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Source: Tropical Conservation Science, 14(1)

Published By: SAGE Publishing

URL: <https://doi.org/10.1177/1940082920985755>


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The Use and Prescription of Pangolin in Traditional Vietnamese Medicine

Tropical Conservation Science
Volume 14: 1–13
© The Author(s) 2021
DOI: 10.1177/1940082920985755
journals.sagepub.com/home/trc


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Abstract

It is now acknowledged that demand stemming from traditional medicine stimulates a continued market for illegal wildlife trade globally. Increasing demand for pangolin fuels widespread unsustainable extraction and an illicit international trade that is threatening pangolin populations worldwide. Vietnam is an important transit country in this trafficking network and a significant consumer country, particularly due to their longstanding tradition of consuming wildlife products as traditional medicine. We conducted 51 semi-structured, questionnaire-based interviews with traditional Vietnamese medicine practitioners in Hanoi, Vietnam to explore the factors influencing their prescription of pangolin. The results show that traditional Vietnamese medicine practitioners are important drivers of pangolin use and that prescription continues despite prohibitive legislation. The main influencing factors were money, illegality (as a deterrent) and supply. Wealthier patients were more likely to use pangolin as medicine and patients generally trusted a doctor's prescription. Awareness of regulations related to pangolin use in traditional medicine was low and pangolin use continued without fear of the law. Lactation, abscesses and circulation were the most prescribed uses for pangolin scales. All respondents believed that pangolin can be substituted, however, a belief remained that substitutes are inferior to pangolin. This study provides a unique perspective of pangolin use in one of the main pangolin consumption countries in the world. The results suggest that the law is not being implemented effectively and that increased enforcement efforts are necessary. Furthermore, these insights serve to inform future demand-reduction campaigns whereby the most common uses and substitutes for pangolin scales may be targeted.

Keywords

pangolin, practitioners, traditional Vietnamese medicine, Vietnam, wildlife trade, scales, substitutes

Introduction

Ranked among the most lucrative illicit markets in the world (Barber-Meyer, 2010), illegal wildlife trade (IWT) is threatening some of the world's most vulnerable species (Broad et al., 2003). There has been renewed interest in wildlife trade due to the recent Covid-19 pandemic, which has highlighted wildlife trade as a potential source of zoonotic disease, and therefore, a threat to human health (Aguirre et al., 2020; Borsky et al., 2020). Contributing towards this trade is the use of wildlife products in traditional medicine (TM). Traditional medicines are sourced from animal, plant and mineral products, which when unsustainably harvested, can result in a significant decline in a variety of plant and animal populations, many of which are already threatened by other factors (Chen et al., 2016; Crudge et al., 2020; Theng et al., 2018; Van & Tap, 2008).

It has been suggested that the impact of TM on the conservation status of pangolin populations should be

seen as equally, if not more, important that the threats posed by anthropogenic factors (Alves & Rosa, 2005). Pangolins are recognised to currently be the most trafficked mammal in illegal wildlife trade (IWT) (Challender et al., 2015), with all 8 species of pangolin currently threatened with extinction (International Union for Conservation of Nature, 2020). Overexploitation combined with the additional anthropogenic pressures resulting from habitat loss and

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Received 29 August 2020; Accepted 14 December 2020

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alteration (Challender et al., 2014) has led pangolins to be grouped among the most threatened mammals in Asia (Davies, 2005). Trade remains extensive in spite of protections in the majority of their range countries (Challender et al., 2014) and despite all species being uplisted to Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in 2017 (CoP17).

Vietnam has become an important transit country in the international wildlife trafficking network in recent decades (Newton et al., 2008). It is a major hub for the global trade in pangolin and an important consumer country, with pangolin products widely available in the domestic market (Shairp et al., 2016). Growing affluence has stimulated increased demand for wildlife products, whilst improvements in infrastructure and stronger trade networks have facilitated better access to wildlife resources (Drury, 2009; World Bank, 2007). In response to this growing criminality, the Vietnamese government has recently strengthened their penal code with respect to wildlife crime. Penalties have increased from a maximum of seven years to 15 years prison sentence, with a fine of up to USD 86,000 from USD 21,500 (ENV, 2020). In force since January 1, 2018, the penal code has also added “possession” as a criminal offense, which closes a critical loophole that had previously permitted the issuance of mere fines for keeping endangered species and their derivatives (ENV, 2020). In 2019, the Vietnamese government updated and amended the list of endangered and rare species prioritised for protection through Decree 64/2019/ND-CP, which provides a higher priority of protection for pangolins under Vietnamese law. Unlike China where pangolin scale stockpiles can be legally prescribed at licensed hospitals and traditional Chinese medicines clinics (Xu et al., 2016), the use of pangolin and any derivatives is completely prohibited in Vietnam (Shairp et al., 2016). Another notable intervention was the removal of pangolin scales from the list of ingredients covered under state medical insurance in Vietnam, which has been in effect since May 2015 (Lowton, 2016), yet the effects of this removal are unknown.

Demand for pangolin in Vietnam, stems from its standing as a luxury food item in restaurants and its prominent role in traditional Vietnamese medicine (TVM) (Nash et al., 2016). Research on pangolin meat consumption revealed that it is considered to be both a delicacy in restaurants and a symbol of status (Drury, 2009; Shairp et al., 2016). Other forms of wildlife trade, including rhino horn and shark fin, have also been subject to such demand, and attempts to understand and stem this demand have been well-documented (Clarke et al., 2007; Dang Vu & Nielsen, 2018). However, little research has been conducted on pangolin use within TVM and consequently there is a dearth of knowledge

about the role that TVM plays in fuelling demand for pangolin.

TM dominates health care systems worldwide, with an estimated 80% of the populations of developing nations dependent upon TM for their healthcare requirements (Van & Tap, 2008). TM is gaining importance globally, as evidenced by its official recognition by the WTO in 2019. Furthermore, owing to the recent Covid-19 pandemic, TM has been suggested as a potential avenue for treatment, which has brought further global attention to this healthcare option (Ling, 2020; Yang et al., 2020). Vietnam shares many cultures and traditions with other countries in South East Asia, particularly with respect to the use of natural products as TM. There is a long history of wildlife consumption for medicinal use, with TVM regarded as being part of Vietnamese heritage and a form of complementary and alternative medicine alongside western medicine (Drury, 2009). In 2008, it was estimated that 75% of Vietnamese people used TVM as their primary source of health care (Van & Tap, 2008). The current health care system in Vietnam is split between state-run health care services and the private medical sector (Ladinsky et al., 2000), with TVM playing an important role in both (Woerdenbag et al., 2012). Both options are perceived to offer differing qualities of health care and thereby tend to attract patients of different income levels. State run hospitals are believed to provide a lower standard of care to patients, therefore, private clinics tend to attract wealthier patients seeking a higher standard of care (Thuan et al., 2008).

Increased popularity of TM brings increased exploitation of natural resources, which can be of concern if not sustainably harvested. Pangolin use in TM has long been believed to cure a variety of ailments and increase prosperity, among other benefits (Woerdenbag et al., 2012), especially the scales (Boakye et al., 2015). These beliefs hold particularly strong in Vietnam where it has driven an increase in pangolin exploitation in recent decades, which has been facilitated by ineffective enforcement, corruption and criminal activity (Challender & MacMillan, 2014; Van Song, 2008). Whilst Vietnam has made notable improvements to their law enforcement efforts by increasing convictions and penalties (ENV, 2020), organised crime networks continue to operate on an industrial scale despite national protections. During the period from 2016–2019, an estimated 206.4 tonnes of pangolin scales were intercepted and confiscated from 52 seizures globally. Vietnam was linked to almost 70% of these pangolin scale seizures, which amounted to 143.6 tonnes. Further analysis revealed an increase in trafficking at unprecedented levels, with nearly two-thirds of the tonnage seized, 132.1 tonnes, detected from 2018–2019. In 2019, the average weight of a single pangolin scale shipment was

6.2 tonnes, compared with 2.2 tonnes three years earlier (Prinsloo, 2020).

Owing to ineffective enforcement efforts, there is a growing acknowledgement that pangolin protection efforts will need to go beyond seizures and penalties (Challender & MacMillan, 2014). Priorities are now shifting towards demand reduction techniques such as social marketing and public education/awareness campaigns, which are deemed to be crucial for pangolin conservation programmes to be successful in China and Vietnam, as well as in the other range states (Challender & MacMillan, 2014; Zhang, 2008; Zhou et al., 2015). However, there has been little evidence of such strategies being successful in reducing demand thus far and evaluations of these strategies have pointed towards the need for more research into the drivers of demand so that more effective interventions can be achieved (Olmedo et al., 2018; Veríssimo et al., 2012). Previous demand reduction interventions in Vietnam have mainly targeted consumers of pangolin through awareness raising campaigns (WildAid, 2019), however, to our knowledge, there has not been a campaign to date that has targeted other possible drivers of pangolin consumption in TM, such as TM practitioners.

By prescribing medicine containing pangolin and promoting its medicinal qualities, TM practitioners are stimulating continued demand for pangolin products (Soewu & Ayodele, 2009). This study aims to explore the perspectives of TVM practitioners and assess their role in driving the continued use of pangolin in TVM. More specifically, we wish to identify their motivations and determine the main factors that are influencing their prescription of pangolin. We assess the impact of these factors on persisting pangolin demand in TVM and suggest possible mitigation strategies that may be successful in reducing demand.

Methods

Study Area

Hanoi, Vietnam was chosen as the study site for this research. In Vietnam, demand from urban centres has been recognised as a key driver for the overexploitation of wild animals (Drury, 2011). As the capital of Vietnam and the second largest city in the country, Hanoi is a core area for trade in pangolin and has an abundance of TVM hospitals and clinics for sampling. Vietnam has around 48 hospitals dedicated to TVM practices, over 240 TVM departments in other hospitals and over 9000 health centres licenced to practice TVM. This is in addition to the many unregistered practitioners throughout the country (Van & Tap, 2008).

Interviews

Semi-structured, questionnaire-based interviews were conducted with TVM practitioners in Hanoi between May and July 2018. This semi-structured style of interview was chosen to allow for flexibility in responses, providing room for respondents to elaborate and further explain their points (Newing et al., 2010). The duration of each interview was around 30 minutes. Interviews were conducted using a structured questionnaire (online Appendix 1 & 2) as a basis for eliciting data on key topics, leaving the opportunity for the researcher to follow up on responses, asking additional questions when deemed appropriate. The questionnaire consisted of a combination of closed and open answer questions and notes were taken of any additional information given. This provided a mixture of both qualitative and quantitative data for analysis. Respondents were initially asked a series of questions about their demographics (gender, age, education, years in practice etc.) followed by questions about the uses of pangolin in TVM, body parts used, possible substitutes and the wealth status of consumers. Remaining questions investigated the factors influencing pangolin prescription and practitioner awareness of existing regulations and protections.

Interviews were conducted in Vietnamese by native speakers, volunteering as translation assistants for the Vietnamese NGO WildAct. A training day was conducted to train all volunteers in the appropriate interview protocol. Mock interviews were conducted with the assistants to ensure that they understood the meaning of the questions and the possible responses. Furthermore, we clarified who our interviewees would be, and they were coached on the correct tone and level of formality required during the interview. All official interviews were conducted face-to-face, with the exception of one phone interview which took place due to logistical difficulties. Researchers and translators identified themselves as associates of The University of Vinh and explained that they were interested in studying the medicinal properties of pangolin and the kinds of ailments that it can be used to treat. Due to the sensitive nature of the topic, interviews could not be recorded, instead written notes were taken. Furthermore, respondents were given the option of meeting outside of their place of work in order to protect their anonymity.

Interviews were arranged with an initial 1 or 2 practitioners through connections of WildAct. Further respondents were identified through chain-referral sampling whereby respondents were asked for suggestions of other individuals that could be interviewed (Newing et al., 2010). Respondents included hospital doctors (HDs) from state-run hospitals and private TVM clinic doctors (PCs). Chain-referral sampling was deemed appropriate due to the need to focus on a particular

subgroup of specialists (TVM practitioners), the sensitivity of the research topic and the difficulties of obtaining interviews with practitioners without a reputable prior recommendation (Newing et al., 2010). All respondents were made aware that there was no obligation to provide any other names. Due to the sampling method used and the sample size obtained, results of this study are limited to the 51 respondents and cannot be seen to be representative of the wider TVM profession in Vietnam.

Data Analysis

Respondents were divided into two categories: Hospital Doctors or Private Clinic Doctors for analysis. All respondents were treated as independent HD or PC practitioners, irrespective of whether they practised at the same hospital or private clinic as other respondents. The data were collated and analysed using descriptive and inferential statistical tests with a mixture of Microsoft Excel (Microsoft Office Professional Plus) and SPSS (IBM SPSS Statistics 24) functions. The Fisher's exact test was used due to small sample sizes and the nominal nature of the data (Pallant, 2013). Owing to the semi-structured design of the study and the sensitivity of the topic, the number of responses varied between questions. Presented here are the response frequencies as percentages of the total number of responses for each question. Supplemental qualitative interview data were manually coded to examine key themes. The dominant themes were in relation to pangolin use, substitute use, factors influencing levels of prescription and practitioner awareness of regulations and protections.

Ethical Considerations

Research ethics approval was obtained from the Research and Ethics Committee of the School of Anthropology and Conservation, University of Kent. Research was carried out in association with the NGO WildAct and the University of Vinh in accordance with the research permits. Informed verbal consent was

obtained from each respondent before the interview and respondents could refuse to answer any question or end the interview at any point. Data collected were used only for the purposes of the study, and participants were assured of the confidentiality of their information.

Results

Responses were obtained from a total of 51 TVM practitioners, 34 Hospital doctors (HDs) and 17 Private Clinic Doctors (PCs). Not all HDs were willing to state their place of work, due to the sensitivity of the interview topic, therefore the total number of hospitals involved in unclear. However, based on confirmed responses, the 34 HDs practiced at a minimum of six different hospitals and the 17 PCs were each from different private clinics. All HDs prescribed western medicine as well as TVM, whereas only 35% ($n = 6$) of PCs prescribed any western medicine to their patients. The largest group of respondents were between the ages of 26–35 (41%). A third had been in practice for 0–5 years, however, the proportions of respondents were similar across all four categories for years in practice. In terms of gender, the majority were males (73%, $n = 37$) and the highest level of education achieved by most respondents was master's degree level (41%, $n = 21$) (online Appendix 3). Due to the sampling method use, these demographics are not representative of the TVM sector in Vietnam.

Uses for Pangolin

The majority of respondents (88%, $n = 43$) believed that scales were the only part of the pangolin used in TVM, with only 12% ($n = 6$) believing that other parts could be used. Only 4 body parts were mentioned: meat, stomach, gall bladder and bones (Table 1). The dominant use of scales was lactation (79%, $n = 38$) followed by "other" (60%, $n = 29$), abscesses (40%, $n = 19$), skin conditions (29%, $n = 14$), cancer (27%, $n = 13$), detox and rheumatism (23%, $n = 11$) and asthma (8%, $n = 4$) respectively (Table 1). The only "other" treatments mentioned by

Table 1. The Uses Reported by Traditional Vietnamese Medicine Practitioners for Particular Pangolin Body Parts in the Treatment of Specific Ailments.

Body parts	Ailments							
	Lactation	Skin conditions	Cancer	Detox	Rheumatism	Asthma	Abscesses	Other
Meat	2	2	1	0	0	0	0	2
Stomach	1	0	0	0	0	1	0	1
Gall bladder	0	0	0	1	0	0	0	0
Bones	0	0	0	0	0	0	0	1
Scales	38	14	13	11	11	4	19	29

Note. Other: Meat = health supplement (x2), Stomach = enhance male sexual organs, Bones = health supplement, Scales = See Table 2.

both HD and PC doctors were circulation and “nourishing” the blood (Table 2). These proved to be the most popular uses within the “other” category (55% (n = 16) and 17% (n = 5) respectively). However, it should be noted that more issues related to circulation were mentioned, such as inflammation (17%, n = 3), vascular diseases (11%, n = 2) and blood clotting (6%, n = 1) (Table 2). When compared against the 8 original use options, circulation (33%, n = 16) was the third most popular use for scales.

Opinions on the use of pangolin scales varied across the respondents but many spoke of its effectiveness and its superiority to substitutes: *‘Pangolin has a very strong effect- you can see the patient getting better day by day. Substitutes just aren’t as effective’* (PC1). Furthermore, another respondent shared their belief that *‘Pangolin scales are not like our nails, it is a good medicine’* (PC12). Upon further questioning, one respondent explained that the belief of its strength stems from the fact that *‘the scales protect the pangolin’* (HD24).

Conversely, there was also the opinion that pangolin scales should not be used because *‘people exaggerate its medicinal properties’* and that *‘people think that it cures cancer when it doesn’t’* (HD2). This was echoed by another respondent who believed that pangolin is not *‘...as incredible as people think it is...there are many other options that can be used’* (PC8). Further, there was the acknowledgement that there is no scientific evidence for any medicinal properties of pangolin scales: *‘The knowledge of how to use scale and the medicinal properties of pangolin comes from word of mouth, there are no clinical studies proving its effectiveness’* (PC4).

Substitutes

All respondents (n = 51) believed that pangolin scales could be substituted with other ingredients. The majority

(n = 45) said that they had offered their patients substitutes for pangolin and all of those that had offered substitutes said that their patients had accepted the offered treatment. An explanation for this was that patients have *‘trust in the doctor’s recommendations’* and *‘will accept substitutes if they are offered because they will use the medicine that is chosen by the doctor’* (HD14).

A total of 73 ingredients were mentioned as substitutes for pangolin scales (online Appendix 4), however, 51 of these substitutes were only mentioned by one respondent each. Further, acupuncture was mentioned three times and antibiotics was mentioned once, but these are not TVM ingredients that can be substituted for pangolin scales, so they have been excluded from further analyses. The Chinese rice paper plant *Tetrapanax papyrifer* was the most frequently mentioned substitute, followed by Indian lettuce *Lactuca indica*, dandelion *Taraxacum* spp., earthworm *Lumbricina* spp. and red sage *Salvia miltiorrhiza* respectively; their uses varied (Figure 1; Table 3). Of the 73 substitutes mentioned, “other” was the most cited use (41%, n = 75), followed by lactation (26%, n = 47) and detox (15%, n = 27) (online Appendix 4). Within the “other” category, two thirds of all mentions were circulation (67%, n = 50), followed by nourishing blood (15%, n = 11) and inflammation (5%, n = 4).

Although there was a belief by most that pangolin could be substituted, opinions on their effectiveness in comparison to pangolin scale varied. There was a dominant view that pangolin scale is difficult to substitute because it *‘cannot be substituted 100%’* by any one ingredient and that the choice of substitute/s is dependent upon the type of ailment in question: *‘Pangolin not only helps cure one symptom but it also strengthens other body parts, whereas the replacements only help cure a specific symptom’* (HD18).

Table 2. The Percentage of Mentions for Each Ailment Cited Under the “Other” Category of Pangolin Scale Uses.

“Other”	HD mentions	%	PC mentions	%	Total mentions	%
Circulation	7	38.9	9	81.8	16	55.2
Nourishing blood	2	11.1	3	27.3	5	17.2
Inflammation	3	16.7	0	0.0	3	10.3
Vascular disease	2	11.1	0	0.0	2	6.9
Antipyretic	1	5.6	0	0.0	1	3.5
Reducing infection	1	5.6	0	0.0	1	3.5
Blood clotting	1	5.6	0	0.0	1	3.5
Allergic reactions	1	5.6	0	0.0	1	3.5
Treat infertility	0	0.0	1	9.1	1	3.5
Reduce pain	0	0.0	1	9.1	1	3.5
Cooling the body	0	0.0	1	9.1	1	3.5
Weight loss	0	0.0	1	9.1	1	3.5
Acne	0	0.0	1	9.1	1	3.5
Herniated disks	0	0.0	1	9.1	1	3.5
Benign prostatic hyperplasia	0	0.0	1	9.1	1	3.5

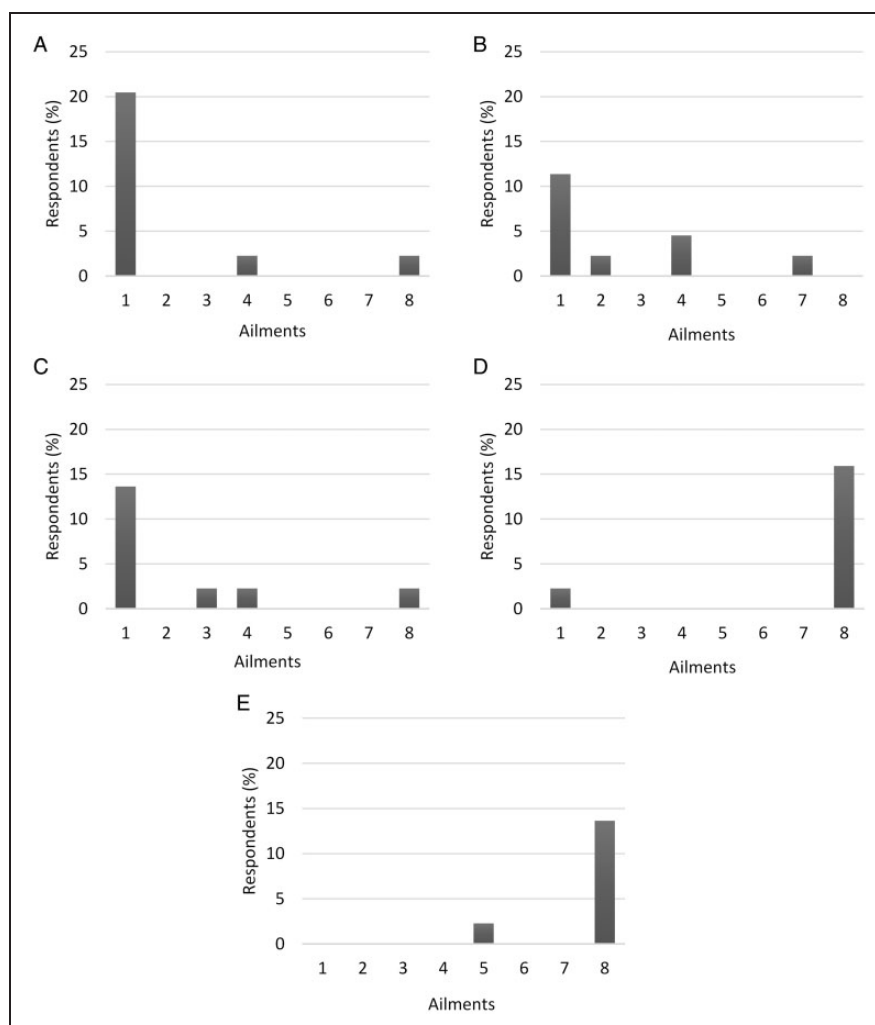


Figure 1. The Five Most Frequently Mentioned Substitutes and the Ailments That They can be Used to Treat, Illustrated as the Percentage of Respondents That Mentioned Each Ailment as a Use. (a) Chinese rice paper plant, (b) Indian lettuce, (c) dandelion, (d) earthworm, (e) red sage. 1 = lactation, 2 = skin conditions, 3 = cancer, 4 = detox, 5 = rheumatism, 6 = asthma, 7 = abscesses, 8 = other.

Table 3. The Number of Mentions of Each Ailment as a Use for the Most Frequently Mentioned Substitutes.

Substitute	Ailments								Total
	1	2	3	4	5	6	7	8	UR
Chinese rice paper plant <i>Tetrapanax papyrifer</i>	9	0	0	1	0	0	0	1	11
Indian lettuce <i>Lactuca indica</i>	5	1	0	2	0	0	1	0	9
Dandelion <i>Taraxacum</i> spp.	6	0	1	1	0	0	0	1	9
Earthworm <i>Lumbricina</i> spp.	1	0	0	0	0	0	0	7	8
Red sage <i>Salvia miltiorrhiza</i>	0	0	0	0	1	0	0	6	7
Safflower <i>Carthamus tinctorius</i>	1	0	0	1	0	0	1	5	8
Pigs nails <i>Sus</i> spp.	5	0	0	0	0	0	0	0	5
Leeches <i>Hirudinea</i> spp.	0	0	0	0	0	0	0	5	5
Job's Tears <i>Coix lacryma-jobi</i>	4	0	0	1	0	0	0	1	6
<i>Caesalpinia sappan</i> / <i>biancaea sappan</i>	0	0	0	0	0	0	0	4	4
Total	47	1	1	6	1	0	2	30	182

Note. 1 = Lactation, 2 = Skin Conditions, 3 = Cancer, 4 = Detox, 5 = Rheumatism, 6 = Asthma, 7 = Abscesses, 8 = Other.

Substitute choice appeared to be personal to each respondent. As mentioned, 51 substitutes were only mentioned once, so consensus about substitute use among the respondents was low. One respondent (PC9) even claimed that, upon pangolin becoming illegal, he had discovered 7 of his own substitutes that could cure 17 different conditions. However, he was unwilling to share these substitutes because they were 'his secret'. This suggests that there is an element of competition and secrecy among respondents, which further substantiates this lack of consensus.

Factors Influencing Pangolin Use in TVM

When asked if there is currently less prescription of pangolin than 10 years ago, 82% of respondents (n=40) agreed. However, only 19 of these respondents had been in practice for greater than 10 years, thus the remaining 21 responses would have been based on experience from both in and outside of TVM practice. Upon examination, the explanatory factor mentioned by most respondents (47%, n=17) was that pangolin is too expensive now (38% of HDs, n=10 and 64% of PCs, n=7). 43% of respondents (n=16) noted the illegality of pangolin use (35% of HDs, n=9 and 64% of PCs, n=7) and 38% of respondents (n=14) noted the low supply of pangolin (42% of HDs, n=11 and 27% of PCs, n=3), while 14% (n=5) cited factors in relation to pangolin conservation (15% of HDs, n=4 and 9% of PCs, n=1) and 11% (n=4) mentioned the existence of alternatives (12% of HDs, n=3 and 9% of PCs, n=1). Only 5% (n=2) implicated an increase in pangolin propaganda (8% of HDs) and 3% (n=1) mentioned the removal of pangolin treatments from state medical insurance coverage as a factor (4% of HDs) (Figure 2).

A large proportion of respondents (83%, n=40) believed that pangolin was prescribed because it is the

best treatment and not because a patient had requested it (17%, n=8). This was said to be due to a lack of awareness among patients about pangolin use: 'Doctors don't get the pressure from the patients because patients usually have no idea what they need for their symptom' (PC4). However, requests for pangolin scales do occur and there was an opinion that these requests generally came from wealthier patients.

Money as a Factor in the Use of Pangolin

Four respondents felt that there was more pangolin prescription today than 10 years ago. However, only one of these respondents had been in practice for more than 10 years. There was the suggestion that it is due to a greater wealth among the population: 'People have more money. They're more willing to spend more on treatments and give scales a try' (PC1). When asked 'Which income level is primarily responsible for requesting medicine containing pangolin?' respondents were offered the options of low income, medium income or highest income. 95% of respondents (n=36) believed that those with the highest incomes were responsible for requesting pangolin, followed by 39% (n=15) choosing middle income and 16% (n=6) choosing low income. Similarly, when asked 'To which income level is medicine containing pangolin primarily prescribed?' respondents were offered the same options as before and 95% (n=37) of respondents believed that pangolin is primarily prescribed to those with high incomes, followed by 38% (n=15) choosing middle income and 20% (n=8) choosing low income. A popular explanation was that 'rich people will request pangolin to show their wealth' (PC5) and that 'people with money will always go for the most expensive treatments' (HD5).

When asked about the possible effect of a price increase, 76% of respondents (n=35) thought that it

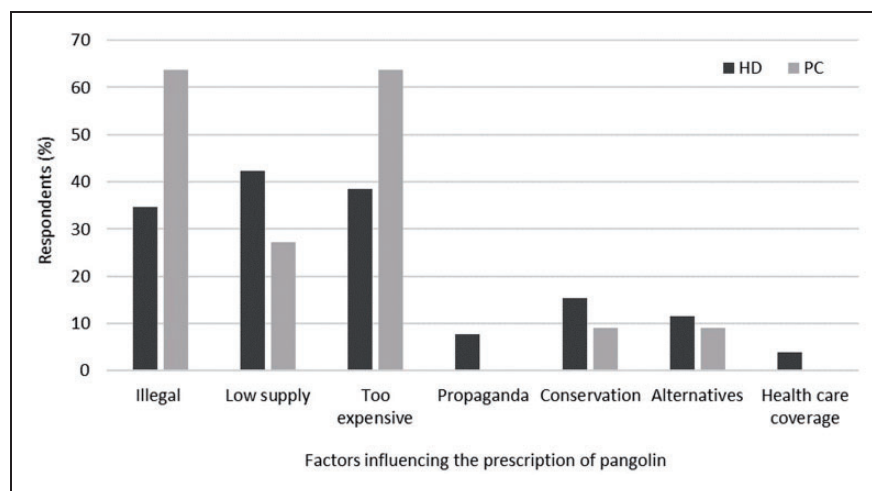


Figure 2. The Influencing Factors for Pangolin Prescription and the Percentage of HD and PC Respondents That Mentioned Each Factor.

would reduce the volume of prescriptions for pangolin. A significant relationship was found between the type of doctor and whether they believed that a price increase would reduce pangolin prescription (Fisher's exact test: $p = 0.024$). Most HDs (87%, $n = 26$) believed that there would be reduced prescription in comparison to 56% of PCs ($n = 9$). This would suggest that PC doctors are less likely to believe that a price increase would succeed in reducing prescription. This is reflected in explanations from PCs which suggest that any income group will find the money to purchase pangolin if deemed necessary: *'Even lower incomes will try and get pangolin scales if they think it will cure them'* (PC14).

The price of pangolin was also mentioned to be a driver for pangolin prescription because doctors know that they can charge more for treatments if they include pangolin among the ingredients: *'Doctors continue to prescribe it just to increase the price of the prescription- everything is about money. Patients will believe what their doctors recommend and not go against it'* (PC8). It was said that practitioners can *'triple the price of a dose by adding only 1 or 2 grams of pangolin'* (PC4) and that *'if they want high profits then they will add pangolin to increase the price of prescription'* (HD9). This belief was substantiated by a hospital doctor (HD12) who explained that their prescription of pangolin was *'only to kin and acquaintances'* because they will understand that she is *'not trying to exploit them'*. Furthermore, her prescription does not extend to hospital patients for fear that they might think that she is *'adding it to the prescription to get more money out of them'*.

Illegality and Awareness

Almost half of respondents (45%, $n = 22$) were not aware of any regulations for the use of pangolin in TVM. One respondent mentioned that they *'got an announcement document from the government saying that pangolin was banned'* (PC9), however this was the only respondent to mention a Government announcement. There were still many doctors, even within state-run hospitals, who were unaware of any regulations for the use of pangolin in TVM. Upon further questioning, a respondent told us that the *'Government has never told the hospital to stop using pangolin'* (HD15).

Conversely, 92% of respondents ($n = 46$) were aware of protections for pangolin species. Further exploration revealed that various forms of propaganda (TV, radio, internet and celebrity endorsements) had increased awareness amongst respondents. However, it was evident that awareness of the need to protect pangolins was not enough to deter their prescription of pangolin. For one respondent, he continued to use pangolin due to his perceived duties as a doctor: *'It is my job. Alternatives are not as good and I need to save peoples' lives'* (PC1).

He freely admitted to using pangolin, stating that he was out of pangolin but that he could show us scales if we came back the next week. With regards to supply, there was an opinion that pangolin is *'not hard to find'* or even *'easy'* to find, despite trade regulations. One respondent stated that he could call someone and have pangolin scales the next day. This is in contradiction to the 38% ($n = 14$) of respondents that mentioned low supply as a restriction to prescription (Figure 2).

It was clear that for many respondents, the law did not have an impact with regards to deterring their prescription of pangolin. Upon further exploration, this seemed to stem from poor implementation of the law: *'Law is not having much effect. If patients want pangolin then they will find the supply'* (HD21). In terms of government enforcement of the law, it did not seem to pose any real threat to practitioners: *'The government do not check clinics, they might check shops like on TM street but even then, if they find small amounts that's okay'* (PC14). Furthermore, there was the belief that private clinics were exceptions to the law: *'Large amounts in shops will get them into trouble but this is a private clinic so it's fine'* (PC1). A dominant view was that the law was being up kept more successfully in hospital environments and that private clinics continue to use pangolin without fear of repercussions: *'The Hospital environment is too risky to prescribe pangolin, but outside of hospitals no one would know and you can just hide it from view'* (PC4). However, it was not just private clinics that mentioned having pangolin scale supplies. A hospital doctor revealed to us that the *'law is allowing the hospital to use a certain amount of pangolin depending upon the severity of the disease'* and that she was *'allowed 6 g of pangolin per patient per day'* (HD21). Furthermore, a doctor from another hospital revealed that the government was giving seized scales to the hospital to use. This respondent was not aware of any regulation for the use of pangolin in TVM. There were *'no restrictions'* on the amount that they could prescribe but the respondent mentioned that there were often shortages of pangolin scale in the hospital supplies (HD15).

Removal From Healthcare Coverage

In 2015, pangolin scales were removed from the list of ingredients covered under state medical insurance (Lowton, 2016) and respondents were questioned about what impact they believed this had on the levels of pangolin prescription. Overall, 54% of respondents ($n = 25$) believed that the removal had succeeded in reducing pangolin prescription (68% of HDs ($n = 21$) and 27% of PCs ($n = 4$)). Around a third of respondents (30%; $n = 14$) thought that it had no impact and that the levels of prescription have stayed the same (19% of HDs ($n = 6$) and 53% of PCs ($n = 8$)) and 15% of respondents

($n=7$) had not noticed any clear trend. A significant relationship was found between doctor type and whether they believed that the removal had reduced pangolin prescription (Fisher's exact test: $p=0.012$). A much larger proportion of HDs (68%, $n=21$) believed that there was a resulting decrease in prescription in comparison to 27% ($n=4$) of PCs. This would suggest that PC doctors are less likely to believe that the removal had succeeded in reducing levels of prescription.

Practitioner Education

In terms of education, there was a strong opinion that lecturers no longer teach about the use of pangolin because it is illegal: *'Not all doctors know how to use pangolin scale. According to traditional textbooks, there are uses of pangolin scales but in modern teaching, pangolins are not talked about. Even if they can source it, they do not know what to do with it'* (PC4). However, respondents mentioned that pangolin scale use *'remains in TM books so the knowledge is still available'* (HD22). Furthermore, some respondents were also TVM university lecturers and stated that they do in fact still teach about pangolin use: *'I teach about the use of pangolin because it is the lecturer's responsibility to teach students everything about the history of TM. But I encourage them to be aware of the laws etc... what's on the list of allowed ingredients'* (HD12).

Discussion

This study serves as a baseline for understanding the motivations and perspectives of an understudied but very important group, practitioners of TVM. In light of the current global Covid-19 pandemic, it is important to note that this research was conducted prior to the emergence of SARS-CoV-2. As such the impact on pangolin use has yet to be determined. To our knowledge, this was the first study to focus on traditional medicine practitioners in Vietnam as drivers of pangolin use. Common uses and popular substitutes for pangolin scales have been highlighted and motivations for prescribing pangolin have been identified and explored. Our findings provide a unique perspective of pangolin use in one of the largest pangolin consumption countries in the world. These insights into the motivations and perspectives of TVM practitioners may inform future conservation initiatives, such as behavioural change interventions, whereby the strength of practitioner-driven demand may be reduced.

Uses and Substitutes

The suggested healing properties of pangolin scales continue to drive their use within TVM. The most popular uses for pangolin scales among practitioners were for

lactation, abscesses and circulation. Other body parts have been cited for use in African TM (Boakye et al., 2015; Soewu & Ayodele, 2009), however practitioners in Vietnam predominantly used scales, with few respondents having knowledge of uses for other body parts.

In terms of reducing pangolin scale prescription, there were a variety of possible substitutes mentioned. The development of alternative substitutes for pangolin has been suggested as a crucial element in suppressing demand in TM (Zhang, 2008). It appears that most respondents already used substitutes for pangolin to some degree, however, there remained a belief that substitutes are effective but still inferior to pangolin scales. A range of replacements have been tested against the medicinal effects of pangolin scales and, in these cases, have shown that the substitutes are as effective if not more effective than pangolin scales (Hou et al., 2000; Hsieh, 2005). Substitutes for the most prevalent uses of pangolin (lactation, abscesses and circulation) have been highlighted in this research. Our findings would suggest that these substitutes should be highlighted in efforts to encourage greater use of substitutes amongst practitioners, providing that the substitutes are themselves not threatened through the TM trade (Table 3). Improvements to the education and training of practitioners with regards to substitute use should be considered, however, research suggests that awareness raising/education does not have much success when used in isolation and thus, such strategies should incorporate other social, political and cultural forces in order to be impactful (Olmedo et al., 2018).

Money as a Factor

As pangolin populations decline, the value of pangolin in illegal trade is increasing at rates greater than inflation (Newton et al., 2008). Based on annual average wholesale price calculations for Vietnam, a kilogram of pangolin scales that cost USD 220 in 2017, cost USD 419 in 2019 (Prinsloo, 2020). Despite these high prices, the findings of this study would suggest that the prescription of pangolin scale may not be price sensitive. According to economic theory, increasing the price of a product relative to substitutes should reduce consumer demand for that product (Browning & Zupan, 1999). Based upon the question of whether a price increase would reduce pangolin prescription, the high proportion of respondents that believed this to be true would suggest that the prescription of pangolin is in line with this economic theory. However, further exploration revealed that the higher price would actually encourage prescription in some respects, with wealthy people choosing the most expensive and rare options. This would suggest that pangolin trade is subject to the anthropogenic Allee effect, whereby consumers will pay more for rarer species.

This creates a greater financial incentive for the exploitation of rare species, which then renders the species even rarer, and therefore, more desirable (Courchamp et al., 2006).

Our findings have also shown that, in dire situations, even low-income groups will find the money to buy pangolin to cure their illnesses. This has been echoed by other studies, which found that consumers of TM are willing to pay high prices for wild sourced animal products due to their perceived potency (Crudge et al., 2020; Dutton et al., 2011; Theng et al., 2018). Furthermore, our findings would suggest an element of inelasticity to the prescription of pangolin at its current price level, such that the quantity of pangolin consumed changes little with a proportionate increase in price (Challender & MacMillan, 2014). Moreover, this inelasticity may be influenced by the fact that practitioners are predominantly in control of prescription. If practitioners believe that consumers will pay what is needed to cure their disease, as reflected in this research, then price increases are not likely to impact their prescription of pangolin scales. Furthermore, increased prices and the subsequent increase in profits can be seen to incentivise pangolin prescription. This idea of profit driven demand has been reflected in previous research which reports that due to lack of regulation, private practitioners can “over-prescribe” medicines for increased profit (Nguyen, 2011).

The significant finding with regards to doctor type would suggest that HDs are more likely than PCs to think that an increase in price would succeed in reducing pangolin use in TVM. It could be expected that PCs would be less concerned by price due to their tendency to attract wealthier patients. The state-run health care service in Vietnam has been believed to have a lower standard of care, therefore, wealthier patients are more likely to visit private clinics where they believe that they will receive a more timely and personal quality of care (Thuan et al., 2008). Furthermore, if PCs are attracting wealthier patients then the rising price of pangolin would be less of an issue for their prescription. Conversely, state-run hospitals generally cater for the lower and middle classes and thus it could be suggested that an increase in the price of pangolin would reduce their patient's ability to afford a prescription for pangolin.

Research on the effectiveness of substitutes has pointed towards the need for a greater understanding of the impact of substitute price changes and how this may impact consumer choice (Broad & Burgess, 2016). However, given the apparent price inelasticity of pangolin use at its current price level, it is unclear to what extent price changes would impact pangolin demand in Vietnam.

Illegality as a Factor

This study has found that the use of pangolin in TVM remains common in Vietnam despite legislative protections. There are still practitioners that are not aware that pangolin use in TVM is illegal. Furthermore, there are practitioners that are aware of the law but continue to prescribe because the repercussions are not deemed worthy of deterring their prescription. If pangolin use is still occurring in state run hospitals and no action is being taken, then the law regarding pangolin use in TVM is not being implemented effectively. Moreover, the continued education about pangolin use in TVM universities has the potential to undermine the purpose of the law and the ease with which some doctors were able to obtain pangolin would suggest that supply is still available despite regulations. Previous studies have suggested that national legislation under Vietnamese Law is being undermined by ineffective enforcement (Challender & MacMillan, 2014; Crudge et al., 2020; Van Song, 2008) and in light of the results of this study, it would appear that this ineffective enforcement also extends to pangolin consumption within TVM.

Despite the acknowledgement that law enforcement alone is not sufficient to combat illegal trade (Challender & MacMillan, 2014), the results of this study would suggest that greater efforts need to be made to deter the prescription of pangolin through improved implementation of the law. Vietnam has made improvements to their law enforcement with regards to wildlife crime in recent years (ENV, 2020), however, this has mainly been evidenced by increased convictions and stricter penalties for scales seized at borders. Our findings would suggest that law enforcement efforts would benefit from increased auditing and inspections of hospitals and clinics to address this element of the illegal activity that is occurring within Vietnamese borders. In combination with increased enforcement efforts, the necessity to increase awareness about the illegality of pangolin use within TVM has also been highlighted by this study.

Practitioner Awareness and Continued Use

Previous studies have shown that an increased awareness of conservation issues can reduce the consumption of threatened wild animals (Liu et al., 2016; Wasser & Jiao, 2010). However, this research has indicated that respondents were aware of the need to conserve pangolins and yet continued to use pangolin regardless. This is reflected in previous research, which proposes that conservation awareness cannot be used in isolation to reduce demand through behavioural change (Lertzman & Baragona, 2016). This would suggest that conservation awareness initiatives alone would not be effective in

this scenario, and thus, demand reduction techniques will need to account for this consumer complexity in their strategies (Olmedo et al., 2018).

There was a mixed response and level of awareness amongst practitioners with regards to the removal of pangolin scales from state medical insurance coverage. The significant finding with regards to doctor type suggests that hospital doctors are more likely to believe that it succeeded in decreasing levels of prescription. This is not surprising, however, since state medical insurance does not extend to private clinics and consequently, most private clinic respondents were not even aware that it was removed from coverage. On the other hand, hospitals are state run, so they are more likely to be affected by changes to state medical insurance coverage. However, given our findings of government provision of seized scales to hospitals, there seems to still be prescription of pangolin scales in government hospitals despite this removal. This finding was only shared by 2 respondents, most probably due to the illegality and sensitivity of the topic, however, if such pangolin scale provision is occurring at two state run hospitals then it is potentially occurring on a wider scale.

Implications for Conservation

Limitations notwithstanding, this study makes valuable contributions towards the understanding of the demand for pangolin within TVM. Our findings are particularly timely given the attention that has been drawn to pangolin use in TM as a result of the current global Covid-19 pandemic. This research serves as a baseline of pangolin use in TVM prior to the pandemic, and therefore may assist in determining the scale of impact that Covid-19 has had on pangolin usage in TVM. A similar post Covid-19 survey would prove useful to assess if the use and prescription of pangolin has been impacted by the virus' emergence and the implication of wildlife trade, and pangolins, in the transmission route of the virus.

Our findings conclude that TVM practitioners are a considerable driver of pangolin consumption in TVM. We have found that the choice of pangolin treatment generally comes from the doctor and not the patient and thus it is actually the practitioners that are fuelling continued demand for pangolin in TVM more so than the consumers. However, previous research on practitioner-consumer dynamics has reported that the education and empowerment of consumers can mitigate the demand driven by practitioners (Nguyen, 2011). Therefore, we would suggest that demand-reduction campaigns with regards to TVM use should consider targeting practitioners, as well as consumers. Furthermore, when targeting consumers, our findings

indicate that consumers of high incomes would be a sensible demographic to target.

With such a strong consumer trust in the knowledge and advice of TVM practitioners, efforts should be made to increase awareness among practitioners and consumers about the illegality of pangolin use within TVM and the effectiveness of substitutes. Targeted campaigns can be used to address the most dominant uses of pangolin scales highlighted in this research (lactation, abscesses and circulation; Table 1) and popular substitutes (Figure 1; Table 3) may be promoted instead. Furthermore, previous research has suggested that improved regulation and surveillance from an authoritative body or an insurance body could help to decrease the power of this practitioner-driven demand in Vietnam (Nguyen, 2011). Therefore, increased enforcement measures, such as audits and inspections, accompanied by appropriate penalties, should complement any awareness-raising efforts for demand reduction. This is necessary in order to demonstrate to practitioners that there are serious repercussions for illegally prescribing pangolin to their patients. Given the prominence of pangolins in IWT and the abundance of other species threatened by use in TVM (Broad et al., 2003), insights into motivations and perspectives within the TVM trade, such as those presented here, may help inform future initiatives to manage demand for species threatened by TVM.

Acknowledgements

This research was funded by the School of Anthropology and Conservation at the University of Kent and WildAct. The authors would like to thank the volunteers from WildAct for assistance with translation and in-country logistics. The authors also thank Dr Dan Challender for discussions around the trade in pangolins.




Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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Supplemental Material

Supplemental material for this article is available online.

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