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Factors associated with knowledge on HIV, TB and malaria among pregnant women and their perception of access to RDTs for HIV, TB and malaria in Savannakhet Province, Lao PDR

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Abstract

Background Lao PDR continues to experience challenges in combating the treatable and preventable diseases of HIV/AIDS, tuberculosis (TB), and malaria among priority groups. One priority group are pregnant women. Given increased availability of diagnosis and treatment for these diseases, understanding community knowledge and access to these technologies can inform community-based interventions. This study aims to determine the factors associated with knowledge of HIV, TB, and malaria and their access to rapid diagnostic tests for such diseases among pregnant women in remote areas of Lao PDR.

Method This cross-sectional quantitative survey explored pregnant women's awareness of HIV/AIDS/TB and malaria in three remote districts (Phine, Thapangthong, and Atsaphone) in Savannakhet province, Lao PDR. A face-to-face questionnaire was administered to 189 pregnant women. Descriptive and inferential statistics were applied to determine factors associated with pregnant women's knowledge and perceived access to information and diagnosis for HIV/AIDS/TB and malaria. This study is under the **HEALTH** project funded by Expertise France.

Results Most participants were 28–42 weeks (50.3%) pregnant; the range was 4–38 weeks, with a mean age of 24.3 years old (range: 14–48 years old). Most participants were farmers (94.2%), 54.5% were illiterate, 74.0% were of the Mon-Khmer ethnic group, and 60% had an income lower than the average. Only 56.6% had accessed ANC, 39.1% attended ANC during the first trimester, and only 19.6% had at least four ANC consults. Less than half of the participants demonstrated (45.5% and 42.3%) a high level of knowledge of HIV and TB, respectively, while slightly above half (54.6%) demonstrated a high level of knowledge related to malaria. Slightly higher than half (53.3% and 52.9%) perceived easy access to HIV and TB services, respectively, while 72.5% perceived easy access to malaria. Less than half of the participants felt it was easy to get tested for HIV (46.5%), TB (52.9%), and malaria (72.5%). Very few

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of the women (1.6%, 2.1%, and 8.5%) reported having had a test for HIV/TB/malaria, respectively. Factors associated with knowledge of HIV were higher household income and attending ANC more than 4 times, while age, number of children under 2 years, and high knowledge of HIV and malaria were associated with knowledge of TB. In addition, factors associated with knowledge of malaria were the number of children under 2 years, high knowledge of HIV, and perceived easy access to malaria tests. Factors associated with perceived easy access to HIV rapid tests and TB tests were high levels of TB knowledge, attending ANC, and high satisfaction with their health. The number of children under 2 years was associated with perceived ease of access to the HIV rapid test. While factors associated with malaria testing were having a high knowledge of malaria and attending ANC more than four times.

Conclusion A very low awareness of HIV, TB, and malaria was identified among pregnant women in this study. Strategies to improve the knowledge of HIV, TB, and malaria in Lao PDR should focus on women who live in rural areas, emerging regions with a high incidence of HIV, TB, and malaria, ethnic pregnant women, the poor, and the illiterate. Lastly, efforts are needed to increase access to early detection and prevention of three deadly diseases, such as HIV, TB, and malaria, among pregnant women by increasing their accessibility to rapid diagnostic tests (RDTs) for HIV, malaria, and TB.

Keywords Pregnant women, Knowledge of HIV, TB and malaria, Perception, Access to RDTs

Introduction

Following on from the Millennium Development Goals, the Sustainable Development Goals (SDGs) contain a pledge to eliminate human immunodeficiency virus (HIV), tuberculosis (TB), and malaria by 2030 [1]. To achieve these pledges, global, regional and country specific frameworks and strategies have been developed for each disease. While progress has been made, inequities within and between countries are evident. Reducing inequities requires ensuring universal healthcare coverage, early detection, including the use of rapid diagnostic tests (RDTs), quality care, improved surveillance, and monitoring of the cascade of care from diagnosis to outcomes. As those most vulnerable to HIV, TB, and malaria are also often amongst the poorest and most disenfranchised segments of the population, it also requires addressing the socio-economic and political determinants of health [2–4]. Lao People's Democratic Republic (Lao PDR), a lower middle-income country in Southeast Asia, has, like other countries in the region, steadily reduced morbidity and mortality associated with HIV, TB, and malaria [5] but is unlikely to meet to the 2030 targets. The epidemiology of these diseases' mirrors that of the broader region. The HIV epidemic for example, is largely concentrated among key populations: female sex workers, men who have sex with men, people who inject drugs, and transgender people. TB and malaria are mostly concentrated among minority ethnic groups and communities that experience geographic, economic, and social marginalization, with women of reproductive age carrying a significant burden, especially those women who are economically disadvantaged [6].

Recognising reducing the prevalence of HIV, TB, and malaria will contribute to achieving its maternal, newborn and child health goals, the Lao PDR has identified pregnant women as a priority population for interventions addressing these preventable diseases. Of particular concern, are pregnant women who are often seen as being harder to reach such as racialized ethnic communities and those in rural areas. Consistent with WHO guidelines HIV, TB, and malaria are integrated into antenatal care (ANC) [7, 8]. Integrated ANC should include pregnant women attending ANC clinics receiving health education on these preventable diseases, testing and appropriate treatment, In the Lao PDR. Since 2005, rapid diagnostic tests (RDTs) for malaria have been available and have subsequently been scaled up nationwide. According to national policy, malaria microscopy should be performed in all public hospitals, while at the village level, village health workers (VHWs) and health centers predominantly use RDTs [9]. Rapid diagnostic tests (RDTs) for HIV are conducted at provincial and district health facilities. However, Lao PDR did not have systematic screening for active TB in pregnant women at the ANC, as the World Health Organization (WHO) recommended it, where the TB prevalence in the general population is 100/100,000 or higher [1]. If pregnant women with TB symptoms were suspected during ANC they should be referred to the provincial level hospitals where GeneXpert for diagnosing TB is available [10]. An integrated approach to ANC should make services more convenient for pregnant women. However, women also need to be aware of such services and their benefits and they need to be socially acceptable, especially for stigmatised conditions such as HIV. and pregnant women also need to know [11]. This study aimed to understand pregnant women's knowledge and perceptions of accessibility to RDT for HIV, TB, and malaria in districts with a high proportion of ethnic minority people in the southern province of Savannakhet. The findings are expected to contribute to developing interventions to support the

achievement of the government's HIV, TB, and malaria elimination strategies.

Methods

This was a cross-sectional survey using a structed questionnaire administered face to face by trained researchers.

Context

The study was conducted in three districts (Thapanthong, Phine, and Atsaphone) in Savannakhet from January to May 2022 as part of the project entitled "Helpful, Efficient, Accessible, Low-Cost, Timely Health Action" (HEALTH) which main objective was to support and strengthen an integrated health system to tackle and reduce the HIV, TB and Malaria diseases burden at village level in Savannakhet province and to increase access to health care for remote and hard to reach communities in Lao PDR. The included districts were selected based on low level of access to general health, maternal and primary health services, and areas where HIV, TB, and malaria are public health concerns.

Phine district has a total population of 68,259 inhabitants, 100 villages, and 46.7% of the population are from racialized minority ethnic populations mainly from the Mon-Khmer ethnolinguistic group. Thapanthong district has a total population of 42,563 inhabitants, 96 villages, and 80% of the population are Katang from the Mon-Khmer ethnolinguistic group. Atsaphone district has a total population of 64.728 inhabitants, 70 villages, and seven health centers (HCs). 69.0% of the population are from the Phoutai ethnic group, while 27.7% are Bru. Many of the villages in the study areas are rural and remote, with limited access to basic services, including for health [12–14].

Study population

The study population was consenting pregnant women living in one of the selected districts at the time of the survey. A multi-stage sampling technique was employed with the aim of ensuring a representative sample. The first stage involved identification of the geographical area, the second was district selection and the third stage, a systematic and random approach to identifying participants, using the sampling frames.

The required sample size was calculated using the single population proportion formula n = $(Z\alpha/2)^2p(1-p)/d2$, where n is the required sample size, $Z_{a/2}$ is the value of the standard score at a 95% confidence interval, p is the expected proportion of knowledge, and d² is the marginal error. The following assumptions were used to calculate the required sample size based on proportion of 93% of Awareness about malaria [15] as the study area has more prevalence of malaria, a 95% confidence interval, a marginal error of 5%, and a 10% non-response rate. The final sample size was 189.

Measures

A questionnaire was administered face-to-face in Lao language by trained research assistants, supervised by a research team lead who completed a quality assurance check each day and during the data entry process. The questionnaire had five sections: (1) socio-demographic data; (2) health and pregnancy history; (3) history of ANC; (4) knowledge of HIV, TB, and malaria; and (5) perceived access to RDTs for HIV and malaria. Sociodemographic characteristics included age, occupation, education, ethnicity, annual household income, and the number of children under 2 years old. Health and pregnancy history consisted of feelings of satisfaction with their health status, gestation age, number of live births or stillbirths, age at first pregnancy, number of miscarriages, and abortion. The survey also included questions about the number of women attending ANC, the person providing ANC, blood pressure being measured, urine and blood samples taken, receiving tetanus injections and iron tablets or syrup, taking SP/Fansidar, and being provided health information on HIV, TB, and malaria. Questions related to knowledge of HIV [16-18], malaria literature [19-21] and TB [22-24] were based on the previous literature.

The overall knowledge scores related to HIV, malaria, and TB were computed by aggregating the knowledgerelated variables with the cut-off point as the mean score. Knowledge variables were recoded to a binary level, with knowledge scores higher than the mean-coded 1-high knowledge and knowledge scores lower than the mean-coded 0-low knowledge. Access to the RDTs for HIV, malaria, and TB was evaluated based on questions related to having been tested for HIV, TB, and malaria, the time of the most recent HIV, malaria, RDT, and TB test, awareness of the RDTs, perceived ease of getting RDTs for HIV, malaria and TB with the answers of difficult and easy access to the RDTs, and barriers to access.

Data analysis

Descriptive statistics on frequency, proportion, mean and standard deviation and 95% confidence intervals (CI) were performed for all independent and dependent variables. Categorical variables were presented as numbers and percentages; numerical variables were presented as means and standard deviation to describe the study population by their sociodemographic and health and pregnancy history, ANC, and the dependent variables knowledge of HIV, TB, and malaria and perception of access to RDTs for HIV, malaria, and TB. Multiple logistic regressions were conducted and further performed to determine predictors of HIV, TB, and malaria knowledge and perceptions of access to HIV and malaria RDTs. Statistically associated variables were adjusted based on the backward elimination technique of multiple logistic regression; all tested variables with p-values greater than 0.05 were excluded from the analysis model one by one, multiple times starting from the greatest p-value, in order to achieve the finally adjusted model of regression (variables with p < 0.05). The goodness-of-fit (GOF) was also given for each final regression model. Data entry and cleaning were conducted using EpiData version 3.1, and statistical analyses were performed using Stata version 17.0 (Stata Corporation, College Station, TX, USA).

Ethical approval

Ethical approval was obtained from the Ethical Committee for Health Research at the University of Health Sciences (Approval No. 0262, dated 7/9/2021). Verbal informed consent, approved by the Ethical Committee, was obtained from each respondent prior to beginning the interview. All identifiable data were removed from the questionnaire prior to analysis.

Results

The survey recruited 189 pregnant women in three targeted districts in Savannakhet province. The ages of the pregnant women ranged from 14 to 48 years, with an average age of 24.3 years. In total, 15.9% of the pregnant women were aged below 19 years. Almost all participants worked in agriculture (94.2%), and over half were illiterate (54.5%). Most respondents were of the Mon-Khmer ethnic group (74.0%). Around 60% reported an annual household income for the year 2021 of less than 3,000,000 LAK (1USD = 17,000 LAK). Additionally, 63.5% lived in households with children below 2 years of age (see Table 1).

A total of 17.5% of participants reported not being satisfied with their current health status. Half of the participants were within 28–42 weeks (50.3%) gestation, followed by 16–28 weeks (30.7%). For 30.2% participants this was their first pregnancy, 40.7% reported having previously had 1–2 pregnancies, and 6.9% had experienced over five pregnancies. A total of 55.3% of participants said their first pregnancy was below 19 years.

Antenatal care (ANC) among pregnant women

Slightly over half of the participants (56.6%) reported that they had access to ANC. Among the 107 pregnant women who accessed ANC, 25.2% used ANC during the first trimester, but only 11.6% had attended at least four ANC visits. During ANC, 74.8% reported having had a blood pressure check-up, 16.8% a urine test, and 9.4% a complete blood count (Table 2) and 58.7% had received iron tablets. Only one woman reported being tested for HIV and malaria; none had been tested for TB.

Knowledge of HIV, TB and malaria among pregnant women Knowledge related HIV, TB and malaria among pregnant women was generally low. Most participants responded incorrectly to each question related to HIV. Most (74.7%) for example, did not know that HIV is the virus that can lead to AIDS. One-third thought that HIV was transmitted by mosquitoes, while two-thirds did not know anything about the route of HIV transmission (Not shown in Table 3). Around two-thirds (64.0%) of participants were unaware that TB is a life-threatening disease. Many (34.9%) did not know the symptoms of TB, while almost half were uninformed regarding how TB is transmitted and preventative actions (Not shown in Table 4). For malaria, most participants knew the cause of malaria but over half were unaware, malaria during pregnancy can have adverse health outcomes. Around 80% of participants reported that treatment for malaria should be sought from medical doctors, while around one-fifth participants felt they could seek treatment from a pharmacy, traditional healers, self-treat with herbs, or there was no need to do anything.

By summing up the knowledge score and categorizing it into higher and lower levels of knowledge, with the mean score as the cut-off point, slightly more than half of pregnant women (54.5% and 57.7%) had low knowledge of HIV and TB, respectively. Less than half (45.5%) had low knowledge of malaria (see Table 5).

Pregnant women's perception of access to RDT of malaria, TB and HIV

Participants had limited information regarding RDTs for HIV, malaria and TB. Nearly all 98.4%, 97.9% and 91.5%) had not tested for HIV, TB or malaria during their pregnancy. Most declared experiencing difficulties accessing ANC due to the transportation difficulty (38.6%, 49.4% and 71.2% for HIV, TB and malaria respectively); and road conditions (17.2%, 13.5% and 67.3% for HIV, TB and malaria respectively) (see Table 3). Some participants reported stigma related to HIV (16.8%) and TB (6.7%). None reported malaria related stigma.

Factors associated with knowledge of HIV, TB and malaria and perception of access to RDTs on HIV, TB and malaria among pregnant women in Savannakhet Province

Independent variables such as age, occupation, ethnicity, education level, household income, number of children under 2 years old living in household, attendance at ANC, frequency of ANC attendance, satisfaction with health, access to HIV/TB/Malaria tests, and knowledge of HIV/TB/Malaria were associated with each outcome of interest (knowledge of HIV/TB/Malaria). Factors associated with knowledge of HIV included primary and higher educational levels (AOR:3.2; 95% CI: 1.7–6.3), higher household income (AOR: 2.2; 95% CI: 1.2–4.3),

Table 1 Socio-demographic and pregnancy history characteristic of pregnant women

Variables	Frequency	Percentage
	(<i>n</i> = 189)	
Age of mother:		
1. 1.Age < 19	30	15.9
2. 2.Age 19–25	82	43.4
3. 3.Age 26–35	70	37.0
4. 4.Age 36–48	7	3.7
Mean(±SD): 24.3(±5.7); Min– Max: 14–48 years old		
Occupation		
1. 1.Farmer/Agricultural	178	94.2
2. 2.Staff	3	1.6
3. 3.Business	1	0.5
4. 4.Labor	1	0.5
5. 5.No job	6	3.2
Educational status		
1.1.Illiterate	103	54.5
2. 2.Primary	45	23.8
3. 3.Lower secondary	27	14.3
4. 4. Upper secondary	11	5.8
5. 5.Higher level	1	0.5
6.6.Graduate/bachelor	2	1.1
Ethnic group	_	
1 1 Jao-Tai (Jao Tai Deng Tai Dam	49	26.0
2 2 Mon-Kmer (Khmu Prai Katang	140	74.0
Total bousehold income last year	110	7 1.0
	1	2.1
	7	2.1
2. 2.5 J00,000 LAN	20	19.0
4.4.1.100.000 2.000.000 LAK	29	12.0
4. 4. 1, 100,000 - 2,000,000 LAN	20	15.0
5. 5.2, 100,000–5,000,000 LAK	10	9.5
0.0.> 3,000,0000 LAN	78	40.2
Miedn(± 5D): 6, 153,514 (± 5D1,070,000); Min_ May: 150,000,-10,000,000		
1 Number of children of age below 2 years living in the household		
	124	65.6
	124	0.0
3. 1.1 Child	01	32.3
4. 2.2 children	4	4.1
Age of the current pregnancy	26	19.0
1. 1. < 16 Weeks	30	30.7
2. 2. 16–27 weeks	58	50.3
3. 3. 28–42 weeks	95	
Mean(\pm SD): 24.5(\pm 9.4/6); Min– Max: 4–38 weeks		
Number of pregnancies before this current pregnancy		
1. 1.First time	57	30.2
2. 2. 1–2 times	77	40.7
3. 3. 3–5 times	42	22.2
4. 3. >= 6 times	13	6.9
Number of live births		
1. 0. Never	10	7.6
2. 1. 1–2 times	77	58.3
3. 2. 3–4 times	34	25.8
4. 3. >= 5 times	11	8.3
Age at first pregnancy		
1. 1. Age < 19	73	55.3
2. 2. Age 19–25	55	41.7

Variables	Frequency	Percentage
	(n = 189)	
3. 3. Age 26–28	4	3.0
Mean(±SD): 18.5(±3.2); Min– Max: 14–28 years old		
Satisfaction with the current health status		
1. Very dissatisfied	9	4.8
2. Somewhat dissatisfied	4	2.1
3. Neither satisfied or dissatisfied	20	10.6
4. Somewhat satisfied	144	76.2
5. Very satisfied	12	6.4

Note:

*1 USD = 17,000 LAK (Dated July, 2022)

and attending ANC more than 4 times (AOR: 2.6, 95% CI: 1.1-6.0). Factors associated with knowledge of TB included the age of pregnant women above 20 years old and above (AOR: 2.2; 95% CI: 1.1-4.7), primary and higher educational level (AOR: 3.0; 95% CI: 1.4-6.7), the number of children under 2 years in the (AOR: 2.8,95%: 1.2-6.6), high knowledge of HIV (AOR: 4.9, 95%CI: 2.3-10.6), and high knowledge of malaria (AOR: 5.2, 95%CI: 2.3-11.8). Factors associated with knowledge of malaria included the number of children under 2 years in the household (AOR: 0.5, 95%: 0.2–0.9), high knowledge of HIV (AOR: 6.3, 95%CI: 3.1-12.6), and easy access to Malaria tests (AOR: 4.9, 95%CI: 2.2-10.7). The goodnessof-fit test model was higher than 0.05, indicating a high correlation between independent and dependent variables (see Table 4).

Table 6 illustrates the multivariate analysis of factors associated with perception of access to HIV, TB and Malaria rapid tests. Factors associated with perception of access to HIV rapid test were: high knowledge on TB (AOR: 2.4, 95%CI:1.3–4.6); attending ANC (AOR: 2.8, 95%CI:1.5–5.2); number of children under 2 years in household (AOR:0.4, 95%:0.2–0.8); and high satisfaction on health (AOR:2.4, 95%CI: 1.1–5.8). Similarly, factors associated with perception of access to TB test were high knowledge on TB (AOR: 2.6, 95%CI:1.4–5.0); attending ANC (AOR:3.3, 95%CI:1.7–6.1); and high satisfaction on health (AOR:2.9, 95%CI:1.2–6.9). While factors associated with perception of malaria test were high knowledge of Malaria (AOR:4.7, 95%CI: 2.2–9.8); and attending ANC more than 4 times (AOR: 3.8, 95%:1.1–13.6).

Discussion

This study examined the knowledge of pregnant women regarding routes of transmission and RDTs for HIV, TB, and malaria in rural and remote areas in Savannakhet province– a province with some the highest prevalence of these diseases in Lao PDR. Most participants were from marginalised ethnic groups, with low levels of education, literacy and income. Other research has also found level of education and income is associated with level of knowledge [11, 25, 26]. Participants had slightly more knowledge of causes and symptoms of malaria, which is probably due to malaria being endemic in the area. Further, most participants self-diagnosed malaria or relied on diagnosis from a pharmacist supporting a similar finding reported in another study in a rural district in Savannakhet [19].

Few participants had received the minimum recommended ANC visits of four or had been tested for HIV, TB, and malaria. The most common reasons for not attending ANC and/or being tested related to distance to a health centre and limited transport options as found elsewhere [27, 28]. Other reasons for low uptake of ANC may be concerns about being discriminated against due to ethnicity, low levels of or lack of confidence in Lao language, low health literacy and services not being culturally responsive [11, 29–32].

Factors associated with knowledge of HIV, malaria and TB

As with other studies, women with higher levels of education demonstrated higher levels of understanding about HIV [33–38]. Formal level of education also provides opportunities for earning a higher income and greater ability to use health services. Those who had attended at least four ANC visits had a higher level of knowledge related to HIV and felt it was easy to access to RDTs for HIV and malaria, indicating the need to increase uptake of ANC within the study population [39, 40].

The positive association between the age of participants and their knowledge of TB is consistent with studies conducted in other locations [41, 42]. Having more children under 2 years old in households was also positively linked with knowledge of TB. Both of these associations are likely due to having more interaction with the healthcare system, including during ANC [43]. Provision of Bacillus Calmette-Guerin (BCG) as part of the routine vaccination schedule for children under one year old in Lao PDR may also be contributing factor in awareness of TB among households with more young children.

 Table 2
 Antenatal care visit among pregnant women

variables	Frequency (n = 189)	Percentage
Attending ANC		
0. No	82	43.4
1. Yes	107	56.6
Gestational age at first ANC		
1. 1. < 16 weeks	27	25.2
2. 2. 16–27 weeks	60	56.1
3. 3. 28–42 weeks	15	14.0
9.DK / cannot remember	5	4.7
Number of ANC for current pregnancy		
1. 1.None	82	43.4
2. 2.1 time	32	16.9
3. 3.2 times	25	13.2
4. 4.3 times	15	7.9
5. 5.4 time	22	11.6
6. 6.>= 5 times	13	6.9
Ever received the following tests ($n = 107$):		
[A] Blood pressure check-up		
0. No	27	25.2
1. Yes	80	74.8
[B] Urine test		
0. No	89	83.2
1. Yes	18	16.8
[C] Complete blood count		
0. No	97	90.7
1. Yes	10	9.4
Receiving tetanus vaccine		
0. No	71	66.3
1. Yes	34	31.8
9. DK	2	1.9
Receiving iron tablets or syrup		
0. No	44	41.1
1. Yes	62	58.0
9. DK	1	0.9
Receiving SP/Fansidar		
1. 0.None	98	91.6
2. 1.1 time	1	0.9
3. 9.DK	8	7.5
Ever been tested for HIV as part of ANC		
0. 0. No	93	86.9
1. 1. Yes	1	0.9
9. DK	13	12.2
Ever been tested for TB as part of ANC		
0. No	105	98.1
1. Yes	0	0
9. DK	2	1.9
Ever been tested for Malaria as part of ANC		
0. No	103	96.3
1. Yes	1	0.9
9. DK	3	2.8

The negative association between having more children under 2 years in the household and knowledge of malaria and access to RDTs for HIV could be due to the demands of caring for young children limiting access to health services, including ANC. This finding is somewhat contradictory however, to the positive association between having more children under 2 years old in the household and knowledge of TB, indicating the need further investigation to better understand these associations.

The strong association between knowledge of HIV and knowledge of TB is likely observed when HIV and TB often coexist, meaning that individuals with a good understanding of one disease also tend to have knowledge of the other [44, 45]. The present study also found an association between a high knowledge of malaria and TB, probably due to these two diseases being common in the study area. The link between high knowledge of HIV and a high knowledge of malaria suggests that understanding one disease may prompt individuals to seek information about other related conditions, given the interconnectedness between the two diseases [46].

Perceived access to RDTs for HIV, TB and malaria and its associated factors

Women need to receive integrated care during their pregnancy, which includes disease screening as a priority [47, 48]. This study found most women were not aware of RDTs for HIV, malaria, and TB and had not deliberately accessed HIV testing, TB check-ups, or been checked for malaria infection during their pregnancy. This finding suggests health centres are not routinely providing HIV and malaria testing or monitoring for TB symptoms or alternatively, women and/or their families are not asking for such tests or are refusing them. This knowledge or practice gap is likely to relate to health workers having limited time or resources to offer these services or women and their families do not know they can have such tests or do not thing screening is necessary in the absence of symptoms. Further, social barriers such as shyness, low social position, and culturally responsive safe care may prevent women from asking about HIV, TB and malaria and options for testing. It is also possible that participants were screened for these diseases but were not aware that they had been tested for these diseases, or they chose not to declare this to interviewers. Additionally, in rural areas such as those districts included in this study, overburdened or under trained health workers staff can contribute to low staff motivation to include additional tasks in ANC such as screening for HIV, TB and malaria [11, 49]. These challenges in term of health services access needs more attention especially in deeper local levels [46].

A correlation was observed between TB knowledge and perceived access to RDTs for HIV and TB. This may Table 3 Pregnant women's perception of access to RDT of HIV, TB and malaria

Variables	HIV		ТВ		Malaria	
	N (189)	%	N (189)	%	N (189)	%
Have you been tested for before?			(N=18		(N=189)	(%)
0. No	186	98.4	185	97.9	173	91.5
1. Yes	3	1.6	4	2.1	16	8.5
Time for the most recent test?						
1. 1.Less than 12 months ago	1	33.3	1	25.0	2	12.5
2. 2.12-23 months ago	1	33.3	2	50.0	6	37.5
3. 3.2 or more years ago	1	33.3	1	25.0	7	7.7
4. 4. DK					1	1.3
Aware of a test place of?						
0. 0.No	139	73.5	86	45.5	48	25.4
1. 1.Yes	50	26.5	100	52.9	139	73.5
99. DK	0	0	3	1.6	2	1.1
Have heard of rapid test kits for						
0. No	187	98.9	NA		178	94.2
1. Yes	2	1.1	NA		11	5.8
Ease of access to test						
1.Difficult & very difficult	101	53.5	89	47.1	52	27.5
2.Easy &very easy	88	46.5	100	52.9	137	72.5
Barriers to access the Malaria test						
1. Transport or no vehicle	39	38.6	44	49.4	37	71.2
2. Road condition	18	17.2	12	13.5	25	67.3
3. Distance	31	30.7	33	37.1	27	51.9
4. Stigma	17	16.8	6	6.7	0	0
5. It might be not available	1	1.1	4	4.5	0	0
6. Other (no money to pay for transport, didn't know about this before)	31	30.7	26	29.2	10	19/2

be because information on TB and HIV are provided together due to the potential risk of co-infection. Pregnant women with a high level of knowledge of TB might also feel they could also be at risk of HIV [44, 50]. As with other studies a correlation between high levels of satisfaction with overall health and the perceived ease of access to RDTs for HIV and TB tests was observed. Knowledge of malaria was positively linked with perceptions of easy access to RDTs for malaria, underscoring the importance of providing pregnant women and their families with easily accessible and relatable health information [51].

Limitation

The findings of this study are limited by the cross-sectional design that not allow for the establishment of causality. Additionally, the study's geographical limitation to Savannakhet province may restrict the generalizability of the results to all pregnant women in Lao PDR. Therefore, further research is needed to understand access to ANC and screening for HIV, TB and malaria in pregnant women from other marginalised populations. Despite these limitations, the study provides valuable insights that can guide local health policy planners in developing strategies to enhance awareness of HIV, TB, and malaria among pregnant women in Lao PDR. Furthermore, it can serve as a baseline for future studies aiming to assess the knowledge of pregnant women regarding these diseases.

Conclusion & recommendations

Our study revealed that the overall level of knowledge among pregnant women in a rural area, largely populated by ethnic minority groups in Lao PDR, regarding HIV, TB, and malaria including RDTs was low. The study underscored the importance of education and having a good knowledge of these diseases regarding taking preventive action such as testing.

Reversing current trends requires addressing the social determinants of health that increase vulnerability to these diseases, including discrimination, poverty and limited access to health information and services. Providing culturally relatable and easily accessible information to women and their families is critical. Also important is addressing the social determinants of health including structural health system barriers that may prevent women accessing ANC and associated RDTs for HIV, malaria and TB.

Table 4 Multivariate analysis of factors associated with knowledge of HIV, TB and malaria

Variables	N (%)	OR (95%CI)	AOR (95%Cl)	P- value
Factors associated with k	nowledge	of HIV		
Educational status				
1. 1.Illiterate	30 (29.1)	1	1	
2. 2.Primary & above	56 (65.1)	4.5 (2.5–8.4)	3.2	
Household income of previous year			(1.7–6.3)	
1. < = 2,000,000 LAK	31 (32.6)	1	1	
2.> 2,000,000 LAK	55 (58.5)	2.9 (1.6–5.3)	2.2	
Frequency of attending ANC			(1.2–4.3)	
1 Fewer than 4 times	57 (396)	1	1	
2. >=4 times	24 (68.6)	3.3 (1.5–7.3)	2.6	
Goodness of Fit (GOF)	0.654		(1.1-6.0)	
Factors associated with k	nowledge	ofTB		
Age of mother	lionicage	0110		
1.< 20 years old (teen mothers)	36 (34.9)	1	1	
2. 20 years old & above	44 (51.2)	1.9 (1.3–3.6)	2.2	
(adult mothers)			(1.1–4.7)	
Educational status				
3. 1.Illiterate	27 (26.2)	1	1	
2.Primary & above	53 (61.6)	4.5 (2.4–8.4)	3.0 (1.4–6.7)	
Number of children under 2 years in household			(1.1 0.7)	
1. 0. None	49 (39.5)	1	1	
1.1 child or above	31 (47.7)	1.9 (1.3–7.5)	2.8 (1.2–6.6)	
Knowledge of HIV				
0.Lower knowledge	20 (19.4)	1	1	
1.Higher knowledge	60 (69.8)	9.5	4.9	
Kanada da ang Katalania		(4.9–18.7)	(2.3-10.6)	
Knowledge of Malaria	15 (17 4)			
U.Lower knowledge	15 (17.4)		1	
I.Higher knowledge	65 (63.1)	8.1 (4.1–16.1)	5.2 (2.3–11.8)	
Goodness of Fit (GOF)	0.419			
Factors associated with k	nowledge	of Malaria		
Number of children under 2 years in household				
2. 0.None	74 (59.7)	1	1	
1.1 child or above	29 (44.6)	0.5 (0.3–0.9)	0.5	
Knowledge of HIV		1	(0.2-0.9)	
0. Lower knowledge	36 (34.9)		1	
1.Higher knowledge	67 (77.9)	6.6	6.3	
Access to Malaria test		(3.4–12.6)	(3.1–12.6)	
1 Difficult & very difficult	14 (26.9)	1	1	
2.Fasy & very easy	89 (65 0)	5.7	4.9	
,,,	((2.5–13.4)	(2.2–10.7)	
Goodness of Fit (GOF)	0.965			

Table 5 Knowledge of HIV, TB and malaria among pregnant women

Variables	Number	Per-
	(N=189)	cent-
		age (%)
Knowledge of HIV		
0.Low knowledge of HIV (<=Mean)	103	54.5
1.High Knowledge of HIV (>Mean)	86	45.5
Mean = 3.15; SD = 2.9; Min = 0; Max = 9		
Knowledge of TB		
0.Low knowledge of TB (<=Mean)	109	57.7
1.High Knowledge of TB (> Mean)	80	42.3
Mean = 4.47; SD = 3.9; Min = 0; Max = 13		
Knowledge of Malaria		
0.Low knowledge of Malaria (<=Mean)	86	45.5
1.High Knowledge of Malaria (>Mean)	103	54.5
$Mean = 7.51 \cdot SD = 4.2 \cdot Min = 0 \cdot Max = 14$		

Table 6	Multivariate analysis of factors associated with
nercenti	on of access to HIV TB and malaria tests

Variables	Freq (%)	OR	AOR	P-
		(95%Cl)	(95%CI)	value
Perception of Access to th	e test of RD	Ts of HIV		
4. Knowledge on TB				
0.Lower knowledge	41 (37.6)		1	
1.Higher knowledge	47 (58.8)	2.3	2.4	
		(1.3–4.3)	(1.3–4.6)	
Attending ANC	26 (31.7)	1	1	
0. No	62 (57.9)	3.0	2.8	
5. I. Yes	10 (60 0)	(1.6–5.4)	(1.5-5.2)	
6. Number of children under 2 years in household	42 (60.9)	1	1	
7. 0.None	46 (38.3)	0.4	0.4	
		(0.2–0.7)	(0.2–0.8)	
1.1 child or above				
Satisfaction on health			1	
8. 0.Less satisfied	10 (30.3)	1	2.4	
			(1.1–5.8)	
9. 1.Satisfied	78 (50.0)	2.3 (1.1–5.1)		
10. Good of Fitness Model	0.293	(,		
(GOF)				
Perception of Access to th	e test TB			
11. Knowledge on TB	47 (43.1)	1	1	
0.Lower knowledge	53 (66.3)	2.6	2.6	
12. 1.Higher knowledge		(1.4–4.7)	(1.4-5.0)	
Attending ANC	30 (36.6)	1	1	
0. No	70 (65.4)	3.3	3.3	
13. 1. Yes		()1.8-6.0)	(1.7–6.1)	
Satisfaction on health				
1.Less satisfied	11 (33.3)	1	1	
2.Satisfied	89 (57.1)	2.7	2.9	
		(1.2-5;9)	(1.2–6.9)	
14. Good of Fit (GOF)	0.369			
Perception of Access to th	e RDTs of N	lalaria		
Frequency of attending ANC				
1.Fewer than 4 times	98 (68.1)	1	1	
15. 2. >=4 times	32 (91.4)	5.0(1.5-	3.8	
		17.2)	(1.1–13.6)	
16. Knowledge of Malaria	48 (55.8)	1	1	
0.Lower knowledge	89 (86.4)		4.7	
			(2.2–9.8)	

17. Good of Fitness Model 0.728

1.Higher knowledge

(GOF)

 * Based on self-report on ease of access to the test of HIV, TB and Malaria (easy & very easy)

5.0 (2.5–10.2)

Abbreviations

ANC	Antenatal Care
BCG	Bacillus Calmette-Guerin
CI	Confidence Interval
HIV	Human Immunodeficiency Virus
HEALTH	Helpful, Efficient, Accessible, Low-Cost, Timely Health Action
GOF	Goodness-of-fit
Lao PDR	Lao People's Democratic Republic

LAK	Lao Kip
OR	Adjusted Odd Ratio
RDTs	Rapid Diagnostic test
SP/Fansidar	Sulfadoxine-Pyrimethamine
ТВ	Tuberculosis
USA	United States of America
USD	United States Dollars
SDGs	Sustainable Development Goals
VHWs	Village health workers
WHO	World Health Organization

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Author contributions

VS and VV conceptualized the idea and designed the study. Data collection, cleaning and analysis was conducted by KC & VV. KC created the tables. Interpretation of results was done by VS, VV, KC, ST, PP and JD. VS & JD wrote the initial draft of the manuscript and finalized by VS and JD. All authors read and approved the final manuscript.

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Data availability

Data will be provided upon on the request.

Declarations

Ethics approval and consent to participate

Ethical approval was obtained from the Ethical Committee for Health Research at the University of Health Sciences (Approval No. 0262, dated 7/9/2021). Verbal informed consent, approved by the Ethical Committee, was obtained from each respondent prior to beginning the interview. All identifiable data were removed from the questionnaire prior to analysis.

Consent for publication

In order to publish the general results of the research, permission was obtained from the participants.

Competing interests

The authors declare no competing interests.

Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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