PREVALENCE OF SELECTED BLOOD-BORNE INFECTIOUS DISEASES AMONG VOLUNTARY BLOOD DONORS IN ABHA, SAUDI ARABIA

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Abstract. Donated blood must be evaluated for the presence of transfusion transmitted infections (TTIs). In this study, we aimed to determine the prevalence of TTIs among blood donors in order to study the epidemiology of these organisms in the study population. We retrospectively reviewed the records of all subjects who donated blood at the Central Blood Bank in Abha, Saudi Arabia, during 2017, 2018 and 2019. All TTIs in these subjects were recorded by year and determined if they were a normal blood donor or someone donating blood for a friend or family member. The lab tests recorded to detect TTIs were: antibodies against hepatitis B virus core antigen (anti-HBc), antibodies against hepatitis B surface antigen (anti-HBsAg), antibodies against hepatitis C virus (anti-HCV), antibodies against human immune deficiency virus types 1 and 2 (anti-HIV1&2), antibodies against human T-lymphotropic virus types 1 and 2 (anti-HTLV-1&2), hepatitis B surface antigen (HBsAg), *Treponema pallidum* hemagglutination test (TPHA) to detect syphilis and a malarial antigen (Malaria Ag) rapid detection test. A total of 25,253 subjects were included in the study; 99.39% (*n* = 25,098) male; 10.98% of subjects (*n* = 2,772) had a positive TTI test, of whom 47.01% (*n* = 1,303) were voluntary blood donors and 52.99% (*n* = 1,469) were replacement donors. The prevalences of positive TTI tests were: 5.91% (*n* = 1,492) for Anti-HBC, 4.56% (*n* = 1,151) for Anti-HBsAg, 0.48% (*n* = 121) for HBsAg, 0.01% (*n* = 3) for Anti-HCV, 0.01% (*n* = 2) for Anti-HIV1&2, <0.01% (*n* = 1) for Anti-HTLV1&2,

<0.01% (*n* = 2) for TPHA and 0.0% (*n* = 0) for Malaria Ag. The prevalence of an abnormal test for hepatitis B was 10.54% (*n* = 2,664) of the total subjects and the prevalence of the other TTIs was 0.03% (*n* = 8). There were no significant differences by year in the prevalences of TTIs and there was no significant difference between usual blood donors and blood replacement donors in the prevalence of TTIs. In summary, the prevalence of TTIs did not show any significant correlation between age, gender, nationality or donor status in the three-year observation.

Keywords: hepatitis B, hepatitis C, HIV, HTLV, syphilis, malaria, transfusion transmitted infections, blood borne infections

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INTRODUCTION

A blood transfusion is an important lifesaving procedure but the donated blood must be first screened (Abdel Gader *et al*, 2011) for the presence of transfusion transmitted infections (TTIs), such as human immunodeficiency virus (HIV), hepatitis B virus (HBV), hepatitis C virus (HCV), human T-lymphotropic viruses 1 and 2 (HTLV1 & 2), syphilis (Fong, 2020) and malaria. The methods used to screen donated blood for TTIs (Stramer and Dodd, 2013; Xu *et al*, 2019) and the donor recruitment process (Stramer, 2014) have been updated continuously over time. TTIs can be found in donated blood due to deficiencies in screening donors, meaning donated blood must rely on correct blood screening (Li *et al*, 2017).

The Ministry of Health (MOH) for Saudi Arabia oversees blood transfusion services in the Kingdom of Saudi Arabia. All donated blood in Saudi Arabia is screened with the following tests: anti-hepatitis B virus core antigen (anti-HBc), anti-hepatitis B surface antigen (anti-HBsAg), anti-hepatitis C virus (anti-HCV), anti-human immune deficiency viruses 1 and 2 (anti-HIV1&2), anti-human T-lymphotropic viruses 1 and 2 (anti-HTLV-1&2), hepatitis B surface antigen (HBsAg), the Treponema pallidum hemagglutination test (TPHA) and malaria antigen (Malaria Ag). In Saudi Arabia, Malaria Ag detection rates among blood donors are low (0.15 to 0.18%) (Saeed *et al*, 2002). Studies from Asir and Jazan, Saudi Arabia conducted during 2006-2015 among 180,000 blood donors found no blood samples positive for malaria Ag despite malaria being present in those areas (Elyamany *et al*, 2016). However, previous studies from Saudi Arabia have reported finding relatively high rates of screening tests positive for HIV, HBV, HCV, and HTLV among blood donors

(Al-Thaqafy *et al*, 2013; Redwan *et al*, 2012).

HCV infection is the most common transfusion-associated cause of non-A, non-B viral hepatitis worldwide (Kleinman *et al*, 2009) and is endemic in Saudi Arabia (Sarah *et al*, 2016). However, there is little data about the seroprevalence of HCV infection in Saudi Arabia. Donated blood was not screened for HCV infection until 1989 (Ibrahim *et al*, 2014).

The prevalence of potential TTIs in donated blood must be determined on a continuous basis due to changes over time and their associations with various factors determined in donor populations in order to guide screening practices. Knowing the prevalence of potential TTIs in a donor population can inform screening guidelines for blood banks (Velati *et al*, 2018). In this study we aimed to determine the prevalence of potential TTIs among blood donors in Asir, Saudi Arabia in order to inform decisions regarding future screening practices of donated blood in this area.

MATERIALS AND METHODS

We retrospectively reviewed the charts of potential blood donors who visited the Central Blood Bank, Asir Central Hospital, Abha, Saudi Arabia (Fig 1) during 2017, 2018, and 2019.

Fig 1 - Map of Saudi Arabia showing the location of the study region, Asir, in southwestern Saudi Arabia

Inclusion criteria for study subjects were all those who donated blood at the study site during the study period and were screened using the selected screening tests. Exclusion criteria for study subjects were those with inadequately screened blood, those in whom the screened blood was unsatisfactory for analysis, those with a metabolic disease, such as diabetes, those with hypertension and those with a malignancy.

In each study subject their blood was obtained and examined using the following tests: anti-HBc, anti-HBsAg, anti-HCV anti-HIV1&2, anti-HTLV-1&2, HBsAg, *Treponema pallidum* hemagglutination test (TPHA) for syphilis and malaria Ag. All tests were conducted using enzyme-linked immunosorbent assay (ELISA) test kits obtained from Abbott Laboratories, Chicago, IL except for the test for *Treponema pallidum* which used a hemagglutination test (TPHA) kit (Omega Diagnostics, Scotland, UK) and the test for malaria, which used the Care Start™ Malaria HRP-2/2DH(PF/pan) combo RDT (ACCESSBIO, Somerset, NJ).

Since the number of subjects who were of other nationalities and the number of female donors were low, we did not do comparison calculations with these groups.

The data were entered into Microsoft Excel (Microsoft Corporation, Redmond, WA). Descriptive statistics and the one-way analysis of variance (one-way ANOVA) tests were performed using Graph Pad Prism software, version 6 (GraphPad Software, San Diego, CA).

The central blood bank gave permission for retrospective review of the data. This study was approved by the Research Ethics Committee, Deanship of Scientific Research, King Khalid University, Abha, Kingdom of Saudi Arabia (ECM-2020-175).

RESULTS

A total of 25,253 subjects were included in the study; 99.39% (n = 25,098) male. Saudis comprised 89.58% of male subjects (n = 22,466) and 10.42% (n = 155) of female subjects (Table 1). A total of 2,772 samples (10.98%) had a positive TTI marker test; of which 121 (4.36%) had a positive HBsAg test. Of the 2,772 subjects with a positive TTI marker test, 47.01% (n = 1,303) were voluntary blood donors and 52.99% (n = 1,469) were replacement donors (Table 1).

The abnormal test results were as follows: 5.91% (n = 1,492) for Anti-HBC, 4.56% (n = 1151) for anti-HBsAg, 0.01% (n = 3) for anti-HCV, 0.01% (n = 2) for anti-HIV 1&2, <0.01% (n = 1) for anti-HTLV-1&2, 0.01% (n = 2) for TPHA and 0.00% (n = 0) for Malaria Ag (Table 2). There were no age specific patterns among study subjects with a positive screening test for TTI (Figs 2 and 3).

Among the subjects with a positive test (n = 2,772), those with 2 simultaneous positive tests were as follows: HBsAg + Anti-HCV in 0.04% (n = 1), HBsAg + Anti-HIV in 0.04% (n = 1), HBsAg + TPHA in 0.04% (n = 1) and Anti-HIV + TPHA in 0.04% (n = 1). Among subjects with a positive test (n = 2,772), 0.04% (n = 1) had 3 simultaneous

Table 1

Study population demography

Parameter	Number	Percent
Total donors	25,253	-
Male	25,098	99.39
Female	155	0.61
Saudi male	22,466	89.58
Saudi female	155	10.42
Non-Saudi*	2,632	10.42
Total TTI positives (Male and Female)	2,272	10.98
TTI positives (Voluntary donors)	1,303	47.01
TTI positives (Replacement donors)	1,469	52.99
Age groups in years		
<20	503	1.99
21 - 30	8,919	35.32
31 - 40	8,878	35.16
41 - 50	4,768	18.88
51 - 60	1,806	7.15
61 - 70	348	1.38
>70	31	0.12

* Males only; there were no females in the Non-Saudi group
TTI: Transfusion transmitted infections

positive tests: HBsAg + Anti-HIV + TPHA. The above lists of simultaneous positive tests excluded subjects who also had an additional positive Anti-HBc or Anti-HBsAg test (Table 3).

TTI test positivity was not significantly associated with gender, nationality being a voluntary or blood replacement donor or age group. There were no significant differences in Anti-HBc or Anti-HBsAg positivity by age group; these tests were positive in 95.34% (n = 2,643) of the 2772 subjects with a positive test for TTI. There was no significant difference in the rates of positive TTI tests by year (11.5% in 2017, 9.8% in 2018, 11.1% in 2019) (Table 2). There was no significant association between any TTI marker and any age group (Table 4).

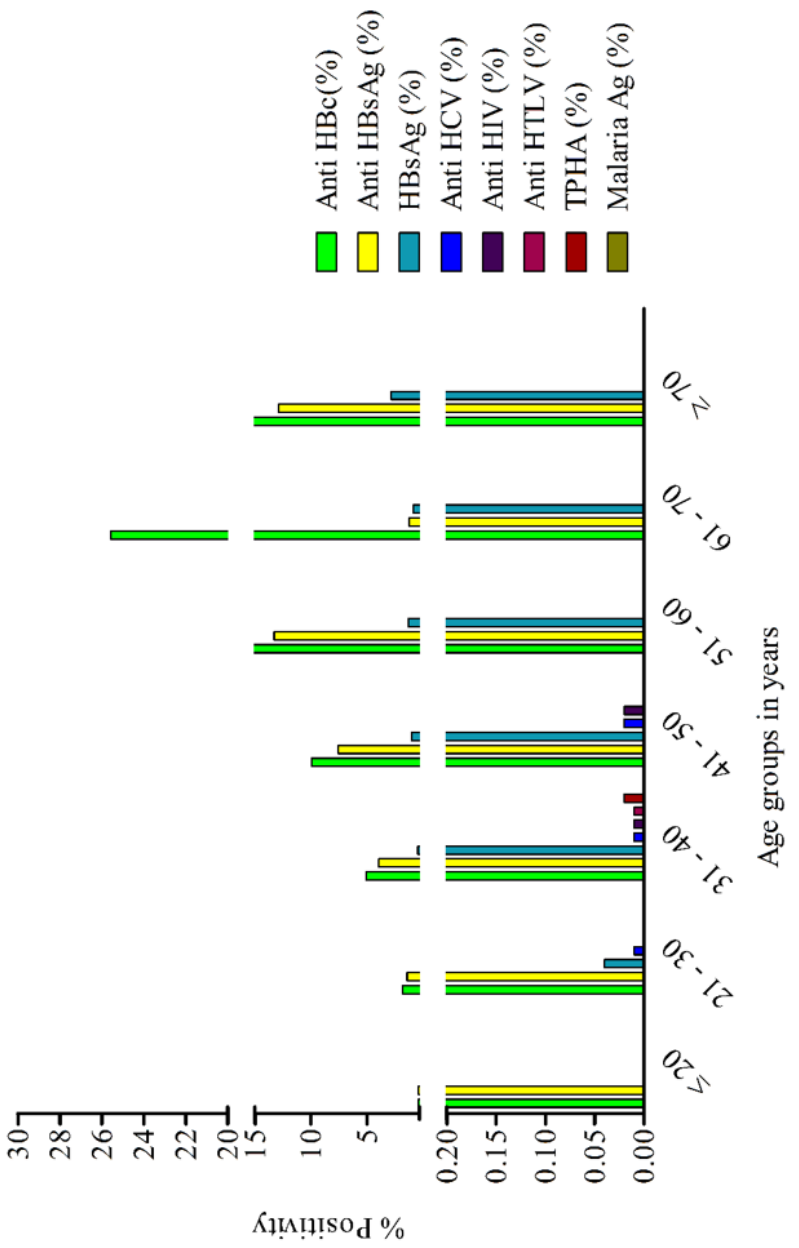

Fig 2 - Percentages of subjects with a positive screening test for a TTI by disease type

Anti HBc: antibodies to hepatitis B virus core antigen; Anti HBsAg: antibodies to hepatitis surface antigen; Anti HCV: antibodies to hepatitis C virus; Anti-HIV: antibodies to human immunodeficiency virus; Anti HTLV: antibodies to human T lymphotropic virus; HBsAg: hepatitis surface antigen; Malaria Ag: malaria antigen; TPHA: treponema pallidum hemagglutination antibodies for syphilis

Table 2

Prevalence of Transfusion-Transmitted Infections (TTI) among study subjects

Year	Total Donors	Total TTI Positives	Anti HBc	Anti HBsAg	HBsAg	Anti-HCV	Anti-HIV	Anti-HTLV	TPHA	Malaria Ag
	(n)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)
2017	9,327	1,075 (11.52)	604 (6.47)	397 (4.25)	68 (0.72)	3 (0.03)	2 (0.02)	0 (0.0)	1 (0.01)	0 (0.0)
2018	5,735	563 (9.81)	324 (5.64)	206 (3.59)	33 (0.57)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
2019	10,191	1,134 (11.12)	564 (5.53)	548 (5.37)	20 (0.19)	0 (0.0)	0 (0.0)	1 (<0.01)	1 (<0.01)	0 (0.0)
Total	25,253	2,772 (10.97)	1,492 (5.91)	1,151 (4.55)	121 (0.47)	3 (0.01)	2 (<0.01)	1 (<0.01)	2 (<0.01)	0 (0.0)

Anti HBc: antibodies to hepatitis B virus core antigen; Anti HBsAg: antibodies to hepatitis surface antigen; Anti-HCV: antibodies to hepatitis C virus; Anti-HIV: antibodies to human immunodeficiency virus; Anti-HTLV: antibodies to human T lymphotropic virus; HBsAg: hepatitis surface antigen; Malaria Ag: malaria antigen; TPHA: treponema pallidum hemagglutination antibodies for syphilis

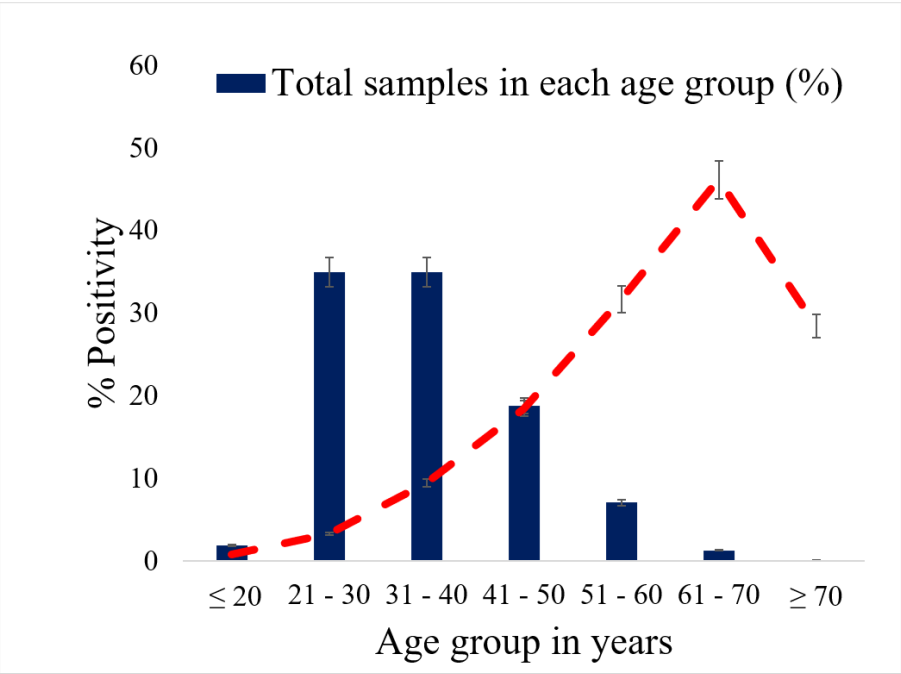

Fig 3 - Frequency of transfusion-transmitted infections by age group of study subject

Table 3

Prevalence of multiple infections among TTI positive samples

Co-infection pattern (2017 - 2019)	*n* (%)
HBsAg + Anti-HCV	1 (0.80)
HBsAg + Anti-HIV	1 (0.81)
HBsAg + TPHA	1 (0.81)
Anti-HIV + TPHA	1 (25.00)
HBsAg + Anti-HIV +TPHA	1 (0.80)

Anti HBsAg: antibodies to hepatitis surface antigen; Anti-HCV: antibodies to hepatitis C virus; Anti-HIV: antibodies to human immunodeficiency virus; HBsAg: hepatitis surface antigen; TPHA: treponema pallidum hemagglutination antibodies for syphilis

Table 4

Association between different age groups and TTI positivity from 2017 to 2109

Transfusion-Transmitted Infections (TTI)	*p*-value
Anti HBc	0.21
Anti HBsAg	0.53
HBsAg	0.74
Anti-HCV	0.87
Anti-HIV	0.42
Anti-HTLV	0.07
TPHA	0.09
Malaria Ag	NA

Anti HBc: antibodies to hepatitis B virus core antigen; Anti HBsAg: antibodies to hepatitis surface antigen; Anti-HCV: antibodies to hepatitis C virus; Anti-HIV: antibodies to human immunodeficiency virus; Anti-HTLV: antibodies to human T lymphotropic virus; HBsAg: hepatitis surface antigen; Malaria Ag: malaria antigen; NA: not applicable; TPHA: treponema pallidum hemagglutination antibodies for syphilis

DISCUSSION

In our study, the overall prevalence of an abnormal screening test for a TTI was 10.9%, higher than that reported from Qatar in 2017 (2.67%) (Aabdien *et al*, 2020) and Saudi Arabia in 2018 (0.7%) (Al-Majid, 2020). In our study, the prevalences of abnormal screening tests for TTI by year (11.52% during 2017, 9.81% during 2018, 11.12% during 2019) were similar to the prevalences reported in studies from Qatar (2.31% during 2016, 2.67% during 2017) (Aabdien *et al*, 2020), Eritrea (11.9% during 2014, 15.3% during 2015, 11.8% during 2016, 6.9% during 2017) (Keleta *et al*, 2019).

In our study, a fairly large percentage of subjects had a positive test for Anti-HBc (5.91%), similar to the results of studies from eastern Saudi Arabia with (3.24%) (Alzahrani *et al*, 2019) and Nigeria (10.1%) (Akinbami *et al*, 2012).

In our study, a fairly small percentage of subjects had a positive test for Anti-HBsAg (4.55%), much lower than studies from the United States (28.1%) and Saudi Arabia (22%) (Alabdallat and Bin Dukhyil, 2018; King *et al*, 2020), most likely reflecting the effects of hepatitis B vaccination.

In our study, the percentage of subjects with a positive HBsAg test

(0.47%) was lower than a study from central Saudi Arabia (1.9%) (Farshadpour *et al*, 2016) and a WHO estimate for the Middle East in general (2.03%) (Babanejad *et al*, 2016).

The rate of HCV positivity among our study subjects (0.01%) was much lower than a previous study from Saudi Arabia (0.23-0.91%) (Madani, 2007) and a WHO estimate for Saudi Arabia (1.5%) (Abdo *et al*, 2012). After Saudi Arabia began screening donated blood for HCV, there was a reduction in TTI due to HCV (Engle *et al*, 2014). Screening of all expatriate populations entering Saudi Arabia and pre-marital screening of Saudi citizens and the interventions as a result of these have contributed to a decline in the HCV infection rate (Shepard *et al*, 2005).

In our study, the prevalence of subjects with a positive screening test for HIV was 0.007%. One study from Saudi Arabia reported the incidence of a positive HIV test to be 1.5 cases/100,000 population per year among Saudi nationals and 1.2 cases/100,000 population per year among non-Saudis (Alharbi *et al*, 2018; Al-Mozaini *et al*, 2021).

In our study, only 1 out of 25,253 subjects had a positive test for HTLV 1 or 2. Saudi Arabia is nonendemic for HTLV 1 and 2; the first reported case of HTLV infection in Saudi Arabia occurred in 2015 (Hindawi *et al*, 2018).

In our study, only 2 out of 25,253 subjects had a positive TPHA test for syphilis. The rate of syphilis infection in Saudi nationals has been reported to be 1.7 cases/100,000 population; the fourth most common sexually transmitted infection in Saudi Arabia after nongonococcal urethritis, trichomoniasis and gonorrhea (Madani, 2006).

In our study, none of the subjects had a positive screening test for malaria. Malaria transmission has been reported from southwestern Saudi Arabia in Asir but this was not in donated blood (Saeed *et al*, 2002). No studies of donated blood in Asir, Saudi Arabia have reported finding malaria (Elyamany *et al*, 2016; Ngoma *et al*, 2019). This may be due to intensive malaria control efforts in the Asir region by the Ministry of Health for Saudi Arabia (Elyamany *et al*, 2016).

In our retrospective study reviewing donated blood screened for TTI among blood donors in Saudi Arabia, the incidence of positive tests was low. None of the abnormal tests were significantly associated with age group, gender or nationality. There were no significant differences in the incidences of TTI positive testing by year. There was a low percentage of subjects with anti-HBsAg indicating a need for hepatitis B vaccination in this study population.

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CONFLICT OF INTEREST DISCLOSURE

The author declares no conflict of interest.

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