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ORIGINAL ARTICLE

Perceptions on Awareness, Knowledge and Confidence in Providing Information and Management of Snake-related Injuries by Medical Students in Sarawak, Malaysia

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ABSTRAK

Pertubuhan Kesihatan Sedunia (WHO) telah mengkategorikan kecederaan berkaitan dengan ular sebagai penyakit tropika terabai yang boleh menyebabkan kecacatan atau kematian jika tidak dirawat dengan segera dan tepat. Pelajar perubatan hanya didedahkan dengan pesakit gigitan ular semasa tahun klinikal dan bergantung kepada lokasi penempatan klinikal. Tujuan kajian ini dijalankan adalah untuk menentukan persepsi kesedaran, pengetahuan dan tahap keyakinan dalam kalangan pelajar perubatan untuk memberikan maklumat dan menguruskan kecederaan disebabkan gigitan ular. Kajian keratan lintang kuantitatif telah dirancang dan data dikumpulkan melalui borang soal selidik menggunakan skala Likert. Persepsi kesedaran, pengetahuan dan tahap keyakinan antara pelajar pra-klinikal dan klinikal diuji dengan menggunakan ujian-t sampel bebas. Nilai p≤ .05 diterjemahkan sebagai signifikan secara statistik. Analisa data menunjukkan perbezaan yang signifikan dari segi persepsi pengetahuan (p = .009) dan persepsi tahap keyakinan (p = .025) dalam kalangan pelajar klinikal dan pra-klinikal. Namun, tiada perbezaan ketara dari segi persepsi kesedaran (p> .05). Pelajar klinikal mempunyai persepsi pengetahuan dan tahap keyakinan yang lebih baik daripada pelajar pra-klinikal dalam memberikan maklumat dan menguruskan kecederaan yang berkaitan dengan ular. Kajian yang lebih mendalam harus dilaksanakan dalam kalangan pelajar perubatan di Malaysia. Langkah-langkah penambahbaikan harus dilaksanakan untuk memperkukuh pengetahuan dan tahap keyakinan pelajar

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perubatan dalam mengendalikan kecederaan yang melibatkan ular di Malaysia.

Kata kunci: gigitan ular, kajian keratan rentas, kurikulum perubatan, Malaysia

ABSTRACT

The World Health Organization (WHO) has categorised snake-related injuries as a neglected tropical disease which can cause permanent disability, or worse, can lead to death if not treated timely and appropriately. Medical students are exposed to snakebite patients predominantly in their clinical years and depending on the location of their medical postings. This study aimed to determine the perceived awareness, knowledge and confidence level of medical students in providing information and managing snake-related injuries. A quantitative cross-sectional study was designed and the data were collected using a Likert scale questionnaire. The perceived awareness, knowledge and confidence level between pre-clinical and clinical students were tested by an independent sample t-test. A p-value of $\leq .05$ was interpreted as statistically significant. Analysis revealed a statistically significant difference of perceived knowledge ($p= .009$) and perception of confidence level ($p= .025$) between clinical and pre-clinical students. However, no difference was found in terms of perceived awareness ($p> .05$). Clinical medical students have a better perception of knowledge and confidence level in providing information and managing snake-related injuries than pre-clinical students. An in-depth study on this topic should be conducted to include all medical students in Malaysia. Steps should be taken to improve the knowledge and confidence level of medical students in managing snake-related injuries in Malaysia.

Keywords: cross-sectional study, Malaysia, medical curriculum, snakebite

INTRODUCTION

Snake-related injury (SRI) declared by the World Health Organisation (WHO) as a neglected public health issue, especially in tropical and subtropical countries (World Health Organisation 2019). WHO reported that 4.5-5.4 million cases of SRIs occur annually worldwide, with fatalities recorded up to 137,880 (World Health Organisation 2019). In Asia, approximately two million snake envenomation cases occur annually; despite that, SRIs are most likely under-reported in Malaysia (Ismail 2015). Remote Envenomation and Consultancy Services (RECS) aims to provide consultation services for healthcare providers about the management of bites or stings due to envenomation as well as poisoning from naturally occurring toxins (Ismail 2014). SRIs is a medical emergency that may happen in rural and urban

settings. As venom is able to cause local and systemic complications, it can be detrimental and fatal if it is not removed or neutralised. (Ismail 2014).

According to Yap et al. (2014), encounters with cobras (*Elapidae* family) especially *Naja kaouthia* and *Naja sumatrana* predominantly contributed to snakebite cases in Malaysia. However, this does not mean that other indigenous species are not contributing to the numbers of SRIs in Malaysia. In 2017, the Ministry of Health, Malaysia (MOH) acknowledged the importance of identifying snake species in Malaysia for appropriate treatment and addressing the lack of data on snake-bites in Malaysia (Ministry of Health, Malaysia 2017).

Land snakes of medical significance found in Malaysia are divided into four families; (i) *Elapidae* (front-fanged snakes); (ii) *Viperidae* (retractable-front-fanged); (iii) *Colubridae* (rear-fanged); and (iv) *Pythonidae* (non-venomous and constricts prey) (Ismail et al. 2022). The venom delivery mechanism is categorised based on the snake's family. Duvernoy's gland is commonly found in rear-fanged snakes such as the *Colubridae,* while the venom gland is mainly found in the front-fanged snakes family which are the *Elapidae* and *Viperidae* (Bae et al. 2019; Rex 2017). The envenomation creates local and systemic manifestations. The respiratory and cardiovascular disturbances are caused by their neurotoxic, haemotoxic and cytotoxic properties (Casewell et al. 2020; Chaisakul et al. 2017; Rusmili et al. 2019).

For this reason, the outcome of a snakebite is strongly dependent on the snakebite victim's health-seeking behaviour and the appropriate treatment administered to avoid complications. Consequently, poor awareness of SRIs hampers pre-hospital care or emergency treatment (Pandey et al. 2016). The public's awareness in Malaysia has been initiated by RECS and the Malaysian Society on Toxinology (MST), but awareness among medical students remains vague (Tan et al. 2019). Sources of awareness and knowledge for medical students were based on medical textbooks and online resources (Subedi et al. 2018). No substantial research has been conducted to assess the Malaysian medical student's knowledge and management of SRIs.

Hence, this study aimed to determine the perception of awareness, knowledge and confidence level among Universiti Malaysia Sarawak (UNIMAS) medical students regarding the appropriate safety and health-seeking behaviour for SRI and to compare the differences in perception between pre-clinical and clinical students. The pre-clinical years in UNIMAS consisted of nine blocks i.e. Foundation Block, Man in The Environment, Blood and Immunology, Musculoskeletal and, Endocrine, Metabolism and Nutrition, Central Nervous System, Gastrointestinal System, Cardiovascular and Respiratory System, and Renal and Reproductive System. However, all blocks including Problem Based Learning (PBL) courses did not include SRI in the curriculum. On the other hand, clinical year students will be

posted in the hospital but there is no syllabus about SRIs. However, there is an Emergency Medicine posting where it is possible for the students to encounter SRIs cases. Besides addressing the perceived knowledge gap, this study allowed students to explore and generate interest toward the importance of health-seeking behaviour on the SRI and to seek appropriate knowledge regarding SRIs.

MATERIALS AND METHODS

Study Settings, Study Populations, Sample Sizes

A quantitative cross-sectional questionnaire study was conducted among pre-clinical and clinical medical students in the Faculty of Medicine and Health Science (FMHS), UNIMAS. The duration of the research carried out was from December 2020 to April 2021. All the registered medical students for 2020/2021 session were included as the study population. The students of non-medical courses, nursing, masters, PhD students in the medical faculty and those who did not consent were excluded from this study. This study utilised a random sampling method that involved medical students from Year-1 to year-5 in FMHS, UNIMAS. There were 437 clinical and 300 pre-clinical students enrolled for the 2020/2021 session. Based on Krejcie and Morgan (1970) formula, 169 out of 300 pre-clinical students and 205 out of 437 clinical students were necessary. A total of 474 samples were obtained from both pre-clinical and clinical medical students of FMHS, UNIMAS.

Data Collection Instruments and Procedures

Five consultants from RECS validated the questionnaire that was designed in English. It has five parts; students demographic data, perceived awareness, knowledge and confidence level in providing instruction for appropriate health-seeking behaviour of snake-bite-related injuries. Two questions were asked about the students' opinions on the inclusion of SRIs in the medical curriculum. A google form was developed to collect the data from the students. The researchers briefed the student that all the study details would be kept confidential and used only for research purposes. The findings would be presented or published anonymously in scientific meetings. The respondents were also informed that they had the right to withdraw their participation without any penalty. Before the actual survey, the questionnaire was pre-tested among the nursing students to ensure excellent internal consistency by calculating the Cronbach's alpha.

Measurements

'Perceived awareness of snake-bites and health-seeking behaviour' were measured by a nine-item Likert scale with five answer options; fully unaware, somewhat unaware, neutral, somewhat aware and fully aware. An item-wise mean was calculated, followed by a composite mean score to get overall awareness. The score

varies from 1 to 5, with a higher score indicated higher awareness.

'Perceived knowledge about the appropriate safety and health-seeking behaviour' for SRIs was measured using a ten-item Likert scale with five answer options. The answer options were strongly unknowledgeable, unknowledgeable, neutral, knowledgeable and strongly knowledgeable. Similar with previous indication, a higher score indicated excellent knowledge.

'Perceived confidence in providing service to SRIs' was measured by a ten-item Likert scale with five answer options. The answer options were strongly unconfident, unconfident, neutral, confident, and strongly confident. Item-wise mean score was calculated, followed by a composite mean score of confidence level. A higher score indicated excellent confidence.

Data Entry and Analysis

Data were directly stored in Microsoft Excel Office 2019 and then imported to IBM SPSS (IBM Corp., Armonk. NY, USA) for further analysis. An exploratory data analysis was done to determine the missing values and inconsistencies. For descriptive statistics, data for frequencies, percentages, means and standard deviations (SD) were reported. An independent sample t-test was done to determine the mean difference between pre-clinical and clinical students regarding perceived awareness knowledge and confidence level on SRIs. Before conducting the test, all the items were checked for normality. The analysis found that no items had more than +2 or -2 absolute skewness and kurtosis values (Hair et al. 2019; Kim 2013). As the sample size was large (n>300) and had no values exceeded +7 or -7, the parametric test of independent sample t-test was appropriate (Byrne 2013). Finally, a Spearman correlation was done to determine the association of perceived awareness, knowledge, confidence level of safety and health-seeking behaviour of SRIs with age, gender and year of study. The gender was dummy coded into '0' as female and '1' as male. We considered a p-value of $\leq$ .05 as statistically significant.

RESULTS

Students Demographic Data

Out of 736 registered medical students, 474 (64.4%) responded to the questionnaire (Table 1). There were 199 (42%) respondents from the pre-clinical years and 275 (58%) from the clinical years, with the majority being females (73.6%). The students' mean (SD) age was 21.64 (1.35) years ranging from 19 to 25 years with majority being between 21 to 22 years (44.3%).

Perceived Awareness on Appropriate Safety and Health-seeking Behaviour for SRIs

There was no significant difference between pre-clinical (Mean = 3.07, SD = 0.84) and clinical students (Mean = 3.21, SD = 0.04) students in the perception of awareness on the appropriate safety and health-seeking

Table 1: Characteristics of the students (N = 474)

Characteristics	Frequency	%	Statistics
Gender			
Male	125	26.4	
Female	349	73.6	
Age in years			
19 – 20	123	25.9	Mean=21.64 years SD=1.35 years Min, Max=19, 25 years
21 – 22	210	44.3	
23+	141	29.7	
Year of study			
Year 1	124	26.2	
Year 2	75	15.8	
Year 3	149	31.4	
Year 4	103	21.7	
Year 5	23	4.9	

behaviour for SRI (p> .05). However, the clinical students were more aware than pre-clinical students. The item-wise analysis revealed that there was a statistically significant mean difference between pre-clinical and clinical students in terms of the statements '*SRIs as a medical emergency', 'minimising SRI complications by using appropriate first aid (measures)' and 'the availability of anti-venoms for treating snakebite envenomation in Malaysia'* (p< .05). However, no significant difference in '*perception of awareness between the two groups of students in terms of the various emergency services for snakes and SRIs'*, '*the appropriate healthcare facilities that one should go to following SRIs'*, '*the status of snakes as one of the protected animals under the Malaysian Wildlife Act 716', 'RECS Malaysia', 'websites for verified information or source of reference for snakebite management in Malaysia and the International Snakebite Awareness Day (ISBAD)'* (p> .05) (Table 2).

Perception of Knowledge on Appropriate Safety and Health-seeking Behaviour for SRIs

Overall, the clinical students (Mean = 3.38, SD = 0.82) had a higher score of perceived knowledge on appropriate safety and health-seeking behaviour for SRIs than pre-clinical students (Mean = 3.17, SD = 0.88), and the mean difference was statistically significant (p< .01). Item-wise analysis revealed that the clinical students had better knowledge than pre-clinical students (Table 3).

Perceived Confidence Level in Providing Instructions on Appropriate Safety and Health-seeking Behaviour for SRIs

Data analysis revealed that the clinical students (Mean = 3.12, SD = 0.92) had a higher score of confidence level in providing instructions on appropriate safety and health-seeking behaviour for SRIs than pre-clinical students (Mean = 2.92, SD = 0.94), and the mean difference was statistically significant (p< .05). The item-wise analysis also showed a higher preponderance of

Table 2: Perceived awareness on appropriate safety and health-seeking behaviour for SRIs among pre-clinical and clinical students (N = 474)

Items	Pre-clinical			Clinical			p-value
	N	Mean	SD	N	Mean	SD	
SRI as a medical emergency.	199	4.13	1.04	275	4.36	0.91	.009**
Minimising SRI complications by using appropriate first aid (measures).	199	3.54	1.16	275	3.89	1.12	.001**
Various emergency services for snakes and SRI.	199	3.29	1.12	275	3.45	1.23	.128
Availability of anti-venoms for treating snakebite envenomation in Malaysia.	199	3.16	1.17	275	3.37	1.15	.048*
Appropriate healthcare facilities that one should go to after being bitten by snakes	199	3.41	1.16	275	3.55	1.15	.176
Snakes as one of the protected animals under the Malaysian Wildlife Act 716.	199	3.03	1.22	275	3.11	1.22	.488
RECS Malaysia.	199	2.33	1.20	275	2.41	1.26	.471
Websites for verified information or source of reference for snakebite management in Malaysia.	199	2.69	1.25	275	2.67	1.25	.858
ISBAD on 19th September.	199	2.14	1.22	275	2.13	1.19	.966
Overall Awareness	199	3.07	0.84	275	3.21	0.04	.067

*p<.05, **p<.01, ***p<.001; p-value obtained from independent sample t-test; SRI=Snake-related injury; ISBAD= International Snake Bite Awareness Day; RECS= Remote Envenomation and Consultancy Services

confidence level among the clinical students than the pre-clinical students (Table 4).

Correlation between Awareness, Confidence, Knowledge of SRI with Selected Characteristics of the Students

Perception of awareness was positively correlated with the perception of knowledge (r= .710, p< .001), confidence level (r= .662, p< .001), age (r= .092, p< .05) and the year of study (r= .103, p< .05). Similarly, the perception of knowledge was significantly associated with the perception of confidence level (r= .843, p< .001), age (r= .102, p< .05) and the year of study (= .115, p< .05). There was no association between gender and perception of knowledge. This indicated that perception of knowledge, awareness and confidence were intercorrelated (Table 5).

DISCUSSION

There was no significant difference between both groups of students in the perception of awareness on the appropriate safety and health-seeking

Table 3: Perceived knowledge on appropriate safety and health-seeking behaviour for SRIs among pre-clinical and clinical medical students (N = 474)

Items	Pre-clinical			Clinical			p-value
	N	Mean	SD	N	Mean	SD	
Performing basic life support to an individual who collapsed after SRIs.	199	2.87	1.19	275	3.19	1.209	.005**
Managing the wound following by SRIs.	199	2.97	1.22	275	3.31	1.170	.002**
Managing the affected eyes following by venom sprayed into the eyes (venom ophthalmia) of the patient.	199	2.46	1.27	275	2.79	1.312	.007**
Various snake species that can cause potential harm to humans in Malaysia.	199	3.01	1.25	275	3.26	1.25	.028*
Important information (history details) following by SRIs.	199	3.10	1.29	275	3.44	1.15	.003**
Types of protective clothing that one should wear against SRIs.	199	3.06	1.23	275	3.07	1.171	.901
Activating emergency response following SRIs.	199	3.95	1.07	275	4.12	0.974	.067
Immobilisation following by SRIs.	199	3.42	1.17	275	3.37	1.147	.693
Applying pressure bandaging following bySRIs.	199	3.39	1.27	275	3.53	1.191	.196
Where a SRIs victim should be brought to.	199	3.46	1.22	275	3.67	1.16	.061
Overall Knowledge	199	3.17	0.88	275	3.38	0.82	.009**

*p<.05, **p<.01, ***p<.001; p-value obtained from independent sample t-test; SRI=Snake-related injury

behaviour for SRI. The medical students were somewhat aware of significant differences in SRIs side effects, reduced with appropriate first aid measures (Ismail 2015). Next, most of the students were fully unaware of RECS, which may be due to a lack of exposure towards RECS existence, roles, seminars or activities conducted by RECS. The majority of the students were fully unaware of ISBAD due to a lack of exposure to it. ISBAD was established in 2018 by WHO to provide awareness on the prevention of snake-bites, reducing the risks and improved the first aid and treatment of snakebite patients (The Royal Society of Tropical Medicine & Hygiene 2018).

Clinical students had a better perception of knowledge compared to pre-clinical students. They perceived themselves better than the pre-clinical students in performing basic life support and pressure bandaging. This is consistent with Subedi et al. (2018) findings that more than 50% of clinical students understand the importance of pressure immobilisation bandages around the SRIs areas. Both groups of students had a low perceived knowledge on the management of venom ophthalmia, perhaps due to the rare occurrence (Agarwalla & Sahoo 2020; Praveen Kumar et al. 2015). Clinical students have higher perceived knowledge on history taking

Table 4: Perceived confidence level in providing instructions about the appropriate safety and health-seeking behaviour for SRIs among pre-clinical and clinical medical students (N = 474)

Items	Pre-clinical			Clinical			p-value
	N	Mean	SD	N	Mean	SD	
Activating emergency response following a SRIs.	199	3.14	1.19	275	3.37	1.24	.038*
How to perform limb immobilization/how to immobilize the affected limb.	199	2.66	1.17	275	2.91	1.15	.023*
How to manage the affected eyes after a snake venom has been sprayed into them (venom ophthalmia).	199	2.22	1.14	275	2.56	1.16	.002**
Providing appropriate information for the identification of the snake.	199	2.89	1.25	275	3.14	1.26	.031*
Providing important history details that needs to be obtained following SRIs.	199	3.06	1.27	275	3.38	1.18	.005**
Types of protective clothing that one should wear against SRI.	199	3.04	1.15	275	3.07	1.19	.766
Performing basic life support to an individual who collapsed after a SRIs.	199	2.86	1.15	275	3.05	1.22	.090
Applying pressure bandaging following SRIs.	199	3.11	1.18	275	3.23	1.16	.244
Managing the wound following SRI.	199	2.83	1.16	275	2.96	1.16	.225
Where one should be brought to following SRIs.	199	3.41	1.15	275	3.50	1.19	.432
Overall Confidence	199	2.92	0.94	275	3.12	0.92	.025*

*p<.05, **p<.01, ***p<.001; p-value obtained from independent sample t-test; SRI=Snake-related injury

regarding SRI cases as they were exposed to clinical settings compared to the preclinical students. This might due to their securing information and clinical reasoning (Furstenberg et al. 2020).

Clinical students have a better perception of confidence level compared to pre-clinical students. The medical students have a good perception of knowledge but lack confidence due to minimum

Table 5: Correlation matrix of awareness, confidence, knowledge of snakebite related injuries with selected characteristics of the students

	Awareness	Knowledge	Confidence	Gender	Age	Year of study
1. Awareness	-					
2. Knowledge	.710**	-				
3. Confidence	.662**	.843**	-			
4. Gender	-.079	-.043	-.018	-		
5. Age	.092*	.102*	.068	-.012	-	
6. Year of study	.103*	.115*	.082	-.012	.937**	-

*p<.05, **p<.01, ***p<.001; p-value obtained from Spearman Correlation test

exposure to SRIs and limited sources of knowledge (Fung et al. 2009). Clinical students had better perceived confidence level in performing basic life support and applying pressure bandaging following SRIs as they might have experienced it in clinical postings. Pre-clinical students had a lower confidence level in providing appropriate information to identify the snake species than clinical students. Singh and Kunal (2020) found that more than 60% of respondents (medical practitioners) wrongly identified non-venomous snakes as venomous.

There were several limitations encountered in this research. Firstly, the data collected was from one university, where the samples did not represent a national population, resulting in limited generalisability. Secondly, the targeted sample size was reached, however, a low response from clinical years students, especially Year 5 medical students, might result in biased findings. Thirdly, the medical students had no formal exposure to snakebite management as it was not adapted into the medical curriculum in UNIMAS.

CONCLUSION

The medical students still lack of knowledge, awareness and confidence in providing instructions on the appropriate safety and health-seeking behaviour for SRIs. However, the clinical students had better perception than the pre-clinical students. The observed difference may have been influenced by the exposure to SRI cases during clinical postings or through online media. However, there was no formal teaching session on snakebite management. In order to improve the confidence, knowledge and awareness level in managing SRIs, a comprehensive curriculum should be introduced in both pre-clinical and clinical years.

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REFERENCES

Agarwalla, S.K., Sahoo, S. 2020. A rare complication of snake bite. *J Med Sci Clin Res* **8**(6): 195-7.

Bae, W.G., Ko, H., So, J.Y., Yi, H., Lee, C.H., Lee, D.H., Ahn, Y., Lee, S.H., Lee, K., Jun, J., Kim, H.H., Jeon, N.L., Jung, W., Song, C.S., Kim, T., Kim, Y.C., Jeong, H.E. 2019. Snake fang-inspired stamping patch for transdermal delivery of liquid formulations. *Sci Transl Med* **11**(503): 3329.

Byrne, B.M. 2013. Structural equation modeling with Mplus: Basic concepts, applications, and programming. Routledge.

Casewell, N.R., Jackson, T.N.W., Laustsen, A.H., Sunagar, K. 2020. Causes and consequences of snake venom variation. *Trends Pharmacol Sci* **41**(8): 570-81.

Chaisakul, J., Rusmili, M.R., Hodgson, W.C., Hatthachote, P., Suwan, K., Inchan, A., Chanhome, L., Othman, I., Chootip, K. 2017. A pharmacological examination of

the cardiovascular effects of malayan krait (*Bungarus candidus*) Venoms. *Toxins (Basel)* **9**(4): 122.

Fung, H.T., Lam, S.K., Lam, K.K., Kam, C.W., Simpson, I.D. 2009. A survey of snakebite management knowledge amongst select physicians in Hong Kong and the implications for snakebite training. *Wilderness Environ Med* **20**(4): 364-70.

Furstenberg, S., Helm, T., Prediger, S., Kadmon, M., Berberat, P.O., Harendza, S. 2020. Assessing clinical reasoning in undergraduate medical students during history taking with an empirically derived scale for clinical reasoning indicators. *BMC Med Educ* **20**(1): 368.

Hair, J.F., Black, W.C., Babin, B.J., Anderson, R.E. 2019. Multivariate Data Analysis (8 ed.). Pearson Education Limited.

Ismail, A.K. 2014. Remote envenomation consultancy services. *Malaysian Society on Toxinology*. http://mstoxinology.blogspot.com/p/recs.html [5 April 2021]

Ismail, A.K. 2015. Snakebite and Envenomation Management in Malaysia. In *Clinical Toxinology in Asia Pacific and Africa*. Chapter 4. 1st edition. Edited by Gopalakrishnakone, P., Faiz, M.A., Fernando, R., Gnanathasan, C.A., Habib, A.G., Yang, C.C. Springer Netherlands; 71 - 102.

Ismail, A.K., Teo, E.W., Das, I., Vasaruchapong, T., Weinstein, S.A. 2022. Land Snakes of Medical Significance in Malaysia. 3rd Edition. Forest Research Institute Malaysia (FRIM), Malaysia; 87.

Kim, H.Y. 2013. Statistical notes for clinical researchers: assessing normal distribution (2) using skewness and kurtosis. *Restor Dent Endod* **38**(1): 52-4.

Krejcie, R.V., Morgan, D.W. 1970. Determining sample size for research activities. *Educ Psychol Meas* **30**: 607-10.

Ministry of Health Malaysia. 2017. *Guideline: Management of Snakebite*. Putrajaya.

Pandey, D.P., Subedi Pandey, G., Devkota, K., Goode, M. 2016. Public perceptions of snakes and snakebite management: implications for conservation and human health in southern Nepal. *J Ethnobiol Ethnomed* **12**(1): 22.

Praveen Kumar, K.V., Praveem Kumar, S., Kasturi, N., Ahuja, S. 2015. Ocular Manifestations of Venomous Snake Bite over a One-year Period in a Tertiary Care Hospital. *Korean J Ophthalmol* **29**(4): 256-62.

Rex, C. 2017. Front- and Rear-Fanged Snake Envenomation Systems. https://owlcation.com/stem/Front-and-Rear-fanged-Snake-Envenomation-Systems [12 April 2021]

Rusmili, M.R.A., Othman, I., Abidin, S.A.Z., Yusof, F.A., Ratanabanangkoon, K., Chanhome, L., Hodgson, W.C., Chaisakul, J. 2019. Variations in neurotoxicity and proteome profile of Malayan krait (*Bungarus candidus*) venoms. *PLoS One* **14** (12): e0227122.

Singh, M.A., Kunal, C. 2020. Awareness of Indian medical practitioners about snakebite and its management: Is there a need to re-evaluate medical training? *Medical J Dr. D.Y. Patil Vidyapeeth* **13**(5): 519-24.

Subedi, N., Paudel, I.S., Khadka, A., Shrestha, U., Mallik, V.B., Ankur, K.C. 2018. Knowledge of first aid methods and attitude about snake bite among medical students: a cross sectional observational study. *J Occup Med Toxicol* **13**: 26.

Tan, C., Safferi, R.S., Tan, K.Y., Ahmad Rusmili, M.A., AB Razak, M.R., Yap, M.K., Ismail, A.K. 2019. *Annual Newsletter of Malaysian Society on Toxinology (MST)*. http://mstoxinology.blogspot.my [5 April 2021]

The Royal Society of Tropical Medicine & Hygiene. 2018. *The first-ever International Snakebite Awareness Day*. The Royal Society of Tropical Medicine & Hygiene. https://rstmh.org/news-blog/news/the-first-ever-international-snakebite-awareness-day [19 Sept 2018]

World Health Organization. 2019. *Snakebite envenoming*. World Health Organization. https://www.who.int/news-room/fact-sheets/detail/snakebite-envenoming [5 April 2021]

Yap, M.K., Fung, S.Y., Tan, K.Y., Tan, N.H. 2014. Proteomic characterization of venom of the medically important Southeast Asian *Naja sumatrana* (Equatorial spitting cobra). *Acta Trop* **133**: 15-25.

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