



**HAL**  
open science

## Indigenous peoples' health: Culturally grounded evidence from the Baka, Southeastern Cameroon

Sandrine Gallois, Appolinaire Ambassa, Fernando Ramírez Rozzi

### ► To cite this version:

Sandrine Gallois, Appolinaire Ambassa, Fernando Ramírez Rozzi. Indigenous peoples' health: Culturally grounded evidence from the Baka, Southeastern Cameroon. *Social Science & Medicine*, 2024, 350, pp.116936. 10.1016/j.socscimed.2024.116936 . hal-04582113

**HAL Id: hal-04582113**

**<https://u-paris.hal.science/hal-04582113>**

Submitted on 21 May 2024

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution - NonCommercial - NoDerivatives 4.0 International License



# Indigenous peoples' health: Culturally grounded evidence from the Baka, Southeastern Cameroon

Sandrine Gallois<sup>a,\*</sup>, Appolinaire Ambassa<sup>b</sup>, Fernando Ramírez Rozzi<sup>c,d</sup>

<sup>a</sup> Institut de Ciència i Tecnologia Ambientals (ICTA), Universitat Autònoma de Barcelona, Cerdanyola del Vallès, Spain

<sup>b</sup> Baka community Moangue-Le Bosquet, Le Bosquet, Cameroon

<sup>c</sup> Eco-anthropologie (EA), Muséum National d'Histoire Naturelle, CNRS, Université de Paris Cité, Musée de l'Homme, Paris, France

<sup>d</sup> UR 2496, Faculté de Chirurgie Dentaire, Université de Paris Cité, Montrouge, France

## ARTICLE INFO

Handling Editor: Professor Alexandra Brewis

## ABSTRACT

Indigenous Peoples are exposed to the impacts of the climatic, ecological and socioeconomic changes, yet there is a need for a better understanding of their health and higher involvement of Indigenous Peoples in health promotion design and implementation. Our study brings empirical data on the healthcare system of the Baka, forager-horticulturalists from Cameroon. Using a mixed methods approach, we explored the health issues they encounter, the emic determinants of health and healthcare system, and the different threats towards their healthcare system. We conducted focus group discussions, interviews with experts, and self-reported health recalls with 302 individuals living in two settlements from southeastern Cameroon during two fieldwork periods between June and November 2022. Our insights highlight the prevalence of respiratory and children's digestive issues, and the occurrence of illnesses implying a combination of symptoms that would deserve further Western biomedical attention. The Baka's healthcare relies on medicinal plants, knowledge experts, and on the social cohesion of the community, all largely affected by the local social-ecological impacts of global change. Exposure to the market and health facilities does not seem to relate to Baka's health state and practices but might affect their perception of health. Deforestation, poor water quality, and alcohol (ab)use were reported and observed threats to the Baka's health and healthcare system. Our work supplies empirical evidence for a better understanding of Baka's health and healthcare system, helpful in designing health prevention and policies adapted to their reality and culture. Further research and interventions on health should consider the current threats to Baka's local ecosystems and cultural knowledge. These insights contribute to a higher recognition of the Baka's, and most broadly, the Indigenous Peoples' emic perspective on health, and on culturally grounded indicators of the resilience of their healthcare system to current and future challenges.

## 1. Introduction

Unprecedented loss of biodiversity, land use changes, over-exploitation of natural resources, and the drastic impacts of climatic change directly and indirectly affect human health at both global and local scales (Whitmee et al., 2015). Indigenous Peoples are the most exposed to the impacts of global change (i.e., climatic, ecological, and socioeconomic changes), because of their sociopolitical and historical contexts as well as their direct reliance on natural resources for their livelihood and health (Ratima, 2019). Generally, Indigenous Peoples present poorer health than non-Indigenous groups (Valeggia and Snodgrass, 2015). For instance, they are more exposed to infectious and

non-communicable diseases, infant and maternal mortality, and pandemics (Power et al., 2020; Silburn et al., 2016; Valeggia and Snodgrass, 2015). Colonialism and cultural trauma have also contributed to breaking down the social and cultural determinants of Indigenous health, along with the pressures on their environment, such as poor access to natural resources and land tenure (Power et al., 2020). Furthermore, Indigenous Peoples' cultures and traditional medicinal knowledge they rely on are highly threatened, weakening their healthcare system (Fernández-Llamazares et al., 2021). Despite these threats, there is still limited knowledge on the health of Indigenous Peoples.

Health policies worldwide have been designed and implemented without sufficient consideration of Indigenous perspectives. Embedded

\* Corresponding author. Edifici ICTA-ICP, Carrer de les columnes, s/n, Campus de la UAB, 08193, Cerdanyola del Vallès, Barcelona, Spain.

E-mail address: [Sandrine.Gallois@uab.cat](mailto:Sandrine.Gallois@uab.cat) (S. Gallois).

<https://doi.org/10.1016/j.socscimed.2024.116936>

Received 6 October 2023; Received in revised form 20 April 2024; Accepted 30 April 2024

Available online 3 May 2024

0277-9536/© 2024 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

in a colonial approach, they hardly integrate emic perspective and local cosmologies, leading to a Western-centric view of Indigenous health (Bussalleu et al., 2021; Carroll et al., 2022; Ninomiya et al., 2022; Ratima, 2019). Many policies and health initiatives have failed because of the ignorance or underexploration of local populations' cultural practices and social rules (Angell et al., 2014). For many Indigenous Peoples, the notion of health not only embraces physical, biological, social, and psychological aspects, but also implies the interconnection between the health of humans and the natural environment (Carroll et al., 2022; Redvers et al., 2022). In the last decades, some projects have been developed to better integrate Indigenous Peoples in health policy design and implementation, such as those led by Madimenos et al. (2022), Greenwood and Lindsay (2019), and the National Collaborating Centre for Aboriginal Health in Canada (NCCA). These initiatives showed the importance of Indigenous self-determination, land access, and voice in the decision-making policy process in global health promotion, as well as their crucial role in identifying potential emerging infectious diseases (Gaddy, 2020). However, there is still a need for more detailed empirical studies to document these cultural conceptions and the local practices, knowledge, and beliefs related to maintaining health, to prevent, avoid or treat sicknesses (Valeggia and Snodgrass, 2015). For doing so, medical anthropology, with a biocultural perspective, is well-suited to explore how cultural, economic, ecological, and biological factors influence health patterns (Roulette, 2019; Valeggia and Snodgrass, 2015).

Most health initiatives occur in, with, or for Indigenous Peoples from the Global North and often overlook children and women (Griffiths et al., 2022; Patterson et al., 2022), leaving a significant part of Indigenous Peoples cultural diversity under-considered. This is especially important in Africa, where there is a lack of empirical evidence on Indigenous Peoples health (Ohenjo et al., 2006; Silburn et al., 2016). For instance, recent research on COVID-19 was mainly conducted among Indigenous Peoples from the USA, Brazil and Canada, leaving the whole African continent blank -except South Africa (Pickering et al., 2023). This is alarming considering the high rate of pressure African Indigenous Peoples suffer from marginalization, land degradation and displacement, as well as the limited resources available for national health policies to tackle Indigenous Peoples health challenges. Limited knowledge exists on both the health state of African Indigenous Peoples and their healthcare system, especially for several societies from the Congo Basin, including the Baka. The Baka are foragers-horticulturalists living mainly in Cameroon, yet also present to a lesser extent in the Democratic Republic of Congo, Gabon, and the Central African Republic. Nomadic foragers by the past, the Baka from Cameroon have faced several changes since the 60s, pushed by sedentarisation and agriculture adoption. Such changes affected their livelihood, health and culture. Dietary transition towards a diet richer in marketable and agricultural foods and lower in wild ones, and the increasing consumption of drugs and alcohol, have considerably impacted their health and fertility (Dounias and Froment, 2006; Ramírez Rozzi, 2018). Recent work highlighted that Baka showed an increased rate of intestinal worms, HIV/AIDS, risk of contracting zoonotic diseases, and a higher vulnerability to tuberculosis, malaria, and oral health than their farmer Bantu-speaking neighbors (Carson et al., 2019). However, these works considered the communities as a whole, overlooking variations in health issues and practices based on gender and life stage. Additionally, no study explored the Baka's conception of health or their medicinal practices and knowledge. Despite health centers and vaccination campaigns, Baka's access to Western biomedicine is largely reduced by economic constraints, distance to the health posts and marginalization (Carson et al., 2019). Furthermore, deforestation and natural resource extraction combined with the absence of Baka land tenure affect their cultural transmission and access to wild resources (Kulesza and Robillard, 2019). As reported in other Indigenous Peoples (Early and Headland, 1998; Hill and Hurtado, 1996), factors such as market integration (i.e. the presence of traders, the selling of natural products and the presence of shops in the villages), presence of missionaries, development

projects and health campaigns might impact both Baka health and their cultural knowledge and practices. Therefore, considering all these potential threats on the Baka, it seems essential to explore the health of their communities (diversity and most problematic health issues), to document how they maintain their health, what resources they use, and the perceived disturbances to their healthcare system.

Our aim was threefold: i) to identify the different health issues the Baka reported; ii) to explore the practices, knowledge, and resources for treating or preventing them; and iii) to understand the main factors affecting Baka health and healthcare system. Recognizing the complex interwoven biocultural processes of health, we took an anthropological approach collecting data from self-reported health recalls, semi-structured interviews, and participatory observation. Based on our results, we proposed a first description of the Baka healthcare system, considering potential variations in health issues and practices based on individual life stage, gender and exposure to external changes. In assessing the factors affecting Baka health and healthcare, we analyzed the threats reported by the Baka, while also comparing two Baka communities with different social-environmental contexts as proxies of the several changes the Baka are living.

## 2. Methods

### 2.1. Case study and positionality

This research took place in southeast Cameroon (Lomie and Messok districts), where most Baka live in villages settled along logging roads, nearby villages of Bantu-speaking farmers with whom they have maintained relations of pseudo kinship and labor (Joiris, 2003; Leclerc, 2012) (see Fig. 1). Baka settlements are built around familiar clusters and used to reach between 50 and 100 different households. Beyond the familial nuclei, every individual belongs to a clan, following a patrilineal inheritance system. The Baka combine foraging activities – gathering wild products, fishing and hunting, with small-scale agriculture, growing principally cassava, plantain and cocoyam. Such livelihood is the dynamic result of decades of changes, first incited by a sedentarisation process in the early 60s led by the government and helped by missionaries and NGO who also aimed to foster agricultural adoption. Before this period, Baka people were nomadic, living in forest camps and relying on foraging and exchanging forest products for farming ones with the Bantu-speaking farmers, for which they seasonally worked in their fields (Leclerc, 2012).

We worked with two villages that differ in their size (300 and 800 individuals each), the kind of settlement (forest camp vs. village along a logging road), their exposure to the market economy, their access to education, and health facilities in order to assess whether changes in

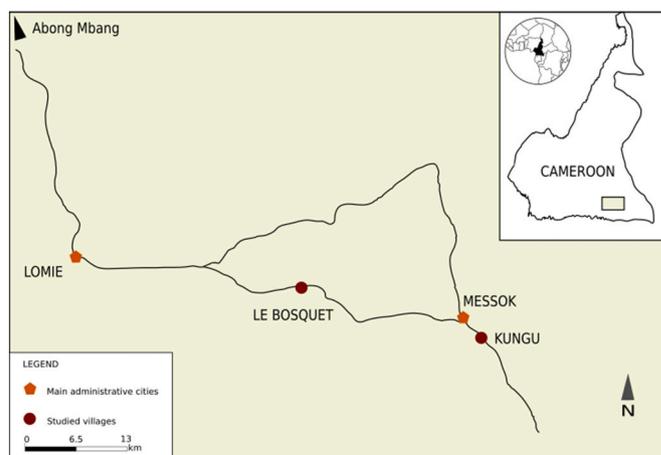


Fig. 1. Map of the studied area.

their health practices accompany these differences.

Kungu is a forest camp located about 1 h walking from the logging road, where the Baka also hold houses in Nkeadinako village of their Nzime neighbors – the Bantu population of the area. In this village, neither shop nor health center are present, so the Baka have to go to Messok, the main administrative town of the district, ca. 7 km. Differently, Le Bosquet is a Baka village located along the logging road and was built for the Baka by a catholic mission (Girolet, 2005), including a health center and a school. This village is more integrated to the market than Kungu as it has about seven small bars that also sell basic necessities. While the Baka have maintained their traditional beliefs and cosmivision, the mission's influence led some Baka to follow catholic ceremonies. In both villages, the Baka have their own fields and divide their time between foraging and agricultural activities, yet the Baka in Le Bosquet are more engaged in cash-providing activities than in Kungu (Gallois et al., 2021).

The authors of this study are two European citizens - a white French woman and a French-Argentinian man-along with a Baka man residing in Le Bosquet. Both Europeans have worked with Baka communities for more than ten and fifteen years, collaborating with about ten different Baka research assistants, who have been employed all along these years, trained to anthropological methods, and with whom we have developed relation of peers. One of them is co-author of this study, also elementary school teacher, who is really esteemed across various villages, including those of this study. Both European authors have been living directly with the Baka, participating in the daily life, from subsistence to ritual activities, and building up a strong relationship of mutual trust. The research originated from a request made by several Baka in 2019, during the first author's previous fieldwork. They asked her to develop a study on their health and medicinal plants for documenting and "revitalizing" their knowledge. The complete list of plants reported in our study, including local and scientific names and pictures, was shared with the Baka communities.

Before the onset of the study, we received the approval of the Ethical Committee of the Autonomous University of Barcelona (CEEAH5926) and the research permit from the Cameroon Ministry of Scientific Research and Innovation (00098/MINRESI/B00/C00/C10/C13). Once arrived in the villages, we presented the aim of our research during a first village meeting and then gathered the Free Prior Informed Consent among all the individuals who wanted to participate in this research. All along the research, we followed the Code of Ethics of the International Society of Ethnobiology (ISE, 2006).

## 2.2. Data collection

Our data were collected during two main fieldwork periods of six weeks each: the first in the minor dry season (June to July 2022) and the second one in the major rainy season (October to November 2022).

We used a mixed-method approach, combining focus groups, self-reported health recalls, semi-structured interviews with Baka healers, and participatory observation (Further details in Supplementary Material A). To approach Baka conception of health, we decided to collect self-reported health issues with local names and symptoms in order to respect the meaning and interpretation given directly by the informants. All the protocols for data collection, initially designed by the first co-author were also reviewed to be adapted to Baka's culture.

In both villages, we first invited all individuals to take part in a series of focus groups with men and women separately (with 12 men, 18 women in Le Bosquet; 11 men, 16 women in Kungu). During these encounters, we gathered data on a) the health issues faced by the community, their local names, the different symptoms and perceived causes, with careful care on gender and children issues; b) the local health system, i.e. the knowledge and practices used for curing the health issues reported, the natural resources used, the knowledge holders (women, elder, men, specific healer), and the perceived disturbance that might affect their health and healthcare system; and c) the list of the local

healers expert recognized by the community.

We then visited all the households of the villages and conducted self-reported health recalls to gather the health issues occurring in both communities with all the participants willing to participate. During these interviews, we asked the interviewees to report all the health issues they might have had during the previous three months, the way they were treated (local medicine remedies or Western biomedicine), the potential cause of the issue; and the provider of the treatment (him/herself, another member of the community, health center, etc.). For children - from newborns up to 16 years old, following Baka classification (Gallois et al., 2015; Ramírez Rozzi, 2018), we asked their mother or father. We also systematically asked our respondents to answer for their husband/wife if this latter was absent during our visit. These questionnaires were conducted during the two fieldwork periods to catch seasonal variability. All the surveys were conducted in Baka language by the first and second author through a respectful, empathetic, and sympathetic way.

A total of 432 self-reported recalls were collected among 302 individuals (148 children and 154 adults) belonging to 83 households (44 in Le Bosquet and 39 in Kungu). One hundred thirty individuals were interviewed twice, i.e. in both seasons (belonging to 45 households), and 172 individuals were interviewed only once (from 38 households).

We then gathered further knowledge from experts recognized by the communities through to better understand the healthcare system, their specific role, and their perception of Baka's health state and its disturbances to it. We interviewed 17 recognized healers (8 in Le Bosquet and 9 in Kungu).

Living in the villages, both authors were able to perform participatory observation, conduct informal talks with the Baka, and gather qualitative information that assist in the triangulation of the data and the interpretation of the different results presented below.

## 2.3. Data analysis

In order to identify the different health issues affecting the Baka, we first analyzed the amount of individual self-reported health recalls in which they reported having been sick, and whether it varied according to gender, life stage –children vs. adults- and village (using Pearson  $\chi^2$  tests). Then, we analyzed the diversity and occurrence of the different health issues from these recalls and calculated their frequency for the whole sample and then by gender, life stage, and village. We completed these insights with the health issues mentioned as the most recurrent or problematic in the focus groups. We recorded local names of the diseases and cross-referenced them by initially translating symptoms into French helped by the Baka-French dictionary (Brisson, 2010), and then into English. To establish a dialogue between local and scientific knowledge, we classified, *as posteriori*, all the health issues reported by our respondents, using as a basis the International Classification of Diseases 11th edition of the World Health Organization (ICD-11, WHO). Such categorization is based on the self-reported symptoms and aimed to be indicative, not exact. We classified into 12 categories including diseases or symptoms that affect: 1) the Circulatory – Blood system; 2) the Nervous system; 3) the Visual and auditive system; 4) the Respiratory system; 5) the Digestive system; 6) the Genito urinary system; 7) the Musculo-skeleton system and connective tissues, 8) Pregnancy, childbirth and puerperium; and then 9) General symptoms 10) Injuries; and 11) Infectious or parasites. For every category, we explored the statistical differences between gender, life stage, and village using Wilcoxon ranking tests.

In order to explore the practices, knowledge, and resources used in the Baka healthcare system, we then explored the different medicinal resources used, and the people who treated them mentioned in the recalls. For each occurrence of a health issue, we analyzed whether it was treated using natural resources, Western biomedicine or a mixture of both. We then looked at the medical journey - the process of treating the disease- and then who was the person who treated the health issues,

differentiating them by 1) themselves or the household member (husband/wife, parents/children), 2) a close kin, 3) another member of the community, 4) community recognized healer, 5) health center, 6) others. We analyzed whether the resources used and the provider differed according to the health issues and for every health category according to the gender, life stage, and village, using Pearson  $\chi^2$  and Fisher exact tests.

To identify the main factors affecting Baka health and healthcare system and the potential threats to them, we used the data gathered through all our methods. We first analyzed specifically the causes provided for each health issues of the recalls and then used the data gathered during the focus groups and semi-structured interviews to explore the determinants and the perceived factors affecting their health and healthcare system. We finally compared the answers according to the village in order to explore whether the Baka healthcare system and Baka health perception might vary according to their exposure to the market and health facilities, considered here as a proxy of the changes experienced by the Baka.

### 3. Results

#### 3.1. Health state: diversity and occurrence of health issues

According to our Baka interviewees, being healthy for them means not experiencing neither physical pain, nor trouble, which can be caused by a friend's or a family member's sickness or absence, or conflicts within or outside the household. In this line, "If you want to know about the health of a community, ask about the number of deaths, the diversity of health issues and the conflicts going on." (Focus group, men, Le Bosquet). Furthermore, the determinants of Baka health are reflected by the remedies they use. Interviewed expert healers reported treatments targeting issues that affect the physical, biological, social, ecological, and cultural components. For instance, Baka experts showed us remedies to bring luck (such as abundance of food or hunting attraction), against sorcery, to reunite people who have been absent for long, or to avoid or resolve social conflicts. Thus, healthcare for the Baka encompasses not only the physical, biological components, but also social, psychological and spiritual dimensions.

During the self-reported health interviews, more than half of our interviewees reported experiencing at least one health issue in the three months prior to the interview (247 out of the 432 individual records). Of the 224 adults records, 149 had health issues, while 98 out of 208 children's records reported health issues (Table 1). The frequency was similar between villages, but adults reported more frequently having been sick than children ( $X^2 = 16.6$ ,  $p < 0.001$ ), and female more frequently than men ( $X^2 = 6.6$ ,  $p < 0.01$ ).

A total of 345 occurrences of health issues (symptoms or diseases) were reported, most of them by women ( $n = 149$ ) for a total of 48 different health issues. Among them, the five most frequently reported

**Table 1**

Proportion of individuals records reporting having been sick the three months before the interviews ( $n = 432$  self-reported health recalls).

	Percent	Number of occurrences of at least one sickness reported	Total number of records
<b>Total</b>	57.2	247	432
Male	50.7	104	205
Female	63	143	227
<b>Adults</b>	<b>66.5</b>	<b>149</b>	<b>224</b>
Men	58.1	54	93
Women	72.5	95	131
<b>Children</b>	<b>47.1</b>	<b>98</b>	<b>208</b>
Boys	44.6	50	112
Girls	50	48	96
Le Bosquet	58.8	127	216
Kungu	55.6	120	216

health issues were *jiyò* (reported 67 times), *tulanga/kotuba* -cough (45), *ko na njo bo* -headache (30), *ko na pe bo* -backpain (25), and *ko na ngobobo* -whole body pain (22) (Table 2). These health issues were also perceived as the main issues at the community level during our focus groups.

*Jiyò* was described as a combination of different symptoms: headaches, whole body pain, getting cold, shaking, getting hot (fever). These symptoms were not always all present in the descriptions. Sometimes, they just mentioned fever ("getting hot," "the whole body is getting hot") and whole-body pain, or headaches, and sometimes shaking and fever.

When grouping these health issues in categories, most of them belonged to "General symptoms" (109 out of the 345 health issues reported), after which diseases and symptoms related to the respiratory system (60), and the digestive system (50) (Table 3).

Slight differences exist among life stages and genders. Digestive issues were more frequently reported among children than adults, and musculoskeletal system issues among adults than children (respectively  $z = 2.48$ ,  $p < 0.05$  and  $z = -3.43$ ,  $p < .001$  to the Wilcoxon ranking tests) (Table 3). In addition to digestive issues, specifically *doo*, adults perceived as a children specific problematic issue a combination of symptoms called *kombe*, including epileptic crisis, fever, chill, and shaking. Some Baka mentioned that it was due to the ingestion of the *buse* -black-foot mangoose's meat by the mother when she was still pregnant of the child. We found no statistically significant difference between genders, neither between girls and boys nor between women and men. However, men reported more circulatory system than women ( $z = -1.99$ ,  $p < 0.05$  to the Wilcoxon ranking tests). Backpain was perceived as a recurrent and problematic issue affecting especially women, and inguinal hernia (*ntomo*) and sexual infection (*ko a sa*), affecting especially men.

When comparing villages, we found that in Le Bosquet, the frequency was higher for health issues of the digestive system and lower of the circulatory system than in Kungu (respectively  $z = -2.82$  and  $z = 3.09$ ,  $p < .01$  to the Wilcoxon ranking tests). Additionally, some perceived important issues differed between villages: hepatitis was only reported in Le Bosquet as affecting children and men, while issues derived from sorcery were only named in Kungu.

#### 3.2. Medical resources and practices

##### 3.2.1. Resources used

The Baka relied mostly on medicinal plants: about 78% of the reported health issues were treated with plants, either taken alone (in 64% of the cases) or mixed with Western biomedicines (in 14%). Only in 14.5% of the health issues, they relied only on Western biomedicines; while in 8% of occurrences, no treatment was provided for the health issue (see Supplementary Material B). In total, the interviewees reported 99 local names of medicinal plants in the recalls, including 85 wild and 14 cultivated plants. On the other hand, most of the Western biomedicines reported were referred to as *bumol* - pill (reported 34 times out of 94 occurrences of Western biomedicines), without specifying the kind of medicine. The Baka also reported buying medicines like paracetamol (16 times) and ibuprofen (11); anti-malaria quinine and artemether (9 and 5 times); and sporadically antibiotics like amoxicillin, ampicillin, cotrimoxazole (twice each); anti-inflammatory dexamethasone; and antiparasitic (vermox) (once each). We found no difference in the type of treatment supplied according to the gender. However, treatments given to adults and children differed. Adults received mixed remedies or no treatment more frequently than children ( $p < 0.05$  to the Fisher test).

Our interviewees from Le Bosquet used Western biomedicines more frequently than from Kungu. In about 40% of the health issues -79 out of 181- they used Western biomedicines (alone or mixed with medicinal plants) while in Kungu Western biomedicine appeared only in 15% of the records (25 out of 164) ( $X^2 = 36.3$ ,  $p < 0.001$ ) (Fig. 2). A higher

**Table 2**

Health issues reported during the self-reported health recalls, by ICD categories (n = 345 health issues).

Categories	Baka name	English equivalence (ICD code equivalence)	Occurrence in self-reported health recalls
<b>TOTAL</b>			<b>345</b>
<b>Blood and blood forming organs (n=14)</b>	kò nà nje	lack of blood (8C0Z)	<b>8</b>
	pimi	pain in the spleen (3B8Z)	<b>6</b>
<b>Nervous system (n=39)</b>	kò nà njò-bo	headache (MB4D)	<b>30</b>
<b>Nervous system (n=39)</b>	jilà	vertigo (MB48.0)	<b>6</b>
	kombe	epilepsie (8A6Z)	<b>2</b>
	sisà e ba na	paralyzed nerve (MB6Y)	<b>1</b>
<b>Visual system (n=5)</b>	kò a la bo	eye pain (MC18)	<b>3</b>
	nde a sia	blurred vision (21)	<b>2</b>
	joko		
<b>Respiratory System (n=60)</b>	tulanga - kotuba	cough (MD12)	<b>45</b>
	asue	difficult breathing (MD11.5)	<b>6</b>
	ko na to-bo	chest pain (MD30)	<b>5</b>
	mbume	asthma (CA23)	<b>2</b>
	semba	nosebleed (MD20)	<b>2</b>
<b>Digestive system (n=50)</b>	sende	diarrhea (DD90)	<b>13</b>
	kò nà bu-bo	stomachache (MD81.1)	<b>12</b>
	nyangale	decay (DA08)	<b>7</b>
	ko na te-bo	teeth pain (DA08)	<b>5</b>
	doo	anus alteration (DB5Z)	<b>5</b>
	nzom	hepatitis (DB97Z)	<b>3</b>
	na jie	vomiting (DD90.4)	<b>3</b>
	mobombo	canker sore (DA01,1)	<b>1</b>
	ntomo	inguinal hernia (DD51)	<b>1</b>
<b>GenitoUrinary System and sexual health (n=2)</b>	jugba	woman infertility (GA31)	<b>1</b>
	kò na mokose	masculine impotency (HA01.1)	<b>1</b>
<b>Musculoskeleton and connective tissue (n=28)</b>	kò nà pe-bo	back pain (ME86)	<b>22</b>
	Be-bo ba ke	pain in the arm (FB56.4)	<b>3</b>
	Kpa-bo e na ke	pain in the hand (ME82)	<b>1</b>
	No-bo e ba ke	pain in the foot (ME82)	<b>1</b>
	bikobo e ba ke	pain in the leg (FB56.4)	<b>1</b>
<b>General Symptoms (n=112)</b>	jiyò	fever, chill, headache, whole body pain (10 1F45)	<b>67</b>
	kò nà ngobo-bo	pain in the whole body (MG3Z)	<b>26</b>
	kope		
	bela	fever (MG26)	<b>13</b>
	mbombo	behaviour disorder	<b>2</b>
	nde titili	losing weigh (MG43.5)	<b>1</b>
	na goko	chill and cold (MG21)	<b>1</b>
	nde gomo jo	lost of apetit (MG43.8)	<b>1</b>
	ko na potupotu	fontanel not closing (MG44)	<b>1</b>
<b>Infectious or parasitic diseases (n=23)</b>	bibà	abscess (1B753)	<b>16</b>
	biba na	abscess due to filiarua fly (1F66)	<b>2</b>
	wosili	sexual infection (1A9Z)	<b>2</b>
	ko a sa		

**Table 2 (continued)**

Categories	Baka name	English equivalence (ICD code equivalence)	Occurrence in self-reported health recalls
	póló	worms (1F90)	<b>1</b>
	bàtākumba	yaws (1C1D)	<b>1</b>
	sàsà	scabies (1G04)	<b>1</b>
<b>Pregnancy, childbirth or puerperium and perinatal period (n=6)</b>	na boto te mE	abortion (JA00.1)	<b>2</b>
	ko na me	trouble during pregnancy (JB64)	<b>2</b>
	ebukeya	child's fracture due to delivery (19)	<b>2</b>
<b>Injuries, poisoning (n=6)</b>	ka	wound/cut (ND56.1)	<b>5</b>
	nyomo na boenge	wasp's bit (NE61)	<b>1</b>

diversity of treatments (both modern and medicinal plants) was reported among people from Le Bosquet – 90 medicinal plants and 13 different Western biomedicines than from Kungu - 62 medicinal plants and seven Western biomedicines.

Of the 53 different health issues gathered, when considering only the ones reported more than twice (n = 22 health issues), medicinal plants were the most frequent treatment. We have not found any health issue that only relies on Western biomedicines: various strategies exist, varying according to the informants. Medicinal plants were the most frequent medicines for all health issues except for vertigo (only 33%, n = 6), wounds (40%, n = 5), and abscesses (50%, n = 16). Additionally, medicinal plants were the only remedies for abortion, hepatitis, delivery injury, chest pain, *doo* and sexual infection. Western biomedicine was said not to work only in cases of illnesses caused by sorcery or other metaphysical reasons.

### 3.2.2. Medical journey and practitioners

The Baka take care of their health mostly through a curative approach rather than a preventive one, although there are some exceptions. For instance, they employ remedies during pregnancy and child rearing (until weaning) aiming to avert health issues during these critical periods to prevent epidemic, and in the presence of the *Jengi*. Spirit of the forest, the *Jengi* occasionally comes close to the settlements and offers a protection remedy for the entire community. However, epidemic prevention and *Jengi* remedies were mostly done in the past, as highlighted in this quote: “Before, when the *peke* (bush mangoes) season was starting, people would go and get all the barks they needed and make a medicine for the whole village. We don't do that anymore, only when the *Jengi* is around.” (Focus group Kungu).

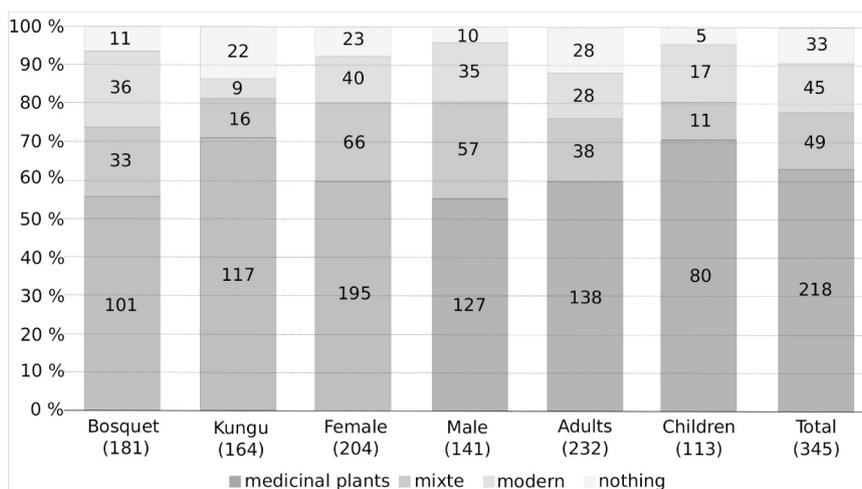
When faced with a health issue, the Baka first try to treat themselves using one or more medicines. If their attempts are unsuccessful, they may seek help from a family member, friend, specialist healer, small shop, or health center. According to self-reported recalls, the respondents were the treatment provider for 252 health issues, and only for 47 they went to a shop or health center (See Fig. 3). Although most Baka hold medicinal knowledge, different specialist healers exist in the communities. In total, 22 persons were named in Le Bosquet and 11 in Kungu as diviner-healers, called *nganga*, midwives, or people who have specific knowledge about particular health issues. For example, some healers were recognized for their ability to treat specific digestive issue (*doo*), bone injuries, hernias, sexual and reproductive health, hepatitis, and child's growth, among others.

We found no difference in treatment providers according to the sick person's gender or life stage. However, the Baka in Le Bosquet consulted significantly more the health center and shops than in Kungu (21% vs. 5%, respectively) where people went more frequently to consult local healers (in 10% of the health issues vs 1% in Bosquet,  $p < 0.001$  to the Fishers exact test) (Fig. 3).

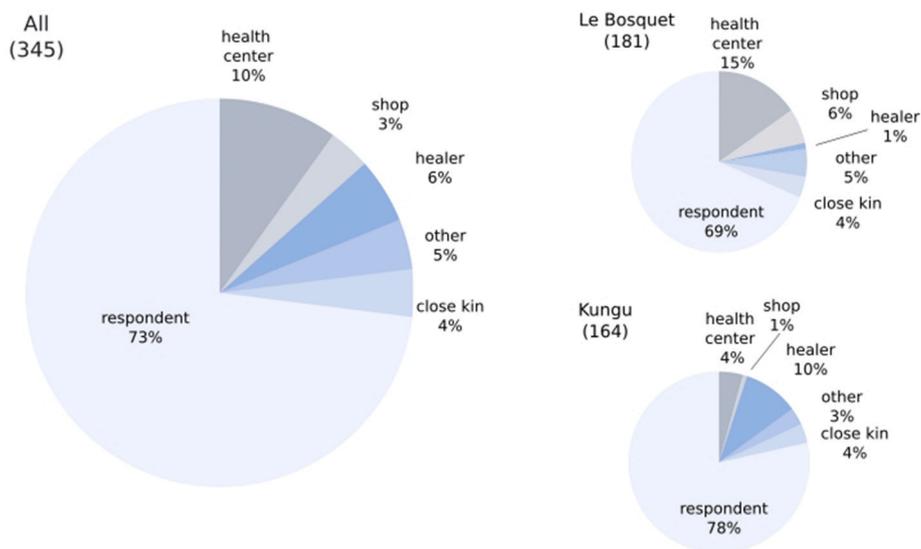
**Table 3**

Health issues categories reported in the self-reported health recalls, overall and per gender and life stage (n = 345 issues).

Health issues WHO categories	Total	Life stage		Gender		Children		Adults	
		Children	Adults	Female	Male	Girls	Boys	Women	Men
<b>Diseases or Symptoms affecting:</b>									
- Circulatory – Blood system	14	7	7	4	10	2	5	2	5
- Nervous system	39	11	28	21	18	5	6	16	12
- Visual and auditory system	5	1	4	4	1	1	0	3	1
- Respiratory system	60	24	36	37	23	14	10	23	13
- Digestive system	50	24	26	29	21	12	12	17	9
- Genito urinary system	2	1	1	2	0	1	0	1	0
- Musculo-skeleton system and connective tissues	28	1	27	19	9	0	1	19	8
<b>General symptoms</b>	112	36	76	66	46	16	20	50	26
<b>Infectious or parasites</b>	23	4	19	14	9	2	2	12	7
<b>Pregnancy, childbirth and puerperium</b>	6	2	4	4	2	0	2	4	0
<b>Injuries</b>	6	2	1	4	2	2	0	2	2
	<b>345</b>	<b>113</b>	<b>229</b>	<b>204</b>	<b>141</b>	<b>55</b>	<b>58</b>	<b>149</b>	<b>83</b>



**Fig. 2.** Distribution of the types of treatments used by the Baka in the self-reported health recalls (n = 345 health issues).



**Fig. 3.** Distribution of the treatment providers of the health issues, from the self-reported health recalls, overall and per village (n = 345 health issues).

3.3. Factors affecting Baka health and healthcare system

Regarding the etiology of the health issues reported, the Baka did not

provide the exact cause of most health issues they reported in the recalls. For only about a quarter of the health issues (n = 78), they reported a specific cause; otherwise, they answered they did not know. The most

frequent categories of causes they provided were workload (n = 21), climate (because of the cold or the rain, n = 12), accidents (n = 10), and sorcery (n = 11) (Fig. 4). Workload was responsible for backpain, cough and *jiyo*, *ko na ngobobo*, *ko na nje*. Climate caused *jiyo*, cough, whole-body pain and headache. Accidents from subsistence activities or fights led to injuries, wounds, eye pain and vertigo. Sorcery was involved in causing fever, abscess, whole-body pain, and decay. However, as mentioned in the focus groups, sorcery might cause a diversity of symptoms, and such origin might be only determined by consulting a diviner-healer who might also be able to treat it. The Baka reported that jealousy regarding for instance field productivity, prestige, and money, has led to an increase in sorcery in recent years.

It is worth noting that sorcery was only named in Kungu, while climate was only reported in Le Bosquet. Additionally, some causes were only named in Kungu, such as hunting meat, breastmilk quality, bad spirit, and sexual relation. In Le Bosquet causes unique to them were related to hygiene, flies, behavior, menstruation, and lack of blood.

Despite the low frequency of causes provided during the recalls, the Baka identified different factors affecting both their health and their healthcare system when conducting group and individual interviews. They mentioned in both villages the same five factors: deforestation; dust and contamination from the road; clean water accessibility; extramarital relations; and bars. Deforestation was mentioned as the first factor affecting their health because it directly affects the accessibility of medicinal trees and creates new pathways of disease transmission, as seen in this quote: “Cutting the trees separates us: us people from the trees, our medicinal trees. Also, without the trees, there are now passages in the forest and the wind blowing through the forest brings diseases.” (Focus group, men, Kungu). The Baka have little power against deforestation: when the loggers come to the villages, they negotiate with the Nzime the

trees to be cut; the Baka do not have any official communal forest they can manage, or if they have, as in Le Bosquet, the final result is the same: the Nzime exploit and take advantage. Baka men are also employed to carry wood from inside the forest to the logging trucks, what causes back pain and hernia. The circulation of logging trucks on the roads was also reported as a factor affecting their health: the contamination and the dust created by their circulation were perceived as causing respiratory issues, especially in the dry season. Then, the dirtiness of the fetched water was seen as responsible for sicknesses. Even if both villages have pumps, Baka access to them is restricted. In the case of Le Bosquet, one pump is in the missionary center, and the Baka cannot currently access it, and the other in the village is often broken down. In Kungu, the pumps are in the Nzime village, and the Baka would have to ask the Nzime to unlock the pump whenever needed. Therefore, in both villages, the Baka would instead go to the closest rivers to fetch water, whose quality depends on the season and is frequently decreased by an intense frequentation of people. Two last factors were reported: extramarital relationships and the frequentation of bars. In both villages, the fact that the Baka used to engage in relationships with non-Baka people from the city is perceived as a reason why sexual infections are increasing. This is also fostered by the consumption of alcohol in bars, which is also identified as an enhancer of conflicts within and between households, violence, and thieves.

#### 4. Discussion

While our understanding of the broad and complex concept of health for the Baka might be partial, our data still provided valuable insights on the culturally grounded determinants of Baka’s healthcare and its threats, contributing to the fields of critical and applied medical

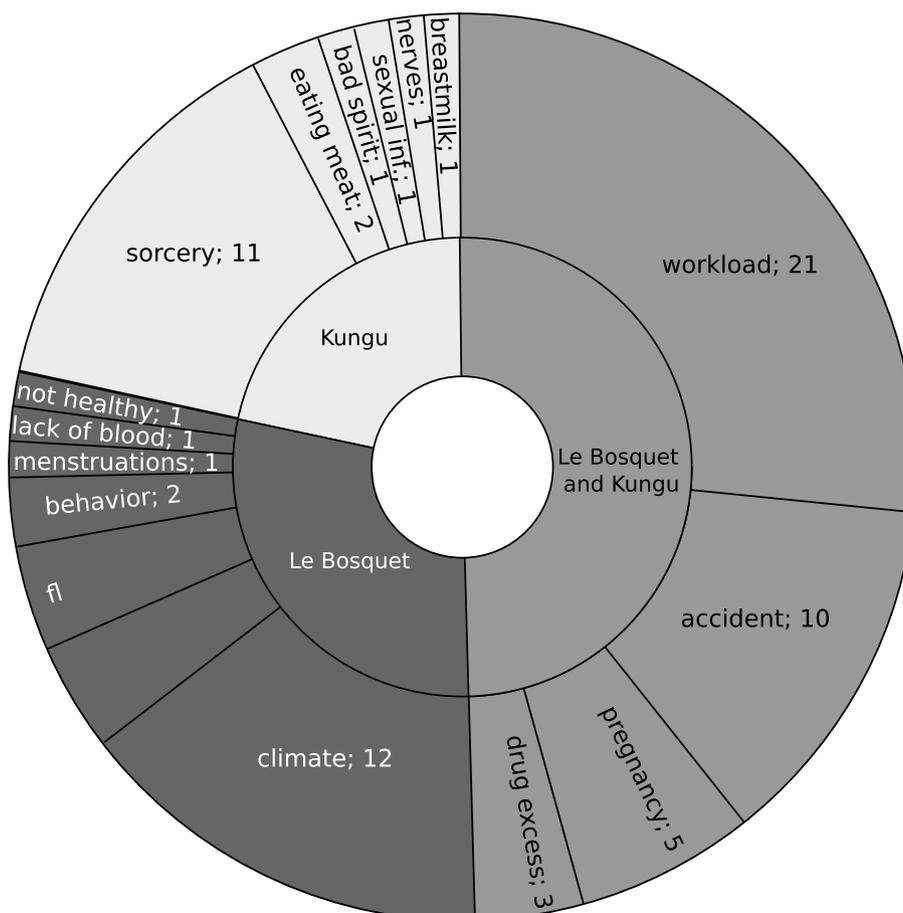


Fig. 4. Causes of health issues gathered in the self-reported health recalls, per village (n = 79 causes).

anthropologies (Page et al., 2018; Roulette, 2019; Valeggia and Snodgrass, 2015).

#### 4.1. On the current Baka health state

The reports from the Baka provide a comprehensive overview into the diversity of health issues prevalent within the communities and shed light on the most critical ones.

First, we saw differences in the health issues suffered by children and adults, as well as women and men. The highest frequency of backpain reported among women, inguinal hernia among men and digestive issues among children might reflect livelihood activities and sanitary conditions of the Baka. We saw here that Baka women especially suffer from workload intensity due to their high involvement in agricultural activities (Froment, 2017). Baka's limited access to quality water might drive to some of the digestive issues and infectious diseases reported, a common issue among Indigenous People (Page et al., 2018). Then, overall, we saw that over the 48 different reported issues, several of them imply a combination of different symptoms. The prevalence of "jiyo," described as a combination of different symptoms, yet not always together, might echo the diversity of infectious elements in this highly biodiverse area. "Jiyo" has been commonly translated as "palu" (malaria) in previous publications (Betti et al., 2013; Brisson, 2010; Carson et al., 2019). However, this term might also include other infectious diseases such as yellow fever, typhoid fever, trypanosomiasis or filaria fly infections. Other local terms, such as *kombe* and *doo* that specifically affect children, would require further Western biomedical exploration. Gathering medical information only based on surveys and translating local terms might hide the complexity of health issues and lead to unreliable interpretations. Considering that the Congo Basin is a hotspot of new diseases' emergence (Eba'a Atyi et al., 2022), there is a need for medical or epidemiological assessment that include a rigorous exploration of the cultural terminologies and understanding of these health issues of the local populations.

The high occurrence of infectious and respiratory diseases, and children's digestive issues reported in these communities is alarming. Indeed, these issues were reported as the main mortality drivers among other Central African societies (Froment, 2017) and foragers' populations (Hill and Hurtado, 1996; Howell, 1979; Melancon, 1982). Causes of Baka mortality, a topic beyond the scope of our study, should be further explored, with a particular focus on women and children, since maternal and newborn mortalities are high among Indigenous Peoples worldwide (Patterson et al., 2022; Silburn et al., 2016).

#### 4.2. The Baka's healthcare system

The Baka healthcare system relies on their access to medicinal plants and to their local respective knowledge, as shown here by the predominance of natural remedies and respondents being their own treatment' provider. However, several pressures exist on these resources and knowledge. The Baka depend primarily on medicinal plants to maintain their health, echoing many small-scale societies worldwide (WHO, 2019). Without any recognized territory, the Baka suffered from marginalization and discrimination (Kulesza and Robillard, 2019), and their access to these natural resources is threatened by deforestation and depends on the decision made either at the governmental level, in the case of concession acquisition by loggers or for conservation, or the agreements the Baka have with their neighbors (Lueong, 2016). Land tenure recognition is thus a central issue for ensuring Baka's health and culture, as for many Indigenous Peoples (Galway et al., 2022; Redvers et al., 2022). At the same time, the Baka mostly treat themselves, highlighting that medicinal knowledge is well spread among the communities, i.e., the Baka share a common pool of knowledge and benefit from expert knowledge of specialists. Beyond the figure of the diviner healer, largely documented among small-scale societies from the Congo Basin (Hewlett, 2017), the healthcare system also involves other

specialists, e.g., on delivery, bones, hepatitis, and sexual health issues. Therefore, even if the Baka still hold knowledge on health and medicine, the way their knowledge is shared plays a crucial role. Such transmission of medicinal knowledge play an essential role in the capacity of Baka health system to adapt to future challenges. While recent work showed the considerable medicinal knowledge held by Baka children (Gallois et al., 2023), further study should explore how medicinal knowledge is distributed and circulate within the communities, considering individual characteristics that shape medicinal knowledge, such as kinship relations, gender, friendship, and social status (Díaz-Reviriego et al., 2016).

The absence of reported causes in our data supported the idea that on many occasions, the Baka consider that illnesses might come spontaneously, which might also explain why preventive remedies are uncommon (Sato, 1998). However, on the identified drivers to health issues, we saw that they belong not only to the ecological, such as their biological and climatic environment, but also the social and cultural aspects of their lives. As already highlighted as one of the main aspects of subjective life appreciation among the Baka, social cohesion is a key factor for Baka wellbeing and health (Reyes-García et al., 2021). This is not only true because social cohesion ensures pathways through which knowledge and practices might circulate but also because disturbance of this cohesion directly affects the health of the Baka, such as conflicts reported here as caused of several illnesses. Increased alcohol and drug consumption lead to conflicts, violence, injuries and sorcery (Gallois et al., 2021), as also recently reported among the BaYaka people (Knight et al., 2021). Among the Baka, the increased consumption of illegally trade Tramadol© drastically impacts the wellbeing and health of both adults and children (Gallois et al., 2021; Ramírez Rozzi, 2018). Therefore, because individual health might relate to the sharing within the communities rather than only on individual knowledge, the increasing rate of conflicts within Baka communities might drastically fragilize their own health and healthcare system.

Thus, the healthcare system of the Baka seems to involve a network of interconnected physical, biological, ecological, and social components. This conception of health is similar to the cosmovision of other societies such as the Batwa (Berrang-Ford et al., 2012), the Agta (Page et al., 2018), and in general, Indigenous Peoples (Redvers et al., 2022). Any health intervention working with the Baka should aim to integrate all different components of the Baka emic perspective on health, considering natural resources and knowledge used by the Baka, and the interconnections between social, ecological, biological and spiritual components of health. To do so, involving Baka members, as, for instance, local specialists in designing and implementing the interventions is key, as shown by initiatives from other settings and broadly claimed by Indigenous representatives (for further examples on how Indigenous Peoples might be involved in health promotion, see Ratima, 2019; Redvers et al., 2022).

#### 4.3. Factors affecting the Baka's healthcare system

Comparing both villages provided interesting insights on how a higher exposure to market integration and health facilities might have on the health state and healthcare system of the Baka communities. First, these factors do not seem to relate to better health, as Baka from Le Bosquet, with higher access to Western health facilities and education, show a similar trend of health issues than Kungu. It somehow struggles with the general assumption that sedentarisation and higher access to health facilities bring health (Page et al., 2018), but echoes similar observations reported among the Agta (Page et al., 2018), Punan Tubu and Kola (Dounias and Froment, 2006). As highlighted previously, sedentarisation came with both potential benefits and threats on Baka health (Dounias and Froment, 2006; Froment, 2017). In addition, we saw that the ways the Baka treat and perceive their different health issues vary between villages. The Baka from Le Bosquet go more to Western biomedicines and to health centers than in Kungu, however they show a

higher diversity in the use of medicinal plants. Thus, exposure to the catholic mission and market integration does not seem to relate to knowledge loss in Le Bosquet. Since Le Bosquet was founded with Baka families from different localities (Girolet, 2005), the higher diversity in medicinal plants used may be due to the aggregation of knowledge coming from different places, and thus the Baka knowledge in medicinal plants varies among groups. However, in Le Bosquet, Baka's health perspective might be affected by the mission's presence. Indeed, while sorcery was present and problematic for Baka in Kungu, no one in Le Bosquet mentioned this cause. The survey of the mission over the life of the Baka living in Le Bosquet varies over time (Ramirez Rozzi, 2021) and can influence the Baka healthcare system. Some years, the representative of the mission threatened some Baka to take them out of the church if they kept performing the *Jengi* ceremony. *Jengi* is the bridge between humans and the forest, ensuring the balance between them and with the ancestors, acts in rituals and ceremonies, shares preventive remedies for the whole community, and serves as a judge in case of grave conflicts, participating in the social cohesion of the communities (Tsuru, 1998). Therefore, situations of rejection of Baka culture as this latter might affect how the Baka from this village perceive, or at least communicate about their health. At the same time, this village encapsulates an interesting mix of cultural dynamics. Indeed, market and religious influences coexist with traditional healers esteemed for their prestige. In Le Bosquet, diviner-healers attract non-Baka people, including notable figures, such as renowned sock players, seeking assistance in various realms (attracting luck, resolving chronic diseases, boosting performance, etc.). However, part of the culture might be hidden or disappearing, as highlighted in other domains of knowledge (Gallois et al., 2015). Considering the risk of cultural expropriation, further study should explore such potential cultural erosion.

Finally, despite village differences, Baka communities identified common threats to their health and healthcare system: deforestation and dust, access to clean water, extramarital relations, and the presence of bars. All these reported threats are embedded within a larger geopolitical framework. Like most Indigenous Peoples worldwide (Ratima, 2019), self-determination, land tenure, and respect for Baka rights are cornerstones of Baka's health, wellbeing, and livelihood. Despite recognizing the Baka as Indigenous People, national health, rights, and education policies still largely ignore their needs. Deforestation threatening the Baka's health and healthcare system is still increasing in the Congo Basin (Eba'a Atyi et al., 2022). Living in remote areas without any Baka representative organization (the only ones active in Cameroon are led by non-Baka or non-Cameroonian people), their voices are hardly heard at the national level and not even in Indigenous organizations worldwide (Kulesza and Robillard, 2019). Therefore, further work still needs to be done to improve the Baka's rights to ensure their health, livelihood, and culture.

## Ethics

Before the onset of the study, we received the approval of the Ethical Committee of the Autonomous University of Barcelona (CEEAH5926) and the research permit from the Cameroon Ministry of Scientific Research and Innovation (00098/MINRESI/B00/C00/C10/C13). Once arrived in the villages, we presented the aim of our research during a first village meeting and then gathered the Free Prior Informed Consent among all the individuals who wanted to participate in this research. All along the research, we followed the Code of Ethics of the International Society of Ethnobiology (ISE, 2006).

## CRediT authorship contribution statement

**Sandrine Gallois:** Writing – review & editing, Writing – original draft, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Appolinaire Ambassa:** Data curation, Formal analysis, Investigation,

Methodology. **Fernando Ramirez Rozzi:** Writing – review & editing, Writing – original draft, Formal analysis.

## Data availability

Data will be made available on request.

## Acknowledgments

Our deepest gratitude goes to the Baka women, men and children who received us in their villages and shared with us their lives. We thank Dr. Libalah and Prof. Sonké for their precious help, Alain Fezeu for his support, and the Cameroonian team of the Institut pour la Recherche et le Développement. This study was funded by the Beatriu de Pinós Programme of the Ministry of Research and Universities of the Government of Catalonia (BP2020-00216), and by the Muséum national d'Histoire Naturelle (Projet Fédérateur H&E: "Le rôle de l'allaitement dans le phénotype des Pygmées Baka"). It received support from the Laboratory for the Analysis of Social-Ecological Systems in a Globalized World (LASEG), Universitat Autònoma de Barcelona and Generalitat de Catalunya (2021-SGR-00182). This research contributes to ICTA-UAB "María de Maeztu" Programme for Units of Excellence of the Spanish Ministry of Science and Innovation (CEX2019-000940-M).

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.socscimed.2024.116936>.

## References

- Angell, B.J., Muhunthan, J., Irving, M., Eades, S., Jan, S., 2014. Global systematic review of the cost-effectiveness of indigenous health interventions. *PLoS One* 9 (11), e111249.
- Berrang-Ford, L., Dingle, K., Ford, J.D., Lee, C., Lwasa, S., Namanya, D.B., Henderson, J., Llanos, A., Carcamo, C., Edge, V., 2012. Vulnerability of indigenous health to climate change: a case study of Uganda's Batwa Pygmies. *Soc. Sci. Med.* 75 (6), 1067–1077.
- Betti, J.L., Iponga, D.M., Yongo, O.D., Mbomio, D.O., Yobo, C.M., Ngoy, A., 2013. Ethnobotanical study of medicinal plants of the Ipassa-Makokou Biosphere Reserve, Gabon: plants used for treating malaria. *J. Med. Plants Res.* 7 (31), 2300–2318.
- Brisson, R., 2010. Petit dictionnaire Baka-Français. In: *Sud Cameroun. L'Harmattan, Paris*.
- Bussalleu, A., King, N., Pizango, P., Ford, J., Carcamo, C.P., Harper, S.L., IHACC Research Team, 2021. Nuya kankantawa (we are feeling healthy): understandings of health and wellbeing among Shawi of the Peruvian Amazon. *Soc. Sci. Med.* 281, 114107.
- Carroll, S.R., Suina, M., Jäger, M.B., Black, J., Cornell, S., Gonzales, A.A., Jorgensen, M., Palmanteer-Holder, N.L., De La Rosa, J.S., Teufel-Shone, N.L., 2022. Reclaiming indigenous health in the US: moving beyond the social determinants of health. *Int. J. Environ. Res. Publ. Health* 19 (12), 7495.
- Carson, S.L., Kentatchime, F., Sinai, C., Van Dyne, E.A., Nana, E.D., Cole, B.L., Godwin, H.A., 2019. Health challenges and assets of forest-dependent populations in Cameroon. *EcoHealth* 16 (2), 287–297.
- Díaz-Reviriego, I., Fernández-Llamazares, A., Salpeteur, M., Howard, P.L., Reyes-García, V., 2016. Gendered medicinal plant knowledge contributions to adaptive capacity and health sovereignty in Amazonia. *Ambio* 45, 263–275.
- Dounias, E., Froment, A., 2006. When forest-based hunter-gatherers become sedentary: consequences for diet and health. *Unasylva -FAO- 57* (2), 26.
- Early, J.D., Headland, T.N., 1998. *Population Dynamics of a Philippine Rain Forest People: the San Ildefonso Agta*. University Press of Florida, Gainesville, FL.
- Eba'a Atyi, R., Hiol Hiol, L., Lescuyer, G., Mayaux, P., Defourny, P., Bayol, N., Saracco, F., Pokem, D., Sufo Kankeu, R., Nasi, R., 2022. The Forest of the Congo Basin: State of the Forests 2021. CIFOR, Bogor, Indonesia.
- Fernández-Llamazares, Á., Lepofsky, D., Lertzman, K., Armstrong, C.G., Brondizio, E.S., Gavin, M.C., Lyver, P.O.B., Nicholas, G.P., Pascua, P.A., Reo, N.J., Reyes-García, V., 2021. Scientists' warning to humanity on threats to indigenous and local knowledge systems. *J. Ethnobiol.* 41 (2), 144–169.
- Froment, A., 2017. Human biology and health of African rainforest inhabitants. In: Hewlett, B. (Ed.), *Hunter-Gatherers of the Congo Basin*. Routledge, New York, pp. 117–164.
- Gaddy, H., 2020. Using local knowledge in emerging infectious disease research. *Soc. Sci. Med.* 258, 113107.
- Gallois, S., Duda, R., Hewlett, B., Reyes-García, V., 2015. Children's daily activities and knowledge acquisition: a case study among the Baka from southeastern Cameroon. *J. Ethnobiol. Ethnomed.* 11, 1–13.
- Gallois, S., van Andel, T., Pranskaitytė, G., 2021. Alcohol, drugs and sexual abuse in Cameroon's rainforest. *Soc. Sci. Med.* 277, 113929.

- Gallois, S., van Andel, T., Ambassa, A., van Bommel, S., 2023. The future is in the younger generation: Baka children in southeastern Cameroon extensive knowledge on medicinal plants. *Econ. Bot.* 78 (1), 15–31.
- Galway, L.P., Esquega, E., Jones-Casey, K., 2022. "Land is everything, land is us": exploring the connections between climate change, land, and health in Fort William First Nation. *Soc. Sci. Med.* 294, 114700.
- Girolet, P., 2005. Avec les Pygmées Bakas de la forêt camerounaise: les combats de soeur Marie-Albéric Moysse (1919-1974). *Mémoire Spiritaine* 21, 133–149.
- Greenwood, M., Lindsay, N.M., 2019. A commentary on land, health, and Indigenous knowledge (s). *Global Health Promotion* 26 (3), 82–86.
- Griffiths, K., Diaz, A., Whop, L.J., Cunningham, J., 2022. The health and wellbeing of indigenous and tribal peoples around the globe: ensuring and promoting best practice in research. *Int. J. Environ. Res. Publ. Health* 19 (1), 261.
- Hewlett, B.S., 2017. *Hunter-Gatherers of the Congo Basin: Cultures, Histories, and Biology of African Pygmies*. Routledge, New York.
- Hill, K., Hurtado, A.M., 1996. *Aché Life History: the Ecology and Demography of a Foraging People*. Transaction Publishers, New Haven.
- Howell, N., 1979. *Demography of the Dobe!* Kung. Aldine, London.
- ISE (International Society of Ethnobiology), 2006. *International society of Ethnobiology Code of Ethics (with 2008 additions)*. <http://ethnobiology.net/code-of-ethics/>. (Accessed 21 July 2023).
- Joiris, D.V., 2003. The framework of Central African hunter-gatherers and neighbouring societies. *African Study Monographs. Supplementary* 28 (November), 57–79.
- Knight, J.K., Salali, G.D., Sikka, G., Derx, I., Keestra, S.M., Chaudhary, N., 2021. Quantifying patterns of alcohol consumption and its effects on health and wellbeing among BaYaka hunter-gatherers: a mixed-methods cross-sectional study. *PLoS One* 16 (10), e0258384.
- Kulesza, P., Robillard, M., 2019. *Quel avenir pour les Pygmées à l'orée du XXIème siècle*. L'Harmattan 1–482. Paris.
- Leclerc, C., 2012. *L'adoption de l'agriculture chez les Pygmées Baka du Cameroun. Dynamique sociale et continuité structurale*. Editions Quae, Versailles.
- Lueong, G.M., 2016. *The Forest People without a Forest: Development Paradoxes, Belonging and Participation of the Baka in East Cameroon*. Berghahn Books.
- Madimenos, F.C., Gildner, T.E., Eick, G.N., Sugiyama, L.S., Snodgrass, J.J., 2022. Bringing the lab bench to the field: point of care testing for enhancing health research and stakeholder engagement in rural/remote, indigenous, and resource-limited contexts. *Am. J. Hum. Biol.* 34 (11), e23808.
- Melancon, T., 1982. *Marriage and Reproduction Among the Yanomamo Indians of Venezuela*. PhD Dissertation. Pennsylvania State University, State College, PA.
- Ninomiya, M.E.M., Maddox, R., Brascoupé, S., Robinson, N., Atkinson, D., Firestone, M., Ziegler, C., Smylie, J., 2022. Knowledge translation approaches and practices in Indigenous health research: a systematic review. *Soc. Sci. Med.* 301, 114898.
- Ohenjo, N., Willis, R., Jackson, D., Nettleton, C., Good, K., Mugarura, B., 2006. Health of indigenous people in Africa. *Lancet* 367 (9526), 1937–1946.
- Page, A.E., Minter, T., Viguié, S., Migliano, A.B., 2018. Hunter-gatherer health and development policy: how the promotion of sedentism worsens the Agta's health outcomes. *Soc. Sci. Med.* 197, 39–48.
- Patterson, K., Sargeant, J., Yang, S., McGuire-Adams, T., Berrang-Ford, L., Lwasa, S., Steele, V., Harper, S.L., 2022. Are Indigenous research principles incorporated into maternal health research? A scoping review of the global literature. *Soc. Sci. Med.* 292, 114629.
- Pickering, K., Galappaththi, E.K., Ford, J.D., Singh, C., Zavaleta-Cortijo, C., Hyams, K., Miranda, J.J., Arotoma-Rojas, I., Togarepi, C., Kaur, H., Arvind, J., 2023. Indigenous peoples and the COVID-19 pandemic: a systematic scoping review. *Environ. Res. Lett.* 18 (3).
- Power, T., Wilson, D., Best, O., Brockie, T., Bearskin, L.B., Millender, E., Lowe, J., 2020. COVID19 and Indigenous Peoples: an imperative for action. *J. Clin. Nurs.* 29 (15–16), 2737–2741.
- Ramírez Rozzi, F.V., 2018. Reproduction in the Baka pygmies and drop in their fertility with the arrival of alcohol. *Proc. Natl. Acad. Sci. USA* 115 (27), E6126–E6134.
- Ramírez Rozzi, F.V., 2021. *Chez les Pygmées Baka de Cameroun. Voyage Dans L'altérité*. L'Harmattan, Paris.
- Ratima, M., 2019. Leadership for planetary health and sustainable development: health promotion community capacities for working with Indigenous peoples in the application of Indigenous knowledge. *Global Health Promotion* 26 (4), 3–5.
- Redvers, N., Celidwen, Y., Schultz, C., Horn, O., Githaiga, C., Vera, M., Perdrisat, M., Plume, L.M., Kobei, D., Kain, M.C., Poelina, A., 2022. The determinants of planetary health: an Indigenous consensus perspective. *Lancet Planet. Health* 6 (2), e156–e163.
- Reyes-García, V., Gallois, S., Pyhälä, A., Díaz-Reviriego, I., Fernández-Llamazares, Á., Galbraith, E., Napitupulu, L., 2021. Happy just because. A cross-cultural study on subjective wellbeing in three Indigenous societies. *PLoS One* 16 (5), e0251551.
- Roulette, J.E.W., 2019. *Ethnobiology, Illness Perceptions, and Health Education Among Maasai Children in Northern Tanzania*. Washington State University, Portland. PhD Dissertation.
- Sato, H., 1998. Folk etiology among the Baka, a group of hunter-gatherers in the African rainforest. *Afr. study Monogr. Suppl. issue* 25, 33–46.
- Silburn, K., Reich, H., Anderson, I., 2016. *A Global Snapshot of Indigenous and Tribal Peoples' Health*. Lowitja Institute.
- Tsuru, D., 1998. Diversity of ritual spirit performances among the Baka Pygmies in southeastern Cameroon. *Afr. Stud. Monogr. (SI25)*, 47–84.
- Valeggia, C.R., Snodgrass, J.J., 2015. Health of indigenous peoples. *Annu. Rev. Anthropol.* 44 (11), 117–135.
- Whitmee, S., Haines, A., Beyrer, C., Boltz, F., Capon, A.G., de Souza Dias, B.F., Ezeh, A., Frumkin, H., Gong, P., Head, P., Horton, R., 2015. Safeguarding human health in the Anthropocene epoch: report of the Rockefeller Foundation–Lancet Commission on planetary health. *Lancet* 386 (10007), 1973–2028.
- World Health Organization [WHO], 2019. *WHO Global Report on Traditional and Complementary Medicine 2019*.