Introduction

Blood safety is defined as the degree to which the blood supply for blood transfusions is free of harmful substances or infectious agents and correctly typed and cross-matched to ensure serological compatibility between blood donors and recipients (1). Neglecting blood safety may cause blood products to carry transfusion-transmissible infections (TTIs). The World Health Organization (WHO) guidelines recommend that several routine laboratory tests be performed to donated blood for potential TTIs, including human immunodeficiency virus (HIV), hepatitis B virus (HBV), hepatitis C virus (HCV) and syphilis (2). Hence, screening tests are implemented in most countries to reduce the occurrence of TTIs.

Despite the screening tests performed, unsafe blood products remain prevalent in developing countries (3). An estimated 5%–15% of HIV infections in developing countries are caused by unsafe blood transfusions (4).
The cost of unsafe blood is immense, causing a loss of productive labour as well as an increased burden on healthcare systems. One of the reasons for TTIs is the donation of blood from donors with high-risk behaviours (5). As a preventive measure, blood donor screening questionnaires had been developed to assess the health status of donors and their suitability for donation. This also helps exclude subjects at high risk of transmitting blood-borne infectious pathogens through blood donation (6).

Blood donor questionnaires rely mainly on the cooperation of blood donors in providing the information related to their health status and risk of exposure to infections (3). Not all blood donors disclose deferrable risk behaviours during blood donation as the questionnaires contain socially sensitive questions that seek responses regarding sexual experience and the use of illicit drugs. A study in Hong Kong reported that 10.2% of the donors who had donated blood possibly had deferrable behaviours that were not disclosed prior to blood donation (7). The importance of research on behavioural risk factors among blood donors, particularly in developing countries, has therefore been emphasised over the years (4).

Blood safety knowledge levels vary among developing countries. Researchers have found that, in Southern Ethiopia, only 38% of the population have adequate knowledge (8). Important information, such as the association of TTIs with permanent deferrable risk behaviours (multiple sexual partners, male-to-male sex and intravenous drug abuse) and temporary deferrable risks (tattoos or acupuncture in the past six months, tooth extraction in the past 24 h and staying with family members who have HBV or HCV), has not previously been assessed among blood donors (9). A study in the United States reported that 23% of the respondents thought that it was appropriate to donate blood in order to be tested for HIV (10). In another study in Serbia, 2.8% of the blood donors either strongly disagreed or disagreed that truthful and accurate answers to the questions on donor questionnaires were essential for the safety of patients who received that blood (11).

Kelantan is a state in Malaysia that located in the north of the country and borders Thailand. A local study conducted in Kelantan determined that the prevalence of HBV infection among blood donors was 1.1% (12). Another study revealed a 0.14% prevalence of HCV infection among blood donors in the north-eastern region of Malaysia (13). These two studies highlighted that improvements in knowledge and the availability of information on HBV and HCV infection are needed among the public to lower the incidence of TTIs. A study conducted at the National Blood Centre of Malaysia reported that the seroconversion rates of syphilis, HIV and HCV increased notably from 2004 to 2008 (14). Despite this alarming scenario, there have been no local studies to explore blood donor knowledge and perceptions regarding blood safety. This study therefore aimed to provide insights regarding the knowledge and perceptions of blood donors on blood safety as this may be useful for the development of donor educational materials and encourage the practice of self-deferral among blood donors.

Methods

This was a cross-sectional study conducted in the Kelantan state of Malaysia. The study was conducted from June 2018 to May 2019 using a self-administered structured validated questionnaire developed in the Malay language, which is the national language of Malaysia. All blood donors who were older than 18 years of age, understood the Malay language and were eligible to donate or were temporarily deferred from donation were invited to participate in the study. Donors who were illiterate, non-Malaysian, medical personnel or health sciences students and/or had any known mental disorder were excluded.

The questionnaire underwent face and content validation by a panel of 10 multidisciplinary experts and two transfusion medicine specialists. Subsequently, a pilot test was conducted among 130 blood donors at the National Blood Centre. The test–retest method was employed whereby the participants were tested twice with the same set of questionnaires. An intraclass correlation coefficient (ICC) of between 0.4 and 0.75 was considered acceptable, and an ICC value of ≥ 0.75 was considered excellent. The reliability of the questionnaire was confirmed, with an ICC value of > 0.8 for the knowledge domain and > 0.6 for the perception domain (15).

The questionnaire comprised 39 questions, which were divided into four sections: (i) social demographic information (10 items), (ii) knowledge of transfusion-transmitted diseases and blood screening (10 items),
Donors’ knowledge and perception on blood safety

The mean age of the respondents was 25.79±8.40 years. Most of the respondents were Malay (92.3%), single (72.2%), students (52.4%) and regular donors (56.3%) and had a bachelor's degree or above (43.4%) (Table 1). Of the 389 respondents, 72 (18.5%) had good knowledge scores, but most of them (81.5%) had poor knowledge scores.

Two hundred and fifty-two (64.8%) respondents were aware that infection could occur through a blood transfusion. Less than one third knew that dengue (33.2%), Zika (32.9%) and mad cow disease (18.0%) can be contracted through a blood transfusion. Only 73.0% (n = 284) answered correctly that an HIV screening test was done for all donated blood. Two thirds or less of the respondents knew that all donated blood was screened for HBV (66.8%, n = 260), HCV (59.1%, n = 230) and syphilis (57.3%, n = 223).

Less than 30% of the respondents were aware that people with multiple sexual partners, bisexual people and male homosexual people are permanently deferred from blood donation (Table 2), and only 29.4% of the respondents strongly agreed or agreed that donors are responsible if their blood causes infection in a recipient. Furthermore, 39.3% of the donors strongly agreed or agreed that they could check their HIV status through blood donation, and 10.3% and 5.4% of the respondents strongly agreed or agreed that donors are free from infection if they wear a condom during sex or only have oral sex when involved in prostitution (Table 3).

The respondents with a secondary or lower educational level had 4.1 times higher odds of poor knowledge compared to those with a bachelor's degree or above (P = 0.010). Those with a low or very low household income had 2.8 times (P = 0.010) and 2.3 times (P = 0.014) higher odds of poor knowledge, respectively, on blood safety compared to those with a high household income (Table 4).

Discussion

The majority of the respondents in our study obtained a poor knowledge score although more than half of the respondents were regular blood donors and had received a tertiary education. Most of the respondents were unable to identify the diseases that could be contracted after an erroneous blood transfusion and were unaware of the high-risk behaviours...
Our study findings revealed poor knowledge among blood donors regarding TTIs: less than one third of the donors were aware that dengue, Zika and mad cow disease could be transmitted through a blood transfusion. Dengue fever is endemic in Malaysia, with more than 60,000 cases reported from January to June 2019. In 2015, there were laboratory-confirmed cases of Zika virus infection among travellers returning from Malaysia, for whom the Zika virus was probably associated with microcephaly (17, 18). It is therefore important to raise awareness about TTIs.

Table 1. Demographic characteristics of donors

| Characteristics            | Frequency (n) | Percentage |
|----------------------------|---------------|------------|
| Age* (years)              | 25.79±8.40    |            |
| Gender                     |               |            |
| Male                       | 186           | 47.8       |
| Female                     | 203           | 52.2       |
| Race                       |               |            |
| Malay                      | 359           | 92.3       |
| Chinese                    | 20            | 5.1        |
| Indian                     | 7             | 1.8        |
| Others                     | 3             | 0.8        |
| Marital status             |               |            |
| Single                     | 281           | 72.2       |
| Married                    | 104           | 26.7       |
| Divorced                   | 1             | 0.3        |
| Widow                      | 3             | 0.8        |
| Household incomeb (RM)     | Median: 2500 (IQR: 3700) |            |
| High income                | 0             | 0.0        |
| Medium income              | 55            | 14.1       |
| Low income                 | 101           | 26.0       |
| Very low income            | 233           | 59.9       |
| Occupation                 |               |            |
| Government                 | 42            | 10.8       |
| Private                    | 118           | 30.4       |
| Self-employed              | 20            | 5.1        |
| Student                    | 204           | 52.4       |
| Unemployed                 | 5             | 1.3        |
| Education level            |               |            |
| Degree/master/PhD          | 169           | 43.4       |
| Diploma                    | 159           | 40.9       |
| Secondary school           | 60            | 15.4       |
| No formal education        | 1             | 0.3        |
| Donation status            |               |            |
| First time donor           | 124           | 31.9       |
| Regular donor              | 219           | 59.3       |
| Lapsed donor               | 46            | 11.8       |

Notes: *Age is expressed as mean standard deviation
bHousehold income is expressed in both median (interquartile range) and categories. Income was categorised according to the Report of Household Income and Basic Amenities Survey 2016. High income: > RM13,146 Medium income: RM6,275–RM13,146, Low income: RM3,000–RM6,274 Very low income: < RM3,000 (30)
### Table 2. Responses on eligibility of blood donation

| Responses on eligibility criteria of blood donation | Correct respondents (n) | Correct percentage (%) |
|----------------------------------------------------|-------------------------|------------------------|
| 1. Frequent change of sexual partner                | 109                     | 28.0                   |
| 2. Male homosexual                                  | 112                     | 28.8                   |
| 3. Bisexual                                         | 102                     | 26.2                   |
| 4. Aesthetic injection on day of donation           | 182                     | 46.8                   |
| 5. Intravenous drug user                            | 146                     | 37.5                   |
| 6. Cupping                                          | 196                     | 50.4                   |
| 7. Acupuncture                                      | 146                     | 37.5                   |
| 8. Body piercing                                    | 149                     | 38.3                   |
| 9. Tattoo                                           | 80                      | 20.6                   |

### Table 3. Perception of donors towards blood safety

| Perception statement                                                                 | Strongly disagree (%) | Disagree (%) | Unsure (%) | Agree (%) | Strongly agree (%) |
|---------------------------------------------------------------------------------------|-----------------------|--------------|-----------|-----------|-------------------|
| 1. Donors are responsible if their blood causes infection to the patient              | 8.7                   | 34.4         | 27.5      | 21.9      | 7.5               |
| 2. Someone who is having fever can donate blood                                       | 23.7                  | 47.6         | 19.8      | 8.2       | 0.8               |
| 3. Donors can donate blood to check the HIV status of themselves                      | 20.3                  | 16.5         | 23.9      | 32.1      | 7.2               |
| 4. Donors should not donate blood if they were aware that their blood is unsafe to be given to the patients | 3.1                   | 1.5          | 7.5       | 32.6      | 55.3              |
| 5. Blood donors who gave untruthful declaration should be brought to justice          | 2.3                   | 4.9          | 21.1      | 41.1      | 30.6              |
| 6. Donors’ blood is 100% safe if the screening test is negative                       | 5.4                   | 5.7          | 37.8      | 31.1      | 20.1              |
| 7. The blood of the donors are free from infection and can be donated if:              |                       |              |           |           |                   |
| (a) Donors wear condom when involved in prostitution or having multiple sexual partners | 22.1                  | 24.2         | 43.4      | 8.5       | 1.8               |
| (b) Donors use the same spoon when eating with HIV patients                           | 20.3                  | 26.2         | 37.5      | 14.1      | 1.8               |
| (c) Donors stay in the same house with Hepatitis B patient                            | 9.8                   | 22.6         | 53.0      | 12.9      | 1.8               |
| (d) Donors involved in oral sex only when getting the service of prostitute            | 25.4                  | 22.4         | 46.8      | 4.6       | 0.8               |
the respondents were aware that high-risk behaviours such as multiple sexual partners, male homosexual relationships, bisexual relationships and illegal intravenous drug usage would lead to a permanent deferral of blood donations. In a study conducted in Norway, approximately 10% of 127 repeat donors were denied the opportunity to donate blood due to drug abuse, while 2% of the repeat donors were permanently deferred as they were in male homosexual relationships (21). Another study in Japan reported that 23 of 5,585 blood donors were deferred due to unsafe sexual practices or drug abuse (22). Face-to-face donor interviews may not ensure truthful declarations by donors (23); however, by instilling donors with good

In this study, less than 75% of the respondents were aware that all donated blood is screened for HIV, and less than two thirds were aware that donated blood is screened for HCV and syphilis. A similar study conducted in the United States found that slightly less than 80% of the respondents knew that donated blood was tested for HIV (19). According to the WHO guidelines, all blood should be routinely screened for HIV, HBV, HCV and syphilis (20).

More than half the respondents did not know that invasive procedures such as aesthetic injections, cupping (bekam), acupuncture, body piercing and tattoos may lead to a temporary deferral of blood donation. Furthermore, it is noteworthy that less than one third of

| Variable                  | Simple logistic regression | Multiple logistic regression* |
|---------------------------|----------------------------|------------------------------|
|                           | b     | OR (95% CI)    | P   | b     | OR (95% CI)    | P   |
| Age, years                | 0.028 | 1.028 (0.994, 1.064) | 0.107 | -     | -                | -   |
| Gender                    |       |                 |     |       |                 |     |
| Male                      | 0     | 1               |     | -     | -                | -   |
| Female                    | -0.517 | 0.596 (0.353, 1.008) | 0.054 | -     | -                | -   |
| Ethnicity                 |       |                 |     |       |                 |     |
| Malay                     | 0     | 1               | 0.781 | -     | -                | -   |
| Chinese                   | -0.086 | 0.918 (0.297, 2.834) | 0.881 | -     | -                | -   |
| Indians/Others            | 0.725 | 2.065 (0.257, 16.579) | 0.495 | -     | -                | -   |
| Education level           |       |                 |     |       |                 |     |
| Degree and above          | 0     | 1               | 0.136 | -     | -                | -   |
| Diploma                   | 0.441 | 1.554 (0.903, 2.676) | 0.112 | 0.366 | 1.442 (0.830, 2.506) | 0.194 |
| Secondary and below       | 1.518 | 4.564 (1.561, 13.348) | 0.006 | 1.420 | 4.139 (1.400, 12.236) | 0.010 |
| Household income          |       |                 |     |       |                 |     |
| Middle income             | 0     | 1               | 0.006 | 0     | 1.042 | 2.316 (1.878, 4.518) | 0.014 |
| Low income                | 1.107 | 3.026 (1.386, 6.606) | 0.005 | 1.042 | 2.316 (1.878, 4.518) | 0.014 |
| Very low income           | 0.996 | 2.708 (1.406, 5.217) | 0.003 | 0.840 | 2.316 (1.878, 4.518) | 0.014 |
| Marital Status            |       |                 |     |       |                 |     |
| Single                    | 0     | 1               | 0.428 | -     | -                | -   |
| Married                   | 0.412 | 1.510 (0.813, 2.805) | 0.192 | -     | -                | -   |
| Divorced/widow/others     | 19.834 | 411080657.5 (0.000, –) | 0.999 | -     | -                | -   |
| Donor type                |       |                 |     |       |                 |     |
| New donor                 | 0     | 1               | 0.048 | -     | -                | -   |
| Repeat donor              | -0.607 | 0.545 (0.299, 0.995) | 0.048 | -     | -                | -   |
| Donor status              |       |                 |     |       |                 |     |
| New donor                 | -0.557 | 0.573 (0.308, 1.064) | 0.078 | -     | -                | -   |
| Regular donor             | -0.752 | 0.471 (0.200, 1.111) | 0.085 | -     | -                | -   |
| Lapsed donor              | -0.752 | 0.471 (0.200, 1.111) | 0.085 | -     | -                | -   |

Notes: b = regression coefficient, OR = odds ratio, CI = confidence interval.
*Forward stepwise multiple logistic regression analysis. Multicollinearity and interaction term were checked and not found. Hosmer-Lemeshow test (P = 0.988), classification table (overall correctly classified percentage = 81.4%) and area under curve (64.5%) were applied to check model fitness.
knowledge about the permanent and temporary donor deferral criteria, it is hoped that voluntary self-deferral among blood donors will be possible.

In our study, knowledge score was significantly associated with educational level and household income. Higher socioeconomic status is commonly considered a predictor of better knowledge (24, 25). A British cohort study reported that the study participants who came from a lower socioeconomic background demonstrated significantly poorer academic performance than those higher in the social hierarchy (26). Fair and equal access to health information is important to reduce the gaps in knowledge between those who come from distinct socioeconomic backgrounds (25). It is therefore imperative that education on blood safety for those from lower socioeconomic backgrounds be prioritised.

It was alarming to note that 39.3% of the respondents in our study strongly agreed or agreed that donors could donate blood to check their HIV status. Similar to our findings, another study reported that more than one third of blood donors felt that it was acceptable to donate blood to screen for HIV (19). Action should be taken to prevent such behaviours, for example, by incorporating the impact of transfusion-transmittable diseases into the current school education syllabus.

Not all blood donors reveal their high-risk behaviours during blood donation (7, 23, 27), yet false declarations may lead to TTIs among recipients. Our study found that 7.2% of the respondents strongly disagreed or disagreed that donors who give untruthful declarations should be brought to justice. A study conducted in Serbia reported that 2.8% of the study participants disagreed that they should give truthful answers in the donor questionnaire (11). In view of the potentially catastrophic outcomes associated with such practices, drastic measures, such as enacting laws to restrict false blood donation declarations, may be warranted by the government.

In addition, 51.2% of the donors in our study falsely believed that their blood is perfectly safe if the screening test results are negative. In a study conducted among American blood donors, 40% of the donors did not know that the available screening tests may not detect a recent infection (10). In a 2012 study conducted by Steele et al. (19), 17.5% of the respondents were not aware of the ‘window period’ of the HIV screening test. The local donors in our study were similarly ignorant of the screening test window period. There is thus a clear urgency to improve donors’ awareness regarding the limitations of the screening tests undertaken after blood donation and the implications of high-risk behaviours.

In terms of perceptions about sexual behaviour, 10.3% and 5.4% of the respondents in our study strongly agreed or agreed that blood is safe from infection if donors wear a condom during sex or only have oral sex during prostitution, respectively. This was a major misconception among the blood donors who thought that common preventive measures can completely prevent them from contracting sexually transmissible infections (STIs). Previous studies have found that oral sex may cause STIs while condom failure is not uncommon (28, 29). Accordingly, awareness regarding STIs should be enhanced to ensure transfusion blood safety.

To the best of our knowledge, this is the first local study to assess the knowledge and perceptions of blood donors concerning safe blood donation. The study questionnaires were distributed to a wide range of blood donors at multiple donor sites in the Kelantan state, which suggests the generalisability of the findings. However, a few limitations were also identified. This study may not represent the knowledge and perception levels among donors in other states of Malaysia where people have different socioeconomic backgrounds. Since the study only included blood donors, the knowledge and perceptions of the general public were not represented. In future, a large-scale nationwide study that includes the general public should be undertaken to assess blood safety knowledge among the general public.

Conclusion

The blood donors in this study had poor knowledge and notable misperceptions regarding what constitutes safe blood. The study findings can be utilised by the Ministry of Health of Malaysia to guide further planning of safe blood educational programmes aimed at the public, to raise awareness among blood donors and to reduce the incidence of untruthful blood donation declarations.
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Ethics of Study

The ethical clearance was obtained from the Human Research Ethics Committee of Universiti Sains Malaysia and Medical Research and Ethics Committee (MREC) of the Ministry of Health, Malaysia.

Conflict of Interest

None.

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Authors’ Contributions

Conception and design: TPP, HMF, RB, CCT, NAAR
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Provision of study materials or patients: RB, NAAR
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