmacol Toxicol, 2018; 19(1): 4–11.