



Knowledge of Employee about Zoonoses-Associated with Reptiles in a Business Units that Imports and Sells Exotic Reptiles in Indonesia

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Abstract | The growing popularity of exotic animals, particularly reptiles, as pets in Indonesia has been notable in recent years. Importing reptiles from countries with a history of reptile-borne zoonoses may potentially introduce pathogenic agents and facilitate their spread in Indonesia. The knowledge and awareness of importers and traders play a crucial role in mitigating the emergence of such potential risks. This research aimed to assess the level of knowledge among importers and sellers of reptiles concerning diseases that may be transmitted by these animals. A survey was conducted involving 113 employees working in reptile import and sales businesses all around Indonesia, utilizing the snowball sampling method. Data was collected through structured questionnaires administered during interviews. According to the research, most employees (63%) working in reptile import and sales industries have excellent knowledge about zoonoses-associated with imported reptiles, while about one-third (34%) have moderate knowledge, and a small fraction (4%) have poor knowledge. However, there are still misconceptions and gaps in understanding, particularly concerning transmission, waste handling, and prevention of zoonoses originating from reptiles. Therefore, efforts should be made to enhance the knowledge of zoonoses from reptiles among importers and reptile traders, aiming to prevent the transmission of zoonotic diseases from the reptiles being traded.

Keywords | Importation, Knowledge, Reptile, Trade, Zoonoses

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INTRODUCTION

The keeping of common pets inside homes has become widespread in many developed countries, including exotic animals, especially reptiles. The range of species kept as pets has expanded from traditional ones like dogs and cats to include unusual species such as rodents, rabbits, civets, birds, amphibians, reptiles, and ornamental fish (Stull et al., 2013; Damborg et al., 2015). The reptile population is estimated to exceed 9 million in European countries,

with over 1.3 million being kept as indoor pets (FEDIAF, 2021).

The hobby of exotic animal enthusiasts in Indonesia has also grown significantly in recent years, particularly among reptile enthusiasts. Like other animals, reptiles can host viruses, bacteria, fungi, and pathogenic parasites, some of which pose zoonotic concerns (Mitchell, 2011). Specifically, the bacterium *Salmonella* is the most common agent causing zoonotic infections due to its biological character-

istics and natural affinity for this host group (Corrente et al., 2017). Some initial studies even hypothesized that the origin of SARS-CoV-2, the causative agent of the COVID-19 pandemic, could be linked to snakes (Tiwari et al., 2020; Ji et al., 2020). Several surveys have also shown the presence of other enteric zoonotic pathogens such as *E. coli* O:157 and *Campylobacter* in cold-blooded reptiles (Dipinto et al., 2010). Snakes and other reptiles can also excrete pentastomid eggs, which, if ingested by humans, can lead to visceral larva migrans (Pantchev and Tappe, 2011). The conservation organizations, IUCN (International Union for Conservation of Nature) and CITES (Convention on International Trade in Endangered Species), have not been adequately socialized to the general public, and there is a lack of information about Indonesian reptiles (Juniarmi et al., 2014).

To date, there have been no reports or scientific publications on the existence of zoonoses in imported reptiles in Indonesia. Importing reptiles from various countries with a history of reptile-borne zoonoses could potentially introduce these pathogenic agents and spread them in Indonesia. Insufficient knowledge about zoonosis related to reptiles has led to a decrease in public awareness regarding the importance of physical checks and advanced examinations in entry and exit borders. This lack of knowledge has resulted in a high risk of entry and spreading of zoonoses-associated reptiles.

Knowledge is defined as memory of specific and general information, memory of methods or processes, and memory of patterns, arrangements, or conditions. Knowledge within the cognitive domain has six levels: knowing, understanding, applying, analyzing, synthesizing, and evaluating. Several factors influencing a person's knowledge level include education, information, culture, experience, and social status. Knowledge is the outcome of "knowing" after an individual has sensed a particular object. Sensing occurs through the human senses: vision, hearing, smell, taste, and touch. Most human knowledge is acquired through sight and hearing (Notoatmodjo, 2007). This research aims to assess the level of knowledge among importers and sellers of reptile pets regarding diseases that may be transmitted by these animals and to analyze the relationship between the individual characteristics of reptile importers and sellers in Indonesia and their knowledge of diseases that may be carried by reptiles.

MATERIALS AND METHODS

This research was conducted at the Animal Quarantine Facility (AQF) owned by importers who import reptiles through Soekarno Hatta Airport and the location of sellers who sell imported reptiles. Data collection and interviews

were conducted over five months (October 2022 - February 2023).

This research was carried out through surveys of importers and sellers of imported reptiles using a structured questionnaire that has been tested for validity and reliability to measure the respondent's level of knowledge. The variables used in this study are the characteristics and knowledge of importers and sellers of reptiles in Indonesia. Data collection was carried out through direct interviews.

The sample selection for this study was made by including all workers whose jobs involve contact with reptiles in business units that import and sell reptiles from importers who bring reptiles through Soekarno Hatta Airport as research respondents. A total of 113 respondents who work in reptile import and sales businesses all around Indonesia were interviewed. The sampling method used in this study was snowball sampling technique.

To measure the level of knowledge of the respondents, each question/statement was scored. Correct answers were given a score of 1, wrong answers and 'don't know' answers were given a score of 0. With a total of 18 questions/statements, the minimum knowledge score is 0, and the maximum score is 18. Based on the total score, the level of knowledge is grouped into 3 levels: poor, moderate, and good. The assessment of the level of knowledge is done by dividing the three differences between the maximum and minimum scores. The resulting divisions are then used as ranges to determine the categories of the level of knowledge (Sumitro, 2015). The data obtained was analyzed descriptively and presented in the form of tables and diagrams.

RESULTS AND DISCUSSION

Characteristics of the respondents observed as research variables include age, formal education, experience in keeping reptiles, and receiving training. The distribution of respondent characteristics is presented in Table 1.

From the data, it is known that most of the respondents are under 40 years old (69.9%), with the youngest respondent being 18 years old and the oldest being 54 years old. The information collected through the questionnaire allows several observations to be made to prove some risk factors related to the health and ethology aspects of reptile management. Most reptile owners are young (below 40 years old) and directly involved in caring for animals. However, there are risk groups in some households, such as children under 5 years old and the elderly. For this purpose, Association of Reptile and Amphibian Veterinarian (ARAV) recommendations emphasize the risk of contact between children and reptiles and suggest that families with children

Table 1: Characteristics of importers and sellers of imported reptiles through Soekarno Hatta Airport

Respondent Characteristics	Number of Respondents	%
Age		
Young (< 40 years old)	79	69,91
Old (> 40 years old)	34	30,09
Education:		
Low		
No formal education	0	0
Did not finish primary school	2	1,77
Primary school	3	2,65
Junior high school	18	15,93
High		
High school	38	33,63
University	52	46,02
Experience		
New (<1 year)	12	10,62
Moderate (1 - 5 years)	56	49,56
Long (>5 years)	45	39,82
Receiving Training		
No	102	90,27
Yes	11	9,73

-n under 5 years old should avoid contact with reptiles (ARAV 2016).

The respondents' education is categorized into low education, for respondents who have education from no schooling to junior high school, and high education, for respondents who have education from high school to university. From the collected data, it is known that the majority of low-education respondents are junior high school graduates (15.9%), while the majority of high-education respondents are university graduates (46.02%).

The experience of keeping reptiles for the respondents is categorized into three groups: new experience for respondents who have kept reptiles for less than 1 year, moderate experience for respondents who have kept reptiles for 1 - 5 years, and long experience for respondents who have kept reptiles for more than 5 years. A majority of those surveyed who own reptiles have a moderate level of experience, meaning they have been keeping reptiles for 1-5 years. Specifically, 56 individuals, or 49.5% fall into this category.

Most of the respondents also answered that they have never received special training about reptiles (90.2%), and only about 9.73% of people have attended special training about reptiles.

Based on the measurement results using the questionnaire,

the level of knowledge of importers and sellers of imported reptiles is presented in Figure 1. The data in Figure 1 shows that the majority (63%) of importers and sellers of imported reptiles have a good level of knowledge, even though most respondents have not received formal training on proper reptile care. Some (34%) have a moderate level of knowledge, and only 4% have a poor level of knowledge.

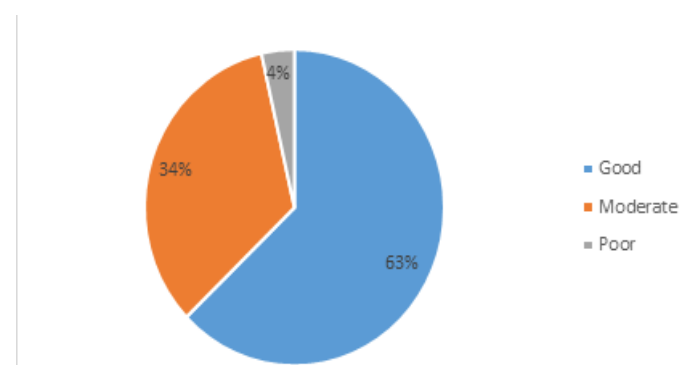


Figure 1: Knowledge level of importers and sellers of imported reptiles through Soekarno Hatta Airport

Figure 2 shows that respondents, in general (49.1%), already have knowledge about the transmission of diseases in maintained reptiles. However, there are still about 32.3% of respondents who do not know about the transmission of diseases in reptiles, and about 18.6% who still have incorrect knowledge. Knowledge about proper care is essential for importers and sellers of imported reptiles before they

sell them to consumers. The survey results show that about 84.1% already have correct knowledge about proper care for imported reptiles.

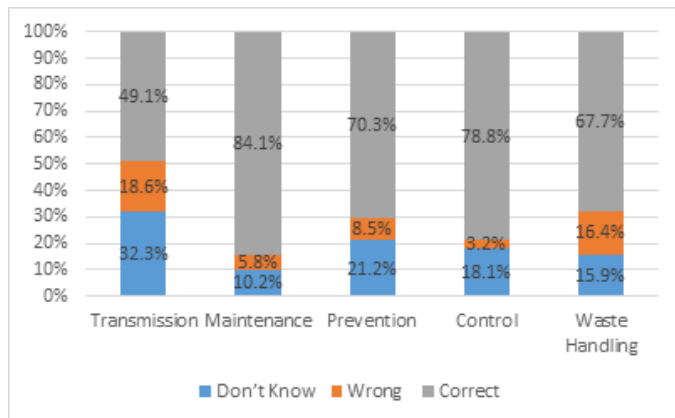


Figure 2: Specific knowledge level of importers and sellers of imported reptiles through Soekarno Hatta Airport

Regarding the aspect of disease transmission, sanitation and hygiene are essential factors in preventing and controlling pathogens, including zoonoses (CDC, 2013). This is a crucial requirement in the field of conservation and maintenance of reptile health, so that reptiles do not get sick, do not transmit diseases to other reptiles, and do not transmit diseases to traders or consumers.

In this study, it was found that many respondents still do not know about zoonoses, as seen from the answers to the questionnaire where most respondents still answered incorrectly or did not know that sick reptiles can transmit diseases to humans. A common example of zoonosis related to reptiles is Salmonellosis, reported that exposure to reptiles and amphibians is associated with approximately 74,000 *Salmonella* infections in humans every year in the United States (Mermin et al., 2004). Young children are at the highest risk of getting Salmonellosis related to reptiles. A study conducted in the UK showed that 27% of *Salmonella* spp. cases in children under 5 years old were related to reptiles (Murphy and Oshin, 2015). A study in Germany also showed that reptiles, especially bearded dragons (*Pogona vitticeps*), can shed various *Salmonella* serovars, including those isolated from infected children from studies on reptiles kept in households (Pees et al., 2013).

In terms of maintenance, proper maintenance is the most crucial factor in maintaining reptile health. Inadequate maintenance can lead to stress and diseases. Improper maintenance is the number one cause of diseases in reptile breeding and the subsequent reason for seeking treatment from reptile veterinarians. Nutrition, cage conditions, temperature, lighting, humidity, substrate, and other factors are all essential for the health of the maintained reptiles (Wilkinson, 2015).

In general, cages with a high animal density tend to increase the spillover of bacteria (Pees et al., 2013). Vertical transmission of *Salmonella* spp. in reptiles has been studied where the prevalence was higher in snakes than in lizards (Zajac et al., 2021). Most carrier animals were identified in bearded dragons (*Pogona vitticeps*) (Weiss et al., 2011). Interestingly, this species is very popular as a pet among reptile owners due to its calm and gentle nature. If this species shares a terrarium with other reptiles, they are significantly more exposed (at least twice) to *Salmonella* spp. infection compared to reptiles living alone in a cage. It is worth noting that in some pet households, dogs and cats are often found living with reptiles, including dangerous species such as snakes, posing an indirect risk of pathogen transmission (Corrente et al., 2017).

Keeping reptiles as pets often presents welfare issues for the animals. For example, metabolic bone disease associated with calcium deficiency is one of the most common and painful pathological conditions in pet reptiles. There are also many reptile diseases that can occur due to hyperthermia, such as burns due to heat or hypothermia due to improper heating (Benn et al., 2019; Schuppli et al., 2014). Other issues such as trauma can also occur in imported reptiles due to escape attempts, improper handling, and limited movement in inadequate enclosures (Grant et al., 2017).

Although recognizing signs of pain and distress in reptiles can be challenging, knowledge of pain recognition and diagnosis in reptiles must be clear enough to justify the diagnosis to protect the reptiles if they suffer from disease. This also has a direct impact on reptile management in breeding, as better understanding of their knowledge and welfare is essential to ensure the best quality of life for these animals (Learmonth, 2020; Lambert et al., 2019; Broom, 2016).

Respondents also need to have knowledge about disease prevention related to reptiles. This knowledge can help prevent the transmission of diseases in maintained reptiles. The survey results show that about 70.3% of respondents understand how to prevent diseases. Knowledge about disease control or health care for imported reptiles is also considered important. The survey results showed that about 78.8% of respondents have good knowledge about disease control.

In this study, many respondents did not use special clothing when in contact with reptiles or during cage-cleaning activities. Therefore, disease prevention through handwashing should be a concern. Handwashing with water alone is the minimum practice after contact with reptiles, and it is even better to wash hands with soap and/or disinfectant. Regarding handwashing practices after contact with pets,

it is known that the prevalence of *Salmonella* spp. is three times higher in animals handled by owners who are not accustomed to handwashing compared to pets cared for with good hygiene practices (CDC, 2022).

Isolation is a practice of separation or quarantine carried out to keep disease agents away from the host. In this case, knowledge of disease control is needed to keep imported reptiles as pets free from diseases and reduce the risk of transmitting diseases from other pets. According to the Republic of Indonesia Law No. 21 of 2019 on animal, fish, and plant quarantine, the quarantine period is about 14 days before the imported reptiles can be released from the Animal Quarantine Facility.

In this study, respondent's knowledge about selling sick reptiles that may not transmit diseases is still very low. Most of them answered that they can still sell sick reptiles because they believe it will not transmit diseases. This can actually cause disease transmission to reptiles or other animals at the buyer's location. This perception is due to the lack of knowledge about the relationship between wildlife and diseases, which can affect the perception of the risk of zoonotic diseases and hinder appropriate health-related behavioral changes (Li et al., 2021).

Knowledge about waste management is also important for importers and sellers of imported reptiles, as solid and liquid waste from reptiles can also become a means of spreading diseases to other animals or humans. The survey conducted showed that about 67.7% of respondents already have correct knowledge about waste management, while 16.4% still have incorrect knowledge, and 15.9% do not know about proper waste management.

Regarding knowledge of waste management, some importers and reptile sellers still do not know how to properly handle waste. Some believe that disposing of imported reptile waste into the sewer is allowed. In the audit of the feasibility of the Animal Quarantine Facility (AQF) by the Agricultural Quarantine Agency, the standard operating procedure (SOP) in waste management at AQF is an essential element that must be available and evaluated by auditors in establishing AQF, given that AQF waste can become a medium of disease transmission carried along with livestock traffic (Zainuddin et al., 2020). Therefore, good hygiene practices related to waste management are essential for preventing zoonoses or other diseases related to reptiles. Prevention should also be based on accurate information and explanations from professional veterinarians (Corrente et al., 2017).

Ultimately, to minimize the risk of zoonotic pathogen transmission anywhere, preventive actions through proper

sanitation must be done along with personal hygiene when handling reptiles, as well as providing suitable enclosures and isolating sick reptiles from healthy animals. Additionally, reptiles kept as pets need to be periodically checked for parasites and other pathogens, and appropriate quarantine measures should be taken to prevent diseases from entering healthy reptile populations. Public health officials should also update the statistics on reptile populations kept as pets to advocate for good care and hygiene policies (Mendoza-Roldan et al., 2020).

The knowledge of importers and sellers of imported reptiles appears to be related to their experience in reptile keeping. However, to determine specific levels of maintenance knowledge, education or training is still needed to convey information in detail. This information is divided into aspects of transmission, maintenance, prevention, control, and waste management. If there are still shortcomings in knowledge of this information, it will be the main focus of future education and training activities. Education by the government and reptile experts on disease transmission, prevention, and waste management in reptiles is also needed to increase awareness of importers and sellers of imported reptiles about diseases that may arise from the imported reptiles. This will prepare them to deal with new disease cases that may arise from imported reptiles.

CONCLUSION

The majority of importers and reptile sellers possess a comprehensive understanding of zoonoses associated with reptiles, encompassing aspects of transmission, husbandry, prevention, control, and waste management. Nevertheless, there are certain areas where misconceptions or lack of knowledge persist among importers and sellers, particularly concerning transmission, waste management, and prevention of zoonoses originating from reptiles. Therefore, targeted efforts should be undertaken to enhance the knowledge of zoonoses from reptiles among importers and reptile sellers, thereby effectively preventing the transmission of zoonotic diseases from the reptiles being traded.

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ETHICAL APPROVAL

Human Research Ethics Committee of the Bogor Agri-

cultural University, with regard to the protection of human rights and welfare in research involving human subjects, has carefully reviewed the research protocol entitled Number : 841/IT3.KEPMSM-IPB/SK/2023

CONFLICT OF INTEREST

We certify that there is no conflict of interest with any financial, personal, or other relationships with other people or organizations related to the material discussed in the manuscript.

NOVELTY STATEMENT

This is the first study in Indonesia that reports Knowledge of Employee about Zoonoses-Associated with Reptiles. This study will continue to reports about attitude and practices among the employee. The findings of this study can serve a valuable reference for the government in establishment some policies related to reptiles importation and it can provide useful information for future studies on specific animals or disease.

AUTHOR'S CONTRIBUTION

Kanda Yanuar Muhamad contributed to collecting data, data analysis, and preparing the original manuscript. Trioso Purnawarman and Chaerul Basri contributed to the study design, revised the manuscript, and supervised. All authors read and approved the final version of the manuscript in the present journal.

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