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Is tattooing associated with increased seroprevalence of transfusion-transmitted infections among blood donors: A single-center study from Southeastern India

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Abstract:

INTRODUCTION: The regulations in India mandate a blanket deferral period of 12 months for donors from the time of acquiring a tattoo. The rationale is that using nonsterile needles, the same dyes for many persons, and other unhygienic practices result in the transmission of blood-borne infections. However, currently, autoclavable tattoo equipment, professional tattoo gun, single-use dye, and needle for tattooing have come up and are known to be devoid of the risks mentioned above. Hence, this study was designed to assess if the seroprevalence of transfusion-transmitted infections (TTIs) among tattooed blood donors was higher than in other nontattooed donors.

METHODOLOGY: This cross-sectional comparative study was conducted in the Department of Transfusion Medicine at the tertiary care teaching hospital in Pondicherry from September 2017 to May 2019. The study group included blood donors in the age group of 18–60 years with one or more tattoos, and the control group was chosen among blood donors of the same age without a tattoo. The sampling technique was consecutive. The serological prevalence of the two groups was compared for HIV, hepatitis B virus, hepatitis C virus, Syphilis, and Malaria.

RESULTS: A total of 368 donors were recruited for the study, 184 donors with tattoos and 184 donors without a tattoo. The detected seroprevalence of TTI among the tattooed and nontattooed groups was 3.8% and 4.3%, respectively. There was no significant association found between tattooing and seroprevalence of TTI. About 60% of the ones who got a tattoo had obtained it from a licensed tattoo parlor.

CONCLUSION: We found that the seroprevalence of TTI among tattooed donors was similar to that of nontattooed donors. However, the seroprevalence among donors who had undergone more than one tattooing experience was higher than those who had a single tattooing event.

Keywords:

Deferral, tattooing, transfusion-transmitted infection

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Introduction

Transfusion-transmitted infection (TTI) is a significant challenge to transfusion services worldwide. The prevalence of TTI among blood donors depends upon the background prevalence of these infections among the general population. In India, hepatitis B/C, HIV, Malaria, and Syphilis are the infections that are routinely tested in blood transfusion services.

Among the many approaches aimed at decreasing the risk of transmitting blood-borne infections, the introduction of donor counseling and screening for different

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pathogens has made blood a very safe product, especially in developed countries. The criteria for donor selection need to balance recipient and donor risk against the ever-increasing need for blood and the challenges of ensuring adequate supply.[1]

Any procedure involving skin penetration in unsterile conditions, as in tattooing, carries the risk of blood-borne infections, especially HIV, hepatitis B, and hepatitis C.[2] Tattooing is one of the reasons for the temporary deferral of the donor for varying lengths depending on the regulatory jurisdictions.[3] Tattooing punctures the skin with a cluster of fine needles containing indelible dyes to achieve a permanent design or mark.[4] The practice of tattooing has been there for ages, spread over multiple countries. There is an increasing trend in body art practices among young adults, especially college-going students who are potential blood donors. Transmission of disease from tattooing may be related to using needles contaminated with the blood of a previously tattooed person, using contaminated dyes and other materials such as sponges or tissues used to wipe the blood away. The ideal recommendation is that the material used for tattooing should be either disposable (single-time use only) or adequately sterilized. Because of the risk of transmission of infectious diseases, the presence of a tattoo is used as a criterion for the deferral of blood donors.[5] As per NACO guidelines, WHO and Drugs and Cosmetic Act, amendment 2020, a 12-month deferral for donors who have had a tattoo is mandatory.[6,7] Not only does temporary deferral decrease the supply but it also affects the donor return rate, further decreasing the donor pool. In such a scenario, finding whether there is an association between tattooing and TTI prevalence will help us avoid unnecessary donor deferral.

This study aimed to assess the seroprevalence of TTIs among tattooed blood donors and compare it with the seroprevalence among nontattooed blood donors.

Methodology

Study design

This was a case–control observational study.

Study setting

This study was conducted in the Blood center of a tertiary care teaching hospital in Pondicherry from September 2017 to May 2019.

Participants

This was a comparative study between two groups. The study group includes blood donors in the age group of 18–60 years with one or more tattoos. The control group was chosen amongst blood donors in the age group of 18–60 years without a tattoo. Donors with a history of previous blood transfusion, surgery, or a history of injection drug abuse were excluded from the study as they can be confounding factors for the TTI. The sampling technique was consecutive, where all the donors who came for donations and had been deferred or donated were included.

Study procedure

Donors who were eligible to donate and met the inclusion criteria were explained about the study and asked about their willingness to participate. Controls matched for age and gender without tattoos were chosen parallelly and included on the same day. Recruited donors were screened with regular questionnaires used in the department to assess donors' health and risk factors for hepatitis B, hepatitis C, HIV, and Syphilis. Each donor was given a unique identification number to maintain confidentiality. The characteristics of the tattoo, i.e., number, size (length × width in cm at longest/widest point), and color, were directly observed and recorded. The venue of tattooing and the time of acquiring each tattoo were enquired about and recorded in a prestructured pro forma. After the routine medical examination, they were allowed to donate, and a 5 ml plain blood sample was collected from the blood bag for serology. For donors who had been deferred within 6 months of tattooing, a 5 ml blood sample was taken with consent, and the donor was advised to come back to donate blood after the deferral period (from the point of acquiring the tattoo). Samples were labeled and run along with routine samples. Deferred donors eligible to donate again during the study period were contacted by phone to call back for donations. Their data was recovered from records for those who returned to donate at our center. The donation status of those who did not return for donation was obtained via phone call.

The participants' demographic data and TTI status/testing results were obtained from the donor registry and laboratory records maintained in the department. Serum samples collected were tested for the TTI by routine tests along with the testing of samples for blood bags in our department by the following: Antibody to hepatitis C virus (HCV) (anti-HCV) by enzyme linked immunosorbent assay (ELISA) (QUALISA microwell enzyme immunoassay-3rd generation) Hepatitis B surface antigen by ELISA (HEPALISA Microwell ELISA J MITRA and CO PVT LTD) HIV-1/2 antibody by ELISA (ENZAIDS MICROWELL ELISA-3rd generation) Syphilis by Rapid Plasma Reagin test (CARBOGEN). In case of a reactive/positive result for any TTI, the sample was sent to the Department of Microbiology for confirmation. For those samples that were confirmed to be positive, the respective/corresponding donor details were retrieved, and the donor was notified in 2 weeks. Those donors who showed up at the blood bank were

counseled and referred to respective departments for further management.

Sample size

To establish the association between having a tattoo and testing positive for at least one TTI, with the given information of the prevalence of the outcome in the nontattoo group as 3%, 80% power of detecting a relative risk of 4, at a significance level of 5%, a minimum sample size of 155 individuals with tattoos and 155 without them was calculated using the PS Power and Sample size calculator which is freely available. The sample size was based on hypothesis testing of relative risk.

Statistical analysis

Data were entered in Microsoft Excel. Categorical variables such as gender, voluntary or replacement donor, donation status (first-time or repeat donor), education and occupation status, and TTI result (outcome variable) were summarized as frequencies and percentages. The normal distribution of a continuous variable, i.e., age, was tested with the Kolmogorov–Smirnov test. Since age was not normally distributed among the groups, the median age was reported for each. The comparison of the outcome variable between the two groups and confounding variables with the outcome variable in the tattooed group was made by the Chi-square test. The comparison between exposures of interest and outcome variable was made by Fisher's exact test. A $P < 0.05$ was considered significant. All the statistical analyses were performed using SPSS software version 19.0 (IBM SPSS Statistics for Windows, Version 19.0. Armonk, NY, USA: IBM Corp).

Results

A total of 368 donors were included in our study. One hundred eighty-four had a tattoo (one or more than one) and formed the study group. The other 184 without a tattoo formed the control. All the socioeconomic and demographic characteristics of the participants classified based on the modified Kuppuswamy scale are summarized in Table 1. Since age was not normally distributed among the participants, it was reported as median with range. The median age of donors with a tattoo was 26 (interquartile range [IQR] 9, 18–51). The median age of donors without a tattoo was 27 (IQR 11, 18–55). The groups were similar, with no statistically significant difference concerning these characters. The majority of donors attending our center were from Puducherry (49% in tattooed donors, 47% in the control group), Villupuram (29% and 22%, respectively), and Cuddalore (7% and 11%, respectively). Table 2 summarizes the frequencies of variables that could be confounding between the two groups. These characteristics were similar in both groups except for the previous hospital admissions. Table 3 summarizes the distribution of tattoo-associated variables. The most commonly used colours of tattoos were black(65.2%) and green(28.8%). Few donors had tattoos in black, green, red, and blue colors in random combinations. The right arm (49.5%) was the most common site tattooed, followed by the left arm (41.4%). The overall prevalence of TTI among the donors combined was 4.07%. Among the 184 tattooed donors total of seven donors were reactive (3.8%), and eight were reactive (4.3%) among the nontattooed donors. The TTI prevalence among tattooed donors was almost equal to that among the nontattooed group. No significant association was found between tattooing and the prevalence of infections, as shown in Table 4. The relative risk of having a tattoo being associated with TTI was 0.88 (95% confidence interval 0.33–2.4) and was not statistically significant ($P = 0.8$). Among the tattooed group, 6 out of the seven reactive donors were replacement donors, and 2 out of those 7 were first-time donors. Among the nontattooed group, 5 out of 8 reactive donors were first-time donors, and 7 out of those 8 were replacement donors.

We found that the number of tattoos a person acquired had a significant association ($P = 0.014$) with the risk of TTI. The venue of tattooing was not significantly associated with having a marker for TTI. All 26 donors who reported a history of hospital admission in the past turned out to be negative for markers of TTI. None of the tattooed donors had a history of high-risk behavior such as IV drug use, promiscuous sexual activity, and history of sexually transmitted disease. There was no significant association between confounding variables such as a history of jaundice, hospital admission, high-risk behavior, and recent hepatitis B virus (HBV) vaccination with seropositivity of any single marker of TTI among tattooed donors. Neither was first-time donation status significantly associated with having a TTI. Among the seropositive donors, three donors had acquired their most recent tattoo <2 years ago, and four got them <5 years ago. However, the time of recent tattooing did not show any association with the risk of TTI.

Donors deferred for tattooing

During the study period, 101 donors were temporarily deferred for presenting with a tattoo <6 months old of these, 33 donors returned for donation after completion of the deferral period. The donor return rate was found to be 45.8%. Among the 72 donors eligible to donate, 33 donors had donated at blood donation camps/JIPMER/other hospital blood banks, 24 donors, even though eligible, were not able to come for donation again because of time constraints and busy schedules, nine donors were from remote places which made it difficult for them to come back for donation postexpiry of the deferral period, two donors were recently tattooed,

Table 1: Socioeconomic and demographic characteristics of the participants

Characteristics	Tattooed donors (*n*=184), *n* (%)	Nontattooed donors (*n*=184), *n* (%)	Total (*n*=368), *n* (%)	Chi-square test *P* value
Gender				
Male	180 (97.8)	177 (96.2)	357 (97)	0.36
Female	4 (2.2)	7 (3.8)	11 (3)	
Education				
Professional	33 (17.9)	36 (19.6)	69 (18.8)	0.39
Graduate	52 (28.3)	61 (33.2)	113 (30.7)	
Intermediate	34 (18.5)	39 (21.2)	73 (19.8)	
High school	30 (16.3)	27 (14.7)	57 (15.5)	
Middle school	14 (7.6)	8 (4.3)	22 (6)	
Primary school	17 (9.2)	10 (5.4)	27 (7.3)	
Illiterate	4 (2.2)	3 (1.6)	7 (1.9)	
Occupation				
Professional	11 (6)	8 (4.3)	19 (5.2)	0.21
Semi-professional	7 (3.8)	15 (8.2)	22 (6)	
Clerical/shop/farm	57 (31)	57 (31)	114 (31)	
Skilled worker	39 (21.2)	36 (19.6)	75 (20.4)	
Semi-skilled worker	25 (13.6)	21 (11.4)	46 (12.5)	
Unskilled	10 (5.4)	3 (1.6)	13 (3.5)	
Unemployed	35 (19)	44 (23.9)	79 (21.5)	
Donor type				
Voluntary	27 (14.7)	27 (14.7)	54 (14.7)	1.0
Replacement	157 (85.3)	157 (85.3)	314 (85.3)	
Donation type				
First time	71 (38.6)	67 (36.4)	138 (37.5)	0.67
Repeat	113 (61.4)	117 (63.6)	230 (62.5)	

Table 2: Distribution of variables that can be potential confounders

Characteristics	Tattooed donors (*n*=184), *n* (%)	Nontattooed donors (*n*=184), *n* (%)	Total, *n* (%)	Chi-square test *P* value
HBV vaccination	8 (4.3)	4 (2.2)	12 (3.3)	0.24
History of jaundice	15 (8.2)	7 (3.8)	22 (6)	0.08
Previous hospital admission	26 (14.1)	4 (2.2)	30 (8.2)	0.001
Admitted high-risk behavior	0	0	0	-

and four donors could not be contacted to call for donation. Sixteen donors had donated at our center, and all of them were TTI nonreactive.

Discussion

This study shows that having a tattoo is not associated with a higher risk of TTI. We observed a seroprevalence rate of 3.8% and 4.3% among tattooed and nontattooed whole blood donors. There was no significant difference between the two groups regarding the seroprevalence of TTI (P = 0.792). The seroprevalence of TTI among whole blood donors attending our center is around 3%.[8] Tattoos are no longer popular only among people with high-risk behavior but also among younger adults with a more conservative lifestyle. Usage of nonsterile needles, the same dyes for many persons, and unhygienic practices are implicated, resulting in the transmission of blood-borne infections.

Among the seven tattooed donors who were reactive for one of the TTI, six were positive for HBV, and only one donor was found positive for Syphilis. The risk of HBV infection among blood donors depends on the background prevalence in the general population. India is an endemic region for HBV infection, with an approximate prevalence of 2.4%.[9] The HBV prevalence rate among tattooed donors in our study was 3.3%. These numbers were too low to find an association of tattooing with the seroprevalence of TTI. The HBV prevalence is slightly higher than the HBV prevalence among the total whole blood donors of JIPMER, which is 2.14%. In the study done by de Nishioka and Gyorkos and Nishioka *et al*., the HBV prevalence among tattooed participants was 21.4%. This was a hospital-based study that included inpatients and outpatients with tattoos along with tattooed voluntary blood donors. The high seroprevalence may be attributed to it.[10,11] Urbanus *et al*. reported an HBV seroprevalence of 4.2% in their study. The study population included individuals with tattoos coming to tattoo conventions, shops, and bi-annual sexually transmitted infections clinics.[12]

Out of the 6 HBV-positive donors, one donor had reported a history of jaundice. None of them had

received an HBV vaccine or reported high-risk behavior. In the meta-analysis published by Jafari *et al*., tattooing was a risk factor for HBV infection, with the strongest association seen among individuals with high-risk behavior such as IV drug use, sex workers, HIV infection, etc. Only one donor was positive for Syphilis among the tattooed group (prevalence of 0.5%).[13] The donor was a first-time donor and had not reported any high-risk behavior. This could be a chance finding. Donors positive for Syphilis usually will have a history of sexually transmitted diseases. The prevalence of Syphilis among the total donors of JIPMER is 0.08%.[8] In the study by de Nishioka *et al*., tattooing was found to be associated with HCV infection and other TTIs. HCV is mainly transmitted through the parenteral route rather than through sexual contact.[11] In our study, no tattooed donors were positive for HCV or HIV infection. Though four donors from the nontattooed group were positive for HCV infection with a prevalence of 2.2%, this is a little higher than the general HCV prevalence of 0.51% found among all the whole blood donors donating at our center. The overall HCV prevalence in the Pondicherry population is 0.2%. The higher prevalence in our study might be because nearly half of the donors were from nearby areas of Tamil Nadu. Only about 50% of the donors presenting to our centre are from Pondicherry.

Table 3: Description of tattoo characteristics

Description	Number of donors (*n*=184), *n* (%)
Surface area covered by tattoo (cm^2)	
1-4	19 (10.3)
5-14	49 (26.6)
14-20	29 (15.8)
>20	87 (47.3)
Number of tattoos	
1	122 (66.3)
2	42 (22.8)
≥3	20 (10.8)
Number of tattooing procedures undergone	
1	134 (72.8)
2	36 (19.6)
≥3	14 (7.5)
Site of the tattoo	
Neck	8 (2.8)
Arms	261 (90.9)
Chest	17 (5.9)
Leg	1 (0.3)
Tattoo obtained from	
Tattoo parlor	108 (58.7)
Temple	49 (26.6)
Fair/festival	15 (8.2)
Friends/self	11 (6)

Out of the seven TTI-positive donors, two had got the tattoo done <2 years ago from the date of donation. The other five donors had got tattoos <5 years ago. There was no significant association between the time of acquiring the most recent tattoo and the risk of TTI infection. This is probably due to increased awareness about safe tattooing practices among tattoo artists and the commercialization of tattoo shops. Tattooed donors are usually deferred for 6 months following tattooing due to the risk of window period infection. Donors who donated postexpiry of the deferral period were not found to be at increased risk.

The study suffers from the usual limitations of a cross-sectional study. Though we recruited more than the planned sample size of donors, the prevalence of TTI found was too low to establish a significant association. More extensive studies by recruiting more donors might help to provide robust data so that the unnecessary deferral of this group of safe and productive donors may be curtailed.

Conclusion

We found that the seroprevalence of TTI among tattooed donors was almost equal to that of nontattooed donors. We did not find a statistically significant association between having a tattoo and the risk of TTI. Depending on the upcoming evidence, the blood donor selection criteria for tattooing may be revised regularly to keep up with the trends of transmissible transfusion infections.

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Nil.

Conflicts of interest

There are no conflicts of interest.

Table 4: Comparison of prevalence of transfusion transmissible infection markers in the donors

Characteristics	Tattooed donors (*n*=184), *n* (%)	Nontattooed donors (*n*=184), *n* (%)	Total, *n* (%)	Chi-square test *P* value
HBV	6 (3.3)	4 (2.2)	10 (2.7)	0.52
HCV	0	4 (2.2)	4 (1.1)	0.1
HIV	0	0	0	1.0
Syphilis	1 (0.5)	0	1 (0.3)	0.5
Total	7	8	15	RR=0.88 (*P*=0.8)

RR=Relative risk

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