*Original Article*

# Survey of Knowledge and Opinion among Thai Veterinarians on Nicotine Toxicity and Second-hand Smoke Effects on Pets' Health+

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*Abstract*

There may be lack of knowledge in nicotine toxicity and second-hand smoke (SHS) effects, as well as the opinion of pets' care among Thai veterinarians (vets). To examine knowledge, opinion of nicotine toxicity and SHS effects on dogs and cats' health in Thai vets. A cross-sectional survey was applied. Data were collected using the self-reported questionnaire. Cronbach's alpha for the knowledge and opinion questionnaire was 0.90 and 0.94, respectively. After MUCIRB approval, systematic sampling was applied to 371 Thai vets. Data were analyzed using descriptive statistics. Thai vets were 5.7 percents current smokers. The majority of them had moderate knowledge (mean = 5.51 ± 4.18) on nicotine toxicity and SHS effects on pets' health. More than half of them agreed that nicotine and SHS may be harmful to pets (mean = 53.41 ± 37.55), vets should act as a smoke-free role model (mean = 65.16 ± 40.11), and vets should protect pets from nicotine toxicity and SHS (mean = 70.25 ± 39.40) vets should be educated on the effects of nicotine and SHS exposure, and the guidelines for treating nicotine toxicity should be developed.

**Keywords:** Knowledge, Nicotine toxicity, Opinion, Second-hand smoke, Veterinarian

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## Introduction

Nicotine, one of the abundant components found in tobacco and cigarettes, has been generally known as a hazardous addictive substance. Several reports demonstrated that direct nicotine or SHS exposure is harmful to smokers' health, such as the respiratory system, cardiovascular, and joint impairment (Lewis *et al.*, 2017). Thereby, dogs and cats, who live in the same environment with those smoking owners, are in high risks of either direct, and/or indirect of nicotine toxicity (Milberger *et al.*, 2009). For example, pets may accidentally intoxicate cigarette butts, lick the electric cigarette liquid, and inhale the smokes from the blowout or the lit tobaccos. As a result, intoxicated pets may exhibit nicotinic toxicity such as oropharyngeal tissue damage, cancers, chronic bronchitis, bronchomalacia, and feline asthma (Reif *et al.*, 1992; Reif *et al.*, 1998; Bertone ER, *et al.*, 2002; Pérez *et al.*, 2014; Lin *et al.*, 2018; Lin *et al.*, 2020). Although both cats and dogs were affected by the SHS, there was no association between this factor and the clinical respiratory problems (Lin *et al.*, 2018). Moreover, the level of the air-pollution was not correlated with the severity of the clinical signs in the pets (Lin *et al.*, 2020). Indeed, cotinine levels in urine or nicotine concentration in dogs' hair may indicate the risk of environmental tobacco smoke (Bertone-Johnson *et al.*, 2008; Knottenbelt *et al.*, 2012). Nevertheless, it is still difficult to recognize the nicotinic toxicity in the pets.

Since the number of unidentified nicotinic toxicity and respiratory distress cases in client-owned pets have been gradually increased, SHS has been issued as one of the possible factors (Bertone- Johnson, *et al*, 2007; Coren, 2016; Campbell, 2017). According to the American Veterinary Medical Association, awareness of the pet owners on tobacco smoking is necessary to improve the pet's health (AVMA, 2020). A survey study has previously shown that this concern has motivated some owners to quit smoking (Milberger *et al.*, 2009). Therefore, client teaching and education by vets are crucial. Nowadays, the number of dogs and cats raised in Thailand has drastically increased (Office of the Permanent Secretary, 2018). However, Thai vets' aspects and opinions on nicotinic toxicity and SHS have never been investigated. Therefore, the current study aimed to survey knowledge and opinion of Thai vets.

## Materials and Methods

The cross-sectional survey-based design has been applied among vets who are taking care of dogs and cats in Thailand. There is a total of 9,383 vets registered under The Veterinary Council of Thailand. By using the sampling tool in accordance with Krejcie and Morgan (Krejcie and Morgan, 1970), Three hundred and seventy-one individuals were recruited in this study by systematic sampling.

***Data Collection, Questionnaires and the Protection of Human Right:*** The questionnaires were asking about the smoking history, knowledge and opinion of vets concerning nicotine toxicity or SHS on pets for 30 topics. The content validity of the questionnaires had been tested and clarified by 3 Vet experts. The reliability of the questionnaires had been certified after the researchers obtained an approval from the Institutional Review Board of Mahidol University (COA No. MUCIRB 2019/120.1807). The questionnaires on knowledge and opinion of nicotinic toxicity and SHS exposure had been preliminarily tested with similar samples of vets. The reliability coefficient was 0.90 and 0.94, respectively. The researchers performed systematic sampling as follow 1) vets from the small animal hospitals of Chiang Mai University, Chulalongkorn University, Kasetsart University, Khonkaen University, Mahanakorn University of Technology, and Mahidol University; and 2) vets from private small animal hospitals and clinics. The questionnaires were distributed during September 2019 to February 2020. Three hundred questionnaires were distributed at the first round. Total 151 questionnaires (50.33%) were responded after 2 months. The other three hundred questionnaires were repeated to send to target samples at the second round. Finally, total respondents were 371 (100.27%) vets in Thailand. The respondents were not required to mention their names and addresses while completing the questionnaire, and all personal health information was not collected; therefore, there was no identifiable data in this study. Data analysis: Smoking status, knowledge and opinion on nicotine toxicity or SHS scores of vets were analyzed by SPSSFW version 18 including average, standard deviation, frequency, and percentage.

## Results

Smoking status of the vets from table 1 represents smoking status of the vets. Only 21 vets were smokers (5.7 %). Nearly half of Thai vets understood and had the mean score of the overall knowledge about nicotine and SHS toxicity symptoms at only 5.51 (SD = 4.18) (Table 2).

Thai vets reflected their opinions on providing knowledge and advice for pets' owners to prohibit smoking while staying with their pets at 70.95%, followed by protecting pets from SHS at 70.25 percent. Additionally, they considered providing knowledge and advice for pet owners to not smoke in their homes where pets live at 67.51%. Nevertheless, providing recommendations on quit smoking procedures to pet owners who smoke and want to quit was found to have the lowest opinion at 46.28% (Table 3).

Approximately 34 vets who responded, only 29.4% (n = 10) of Thai vets completed a history taking on nicotine poisoning or SHS exposure from pet owners with only 35.3% (n = 12) Thai vets provided advice on SHS hazards to the pet owners. Other 32 - 33 vets feedback on pet protection in the aspects of SHS hazards on pets' health 48.5% (n = 16), steps to quit smoking for the owners 9.1% (n = 3), recommend prohibiting smoking when pets are nearby 39.4% (n = 13),

suggest not to smoke in the same house where their pets live 24.2% (n = 8), suggest preventing pets from accidentally exposed to nicotine poisoning by eating cigarettes butts or exposed to contact SHS 21.9% (n = 7), suggest not to smoke in the house or when staying near pets 21.2% (n = 7), provide first aids care knowledge in case of pets accidentally exposed to nicotinic toxicity 24.2% (n = 8), recommend observing nicotine poisoning symptoms in pets 15.2% (n = 5), recommend continuing care to keep pets safe from nicotine poisoning 12.1% (n = 4), and provide the nicotine antidote administration knowledge 3.0% (n = 1) (Table 4).

**Table 1** Statistical analysis showing the frequency, percentage, average, standard deviation, and range of smoking status

| Smoking status | | Frequency | Percentage |
|---|---|---|---|
| | Non-smoker | 347 | 94.3 |
| | Smoker | 21 | 5.7 |
| | **Total** | 368 | 100.0 |

**Table 2** Statistical analysis showing the frequency and percentage of knowledge among vets about nicotine poisoning or second-hand smoke by item and order by total score.

| Item No. | Knowledge about nicotine poisoning or second-hand smoke | Wrong | | Correct | | Order |
|---|---|---|---|---|---|---|
| | | Frequency | Percentage | Frequency | Percentage | |
| **1.** | May cause vomiting | 159 | 43.2 | 209 | 56.8 | 2 |
| **2.** | May cause shaking/shivering | 161 | 43.8 | 207 | 56.3 | 3 |
| **3.** | May cause disoriented | 175 | 47.7 | 192 | 52.3 | 4 |
| **4.** | May cause abnormal hearing | 283 | 77.5 | 82 | 22.5 | 13 |
| **5.** | May cause visual interference | 263 | 71.7 | 104 | 28.3 | 12 |
| **6.** | May cause death | 189 | 51.4 | 179 | 48.6 | 5 |
| **7.** | Cats have higher chance to get nicotine toxicity than dogs | 235 | 64.6 | 129 | 35.4 | 8 |
| **8.** | Pets which receive supportive treatment over 4 hrs. after been exposed to nicotine toxicity have a chance to survive | 243 | 66.8 | 121 | 33.2 | 11 |
| **9.** | Differential diagnoses from strychnine poisoning should be performed | 199 | 54.2 | 168 | 45.8 | 6 |
| **10.** | serum toxicity index in bloodstream should be tested | 205 | 55.9 | 162 | 44.1 | 7 |
| **11.** | Toxic absorbent medication should be provided orally | 240 | 65.4 | 127 | 34.6 | 9 |
| **12.** | Gastric acidosis should be addressed to prevent nicotine absorption | 246 | 67.0 | 121 | 33.0 | 10 |
| **13.** | Adequate fluids intake should be provided to eliminate nicotine via urination as soon as possible | 142 | 38.7 | 225 | 61.3 | 1 |
| | Total score 13 items | mean 5.51 ± 4.18 | | | | |

**Table 3** Statistical analysis showing the average value, standard deviation, and order of opinions about the roles of vets on nicotine poisoning or second-hand smoke exposure among dogs or cats.

| Item No. | Opinion: total disagree (0) – totally agree (100) | mean | Order |
|---|---|---|---|
| 1. | Should motivate pet owners to start quitting smoking | 56.37±38.09 | 7 |
| 2. | Pets in the home are more likely to get nicotine poisoning | 53.41±37.55 | 8 |
| 3. | Should protect pets from the dangers of second-hand smoke | 70.25±39.40 | 2 |
| 4. | Should educate and advise pet owners to prohibit smoking while staying with their pets | 70.95±38.42 | 1 |
| 5. | Education and advice should be given to pets' owners to not smoke in the home where their pets live | 67.51±39.31 | 3 |
| 6. | Should provide quit smoking advice/step to pet owners | 50.46±37.34 | 9 |
| 7. | Should play a role in promoting pets' health by educating nicotine hazards to pet owners | 63.17±39.44 | 5 |
| 8. | Should act as a role model by not smoking in front of pet owners | 65.16±40.11 | 4 |
| 9. | Should determine guidelines for non-smoking practice at home in homes with pets | 60.07±38.40 | 6 |
| 10. | Should recommend quitting smoking procedures to pet owners who smoke and want to quit smoking | 46.28±36.10 | 10 |
| Total opinion score of the 10 items | | 598.75±311.74 | |

**Table 4** Statistical analysis showing the frequency and percentage of veterinary practices for treating sick pets from nicotine poisoning or second-hand smoke exposure.

| Veterinary Practices | Classification | Frequency | Percentage |
|---|---|---|---|
| History taking | Never | 24 | 70.6 |
| | Ever | 10 | 29.4 |
| Advising about second-hand smoke hazards to pet owners | Never | 22 | 64.7 |
| | Ever | 12 | 35.3 |
| The advices given by the vets are as follows: | | | |
| 1. Advice on second-hand smoke hazards on pets' health | Never | 17 | 51.5 |
| | Ever | 16 | 48.5 |
| 2. Advice on how to quit smoking | Never | 30 | 90.9 |
| | Ever | 3 | 9.1 |
| 3. Recommend prohibiting smoking when pets are nearby | Never | 20 | 60.6 |
| | Ever | 13 | 39.4 |
| 4. Suggest not to smoke in the house where pets live | Never | 25 | 75.8 |
| | Ever | 8 | 24.2 |
| 5. Suggest preventing pets from accidentally exposed to nicotine poisoning by eating cigarettes butts or exposed to second-hand smoke | Never | 25 | 78.1 |
| | Ever | 7 | 21.9 |
| 6. Suggest not smoke in the house or when staying near pets | Never | 26 | 78.8 |
| | Ever | 7 | 21.2 |
| 7. Recommend observing nicotine poisoning symptoms in pets | Never | 28 | 84.8 |
| | Ever | 5 | 15.2 |
| 8. Provide first aids care knowledge in case of pets accidentally exposed to nicotine toxicity | Never | 25 | 75.8 |
| | Ever | 8 | 24.2 |
| 9. Recommend continuing care to keep pets safe from nicotine poisoning | Never | 29 | 87.9 |
| | Ever | 4 | 12.1 |
| 10. Provide nicotine antidote administration knowledge | Never | 32 | 97.0 |
| | Ever | 1 | 3.0 |

## *Discussion*

Vets' knowledge and opinions are one of the influential factors to reduce the risk of nicotine toxicity and SHS exposure in client-owned pets. This survey was the first study to reveal the awareness and aspects of vets associated with the toxicity in pets. The number of vets were proportionally closed to the distribution of the veterinary population currently operating in Thailand (Office of the Permanent Secretary, 2018). Although the vets included in the study was approximately average knowledge; however, the number of nicotine toxicity encounters was very low. Findings suggested that the incidence of this issue was rarely presented. Since there were no epidemiological studies on the prevalence of nicotine toxicity and SHS in Thailand's small animals; therefore, investigations on this topic are needed. According to our study, the most common cause of nicotine poisoning or SHS in Thai pets was via the inhalation of tobacco smokes from the pet owners or household members. There are few reasons explaining this issue. Firstly, due to the outbreak of the Coronavirus disease 2019 (COVID-19), the lock-down measure in Thailand mandatorily caused owners and their pets to spend more time together. Inevitably, the possibility of the SHS exposures were increased. This situation is consistent with the article from the New Hampshire website on the danger of pets suffering from SHS or third hand smoke during the outbreak of the COVID-19 virus (Liddell, 2020). Secondly, dogs and cats are more smell-sensitive than human species. Dogs contain around 125-300 million olfactory receptors, whereas humans possess only 5 million. Likewise, the smell senses in feline species are 14 times stronger than humans (Padodara and Jacob, 2014). Regarding these numbers of scent-detecting cells, the chances of smoke inhalation by those pets were high. These were supported by previous studies where 60% of pets living with owners who smoke have both oronasal and pulmonary cancers, as well as chronic bronchitis and asthma (Coren, 2016). Apart from the inhalation, accidental ingestion of tobacco butts was also noted from the study. Naturally, this commonly occurs in dogs and cats compared to other domestic animals (Novotny *et al.*, 2011). Since the reports of the butts ingestion in domestic animals, as well as wildlife, are rarely published; therefore, the prevalence of these issues is needed for further investigation. Additional research studies to confirm short-term and long-term adverse effects of nicotine poisoning, and SHS or third-hand smoke on pets should be conducted. This empirical evidence would enhance the importance and attention in detecting smoking related health issues in pets. Moreover, it could be an initiation point for pet owners to reduce, refrain, and retire smoking in order to keep their pets healthy and safe.

In this study, Thai vets have moderate knowledge about nicotine poisoning and the SHS exposure. The most corrected understandable items were fairly

chosen rightly, including the vomiting, shivering, and disorientated signs. Interestingly, nine out of thirteen questions were misunderstood by most of Thai vets. This survey indicated that Thai vets might not fully understand the nicotine harmfulness and SHS effect. This can be associated with the review of the Bachelor of Veterinary Teaching Program, which was offered in various Universities in Thailand. Evidence has shown that Vet students from this program were required to enroll only two credits in veterinary toxicology. Despite studying on pathophysiology of intoxicants, there was no specific data about nicotine poisoning and SHS harmfulness (Khon Kaen University, 2015; Walailuk University, 2018). We speculated that the inadequate information disregards students to have an in-depth knowledge on the dangers of nicotine or SHS, which is a rare case. In addition, most vets do not smoke in accordance with Table 1; thereby, the level of awareness on this issue was insignificant. Regarding the author's recommendation, we suggested that the addition of this issue in the veterinary science curriculum might provide insights of new generation vets to be able to correctly the clinical signs of nicotine intoxicated in animals. Additionally, knowledge development to gain more understanding on the dangers of nicotine and SHS exposure among vets should be advocated. This should be done on various occasions to keep current professional knowledge, cultivate a positive attitude, and create opportunities of paying attention to pet health issues caused by nicotine poisoning, SHS or third-hand smoke.

As previously described, one of the most meaningful procedures to lower the risk of SHS exposure was the client education by vets. These vets were good at inspiring and motivating pet owners to quit smoking or prevent it while living with their companion creatures. More than 50% of the vets had an optimistic attitude on their role in preventing nicotine toxicity and SHS. Favorably, only 46.28% of them recommended procedures for the owners to quit smoking. Therefore, vets should be encouraged to have the opportunity in providing knowledge about nicotine poisoning, SHS, and third-hand smoke impacts to pet owners, especially when administering health checkup and treatment. As in Thailand, there are guidelines for the medical management to cure tobacco-addicted syndrome (Thai Physicians Alliance against Tobacco, 2009), more attention should be paid on history taking on pets' health problems caused by nicotine poisoning, SHS or third-hand smoke exposure. Besides, the advancement of treatment skills among vets should be promoted. As can be seen in Table 2 and 3. The understanding of physical, behavioral, and environmental factors related to each animal, combining with history taking, physical examination, laboratory examinations, and nicotine poisoning/SHS exposure symptoms would provide guiding for differential diagnosis and allows vets to choose appropriate medical treatment for intoxicated pets (Becker, 2018). For this reason, vets need to maintain professional competence and promote professional skills by paying attention to recent research. More importantly, illness among dogs and cats should be closely monitored since they live closer to people than other animals.

Unfortunately, Thai vets participating in this study have medium to low levels of knowledge and understanding about nicotine and SHS toxicity. So that the health education program about smoking should be appropriately implemented among all vets. The education program would lead them in increasing potential for providing recommendations/treatment, helping pet owners change behavior, and promoting smoking reduction, exemption, and cessation. Furthermore, pet owners expect their vets to be a role model by not smoking. Whenever the vets could meet with pet owners, they should put more effort to recommend pet owners who smoke and share the same ambient with pets to beware of smoking. This suggestion should be provided regardless of the types of a cigarette (hand-rolled, factory-made, electronic, or any new forms of cigarettes) to protect their pets from SHS exposure since all types of cigarettes contain nicotine as the primary chemical.

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