

RESEARCH ARTICLE

Spiritual beliefs, traditional healing, ritual animal contact, and potential zoonotic exposure pathways among the Lua community in northern Thailand: A qualitative One Health study



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ABSTRACT

Background and Aim: The Lua ethnic community in northern Thailand maintains distinctive spiritual beliefs, traditional healing practices, and close interactions with domestic animals, wildlife, and the environment. These culturally embedded practices may influence healthcare-seeking behaviors and create potential pathways for zoonotic exposure. This study aimed to identify spiritual beliefs, traditional healing practices, and human–animal–environment interactions that influence healthcare practices, perceived zoonotic risks, and potential exposure pathways among the Lua community in Thung Chang District, Nan Province, Thailand, within a One Health framework.

Materials and Methods: A qualitative descriptive study was conducted from October to December 2022 in a Lua community in Thung Chang District. Twenty-six respondents, recruited through purposive and snowball sampling, participated in three focus group discussions involving 20 community members and six key informant interviews. Data were collected in Thai and the Northern Thai dialect using audio-recorded interviews and field notes. Recordings were transcribed verbatim, and qualitative content analysis was performed using NVivo 12.0. Codes were iteratively organized into categories and themes through multidisciplinary review and consensus. Methodological triangulation and community member checking were used to strengthen the credibility of the findings.

Results: Spiritual beliefs were closely interconnected with ancestral, household, forest, field, and land spirits and continued to influence traditional healing and healthcare-seeking practices. Respondents generally used modern healthcare services but also consulted shamans and performed healing rituals when illnesses were perceived as spiritually caused or when recovery was delayed. Reported potential zoonotic exposure pathways included ritual slaughter and handling of domestic animals, direct contact with animal blood during house-spirit ceremonies, ritual use of dogs selected on the advice of the “Kha Jam,” hunting and butchering wildlife without personal protective equipment, and consumption of raw or undercooked domestic animal and wildlife products. These findings represent reported practices and biologically plausible exposure pathways; no clinical, serological, or pathogen testing was conducted.

Conclusion: In the studied Lua community, cultural traditions demonstrated complex interconnections among spiritual beliefs, healthcare practices, animal contact, and environmental interactions. Culturally appropriate health education, community engagement, and One Health approaches, proposed here as implications of the findings rather than evaluated interventions, may help reduce potential zoonotic exposure while respecting local beliefs and traditional practices.

Keywords: ethnomedicine, Lua, One Health, qualitative research, traditional healing, wildlife, zoonotic exposure, zoonotic risk.

INTRODUCTION

Ethnic and Indigenous communities often maintain close relationships with natural environments, domestic animals, and wildlife [1, 2]. Their cultural beliefs and traditional practices can influence healthcare-seeking

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Received: 01-07-2026, **Accepted:** 22-09-2026, **Published online:** 22-10-2026

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How to cite: Kanthawee, P., Suwannarong, K., Thammasutti, K., Ponlap, T., Khamrangsee, K., Gunchana, P., *et al.* Spiritual beliefs, traditional healing, ritual animal contact, and potential zoonotic exposure pathways among the Lua community in northern Thailand: A qualitative One Health study. *Vet World*, 2026, 19(10): 4729–4752.

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behaviors, patterns of animal contact, and disease prevention practices [1, 2]. These relationships are particularly relevant within the One Health framework, which recognizes the interconnectedness of human, animal, and environmental health. Emerging and re-emerging zoonotic diseases continue to pose important public health challenges worldwide [3]. Infectious agents of animal origin may be transmitted through direct animal contact, consumption of animal products, environmental exposure, or animal-related cultural practices [4, 5]. Understanding these pathways requires consideration not only of biological hazards but also of the cultural and behavioral contexts in which human–animal–environment interactions occur.

The Lua are an ethnic group in Thailand with a distinctive language, traditions, and cultural practices [6, 7] closely connected to spiritual beliefs and rituals involving spirit worship [8]. These cultural characteristics can shape healthcare-seeking behaviors and interactions with domestic animals and wildlife, making the Lua community relevant to understanding health practices from a One Health perspective [9, 10]. In Nan Province, including Thung Chang District, Lua communities have maintained distinctive cultural traditions while gradually adapting to broader Thai society [6, 11]. The Lua population in this province reportedly migrated from Laos in response to oppressive taxation and tribute demands [6, 11]. These historical and cultural circumstances have contributed to a distinct community context in which traditional beliefs, healthcare practices, animal interactions, and environmental relationships coexist.

Previous studies have identified gaps in understanding how the Lua have adapted their traditional beliefs and rituals while engaging with modern healthcare services in Thailand [12–14]. Cultural and structural circumstances have also been associated with barriers to public health services and concerns involving maternal and child health, nutrition, child development, parasitic infections, and environmental health [15]. Our research group previously conducted a series of qualitative One Health studies examining culturally grounded health beliefs, healthcare-seeking practices, and human–animal–environment interactions among the Phu Thai, Mani, Urak Lawoi, and Kaleung ethnic groups in different regions of Thailand [16–19]. These studies provided a comparative foundation for understanding how cultural and environmental contexts influence health-related practices among ethnic communities [16–19]. However, the previous studies did not include the Lua community and therefore did not address how Lua spiritual beliefs, traditional healing practices, and interactions with domestic animals, wildlife, and the environment relate to healthcare-seeking practices and perceived zoonotic risks [16–19]. This distinction is particularly relevant because the Lua community in Thung Chang District maintains a distinct cultural identity within a Thailand–Laos border setting characterized by close human–animal–environment interactions [20].

Although previous research has documented traditional beliefs, healthcare behaviors, and public health challenges among ethnic populations in Thailand [12–19], understanding remains limited of how these factors intersect within the Lua community. In particular, no qualitative study has comprehensively examined how Lua spiritual beliefs and traditional healing practices interact with animal-related activities and environmental exposures to shape healthcare practices, perceived zoonotic risks, and potential zoonotic exposure pathways in Thung Chang District. This gap matters because culturally embedded practices involving domestic animals, wildlife, food preparation, traditional healing, and ritual activities may create distinctive patterns of human–animal contact that conventional biomedical assessment alone cannot adequately capture. Thung Chang District provides a particularly relevant setting because of its location along the Thailand–Laos border, close human–wildlife interactions, and continued practice of traditional rituals [21, 22]. Building on previous qualitative One Health studies of other ethnic communities in Thailand [16–19], investigation of the Lua community is therefore needed to characterize how its distinct cultural and environmental context influences the interconnected domains of human, animal, and environmental health.

The present study was guided by the following research question: “What beliefs and cultural contexts influence healthcare practices, disease prevention, and interactions with domestic and wild animals among the Lua ethnic group in Nan Province, Thailand, within the One Health framework?” Accordingly, this study aimed to determine the spiritual beliefs, traditional healing practices, and human–animal–environment interactions that influence healthcare practices, perceived zoonotic risks, and potential exposure pathways among the Lua community in Thung Chang District, Nan Province, Thailand, within a One Health framework [20, 23]. By examining these interconnected cultural, health, animal contact, and environmental dimensions, the study sought to provide a culturally grounded understanding of reported practices and potential exposure pathways that may inform context-appropriate One Health health promotion and zoonotic disease prevention strategies.

MATERIALS AND METHODS

Ethical approval

Ethical approval for this study was obtained from the Research Ethics Review Committee for Research Involving Human Research Respondents, Health Sciences Group, Chulalongkorn University (Certificate of Approval [COA] No. 243/2564, approved on December 14, 2021, and COA No. 088/2566, approved on May 2, 2023). The first approval covered the original study protocol, while the second covered a subsequent protocol amendment for extended analysis and reporting, and it did not alter the data collection procedures or the consent obtained from respondents. Fieldwork conducted from October to December 2022 was undertaken under valid ethical approval. The study was conducted in accordance with the Declaration of Helsinki and relevant ethical principles, including respect for persons, beneficence, and justice.

Before data collection, all respondents were informed about the study objectives, procedures, including audio recording, potential risks and benefits, confidentiality measures, and their rights as research respondents. Written informed consent was obtained from all respondents in Thai. For respondents with limited Thai literacy, trained research team members read the study information aloud in Thai or the Northern Thai dialect, confirmed respondents' understanding, and documented consent by signature or thumbprint, as permitted by the approved protocol. Consent was obtained privately, and respondents were informed that refusal to participate or subsequent withdrawal would not affect their access to health services or compensation. Respondents received compensation of 200 Thai Baht for participation.

To protect confidentiality, personal identifiers were removed from the collected data, study codes were assigned, and the identity of the study community was withheld. Photographs were published only with informed consent and contained no identifiable faces or private household shrines. Research data were stored securely in password-protected electronic files and/or locked storage accessible only to authorized members of the research team.

Study period and location

The study was conducted from October to December 2022 in a single Lua community in Thung Chang District, Nan Province, northern Thailand. Nan Province shares an international border with the Lao People's Democratic Republic [24], and Thung Chang District also borders Laos [25–27]. The district is inhabited by the Lanna Thai population and several ethnic groups, including the Hmong, Lua, Khmu, and Tai Lue [27, 28]. Lua people constitute a substantial population in villages within Thung Chang District [29] and continue to maintain their traditional culture, language, customs, rituals, and ancestral beliefs [25]. The district's preserved cultural identity and traditional practices provide an important context for understanding healthcare behaviors [30, 31].

During the preliminary scoping phase, the research team visited several Lua communities across Thung Chang District. A single community was selected for the study based on accessibility, community willingness to participate, and the concentration of Lua residents. Agreement was obtained from local authorities before data collection. To protect respondent and community confidentiality, the community is not identified by name in this article. Figure 1 presents only the location of Thung Chang District within Nan Province and does not identify the study village or individual households. Accordingly, the findings represent the experiences and practices reported within this single Lua community and should not be interpreted as representative of all Lua communities in Thung Chang District or Nan Province.

Study design

This study employed a qualitative descriptive design with qualitative content analysis and formed part of a series of One Health studies conducted by our research team among ethnic communities in different regions of Thailand, including the Phu Thai, Mani, Urak Lawoi, and Kaleung communities [16–19]. Qualitative data were collected through key informant interviews (KIIs) and focus group discussions (FGDs) to explore spiritual beliefs and cultural contexts influencing healthcare practices, disease prevention, interactions with domestic and wild animals, and environmental exposures among the Lua community.

The One Health framework [9, 20] guided the study objectives, development of data collection tools, data collection, analysis, and interpretation of relationships among human health, animal interactions, and environmental exposures within the cultural context of the Lua community. Operationally, the discussion guides were organized into three One Health domains. The human domain addressed illness experiences, healthcare-seeking behavior, traditional healing, hygiene, and coronavirus disease 2019 (COVID-19) experiences. The animal domain addressed livestock and poultry keeping, hunting and trapping, butchering, ritual animal use, meat

preparation, and consumption. The environmental domain addressed forest and field use, water and waste, seasonality, and land-use change. Cross-cutting probes explored how cultural beliefs and rituals interconnected these three domains.

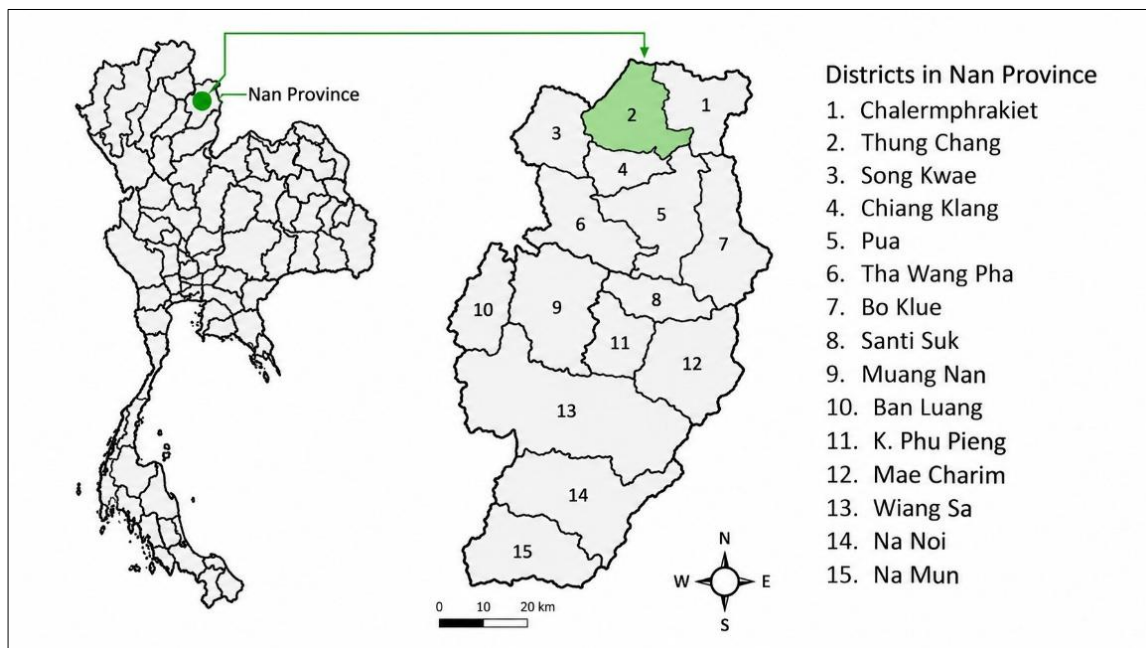


Figure 1: Map of the study location in Thung Chang District, Nan Province, Thailand.

Before data collection, the research team conducted site-scoping visits to understand the local context, establish community engagement, and refine the interview guides. Information obtained during these visits was considered alongside the existing literature to ensure that the discussion guides were culturally appropriate and relevant to the study objectives. Site observations indicated that the community had adapted to its environment through resource utilization associated with sustainable living and community development, with support from government agencies.

Study respondents

Purposive sampling was used to recruit respondents from the Lua community [32]. Respondents were selected with assistance from community leaders and local health authorities based on their knowledge of local traditions, healthcare practices, and interactions with domestic and wild animals. Additional respondents were identified through snowball sampling and community referrals [33]. Key informants were selected for their community or administrative roles and their knowledge of local traditions, health services, and animal-related practices, whereas FGD respondents were general community members. In total, 34 individuals were approached; 26 consented and participated, five declined primarily because of agricultural work commitments, and three were unavailable at the scheduled time and could not be rescheduled within the fieldwork period.

Saturation was defined *a priori* as two consecutive sessions in which no new codes were generated. Saturation was assessed iteratively during coding. No new codes emerged in the final two consecutive sessions (TC_NAN_KII_006 and TC_NAN_FGD_003), meeting the predefined criterion.

Eligible respondents were Lua individuals aged 30–65 years who had resided in the community for at least 12 months and were actively engaged with domestic or wild animals. For this study, active engagement was operationally defined as reporting at least one of the following activities during the preceding 12 months: keeping or tending livestock or poultry; hunting, trapping, or foraging for wild animals; slaughtering, butchering, or preparing meat from wild or domestic animals; or participating in a ritual in which an animal was offered, slaughtered, or handled.

Individuals were not enrolled if, at the scheduled session, they were unable to participate in a sustained conversation or complete the informed consent process because of circumstances such as acute illness or intoxication. This criterion represented a practical assessment of the individual's capacity to participate on that particular day rather than a judgment based on any medical diagnosis, and rescheduling was offered when appropriate. All respondents were able to communicate in Thai or the Northern Thai dialect, both of which were spoken by members of the research team.

Before participation, respondents provided written informed consent and were informed that they could withdraw from an interview or discussion at any stage. The respondent information sheet and consent form were prepared in Thai, and trained research team members verbally explained their contents in Thai or the Northern Thai dialect to ensure understanding before consent was documented.

Data collection tools

Discussion guides (DGs) for the KIIs and FGDs were adapted from previous studies [16, 17] and further developed according to the objectives of the present study and the One Health framework [34]. The guides explored relationships among cultural beliefs, healthcare practices, animal interactions, environmental exposures, and perceived zoonotic disease risks. The version used in this study was adapted for the Lua community and is provided in Supplementary File 1.

Lua-specific probes addressed “Wan Kam” work taboos; the “Su Khwan” or “Huen Lak” soul-calling ceremony; “Phi Kam” days; “Phet Phi” or “Lu Hit” situations; the role of the “Kha Jam” as a spiritual intermediary; placement of animal blood on betel leaves; and the symbolism of dog color in ritual offerings. The DGs also collected information on geographic characteristics, occupations, socioeconomic circumstances, cultural contexts, and spiritual beliefs associated with healthcare practices. One Health-related questions explored relationships among traditional beliefs, animal exposure, environmental factors, and human health. The guides additionally included a distinct COVID-19 module addressing knowledge, attitudes, personal protective measures, community-level protection, and perceptions of healthcare-seeking behaviors.

The study tools were pretested among five Lua adults from a neighboring Lua village in Thung Chang District who did not participate in the main study. Three modifications were made following pretesting. First, double-barreled questions combining cultural beliefs and healthcare-seeking behaviors were separated. Second, the technical term for zoonotic disease was replaced with locally understandable descriptions of illnesses transmitted from animals to humans. Third, COVID-19 questions were moved to the end of the guide and kept as a separate module to ensure they did not detract from questions about rituals and wildlife.

Data collection and analysis

Data were collected at respondents' homes or at a designated community center. To maintain privacy and confidentiality, individuals who were not participating in the study were not permitted to attend or observe the KII or FGD sessions. Audio recordings and field notes were obtained during the sessions. Each KII and FGD lasted approximately 60 min (range, 45–75 min). All sessions were conducted by two trained research team members, with one serving as moderator and the other recording field notes. Sessions were conducted in Central Thai, with the Northern Thai dialect used whenever preferred by respondents. The discussion guides were prepared in Thai, and moderators fluent in the Northern Thai dialect asked the questions orally in the dialect when respondents preferred it, using the locally understandable wording refined during pretesting to keep the meaning of each question consistent across sessions. All six KIIs and all three FGDs included exchanges in the Northern Thai dialect.

Audio recordings were transcribed verbatim. Exchanges conducted in the Northern Thai dialect were translated into Central Thai by bilingual members of the research team. Quoted excerpts subsequently included in the English-language manuscript were back-checked by a second bilingual research team member to preserve their original meaning. The multidisciplinary research team comprised public health professionals, veterinarians, and social scientists, facilitating interpretation of the findings across human health, cultural practices, and animal contact behaviors. Particular attention was given to preserving the contextual and culturally nuanced meanings expressed by respondents during transcription, translation, and interpretation.

Qualitative content analysis and data management were conducted using NVivo version 12.0 (QSR International, Melbourne, Australia) [35–37]. Transcripts were read repeatedly to become familiar with the data, then reviewed line by line to identify relevant words, phrases, codes, and emerging themes. A codebook was developed from an initial subset of transcripts and refined iteratively throughout the analysis, with definitions and exemplar quotations recorded for each code. The three One Health domains served as an initial organizing framework, whereas codes were developed inductively from respondents' accounts and then mapped to one or more of these domains. Coded data were organized into categories based on similarities and conceptual relationships, from which the final themes were developed [35].

Coding and thematic interpretation were reviewed by multiple members of the multidisciplinary research team to strengthen analytical credibility. All nine transcripts, comprising three FGDs and six KIIs, were independently double-coded by two research team members. Disagreements regarding coding or thematic

interpretation were discussed and resolved by consensus rather than by calculating a numerical intercoder reliability coefficient. The complete codebook, including code definitions and exemplar quotations, is provided in Supplementary File 2. Disagreements arose primarily when determining whether an account represented ritual animal contact or routine livelihood contact. For example, when a pig slaughtered for a house-spirit ceremony was subsequently consumed as an ordinary meal, the final coding rule classified the activity according to the stated purpose of the slaughter.

The research team members were external to the Lua community but had previous fieldwork experience with ethnic communities in northern Thailand and were fluent in Thai and the Northern Thai dialect. This combination of outsider positionality and local linguistic and cultural familiarity was considered throughout data collection, coding, and interpretation to reduce potential interpretive bias.

During analysis, the team grouped related codes into broader categories and iteratively refined them into overarching themes through team discussions. The final themes addressed historical and cultural contexts, wildlife and domestic animal use, healthcare practices and zoonotic risk awareness, and experiences during the COVID-19 pandemic. The final analytical stage synthesized these themes into a coherent narrative describing the findings and their implications [38].

Methodological triangulation incorporated KIIs, FGDs, field notes, and multidisciplinary review of coding and interpretation to enhance the credibility and trustworthiness of the findings. KII and FGD data were coded with the same codebook and compared during analysis, so that the perspectives of key informants in administrative roles were considered alongside those of community members without administrative responsibilities. Field notes were completed within 24 h of each session, imported into NVivo as separate sources, and coded using the same framework as the interview and FGD transcripts. These notes documented the setting, nonverbal responses, and observations of animal keeping around households and contributed to interpretation of ritual and animal contact themes [39, 40]. Findings on slaughter, blood handling, butchering, and the consumption of raw or undercooked meat are based on respondents' accounts; the field-note observations were limited to the interview setting, nonverbal responses, and animal keeping around households.

Preliminary findings were subsequently presented for member checking during a single 2-h community meeting held in the study village after data collection and preliminary analysis. The meeting was attended by 18 individuals: 12 study respondents, the village headman, two village health volunteers, and three district or subdistrict health officers. Member checking resulted in two substantive interpretive revisions. First, respondents clarified that the "Kha Jam" determines which animal is required for a ritual but does not treat the patient; the interpretation was revised accordingly. Second, respondents requested that ritual animal use be described as an obligation to household spirits rather than as a personal preference, and the manuscript wording was revised to reflect this distinction. Both revisions originated from feedback from the 12 study respondents; the other six attendees were community and health representatives.

RESULTS

Profiles of the study respondents

The study included 26 Lua respondents from a single community in Thung Chang District, Nan Province. Of these, 10 (38.5%) were male, and 16 (61.5%) were female. The mean age was 50 years, with an age range of 30–65 years. Three FGDs, each comprising 5–9 respondents, included 20 respondents in total: seven males (35.0%) and 13 females (65.0%). The KIIs included six respondents: five males and one female. No individual participated in both an FGD and a KII. FGDs were conducted with general community members to explore shared perspectives, whereas KIIs involved individuals in key community or administrative roles to obtain insights based on their specific experiences.

Among the 20 FGD respondents, 15 (75.0%) were agricultural or general workers, three (15.0%) were housewives, and two (10.0%) were retired. Among the six KII respondents, three were local government officials, one was a village health volunteer (VHV), one was a village headman, and one was a retired government official. Regarding educational status, 13 FGD respondents (65.0%) had completed primary education, four (20.0%) had completed secondary education, and three (15.0%) had no formal education. Among the KII respondents, three had completed primary education, and three had completed secondary education. Overall, 16 of the 26 respondents (61.5%) had completed primary education, seven (26.9%) had completed secondary education, and three (11.5%) had no formal education (Table 1).

Table 1: Demographic distribution, educational status, and occupational profile of the study respondents (N = 26).

Demographic characteristic	Number of respondents	Percentage
Gender		
Male	10	38.5
Female	16	61.5
Total	26	100.0
Age group (years)		
30–39	6	23.1
40–49	6	23.1
50–59	7	26.9
60–65	7	26.9
Total	26	100.0
Educational status		
Primary education	16	61.5
Secondary education	7	26.9
No formal education	3	11.5
Total	26	100.0
Occupation		
Agricultural and general workers	15	57.7
Government officials	3	11.5
Village health volunteer	1	3.8
Village headman	1	3.8
Housewife	3	11.5
Retired	3	11.5
Total	26	100.0
Data collection method		
Focus group discussion respondents	20	76.9
Key informant interview respondents	6	23.1
Total	26	100.0

Values are presented as the number of respondents and the corresponding percentage of the total study population (N = 26). Percentages may not total 100.0% because of rounding. FGD = Focus group discussion; KII = Key informant interview.

History and cultural contexts of the Lua

History of the Lua ethnic group: Respondents reported that members of their Lua community had fled conflict in western Laos and migrated along the Mekong River near Thailand's northern border. According to their accounts, they subsequently settled in hillside areas of what is now Nan Province during the late 1960s to early 1970s. Respondents also indicated that Lua communities continued to reside in Chiang Rai and Mae Hong Son provinces. They described shifting cultivation across neighboring valleys, which facilitated travel and communication among communities. Respondents further explained that they selected the first village leaders and community names based on the characteristics of the local area and its surroundings. Although “Lua” was used in relation to their language and ethnic identity, community members commonly identified themselves as “Thin,” their local ethnonym. Over time, community members learned to communicate in Northern Thai and Central Thai and adopted the practice of electing village heads.

Respondents recalled obtaining land deeds in 1978 through the efforts of the village headman at that time. Their traditional livelihoods included raising livestock, particularly native black pigs, chickens, and cattle, and hunting wildlife for subsistence. Respondents described gradual population growth through family formation and expansion, together with marriages between individuals from different ethnic and regional backgrounds. They reported that many Lua community members practiced a combination of Buddhism and animist traditions, while some maintained predominantly animist beliefs and others had adopted Christianity. Seasonal agricultural labor was described as a major source of income.

Cultural beliefs, traditions, and rituals related to health: Respondents reported that Lua spiritual beliefs involved spirits associated with their living environment, including household, field, and land spirits. Ancestral and guardian spirits were also honored through traditional rituals. Respondents described observing ceremonies rooted in these ancestral beliefs and emphasized the importance of showing respect and avoiding actions considered disrespectful to spirits. “Wan Kam,” which involved offerings of food, flowers, incense, and other symbolic items to household spirits, was described as an important tradition. Some families observed specific “Wan Kam” days during which they refrained from working on their own land, although they could work for

others. Certain activities, including family marriages and the preparation of particular foods such as chilies and rice, were reportedly prohibited during “Wan Kam” because they were believed to disturb the spirits.

“(We) can work (on anyone’s lands) for others, but we must not do our own work because it is Wan Kam (a traditional rest day for making offerings to the household spirits). If we do, it will go against what we believe in (that will disturb the spirits).” (*A government official, TC_NAN_KII_001*)

Respondents also described the “Su Khwan” ceremony, a traditional soul-calling ritual believed to restore a wandering or displaced spirit and promote health, protection, and well-being. The ceremony was described as a long-established tradition passed down through generations and performed under various circumstances. For example, a “Su Khwan” ceremony could be conducted on “Phi Kam,” a day regarded as sacred to ancestral spirits. A disturbing dream could be interpreted as a warning from ancestral spirits, prompting a “Su Khwan” ceremony to demonstrate respect and avert perceived misfortune. Respondents reported that this ritual could require a pair of chickens and a bottle of liquor, with a respected ritual master, often described as a shaman, invited to conduct the ceremony.

The “Su Khwan” ceremony, also known as “Huen Lak” in the Lua language, was described as symbolizing family bonds and serving as an important occasion for family reunion (Figure 2).



Figure 2: A ritual for calling back the soul or spirit of a person, the “Su Khwan” ceremony. Photograph taken and reproduced with the informed consent of those present; no identifiable faces or private household shrines are shown.

Respondents reported that the ceremony was generally held annually in April. A ritual master conducted the ceremony using a black pig, flowers, incense, candles, and a bottle of liquor. The “Su Khwan” ceremony was also performed in situations referred to as “Phet Phi” or “Lu Hit,” involving courtship between a young unmarried couple. In such circumstances, a “Su Khwan” ceremony was arranged for the woman to inform the “Phi Ho” (house spirits) about the relationship. Respondents believed that failure to perform the ceremony could result in illness affecting the woman or her relatives.

“When someone had a disturbing dream, it was believed to be a warning from the spirits of ancestors. To show respect and protect the household, we would perform the ‘Su Khwan’ ceremony, making offerings of chicken and liquor. They would invite a shaman to lead the ritual.” (*A retired government official, TC_NAN_KII_006*)

Respondents also described rituals involving appeasing and feeding spirits as traditional approaches to health care. When an individual did not recover following hospitalization or when the cause of illness remained unidentified, some community members sought assistance from a shaman (Figure 3).

Before consulting the shaman, the patient or family members typically prepared a container of rice and two raw eggs as offerings. Respondents reported that a monetary fee was generally charged for the consultation, during which the shaman sought to identify the perceived spiritual cause of the illness and determine the appropriate ritual. If an illness was attributed to a household or hearth spirit, the shaman used a black pig; if it was attributed to a forest, field, or garden spirit, the shaman generally used a pair of live chickens. The rituals involved offerings to local or land spirits, including sticky rice cakes, sweet water, fruit, and traditional rice liquor, which were presented at an appropriate spirit shrine or ritual site (Figure 4).



Figure 3: A shaman performing a spirit-feeding ritual to treat illness. Photograph taken and reproduced with the informed consent of those present; no identifiable faces or private household shrines are shown.



Figure 4: A spirit shrine of the Lua people in the study community. Photograph taken and reproduced with the informed consent of the household concerned; the shrine is a communal site, and no private household shrine or identifiable person is shown.

Fifteen of the 26 respondents reported that domestic animals, including chickens and dogs, were used as ritual offerings on certain occasions under the guidance of the “Kha Jam,” whom respondents described as a person possessed by a spirit who served as a spiritual intermediary and decision-maker. For example, a black dog (black Thai Ridgeback, *Canis lupus familiaris*) or a red dog (red Thai Ridgeback) could be purchased from outside the community and selected according to the guidance of the “Kha Jam.” According to respondents, a black dog was used in rituals associated with protection and the removal of negative energy, whereas a red dog was selected for rituals associated with prosperity, health, or renewal. Because these dogs were purchased outside the village, introducing them for ritual purposes meant direct contact with animals of unknown health status.

“Sometimes they buy and use a black dog (a black Thai Ridgeback, *Canis lupus familiaris*), while sometimes a red dog (a red Thai Ridgeback) from outside the community, depending on what the ‘Kha Jam’ or the person possessed by the spirit advises. The Kha Jam is the one who decides.” (*Agricultural workers and housewives, TC_NAN_FGD_001*)

Respondents described the house-spirit ceremony as beginning with preparing a ceremonial tray to invite the spirit. Flowers, incense, candles, rice, betel leaves, and other offerings were placed on the tray. The head of the household, typically a man, performed the ritual slaughter of a black pig. According to respondents, the household spirit was believed to reside in a woman's body, which influenced certain aspects of ritual practice, including the roles of household members and the conduct of the ceremony.

Following ritual slaughter, the shaman collected the pig's blood, placed it on betel leaves, and applied it to the patient's body while presenting incense, candles, and flowers so that, according to respondents' beliefs, the house spirits could consume the blood. Respondents did not report the use of gloves or other personal protective equipment during this process. The shaman subsequently used a divination stick to interpret the perceived response of the house spirits and earth deity. Respondents explained that extension of the stick indicated that the offering had been accepted and the spirits were satisfied. The ceremony then continued with additional

offerings, including cooked pork, flowers, incense, and candles.

At the conclusion of the ceremony, the shaman tied a sacred thread around the wrists of the patient and the shaman while symbolically calling the patient's spirit back. Respondents believed that the ritual promoted healing, although they did not specify when recovery would occur.

"The shaman ties a sacred thread around the patient's wrists to apologize and call the spirit back. If the patient did not recover today, the family would wait for him/her to recover by tomorrow or the day after." (*A government official, TC_NAN_KII_001*)

Several respondents further reported that the shaman apologized to guardian spirits during the ritual to demonstrate respect and seek forgiveness for perceived wrongdoing. Respondents described specific practices and taboos around handling and consuming ritual offerings. In particular, offerings were not permitted to be taken back to the patient's home. They also emphasized the importance of selecting an auspicious day, such as "Phi Kam," for the soul-calling ceremony because this was believed to enhance the ritual's success.

"The shaman would also apologize to the guardian spirits. Once the ritual was complete, the chicken could not be taken back home; whether it was pork or chicken, it had to be consumed entirely at the site of the ritual and not brought to the patient's home." (*A government official, TC_NAN_KII_001*)

Lua wildlife and domestic animal uses

Hunting, trade, and consumption activities: Animal contact practices reported by respondents were broadly categorized as routine livelihood contact and ritual contact because these activities differed in frequency, the individuals involved, and their potential amenability to behavioral change. Routine livelihood contact included keeping livestock and poultry, hunting, trapping, butchering, and preparing meat for household consumption. Ritual contact included slaughtering black pigs or chickens during household- and forest-spirit ceremonies, handling and applying animal blood to betel leaves, and using dogs selected according to the guidance of the "Kha Jam."

Respondents described seasonal patterns of wildlife hunting and consumption within the Lua community and reported that wild and domestic animals had traditionally been important food sources. Wildlife consumption varied according to season, species availability, and individual preference. In northern Thailand, respondents distinguished three main seasonal periods: summer (March–May), rainy season (June–October), and winter (November–February). During the rainy season, respondents reportedly consumed frogs, fish, monitor lizards, and pangolins, depending on availability. During summer, forest crabs and frogs were preferred, whereas the meat of the greater coucal (*Centropus sinensis*) was described as dry and lacking flavor. During winter, respondents reported consuming rats, squirrels, and wild boar. They also described consuming liquor infused with cobra or king cobra bile, which was believed to keep the body warm. Wild boar was reportedly slaughtered for consumption during Songkran, the Thai New Year festival. Thus, respondents characterized hunting as a seasonal activity influenced by wildlife availability rather than a daily practice.

"They didn't go hunting in the forest daily; this practice depended on the hunting season." (*Agricultural and general workers, TC_NAN_FGD_001*)

Hunting in the forest was described as a leisure or subsistence activity undertaken by individuals free from other work and skilled at navigating forest environments. Respondents referred to forest hunters as "Kon Lo Yo." Hunters reportedly used shotguns, air guns, crossbows, and various traps to capture wild chickens, birds, rats, monitor lizards, moles, porcupines, civets, squirrels, and other animals. Bamboo traps constructed from poles were placed around agricultural fields. When animals approached rice or other crops, the traps were triggered, causing a bamboo pole to fall onto the animal. Respondents reported that these traps were used for small wildlife, including monitor lizards, moles, bamboo rats, and porcupines.

"Around here, only two 'Kon Lo Yo' (forest hunters) are left. They have used air guns to hunt birds, wild chickens, and sometimes set bamboo traps for small animals like monitor lizards and rats." (*Agricultural and general workers, TC_NAN_FGD_001*)

Respondents also described traditional traps known as "Tum" (log traps), in which barriers were arranged to direct animals toward an enclosed area where a hunter waited with a gun. These traps were reportedly used for monitor lizards, moles, bamboo rats, porcupines, and other small animals. A smaller version, known as "Tum Lek," consisted of wooden poles positioned around agricultural fields to attract or intercept animals. Traditional wooden crossbows and arrows were also used to hunt small- to medium-sized animals, including rats, squirrels, and birds (Figure 5).



Figure 5: Traditional wooden crossbows and arrows used by members of the Lua community for hunting.

After capturing small animals such as rats and squirrels, respondents reported removing the fur by singeing it or immersing the carcass in hot water before preparing the meat. One reported preparation was “Kaeng Khae,” a traditional curry containing animal meat and various locally available vegetables, including ivy gourd flowers, *Acacia insuavis*, betel leaves, fennel, berry eggplant, local mushrooms, and *Sesbania bispinosa* flowers [41].

“They once killed a rat using a trap called ‘Tum.’ They cleaned and cooked it; if it was dry, they would roast it dry and then make ‘Kaeng Khae’ (meat and mixed vegetable curry) with vegetables and long beans.” (A retired government official, TC_NAN_KII_006)

Respondents reported that hunting parties generally comprised two or three individuals equipped with shotguns, air guns, and knives. Hunters entered forested and mountainous areas and sometimes camped for 2–3 days, depending on their availability, weather conditions, and hunting success. When hunters captured larger wildlife, such as wild boar or barking deer, they reportedly butchered the animals themselves and divided the meat in the forest. Respondents did not report the use of gloves or other personal protective equipment during butchering. Bats captured during hunting trips were reportedly cooked in bamboo tubes with chili and shallots for consumption during the trip. Smaller animals, such as squirrels and civets, were wrapped in banana leaves before being transported home for further preparation.

Respondents described gender-related roles in these activities, with men generally responsible for hunting and butchering and women primarily responsible for cooking, sometimes with assistance from other family members. Meat obtained from hunting was also shared with neighbors and relatives. One commonly reported preparation was “Kaeng Om,” a curry containing meat and intestines with herbs and spices such as lemongrass, galangal, chili, and shallots [42].

Respondents provided differing accounts regarding restrictions on hunting. Some stated that no specific community-level regulations prohibited hunting in areas around the community and that hunting was undertaken for household consumption rather than commercial purposes. However, respondents also reported that hunting was prohibited in community-protected forests, government-protected forests, and sacred forest areas maintained for environmental conservation and cultural or spiritual purposes. Interviews with the village headman indicated that wildlife consumption had historically formed part of the community's traditional way of life. Respondents further reported that community members were discouraged from posting images of animals killed during rituals, including dogs, on social media.

Respondents stated that the village headman had been invited by the District Chief to participate in discussions concerning hunting practices to reduce conflicts among villages and encourage cooperation in wildlife conservation, which respondents associated with Thailand's wildlife conservation policies under the Wildlife Conservation and Protection Act, B.E. 2562 (2019). Some respondents reported that wildlife hunting did not occur within the village because it was situated within a protected area, whereas others reported that no specific prohibitions applied within the village itself and that hunting was prohibited in government forest reserve areas. The study did not verify the boundaries of the village in relation to protected areas. Traps continued to be placed in agricultural fields and gardens.

“There are no specific regulations or prohibitions on hunting wild animals within the village; it depends on individual preference. However, hunting in government forest reserve areas is prohibited.” (Agricultural and general workers, TC_NAN_FGD_001)

Respondents perceived that hunting and foraging had declined over time in association with wildlife

protection laws and regulations. They reported that wildlife, including deer and wild boar, was protected and that illegal hunting could result in penalties. Respondents also reported the presence of wild boar, tigers, bears, monkeys, and foxes in protected areas. In addition, they perceived increasing urbanization, population growth, housing development, and reduction of community forest areas in Thung Chang District. Monitor lizards, pangolins, deer, and wild boar were reportedly encountered less frequently than in the past, whereas wild birds, white-bellied rats, rice-field rats, squirrels, civets, wild chickens, and bats were still observed in and around the community.

“There (wildlife) is much rarer now. In the past, the older generations hunted in the forest. However, now, it is tough to find these wild animals. We (Lua people) used to eat wild boars, deer, and barking deer, but now they (the wildlife) are really rare.” (*A village health volunteer, TC_NAN_KII_002*)

Although respondents understood commercial wildlife hunting to be prohibited, they reported that wild animals and wildlife meat continued to be traded within and around the study area. According to respondents, some wild animals were obtained from Hmong traders who transported them from forested areas along the Thailand–Laos border. Respondents also reported that some hunters sold wild animals at a local Saturday market, where squirrels, shrews, mouse deer, moles, rats, and birds had reportedly been observed for sale. Some traders were described as accepting orders by telephone within established networks, and market vendors reportedly cleaned and prepared animals before sale. Some respondents also said they preferred consuming lizards, although they perceived these animals as increasingly scarce.

“I saw squirrels like these at the market on Saturdays. Around 4–5 PM, Hmong people from the mountains would bring them to sell.” (*A village health volunteer, TC_NAN_KII_002*)

Respondents reported consumption of raw wildlife meat, particularly squirrels, shrews, barking deer, and wild boar, in a dish known as “Larb Dip.” They described this dish as raw minced meat mixed with animal blood, seasonings, and spices, including coriander seeds, cinnamon, star anise, white cardamom, pepper, and chili powder [43]. Respondents reported that barking deer meat had become increasingly difficult to obtain during the preceding 5–6 years and was therefore consumed less frequently.

“Mostly, squirrels and shrews were eaten raw as Larb Dip (raw minced meat salad made with various herbs and spices), as were barking deer and wild boars if available. Over the past 5–6 years, there hasn't been any barking deer meat available, but I've really wanted to eat it.” (*Agricultural and general workers, TC_NAN_FGD_003*)

When meat was dried or cooked, respondents described preparing dishes such as “Kaeng Om,” a curry containing meat and intestines with lemongrass, galangal, chili, and shallots [42], and “Kaeng Khae,” a meat and vegetable curry [41]. They also reported grilled preparations and “Saa Nam Kao,” described as a stew made from dog meat and offal.

“They made Larb (a spicy minced meat salad made with various herbs and spices) from freshly caught animals like mouse deer, squirrels, and moles, but they would blanch the meat in hot water first and remove the intestines.” (*Agricultural and general workers, TC_NAN_FGD_001*)

Respondents described both raw and cooked dishes prepared from wildlife. These included “Kaeng Om,” also referred to as “Kea,” a curry containing meat and intestines and seasoned with ingredients such as salt, monosodium glutamate, chili powder, lemongrass, kaffir lime leaves, coriander, and green onions [19]. Wildlife reportedly prepared by grilling included squirrels, wild boar, animals locally described as flying lemurs, soft-shelled turtles, wild chickens, moles, and geckos. Bats were placed in bamboo tubes, roasted over a fire, and subsequently prepared as “Hor Mok,” a steamed curry preparation [44]. Respondents also described “Sa,” a fresh sliced-meat salad containing boiled internal organs, spices, and herbs [45]. Stir-fried dishes with basil were reportedly prepared using wild animal meat, including rat and wild boar.

“They (Lua people in the community) mostly eat bats, but they need to cook them thoroughly. Usually, they put the bats in bamboo tubes and roast them, then cook them (bats) into a curry or ‘Hor Mok’ (a steamed curry mousse wrapped in a banana leaf).” (*Agricultural and general workers, TC_NAN_FGD_002*)

Some respondents described consuming king cobra meat and internal organs. Preparation reportedly involved singeing or burning the scales, removing the head and tail, and boiling the meat or preparing it as a curry. The cooked meat was subsequently shredded and seasoned with ingredients such as seasoning powder, coriander, green onions, and lemongrass, and respondents described its texture as similar to that of chicken. Respondents also reported that dog meat was generally grilled or prepared in spicy curries with curry paste, lemongrass, garlic, galangal, kaffir lime leaves, and chili to reduce its strong odor.

Collectively, respondents' accounts identified repeated points of direct animal contact during hunting, trapping, slaughtering, butchering, handling of carcasses and blood, meat preparation, and consumption of raw or inadequately cooked animal products. Within the One Health framework used in this study, these activities represent potential interfaces among human practices, wildlife and domestic animals, and the surrounding environment. These findings describe reported practices and biologically plausible exposure pathways only; this study did not assess clinical infection, serological evidence, or pathogen presence.

Wildlife and domestic animals used as medicine: Respondents reported that some wild and domestic animals were traditionally believed to possess medicinal properties and were used as remedies for various health conditions. Gecko meat, prepared as curry or grilled, was believed to benefit individuals with asthma. In particular, the gecko tail was regarded as a traditional remedy for asthma. Geckos were also reportedly consumed by pregnant women because of a belief that they increased strength and facilitated childbirth. Some respondents described soaking dried geckos in alcohol and consuming the preparation because it was believed to enhance sexual performance.

“Some people who have asthma should eat geckos. The tail of the gecko is said to cure asthma.” (*A village health volunteer, TC_NAN_KII_002*)

Some respondents described a local account in which children were unknowingly given dog liver by adults and subsequently experienced dizziness or reactions described by respondents as allergic. Consumption of black dogs (black Thai Ridgebacks) was also believed by some respondents to enhance sexual performance. Similarly, liquor infused with cobra bile was believed to warm the body during winter, whereas oil obtained from the serow (*Capricornis sumatraensis*) was reportedly used to relieve body aches.

“Some people believe that eating a black dog (a black Thai Ridgeback, *Canis lupus familiaris*) can improve sexual performance and keep the body warm.” (*A retired government official, TC_NAN_KII_006*)

Respondents reported that animal slaughter and preparation practices varied by ritual type and associated spiritual beliefs. For black pigs, a person considered skilled in slaughtering reportedly made an incision along the right side of the pig's spine using a knife. For white local-breed chickens, slaughter was traditionally performed by a grandmother, reflecting the reported belief that spirits resided in women's bodies. Internal organs, including the liver and intestines, were separated, and blood was collected in a bowl for ritual use.

Respondents described dripping animal blood onto betel leaves and applying it to the patient's body. The shaman then placed the betel leaves, blood, and animal parts on a ceremonial tray and performed the ritual, which included tying a sacred thread around the patient's wrist. These practices were understood by respondents as promoting spiritual healing and recovery rather than providing a specific medicinal effect. After completion of the ritual, the meat was cooked and consumed.

“For problems believed to be caused by spirits, we had to see a shaman. The shaman performs a ritual to remove the spirit, and the person then recovers. We truly believed in it at that time.” (*Agricultural and general workers, TC_NAN_FGD_001*)

Healthcare practices and the impact of the COVID-19 pandemic on the Lua community

Healthcare practices among the Lua community: Respondents reported communicable diseases in their community, including tuberculosis, influenza, dengue fever, and malaria, with malaria particularly associated in their accounts with individuals who stayed overnight in forested areas. They described responses by health personnel, VHVs, and local health centers, including activities to eliminate mosquito breeding sites. Respondents were also aware of animal-to-human disease transmission and specifically mentioned *Streptococcus suis* infection, locally referred to as “deafness disease.” Although respondents reported no known cases within their subdistrict, they had heard of cases in nearby villages, which they indicated had increased community awareness of the potential risks associated with raw pork consumption.

“Since hearing the news about the deafness disease, people have been avoiding eating raw pork, only consuming fresh meat from cows and buffaloes.” (*Agricultural and general workers, TC_NAN_FGD_002*)

Respondents described several illnesses and potential health risks that they associated with animals, including rat-bite fever, leptospirosis, illness following bites from animals locally described as flying lemurs, suspected *Streptococcus suis* infection associated with raw pork consumption, a perceived association between bats and COVID-19, and illness attributed to spoiled meat. These accounts represented respondents' perceptions and locally reported experiences rather than clinically or laboratory-confirmed diagnoses within the study community. Some respondents also reported exercising caution when handling wild boars with visible wounds or

injuries after receiving advice from VHV that contact with wild boar blood could represent a potential route of zoonotic exposure. Nevertheless, respondents indicated that some individuals continued to handle wild boar blood with bare hands or allowed blood to come into direct contact with their bodies during handling and butchering.

Respondents also reported recognizing the importance of seeking medical attention promptly if they became ill or suspected an animal-associated infection. When handling and butchering wild animals, some individuals reported using alcohol-based products, including isopropyl alcohol obtained from local pharmacies or health-promoting hospitals and alcohol-based hand sanitizers, to clean wounds. Respondents also emphasized thorough cooking of animal meat as a measure they believed could reduce the risk of foodborne illness.

“If we experience any illness or are at risk of zoonotic diseases, we understand the importance of promptly visiting a doctor for treatment. We also use alcohol-based hand sanitizers to clean and treat wounds when butchering wild animals and ensure the meat is thoroughly cooked to prevent diseases.” (*Agricultural and general workers, TC_NAN_FGD_002*)

Alongside conventional healthcare practices, respondents described the continued use of traditional health beliefs and healing practices. When an individual remained unwell after several days of medical treatment or when no diagnosis had been established, some respondents reported considering the possibility of a spiritual cause. In such circumstances, they described performing “Soh Mue,” a traditional ritual in which a shaman sought to identify the perceived spiritual cause of illness and determine the appropriate offerings. Respondents' accounts therefore indicated that conventional medical care and traditional spiritual practices could be used sequentially or alongside one another.

“If someone stayed in the hospital for 3–4 days and the doctor couldn't diagnose the disease, then the shaman would take action, and we believed it would be something wrong (spiritual thing).” (*Agricultural and general workers, TC_NAN_FGD_001*)

Respondents described spirit-worship as a long-standing component of traditional Lua approaches to health and healing. They associated these traditions with the community's historical relationships with forests, mountains, and ancestral beliefs. Such beliefs were incorporated into health-related practices through rituals involving household, ancestral, and forest spirits. Although respondents said hospital-based medical care had become increasingly common, traditional beliefs and rituals continued to be practiced and passed down across generations.

Respondents who described spirit-worship rituals also referred to a local concept translated as “sorcery,” which they used to describe perceived spiritual disturbances rather than malicious intent. Both male and female shamans reportedly performed spiritual healing rituals. These practices could include one or two rounds of incantations intended to ward off perceived misfortune and the provision of holy water prepared using bael leaves, Bengal root, and rice. Shamans were also reported to massage painful areas, including the thighs, back, and shoulders, as part of the healing practice.

Some respondents described incantations performed together with physical manipulation or stretching as a form of “energy healing.” In their accounts, these practices were intended to stretch the muscles of individuals with paralysis and provide psychological or spiritual encouragement to support attempts to stand and walk. Respondents also reported that some individuals with muscle pain or cancer had previously sought assistance from shamans. One traditional practice involved incantations intended to remove pieces of metal believed to cause pain. Respondents indicated that this practice had largely declined over time as hospital-based diagnostic procedures, including X-ray examinations, became more commonly used. Overall, these findings demonstrate the coexistence of biomedical healthcare-seeking and culturally embedded traditional healing practices within the Lua community.

Impact of the COVID-19 pandemic among the Lua community: During the COVID-19 pandemic, respondents described performing a ritual known as “Suep Chata” (life-prolonging ceremony), which involved binding holy basil and spring onions together and was intended to provide peace of mind. Respondents indicated that some traditional activities and rituals were disrupted by pandemic-related public health measures, including restrictions on social gatherings and physical distancing. For example, spirit-calling rituals involving blowing with the mouth while securing a patient's wrists were described as difficult to perform under these conditions.

Respondents also described various self-care practices during the COVID-19 pandemic, including cold medicines, analgesics, and herbal preparations. Herbal remedies included “Fah Talai Jone” (*Andrographis paniculata*) and lemongrass, while some respondents also reported consuming lemon juice and galangal

preparations. These were reported practices and should not be interpreted as evidence of therapeutic effectiveness against COVID-19. At the time of data collection (October to December 2022), respondents perceived that COVID-19 cases had declined in their community.

Medical personnel at hospitals were reported as the most trusted source of COVID-19-related health information. Other information sources included television, mobile phones, and internet-based platforms such as YouTube, LINE, Facebook, and Google. Throughout the pandemic, VHVs and family members reportedly helped individuals obtain medicines and food supplies.

Respondents recalled that during the early period of the COVID-19 pandemic, some community members were apprehensive about approaching individuals with COVID-19, and some were reluctant to receive COVID-19 vaccination. They reported that information from government officials, community leaders, and VHVs improved their understanding of the disease. Respondents perceived that, over time, fear and stigma toward individuals with COVID-19 decreased and willingness to receive vaccination increased.

“At first, we were afraid of getting close to COVID-19 patients and didn’t want the vaccine, but after hearing from health staff, a community leader, and VHVs, we understood better and started getting vaccinated.” (*Agricultural and general workers, TC_NAN_FGD_003*)

Respondents suggested that health information should be communicated clearly through the village public announcement system, with accessible explanations of treatment and personal protective measures against COVID-19. They considered such communication important for improving community understanding and reducing stigma toward affected individuals. VHVs were described as actively providing health information and contributing to changes in community attitudes toward individuals with COVID-19. Respondents' accounts also indicated increased discussion and awareness of animal-to-human disease transmission during the pandemic period.

DISCUSSION

Distinctive Lua practices and potential zoonotic exposure pathways

The most distinctive findings of this study involved three culturally embedded practices that created direct interfaces between humans and animals. First, house-spirit ceremonies involved the ritual slaughter of black pigs or white local-breed chickens, followed by the placement of fresh animal blood on betel leaves and its application to the patient's body by a shaman. Second, 15 of the 26 respondents reported the ritual selection and purchase of black or red dogs from outside the community according to the guidance of the “Kha Jam.” Third, respondents described routine wildlife hunting, bare-handed butchering, and consumption of raw or lightly cooked animal products, including preparations such as “Larb Dip” and “Sa.” These practices represented biologically plausible opportunities for exposure to animal blood, tissues, and other biological materials; however, this qualitative study did not determine whether zoonotic transmission occurred.

When considered alongside our research team's previous qualitative One Health studies among the Phu Thai, Mani, Urak Lawoi, and Kaleung ethnic groups, the Lua findings revealed both shared and distinctive features. The coexistence of biomedical care and spirit-based healing was reported across these communities, whereas sustained direct contact with fresh animal blood as an integral component of healing rituals and the specification of ritual animals by color through a spiritual intermediary were particularly prominent in the present Lua study. Thus, although cultural–biomedical integration represents a recurring pattern across the ethnic communities studied, the specific forms of human–animal contact vary according to local beliefs and ritual practices. These findings extend understanding of how spiritual beliefs, healthcare practices, animal use, and environmental interactions intersect within the Lua community in Thung Chang District and illustrate their relevance within a One Health framework.

The Lua community's way of life remained closely connected to forests, wildlife, and the broader natural environment, while spiritual beliefs involving forest, ancestral, and household spirits remained particularly relevant among older generations [28, 46]. Rituals involving incantations and offerings continued alongside modern medical services [47], demonstrating the persistence of traditional healing within a changing healthcare environment.

Ritual animal contact and the One Health interface

The ritual use of domestic animals, particularly chickens and black pigs, reflected deeply embedded spiritual beliefs and cultural identity among respondents. These practices appeared to serve symbolic, social, and emotional functions within households and the wider community. At the same time, respondents did not report

the use of gloves or other personal protective equipment during ritual slaughter, blood collection, or subsequent handling. Direct contact with fresh animal blood therefore represented a biologically plausible pathway for zoonotic exposure, particularly where blood contacted bare skin or was applied directly to the patient's body. Nevertheless, the present qualitative findings cannot establish that exposure resulted in infection or disease transmission. This intersection between culturally important practices and potential biological exposure is particularly relevant to the One Health framework [23, 48].

Figure 6 summarizes the relationships among the human, animal, and environmental domains identified in this community.

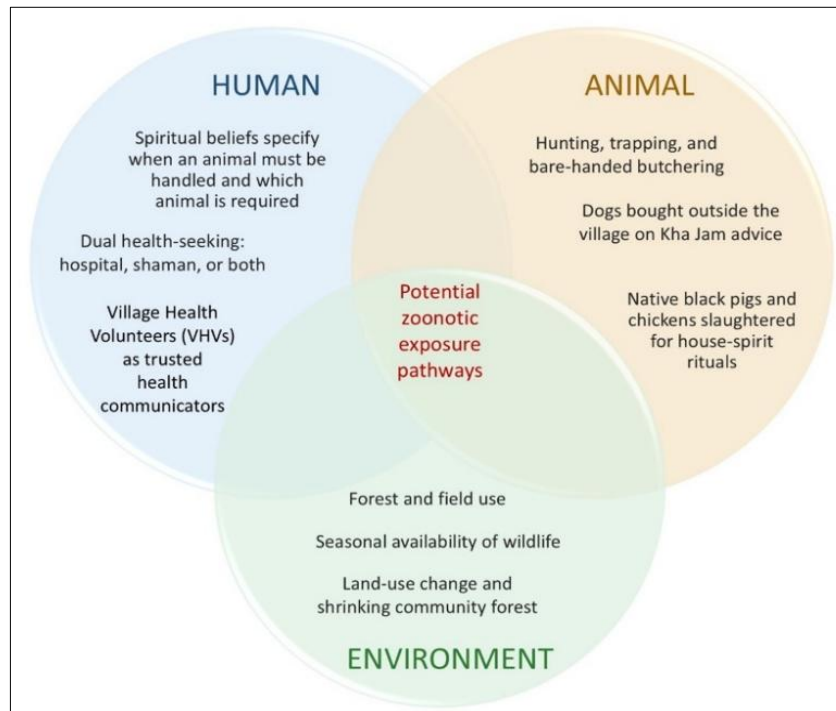


Figure 6: Conceptual framework of human–animal–environment interactions underlying potential zoonotic exposure pathways among the Lua community in Thung Chang District.

Within the environmental domain, forest and field use, seasonal wildlife availability, and land-use change influenced the species encountered and the timing of these encounters. Within the animal domain, encounters became direct contact events through hunting and trapping, bare-handed butchering, sharing of meat in the forest, keeping native black pigs and chickens, and introducing dogs purchased outside the community for ritual purposes. Within the human domain, spiritual beliefs influenced when animals were required for rituals and which animals were selected, whereas healthcare-seeking behavior influenced whether illness was managed through biomedical services, traditional spiritual practices, or both.

These domains were interconnected rather than independent. Respondents' accounts suggested that restrictions on hunting reduced some forms of direct wildlife contact, while animals and animal products could also be obtained through markets and traders. Conversely, beliefs concerning spiritually caused illness could generate ritual animal contact events that might not otherwise occur. Consequently, focusing on a single domain would provide an incomplete understanding of potential exposure pathways and opportunities for risk reduction. Previous studies have emphasized community-centered, culturally appropriate approaches to zoonotic disease prevention that recognize local beliefs and practices while promoting feasible risk-reduction measures through cross-sectoral collaboration and community engagement [23, 48]. In the Lua context, this supports consideration of approaches that preserve the cultural meaning of rituals while introducing safer animal handling, blood contact, and hygiene practices.

Integration of traditional healing and biomedical care

The findings indicated that respondents commonly used modern medical services while retaining traditional healing practices, particularly when illness persisted despite medical treatment or was perceived to have a spiritual cause. Spiritual beliefs, rituals, and herbal remedies therefore remained relevant to healthcare-seeking behavior rather than functioning simply as alternatives to biomedical care. Respondents' accounts suggested a

pluralistic pattern in which biomedical and traditional approaches could be used sequentially or in combination.

Previous research has similarly documented changes in traditional disease-management practices among Lua communities in response to environmental and social conditions. Qin and Ketkaew [49], for example, reported that Lua people in Nongkham District, Bangkok, increasingly sought care from nearby healthcare facilities that were perceived as faster and more effective. Earlier studies reported a stronger preference for traditional medicine among some Lua communities, with language barriers and socioeconomic constraints influencing access to modern healthcare [49–51]. In the present study, however, respondents commonly described hospital or clinic attendance while continuing to use traditional healing for conditions interpreted as spiritually caused or unresolved by biomedical care. This difference suggests that patterns of healthcare use may vary according to geographic, social, cultural, and healthcare-access contexts and should not be generalized across Lua communities.

Traditional practices nevertheless remained important. Respondents described the continued use of herbal preparations, including remedies obtained from other provinces for postpartum recovery, while some characterized these treatments as cumbersome or time-consuming and noted limitations in the tools required for their preparation [49]. When biomedical treatment was perceived as unsuccessful, some respondents continued to seek spiritual assistance from Lua shamans [49]. The present findings therefore indicate the coexistence and integration of traditional and biomedical healthcare practices within the studied community in Nan Province, rather than the complete replacement of one system by the other.

These observations are broadly consistent with our research team's previous qualitative studies among the Phu Thai [16], Mani [17], and Urak Lawoi [18], which documented coexistence of spirit-based beliefs and rituals with modern healthcare and identified hunting, animal contact, and consumption practices as potential zoonotic exposure pathways [16–19]. Similar to those communities, Lua respondents generally described using modern medical services while retaining traditional healing for illnesses perceived to have spiritual causes. A notable feature of the Lua findings was the prominence of direct contact with animal blood during house-spirit ceremonies and the ritual use of dogs selected through the “Kha Jam.” These findings indicate that, although broad patterns of cultural and biomedical integration may be shared among the ethnic communities studied, specific potential exposure pathways are shaped by distinctive local rituals and animal use practices. This variation supports context-specific rather than uniform One Health risk reduction approaches.

Healthcare communication and experiences during the COVID-19 pandemic

Healthcare-seeking behavior among respondents was influenced by established cultural practices, social relationships, and access to trusted health information. During the COVID-19 pandemic, local health workers, VHVs, community leaders, and familiar media platforms were reported as important sources of information. Previous studies have similarly indicated that trusted communication channels, including local health workers and media, can influence health knowledge and healthcare-seeking behaviors among ethnic communities during public health emergencies [52, 53]. Conversely, stigma and mistrust may impede engagement with public health measures and complicate health-crisis management [54].

Some respondents described using traditional or herbal remedies during the COVID-19 pandemic, while others reported initial reluctance toward vaccination and apprehension about approaching individuals with COVID-19. Respondents also described greater acceptance of vaccination and reduced stigma following community health communication. Because this study was qualitative and retrospective regarding these experiences, it cannot establish that communication activities directly caused these changes. Nevertheless, the accounts highlight the importance of culturally understandable health communication delivered through trusted local channels. Community engagement and stigma-reduction strategies may therefore be important components of health communication in similar settings [55, 56].

The gender composition of the qualitative sessions is also relevant to interpretation. Five of the six KII respondents were male, whereas 13 of the 20 FGD respondents were female. Hunting, slaughter, and butchering were described predominantly in accounts from male respondents, whereas female respondents contributed substantially to accounts concerning healthcare-seeking, postpartum herbal practices, and food preparation. Consequently, reported gender-related patterns should be interpreted in light of the composition of the KIIs and FGDs and should not be assumed to represent the distribution of these roles throughout the entire community.

Implications for culturally appropriate One Health interventions

The findings demonstrate how spiritual beliefs, ritual practices, wildlife use, food preparation, and

healthcare-seeking can create interconnected human–animal–environment interfaces. Animal offerings, handling of fresh animal blood, bare-handed butchering, hunting, and consumption of raw or undercooked animal products represented potential zoonotic exposure pathways reported by respondents. At the same time, reliance on forests, wildlife, domestic animals, and culturally important healing practices demonstrates why potential health risks cannot be considered independently of cultural and environmental contexts.

Public health programs could therefore address potential zoonotic exposure pathways in ways that preserve respect for local cultural traditions. A One Health approach may provide a framework for integrating health promotion, animal health, and environmental conservation; however, the present study did not evaluate the effectiveness of any intervention. Furthermore, findings from the Lua community in Nongkham District, Bangkok [49], provide a contextual comparison rather than evidence that the findings from Thung Chang District are transferable to other Lua populations.

The findings also have potential implications for the Thai public health system and the VHV network [57]. Zoonotic disease prevention information could be incorporated into existing VHV training and routine community health activities in ethnic communities, with culturally adapted communication addressing practices such as bare-handed butchering, direct ritual blood contact, and consumption of raw or undercooked wildlife [57–61]. Such approaches should focus on feasible risk reduction without dismissing the cultural meaning of traditional practices.

Coordination among provincial and district health services, livestock and wildlife authorities, community representatives, and ritual leaders could further support alignment between health promotion and wildlife conservation within a One Health framework [62]. Importantly, these proposed approaches represent implications derived from the qualitative findings and require formal development and evaluation before their effectiveness can be established.

Strengths and limitations

A major strength of this study was the detailed qualitative exploration of spiritual beliefs, traditional healing, animal contact, wildlife use, and healthcare-seeking within an integrated One Health framework. Community members, local leaders, and health personnel supported the fieldwork, while the inclusion of both FGDs and KII enabled examination of shared community perspectives and role-specific experiences. Methodological rigor was further strengthened through double-coding of all nine transcripts, multidisciplinary interpretation, field-note triangulation, explicit consideration of researcher positionality, and community member checking. The latter resulted in substantive clarification of the role of the “Kha Jam” and the cultural meaning of ritual animal use.

Several limitations should be considered. Data collection occurred from October to December 2022, when agricultural work, forest foraging, hunting, and other livelihood activities affected respondent availability and scheduling. Nevertheless, 26 respondents participated, and the study achieved its predefined criterion for data saturation. Previous methodological literature has discussed the relationship between qualitative sample size and saturation [63–65]; however, adequacy in the present study is supported primarily by the study's documented saturation process rather than respondent number alone.

First, hunting protected wildlife and some ritual activities may be socially or legally sensitive; consequently, reports of these behaviors may have been affected by social desirability or underreporting. Second, five of the six KII respondents were male, potentially limiting women's representation among key informants, although the FGDs were predominantly female. Third, the study was conducted in a single Lua community during a specific period; therefore, the findings are context-specific and should not be generalized to all Lua communities in Thung Chang District, Nan Province, or elsewhere.

Additional limitations include the outsider status of the interviewers, potential loss of nuance during translation from the Northern Thai dialect into Central Thai and subsequently into English for quoted material, and possible selection or elite bias arising from recruitment facilitated by community leaders and local health authorities. Restricting eligibility to adults aged 30–65 years may also have limited the representation of intergenerational beliefs, traditional knowledge, and ritual practices. The findings may also have limited transferability across households with different religious orientations because the study did not analyze Christian and animist Lua households separately. Finally, the qualitative design identified reported practices, perceptions, and biologically plausible exposure pathways but did not quantify exposure frequency or magnitude, determine disease prevalence, or demonstrate actual zoonotic transmission. Epidemiological and laboratory investigations are needed to address these questions.

Future research directions

Future studies should build on these qualitative findings using mixed-methods approaches and quantitative risk assessment. Epidemiological investigations incorporating serological or pathogen surveillance could examine whether individuals with frequent animal contact, including hunters, butchers, and ritual practitioners, have measurable evidence of exposure to relevant zoonotic pathogens. Such studies would require pathogen-specific hypotheses, appropriate comparison groups, validated laboratory methods, and adequate sample sizes, rather than assuming infection based on the behaviors identified here.

Future research should also develop and evaluate culturally tailored interventions that address direct animal-blood contact, safer butchering and carcass handling, food preparation, and communication about zoonotic disease risks. Collaboration with VHVs, community leaders, ritual practitioners, animal health professionals, wildlife authorities, and community members could facilitate interventions that retain culturally important practices while reducing avoidable exposure. Longitudinal or multisite research across different Lua communities would also help determine which findings are specific to Thung Chang District and which may be shared across different Lua cultural, religious, and geographic settings.

RECOMMENDATIONS

Promote appropriate healthcare and animal contact practices

Although Lua respondents demonstrated awareness of several health-protective practices, including thorough cooking of animal products and basic wound care, the findings identified opportunities to strengthen understanding of potential zoonotic exposure, particularly during hunting, slaughtering, butchering, and animal handling associated with traditional rituals. Local health authorities and health personnel could collaborate with VHVs to provide culturally appropriate health promotion and social and behavior change communication. Capacity-building activities for VHVs could strengthen their ability to communicate practical zoonotic disease prevention measures while respecting Lua cultural beliefs and ritual practices. Thailand's VHV initiative provides an established community-based mechanism for infectious disease surveillance and health promotion [66]. Similarly, the Lawa Project in Khon Kaen Province provides an example of culturally tailored community engagement using an EcoHealth approach [67]. Because the Lawa Project addresses opisthorchiasis within a different epidemiological and ecological context, it should be considered an analog for community engagement rather than a directly transferable zoonotic disease-control model.

Based on the potential exposure pathways identified in this study, culturally adapted VHV training could use locally understandable language and examples from Lua ritual, hunting, butchering, and food preparation practices. Communication should distinguish between preserving the cultural meaning of traditional practices and reducing avoidable biological exposure. Particular attention could be given to direct contact with animal blood, handling of carcasses and internal organs, wound care during slaughter and butchering, and consumption of raw or undercooked animal products.

Practical risk reduction measures could include promoting appropriate hand hygiene and wound care and encouraging the use of suitable, affordable personal protective equipment, such as gloves, during slaughtering, butchering, and activities involving direct contact with animal blood. For ritual practices, these measures should be developed collaboratively so that they do not unnecessarily interfere with the spiritual meaning or sequence of ceremonies. Shamans, the “Kha Jam,” community leaders, and other individuals involved in traditional rituals could therefore be engaged as community partners in co-designing culturally acceptable approaches to safer animal handling.

Food-safety communication should encourage thorough cooking of wild and domestic animal products and explain the potential risks associated with raw or undercooked meat using locally relevant examples, including *Streptococcus suis* infection in relation to raw or inadequately cooked pork. Messages should avoid stigmatizing traditional foods or cultural practices and instead emphasize feasible modifications that can reduce exposure while preserving culturally important aspects of food preparation and consumption.

Any intervention developed from these recommendations should incorporate monitoring and evaluation. Potential indicators could include VHV training coverage, self-reported use of protective measures during animal slaughter and blood handling, self-reported consumption of raw or undercooked meat, and the number of collaborative health promotion activities conducted with community and ritual leaders. Household-level indicators could be collected by the subdistrict health-promoting hospital and VHV team at baseline and at 12 and

24 months. The Thung Chang District Health Office could review training coverage and collaborative activities with ritual leaders every 6 months, while the Nan Provincial Health Office could undertake annual review and coordinate relevant activities with district livestock and wildlife authorities. These proposed indicators and responsibilities represent potential applications of the study findings and were not evaluated in the present study.

Recommendations for future research

Future research should examine Lua communities in other geographic and sociocultural settings in Thailand and, where relevant, neighboring areas to determine which beliefs, traditional practices, healthcare behaviors, and human–animal–environment interactions are specific to the community studied in Thung Chang District and which may be shared more broadly. Multisite studies would be particularly valuable for examining differences in religious practices, livelihood patterns, access to healthcare, wildlife availability, environmental change, and local regulations on hunting and wildlife use.

Mixed-methods research could combine qualitative investigation with quantitative assessment of the frequency and characteristics of potentially relevant exposures, including hunting, slaughtering, butchering, direct contact with animal blood, ritual animal handling, and consumption of raw or undercooked animal products. Such research could help determine which reported practices warrant more focused epidemiological investigation.

Where justified by specific epidemiological hypotheses, future studies could incorporate serological or pathogen surveillance among groups with frequent animal contact, such as hunters, individuals involved in butchering, and ritual practitioners. Such investigations should identify relevant animal hosts and pathogens *a priori*, use validated laboratory methods, and include appropriate epidemiological comparison groups rather than assuming that the practices identified qualitatively resulted in infection.

Future studies should also develop and prospectively evaluate culturally tailored One Health interventions in collaboration with VHV, health personnel, veterinarians, wildlife authorities, community leaders, shamans, the “Kha Jam,” and community members. Evaluation should determine whether interventions are acceptable and feasible and whether they improve knowledge and protective practices or reduce specific potential exposure behaviors over time without undermining culturally important traditions.

CONCLUSION

This qualitative One Health study demonstrated that spiritual beliefs, traditional healing, healthcare-seeking practices, and interactions with domestic animals, wildlife, and the environment were closely interconnected within the Lua community in Thung Chang District, Nan Province, Thailand. Respondents commonly described using modern healthcare services while continuing to practice traditional healing when illnesses persisted, remained unexplained, or were perceived to have spiritual causes. Particularly distinctive reported practices included ritual slaughter of black pigs or white local-breed chickens with direct handling and application of fresh animal blood, ritual selection of black or red dogs under the guidance of the “Kha Jam,” and routine wildlife hunting, bare-handed butchering, and consumption of raw or lightly cooked animal products. These practices represent biologically plausible pathways for zoonotic exposure; however, this study did not measure infection or demonstrate zoonotic transmission.

The Lua community illustrates how health cannot be considered independently of cultural beliefs, animal relationships, and environmental practices. Traditional rituals and wildlife-related activities remain culturally meaningful while creating particular forms of human–animal contact that may represent potential zoonotic exposure pathways. A culturally responsive One Health approach should therefore seek to reduce avoidable biological exposure rather than replace or stigmatize traditional practices. Collaboration among community members, ritual leaders, village health volunteers, healthcare personnel, animal health professionals, and relevant environmental and wildlife authorities may provide a practical foundation for developing acceptable, sustainable risk-reduction strategies. The present findings provide a qualitative basis for such future work but should not be interpreted as evidence of actual zoonotic infection or of the effectiveness of any proposed intervention.

DATA AVAILABILITY

The Supplementary Files 1 and 2 are available from the corresponding author. Interview and focus group discussion transcripts are not publicly available because their disclosure could potentially identify individual respondents or the study community. Relevant data may be made available by the corresponding author upon

reasonable request, subject to approval by the Research Ethics Review Committee for Research Involving Human Research Respondents, Health Sciences Group, Chulalongkorn University, and consistency with the consent provided by the respondents.

GENERATIVE AI DECLARATION

The authors declare that no generative artificial intelligence or AI-assisted technologies were used in the writing, analysis, or preparation of this manuscript.

AUTHORS' CONTRIBUTIONS

PK and KS conceived and designed the study. PK, KS, TP, and KT contributed to material preparation and data analysis. All authors participated in field data collection and reviewed and revised the initial manuscript draft. PK, KS, and KT finalized the manuscript. All authors read and approved the final manuscript.

ACKNOWLEDGMENTS

The authors thank the Thung Chang District Health Office, the Nan Provincial Health Office, and their staff for their support and cooperation throughout the study. The authors are grateful to Prof. Dr. Alongkorn Amonsin for his guidance during study planning and implementation and to Mr. Watthanachai Boonlakorn for his assistance with coding and data analysis. The authors also thank all study respondents and others who contributed to the completion of this research.

The corresponding author received support through a Postdoctoral Fellowship from the Ratchadapisek Somphot Fund of Chulalongkorn University. This study was also supported by Mae Fah Luang University and Area-based Research and Innovation in Cross-Border Health Care Group, Mae Fah Luang University. The article processing charge (APC) was funded by Mae Fah Luang University.

COMPETING INTERESTS

The authors declare that they have no competing interests.

PUBLISHER'S NOTE

Veterinary World remains neutral with regard to jurisdictional claims in the published institutional affiliations.

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