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Knowledge, Attitude, and Practice on Blood Donation among Postgraduate Students of Advanced Medical and Dental Institute, Universiti Sains Malaysia

Abstract – **Introduction:** Donating blood voluntarily and repeatedly by healthy individuals can prevent shortages of blood products. This study aims to determine the knowledge, attitudes, and practices (KAP) on blood donation and their association with demographic factors among postgraduate students at AMDI, USM. **Methods:** A total of 118 postgraduate students had answered an online validated questionnaire in Google Form via the invitation links, which were distributed by email, WhatsApp messages, and QR codes printed on flyers. Both simple and multiple logistic analyses were used to perform statistical analysis. The analyzed results with a p-value of <0.05 were considered significant. **Results:** Participants in the study demonstrated good knowledge and positive attitudes towards blood donation. All items from the knowledge section received correct responses from 53.4% to 100% of participants, while all items from the attitude section received positive responses from at least 80% of participants. They showed good blood donation practices, as 69.5% of participants have donated blood. However, there was no significant association with the p-value more than 0.05 between demographic characteristics (gender, age, ethnicity, marital status, and academic courses) and KAP of blood donation. **Conclusion:** This study showed that postgraduate students at AMDI, USM have positive attitudes, good knowledge, and good practice regarding blood donation regardless of socio-demographics. Understanding factors influencing blood donation in a population is important for developing effective strategies to sustain blood supply. Future research should investigate additional factors that influence blood donation behaviour, such as motivation, barriers, and expectations.

Keywords – *Knowledge, attitude, practice, blood donation, KAP*

1   INTRODUCTION

Blood is being used in various types of diseases, resulting in constant blood supply essential to the support of the modern and advanced field of medicine. Patients with bone marrow and blood diseases like thalassaemia, aplastic anaemia, and leukaemia need regular blood transfusions. Various medical specialties, such as general surgery, neurosurgery, obstetric surgery, and orthopaedic surgery depend on the presence of blood supplies to carry out invasive procedures. Emergency scenarios can arise when patients experience severe bleeding and require large amounts of blood and blood products. This can be due to various reasons such as bleeding disorders, trauma, accidents, or surgical complications (1).

At present, despite more than 30 decades of effort the availability of an effective substitute for blood and artificially synthesised blood remains inaccessible (2). The closest function of red blood cells that they can replicate is that of synthetic oxygen carriers. Ideally, these artificial red blood cells are produced not only as a measure to ensure that the need for blood is always sufficient without having to rely on blood donation but also, hopefully, to reduce blood transfusion complications such as allergy reactions, alloantibody formation, and haemolytic transfusion reactions (3). If researchers and scientists have not succeeded in manufacturing artificial red blood cells that are free from safety and effectiveness difficulties, blood transfusion services will continue to rely primarily on blood donations and altruistic blood donors (2).

The donation of blood is the main source of blood and blood products. Donations of blood from a significant number of healthy people are required for a nation to be able to consistently meet the clinical demands for blood and blood products. The health care system of a nation is in jeopardy if it does not have access to an adequate and trustworthy source of blood donors (4). The foundation of a sustainable pool of blood donors is made up of voluntary donors who are well-informed and have committed themselves to donating blood regularly. This pool of donors can provide a supply of blood that is safe, reliable, and sufficient in all circumstances (5).

Pusat Perubatan USM Bertam (PPUSMB) is a medical centre under the governance of Advanced Medical and Dentistry Institute, Universiti Sains Malaysia (AMDI, USM) which serves patients that require blood transfusions for conditions such as thalassemia major, cancer, surgeries, trauma, primary immunodeficiencies and bleeding. Because of that, AMDI, USM's in-house blood transfusion service, follows WHO's recommendation and framework to do blood donation campaigns, processing of blood and blood components, and blood testing for their patients (6). So far, there are approximately 150 voluntary blood donors registered in its blood bank, which needs to be expanded to prevent shortages of blood supply in the future (7).

It is important to understand the characteristics of potential donors and recognized any concerns about blood donation to improve blood transfusion services at AMDI, USM. Postgraduate students are ideal participants for the study because they correspond to the WHO framework's recommendations. In order to obtain an in-depth understanding related to this study, the Knowledge, Attitude, and Practice (KAP) survey can be one of the mechanisms to achieve it. This kind of survey is conducted to gather information about people's knowledge, attitudes, and practices related to a specific topic (5).

The KAP survey provides researchers with valuable insights into the level of understanding, attitudes, and behaviours of a target population related to the study. The information collected through the survey helps identify gaps in knowledge, misconceptions, and areas where intervention or education may be needed. According to Andrade et al. (2020), there are a few steps in conducting a KAP survey, which are study design, question preparation, answer options, questionnaire scoring, and questionnaire validation. The design, execution, analysis, and interpretation of KAP surveys are straightforward (8).

There have been several studies in Malaysia on the KAP model study concerning blood donation (9–11). However, previous studies have been done in different areas, populations, and demographic characteristics. Thus, the aim of this study was to determine the level of knowledge, attitude and practice and its association with the socio-demographic characteristics of postgraduate students at AMDI, USM. The findings of this survey can be used to design targeted interventions, develop educational campaigns, or formulate policies that address the identified knowledge gaps and promote positive attitudes and behaviours among the surveyed population.

2   MATERIALS AND METHODS
2.1 Participants and Settings
This was a cross-sectional, institution-based study carried out in Advanced Medical and Dental Institute (AMDI), Universiti Sains Malaysia, Kepala Batas, Penang. As the inclusion criteria for this research were all registered postgraduate students at AMDI, USM who are residing in Malaysia. Students of Master of Medicine (Transfusion Medicine) at AMDI, USM were excluded from this study. A total of 118 postgraduate students at AMDI, USM participated and completed the questionnaire. This study was approved by the Human Research Ethics Committee (HREC) of USM with JEPeM code: USM/JEPeM/23010058.

2.2 Instrument
The validated questionnaire was wholly adopted from the original study by Zainal Abidin and Shet (2021) with permission from the author. The questionnaire was utilized in English, as the language is the medium of learning and teaching for postgraduate students at AMDI, USM. All participants answered an online self-administered and validated questionnaire in Google Form. They were invited to participate in the study via the invitation links, which were distributed by email, WhatsApp messages, and QR codes printed on flyers.

2.3 Sampling Techniques and Operational Definitions
The sample size was determined by taking the prevalence of participant who had good

knowledge about blood donation (53.3%) from a previous study using the single proportion formula (n=(z/Δ)² P(1-P)). Where, n = sample size, Z = the value to estimate the 95% confidence interval (1.96), Δ = absolute precision (0.1), P = anticipated population proportion (53.3%). The calculated sample size was as follows: (384.16 X 0.533 (1 - 0.533) = 96. By adding 20% response rate, the final sample size was 115 students.

Data were obtained from the respondents, which consisted of demographic information (age, gender, race, marital status, and courses), knowledge, attitude, and level of practice towards blood donation.

The operational definition was determined for the study. Good knowledge was defined by a minimum of five items from the knowledge section of the questionnaire gaining correct answers from 50% or more of the participants (9). Positive attitude was defined by a minimum of three statements from the attitude section of the questionnaire that received positive responses from 80% or more of the participants (9). Good practice was defined by a minimum of 50% or more of the participants having donated blood, regardless of the frequency of their donations (9,10,12).

2.4 Statistical Analysis

Statistical analysis was performed using SPSS version 27.0 for Windows. The demographic information was analyzed and presented using descriptive statistics. The frequency (n) will be expressed for the categorical data in percentages (%). Meanwhile, simple logistic regression and multiple logistic regression were used to analyze the significance of the association between each demographic factor and blood donation knowledge, attitude, and practice. Both simple and multiple logistic analyses were used to perform statistical analysis. The analyzed results with a p-value of <0.05 were considered significant.

3   RESULTS
3.1 Socio-Demographic Characteristics
Table 1 represents the distribution of the data collected for this study. A total of 118 students participated in this study, with more than half of the respondents recruited being female, amounting to 78 (66.1%), whereas only 40 (33.9%) were male. The mean (SD) for age reported was 32.14 (±5.53) years old, with 40 students (33.9%) being less than 30 years old

and the remaining 78 (66.1%) being more than 30 years old. Regarding race, Malays were the highest with 76 respondents (64.4%), followed by Chinese and Indians with 19 (16.1%) and 12 (10.2%) respondents, respectively. Also, there are four (3.4%) respondents identified as Bumiputeras and seven (5.9%) respondents as Others. Married respondents were reported at 63 (53.4%), and single respondents at 54 (45.8%). Only one respondent was divorced or widowed.

3.2 Knowledge, Attitudes, and Practices on Blood Donation
3.2.1 Knowledge on Blood Donation
Table 2 represents the outcome of knowledge among the participants, where the participants were assessed on their knowledge of blood donation based on ten statements. Overall, the participants had good knowledge regarding most aspects of blood donation. All 118 (100%) participants were aware that before donating, a donor should be in a stable condition with levels of blood pressure, temperature, pulse, and respiratory rates within the normal range. About 112 of the participants were well informed that all donated blood needs to be screened for diseases such as AIDS, Hepatitis B, and C before being given to patients, and 113 participants also correctly stated that pregnancy is not a limiting factor in donating blood.

However, knowledge about the amount of blood drawn for each donation, the correct age for donation, and numbers on how many times blood can be donated were the three statements reported to have the lowest percentage of correct answers by the respondents, ranging from 51.7% to 55.9%. The others recorded percentages between 68.6% and 74.6% on the corrected answer, especially on the weight of the donor, duration of donated red blood cells replacement, blood group receiver, and status of women who donate during their period.

3.2.2 Attitude Towards Blood Donation
In terms of attitude, respondents were asked questions that assessed the reason for positive or negative attitudes towards blood donation as shown in Table 3. A total of 116 (98.3%) of those polled stated that blood donation is a good practice. Furthermore, 103 (87.3%) respondents stated that they were willing to donate blood to anyone in urgent need. Despite most of the respondents' selfless acts of kindness, twelve

(10.2%) respondents felt that they would donate blood to people they knew, and ten (8.5%) respondents were willing to donate only if they were being reimbursed.

3.2.3 Practice on Blood Donation
In the aspect of blood donation practices, only 69.5% of the total respondents, or 82 people, have donated before. Out of 82 respondents, 7.3% reported donating once a year, 12.2% twice a year, 18.3% every three months, and more than half (62.2%) were not frequent blood donors. The respondents demonstrated a very good habit, with 77.1% to 80.5% stating that they donate blood willingly, not for money and not only for relatives, but also for others. Table 4 shows the data on the respondent's practice toward blood donation.

3.3 Relationship Between Socio-Demographic Characteristics with Knowledge, Attitudes, and Practices on Blood Donation
3.3.1 Socio-Demographic and Knowledge on Blood Donation
Table 5 shows the relationship between socio-demographic characteristics and knowledge of blood donation. The single linear regression analysis comparing the demographic factors of respondents with their level of knowledge (good and poor knowledge on blood donation) has found that none of them was significantly associated with the respondent's knowledge (p-value > 0.05). Therefore, no multiple logistic regression analysis was required.

3.3.2 Socio-Demographic and Attitude on Blood Donation
Table 6 shows the relationship between socio-demographic characteristics and attitudes on blood donation. It showed that none of the respondents' demographics was significantly associated with their attitude towards blood donation. By selecting eligible factors (marital status and courses of the respondents) with a p-value less than 0.25 to be included in the multiple logistic regression, marital status and courses of the respondents have indicated a non-significant outcome with a p-value recorded of more than 0.05.

3.3.3 Socio-Demographic and Practice on Blood Donation
Table 7 shows the relationship between socio-demographic characteristics and blood donation practice. The result indicated that none of the factors analyzed showed a p-value less than 0.05.

In single linear regression analysis, only the gender and courses of the respondents had a p-value less than 0.25, which was a clinical requirement for advanced multiple linear regression. However, the result showed no significant factors between gender and courses (p-value > 0.05) with the practice of the respondents on blood donations.

4. DISCUSSION
Healthcare providers are concerned about maintaining a sufficient and secure blood supply, particularly in light of the increased demand. Given that AMDI, USM possesses its own medical facility called Pusat Perubatan USM Bertam (PPUSMB), the institution needs to identify a pool of potential blood donors within its vicinity to mitigate the risk of insufficient blood supply. The study focuses on the knowledge, attitude, and practice of postgraduate students at AMDI, USM about blood donation. This study, to the best of our knowledge, is the first of its kind involving postgraduate students in this organisation to improve blood bank service in AMDI, USM and obtain a better understanding of the subject.

4.1 Knowledge of Postgraduate Students in AMDI, USM on Blood Donation
The knowledge component of the study was designed to determine whether postgraduate students at AMDI, USM are aware, informed, and capable of understanding certain instances of blood donation activities and processes. It can be acquired through study or experience, theoretically or practically, about the subject. Our study concluded that the participants had good knowledge of blood donation. This is based on the percentage of participants who answered the knowledge component's questions correctly, ranging from 51.7% to 100%, as shown in Table 2.

Our outcome was also reflected in two previous studies among health sciences students where they demonstrated good knowledge of blood donation (9,13). The reason is probably due to postgraduate students at AMDI, USM who are pursuing advanced degrees in medicine, medical-related sciences, and health sciences. These students may have been exposed to, studied, or come across any educational materials or lectures about blood, blood components, and its physiological role. Secondly, these students may have received promotional advertisements promoting blood donation that are distributed by the blood bank at AMDI's Medical Centre, namely Pusat Perubatan USM Bertam (PPUSMB) (6).

Table 1. Demographic characteristics among respondents

Socio-demographic Characteristics	Frequency (N=118) (%)
Gender	
• Male	40 (33.9)
• Female	78 (66.1)
Age (mean±SD*)	32.14 (±5.53)
Age group	
• <30 years	40 (33.9)
• ≥30 years	78 (66.1)
Ethnicity	
• Malay	76 (64.4)
• Chinese	19 (16.1)
• Indian	12 (10.2)
• Bumiputera	4 (3.4)
• Others	7 (5.9)
Courses	
• PhD	45 (38.1)
• MSc Mixed Mode	33 (28.0)
• MSc Research	23 (19.5)
• MMed	17 (14.4)

Table 2. Knowledge of the respondents on blood donation

Questions	Correct answer (N=118) (%)	Incorrect answer (N=118) (%)
1. Amount of blood drawn for each donation.	61 (51.7)	57 (48.3)
2. Correct age range for blood donation in Malaysia.	66 (55.9)	52 (44.1)
3. Minimum weight of donor.	81 (68.6)	37 (31.4)
4. Duration of donated red blood cells replacement in donor.	82 (69.5)	36 (30.5)
5. Frequency of blood can be donated by a person in a year.	63 (53.4)	55 (46.6)
6. Donated blood screened for AIDS, Hepatitis B and C before transfusion.	112 (94.9)	6 (5.1)
7. Can pregnant woman donate blood?	113 (95.8)	5 (4.2)
8. Which blood group can be received by all patients who need blood transfusion?	88 (74.6)	30 (25.4)
9. Can a woman donate blood during her period?	83 (70.3)	35 (29.7)
10. A potential donor should have a stable vital sign (blood pressure/temperature/pulse and respiratory rates) before donate blood.	118 (100.0)	0 (0)

Table 3. Attitude of the respondents on blood donation

Statements	Yes (N=118) (%)	No (N=118) (%)
Blood donation is a good habit	116 (98.3)	2 (1.7)
I am interested to donate blood only to the person I know	12 (10.2)	106 (89.8)
I want to donate blood only if I get paid for it	10 (8.5)	108 (91.5)
I am not willing to donate blood to anyone if emergency	15 (12.7)	103 (87.3)

Table 4. Practice of the respondents on blood donation

Questions	N (N=118)	Percentage (%)
Have you ever donated blood		
Yes	82	69.5
No	36	30.5
If yes, please specify:		
Once a year	6	7.3
Twice a year	10	12.2
Every three months	15	18.3
Not regular	51	62.2
Statements	**Yes (N=118) (%)**	**No (N=118) (%)**
I donated blood voluntarily	95 (80.5)	23 (19.5)
I donated blood not only for my relatives or friends	91 (77.1)	27 (22.9)
I donated blood not because of money reward	94 (79.7)	24 (20.3)

Table 5. Correlation between the score of knowledge, attitude, and practice on blood donation among respondents

Factor		Knowledge	Attitude	Practice
Knowledge	Pearson Correlation	1	-0.13	0.09
	Sig. (2-tailed)		0.161	0.334
	N		118	118
Attitude	Pearson Correlation	-0.13	1	-0.16
	Sig. (2-tailed)	0.161		0.080
	N	118		118
Practice	Pearson Correlation	0.09	-0.16	1
	Sig. (2-tailed)	0.334	0.080	
	N	118	118	

Table 6. Relationship between socio-demographic characteristics and knowledge of respondents on blood donation

Socio-demographic characteristics	Simple Logistic Regression			Multiple Logistic Regression		
	β	Crude OR (95% CI)	p-value	β	Adjusted OR (95% CI)	p-value
Gender						
Male	1					
Female	-0.46	0.63 (0.12,3.28)	0.585		-	
Age group						
<30 years	1					
>30 years	0.17	1.18 (0.27,5.23)	0.824		-	
Ethnicity						
Malay	1					
Non-Malay	-0.64	0.53 (0.13,2.23)	0.385		-	
Marital status						
Single	1					
Married/Divorced	-0.37	0.69 (0.16,3.05)	0.629		-	

[a]Hosmer-Lemeshow test (P-value=0.200), Classification table (overall correctly classified percentage=76.3%) and area under ROC curve (51.5%) were applied to check model fitness
[b]Hosmer-Lemeshow test (P-value=0.529), Classification table (overall correctly classified percentage=70%) and area under ROC curve (57.3%) were applied to check model fitness

Table 7. Relationship between socio-demographic characteristics and practice of the respondents on blood donation

Socio-demographic characteristics	Simple Logistic Regression			Multiple Logistic Regression		
	β	Crude OR (95% CI)	p-value	β	Adjusted OR (95% CI)	p-value
Gender						
Male	1					
Female	-0.60	0.55 (0.23,1.32)	0.179	0.60	1.83 (0.76,4.40)	0.178
Age group						
<30 years	1					
>30 years	-0.22	0.80 (0.35,1.87)	0.612		-	
Ethnicity						
Malay	1					
Non-Malay	0.14	1.15 (0.51,2.64)	0.734		-	
Marital status						
Single	1					
Married/Divorced	0.25	1.28 (0.58,2.80)	0.541		-	

Courses						
MMed		1				
Non-MMed	-0.06	0.94 (0.31,2.90)	0.224	-0.09	0.91 (0.29,2.84)	0.873

[a]Hosmer-Lemeshow test (*P*-value=0.200), Classification table (overall correctly classified percentage=76.3%) and area under ROC curve (51.5%) were applied to check model fitness
[b]Hosmer-Lemeshow test (*P*-value=0.529), Classification table (overall correctly classified percentage=70%) and area under ROC curve (57.3%) were applied to check model fitness

The promotional advertisements may contain informative material and knowledge related to blood donation. A study conducted among degree nursing students on the west coast of Peninsular Malaysia showed that their experience working in healthcare facilities involving patients who need transfusions of blood and blood components has automatically exposed them to the vast information about blood donation (13). Furthermore, a paper by Zainal Abidin et al. (2021) supported the idea that the respondents equipped with health-based science education have a better level of knowledge about blood donation than the non-medical and non-health sciences population (9).

However, our respondents showed a lack of knowledge regarding the volume of donated blood. The present observation is in accordance with that of an earlier documented work by Kabrah et al. (2022) (14). The probable reason is that the participants had a basic understanding of blood donation, including what it is and why blood donors need to be healthy but were less aware of the details of the blood collection process and procedure. This fact of knowledge had been discussed in a previous study that investigated knowledge as a motivating factor for blood donation (15).

The age range for regular blood donors is 17 to 65 years old. Only half of the participants knew the correct age range for blood donation. Mostly, the respondents were unable to determine the correct maximum age. A previous study by Govindasamy et al. (2019) demonstrated that only less than half of the respondents correctly answered the maximum age for donating blood (16). This is likely becausemost of them are aware that blood donors must be adults, but blood donors will continue to donate blood until they are being told to stop donating blood for any reasonbased on eligibility criteria, regardless of their age (17). The blood bank service should use social media to disseminate more information regarding eligible criteria such as age and the process of blood donation, such as the volume of donated blood. An update in knowledge will increase motivation for blood donation.

Regarding the association between socio-demographic factors and knowledge pertaining to blood donation, our investigation demonstrated that none of the factors, namely gender, age, ethnicity, or marital status, exhibit a statistically significant association with knowledge on blood donation. It has been reported that research conducted in West Ethiopia concluded similar findings despite both countries' differences in continent and socio-economic status (18). This analysis demonstrated that socio-demographic factors may influence knowledge does not apply to blood donation. The majority of participants know the significance of blood donation, and the only way to acquire blood is by donating it. Therefore, the finding is probably based on that rationale.

4.2 Attitude of Postgraduate Students in AMDI, USM on Blood Donation

Attitude is how a person perceives and feels about something or someone. It is also a person's tendency to react positively or negatively to an idea, object, person, or occasion. In the attitude component of this study, participants were asked about their perceptions of blood donation. Overall, it can be concluded that the participants in this current study have a positive attitude towards blood donation. However, the socio- demographic characteristics of the participants were not significantly associated with a positive attitude. A previous study had comparable findings on attitudes towards donating blood (19).

Experience with something can influence someone's attitude toward a situation. The likely reason for a positive attitude is that the participant might have had good experiences with blood donation in the past (20). About 69.5% of them had donated blood, as shown in Table 3. Many people who have never given blood believe that it can weaken the body, be a painful procedure because large needles are used, or be harmful since it may cause sickness following donation. They have proven their belief to be false by becoming blood

donors and will continue to be supporters of the blood donation campaign. This aspect has been explored since many years ago, when it was revealed that many blood donors felt a positive impact on their beliefs, pride, and feelings after blood donation (21). Besides that, they experienced good service and good facility at the donation site, which gave them a positive attitude towards their next blood donation. To support this statement, a meta-analysis study conducted by Bednall et al. (2013) identified experiences of blood donation and feeling satisfaction after blood donation as among the strongest factors influencing intentions for blood donation (22).

4.3 Practice of Postgraduate Students in AMDI, USM on Blood Donation

Practice is performing a certain action, procedure, or ritual continuously or frequently. Our study demonstrated that the participants have good practice towards blood donation as 69.5% are blood donors. However, there is no significant association between demographic characteristics and practice in blood donation. In contrast, several previous studies revealed that certain demographic characteristics were associated with the practice of blood donation (10,11).

Altruism is probably the reason for good practice in blood donation in this cohort. Altruism has been identified as one of the main motivation factors for blood donation (23). Someone who has studied and worked in medical and health-related fields and knows the importance of blood in saving lives might have pure altruism to help people who need blood without any rewards. Furthermore, the participants also showed their altruism, as more than 90% of them answered that they were willing to donate blood voluntarily to anyone in need, even during emergencies. This is most likely because they have a feeling of satisfaction about being able to help others or because they performed a heroic act by saving lives (21). Besides that, the other reason is that they acknowledge that the blood service in Malaysia promotes voluntary, non-remunerated blood donation (24).

Giving an incentive such as money can positively attract many people to donate blood. But on the negative side, incentives could make blood products less safe because some people may not declare if they have infections such as HIV, Hepatitis B, Hepatitis C, or Syphilis to get the reward for donating blood (25). In this current study, only a small percentage (20.3%) of the participants want to donate blood if money is given as a reward. The reason is probably that they know

some countries are offering money to blood donors, either for direct compensation or as an allowance for donation. A study in Germany discussed how they are practising money reimbursements for blood donation as a strategy to maintain the blood supply (26). However, in Malaysia, there is a non-monetary incentive given in the form of healthcare benefits to motivate consistent blood donations for regular blood donors who meet the specific criteria.

Regular or repeated blood donation is one of the strategies to have a sustainable blood stock (27). This current study found that 62.2% of the blood donors were not regular donors. This is probably due to time constraints that restrict their ability to donate blood. They are busy as a result of a hectic study schedule and are involved in time-consuming research projects. A previous study among nursing students mentioned a similar reason (13). The other reason they are not donating regularly is probably due to their experience with adverse donor reactions during previous donations, such as vasovagal reactions or hematoma. A blood donor can have symptoms like dizziness, fainting, vomiting, or seizures if they develop a vasovagal reaction during or after donation (27).

Furthermore, there is a possibility that most of them did not know the location of AMDI, USM's blood bank centre. The student research centre and blood bank centre are in two different buildings, and the distance between them is one kilometre. The blood bank should promote its location and organize a mobile blood donation campaign in the student research centre building to encourage them to donate blood more frequently. They should have given them the chance to donate blood, as a previous study mentioned that the possible reason for not giving blood was a lack of opportunity (9). A study in Malaysia suggested that mobile blood collection is one of the strategies to encourage people to donate blood (24). Another recent study suggested blood donation's promotion via mobile phone applications such as WhatsApp messaging are more effective to convey the information (28).

Non-blood donors in this study accounted for 30% of the participants. Several studies on a similar topic also documented a percentage of non-blood donors in their cohort, but for multiple reasons (10,29,30). The reasons they are not donating blood in this current study are likely due to having a medical illness or knowing that they do not fit the eligibility criteria for donation. A previous study among health professional students

revealed health reasons as the top reason for not being a blood donor (31). Being busy with studies, limiting their ability to go for blood donation can be a probable reason for not becoming a blood donor (10). A previous study also suggested the same reason (13). Even though they are involved in medical and health sciences education, fear of the needle or pain can also be a reason for not donating blood. The previous studies revealed that the participants stated that these factors hindered them from donating blood (11,30).

This research has several limitations. The questionnaire facilitates our comprehension of the knowledge, attitude, and practice that determine patterns of blood donation behaviour. We intended to examine the association between knowledge, attitude, and practice using the KAP model, but due to the cross-sectional nature of our study, we were only able to examine the correlation between these factors and not their causality. Other potential causes, such as barriers to donation, personal motives, psychosocial determinants, and social and cultural factors that may interact with and influence donor behaviour, are not investigated.

This study is a single-centre, cross-sectional study using purposive sampling limited to graduate students from an institute. While the design and sampling method appear to meet the objective of the study, it is important to highlight that the findings might not be representative of the entire adult population in the surrounding area.

Another limitation was that questions in the knowledge component only had "yes" and "no" answers. The participants can randomly guess the answer, although they don't know the real answer. Furthermore, to assess the level of knowledge, we did not use a scoring system. So, the level of knowledge was determined based on the frequency of the questions that received correct answers from at least 50% of the participants, not the score of the correct answers. More difficult questions should get higher marks for correct answers.

Future research should consider a qualitative approach to facilitate a better understanding of these potential factors. We propose a follow-up study using the structure equation model to investigate the causal relationship between blood donation and the potential factors.

Besides the qualitative approach, we also suggest another KAP model study that focuses on motivating factors and barriers to donating blood to prove the reasons behind the results of this current study. Besides that, large-scale studies with more field sites using random sampling may reflect more representative data and facilitate comparisons of knowledge, attitude, and practice towards blood donation.

Whenever designing future KAP studies, "I do not know" or "I am not sure" should be added to the questions with a "yes" or "no" answer. It will reduce the possibility of participants randomly guessing the answers. Then, a scoring system should be included in future research to evaluate the level of knowledge. With this, data on knowledge is easier to measure and can be measured more accurately.

5. CONCLUSION

This study concluded that postgraduate students exhibit positive attitudes as well as good knowledge and practice regarding blood donation, regardless of their demographic background. Identification and understanding of the knowledge, attitude, and practice of a population of blood donors and non-donors towards blood donation is important for creating effective marketing strategies to promote regular blood donation and maintain a sufficient blood supply. Future research is recommended to identify the multiple variables that influence blood donation behaviour. Various aspects can be explored, such as motivation factors, barriers, expectations, and the effectiveness of promotional strategies.

Ethics Approval and Consent to Participate
Ethical approval with JEPeM code: USM/JEPeM/23010058 was obtained from Human Research Ethics Committee (HREC) of Universiti Sains Malaysia.

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Not applicable.

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Authors' Contributions
IFH: Conceptualization, Supervision, Writing – review & editing.
IJAH: Conceptualization, Supervision, Writing – review & editing.

SMB: Data curation, Investigation, Formal analysis, Writing – original draft.
NA: Analysis.

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Abbreviations

AMDI	Advanced Medical and Dental Institute
COVID-19	Coronavirus Diseases 2019
FDA	Food and Drug Administration
HIV	Human Immunodeficiency Virus
HREC	Human Research Ethics Committee
IPPT	Institut Perubatan dan Pergigian Termaju
KAP	Knowledge, attitudes, and practices
MJMHS	Malaysian Journal of Medicine and Health Sciences
Mmed	Master of Medicine
MSc	Master of Sciences
NPRA	National Pharmaceutical Regulatory Agency
PhD	Doctor of Philosophy
SPSS	Statistical Package for the Social Sciences
WHO	World Health Organization
USM	Universiti Sains Malaysia

REFERENCES

[1] World Health Organization. Global Status Report on Blood Safety and Availability 2021 [Internet]. 2023 [cited 2023 Aug 7]. Available from: https://www.who.int/publications/i/item/9789240051683

[2] Haldar R, Gupta D, Chitranshi S, Singh MK, Sachan S. Artificial Blood: A Futuristic Dimension of Modern-Day Transfusion Sciences. Cardiovasc Hematol Agents Med Chem. 2019 Jun 17;17(1):11–6.

[3] Matsuhira T, Sakai H. Artificial oxygen carriers, from nanometer- to micrometer-sized particles, made of hemoglobin composites substituting for red blood cells. 2021.

[4] Torrado A, Barbosa-Póvoa A. Towards an Optimized and Sustainable Blood Supply Chain Network under Uncertainty: A Literature Review. Cleaner Logistics and Supply Chain. 2022 Mar 1;3.

[5] WHO and International Federation of Red Cross and Red Crescent Societies. Towards 100 % Voluntary Blood Donation a Global Framework for Action. World Health. 2010;123.

[6] PPUSMB USM. Pusat Perubatan USM Bertam [Internet]. [cited 2023 Aug 26]. Available from: https://ppusmb.usm.my

[7] Abd Aziz S. Institut Perubatan dan Pergigian Termaju. Bertam, Pulau Pinang; 2016 [cited 2023 Aug 7]. World Blood Donor Day: Everyone encourage to donate blood. Available from: https://www.amdi.usm.my/newshighlight-en/1098-world-blood-donor

[8] Andrade C, Menon V, Ameen S, Kumar Praharaj S. Designing and Conducting Knowledge, Attitude, and Practice Surveys in Psychiatry: Practical Guidance. Indian J Psychol Med. 2020 Sep 1;42(5):478–81.

[9] Zainal Abidin NI, Shet D. Knowledge, attitude, and practice towards blood donation among undergraduate students of health campus, universiti sains malaysia. The malaysian journal of nursing. 2021 jan 2;12(3).

[10] Farzana Binti Ayob N, Kankanamge Nilusha G, Abdul Moieed Ahsan Siddiqui B, Baskaran L, Abavanan M, Santhosh V, et al. Knowledge, attitude and practice towards voluntary blood donation among students from Quest International University, Malaysia. Quest International Journal of Medical and Health Sciences. 2022;5(1):6–12.

[11] Noh SM, Karim FA, Kambali MM, Fauzi HM. Knowledge and Attitude towards Blood Donation among Non-Blood Donor Residents of Kuala Terengganu at Hospital Sultanah Nur Zahirah, Kuala Terengganu. Vol. 15, Malaysian Journal of Medicine and Health Sciences. 2019.

[12] Gelaw Y, Zayede A, Wudie A, Aklilu A, Dawit R, Mekuria A, et al. Knowledge, attitude, and practice toward blood donation and transfusion and associated factors among the adult population of Gondar town. 2022; Available from: http://journals.lww.com/ajts

[13] Rosuzeita F. Knowledge, Attitude and Practice (KAP) Towards Blood Donation among E-pjj Degree Nursing Students. The malaysian journal of nursing. 2022 Jan;13(3):47–52.

[14] Kabrah SM, Aslam A, AlSubhi SA, Bakary W, Al-Khalofah M, Alghashmari LF, et al. Blood donation knowledge and attitude in the Kingdom of Saudi Arabia. Med Sci. 2022 Nov 23;26(129):1–9.

[15] Klinkenberg EF, Huis in 't Veld EMJ, de Wit PD, de Kort WLAM, Fransen MP. Barriers and motivators of Ghanaian and African-Surinamese migrants to donate blood. Health Soc Care Community. 2019 May 1;27(3):748–56.

[16] Govindasamy V, Sivasankaran D, Purushothaman V. Knowledge, attitude, and practice regarding blood donation among medical students of Tamil Nadu- a cross sectional study. Int J Community Med Public Health. 2019 Sep 26;6(10):4583.

[17] Davison TE, Masser BM, Thorpe R. Growing evidence supports healthy older people continuing to donate blood into later life. Vol. 59, Transfusion. Blackwell Publishing Inc.; 2019. p. 1166–70.

[18] Melku M, Asrie F, Shiferaw E, Woldu B, Yihunew Y, Asmelash D, et al. Knowledge, Attitude and Practice Regarding Blood Donation among Graduating Undergraduate Health Science Students at the University of Gondar, Northwest Ethiopia. Ethiop J Health Sci. 2018 Sep 1;28(5):571–82.

[19] Enawgaw B, Yalew A, Shiferaw E. Blood donors' knowledge and attitude towards blood donation at North Gondar district blood bank, Northwest Ethiopia: A cross-sectional study. BMC Res Notes. 2019 Nov 6;12(1).

[20] Kabrah SM, Abuzerr S, Almaghrabi RO, Alserihi R, Felimban RI, Mujalli A, et al. The Quality of Blood Donation Services and Its Association with Blood Donors' Trust and Loyalty at Makkah Blood Donation Centers in Saudi Arabia: A Cross-Sectional Study. Healthcare [Internet].

2023 Jul 25;11(15):2115. Available from: https://www.mdpi.com/2227-9032/11/15/2115

[21] Sojka BN, Sojka P. The blood-donation experience: Perceived physical, psychological, and social impact of blood donation on the donor. Vox Sang. 2003 Feb;84(2):120–8.

[22] Bednall TC, Bove LL, Cheetham A, Murray AL. A systematic review and meta- analysis of antecedents of blood donation behavior and intentions. Vol. 96, Social Science and Medicine. 2013. p. 86–94.

[23] Mohamad Yunus ain, Alini Mat Ali S, Fatiany Abdul Kader Jailani S. Understanding Blood Donor Intention: Towards Sustainable Blood Supply in Malaysia. Malaysian Journal of Social Sciences and Humanities (MJSSH) [Internet]. 2019;4(4):36. Available from: www.msocialsciences.comwww.msocialsciences.com

[24] Hairani N, Rahman A, Asri M, Ali M, Farhan M, Yusof M. Blood Donation Program in Malaysia: Government Initiatives towards Attracting Volunteer Blood Donors [Internet]. International Journal of Engineering & Technology. 2018. Available from: http://www.nst.com.

[25] Goette L, Stutzer A. Blood Donations, and Incentives: Evidence from a Field Experiment. 2008.

[26] Suemnig A, Konerding U, Hron G, Lubenow N, Alpen U, Hoffmann W, et al. Motivational factors for blood donation in first-time donors and repeat donors: a cross-sectional study in West Pomerania. Transfusion Medicine. 2017 Dec 1;27(6):413–20.

[27] Ling LM, Hui TS, Tan AKG, Ling GS. Determinants of blood donation status in Malaysia: Profiling the non-donors, occasional donors, and regular donors. Kajian Malaysia. 2018;36(1):43–62.

[28] Ibrahim AA, Koç M, Abdallah AM. Knowledge level, motivators, and barriers of blood donation among students at Qatar university. Healthcare (Switzerland). 2021 Aug 1;9(8).

[29] Hossain MS, Siam MHB, Hasan MN, Jahan R, Siddiqee MH. Knowledge, attitude, and practice towards blood donation among residential students and teachers of religious institutions in Bangladesh – A cross-sectional study. Heliyon. 2022 Oct 1;8(10).

[30] Cheng Lee O, Muthalib NA. Knowledge, Attitude and Practice of Blood Donation: A Single-Centred Experience in Sandakan, Sabah Borneo Journal of Medical Sciences BJMS. Vol. 14, Borneo Journal of Medical Sciences. 2020.

[31] Alsalmi M, Almalki H, Alghamdi A, Aljasir B. Knowledge, attitude and practice of blood donation among health professions students in Saudi Arabia; A cross- sectional study. J Family Med Prim Care. 2019;8(7):232