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Development and Validation of a KAP Scale on Deworming Practices in Captive Asian Elephants, Assam

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ABSTRACT

The study was conducted during May–June, 2025 at the Dihing Patkai landscape of Assam on the development and validation of an Elephant Deworming KAP Scale involved in the care of captive Asian elephants (*Elephas maximus*). An initial pool of 42 items was generated through literature review, field observation, and expert consultation. Following content validation by 10 experts, 30 items (10 each for knowledge, attitude, and perception) were retained, all achieving a Scale Content Validity Index/Average (S-CVI/Ave) above 0.90. Knowledge items, scored on a 3-point scale, showed acceptable difficulty (p=0.43–0.73) and discrimination (r>0.30) indices, with three items flagged for refinement. Attitude and perception items, measured on a 5-point Likert scale with both positive and negative statements, demonstrated high internal consistency (Cronbach's Alpha= 0.90 and 0.89, respectively). Pretesting and pilot testing were conducted with 20 elephant caregivers to ensure the tool's clarity and usability. Pilot testing revealed moderate levels of knowledge (56.83%), attitude (63.20%), and perception (61.00%), which resulted in an overall moderate KAP score of 60.88%. These results indicated that, elephant handlers possessed a moderate degree of awareness and attitudes toward deworming practices. Nonetheless, the findings underscored the need for targeted educational interventions to further improve knowledge and perception levels. The validated KAP scale demonstrated strong reliability and was deemed a suitable instrument for future behavioural assessments and program evaluations aimed at enhancing elephant health management in similar contexts.

KEYWORDS: Captive Asian elephant, parasites, deworming, KAP-scale, item-analysis, Assam

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1. INTRODUCTION

Parasitic infections represent a significant health challenge for captive and working elephants, affecting their welfare, productivity, and overall longevity (Abhijith et al., 2018; Shahi and Gairhe, 2019; Qurratul-Saadah et al., 2023). These infections can compromise immune function, reduce physical performance, and predispose elephants to secondary infections. Therefore, effective deworming practices are essential components of routine health management, contributing directly to improved well-being and sustainable care systems (Panayotova-Pencheva, 2024).

Captive elephants are highly vulnerable to various endoparasites, including nematodes like Strongyloides and Ascaris, as well as cestodes and trematodes. These parasites can cause significant health issues such as anemia, enteritis, weight loss, and protein-losing gastroenteropathy. In severe cases, especially among calves and immunocompromised elephants, parasitic infections may lead to mortality (Fowler and Mikota, 2006; Punya et al., 2021; Obanda et al., 2011). Factors such as restricted mobility, confinement in unhygienic enclosures, and close contact with infected animals or contaminated environments often worsen parasite burdens. Effective management and veterinary supervision are crucial to monitor and control parasitic infections, ensuring the health and welfare of captive elephant populations.

Regular and strategic deworming significantly reduces parasitic burden, improves body condition, enhances reproductive performance, and promotes longevity in elephants (Lynsdale et al., 2022). Common anthelmintics such as fenbendazole, ivermectin, and albendazole are administered orally or parenterally depending on the elephant's temperament, size, and health status (Tiwari and Rao, 1996). Besides drug treatment, routine fecal examinations, rotational grazing where feasible, and maintaining hygienic enclosures are essential supportive practices to prevent reinfection (Abeysinghe et al., 2012; Lynsdale et al., 2015). These combined approaches are critical for effective parasite control in captive elephants.

Veterinary supervision is essential for accurate diagnosis, proper drug selection, and correct dosing, which help prevent issues like drug resistance and toxicity (Abeysekara et al., 2018; Nigam et al., 2022). However, successful deworming also depends heavily on the knowledge, attitudes, and perceptions (KAP) of those directly involved in elephant care, including mahouts, handlers, owners, and support staff. Their understanding and practices significantly influence the effective implementation of deworming protocols. Therefore, addressing both veterinary guidance and caregiver KAP is critical to achieving optimal parasite control and improving overall elephant as well as other animal health management (Mapatse et al., 2022).

Despite the critical role of human factors in elephant health, standardized tools to assess Knowledge, Attitude, and Practices (KAP) related to deworming remain lacking. This gap limits the ability to identify behavioral and informational barriers that undermine parasite control efforts. Previous studies in livestock and wildlife management highlighted the importance of KAP assessments for designing targeted, context-specific interventions that enhance compliance and effectiveness (Haladyna, 2004; Ardiantiono et al., 2021; Kittisirikul et al., 2024). Developing and validating such tools for elephants is essential to improve health outcomes and strengthen deworming programs.

To address this critical gap, the present study focused on the development and validation of an Elephant Deworming KAP Scale, designed to systematically evaluate the understanding, beliefs, and practices of key stakeholders involved in captive elephant care. Through a methodical process involving literature review, expert input, and field testing, the study aimed to create a reliable and psychometrically sound instrument that could be used for both research and extension purposes. This scale is expected to aid in identifying knowledge gaps, guiding targeted awareness programs, and ultimately enhancing deworming outcomes for captive Asian elephants, particularly in regions like north-eastern India where such management is culturally and ecologically significant.

2. MATERIALS AND METHODS

The study was conducted during May–June, 2025 at the study site (approx. lat 27.654163, long 95.345485), located in the Dihing Patkai landscape of Assam.

2.1. Development of KAP items

An initial pool of 42 items was generated to evaluate Knowledge (15 items), Attitude (15 items), and Perception (12 items) related to elephant deworming practices. Item formulation was informed by an extensive literature review, direct field observations, and consultations with veterinarians, mahouts, and subject matter experts to ensure scientific rigor and contextual relevance.

2.2. Content validity assessment

To ensure the relevance, clarity, and appropriateness of the KAP items, a panel of 10 subject matter experts, including academicians, veterinarians, and experienced field professionals, evaluated them using a 4-point Likert scale (1=Not Relevant to 4=Highly Relevant). The Item-Level Content Validity Index (I-CVI) was calculated for each item. Items with an I-CVI ≥ 0.78 were retained as-is, items scoring between 0.60 and 0.77 were revised based on expert feedback if contextually important, and those below 0.60 were excluded.

2.3. Structure and scoring of the KAP scale

2.3.1. Knowledge section

The knowledge section of the scale comprised 10 multiple-choice or open-ended items designed to assess awareness of parasitic infections, clinical signs, associated risks, and standard deworming protocols in elephants. Each response was rated on a 3-point scale: Correct=3, Partially correct=2, and Incorrect/'Don't know'=1.

2.3.1.1. Item analysisfor knowledge scale

Each item was analysed for mean score, difficulty index, and discrimination index. Items with ideal difficulty (0.30–0.70) and discrimination ($r \geq 0.30$) were retained or revised accordingly.

2.3.2. Attitude and perception section

These sections each included 10 statements designed to capture respondents' beliefs and outlooks regarding deworming practices. To minimize response bias, an equal number of positive and negative statements were used. Respondents rated each item on a 5-point Likert scale (1=Strongly Disagree to 5=Strongly Agree). Negative statements were reverse-scored to ensure consistency in interpretation, with higher scores reflecting more favourable attitudes and perceptions toward deworming.

2.1.1.1. Reliability analysis for attitude and perception scale

Item analysis was conducted using mean scores, item-total correlations, and Cronbach's alpha if item deleted. Items with item-total correlations below 0.40 or those whose removal resulted in an increase in Cronbach's alpha were considered for revision or elimination to enhance the internal consistency of the scale.

2.3.3. KAP scoring and classification based on pilot respondents (n=20)

Knowledge, Attitude, and Perception (KAP) were assessed using structured scales. Knowledge was scored on a 0–3 scale (maximum 30 points), while Attitude and Perception were scored on 1–5 scales (maximum 50 points each). Mean percentage scores were calculated by dividing the mean score by the maximum possible score and multiplying by 100 for each component. The overall KAP score combined all components (maximum 130 points) and was similarly converted to a percentage. Scores were classified as low (<50%), medium (50–75%), or high (>75%) to interpret respondents' KAP levels.

2.4. Pre-testing, pilot testing and sampling

A total of 20 purposively selected respondents, including elephant handlers, mahouts, owners, and veterinary support staff, participated in the pre-testing and pilot testing of the KAP scale. The process aimed to evaluate item clarity, scale structure, and response feasibility. Feedback obtained during administration was used to make minor refinements to the instrument. As this was an exploratory tool validation exercise, no further data collection was conducted beyond this sample.

2.5. Data collection procedure

Structured face-to-face interviews (Figure 1 and 2) were conducted by research investigators, Dr. Nikita Phukan and Dr. Pallabi Pathak. Participation was voluntary, and informed consent was obtained. Respondents were assured of the confidentiality of their responses.

Figure 1: Data collection

Figure 2: Data collection

2.6. *Data analysis plan*

Descriptive and inferential statistics were planned to analyse KAP scores and associations.

3. RESULTS AND DISCUSSION

3.1. Content validity assessment

Expert selection for reviewing an assessment tool relied on

relevant subject expertise. While a minimum of two experts was considered acceptable for content validation (Davis, 1992), most guidelines recommended six to eight (Polit et al., 2007). Based on these recommendations and the authors' experience, an optimal range of six to ten experts was deemed to ensure diverse, credible input without creating logistical challenges (Yusoff, 2019). However, Asaye et al. (2021) involved a panel of 19 experts in two rounds in their study on the assessment of content validity for a Neonatal Near Miss Scale in the context of Ethiopia. Consistent with these recommendations, the present study involved ten experts, and the summary of their evaluations along with the resulting S-CVI/Ave was presented in Table 1.

Table 1: Content validity assessment

Section	Items developed	Not selected/ Rejected	Items selected	S-CVI/ Ave
Knowledge	15	5	10	0.95
Attitude	15	5	10	0.93
Perception	12	2	10	0.90

Following the expert review process, out of the 42 items initially developed, 30 were retained for the final version of the assessment tool. This reduction reflected the removal or modification of items that were considered ambiguous, redundant, or less relevant by the expert panel. All three sections of the instrument achieved S-CVI/Ave scores exceeding 0.90, which indicated a high degree of agreement among the experts and provided strong evidence of content validity. These findings were consistent with the results reported by Ok et al. (2025), who obtained an S-CVI/Ave of 0.943 for AI-generated anatomy content, demonstrating a similarly high level of expert consensus. The results also aligned with the widely accepted standards proposed by Polit and Beck (2006), who recommended an S-CVI/Ave threshold of ≥0.90 to ensure excellent content validity in newly developed tools. Furthermore, earlier studies by Shi et al. (2012) and more recent work by Wei et al. (2025) both emphasised that an S-CVI/Ave value of 0.90 or above was generally regarded as satisfactory for establishing strong content validity. The results of the present study therefore reinforced existing evidence, confirming that the retained items collectively met the required standards for relevance, clarity, and representativeness as judged by a panel of qualified experts.

3.2. Knowledge scale item analysis

Table 2 depicted that, the difficulty index (p) values ranged from 0.43 to 0.73, with most items falling within the recommended moderate range of 0.30 to 0.70. For instance, Q3 (What is the ideal frequency for deworming?) had a p-value of 0.45, indicating moderate difficulty, while Q10 (Do seasonal factors influence parasite load in elephants?) had a p-value of 0.73, suggesting it was easier for most respondents. Similar findings with a comparable range of p-values were also reported by Nibret (2019) and Adamu et al. (2021). According to established guidelines, indices between 0.2 and 0.8 are generally acceptable, with 0.3 to 0.7 preferred for effective discrimination between different ability levels. Items above 0.8 tend to be too easy, and those below 0.2 too difficult, potentially reducing their assessment effectiveness (Ebel and Frisbie, 1991; Crocker and Algina, 2006; Taib and Yusoff, 2014; Lüdecke, 2025).

The discrimination index analysis (r) indicated that seven items demonstrated effective differentiation between high and low scorers, with values exceeding the acceptable threshold of 0.30. Similar findings, with a comparable range of discrimination index (r) values, were also reported by Anastasi and Urbina (1997), Adamu et al. (2021) and Zhu et al. (2023), reinforcing the consistency of the observed item performance trends. Notably, Q10 (r=0.579), Q1 (r=

Table 2: Knowledge scale item analysis

Sl. No.	Knowledge item	Mean score	Difficulty (p)	Discrimination index (r)	Retention decision
1.	Do you know why elephants need regular deworming?	2.10	0.70	0.512	Retain
2.	What are the visible signs of parasitic infection in elephants?	1.65	0.55	0.431	Retain
3.	What is the ideal frequency for deworming?	1.35	0.45	0.377	Retain
4.	What type of worms are commonly found in elephants?	1.55	0.52	0.444	Retain
5.	Can traditional medicines control worm infections?	1.60	0.53	0.398	Retain
6.	Name one veterinary deworming medicine used for elephants.	1.30	0.43	0.172	Revise
7.	Who should prescribe the dose of deworming medicine?	2.05	0.68	0.276	Revise
8.	How can worm load be confirmed in elephants?	1.80	0.60	0.230	Revise
9.	What risks are there if deworming is delayed or skipped?	1.45	0.48	0.365	Retain
10.	Do seasonal factors influence parasite load in elephants?	2.20	0.73	0.579	Retain

0.512), and Q2 (r=0.431) exhibited strong discrimination, suggesting these items were both conceptually relevant and statistically robust in assessing the construct. Conversely, Q6 (r=0.172), Q7 (r=0.276), and Q8 (r=0.230) recorded lower discrimination values, implying a weaker capacity to distinguish knowledge levels among respondents. Such items may require rewording for clarity, simplification, or enhanced contextual alignment. For instance, Q6 could be revised to incorporate options that better reflect locally used dewormers. Interpretation of discrimination indices followed established criteria, wherein values of 0.00–0.19 denote poor discrimination, 0.20–0.29 indicate acceptable but improvable performance, 0.30–0.39 reflect good functioning, and ≥0.40 represent very good to excellent discrimination (Johari et al., 2012; Lüdecke, 2025).

Based on this analysis, seven items (Q1, Q2, Q3, Q4, Q5, Q9, Q10) were retained for their solid psychometric properties, while three items (Q6, Q7, Q8) were recommended for revision to enhance the overall reliability and validity of the knowledge subscale. These findings supported the robustness of the Knowledge scale, which, when combined with Attitude and Perception sections, provides a comprehensive framework for assessing understanding and beliefs related to elephant deworming practices. The scale met the foundational standards for educational and behavioral assessment tools and was suitable for future application in training programs and baseline knowledge assessments.

3.3. Reliability analysis of attitude scale

As shown in Table 3, the attitude component of the Elephant Deworming KAP Scale demonstrated a high level of internal consistency, with an overall Cronbach's alpha of 0.90, indicating excellent reliability. According to established interpretation ranges, overall alpha values were described as excellent (0.93–0.94), strong (0.91–0.93), reliable (0.84–0.90), good (0.71–0.91), moderate (0.61–0.65), and low (<0.55), with other intermediate categories reported in earlier studies (Tavakol and Dennick, 2011; Taber, 2018). Based on this classification, the observed alpha of 0.90 placed the scale firmly in the "reliable" category, close to the "strong" range, suggesting that the items within the attitude component were highly consistent in measuring the intended construct.

Positively framed statements, such as "Regular deworming was essential for elephant health" (mean=4.3), "I trusted veterinarians' advice about deworming" (mean=4.2), and "Deworming medicines were safe for elephants when used correctly" (mean=4.1), received high scores, reflecting favorable attitudes and strong alignment with recommended practices. In contrast, negatively worded items, such as "Traditional remedies were more reliable than veterinary medicines" (mean=2.0) and "Deworming should only be done when elephants showed symptoms" (mean=2.1), scored lower, suggesting that respondents disagreed with common misconceptions, indicating good awareness and orientation toward evidence-based practices.

Table 3: Reliability analysis of attitude scale items

Item No.	Item description	Mean score	Item-total correlation	Cronbach's alpha if item deleted	Interpretation
1	Regular deworming is essential for elephant health. (+)	4.3	0.62	0.89	Retain
2	I prefer veterinary medicines over traditional remedies. (+)	4.0	0.68	0.88	Retain
3	Deworming medicines are safe for elephants when used correctly. (+)	4.1	0.55	0.90	Retain
4	I trust veterinarians' advice about deworming. (+)	4.2	0.60	0.89	Retain
5	Training on parasite control is important for mahouts. (+)	3.9	0.50	0.91	Retain
6	Deworming should only be done when elephants show symptoms. (-)	2.1	0.40	0.92	Revise
7	Traditional remedies are more reliable than veterinary medicines. (-)	2.0	0.35	0.92	Revise
8	I find deworming procedures risky and stressful for elephants. (-)	2.3	0.45	0.91	Retain
9	I don't feel confident in identifying signs of parasitic infection. (-)	2.5	0.50	0.90	Retain
10	Awareness about parasitic infections is low among elephant keepers. (-)	2.2	0.65	0.88	Retain
Overall Cronbach's Alpha (B):			0.90	High internal consistency	

Item-total correlations ranged from 0.35 to 0.68, with eight of the ten items exceeding the widely accepted benchmark of 0.40, indicating strong internal consistency and good item relevance to the overall construct. Psychometric guidelines suggested that item-total correlations above 0.30 or 0.40 generally reflected adequate alignment with the measured construct (Anastasi and Urbina, 1997; Lee, 2025). The item "I preferred veterinary medicines over traditional remedies" recorded the highest correlation (r=0.68), indicating strong alignment with the underlying attitude construct. However, two items, Q6 (r=0.40) and Q7 (r=0.35), showed comparatively lower correlations, suggesting these items may have contributed less effectively to the scale. These findings supported the scale's robustness and aligned with prior studies (Moser et al., 2009; Myong et al., 2021; Ornek et al., 2023).

Further analysis of Cronbach's alpha if an item was deleted showed values ranging from 0.88 to 0.92, confirming that all items contributed acceptably to internal consistency. Notably, alpha values increased slightly when Q6 or Q7 were removed, suggesting these items might have benefited from rephrasing for clarity or better conceptual fit. For example, Q7 could have been revised to specify conditions where traditional remedies were perceived as effective. Generally, alpha values close to 1.00 indicated high internal consistency, meaning items were strongly correlated and measured the same construct, while values near 0.00 indicated low consistency. A threshold of 0.70 or higher was typically considered acceptable in social science research (Taber, 2018). The present results aligned with those reported by Wadkar et al. (2016), Myong et al. (2021), and Seong (year), reinforcing the consistency of findings across studies.

Overall, the attitude scale exhibited strong psychometric properties and effectively captured respondent attitudes regarding deworming. These findings validated its use in future behavioral assessments and program evaluations, particularly in contexts involving elephant caregivers and veterinary personnel.

3.4. Reliability analysis of perception scale

As shown in Table 4, the perception component of the Elephant Deworming KAP Scale demonstrated high internal consistency, with an overall Cronbach's alpha of 0.89, which was similar to the attitude component's alpha of 0.90. This similarity indicated that both scales reliably measured their respective constructs, supporting the overall robustness of the KAP Scale (Tavakol and Dennick, 2011; Taber, 2018; Botello-Hermosa et al., 2024).

Positively worded items, such as "I feel I have enough knowledge about parasitic diseases in elephants" (mean =

Table 4: Reliability analysis of perception scale items

Item No.	Item description	Mean score	Item-total correlation	Cronbach's alpha if item deleted	Interpretation
1	I feel I have enough knowledge about parasitic diseases in elephants. (+)	4.1	0.60	0.89	Retain
2	I can confidently identify when an elephant needs deworming. (+)	4.0	0.58	0.90	Retain
3	I believe my deworming practices are effective. (+)	3.8	0.52	0.91	Retain
4	I know which dewormers are suitable for elephants. (+)	3.9	0.55	0.90	Retain
5	I feel NGOs or vet camps should guide deworming practices. (+)	3.7	0.50	0.91	Retain
6	I believe that skipping deworming does not immediately harm elephants. (-)	2.2	0.38	0.92	Revise
7	I think most elephant keepers lack awareness about parasites. (-)	2.1	0.35	0.92	Revise
8	I think laboratory testing is unnecessary for routine deworming. (-)	2.3	0.40	0.92	Revise
9	I believe deworming should be done only when parasites are visible. (-)	2.4	0.42	0.91	Retain
10	I think parasitic infections are not a serious concern for elephants. (-)	2.0	0.60	0.89	Retain
Overall Cronbach's Alpha (C):			0.89	High internal consistency	

4.1), "I can confidently identify when an elephant needs deworming" (mean=4.0), and "I believe my deworming practices are effective" (mean=3.8), reflected respondents' confidence and perceived competence in managing parasitic issues.

Negatively worded items, including "I believe that skipping deworming does not immediately harm elephants" (mean= 2.2), "I think most elephant keepers lack awareness about parasites" (mean=2.1), and "I think parasitic infections are not a serious concern for elephants" (mean=2.0), received low mean scores. This indicated that most respondents disagreed with these misconceptions, demonstrating favorable perceptions about the importance of deworming.

Item-total correlations ranged from 0.35 to 0.60, with most items exceeding the acceptable threshold of 0.40 (Anastasi and Urbina, 1997), showing a pattern similar to that observed in the attitude component. The highest correlations were observed for "I feel I have enough knowledge about parasitic diseases in elephants." and "I think parasitic infections are not a serious concern for elephants." (both r=0.60), indicating a strong internal coherence. Three items, Q6 (r=0.38), Q7 (r=0.35), and Q8 (r=0.40), fell on the lower end, potentially due to vagueness or negative framing, which could have introduced confusion. Comparable findings were reported by Shah et al. (2019) and Botello-Hermosa et al. (2024), supporting the consistency of these results across studies.

Evaluation of Cronbach's alpha if deleted showed that removal of Q6, Q7, or Q8 would slightly increase the alpha to 0.92, supporting the need to revise these items. For example, Q6 could be reworded to focus on long-term impacts of skipping deworming, thereby reducing interpretive ambiguity. These findings were consistent with those reported in prior research (Taber, 2018; Izah et al., 2024), reinforcing the need for careful item revision to improve scale reliability.

The present perception scale hence exhibited robust reliability and captured respondents' self-assessed awareness and beliefs regarding deworming practices. These results confirmed the scale's validity and applicability in similar field settings, particularly for monitoring and evaluating elephant health interventions.

3.5. Overall KAP score interpretation among pilot respondents (n=20)

Table 5 presented the overall Knowledge, Attitude, and Perception (KAP) scores of the pilot respondents (n=20), which were analyzed to evaluate their level of understanding and perspectives. The mean percentage scores indicated a moderate knowledge level (56.83%), with attitude scores being slightly higher at 63.20%. Perception scores also reflected a moderate positive outlook, averaging 61.00%. The combined overall KAP score was 60.88%, suggesting that respondents demonstrated a fair level of awareness accompanied by generally favorable attitudes and perceptions. Similar moderate KAP levels were observed in the studies of Al Ahdab (2021), Naser et al. (2021), and Alsaleh et al. (2023). Jubayer et al. (2022) in their study reported that, KAP scores above 60% were considered acceptable, whereas scores below this threshold were regarded as poor. Similarly, Xu et al. (2025) categorized scores between 80–100% as "good," 60–79% as "moderate," and below 60% as "poor" or "negative." According to these criteria, the findings of the present study suggested that the respondents' knowledge and perception were moderate, with attitudes being somewhat more positive. These results highlighted the need for targeted educational interventions to enhance knowledge and further improve attitudes and perceptions.

Table 5: Overall KAP scores of pilot respondents (n=20)

Component	Total mean score	Maximum score	Mean % score calculation	Mean % score
Knowledge	17.05	30	(17.05÷30)×100	56.83%
Attitude	31.60	50	(31.60÷50)×100	63.20%
Perception	30.50	50	(30.50÷50)×100	61.00%
Overall KAP	79.15	130	(79.15÷130)×100	60.88%

4. CONCLUSION

The study developed a valid and reliable KAP scale for assessing knowledge, attitude, and perception regarding elephant deworming. Expert review confirmed strong content validity, and item analyses showed good difficulty and discrimination. The pilot respondents demonstrated moderate KAP levels, consistent with previous research, indicating acceptable but improvable awareness and attitudes.

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