O R I G I N A L   A R T I C L E

Prevalence of oral conditions and feasibility of self-reported oral conditions (SROC) questionnaire for screening voluntary blood donors

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Abstract. *Background and aim of the work:* Oral conditions like caries, periodontitis, abscess, and pericoronitis can cause significant bacteremia. Blood donors with oral conditions may pose a potential risk to transfusion recipient. Hence, we aimed evaluate the prevalence of oral conditions and the feasibility of a self-reported oral conditions questionnaire for screening of blood donors. *Research design and Methods:* We conducted a cross-sectional survey among voluntary blood donors attending out-reach camps in Udupi district, India using consecutive sampling. A self-administered questionnaire was designed in English to capture information on age, sex and four self-reported oral conditions rated as yes/no or dont know. A calibrated dentist evaluated decayed teeth, pulpal involvement, periodontitis, pericoronitis, abscess, or purulent discharge. The blood collected from donors with potential for bacteremia were sent for bacterial culture and sensitivity tests. *Results:* A total of 351 voluntary blood donors participated with a mean age of 39.12. Decayed teeth (59%) were the most prevalent oral condition, followed by periodontitis (29.1%) and decay with pulpal involvement (25.9%). The sensitivity and specificity for self-reported decayed teeth was 63.8% and 95.8%, respectively. The self-reported pain in gums and teeth showed above 80% specificity versus decayed teeth (81.9%), decayed teeth with pulpal involvement (82.3%), and periodontitis (82.7%). The specificity values for self-reported gum disease and infections in the mouth versus periodontitis were 72.7 and 77.1%, respectively. *Conclusions:* Decayed teeth, periodontitis, and tooth decay with pulpal involvement were common conditions among blood donors. Self-reported questions may be adopted to aid in identifying donors and to re-evaluate for blood donation to implement safe practices. (www.actabiomedica.it)

Key words: decayed teeth, periodontitis, pericoronitis, blood donors, screening

Introduction

Around 120 million blood units are donated worldwide annually to save lives (1). There is a potential risk of infections due to blood transfusion, known as Transfusion transmissible infections (TTI). Blood screening is routinely performed for TTI like HIV, Hepatitis B and C, Syphilis, and Malaria as per the prevailing guidelines (2). However, there are a significant number of other infectious diseases that may account for morbidity and mortality among recipients. Transfusion transmissible bacterial infection (TTBI) is among them, and to reduce the risk of TTBI, there is no test to screen all the blood components routinely.

But a set of measures may be adopted at the blood centers to prevent this infection. These include obtaining a detailed history through a donor questionnaire, use of sterile bags, diversion pouches in the blood bags during blood collection, closed system of component preparation, and testing 1% of blood components collected for bacterial contamination. Still, the burden of TTBI is high compared to transfusion transmissible viral infections (3).

Oral conditions like caries, periodontitis, abscess, and pericoronitis are common and cause significant bacteremia. The prevalence of these oral conditions can be as high as 100%. Previous studies have shown that routine actions like eating, and tooth brushing can cause bacteremia in patients with periodontitis (4–8). Such bacteremia can have clinical implications for individuals receiving the blood and its components, mainly when the recipient is immunocompromised.

As per the general guidelines, there is an emphasis on recent dental treatment or dental extraction but a minimal emphasis on current oral conditions (2). As described earlier, it would be better to screen the oral cavity for active sources of infections due to the potential of bacteremia associated with various oral conditions. However, there is not much evidence in the literature from TTBI in donors with oral conditions prone to bacteremia. Petrini M et al. reported bacterial contamination in 62% of blood samples from donors with periodontitis, and none of them tested positive for bacterial contamination when each buffy coat was screened. They found bacteria which were associated with nosocomial infections. The plausible reason for bacteremia in periodontitis patients is due to the increased permeability of the connective tissue (9).

There is substantial variation in the guidelines for donor deferral criteria concerning oral conditions. There are guidelines given by different countries and regulatory bodies that modify them periodically as per need and time. According to the Indian guidelines, deferral is for six months after tooth removal or dental surgery under anesthesia. There is no mention of the prevailing dental conditions in the donor which can have bacteremia (10) American red cross society guidelines specify a deferral of three days after oral surgery. Also, no deferral is required for dental procedures when there is no infection or defer till the completion of prescribed antibiotics (11). WHO recommends a deferral of one month for a major dental practice and one day for minor procedures (12). FDA omitted the guideline on deferral of donors due to recent dental treatment (13). As per the Italian guidelines, there is a deferral of 48 hours after minor dental interventions, one week after tooth removal, root canal treatment or minor surgery and four months after major surgery with bone implants (9).

These guidelines emphasize recent dental treatment or extraction with limited emphasis on current oral conditions that may have clinical implications. Due to the potential of bacteremia in oral conditions, it is prudent to have oral cavity screening for any active sources of infections. Such screening is not feasible due to the lack of workforce, resources, and time required. Hence, there is a need to develop self-reported questions that can effectively screen blood donors. Studies in the past have reported the feasibility of self-reported oral health in diverse contexts (14–16). Limited literature exists on its use among blood donors (17). Questions on self-reported oral conditions should be developed given the blood donors' prevailing oral conditions, knowledge and health literacy, language, and sociodemographic factors. Hence, there is a need to develop self-reported questions that can effectively screen blood donors. We aimed to evaluate the prevalence of oral conditions among blood donors and to screen the corresponding blood units for viable bacteria using standard screening procedures. The feasibility of a questionnaire for self-reporting of oral conditions was assessed to screen blood donors.

Patients and methods

Participants

We conducted a cross-sectional survey among voluntary blood donors attending out-reach blood donation camps conducted by a transfusion medicine center attached to a medical college in Udupi district, Karnataka, between 1st August 2021 and 31st March 2022. The blood donors were recruited for blood donation after fulfilling all the blood donation criteria as per the departmental standard operating procedures and guidelines (18).

Sample size estimation

Based on the results of our pilot study, the prevalence was 35% for periodontitis and 30% for caries, respectively. The sample size was 344, with a 95% confidence interval and 5% precision. Enrolment of blood donors was done using consecutive sampling.

Inclusion and exclusion criteria

We included voluntary blood donors in this study after the blood donation. Voluntary blood donors who were deferred from blood donation were excluded from the study.

Development of the questionnaire

A self-administered questionnaire was designed in English to capture information on demographics (age and sex) and self-reported oral conditions (SROC). A total of four questions that evaluated SROC were adapted from earlier studies (14,17) with appropriate modifications ["do you have decayed teeth?", "do you have gum disease?", "do you have any infection in your mouth?" and "do you have pain in your gums or teeth?"]. The responses for the questions were "yes" or "no" or "dont know". A bilingual expert translated the English questionnaire into the local language (Kannada). It was then translated into English by another expert and evaluated for consistency. A pilot study evaluated the face validity of the questionnaire among 15 participants. The participants were able to understand and respond to the questionnaire. Criterion validity was assessed by comparing the SROC with clinical oral examination (gold standard).

Clinical oral examination

A trained and calibrated dentist performed a clinical oral examination with universal precautions using a mouth mirror and probe under artificial illumination as per WHO criteria (2013) (19). The oral conditions evaluated were decayed teeth, pulpal involvement, periodontitis (pockets, recession, or mobility), pericoronitis, abscess, or purulent discharge.

Culture and sensitivity test

The blood collected from donors with active oral conditions and potential for bacteremia were sent for bacterial culture and sensitivity tests. The units were quarantined until the reports were available. Bacterial culture was performed using Brain heart infusion agar (HiMedia labs, Wagle Industrial Area, Thane, Maharashtra, India) using Castaneda method which provides both solid and liquid medium in the same bottle. The inoculum is added to the liquid medium, and when subcultures are made, the bottle is tilted to allow the liquid to flow over the solid medium. This obviates the need for frequent opening of the culture bottle to subculture. The culture reports were obtained 24hrs and 14 days post incubation at 37° C. Any growth observed will be subjected to species identification and discarding corresponding components from the inventory. Data from all the participants was compiled and entered into an excel spreadsheet.

Statistical analysis

All the analysis was done using SPSS version 20 (IBM Corp. Released 2011. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp). The sensitivity, specificity, positive and negative likelihood ratios and Area under curve for SROC were calculated. Internal consistency reliability was not assessed as the items in the questionnaire assessed different underlying conditions.

Ethical considerations

We sought informed consent from all the participants before recruiting to the study. The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board (or Ethics Committee) of Kasturba Medical College and Kasturba Hospital (IEC: 424/2021).

Results

A total of 351 voluntary donors participated in this survey. The mean age was 39.12 (SD: 10.2; 19-60).

The majority of them were males (n=310). The most common SROC was decayed teeth (39.3%), followed by gum disease (27.6%), infections in the mouth (22.2%), and pain in gums and teeth (17.9%). Clinical examination showed that decayed teeth (59%) were the most prevalent oral condition, followed by periodontitis (29.1%) and decay with pulpal involvement (25.9%). The less common conditions include mobile teeth (2.6%), active infection (2.3%), pericoronitis (2.3%), and pus discharge (1.1%) (Table 1).

Tables 2, 3 and 4 represent the criterion validity of self-reported oral conditions questionnaire when compared to clinical oral examination (gold standard). The sensitivity and specificity for self-reported decayed teeth) was 63.8% and 95.8%, respectively (AUC=0.79) (Table 2). The SROC addressing pain in gums and teeth showed lower than 20% sensitivity against decayed teeth (17.9%), decayed teeth with pulpal involvement (18.7%), and periodontitis (19.6%). However, the SROC addressing pain in gums and teeth showed above 80% specificity against decayed teeth (81.9%), decayed teeth with pulpal involvement (82.3%), and

periodontitis (82.7%) (AUC= 0.5, 0.51 and 0.51) respectively. The specificity values for SROC addressing gum disease and infections in the mouth against periodontitis were 72.7 and 77.1% (AUC=0.51 and 0.49) respectively (Table 3 and 4). Based on these findings, we could infer that only self-reported decayed teeth could be a valid measure to screen voluntary blood donors prior to blood donation. No bacterial growth was found in any samples tested at 24hrs and 14 days of incubation.

Conclusions

Oral conditions like caries, periodontitis, abscess, and pericoronitis are prevalent among adults. They can cause bacteremia, which is of relevance to blood donation. Blood collected from donors who have bacteremia can pose a severe risk of infection to susceptible patients. Detailed clinical oral examination of the potential blood donors by the dental team is not practical. Hence, questionnaire-based screening through self-reported questions can be promising. Studies have shown the feasibility of SROC (14–16); however, limited research has been done among voluntary blood donors and in the Indian context (17).

Majority of the donors (59%) had decayed teeth, and 26% had pulpal involvement which could act as a source of bacteremia. Other sources of bacteremia that were seen in our study were mobile teeth (2.6%), active infection (2.3%), pericoronitis (2.3%), and pus discharge (1.1%). Schmalz et al. evaluated the mean decayed, missing, filled and total scores and have not reported the prevalence among donors (17). However, we focussed only on the decayed teeth and their sequelae which can be a source of bacteremia. Previous research among blood donors showed periodontitis from 41.7 to 75% (17,20). Our study showed a low prevalence of 29%, which could be attributed to the young and donor pool (mean age 39 years) and Periodontits is generally manifested among the elderly. Significantly less prevalence of mobile teeth (2.6%), active infection (2.3%), pericoronitis (2.3%), and pus discharge (1.1%) were noted in our study. Comparison of these conditions with literature was not possible as they were not evaluated among blood donors in the past.

Table 1. Distribution of oral conditions (self-reported and clinical examination) among blood donors.

N=351	N	%
Self-reported questions		
Do you have decayed teeth?	138	39.3%
Do you have gum disease?	97	27.6%
Do you have any infection in your mouth?	78	22.2%
Do you have pain in your gums or teeth?	63	17.9%
Clinical Examination		
Decayed	207	59.0%
Pulpal involvement	91	25.9%
Periodontitis	102	29.1%
Active infection	8	2.3%
Pericoronitis	8	2.3%
Purulent discharge	4	1.1%
Mobile teeth	9	2.6%

Table 2. Criterion validity (Sensitivity and specificity) of self-reported questions on decayed teeth and pain in your gums or teeth.

		Decayed Teeth (Clinical Examination)		Sensitivity (95% CI)	Specificity (95% CI)	LR+	LR-	AUC (95% CI)
		Yes	**No**					
Do you have decayed teeth? (self-reported)	Yes	132	6	63.8 (56.78-70.24)	95.8 (90.76-98.3)	15.3	0.38	0.79 (0.75-0.85)
	No	75	138					
Do you have pain in your gums or teeth? (self-reported)	Yes	37	26	17.9 (13.04-23.93)	81.9 (74.48-87.66)	0.98	1	0.5 (0.44-0.56)
	No	170	118					

Abbreviations: LR+: Positive Likelihood ratio; LR-: Negative likelihood ratio; AUC: Area under the curve; CI: confidence interval

Table 3. Criterion validity (Sensitivity and specificity) of self-reported questions on pain in your gums or teeth.

		Decayed Teeth with Pulpal Involvement (Clinical Examination)		Sensitivity (95% CI)	Specificity (95% CI)	LR+	LR-	AUC (95% CI)
		Yes	**No**					
Do you have pain in your gums or teeth? (Self-reported)	Yes	17	46	18.7 (11.56-28.51)	82.3 (77-86.64)	1.05	0.99	0.51 (0.44-0.57)
	No	74	214					

Abbreviations: LR+: Positive Likelihood ratio; LR-: Negative likelihood ratio; AUC: Area under the curve; CI: confidence interval

Schmalz et al. reported a significant association of procalcitonin and CRP with periodontitis, while no such association was seen with any other hematological parameters (17). However, using such markers can be time-consuming and may not be feasible and cost-effective to implement routinely. Hence, a cost-effective and feasible alternative to screen blood donors would be SROC. Schmaltz et al. reported a significant association of periodontitis with dental visits (17). However, regular dental visits as a proxy for dental problems are seen among highly aware and motivated individuals and developed countries and may not be suitable for the Indian scenario. Hence, we adapted self-reported questions from previous studies that are contextually suitable to this geographic area. Our questionnaire showed acceptable sensitivity and specificity in screening blood donors only for SROC concerning decayed teeth. Donors who positively respond to the SROC can be further evaluated through clinical oral examinations in the dental office. Previous reports by Schmalz et al. and Ziebolz et al. showed a lack of significant association between hematological parameters and periodontitis and reported that the changes due to periodontitis might be small (17,20). In contrast, studies have shown increased leucocytes (21–23) and reduced hemoglobin among subjects with periodontitis (20,24). Reduced hemoglobin among donors with periodontitis doesn't pose a problem to other

Table 4. Criterion validity (Sensitivity and specificity) of self-reported questions on gum disease, infection in the mouth, pain in gums or teeth.

		Periodontitis (Clinical Examination)		Sensitivity (95% CI)	Specificity (95% CI)	LR+	LR-	AUC (95% CI)
		Yes	No					
Do you have gum disease? (Self-reported)	Yes	29	68	28.4 (20.16-38.36)	72.7 (66.63-78.03)	1.04	0.98	0.51 (0.44-0.57.)
	No	73	181					
Do you have any infections in your mouth? (Self-reported)	Yes	21	57	20.6 (13.47-29.97)	77.1 (71.29-82.07)	0.9	1.03	0.49 (0.42-0.56)
	No	81	192					
Do you have pain in your gums or teeth? (Self-reported)	Yes	20	43	19.6 (12.66-28.89)	82.7 (77.32 – 87.09)	1.14	0.97	0.51 (0.45-0.58)
	No	82	206					

Abbreviations: LR+: Positive Likelihood ratio; LR-: Negative likelihood ratio; AUC: Area under the curve; CI: confidence interval

recipients because blood donation would be acceptable only when donors have an optimum hemoglobin level. However, periodontitis can decrease hemoglobin levels which can cause donor deferral.

The potential role of other oral infections like decayed teeth with or without pulpal involvement, active infections like chronic abscesses with or without pain, and pericoronitis cannot be ruled out. Our study could not establish bacterial growth among the donors who had potential oral infections because periodontal pathogens are difficult to grow due to their anaerobic nature (25). The problem of periodontitis among blood donors is mainly associated with aged donors, while decayed teeth and other oral infections can be present at any age. Care should be exercised when screening aged donors concerning periodontitis.

Our study was one of the preliminary studies to evaluate the oral conditions among blood donors and check the validity of SROC for screening blood donors. At the same time, we assessed if blood collected from a donor with active dental conditions potential for bacteremia is prone to bacterial contamination of the product. Though this study is not practically proven, a theoretical risk of TTBI exists for the components collected from donors with such oral conditions as there could be associated bacteremia among donors which could be a potential risk for susceptible recipient. According to the National blood transfusion council guidelines for India, deferral is for six months after tooth removal or dental surgery under anesthesia. However, there is no mention of the prevailing dental conditions in the donor (2).

Self reported decayed teeth has acceptable validity and could be used to screen donors with decayed teeth. It may be adopted to aid in identifying such donors, and re-evaluation for blood donation would help implement safe transfusion practices. Donors with pus discharge and active infections should be deferred for the recipient's benefit. The large sample size, highly motivated young donors, and standardized oral examination are a few strengths of this study. Limitations include self-reported questionnaire, single center study, recall bias and social desirability bias. Future studies should include larger sample sizes among diverse populations, including all age groups, to further strengthen the findings.

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