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Qualitative analysis of the acceptability of community health workers for malaria prevention and management in Burkina Faso

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Abstract

Background In Burkina Faso, few studies focused on the factors that influence the satisfaction of populations benefiting from health interventions and that may lead to low acceptability of these interventions and even affecting their effectiveness. The aim of this study was to collect data and to analyse the conditions that promote the integration/acceptability of community health workers (CHWs) in order to improve access to malaria prevention and care for the most vulnerable populations in Burkina Faso.

Methods The study used a qualitative approach. Data were collected through focus groups centred on the experiences of local populations in November 2022, before the introduction of CHWs in six villages by the REACT 2 initiative in the Diébougou health district of Burkina Faso in 2021. The focus groups included all future beneficiaries of the CHW-based programme (12-13 volunteer participants per group). Data were analysed using two complementary approaches: a lexical approach (lexicometric analysis) and a thematic approach (content analysis).

Results Six factors that may influence the CHWs' social acceptability were identified: the participants' level of knowledge on malaria, use of traditional medicine, geographical and financial accessibility to modern medicine, participants' perceptions of the intervention, and CHWs' sociodemographic and professional profiles. Participants identified multiple benefits, showed strong interest in the initiative, and considered all activities acceptable. The CHWs' permanent presence in the village and their belonging to the village were positive elements. Local beliefs about malaria and the continued use of traditional medicine could negatively influence the CHWs' acceptability. Moreover, participants expected CHWs to be qualified and to ~~respect~~ reflect a set of social values: availability, willingness, honesty, responsibility, attentiveness, and respect.

Conclusions To ensure the effectiveness and sustainability of health programmes relying on CHWs' activities, health authorities and policymakers must give greater consideration to the population

perceptions, expectations and needs when allocating CHWs for the implementation of such programmes.

Trial registration The REACT 2 project was a step-wedged cluster randomized controlled trial (ClinicalTrials.gov: (NCT05535465).

Keywords Malaria, community health worker, acceptability, rural communities, Burkina Faso

Background

Despite the World Health Organization recommendations, many populations still lack access to quality healthcare services for malaria diagnosis, treatment and prevention particularly, in the twelve most affected countries by malaria, including Burkina Faso (1). In 2013, the Third Global Forum on Human Resources for Health concluded that community health workers (CHWs), together with frontline primary healthcare providers, “play a unique role that can be essential in accelerating the achievement of the Millennium Development Goals and universal health coverage” (2). CHW-based programmes strengthen and expand the existing healthcare services by reaching vulnerable and marginalized populations (3), and have a significant impact on malaria-related mortality and morbidity (4).

In Burkina Faso, the number of malaria cases recorded by healthcare centres in 2024 was 10,805,020, with 563,308 hospitalizations and 3,523 deaths (5). In this country, CHWs started to be trained in malaria care in 2010 (6). According to the Burkina Faso National Community Health Strategy, CHWs working within five kilometres of a Health and Social Promotion Centre (HSPC) are trained to provide curative care, and those located more than five kilometres from a HSPC must provide health promotion, prevention and support services, and refer patients in need of medical care to the HSPC (7). However, CHWs’ use for malaria management remains limited, primarily due to insufficient support from the authorities and policymakers, and their inadequate integration into the healthcare system (8). Furthermore, key factors contributing to the success of these programmes, such as community perception and CHWs’ acceptance, CHWs’ motivation, and individual and community perceptions of CHW-based interventions, remain insufficiently explored(9–11).

Several interventions involving CHWs have been launched in Burkina Faso, including ~~the~~ one implemented by the REACT 2 project in the south-western region. The REACT 2 intervention consisted in deploying, in each village, 1 CHW for a maximum of 35 households, supervised by a mobile health provider who helped the CHW to manage drug supplies, rapid diagnostic tests (RDTs) and mosquito nets, and to report on malaria prevention and case management activities. To evaluate this

intervention strategy, a randomized controlled trial was conducted in the Diébougou Health District in southwestern Burkina Faso. The objective of the present study was to analyse the conditions for the acceptability of CHWs' deployment before the rollout of the REACT 2 project intervention.

Methods

Theoretical considerations on the concept of acceptability

Acceptability refers to how an intervention is perceived by the target population, how the intervention, or its various components, can meet the needs of the population, and how it can be integrated in the organizational context in which it is implemented (12). Acceptability influences the intervention implementation, adoption, adherence and also the expected outcomes and overall effectiveness (13,14). A public health intervention that is not accepted by its proponents or beneficiaries is difficult to implement and to evaluate (15).

For this study, the theoretical framework of acceptability (TFA) developed by (16) for the analysis of health interventions was employed. This framework provides guidance for the quantitative and qualitative assessment of the acceptability of a health intervention, from the providers and beneficiaries' perspectives, prospectively or retrospectively. The TFA has seven key dimensions: affective attitude, perceived burden, intervention coherence, perceived effectiveness, self-efficacy, opportunity costs, and ethicality (Fig. 1).

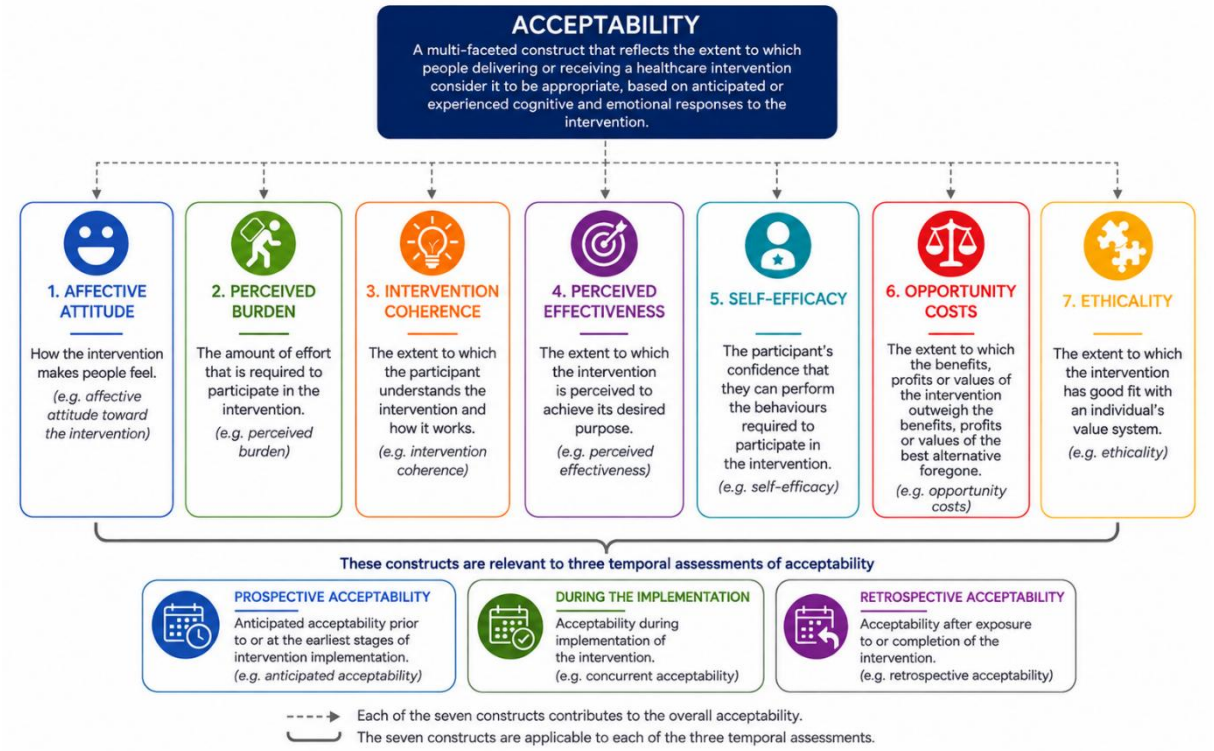


Fig. 1 The seven dimensions of the theoretical framework of acceptability (adapted from (16))

Study area

The study was conducted in the province of Bougouriba, in the South-West of Burkina Faso (Fig. 2). This province comprises four rural municipalities (Bondigui, Dolo, Iolonioro, and Tiankoura) and one urban municipality (Diébougou) (17). According to the latest general population and housing census in Burkina Faso carried out in 2019 (18), the estimated population number in the province was 153,653, (51.19% of women). Economically, the region is primarily agricultural, but trade and craft industries are also strongly developed, and mining activities are rapidly growing (18).

The main languages are Dagara (22.2%), Mooré (21.2%), Lobiri (20.0%), Birifor (11,1%), Dyan (9,9%), Dioula (5,5%), Fulfuldé (3,5%) and others (6,6%) (17). Overall, 69.1% of the population does not have any formal education and 19.2% has completed primary education (18).

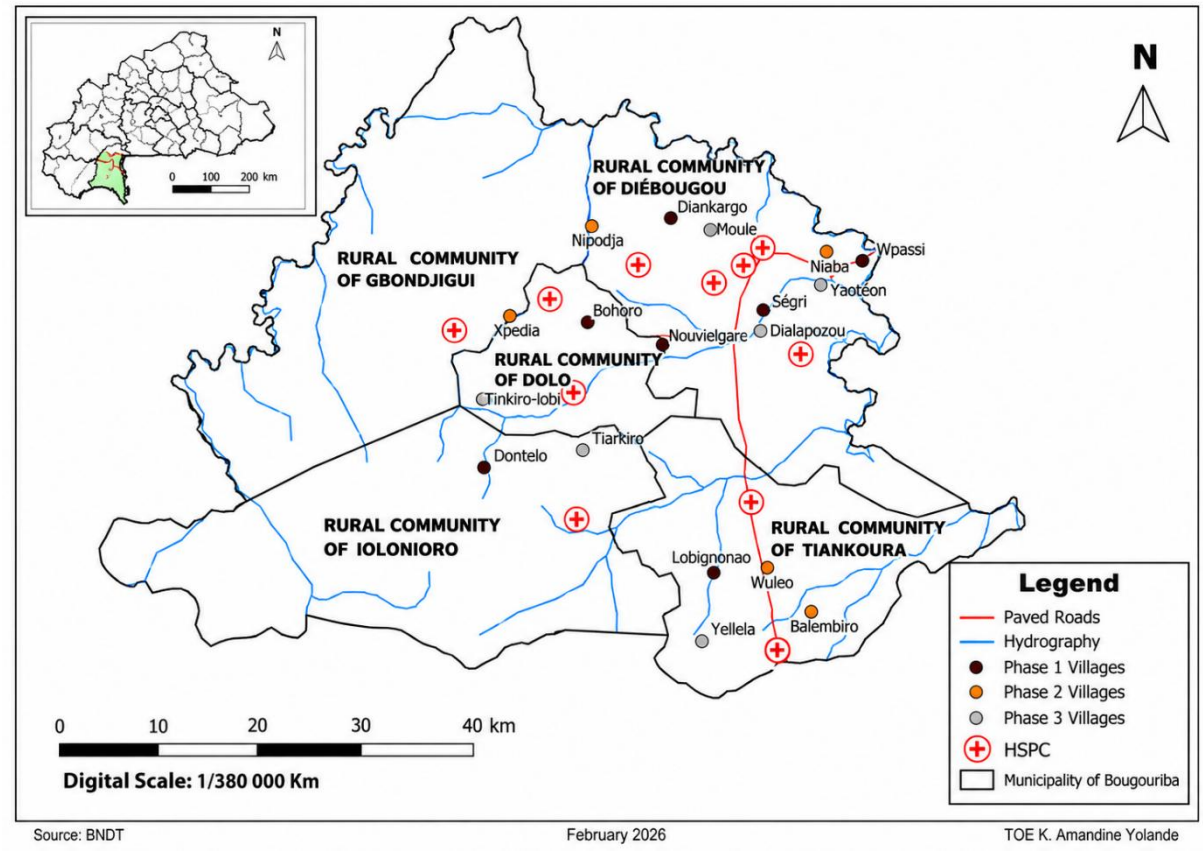


Fig. 2 Presentation of the study area

Study background

The REACT 2 project was a step-wedged cluster randomized controlled trial (ClinicalTrials.gov: (NCT05535465) to improve access to malaria prevention, diagnosis and care for vulnerable rural communities. This approach allowed all the included communities to benefit from the intervention and for the same community, to collect data during the control phase and the intervention phase, thereby improving comparability. The intervention involved the deployment of CHWs supervised by a mobile medical team. Three main differences distinguish the REACT 2 programme from the national strategy: (1) a more favourable CHW-to-population ratio: 1 CHW for a maximum of 35 households (while the national strategy stand with 2 CHWs per village) (2) free access to malaria prevention, diagnosis and treatment for all village residents, regardless of age; (3) enhanced support for CHWs,

based on more frequent supervision and higher financial incentives. In the framework of the REACT 2 project intervention, CHWs are responsible for raising public awareness of malaria through home visits, one-to-one discussions and group discussions. They are also required to diagnose malaria, administer artemisinin-based treatments for uncomplicated cases, and refer severe cases of malaria and other diseases beyond their scope of practice to the appropriate healthcare facilities. When a person presents with fever or history of fever (axillary temperature ≥ 37.5 °C), a RDT, which requires collecting a small amount of blood from the fingertip, is carried out, free of charge. If the RDT is positive, the person is treated, free of charge, in accordance with the national guidelines for the management of uncomplicated malaria (i.e. artemisinin-based combination therapy). If the RDT is negative, the person is referred to the nearest HSPC.

The REACT 2 intervention was carried out in 18 villages in the Diébougou district, organized in three phases, each involving six villages (Figure 2). It was overseen by 11 HSPCs. The selected villages were located more than 5 km from their designated HSPC and at least 2 km apart from one another (Table 1). The present study was carried out in the six villages in the third phase of the intervention, i.e. those in which it had not been rolled out yet: Bohero, Dialanpozou, Moulé, Tiarkiro, Yaotéon and Yellela (Fig. 2).

Data collection

A qualitative approach was adopted to analyse the conditions for the REACT 2 intervention acceptability, based on data collected at local communities. To this end, focus groups were organized to gather information on the community norms and beliefs about the intervention.

At each village, a focus group discussion (men and women) was conducted, following a semi-structured interview guide to explore the social acceptability of the REACT 2 intervention. The guide first explored the participants' knowledge and perceptions of malaria, including its causes, symptoms, treatment and

prevention, as well as the barriers to seeking care at healthcare facilities and the potential influence of free healthcare and transportation costs. The second part was structured around the seven constructs of the TFA: intervention coherence, affective attitude, burden, ethicality, opportunity costs, perceived effectiveness, and self-efficacy. Questions explored the participants' understanding of the CHWs' role, their feelings and perceptions towards the intervention, the effort and time required to engage with CHWs, the intervention compatibility with local values and practices, perceived advantages and alternatives to the CHW's services, perceptions of the CHW's effectiveness, and confidence in and recommending the CHW's services. The guide also explored potential barriers related to the CHWs' gender and place of origin and specific practices, such as blood sampling for malaria RDT and household visits to inspect mosquito nets (presence or absence physical integrity). This format was chosen to encourage a diversity of viewpoints and maximize the range of responses. Data were collected by audio-recording and analysed according to the TFA dimensions. A phase of direct field observation complemented the methodological approach. This helped to enrich the collected data by comparing the statements made with the observed practices and identifying any discrepancies between perception and reality.

Data processing and analysis

The transcripts from the six focus group discussions were translated into French and supplemented with direct observations. To minimize subjectivity in the analysis, a mixed-methods approach that combined lexicometric and thematic analyses was adopted (19,20).

The lexicometric analysis was carried out using the IRaMuTeQ software (https://pratinaud.gitpages.huma-num.fr/iramuteq-website/). A text corpus was compiled from the six transcripts. Then, a statistical analysis using Reinert's method (1984) was used to identify lexical

domains within the corpus (descending hierarchical classification) and to carry out comparisons (correspondence analysis).

Then, the thematic content analysis was carried out using the NVivo 14 software to refine the interpretation of the quantitative results and give them meaning. This method is based on assigning different discourse units to categories constructed using a coding framework (21)). The transcripts imported into the software were coded to identify recurring themes using a logic-semantic approach to qualitative text analysis.

The coding process was based on an evolving analysis grid, enabling the gradual development, over the course of the analytical process, of a code tree structured around key themes.

Results

Sociodemographic characteristics of the study population

In November 2022, six focus group discussions were conducted (n=12 participants in five villages and n=13 participants in the sixth). The participants' mean age was 42 years, and included household heads (41% among whom 41% were farmers) and their wives (43% among whom 49% were housewives) (Table 1).

Table 1 Sociodemographic characteristics of the participants in the six focus group discussions

Characteristics		**%**
Age (years)	Min	15
	Max	90
	Mean	42
Sex (%)	Male	51
	Female	49
Participants' family status (%)	Householder	41
	Child	16
	Spouse	43
Occupation (%)	Retired	3
	Farmer	41
	Student	3

	Livestock farmer	3
	Housewife	49
	Fisherman	1

Source: Survey data, November 2022

Analysis of the identified lexical classes

The corpus included the six texts corresponding to the six focus group discussions. It contained a total of 19,128 lexical occurrences that were divided into 1,176 distinct forms, including 451 hapaxes (forms appearing only once in the corpus; 2.4% of occurrences and 38.4% of forms). The mean number of occurrences per text was 3,188. The seven most frequently occurring forms were 'to go' (335; 28%), 'CHW' (175; 15%), 'children' (124; 11%), 'malaria' (117; 10%), 'hospital' (115; 10%), 'sick' (108; 9%) and 'to come' (105; 8%). The village of Bohero recorded the highest number of occurrences (5,241), followed by the villages of Yaotéon (3,097), Yellela (2,898), Dialanpozou (2,695), Tiarkiro (2,672) and Moulé (2,525).

Of the 520 text segments considered for the descending hierarchical classification, 430 could be classified (82.7% of the total corpus), confirming the quality and robustness of the obtained thematic structure. The descending hierarchical classification produced a class dendrogram to visualize the words that achieved the highest mean frequency and that differed from the others. The class dendrogram included only words that showed a chi-squared test (χ^2) value >3.84 and a p value <0.0001 (Fig. 3).

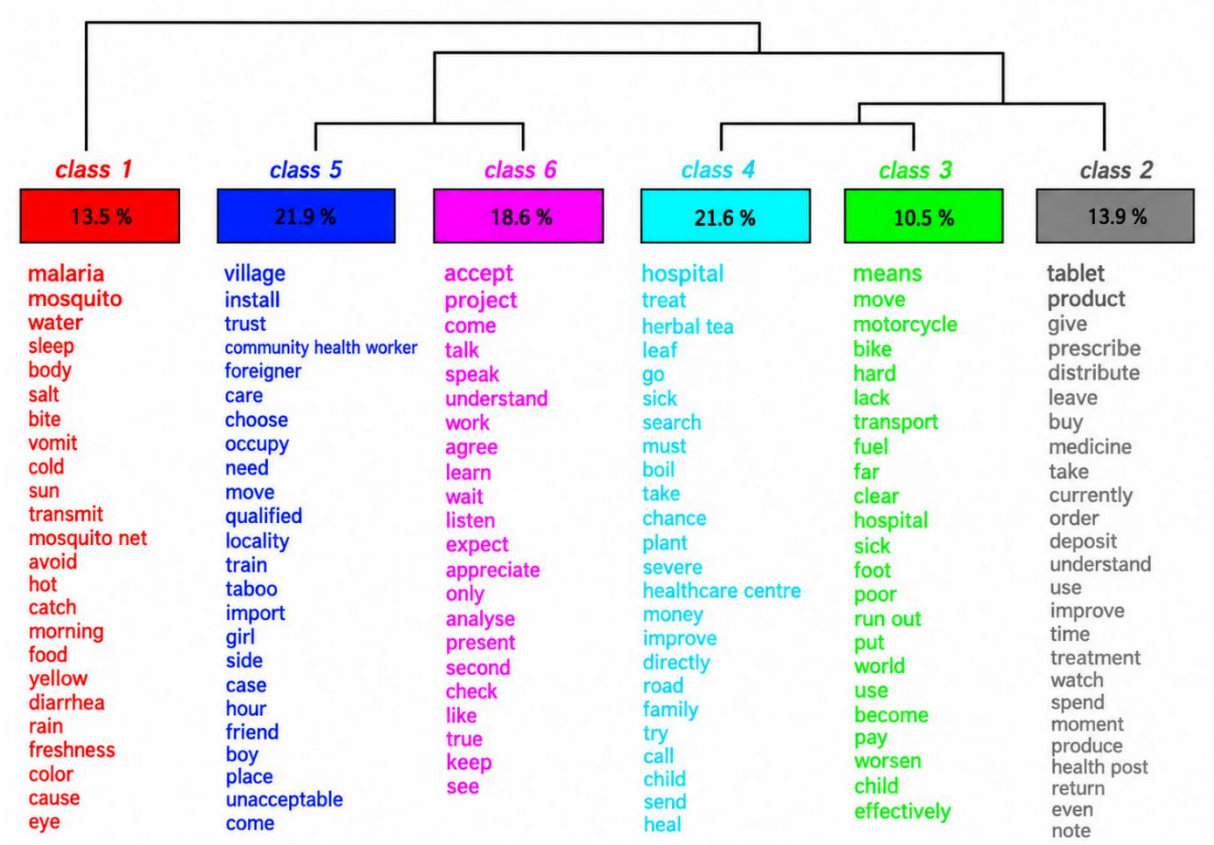


Fig. 3 Dendrogram showing the percentage of text segments in each class and the words with the highest chi-squared (χ^2) values. For each class, the most significant lexical forms are presented in descending order of contribution.

The dendrogram had two main branches. The first corresponded to Class 1 (13.5% of the text segments) and the second included the other five classes, which were divided into two sub-branches: Classes 4 (21.6%), 3 (10.5%) and 2 (13.9%); and Classes 5 (21.9%) and 6 (18.6%). Then, the classes were named according to the lexical and thematic clusters that characterized them.

Class 1 focused primarily on the theme of knowledge about malaria, with the term 'malaria' as its lexical core. It included words, such as 'mosquito', 'water', 'to bite', 'body', 'dirty', 'to transmit', 'to avoid', 'mosquito net', 'to sleep', 'to catch', 'sun', 'food' and 'morning', that relate to the perceptions of the causes and methods of malaria prevention and control. The analysis highlighted two modes of representation: i) a relatively accurate biomedical understanding of the modes of transmission and

prevention; and ii) some local beliefs, evident in the terms 'sun' and 'food', suggesting non-scientific explanations for malaria origin. Furthermore, the terms 'cold', 'hot', 'body', 'vomit', 'eye' and 'yellow' were associated with the perception of the disease symptoms, reflecting a symptomatic representation of malaria centred on observable physical manifestations.

Class 2 focused on the issue of affordability of modern treatments. It highlighted the material elements required for malaria treatment, such as 'tablet', 'product', 'to take', 'medicine' and 'treatment'. It also emphasized the need to use healthcare facilities, which involves travelling to healthcare centres for consultations and treatment, as indicated by the terms 'to go', 'to consult', 'HSPC, 'to go to', and 'to return'. This class also indirectly highlighted the economic constraints associated with malaria drugs, particularly through the words 'to prescribe', 'to buy' and 'prescription'.

Class 3 focused primarily on mobility to access healthcare, particularly modes of transport. It included terms, such as 'means', 'journey', 'motorbike' and 'bicycle'. A second set of terms ('difficulty', 'lack', 'distant', 'difficult', 'distance' and 'to manage') referred to the logistical constraints and the generally difficult travel context due to the lack of suitable transport infrastructure. These elements highlighted the issue of geographical accessibility to healthcare, particularly during the night ('night'). Furthermore, the terms 'petrol', 'to borrow', 'poverty' and 'to pay' reflected the socioeconomic constraints linked to the cost of transport, which was a further barrier to accessing healthcare facilities. Lastly, the words 'sick person' and 'child' referred to the categories of people concerned by these journeys, particularly vulnerable groups such as children.

Class 4 focused on traditional medicine, particularly the remedy types, the resources used for this purpose and the process ('to treat', 'herbal tea', 'leaf', 'to go', 'to look for', 'to force', 'to boil', 'plant', 'to wash'). The words 'hospital', 'to go', 'centre', 'health', 'to take', 'journey', 'money' refer to the reasons for resorting to folk medicine as first-line of defence and to visit the healthcare centre if no improvement is seen ('serious', 'improvement', 'to cure').

Class 5 focused on the CHWs' socio-professional characteristics, mainly on what was perceived as unacceptable and that would lead to lower adherence or refusal by the population ('unacceptable'). In this class, the words 'village', 'to set up', 'CHW', 'trust', 'locality', 'to come', 'outsider', 'to choose', 'taboo, 'to prevent', 'to prefer', 'to import', and 'side' indicated a preference for CHWs who are from and live in the village because they are perceived as more beneficial. The words 'girl', 'same' and 'boy' indicate indifference regarding the CHW's sex. The words 'to train' and 'qualified' referred to the characteristics of the CHW's work, particularly the idea that work must be carried out to a high standard, combined with high-quality training, mastery of tasks and availability ('to occupy', 'to move around', 'hour').

Lastly, Class 6 focused on the participants' perceptions of the intervention proposed by the REACT 2 project. The term 'project' was one of the core lexical items in this class. This class referred to the participants' relationship with the project across several dimensions: i) their level of information, illustrated by verbs such as 'to come', 'to hear', 'to talk' and 'to learn'; ii) their level of understanding, through the term 'present', suggesting a gradual familiarization with the intervention; and iii) an evaluative and normative dimension, characterized by expressions of a positive judgement, such as 'enjoyment' and 'to appreciate', and by the degree of acceptance of the project activities, expressed through the terms 'to accept', 'to agree', 'to expect', 'expectation', 'work' and 'quickly'.

Then, to establish a lexical distinction of the six classes and to provide an overview of the most fundamental differences in the corpus, a correspondence analysis was carried out (see Additional file 1).

The correspondence analysis distinguished Class 1 (knowledge of malaria) from the other five classes that were interconnected, revealing homogeneous discourses. Class 4 (traditional medicine) and Class 2 (affordability of modern treatments), which were also linked on the same branch of the dendrogram, were the closest to each another and were also closely related to Class 3 (mobility to access healthcare). This group was broadly focused on the theme of access to malaria treatment, highlighting

the participants' treatment options and the associated constraints (economic, geographical or related to healthcare practices). Class 5 (CHWs' socio-professional characteristics) and Class 6 (perception of the REACT 2 intervention) were closely related, highlighting the participants' perceptions of the project and their preferences that were centred on the CHWs' social and professional characteristics, considered to be key determinants of the intervention implementation success.

Thematic analysis of the conditions for acceptability

Then, a thematic analysis was carried out to support the six classes of factors that can influence the CHW's acceptability identified by the lexicometric analysis: the participants' level of knowledge of malaria; use of traditional medicine; geographical and financial accessibility to modern treatments; participants' perceptions of the intervention; and CHWs' sociodemographic and professional profiles.

Level of knowledge about malaria

Overall, before the intervention implementation, participants had a good understanding of the causes, symptoms and methods for preventing and controlling malaria, although local beliefs persisted. Most participants knew that mosquitoes transmit the disease through their bites. For a fairly significant proportion of them, malaria was linked to hygiene in their living environment. Wastewater and stagnant water, as well as high humidity are factors that encourage the proliferation of mosquitoes and must not be overlooked:

> *Sometimes the area is damp and there's water there too – the waste water from outside – and that's what breeds the mosquitoes; and if they bite the children, that's what causes malaria.* (FG1-P9, 41-50-year-old farmer)

However, in each village, a minority of participants held local beliefs that malaria transmission is linked to other factors, most often of a physical or dietary nature, such as the wind, the sun, the cold and the consumption of specific foods, particularly when eaten cold.

> *If you work for a long time in the sun, you'll catch malaria, and if you carry your baby on your back while working in the sun, they'll catch it too.* (FG4-P10, 41-50-year-old housewife)

There was also some confusion between transmission *via* a bite and the severe anaemia caused by the disease. Some participants thought that the blood drawn by the mosquito was the cause of the disease by leading to a reduction in the amount of blood in the body, thereby making the person ill, rather than through the transmission of a parasite:

> *When mosquitoes bite you a lot, they take a lot of blood from your body and you're no longer in good health, so that's what causes malaria.* (FG6-P2, 31-40-year-old farmer)

Participants had a good understanding of the malaria symptoms and identified a total of seven symptoms. Fever and vomiting were cited by almost all participants, followed, in order of occurrence, by chills, aching muscles, headaches, a change in the eye colour and diarrhoea:

> *If you touch their palms, they're really cold; their feet get cold too, and the child's whole body is hot.* (FG6-P11, 71-80-year-old housewife)

> *When you have malaria, you vomit, and if the person vomits, it's all yellow.* (FG5-P12, 31-40-year-old housewife)

The local population also had a good understanding of how to control and prevent malaria. Improving the living environment and using insecticide-treated bed nets were cited as the main tools for preventing malaria by most participants. They said that it was essential to prioritize good environmental hygiene to eliminate larval breeding sites by cleaning up their land and the immediate

surroundings, draining or reducing wastewater and stagnant water around homes, and keeping animals away from their land. It was also considered essential to sleep under a mosquito net and to protect children by dressing them in clothing that covers their skin to prevent mosquito bites:

> *Where we live, if you don't want to catch malaria, you have to sleep under a mosquito net. If you don't sleep under a mosquito net and a mosquito bites someone who has malaria and then comes and bites you, you'll be infected.* (FG3-P2, 31-40-year-old farmer)

Use of traditional medicine

Most participants reported that traditional herbal remedies (roots, stems, bark, leaves) were the first-line treatment for malaria. These remedies are administered through sponging, ingestion and purging. Thus, traditional practices persist despite the HSPC presence. People only turned to the HSPC as a secondary option when there was no improvement in their health following the herbal treatment, and also to confirm that they had malaria.

> *The reason we don't go straight to the clinic is that we're used to it. Back in the day, there were no hospitals, but malaria was rife, and we used herbal remedies to treat ourselves, and that was that. It is for this very reason that even today, despite the presence of health centres, some people prefer to try herbal remedies first, and only go to the clinic if there is no improvement.* (FG6-P1, 51-60-year-old farmer)

Priority was given to traditional treatments for cultural and economic reasons, as well as due to geographical accessibility, but also because of negligence or lack of willingness. The use of these remedies was regarded as a legacy because the elders used to treat themselves in this way before

329 healthcare centres existed, and not every illness can be treated at a HSPC. Furthermore, the
330 community had in-depth knowledge of these remedies and was accustomed to them.

331 However, a minority of participants said that they preferred to turn to modern healthcare services
332 (hospitals, HSPC) as their first port of call. For them, the immediate and most recommended course of
333 action was to go to these centres at the first symptoms of malaria, in order to confirm the diagnosis of
334 malaria and to obtain a treatment deemed effective. They used also traditional treatments, but as a
335 second-line option, as a backup or as a complementary treatment:

336 *What I know is that as soon as someone shows signs of malaria, we go to the*
337 *hospital first; once there, the doctor prescribes tablets; if, despite this, the patient*
338 *does not recover, we look for herbal remedies.* (FG6-P9, 41-50-year-old housewife)

339 Most participants were prepared to commit fully to the CHW for their treatment and to make
340 compromises by changing their behaviour and adhering closely to the services offered by the CHWs
341 once implemented. They were also prepared to recommend the CHW to other patients based on their
342 own positive experience. They were prepared to forgo benefits, such as hospital care, and to set aside
343 traditional values in order to ensure the effectiveness and sustainability of the CHW-based
344 intervention. Indeed, the success and long-term viability of the intervention will depend on the
345 satisfaction of the first patients, who are likely to act as advocates for those around them by
346 recommending, or not recommending, the CHW's services. Participants understood that if the CHW
347 were to become a permanent feature in the village, they would no longer have to travel, and in the
348 event of a night-time emergency, the CHW would provide initial care or refer them if necessary. They
349 were prepared to accept the CHW as a primary care provider and place their trust in them. This trust
350 will be established because the CHW is a member of the community, selected by the community,
351 trained and supported by qualified nurses, a prerequisite for this acceptance and for local consultation:

352 *As the CHW is there to help us, we will agree to consult them if we fall ill. I will*
353 *trust them because they are qualified nurses who have the mission to provide care*
354 *to us; we have confidence in them.* (FG4-P11, 11-20-year-old housewife)

355 Nevertheless, a minority of participants thought that even after the CHW will be established, they will
356 go directly to hospital if they can afford it or if the illness appears to be very serious. For instance, in
357 the villages of Moulé and Yaotéon, participants explained that they would take measures, even going
358 into debt, to receive hospital care rather than rely on the CHW. The HSPC was seen as the best
359 guarantee of recovery, while the CHW was viewed as a stopgap solution for minor illnesses or as an
360 economical compromise when money is lacking. Under no circumstance the CHW would replace a
361 consultation at a HSPC in case of doubt about the symptom severity. Similarly, other participants from
362 the villages of Dialanpozou and Tiarkiro thought that it would be more beneficial to self-treat at home
363 with herbal remedies initially, rather than to call the CHW. For these participants, traditional remedies
364 were the first-line option, followed by the CHW, who was seen as an intermediary should the herbal
365 preparations prove ineffective, and then the HSPC, as a last resort if the CHW was unable to provide
366 treatment:

367 *In my opinion, if you're ill and can afford it, go straight to hospital, but if you can't*
368 *afford it, you can contact the CHW: they'll know whether they can get you some*
369 *medicines. (..) Because if someone's ill and it's serious – if you look at their face*
370 *and can tell something's wrong – you'll have to go to hospital; it's better than*
371 *relying on the CHW. You've got to go straight to hospital, well – whatever happens,*
372 *even if you have to take out a loan, you'll do it; that's understandable*. (FG3-P12,
373 31-40-year-old housewife)

374

375 ***Geographical accessibility***

The geographical accessibility of healthcare services was another constraint mentioned by most participants. Difficulties in accessing healthcare services were directly linked to the distance, the state of the road infrastructure and the lack of transport, which made evacuation very difficult, particularly during the rainy season. The main problem was the lack of transport, forcing them to stay at home with the patient whose condition could worsen. Participants generally used motorbikes and bicycles to travel to the HSPC. Bicycles were the most commonly used mode of transport, particularly for non-serious illnesses, and ambulances were only used in cases of extreme severity. As an emergency solution, borrowing a motorbike was a common practice, but limited if there was no one available to transport the patient or if the driver was too old to carry a child.

Most of the participants said that the journeys to the healthcare centre were very long and difficult, especially on foot, particularly if the patient was weakened by malaria. Night-time journeys were dangerous, with risks linked to the road condition, the forest proximity, the lack of lighting, and possibly the husband's absence. These factors drove people to seek home-based care:

> *It's a long way away, that's for sure, and you know, these days the world isn't a safe place. If your husband isn't there and your child is unwell, and you have to carry the child on foot, especially at night, it's really difficult. There's no transport; if you have to take your child out at night and you have to go round the long way to reach the tarmac road, it's a very long way; if you have to take the shortcut, which is a track through the forest, it's dangerous, so all of this creates difficulties for us.* (FG1-P4, 21-30-year-old housewife)

Modern medicine affordability

Financial hardship was the most significant barrier to access modern healthcare. Participants explained that if they did not have the money, they were forced to delay seeking medical advice or to resort to traditional remedies. They mentioned costs related to consultations, treatments and transport.

Particularly, they were concerned about travelling to the HSPC, obtaining a prescription and then being unable to afford the drugs. Lack of money for the petrol was another difficulty. Therefore, the root of the problem was primarily financial resources; distance only became an issue when there were insufficient means to overcome it:

> *The real reason we don't go straight to hospital is poverty. Sometimes your child is ill; well, if you go and are given a prescription, even if it's a small child, there are tablets prescribed that the doctor will advise you to collect from another pharmacy, and at that point it comes down to money. If you don't have any money, that's what complicates matters, and sometimes people simply won't agree to go.* (FG1-P6, 51-60-year-old pensioner)

> *For me, transportation is not really the problem. The important issue is having the money to go to the HSPC. If you have money, you can borrow a means of transport from someone to take your patient there. However, if you need to borrow money to pay for your patient's treatment and the person refuses, you are forced to keep the patient at home.* (FG1-P9, 41-50-year-old farmer)

Some participants perceived negligence or lack of willingness to seek care as the main barriers to healthcare access. They interpreted this attitude as a failure of individual responsibility, leading them to downplay the transportation and financial constraints. In their view, the lack of transport or money was no longer an insurmountable obstacle in the current context. Access to a bicycle was relatively easy, passers-by could be called upon to help to transport a sick child, and walking long distances to reach healthcare facilities had historically been common practice. Some participants even considered the lack of money to be an excuse reflecting "bad faith":

> *That's all bad faith. When people hear that healthcare is free, everyone rushes to benefit from it. Some people actually have the money, but still refuse to take their children to the health centre. It's not a question of transportation; it's simply bad*

faith. Some people have money, while others genuinely do not, but if you truly care about your child who is sick, nowadays you can't say you don't have a bicycle to get to the hospital. Almost everyone owns a bicycle, and even if you set out on the road carrying your sick child, a passer-by can help you to get to the hospital. But if you keep saying you have no means of transport while your child dies, then you are the one who lost the child. In the past, we used to walk long distances to reach hospitals that were far away, whereas nowadays almost everyone has a bicycle. (FG5-P4, 41-50-year-old livestock farmer)

Participants' perceptions of the intervention

Most respondents were aware of the intervention planned in the framework of the REACT 2 project and demonstrated a good understanding of its objectives, largely because they were already familiar with CHWs and their role in malaria control. They could clearly relate the presence of CHWs in their village to improvements in community health. However, few respondents specifically mentioned the CHWs' role in malaria diagnosis. Instead, they described CHWs as responsible for distributing drugs, providing home-based care in connection with seasonal malaria chemoprevention (SMC), assisting with the transportation of sick individuals to healthcare facilities, and conducting malaria awareness-raising and prevention activities:

I have heard about them because they have helped us on many occasions. Every month during the rainy season, they come to give us tablets to protect our children. Some years they also provide us with mosquito nets, and I remember one year when they came with equipment to catch mosquitoes. They do all this to prevent malaria from affecting our children and ourselves. (FG1-P4, 21-30-year-old housewife)

For me, the main benefit of CHWs is that they can treat sick people directly in the village. (FG6-P8, 31-40-year-old housewife)

The presence of CHWs was expected to reduce several burdens on households by eliminating the need to travel to the HSPC, lowering the cost of care, and avoiding long waiting times at healthcare facilities. Participants also thought that these time and cost savings would allow them to devote more time to agricultural activities, thereby improving their productivity. Overall, they perceived the introduction of CHWs as likely to achieve its intended objectives by improving access to care and contributing to better health in the community:

> *Because the CHW is in the village, it is easy to go and see them for a consultation. It's even easier than going to the hospital because, at the hospital, you may find many patients waiting. You have to sit and wait for a long time before receiving treatment, and by then your illness may have become worse*. (FG5-P11, 21-30-year-old housewife)

> *For example, if your child's body becomes hot during the night and the health centre is far away, you can inform the CHW, who can give you some drugs because it is night time. If you give the drug to your child and see that they are getting better, then the next day there is no need to go to the health centre, you can go to your field instead*. (FG1-P7, 41-50-year-old farmer)

However, a small number of participants from two villages (Moulé and Dialanpozou) reported having limited knowledge of the intervention and of the CHWs' roles and responsibilities. Although they acknowledged that the introduction of CHWs had been discussed in their communities, their absence from community meetings, due to irregular attendance or agricultural work, had prevented them from receiving or remembering the information, which had been communicated some time earlier:

> *Sometimes I'm not at home. When we are out working in the fields, we don't know what's happening in the village. The issue of CHWs was discussed here, but I wasn't present, so I don't know much about it*. (FG3-P13, 11-20-year-old farmer)

Respondents also identified several factors that could limit their participation in the awareness-raising and prevention activities organized by CHWs, including farming activities, funerals, weddings, and travel. Nevertheless, they expressed their willingness to support the CHWs' work by informing them of the times when they would be available, typically in the afternoon during the farming season and in the morning outside this period. They emphasized that health should take precedence over other activities and considered that taking the time to listen to the CHW would be beneficial, particularly because CHWs set aside their own work to serve the community. Participants also suggested that CHWs should announce meetings in advance to encourage greater participation. In addition, participants stated that they would support and acknowledge the CHWs' work by consulting them whenever malaria symptoms occurred:

> *It is because we ourselves have seen that they help us. Therefore, if we are sick, we will make the effort to go to them and seek their help, and in this way they will also gain recognition. If we do not go to them, it would be as if we do not respect them; it would be as if we had chosen them for nothing. We will participate in the activities because the CHWs most often leave their own work aside to help us. If they, who are the ones losing their time, do not see it as a problem, it is not for us to say otherwise. Even if the appointment means leaving the dolo (a traditional millet beer) to evaporate over the fire, so be it, because the CHWs do a lot for us.* (FG1-P4, 21-30-year-old housewife)

> *In my opinion, what could prevent us from participating is farm work.* (FG4-P6, 11-20-year-old student)

> *If it is not an unfortunate event that has occurred in the village, such as a death that would cause the CHW activities to be rescheduled, there cannot be anything unacceptable that would prevent participation.* (FG6-P2, 31-40-year-old farmer)

Overall, all participants expressed enthusiasm about the establishment of CHWs in their villages in the framework of the REACT 2 project. According to them, any initiative that supports the village should be welcomed because it brings benefits and contributes to the well-being of everyone. They accepted this initiative because without health, no activity would be possible, and they were also very eager to see the results:

> *For me, it is a good thing that the project is giving CHWs the opportunity to treat us because if a child is sick, and it is at night, and even worse, if you do not have a means of transportation, you are forced to get up and ask someone for a motorcycle, and all of that is difficult for us.* (FG6-P5, 20-30-year-old farmer)

In almost all villages, participants thought that all activities assigned to CHWs (i.e. prevention and awareness-raising, RDT-based diagnosis, and treatment) were acceptable and were not against the community values. Receiving CHWs at home, particularly for checking or installing mosquito nets was acceptable if sacred objects were not kept in the bedroom.

Regarding RDTs, respondents noted that if they accepted the intervention of an unknown person for blood sampling at the hospital, it was logical to accept a CHW, who was a close community member and provided the service directly at home. They said that they would manage individual constraints (taboos, prohibitions) in such a way that they would not hinder the CHWs' work:

> *Indeed, my daughter has said everything, meaning that you go to an unknown person who takes your blood for tests, so why would you refuse your own brother taking your blood? The CHW comes directly to your home to help you; what else could you say? There will not even be any inconvenience.* (FG1-P6, 51-60-year-old pensioner)

> *For me, there will be no problem in this regard because what the CHWs do is for our well-being. Even if a person has restrictions or a taboo, they will make*

arrangements so that it does not become a problem. Therefore, I know that there is nothing that contradicts our values. (FG6-P2, 31-40-year-old farmer)

However, for a minority of participants, some social norms, particularly feelings of shame, could constitute a barrier to seeking care from CHWs. The main obstacle mentioned related to the lack of financial resources needed to continue care at the HSPC in the event of a referral by the CHW. This inability to cover healthcare-related costs created feelings of embarrassment or shame, leading some sick individuals to avoid seeking help from the CHW:

Well, you may be sick, for example, and you do not have money at that moment, so you cannot ask the CHW to come and examine you. It is true that the CHW provides treatment free of charge, but if you do not have money to go to the hospital in case the CHW send you there, shame can prevent you, and you may be afraid to call them. (FG4-P8, 41-50-year-old housewife)

Socio-professional characteristics of the CHWs

For all participants, the CHWs' sex did not influence the effectiveness of their work. They rejected the idea of choosing between a male or female CHW, considering such distinction as discriminatory. They referred to the example of HSPC, where healthcare services are accepted regardless of whether the healthcare provider is a man or a woman. Participants thought that no sex-related consideration should influence the choice of a CHW for home-based care. In their view, the quality of the care provided and the patient's recovery took precedence over any other characteristic of the service provider. On the other hand, the CHW's qualifications and performance were considered important criteria:

Why would we choose between a woman and a man? When we go to the hospital, there are male and female nurses. Sometimes we find men, sometimes women, and

we receive treatment. What difference would there be here at home that would make us say that a woman cannot treat me or that a man cannot treat me? Whether the CHW is a man or a woman, let them treat me so that I regain my health and return home. (FG1-P4, 21-30-year-old housewife)

Regarding social status, participants expressed a strong preference for a CHW who resides in the same village rather than in another locality. The main arguments put forward were accessibility, rapid response in emergency situations, knowledge of the local context, and economic advantages. Seeking assistance from a CHW who does not live in the village could generate fuel and food expenses for the CHW. Participants also expressed a preference for someone who is from the village. They thought that this initiative could be more effective if the CHW was a permanent resident and also a native of their village. This advantage was mainly explained by community trust, a sense of comfort, ease of contact and communication, the CHW's in-depth knowledge of local customs and values, the existence of social ties, and the service sustainability over time. Participants thought that when the CHW belongs to the village, people can freely explain their problems because the CHW is a close community member rather than a stranger. If the CHW is a son or daughter of the village, they will respect local traditions and customs, restrictions and taboos. They will not do anything that goes against the community values:

The advantage of having a CHW from the village is that we can easily share our problems with them. In fact, whatever discomfort or health issues you have, you can explain them to them, so you do not need a stranger. Unless it is a qualified doctor or nurse, I believe it is better to work with someone who comes from the village. (FG4-P2, 61-70-year-old pensioner)

As they know everything about the village, they will not do anything that would displease us. They are from the village, so they know what should be done and what should not be done; they know all our restrictions and taboos. That is why, if a

stranger were to come, they would not know all these details, and it would be complicated. (FG1-P6, 51-60-year-old pensioner)

For others, the local origin of the CHW was a major advantage and a privilege for the community because it represented a sustainable investment that should not be given to an outsider. The main benefit was the acquisition of knowledge and skills that could be shared within the village, unlike an outsider who would eventually leave with all the acquired knowledge, which would represent a loss for the village. Lastly, participants perceived the CHW's success as a collective success because, if the CHW succeeds, the entire village benefits:

If the CHW is from the village, it is advantageous for us because they have acquired some knowledge in this field, and in the future, they can share their knowledge with another person, which will benefit us. But if someone comes from elsewhere, once they finish their work, they will leave with all the knowledge they have in their head. However, if it is one of our own people, part of that knowledge will remain here, and that is why. (FG3-P2, 31-40-year-old farmer)

If one of our own people succeeds, the whole village will benefit. There will be times when we are facing difficulties and they can help us. We cannot give this privilege to someone from elsewhere. (FG3-P12, 31-40-year-old housewife)

Only a minority of participants from Dialanpozou and Yellela considered that the CHW's origin was of little importance and that only their permanent presence in the village and their ability to provide quality healthcare services locally were crucial:

For me, whether the CHW comes from our village or from elsewhere, we need them. Because even now, if you have a family member who is sick and needs to be taken to the hospital, we are forced to travel with them to the hospital. Therefore, I think that regardless of where the CHW comes from, the most important thing is that they provide us with care when we need it. (FG6-P6, 11-20-year-old housewife)

Participants also expressed strong expectations on the CHWs' competence, availability, reliability, ethics, and integrity. Any failure to uphold these principles was perceived as unacceptable. Regarding the CHWs' competence, participants thought that training was crucial:

> *We expect them to be like nurses for us. You call them CHWs, but for us they would be great doctors. We expect you to provide them with the knowledge that they can use to help us. In this way, we will no longer have to burden the hospital; we will only rely on our CHWs*. (FG1-P7, 41-50-year-old farmer)

When seeking assistance from the CHW, participants expected them to respond without waiting for a second or third request; otherwise, this could lead to dissatisfaction or disputes. Participants suggested that a small house should be built where the CHW could carry out their healthcare activities, and that a means of transportation should be provided to facilitate their movements and patient transfer to the HSPC in emergency situations:

> *If the CHW comes, they should do their work properly. There are some CHWs who may have to travel a lot, and when you go for a consultation, you may not find them, and that is the problem. If the CHW is always present and works well, then everything will be fine and there will be no problem*. (FG5-P2, 61-70-year-old farmer)

> *But first, you must properly train them so that when someone comes to call them, they do not wait for a second message. If this happens repeatedly, it is what leads to disputes, and we do not like that*. (FG2-P4, 21-30-year-old farmer)

> *What I would suggest is that the project builds a small house in the village where the CHW can be based. Then, in the event of malaria, one would automatically know where to go. But if the CHW is not settled in one place, one may call them and they may take too long to come, which could be dangerous*. (FG4-P7, 51-60-year-old housewife)

Participants considered willingness, honesty, responsibility, attentiveness and respect as essential qualities for a CHW. They said that CHWs must demonstrate commitment and determination in carrying out their work. They considered essential that they show great honesty and dedication to their duties by prioritizing their responsibilities over personal concerns, such as farming activities, to preserve the community trust, their credibility and their role sustainability. They must also demonstrate active listening toward community members. Participants thought that personal conflicts with a patient should not interfere with their healthcare work, and therefore this requires complete neutrality from the CHWs to ensure impartiality:

> *If the CHWs have the willingness to do the work properly, the village will feel reassured. However, if we have a CHW who, when you inform them of a malaria case at your home, chooses to go to their field instead and leaves you to your own fate, we will say that the CHW we have is not doing the job properly, and there will be a lack of trust.* (FG4-P1, 41-50-year-old farmer)

> *The person must listen to us. Going to learn something and then getting up and turning their back on a sick person would not work for us. If they listen to the people of the village, then we will be happy.* (FG3-P2, 31-40-year-old farmer)

> *They must set aside their disagreements, even with a patient, because even if they have a personal problem with a patient that has nothing to do with providing care.* (FG4-P2, 61-70-year-old pensioner)

> *But the real concern is that those who go to learn this profession should be honest for the future; that will be an advantage for our village. Because a job is assigned to this person. Then, if a patient contacts them and this person turn their back on the patient under the pretext that they have other work to do, honestly, I do not know what to say, because this is something that should have been agreed upon beforehand.* (FG3-P1, 31-40- year-old, farmer)

Discussion

We explored the conditions that influence the acceptability of an intervention involving the deployment of CHWs in villages located in southwestern Burkina Faso to improve access to malaria care. The findings showed that the intervention acceptability was influenced by the participants' knowledge of malaria, use of traditional medicine, financial and geographical accessibility of healthcare services, perceptions of the intervention, and CHWs' sociodemographic and professional profiles.

The results revealed that most participants had a good understanding of malaria, even though some local beliefs persisted. Previous studies showed that communities often attribute malaria to a variety of causes (22–24). These beliefs remain prevalent and may negatively influence the acceptability of CHW-based interventions. Indeed, the communities' knowledge of malaria is positively associated with the acceptability of malaria control interventions (25–27). For example, (25) showed that a good understanding of the causes and transmission mechanisms of malaria promoted the acceptability of a biological larvicide programme to target the malaria vectors in rural Burkina Faso.

Our findings also indicate that before the intervention, traditional remedies constituted the primary source of care for most participants, despite the presence of healthcare facilities in these communities. (28) and (29) identified financial constraints, geographical barriers, poor road conditions, and inadequate transportation as major obstacles to accessing modern healthcare services. In addition, social and cultural values play an important role in healthcare-seeking behaviours. (30) demonstrated that medicinal plants hold considerable importance in the magical-religious and medical-magical traditions of Burkina Faso. Local communities maintain close relationships with their natural environment, and plants are an integral part of everyday life. Similarly, (31) and (29) reported that despite advances in modern medicine and the availability of healthcare facilities, communities continue to rely on medicinal plants because they have preserved the traditional medical knowledge inherited from their ancestors.

671 Among the seven dimensions of the TFA, opportunity costs refer to the benefits, resources, or activities
672 that participants must give up to engage in an intervention. As this dimension is considered central to
673 the assessment of acceptability, it was specifically examined. When asked whom they would consult
674 first in the event of malaria symptoms after the intervention implementation (i.e., a CHW, a nurse, or
675 a traditional healer), most participants indicated that they would first seek care from a CHW. This
676 suggests that community members are willing to forgo some cultural and social practices associated
677 with traditional medicine. They also appear willing to forgo seeking care directly at a HSPC, where more
678 comprehensive services may be available. This can be partly explained by the geographical distance
679 between villages and healthcare facilities, but also reflects the high CHWs' acceptability level.
680 Nevertheless, some participants stated that they would continue to consult traditional healers or
681 would seek care directly at a healthcare facility, provided they had the financial means to do so in order
682 to receive what they perceived as more appropriate care. The persistence of traditional practices may
683 reflect delayed recourse to biomedical services, which are often sought only after failure of traditional
684 treatments, but may also be driven by financial constraints. According to (29) and (31), by using
685 medicinal plants, communities express their desire to preserve the traditional medical knowledge
686 inherited from their ancestors. The preference for seeking care directly at healthcare facilities rather
687 than consulting CHWs may also reflect a lack of confidence in the CHWs' ability to provide high-quality
688 care. Therefore, the social and cultural perceptions of illness and trust in traditional treatments
689 constitute barriers to the intervention acceptability, CHWs' services, and more broadly, medical
690 healthcare.

691 Our findings also indicate that knowledge of the intervention and its expected contribution to malaria
692 management were key determinants of its acceptability. Most participants demonstrated a clear
693 understanding of the intervention, reflected in their perception of the CHWs' role, usefulness and
694 expected impact on community health. This may be explained by the long-standing presence of CHWs
695 in the study area where they have been already involved in maternal and child health activities,

including SMC delivery, immunization campaigns, and health education activities in the framework of the National Malaria Control Programme.

Participants thought that the CHWs' presence would reduce some of their workload and enable them to be more productive in their fields. Similar findings were reported by various authors (32,33). For example, (33) showed that malaria confirmation using RDTs is well known within communities and that 94.3% of participants were aware of RDT administration by CHWs. RDT administration by CHWs is most often done at home, improves access to healthcare and avoids waiting times at healthcare facilities, making the intervention easily acceptable.

Although a minority of participants was not informed about the intervention, nearly all participants from the six villages expressed a positive affective attitude about the incoming intervention. They showed enthusiasm and a strong desire to see its implementation for effective malaria control. This is consistent with the findings reported by (32) in Mozambique, (33) in Burkina Faso, (34) in Tanzania, and (27) in Senegal. In the study by (32), all participants welcomed the mass drug administration programme implemented as part of the malaria elimination initiative, because they perceived a positive relationship between the intervention and the reduction in malaria cases and deaths, improved health outcomes and lower transportation costs.

Furthermore, the present study revealed that all activities carried out by CHWs were acceptable to participants and did not conflict with their values. (35) found that the ethical foundation of a community-based intervention is crucial for its acceptance and that interventions that are not culturally or ethically appropriate often face reduced participation and engagement from the target community. For example, the blood sampling required for RDTs was well accepted and was not perceived as contrary to the respondents' values, consistent with findings reported by (36) in Tanzania, and by (33) and (37) in Burkina Faso.

Participants expressed their willingness to facilitate CHWs' work by informing them of events that could hinder their participation in awareness-raising and prevention activities, such as farming

activities or social events. They suggested that CHWs should notify them in advance of any planned activity. Such coordination would further strengthen the intervention acceptability.

It also emerged that as long as CHWs contributed to improving health in the community, their presence would be perceived as effective, and this effectiveness would not depend on the CHW's sex. Conversely, in Afghanistan, (38) reported a preference for female CHWs in reproductive health services due to cultural norms that discourage interactions between women and men outside the family context. This difference may be attributed to the specific social context and the type of care provided by CHWs in the present study (malaria treatment versus reproductive health services).

The intervention would be perceived more positively if CHWs were residents of the village and ideally, originally from the village because they would be considered to have stronger ties with the community and to be better able to share their knowledge with their own community. These findings are consistent with (39) study on SMC in Senegal showing that CHWs are generally appreciated and listened in their home villages. They are regarded as role models of dedication and commitment: they are local individuals who have chosen to devote their time to serving the community, and this enhances their social prestige and influences the families' attitudes toward SMC. However, the same author noted that being from the village does not always facilitate their work because some CHWs refused to visit some households in their own villages due to conflicts (political or social) between their families.

The study highlighted that participants considered unacceptable several CHWs' behaviours, attitudes, and characteristics. Participants clearly expressed their disapproval of CHWs who were poorly trained, unavailable, unmotivated, irresponsible, or disrespectful, as well as those who failed to listen or demonstrated dishonesty or resentment. Other studies confirmed that some of these factors are considered important by communities, particularly the CHWs' qualifications and availability (33,34,40). For example, (34) found that the community accepted RDT use by CHWs after learning that they had received formal training, first at the district headquarters and then at local healthcare facilities, and that they had completed practical sessions in a clinic or near a healthcare centre. Such acceptance

746 could have been difficult to achieve because people did not expect individuals who had not completed
747 secondary education or who had no nursing experience to be able to learn and perform delicate tasks,
748 such as using RDTs and administering drugs to children.

749

750 Conclusions

751 This study analysed the conditions for CHWs' acceptability in the Bougouriba Province of Burkina Faso
752 to improve access to malaria care, using for the first time the TFA of health interventions in this context.
753 The findings demonstrated an overall high level of acceptability of the intervention and identified
754 several factors that may facilitate or hinder its implementation. Besides the recognition of the CHWs'
755 role and the expected benefits of their intervention, the study highlighted the importance of
756 considering the local perceptions of malaria, socioeconomic constraints, healthcare-seeking practices,
757 and community expectations on CHWs' professionalism.

758 These findings provide valuable insights for adapting the CHWs' deployment strategies and
759 strengthening their acceptability, community ownership, and ultimately their effectiveness in malaria
760 control. This high level of acceptability provides a strong foundation for the design and management
761 of CHW-based interventions. The results may also strengthen the relationships between communities
762 and healthcare services and contribute to improve national policies on community health. However,
763 for these interventions to be sustainable, it is essential that health and political authorities give greater
764 consideration to the community's perceptions and expectations. This includes ensuring adequate
765 CHWs' training and supervision and actively involving communities in the planning and
766 implementation of interventions.

767 **Declarations**

768 **Ethics approval and consent to participate**

The Institutional Ethics Committee for Health Sciences Research approved the implementation of the REACT 2 project (reference number 18-2021/CEIRES dated 8 April 2021). All participants provided consent before participating in the focus groups, and their verbal consent was audio-recorded. All participants were informed about the study objectives and were aware of their right to withdraw at any time without any negative consequences. Sociodemographic data were collected before the start of the focus groups. Information on participants was treated confidentially, and the results were presented in a completely anonymous manner.

Consent for publication

Not applicable

Availability of data and materials

The data will be made available upon request

Competing interests

The authors declare no competing interests.

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Author contributions

CP, FF, SF, AS, RKD, PT and YAKT conceived and designed the study; YAKT was responsible for the conception of the focus group guides with SF; YAKT supervised the data collection and performed all the qualitative analysis under the supervision of SF; YAKT wrote the first draft of the manuscript; All authors have read and agreed to the submitted version of the manuscript.

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Additional file 1 Correspondence analysis of the six classes (See Fig. 3 for a description of the six ssclasses)

