

LIMITED KNOWLEDGE ON THIAMINE'S ROLE IN FELINE HEALTH AMONG CAT OWNERS IN IPOH, MALAYSIA

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SUMMARY

Feline health requires dietary thiamine for carbohydrate metabolism and neurological function, yet preventable deficiencies persist in veterinary practice. This cross-sectional study assessed thiamine nutritional literacy among cat owners in Ipoh, Malaysia. Data were gathered from September 6–29, 2024, using a questionnaire distributed via 17 veterinary clinics and digital platforms like WhatsApp and Facebook. Screening questions restricted participation to current Ipoh residents, requiring parental consent for minors. Statistical analyses on the final convenience sample (N = 52) were executed in SPSS Version 27, using Chi-Square tests for categorical variables and Mann–Whitney U tests for non-normal Likert-scale data. The findings revealed a notable knowledge deficit whereby most respondents lacked basic awareness of thiamine's function (n = 31) or its deficiency signs (n = 35). A significant misconception was also identified, as 65.4% (n = 34) mistakenly viewed raw fish as a beneficial thiamine source, unaware of destructive thiaminase enzymes. Interestingly, the questionnaire itself served as a brief learning experience, as 76.9% of the respondents noted that their awareness of thiamine increased just by completing the survey. These outcomes highlight an urgent need for veterinarian-led initiatives to correct feeding myths and protect domestic cats from nutritional disorders.

Keywords: carbohydrate metabolism; feline health; owners' education; thiamine deficiency; vitamin B1

INTRODUCTION

Thiamine is a water-soluble vitamin (Mrowicka et al., 2023) required for numerous physiological functions in cats. Thiamine (vitamin B1) is converted in the body to its active coenzyme form, thiamine pyrophosphate (TPP). In its active form, TPP serves as a vital coenzyme in energy metabolism. In addition, TPP also acts as an essential cofactor in the pentose phosphate pathway, contributing to antioxidant defence and the synthesis of fatty acids and nucleic acids (Fascetti et al., 2024). Thiamine is naturally produced only by bacteria, fungi, and plants. Despite the capability of intestinal microflora to synthesize thiamine in cats, production occurs in regions of the gut where absorption is limited. As a result, this endogenous synthesis of thiamine does not substantially meet the cat's physiological requirements, and the body retains only a small amount of thiamine reserves (Chang et al., 2017). Thus, adequate intake of thiamine through diet is necessary to prevent deficiency (Kritikos et al., 2017; DiSabatino et al., 2021).

Thiamine is commonly included in pet food formulations as thiamine mononitrate, either as a vitamin

premix or as an individual additive. Ingredients such as *Saccharomyces cerevisiae* may also be included, contributing alternative forms of thiamine while serving as a protein source and improving the palatability of pet food (Dainton et al., 2022). To standardise thiamine intake, regulatory bodies such as the Association of American Feed Control Officials (AAFCO) and the European Pet Food Industry Federation (FEDIAF) have established nutritional guidelines based on National Research Council (NRC) recommendations (Kritikos et al., 2017). Despite these frameworks, cases of thiamine deficiency continue to be reported in cats. This includes the intake of raw fish containing thiaminase, the consumption of commercial diets where thiamine is severely degraded by extreme heat and pressure during industrial extrusion (for dry kibble) or thermal retort sterilization (for canned wet food), and the progressive degradation of the vitamin during long-term storage. Additionally, the use of sulphites to preserve meats can further deactivate available thiamine (Moon et al., 2013). Deficiency in thiamine can result in multi-systemic manifestations affecting neurological, cardiovascular, gastrointestinal, and metabolic function (Smith et al., 2021). In feline patients, a hallmark clinical feature of thiamine deficiency is spastic cervical ventroflexion, which may initially resemble the presentation of severe hypokalaemia. Ocular abnormalities (e.g., anisocoria or mydriasis) are also commonly observed in addition to neurological signs such as nystagmus or vision loss (Markovich et al., 2013).

Given that commercially balanced diets are not immune to nutrient degradation and that awareness of

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proper feline nutrition among pet owners is variable, it becomes essential to assess knowledge levels within specific populations. Malaysia, with its rapidly growing pet ownership, represents a highly relevant demographic for this investigation. Yet, there remains a lack of data on thiamine awareness among cat owners in this region. Therefore, this study aims to investigate the level of awareness regarding dietary thiamine and its health implications among cat owners specifically in Ipoh, Malaysia, to identify potential knowledge gaps and inform future educational strategies for improved feline nutritional care.

MATERIALS AND METHODS

Questionnaire development, validation, and bias mitigation

The questionnaire was originally drafted due to the absence of pre-existing instruments on this specific topic. The initial draft of the survey and the research protocol was submitted to the Ethics Committee for Research Involving Human Subjects, Universiti Putra Malaysia (JKEUPM) to establish the questionnaire content and validity. The committee evaluated and formally sanctioned the structural design, linguistic clarity, and contextual appropriateness of the survey items before public deployment. Following institutional approval, a pilot trial was executed with a small cohort of cat owners ($n = 5$) to assess readability, evaluate user comprehension, and monitor completion of metrics. Minor phrase modifications were incorporated based on preliminary feedback to maximise data accessibility for the public. The final version of the survey was approved by the committee under protocol JKEUPM-2024-431. The questionnaire comprised four sections. Section A collected socio-demographic information of participants. Section B assessed cat owners' knowledge and experiences related to thiamine in feline diets. Section C evaluated their understanding of the health impacts associated with adequate thiamine intake. Section D explored public awareness of thiamine and the extent of owners' efforts to seek information regarding its importance in feline nutrition.

Study setting, sampling, and participants

The study was conducted in Ipoh, Malaysia, from 6 to 29 September 2024. Eligible participants were individuals aged 18 years and above who were current residents of Ipoh. Using Cochran's sample size formula for an unknown population with a 95% confidence level and a 5% margin of error, the initial theoretical target sample size was calculated to be $N = 384$. To reach this target, data were collected using a structured questionnaire distributed via QR codes at 17 veterinary clinics across Ipoh, as well as through social media platforms including Facebook, Instagram, WhatsApp, and Telegram. To ensure data relevance, screening questions were used at the start of the

questionnaire to filter out respondents who did not reside in Ipoh. Participation was voluntary, and informed consent was obtained from all respondents; for participants under the age of 18, explicit consent was obtained from their parents or guardians. Personal information collected from pet owners was treated with strict confidentiality and was not disclosed publicly at any stage of the study. A final convenience sample of complete responses ($N = 52$) was obtained during the study period. This sample size reflects the strict time constraints of the 23-day data collection window and the inherent challenges of passive QR-code sampling, where veterinary clients frequently face time constraints.

Data analysis

All statistical analyses were performed using SPSS Statistics Version 27 (IBM Corporation, New York, USA). Normality of continuous data was assessed using the Kolmogorov–Smirnov test. As the data were not normally distributed, the Mann–Whitney U test was applied for comparisons involving continuous variables, while categorical variables were analysed using the Chi-Square test. Associations between cat owners' characteristics and their awareness of thiamine's role in feline health were evaluated, with a significance level set at $p \leq 0.05$.

RESULTS

This study assessed the relationship between cat owners in Ipoh and their awareness of thiamine's role in feline nutrition ($N = 52$). Demographic data from Section A indicated that a slight majority of respondents were male ($n = 28$, 53.8%), with females comprising the remaining 46.2% ($n = 24$) as shown in Figure 1. In terms of ethnicity (Figure 2), most participants identified as Malay ($n = 31$, 59.6%), followed closely by equal distributions of Chinese ($n = 10$, 19.2%) and Indian ($n = 10$, 19.2%) respondents, while other ethnicities accounted for 2.0% ($n = 1$). Regarding educational attainment (Figure 3), a substantial majority held a bachelor's degree ($n = 37$, 71.2%), followed by diplomas ($n = 7$, 13.5%), A-Levels ($n = 7$, 13.5%), and master's degrees ($n = 1$, 1.9%).

Figure 1: Demographic characteristics of the study respondents based on gender.

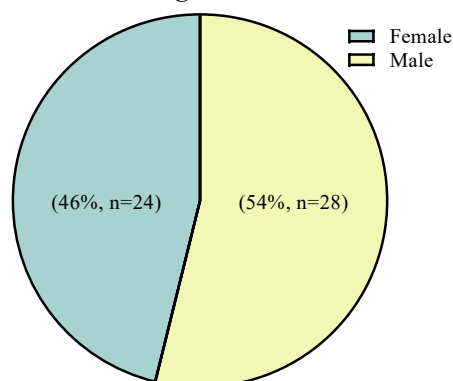


Figure 2: Demographic characteristics of the study respondents based on ethnicity.

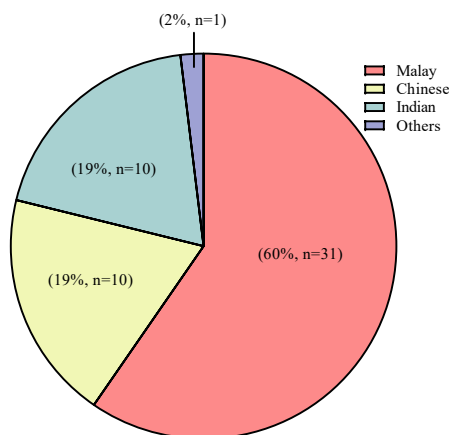
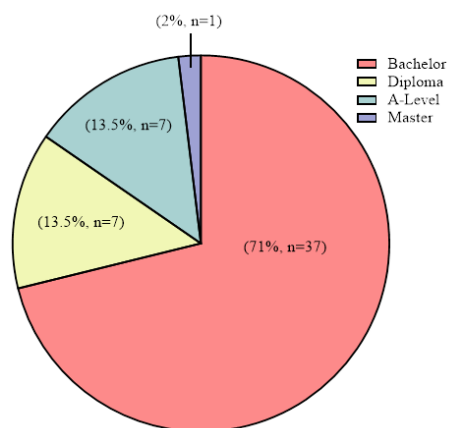


Figure 3. Demographic characteristics of the study respondents based on education level.



Analysis of Section B revealed a statistically significant association ($p \leq 0.05$) between cat owners in Ipoh and their level of awareness regarding thiamine as illustrated in Figure 4.

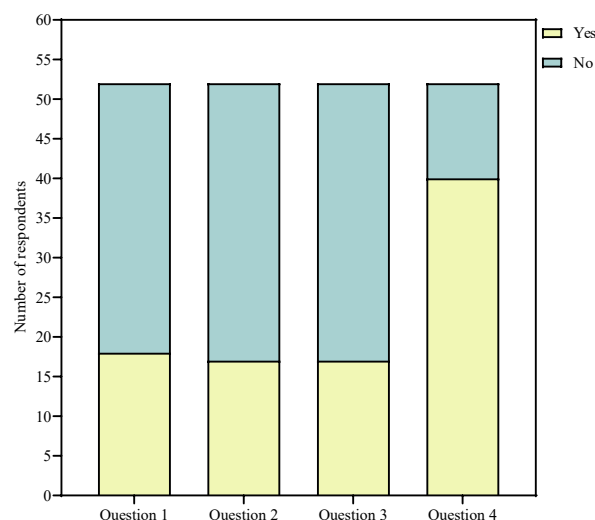
The distribution of responses predominantly reflected a lack of awareness. Initial analysis revealed a distinct gap between general veterinary literacy and owner beliefs. Initial assessment of baseline literacy revealed that majority of respondents perceived public awareness surrounding feline thiamine requirements to be lacking (65.4%, $n = 34$). This knowledge deficit was also reflected in individual understandings of deficiency consequences and associated neurological impacts, with identical majorities (67.3%, $n = 35$) reporting no prior knowledge of either item. Conversely, a significant majority of participants (76.9%, $n = 40$) recognized that adequate thiamine intake is crucial for general feline well-being. These findings indicate that while many cat owners in Ipoh may lack specific knowledge about thiamine and its physiological roles, they nonetheless perceive its intake as important for feline health. This suggests a gap between general health beliefs and specific nutritional literacy.

Analysis of Section C (Figure 5) indicated statistically significant differences in responses regarding

the nutritional properties of raw fish ($p \leq 0.001$). Only 34.6% ($n = 18$) of respondents acknowledged that cooking impacts thiamine content, highlighting a limited public understanding of thermal thiamine degradation.

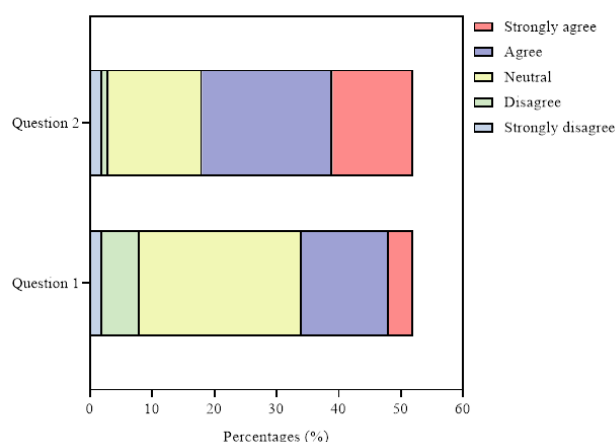
Furthermore, a large majority (65.4%, $n = 34$) incorrectly believed raw fish to be a nutritionally beneficial dietary source for cats, while only 5.7% ($n = 3$) correctly disagreed with this notion. This widespread misconception points to a critical lack of public awareness regarding thiaminase activity and its role in destroying thiamine.

Figure 4. Survey responses from Section B evaluating baseline public awareness of thiamine and its clinical relevance.



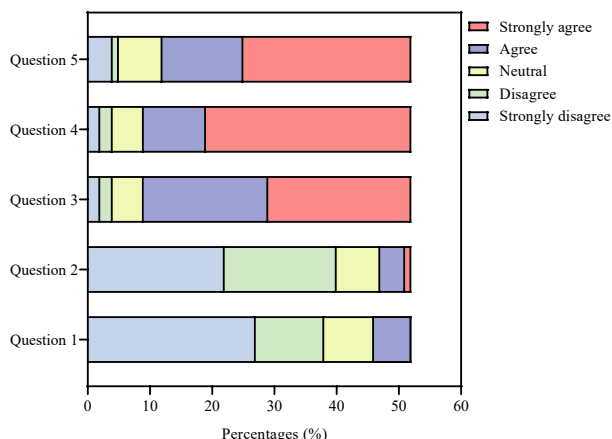
Question 1: Baseline Awareness ("Do you think there is enough public awareness surrounding thiamine requirements in cats?"); Question 2: Deficiency Consequences ("Are you aware of the health consequences of thiamine deficiency?"); Question 3: Neurological Impacts ("Are you aware of the neurological signs associated with a lack of thiamine?"); and Question 4: Dietary Importance ("Do you believe adequate thiamine intake is crucial for general feline well-being?").

Figure 5. Survey responses from Section C assessing owner understanding of thiamine dynamics in raw fish diets.



Question 1: Thermal Degradation ("Are you aware that cooking impacts the thiamine content of food?"); and Question 2: Raw Fish Suitability ("Do you think raw fish is a good dietary source of thiamine for cats?").

Figure 6. Survey responses from Section D detailing outlook and immediate questionnaire impact.



Question 1: Public Awareness Adequacy ("Do you feel current public awareness regarding thiamine is sufficient?"); Question 2: Workshop Attendance ("Have you ever attended a feline nutrition workshop or educational program?"); Question 3: Future Research Needs ("Do you agree that more research is needed on this topic?"); Question 4: Interest in Resources ("Would you be interested in receiving more educational resources about thiamine?"); and Question 5: Post-Survey Awareness Lift ("Are you now more aware of the importance of thiamine after completing this survey?").

Section D (Figure 6) assessed broader public awareness, educational engagement, and future interest regarding feline thiamine nutrition. Regarding broader public awareness, 73.1% ($n = 38$) of respondents categorized current outreach efforts as insufficient. This perceived gap aligns with actual educational participation, as 76.9% ($n = 40$) of participants reported never attending a feline nutrition workshop. To address these gaps, respondents strongly supported future research initiatives (82.7%, $n = 43$) and expressed an identical level of interest (82.7%, $n = 43$) in accessing future educational resources. Finally, completing the survey appeared to exert an immediate educational effect, with 76.9% ($n = 40$) of respondents indicating an increased awareness of thiamine's clinical importance post-survey. The outcomes of Section D highlight a critical unmet need for targeted veterinary outreach and scientific investigation regarding thiamine in feline nutrition. However, this sudden shift in post-survey awareness requires careful statistical interpretation before it can be viewed as a true educational outcome. While this high affirmative response rate points toward an immediate educational value derived from answering the survey items, several interpretive limitations must be noted. Given that this study utilized a cross-sectional design rather than a longitudinal or intervention-based framework, these metrics do not represent a verified long-term improvement in nutritional knowledge or permanent behavior change. Instead, this spike in self-reported awareness is highly indicative of survey-induced priming or immediate response bias, where the structural focus of the questionnaire temporarily heightens participant attentiveness to the subject matter.

Consequently, while these findings demonstrate that local pet owners are highly receptive to new clinical information, structured educational frameworks remain necessary to translate this immediate interest into sustained veterinary literacy.

DISCUSSION

The findings of this study demonstrate that a considerable proportion of cat owners in Ipoh, Malaysia possess limited awareness of the role of thiamine in feline nutrition. This observation is consistent with previous research reporting inadequate understanding of species-specific dietary requirements among pet owners, even in populations with relatively high formal education levels (Janke et al., 2021). While many owners express general concern for their cats' health, this concern does not always translate into informed nutritional decision-making, particularly regarding micronutrients such as thiamine, which are not immediately visible in their effects.

Cats fed raw or home-prepared diets appear to be at heightened risk of thiamine deficiency, especially when these diets include raw fish. The presence of thiaminase, an enzyme that actively degrades thiamine, is well documented in certain fish species (Kritikos et al., 2017). Without adequate heat treatment to inactivate thiaminase, repeated consumption of such fish can progressively deplete thiamine stores, potentially leading to neurological dysfunction. The persistence of misconceptions regarding raw fish as a nutritionally beneficial component of feline diets highlights a potential risk where traditional feeding beliefs conflict with evidence-based nutritional recommendations, though further research is required to quantify how often local owners actively offer raw fish to their pets.

A key contributor to this knowledge gap may be the low level of engagement in pet nutrition education. Many owners do not actively seek out educational programs unless their pets exhibit overt clinical signs, reflecting a reactive rather than preventive approach to animal health (Janke et al., 2021). The survey establishes that 76.9% of owners had never attended an educational program. Although the underlying drivers of non-participation were outside the scope of this survey, external veterinary literature suggests that factors such as time constraints, perceived inconvenience, and a lack of immediate, tangible benefits frequently discourage owner attendance (Janke et al., 2021). Future research utilising dedicated qualitative interviews is required to determine whether these specific structural barriers explain the low engagement rates observed within the Ipoh cohort. Furthermore, general literature indicates that communication challenges between veterinarians and pet owners frequently play a significant role, as nutritional discussions are often constrained by limited consultation time. Owners may rely more heavily on information from online sources, social media, or anecdotal advice. Unfortunately, such platforms can propagate inaccurate or oversimplified information, shaping owners' beliefs in ways that conflict with professional guidance (Alvarez et al., 2022; Wenzel et al.,

2024). When owners approach consultations with rigid viewpoints, their willingness to accept veterinary advice may be reduced, thereby weakening the impact of evidence-based recommendations. Furthermore, preventive nutrition advice is often undervalued when cats appear outwardly healthy. Thiamine deficiency can develop gradually, and early clinical signs may be subtle or nonspecific, leading owners to underestimate the importance of dietary compliance (Saunders et al., 2017; Downes et al., 2017; Knight et al., 2021; Prata, 2022). This tendency to equate visible wellness with nutritional adequacy poses a significant challenge to preventive veterinary care. Despite these gaps, the present study also revealed encouraging trends. While initial responses reflected limited baseline knowledge, later sections of the survey demonstrated increased interest, awareness, and willingness to engage with educational resources. This suggests that even brief exposure to structured information may positively influence owner perceptions and openness to learning. The survey itself may have functioned as a low-level educational intervention, highlighting the potential effectiveness of targeted, accessible awareness strategies.

Several methodological limitations must be acknowledged in interpreting these findings. First, the final sample size ($N = 52$) is relatively small, which limits the statistical power and generalizability of the findings to the broader population of cat owners in Ipoh or Malaysia as a whole. Second, because respondents were recruited partly through veterinary clinics and online pet platforms, a selection bias may exist, favouring owners who are already more proactive in pet care. Finally, as an exploratory cross-sectional survey utilising an originally developed tool, extensive statistical reliability metrics like factor analysis were beyond the scope of this baseline study. Future multi-centre studies utilizing larger, randomized cohorts across different geographic regions are warranted to validate these trends on a wider scale.

Based on these findings, the implementation of veterinarian-led educational initiatives in Ipoh, Malaysia is strongly recommended. Such programs should focus not only on thiamine deficiency but also on broader aspects of feline nutritional balance, emphasizing prevention, evidence-based feeding practices, and the risks associated with unverified dietary trends. By fostering clearer communication and improving nutritional literacy, these efforts have the potential to strengthen owner and veterinarian relationships, reduce preventable nutritional disorders, and enhance overall feline health within the community.

CONCLUSION

This study highlights a clear gap in awareness among cat owners in Ipoh, Malaysia regarding the importance of thiamine in feline nutrition, particularly in relation to dietary sources and preventive health practices. Despite general concern for pet well-being, many owners demonstrated limited understanding of species-specific nutritional needs, which may increase the risk of avoidable

thiamine deficiency, especially in cats fed raw or home-prepared diets. Misconceptions surrounding raw fish consumption and the underestimated significance of micronutrients underscore the need for more effective nutrition education. At the same time, the observed increase in interest and self-reported awareness during the survey suggests that cat owners are receptive to learning when information is presented in a clear and accessible manner. These findings emphasise the pivotal role of veterinarians in delivering evidence-based nutritional guidance and countering misinformation. Targeted educational initiatives that prioritize preventive nutrition and strengthen communication between veterinarians and pet owners may substantially improve nutritional literacy and feeding practices. Ultimately, improving awareness of thiamine and other essential nutrients is likely to contribute to better long-term health outcomes for domestic cats and reduce the incidence of preventable nutritional disorders. Future research directions should focus on expanding the geographic scope to multi-centre provincial evaluations and designing longitudinal, intervention-based educational campaigns to track measurable changes in pet owner feeding behaviours over time.

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CONFLICT OF INTEREST

None of the authors of this paper has any financial or personal relationship with other people or organisations that could inappropriately influence or bias the content of the paper.

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