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Community's Knowledge, Attitude and Practice toward Leptospirosis and its Prevention and Control: A Systematic Review

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Abstract

BACKGROUND: Multiple studies have been conducted on the level of knowledge, attitude, and preventive practices (KAP) toward leptospirosis, descriptively, analytically pertaining to its relationship, and also associated factors such as sociodemographic and economic factors. Over the years, different community settings and sampling frames were applied.

AIM: The goal of this review is to identify available literature evidence on the community's knowledge, attitudes, and behaviors about leptospirosis, taking into account variations and similarities in techniques, tools, and data analysis.

METHODS: A literature search was undertaken using the electronic databases PubMed, Scopus, Web of Science, and Ovid. Open access articles produced between 2011 and 2021 were analyzed, with an emphasis on community's KAP.

RESULTS: Eight articles met the inclusion benchmarks. The relationship between KAP is not congruent. However, most studies showed that good knowledge is attributed to good attitude, but attitude does not necessarily contribute to good practice. Socio-demographic factors such as educational level, ethnicity, age, income, and geographical location (distance to the river) have an influence on KAP.

CONCLUSION: More KAP studies with standardized methodology and questionnaires regarding leptospirosis are required in order to formulate effective, sustainable, and replicable health program interventions to prevent the community from leptospirosis infection and fatality. In the future, more qualitative studies should be done to further investigate and combine with quantitative studies to form prediction modeling.

Introduction

Leptospirosis is a zoonotic disease that affects both humans and animals globally [1], [2]. Rodents, dogs, cattle, buffaloes, horses, sheep, goats, and swine are known as the common reservoirs for this spirochete [3]. However, rodents are known to be the most important carrier for the transmission of leptospirosis to humans, attributable to their ability to survive without any clinical manifestations [4], [5], [6]. Leptospirosis is transferred to humans by skin wounds and abrasions or through intact mucous membranes that come in touch with any surfaces or elements compromised by the urine of an infected animal [6]. Most

leptospirosis infections in humans are asymptomatic, in which nine out of 10 appear as a non-specific febrile illness, with the remaining progressing to severe, deadly disease with multiple organ dysfunction. The fatality rate in individuals with severe disease can be as high as 15% and is accompanied by jaundice, hemorrhage, and renal failure. There are an estimated 1 million severe human cases of leptospirosis worldwide each year, with a death rate of roughly 10% and an increasing number of nations reporting outbreaks and leptospirosis cases [1], [7], [8]. Tropical and subtropical places with excessive rainfall, such as those in Latin America and Southeast Asia, are highly endemic zones for leptospirosis. Nevertheless, the incidence of the illness varies from region to region [9].

With leptospirosis, we can see how disease transmission may be so complicated, involving human-animal-environment interactions. To prevent it, the general people must be made aware of its presence and provided with basic information or knowledge. Knowledge, attitude, and practice (KAP) surveys are valuable public health tools to identify successful ways for behavioral changes towards safer behaviors [10], [11], [12]. KAP studies provide an insight into what a certain demographic group knows, believes, and acts with respect to a specific issue [13]. As a result, we performed this review to capture what is currently known about community knowledge, attitudes, and behaviors toward leptospirosis, as well as the tools that have been used to assess or evaluate each of these areas. Once collated and critically examined, this information can help with the development of health program interventions as part of leptospirosis preventive and control initiatives. The goal of this review is to identify available literature evidence on the community's knowledge, attitudes, and behaviors about leptospirosis, taking into account variations and similarities in techniques, tools, and data analysis.

Methods

Study design

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) review process was used to lead the study, which was established particularly for systematic reviews and meta-analyses [14]. PRISMA has a goal to urge researchers to find relevant information with the proper amount of detail. The authors began their systematic literature evaluation based on this review process by developing acceptable research questions. The systematic search is divided into three stages: identification, screening, and inclusion.

PICO was used to develop the research topic for this study. PICO is a technique that helps authors establish an appropriate research topic for the review. It is founded on three fundamental concepts: population or problem, interest or intervention, context or comparison, and outcome [15]. Based on these principles, the three main areas covered in the review which include community (population): KAP (outcome); and leptospirosis (Interest) guided the authors in formulating its main purpose, as previously stated.

Search strategy and data sources

The systematic search strategy procedure consists of three primary steps: Identification, screening, and eligibility. Medical Subject Heading phrases and

related terms are also searched in the identification process. The major keywords are community, leptospirosis, and KAP (Table 1). This process will provide a larger coverage of findings of the related articles with the selected databases (Web of Science, Scopus, PubMed, and Ovid) for literature search. Some of the distinct features of these databases were a large collection of literature, high-quality articles, and advanced search functions.

Table 1: Keywords used in systematic searching

Population	Interest	Outcome 1	Outcome 2	Outcome 3
Community	*Leptospira canicola*	Knowledge	Attitude	Practice
Public	Rice-field fever	awareness	Opinion	Habit
Society	Rice field fever		Belief	
People	Cane cutter fever cane-cutter fever		Perspective	
Resident	leptospira infection leptospira			
	Stuttgart disease Canicola fever			
	Swineherd's disease			
	Mud fever leptospiroses			
	leptospirosis			

Eligibility criteria

The eligibility process aims to choose the articles that fulfill the objective of the study from reading the titles and abstracts of the articles. A total of 22 articles that satisfied the outcome of KAP of the community toward leptospirosis were manually sorted. Studies not related to the interest and intended outcomes were excluded from the study. This process excluded 14 articles as they did not fulfill the inclusion criteria by having unrelated outcome, irrelevant population of interest, KAP scores that were not computed, no full text available, and qualitative study. In the final eligibility process, only eight articles were selected (Figure 1).
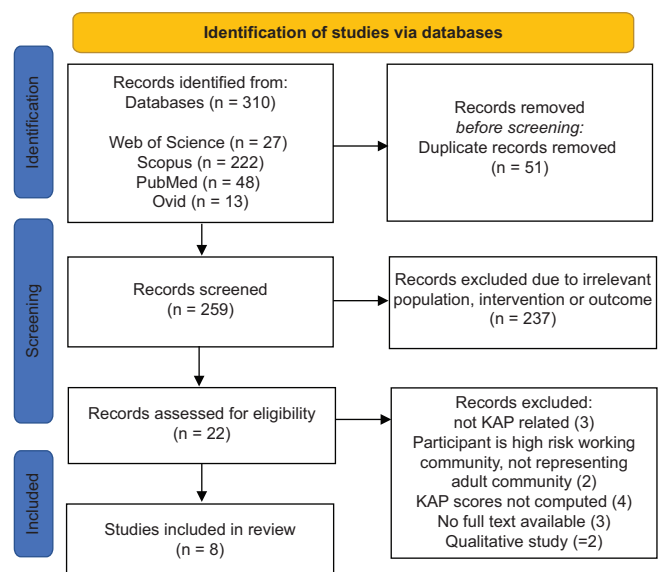

Figure 1: The PRISMA flow diagram

Study selection

The screening process of the 259 articles took place with the sorting function from each database. The inclusion criteria of the articles were journal

articles, in the English language, within the year 2011–2021, observational and interventional studies, and quantitative studies. Studies that are systematic reviews, comments or letters to the editor, conferences of abstracts and in vivo or in vitro studies are excluded. Two review authors independently screened the studies for inclusion. A total of 237 articles were excluded due to irrelevant population, intervention or outcome.

Data extraction

Four authors collected the data from the included studies in a Microsoft Excel© 2013 data extraction sheet (NRMN, NS, HKA, SKB). These include author/year, study setting, variables, and items for KAP assessment, data analysis, and outcomes.

Quality assessment

The Joanna Briggs Institute (JBI) was utilized in this approach to assess the quality of analytical cross-sectional research [16]. The goal is to evaluate the methodological quality of a study and to identify how well a study handled the risk of bias in its design, conduct, and analysis. These articles were evaluated by two separate reviewers. It is necessary for both reviewers to approve the articles for them to be included in the systematic review. Any disagreements will be discussed among them before a final decision is reached. The review of all eight items was approved.

Data synthesis

Thematic analysis was used in this systematic review as it is considered in synthesizing and integrating the mixed research design [17]. The thematic analysis is also a descriptive analysis that allows data to be merged with other data analysis techniques [18]. The selected four articles were read in detail, especially the abstract, method, results, and discussion. Then, the data were extracted based on the ability of the study to answer its research questions, extracted, and simplified the findings as tabulated in Table 2. Only after these lengthy processes, the authors can proceed with the thematic analysis. To generate relevant themes, each author identified patterns of extracted data from reviewed articles and gather them in a group before successfully categorizing them into different themes. The accuracy, usefulness, and accurate data representation of the themes were again reviewed. The developed themes were then submitted to a group of panel experts who are well versed in the systematic review as well as public health-related research. The panel of experts concluded that the themes developed by the review were suitable and accurate.

Results

Study selection

Our systematic search retrieved 310 articles from all the databases used. A total of 51 duplicated articles were found and removed. It ended with 259 articles in this process. Finally, only eight articles on studies of KAP toward leptospirosis were included in this review with all eligibility criteria (Table 2). Four studies were done in Malaysia, two in Thailand, one in the Philippines, and one in Argentina [19], [20], [21], [22], [23], [24], [25], [26]. The process of study selection was portrayed in a flow diagram (Figure 1).

Study characteristics

All selected articles are cross sectional studies involving adults 18 years and above, except for the study in Santa Fe where the community approach included 12-year-olds as the youngest age [26]. Sampling sizes ranged from 104 to 568, with one study in Ubon Ratchathani, Thailand, that did a comparative study between communities with a history of leptospirosis and no history of leptospirosis with sample sizes of 60 and 48, respectively [24]. The sociodemographic characteristics were summarized using descriptive statistics. To varying degrees, all of the research employed a variety of diverse analytical methodologies to fulfill their study aims.

Questionnaire items, scoring method, and computation of category

Abdullah *et al*. used eight measures to assess knowledge about leptospirosis, 13 items to assess attitude, and 17 items to assess prevention practice [19]. However, it was not stated how composite were scored and what is the cut-off scores to categorize the level for KAP. Based on the table shown in the article, knowledge is computed into poor and good, preventive practices into good and unacceptable, and attitude only mentions the level of good attitudes [19].

Perceptions of leptospirosis (PRL) and leptospirosis prevention (PBL) are assessed by Jittimanee and Wongbutdee using 16 questions for each part. The purpose of the PRL is to determine the participants' knowledge about leptospirosis and other diseases related to it. In this case, the sentence "I agree" will receive a score of 1. On the contrary, those who picked the option of "I don't know" received zero points. Based on a total of 16 points, three levels of PRL were calculated. PRL levels 11–16 were judged as high, whereas levels 6–10 were regarded as moderate. Because of this, a score of <6 was considered poor. This response would obtain a score of 4 if participants had been engaged in an activity relevant to leptospirosis

Table 2: Studies characteristics

Author/year	Study setting	Variable	Items for KAP assessment	Data analysis	Outcome	Comments
Abdullah *et al.*, 2019 [19]	Urban community/ Hulu Langat/ Malaysia	Sociodemographic Knowledge Attitude Practice	Knowledge – 8 items Attitude – 13 items Practice – 17 items	Descriptive, Chi-square test, Logistic regression analysis	(n = 315) Poor knowledge: 80.3% Good attitude: 87.0% Poor practice: 81.3%. Age is the primary predictor of good knowledge. Education level is a strong determinant of the overall practice.	Association between KAP has not been tested Inadequacy in preventative practice, emphasizing the significance of properly integrating information and attitude into establishing an acceptable practice to minimize Leptospira transmission among Malaysia's urban population.
Jittimanee and Wongbutdee 2019 [23]	Villages/Ubon Ratchathani Province/Thailand	Sociodemographic Perceptions Preventative Behaviors Leptospira detection in rats and surface water	Perceptions – 16 items Preventative Behavior – 16 items	Descriptive, Mann–Whitney U test	(n = 60, village with history of leptospirosis, n = 48, village with no history of leptospirosis) Awareness both villages: 91.6%. Preventive behaviours village with history of leptospirosis: 96.7% Preventive behaviours village with no history of leptospirosis: 90.7% *No significant difference	Association between perceptions and practices not tested Even when the existence of leptospirosis is not found, perception and preventative practices for coping with it should be consistently reinforced.
Manlapaz *et al.*, 2019 [25]	Barangay Quezon City, Phillipines	Sociodemographic Knowledge Attitude Practice	Not specified	Descriptive, Pearson Correlation	(n = 318) Knowledge: 92.36% Attitude: 87.74% Practices: 57.26% There is a substantial association between knowledge and attitude, as well as attitude and practice; however, no significant relationship exists between knowledge and practice.	An informed respondent's perception of leptospirosis reflects their attitude. A positive approach toward prevention and treatment leads to practice consolidation. A health initiative aimed at raising the population's awareness of leptospirosis.
Nozmi *et al.*, 2018 [21]	Rural communities, Hulu Langat, Malaysia	Sociodemographic Knowledge Attitude Practice	Knowledge –8 items Attitude – 16 items Practice – 17 items	Descriptive, Chi-square test, Logistic regression analysis	(n = 444) poor knowledge: 57.0% unacceptable attitudes: 90.3% unacceptable preventive practices: 69.1% The only significant predictor of both knowledge level and preventative measures was ethnicity. Ethnicity, income, and education level were all significant predictors of attitudes. The sole predictor of preventative actions was attitude.	The leptospirosis KAP aspects are still inadequate, and poor health-seeking behavior and attitudes are of the biggest concern. As a result, efficient techniques for imparting information and developing proactive measures and appropriate preventative modules on leptospirosis should be developed for this leptospirosis-prone group.
Pathman *et al.*, 2018 [22]	Urban and rural, Northeastern Malaysia	Sociodemographic Knowledge Attitude/Belief Practice	Not specified	Descriptive, Logistic regression analysis	(n = 214) Good knowledge: 52.8% Positive attitudes: 84.6% Positive beliefs: 59.8% Satisfactory practices: 53.7% Educational status significantly associated with attitude and belief domains	Association between KAP has not been tested Higher education exhibited better attitudes and beliefs. In general, they have strong knowledge and a positive attitude; nevertheless, this attitude cannot be translated into practice since the number of individuals with adequate practice habits is significantly smaller than the number of people with a positive attitude. In terms of the belief domain, communities must have positive beliefs to recognize the disease's danger.
Ricardo *et al.*, 2018 [26]	Riverside slum settlements/Santa Fe/Argentina	Sociodemographic Knowledge Attitude Practice	Knowledge –7 items Attitude – 7 items Practice – 8 items	Descriptive, ANOVA, Linear mixed-effects models (LMM)	(n = 113) The impact of leptospirosis knowledge and attitudes on the chance that an individual will utilise preventative measures was assessed using linear mixed-effects models. The vast majority of responders (83.2%) had heard of leptospirosis; nevertheless, a particular understanding of leptospirosis was limited. According to the findings of the modeling efforts, the chance of employing preventative behaviors was connected with having a higher knowledge score, but not with having more positive attitudes. Females were more likely than males to employ safer behaviors.	Leptospirosis prevention efforts in riverfront communities should be geared at teaching the public about the illness's numerous aspects rather than trying to modify people's ideas or attitudes about the disease, which had little effect.

(*Contd...*)

Table 2: (*Continued*)

Author/year	Study setting	Variable	Items for KAP assessment	Data analysis	Outcome	Comments
Aidid *et al.*, 2018 [20]	Rural residential/ Kuantan/Malaysia	Sociodemographic Knowledge Attitude Practice Geographical Location distance from Kuantan River (Stratum) - more than 1000 m (Low risk) - 500–1000 m (Moderate Risk) - <500 m (high risk)	Knowledge – 24 items Attitude – 12 items Practice – 14 items	Descriptive, Chi-square test, Logistic regression analysis	(n = 568) Good Knowledge: 68% Satisfactory Attitude: 38% Satisfactory practice: 18% High-risk stratum and monthly personal income of<RM1000 is predictors of satisfactory leptospirosis preventive practices.	Association between KAP has not been tested Varied geographical areas have different health education programmes, therefore a high-risk area may have more health education geared toward leptospirosis prevention.
Wongbutdee *et al.*, 2016 [24]	Village/Ubon Ratchathani province/Thailand	Sociodemographic Perceptions Behavioral risks	Perceptions – 16 items Behavioral Risks – 16 items	Descriptive, Pearson Correlation	(n = 104) Perceptions: 97.1% (high) Risky behaviors: 74.0% (moderate risk), 25.0% (high risk) No correlation between perceptions and risky behaviors	Excellent understanding of leptospirosis. However, some persons engage in leptospirosis associated risky behavior. As a result, a behavioral change campaign should be developed to raise public awareness of the consequences of such behaviour.

preventive activities during the week. A score of 3 was given to answers marked "often" (4–6 times/week); "sometimes" (1–3 times/week) earned a score of 2; and "never," was given a score of 1. Negative items ranging from "Always" (1) to "Often" (2) to "Sometimes" (3), and "Never" (4). Based on a total score of 64 points, three levels of PBL were interpreted. PBL ranging from 43–61 points were considered 'high levels', 22–42 points were considered 'moderate levels,' and 1–21 points were considered 'low level' [23].

Manlapaz *et al.* (2019) did not specify how many items were assessed to measure KAP [25]. For knowledge questions, the questionnaire employs a true-false question style, and two 5-point Likert scales for attitude and practice. For attitude, 1 – strongly disagree, 2 – disagree, 3 – not sure, 4 – agree, and 5 – strongly agree. For practice, 1 – never, 2 – rarely, 3 – sometimes, 4 – often, and 5 – always. To arrive at the percentage results, they used the raw scores for KAP, and then multiplied those results by 100. The mean of the percentage scores of the data was used to compute the overall KAP scores. Scores are not computed into levels [25].

Nozmi *et al.* used eight items to assess knowledge, 16 items to assess attitude, and 17 items to assess practice [21]. Participants were given three knowledge answer options: "Correct," "Wrong," and "Do not know." The correct answer received a score of "1," while incorrect answers and "do not know" received a "0" score. It was determined that individuals who scored 60% or above on the knowledge test were regarded to have "good knowledge," whilst those who scored lower than 60% were considered to have "poor knowledge." A 5-point Likert scale was used to measure sentiments, with 5 indicating strongly agreeing, 4 indicating agreeing, 3 indicating unsure, 2 indicating disagreeing, and 1 indicating strongly disagreeing. In the case of negative utterances, the scales were reversed and recorded. Attitude ratings above 80% were regarded as acceptable, while scores below 80% were considered unsatisfactory. Participants were divided into two groups based on their

results. Those who answered, "Not applicable," "Never," "Sometimes," "Most of the time," and "All of the time" when questioned about preventative practices were given a score of"0," "1," "2," and "3" correspondingly. Participants with scores of 80% or more were considered to have acceptable preventive practices, whereas those with scores below 80% were considered to have unacceptable preventive practices. The previous research was used to determine the cutoff point [21].

Pathman *et al.* (2018) did not provide the number of items used to assess KAP [22]. According to the judgment reached by the researchers and expert opinion, a cutoff point of 80% or higher was recognized as having adequate knowledge, a positive attitude, a positive belief, and satisfactory practice [22]. Ricardo *et al.* used seven items to assess knowledge, seven items to assess attitude, and eight items to assess practice [26]. For knowledge, the score increased as the individual gained further knowledge about the condition. For attitude, scores climbed if respondents indicated a better knowledge of the risk and/or a stronger proclivity to act when symptoms appeared or during an epidemic. In terms of practices, a low score suggested dangerous actions or habits, whereas a high score indicated safer behaviors or habits. The crude scores for KAP were calculated by dividing the maximum possible score for each area by 100 and multiplying by 100. There was no indication of a cutoff point by Ricardo *et al.* There was no cutoff point mentioned [26]. Aidid *et al.* used 24 items to assess knowledge, 12 items to assess attitudes, and 14 items to assess practice [20]. Positive attitude questions received scores of "4," "3," "2," "1," and "0" for "highly agree," "agree," "not sure," and "strongly not agree." The aforementioned scoring method was flipped for negative attitude components. Excellent preventative practice items received ratings of "4," "3," "2," "1," and "0" for "always," "often," "occasionally," "seldom," and "never." A cutoff criterion of 75% was chosen to differentiate between poor and good knowledge, as well as between unsatisfactory and satisfactory attitudes and practices [20].

To evaluate perceptions and behavioral risks, Wongbutdee *et al*. used 16 items for both categories [24]. These questionnaire items were rated on a scale of positive to negative. It ranged from "agreed" (1) to "disagreed" (0). Negative items ranged from "agreed" (0) to "disagreed" (1). The findings were interpreted based on the total scores of respondents out of 16. Perception scores of 11–16 were judged as high, 6–10 were considered moderate, and 1–5 were considered poor. The behavioral hazards of leptospirosis were rated on a scale of positive to negative. Positive items needed YES/NO replies, with YES earning 1 point and NO receiving 0 points. Negative elements were scored NO(1)/YES(0). The interpretations were based on 16 scores. Scores of 11 to 16 were considered high-risk, 6 to 10 moderate-risk, and 1–5 low-risk [24].

Pearson's Chi-square

For the relationships between sociodemographic and KAP, Abdullah *et al*., in the Malaysian urban population of Selangor, observed substantial associations between "age with knowledge" and "education level with preventative actions" [19]. However, Nozmi *et al*. observed that ethnicity and income were substantially linked with knowledge level and preventative measures [21]. However, the attitudes were associated with ethnicity, income, and education. Aidid *et al*. found significant relationships between geographical location (distance of neighborhood from the river), age group, and personal income with preventative measures in Kuantan, Malaysia [20].

Analysis of variance (ANOVA)

Three riverbank villages were studied by Ricardo *et al*. in Santa Fe [26]. ANOVA was used to see if there was a difference between the three sites. All three locations were in the Parana River flood basin, an area prone to flooding and lacking in sanitary facilities. The ANOVA test revealed significant variations in the knowledge between sites, but not in the attitudes or preventative measures. As the distance to Santa Fe increased, so did the knowledge of leptospirosis. Rural residents may have less access to information and may be further away from hospitals, despite the fact that they all appear to have identical living conditions.

Mann–Whitney U-test

Participants from villages with and without a history of leptospirosis in Thailand were compared. The Mann–Whitney U-test revealed no significant differences in preventative behavior between the two communities [23].

Correlation

The Pearson correlation model was used to determine the association between the variable's KAP. In Quezon City, Philippines, a study conducted in selected areas near the San Juan River, where the majority of the floodwater overflows had discovered a substantial association between knowledge and attitude, and attitude and practice [25]. There was no substantial relationship between knowledge and practice. Wongbutdee *et al*. investigated people's perceptions (knowledge) and risky behavior about leptospirosis in a hamlet of an endemic region in the province of Ubon Ratchathani, Thailand [24]. There is no link between leptospirosis perceptions and hazardous behavior.

Logistic regression

In Selangor, Malaysia, Abdullah *et al*. used logistic regression to find that respondents under 32 years old had better knowledge than those 32 years and older [19]. Those with greater education also have stronger preventative practices than those without. In contrast, a study in rural Hulu Langat, Selangor, by Nozmi *et al*. revealed that ethnicity was the sole significant predictor of knowledge level, with Malays having 2.6 times the odds of strong knowledge as non-Malays [21]. Those earning RM1500 or more had 1.8 times more chances of having adequate preventative behaviors than those earning less. Affective attitudes were also strongly influenced by ethnicity, income, and education level, with Malays having 2.5 times the odds of having acceptable attitudes than non-Malays, those earning RM1500 or more had 1.6 times the odds of having acceptable attitudes, and those with formal education had 3.7 times the odds of having acceptable attitudes. By logistic regression analysis, persons with acceptable attitudes had 4.4 times greater odds of having an acceptable level of preventative measures than those with unacceptable attitudes.

Pathman *et al*. discovered that no significant sociodemographic characteristics are linked with knowledge and practice in both urban and rural groups in North-east Malaysia, with the exception of educational status, which was significant in the attitude and belief domains [22]. Those with a greater level of education had more positive attitudes and beliefs. Aidid *et al*. (2018) used the multivariate logistic regression to examine the risk factors for leptospirosis prevention in Kuantan, Malaysia, and found that those who lived within 500 m of the Kuantan riverbank (a high-risk stratum) and had a monthly personal income of <RM1000 were more likely to practice leptospirosis prevention [20].

Linear mixed-effect model

Three riverbank villages in Argentina were studied by Ricardo *et al*. using a linear mixed-effect

model, which found that knowledge was associated with the chance of applying preventative activities, but not positive attitudes [26].

Quality appraisal

The eight-item JBI checklist for critical evaluation of cross-sectional research was utilized [16]. However, items three and four were not relevant since they are connected to the assessment of exposure and a specific disease or condition. Manlapaz *et al.*, Pathman *et al.*, Ricardo and colleagues, and Aidid *et al.* did not explicitly describe the criteria for inclusion in the sample [20], [22], [25], [26]. Confounding elements and ways of dealing with them were not identified by any researchers who investigated the subject matter in detail. Out of the eight articles reviewed, six of the literatures applied validated questionnaires to measure the KAP which are the main outcome of the studies whereby two articles did not further describe in detail on the validity and reliability of the questionnaire. All articles used appropriate statistical analysis according to their study design. Table 3 summarizes the findings of the critical appraisal.

Discussion

Leptospirosis continues to be underreported due to underdiagnosed and poor disease surveillance, monitoring, and recording in some countries in South-east Asia and Southern America [6], [27]. For the most part, leptospirosis is actually underdiagnosed because the diagnosis is difficult to confirm with a lack of rapid diagnosis [6], [9]. Another reason for being underdiagnosed is misdiagnosis due to symptoms similar to other endemic diseases such as dengue, and the disease may be mild that laboratory investigation is not warranted [6], [9]. With a worldwide burden of over 1 million severe human cases per year, a case fatality rate of 10%, and an increasing number of countries reporting leptospirosis outbreaks, improved prevention and control techniques are required [1], [7], [8]. These studies are frequently employed in many fields of public health because they are based on the premise

that information may change attitudes and behaviors; thus, reducing disease burden [28]. A leptospirosis intervention program was implemented in Selangor, Malaysia, based on the findings of two KAP studies, and its effectiveness in improving KAP among high-risk wet market workers was shown [29]. Human activities are known to influence the survival of leptospirosis vectors and viral transmission. Occupational, recreational, daily, or avocational exposures [30].

A study on other infectious illnesses found that higher education impacts better knowledge and prevention of dengue vectors [31]. Similar findings were reported among butchers in Jamaica, where most had barely completed elementary school and had negative views regarding infectious illnesses [32]. Research in Thailand found that educational status influenced the result of practice, with lower educational status related to an increased risk of leptospirosis [33], [34]. Acceptable preventative activities increase income. A survey of non-agricultural employees in the Philippines confirms this [11]. Notably, poverty has been identified as an independent risk factor for leptospirosis [35].

There is currently a shortage of data on leptospirosis knowledge, attitudes, and prevention behaviors. Several investigations have shown that the causal correlations of these characteristics vary among zoonotic illnesses. Some research shows a link between knowledge, attitudes, and preventative measures, whereas others show no link [36], [37], [38], [39]. It is important to note that most research on leptospirosis KAP was descriptive and did not attempt to establish specific risk factors. Knowledge enhanced the chance of applying preventative behaviours, as reported by Ricardo *et al.* [26]. According to Arbiol *et al.*, Lau *et al.*, and other research on zoonotic disease prevention strategies, better awareness of the illness leads to increased adoption of preventative actions [11], [40], [41], [42].

KAP research toward leptospirosis has employed a variety of statistical techniques. However, the knowledge, attitude, and preventative actions of many individuals from various socioeconomic and educational backgrounds were found to be inconsistent. Furthermore, the predictive model formulated on KAP towards leptospirosis in these existing studies is very scarce. The variableness of questionnaire content, non-standardized scoring and computation process,

Table 3: The Joanna Briggs institute critical appraisal tools: checklist for analytical cross-sectional studies, Moola *et al.* 2017 [16]

JBI critical appraisal checklist	References							
	Abdullah *et al.*, 2019 [19]	Jittimanee and Wongbutdee 2019 [23]	Manlapaz *et al.*, 2019 [25]	Nozmi *et al.*, 2018 [21]	Pathman *et al.*, 2018 [22]	Ricardo *et al.*, 2018 [26]	Aidid *et al.*, 2018 [20]	Wongbutdee *et al.*, 2016 [24]
Criteria for inclusion in the sample clearly defined	Yes	Yes	No	Yes	No	No	No	Yes
Study subjects and the setting described in detail	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Exposure measured in a valid and reliable way	NA	NA	NA	NA	NA	NA	NA	NA
Objective, standard criteria used for measurement of the condition	NA	NA	NA	NA	NA	NA	NA	NA
Confounding factors identified	No	No	No	No	No	No	No	No
Strategies to deal with confounding factors stated	No	No	No	No	No	No	No	No
Outcomes measured in a valid and reliable way (questionnaire)	Yes	No	Yes	Yes	Yes	No	Yes	Yes
Appropriate statistical analysis used	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

and sample size of the studies included in this review hinders it from becoming generalized. Questionnaire validity and reliability should be prioritized and described in detail. The validated questionnaire should be standardized internationally and used widely with proper alteration according to the cultural, socioeconomic, and educational background of the community.

Conclusion

It is demonstrated that the levels of KAP on leptospirosis are still not up to the requirement to prevent and control the endemicity of leptospirosis. It is also shown that sociodemographic variables influenced KAP toward leptospirosis albeit the incongruous results of the studies reviewed. Thus, there is an urgent call to develop more solid and standardized KAP studies with a validated and reliable questionnaire. Interventions on leptospirosis that aim to modify public perceptions or attitudes about the disease have had little effect; therefore, they should instead focus on increasing public awareness of the numerous characteristics of leptospirosis and encourage higher compliance with preventative activities. Developing a successful leptospirosis health intervention program will be made easier with the incorporation of qualitative and quantitative modeling into KAP research in the future.

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