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Prevalence of serological markers and risk factors for bloodborne pathogens in Salvador, Bahia state, Brazil

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SUMMARY

This study aimed to determine the prevalence of serological markers for HIV-1/2, HBV, HCV, *Treponema cruzi* and *T. pallidum* infections. The association of these infections with risk factors in a population from Salvador, Bahia, Brazil was also analysed. Of the 780 enrolled individuals, 545 (70%) were female and 235 (30%) were male. Seroprevalence of 0·8% (6/702), 1·3% (9/678), 1·5% (10/684), 3·5% (23/663) and 11·5% (77/668) for HIV-1/2, HBV, HCV, *T. cruzi* and *T. pallidum* infections, respectively, was observed. The seroprevalence of *T. pallidum* was higher in males 20% (43/210) than in females 7% (34/458) ($P<0·01$). An association between age and seroprevalence for *T. cruzi* ($P=0·02$) and *T. pallidum* ($P<0·01$) was observed. HBsAg was associated with having tattoos (3/37 *vs*. 6/623, $P=0·01$) and not having a steady sexual partner (5/141 *vs*. 4/473, $P=0·04$), while anti-HIV-1/2 was associated with having tattoos (2/39 *vs*. 4/647, $P=0·04$); however, larger studies are needed to categorically state the relationship of these risk factors with infectious agents. The prevalence of serological markers for HIV-1/2, HBV, HCV and *T. cruzi* was consistent with other studies.

Key words: Chagas disease, hepatitis, infectious diseases, syphilis, seroprevalence.

INTRODUCTION

Infectious diseases are among the leading causes of morbidity and mortality in healthcare institutions throughout the world and are considered a major public health problem [1]. HIV-1/2, hepatitis B virus (HBV), hepatitis C virus (HCV), *Treponema cruzi* and *T. pallidum* are infectious agents that mainly affect residents of underdeveloped or developing countries [1–3]. Modes of transmission of infectious agents include vertical transmission from mothers to infants, sexual contact (except for *T. cruzi*), and exposure to blood and/or transfusion of blood products, sharing sharp objects and undergoing body piercing [4].

In 2009, the overall number of individuals infected with HIV was estimated to be 33 million [5]. In Brazil, from 1980 to June 2010, there were about 0·6 million cases of AIDS reported. There were 17 886 cases reported in Bahia, ranking 8th in the Brazilian ranking of notifications in that referral period [6]. The World Health Organization (WHO) estimates that there are 350 million people worldwide with chronic HBV infection and 130 million people infected with

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hepatitis C, most of whom have chronic HCV infection [7, 8]. Sexually transmitted disease (STD) statistics show that there were 11 million new cases of syphilis worldwide in 2005 [9]. This infection affects about one million pregnant women per year, causing serious problems ranging from congenital syphilis to spontaneous abortion [10]. With respect to Chagas disease, it is believed that there are between 12 and 14 million individuals infected with *T. cruzi* in Latin America, and more than 60 million people are at risk of transmission in endemic areas [11].

This study aimed to determine the prevalence of serological markers for HIV-1/2, HBV, HCV, *T. cruzi* and *T. pallidum* in the population assisted by the Family Health Programme (FHP) in neighbourhoods of the city of Salvador, Bahia. The association of seropositivity rate with risk factors for such pathogens was also evaluated here.

METHODS

Population and study design

The studied population was informed of the research objectives and all persons who signed the informed consent were included. Thirty-two persons refused to participate. We obtained a blood sample from 780 individuals. Bloods samples were collected at a FHP healthcare unit in five major areas of the city of Salvador, Bahia.

For this cross-sectional study, secondary data were obtained through a questionnaire enquiring about potential risk factors for infection by HIV-1/2, HBV, HCV, *T. cruzi* and *T. pallidum*, including condom use, steady sexual partner, use of own manicure or pedicure kit, prior haemodialysis procedures, tattooing, piercing and history of blood transfusion. The participants completed the questionnaire alone in a separate room. Each subject was identified by a number control and the confidentiality of informations was guaranteed.

We collected 5 ml blood in a vacuum system, using a test tube without anticoagulant or separating gel (BD Vacutainer® SS^{TT}, USA). Biological samples were packed correctly and sent to the Immunology Service of Infectious Diseases (ISID) at the Faculty of Pharmacy, Federal University of Bahia (UFBA), where serological tests were performed.

The results of the immunoassays were sent to all FHP healthcare units, according to the origin of the biological material, as agreed previously with the participants. Thus, the participants could receive their results. This research protocol was approved by the Ethics Committee of Climério de Oliveira Maternity at UFBA.

Serological tests

The samples were subjected to serological tests for detection of markers of HIV-1/2 (Genscreen™ HIV-1/2, v. 2, Bio-Rad, France), HBV (HBsAg Monolisa™ Ultra, Bio-Rad), HCV (HCV Ab, Radim, Italy), *T. pallidum* (Syphilis Screening Recombinant, Radim) and *T. cruzi* (ELISA Recombinant Chagatest, v. 3.0; Wiener, Argentina). The tests were performed using the automated system ALISEI (Radim), according to the manufacturer's protocol. The markers of HIV-1/2 and *T. cruzi* detected by ELISA were confirmed with an immunofluorescence assay (IFA-HIV-1, Bio-Manguinhos, Brazil and Immuno-Con Chagas, WAMA Diagnostica, Brazil). Reactive samples for HBsAg, anti-HCV or anti-*T. pallidum* were confirmed in duplicate.

Statistical analysis

Statistical analysis was performed using SPSS v. 9.0 for Windows (SPSS Inc., USA) and GraphPad InStat (GraphPad Software Inc., USA). Categorical data were analysed with Fisher's exact test or χ^2 test, accepting statistical significance as $P<0{\cdot}05$, with a two-tailed analysis. The association between infections and the study variables was measured by unadjusted odds ratios (OR) at intervals of 95%.

RESULTS

The present study included 780 individuals. Of these, 545 (70%) were female (mean age 43·2, median age 44·0, S.D. = 14·7, min–max 0–82 years) and 235 (30%) were male (mean age 45·8, median age 47·0, S.D. = 16·7, min–max 4–84 years). Overall, the mean age of the study population was 44 years (median 44·0, S.D. = 15·4, min–max 0–84).

Figure 1 shows the total seroprevalence found and the seroprevalence stratified by gender. The observed seroprevalence was 0·8% (6/702), 1·3% (9/678), 1·5% (10/684), 3·5% (23/665) and 11·5% (77/668) for infections with HIV-1/2, HBV, HCV, *T. cruzi* and *T. pallidum*, respectively. Male subjects had a higher seroprevalence of *T. pallidum* (20%, 43/210) than females (7%, 34/458) ($P<0{\cdot}01$).

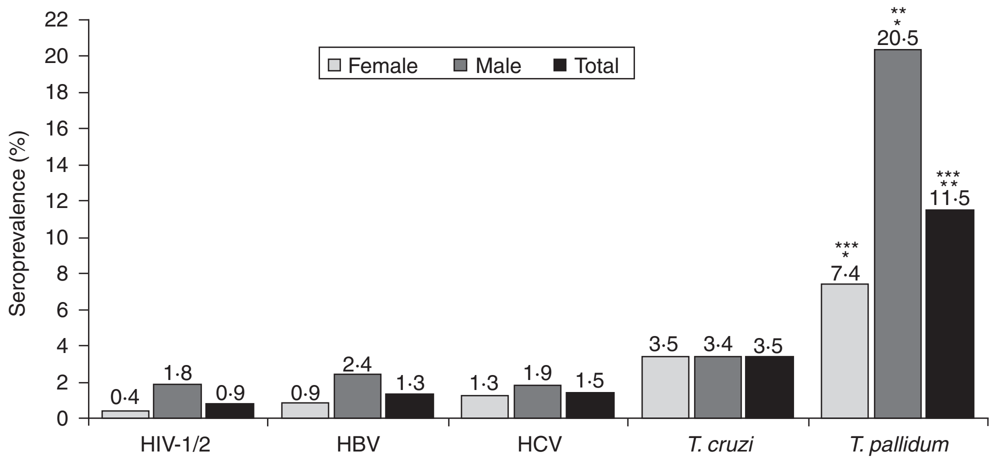

Fig. 1. Seroprevalence total stratified by gender. Data in absolute numbers for female, male and total, respectively: HIV-1/2 (2/485, 4/217, 6/702); HBV (4/466, 5/212, 9/678); HCV (6/471, 4/213, 10/684); *Treponema cruzi* (16/457, 7/208, 23/665); *T. pallidum* (34/458, 43/210, 77/668) (* $P<0{\cdot}01$, ** $P<0{\cdot}01$, *** $P=0{\cdot}02$).

Figure 2 shows the seroprevalence according to age group. Increasing prevalence was directly proportional to age in markers for infection by *T. pallidum* ($P<0{\cdot}01$) and *T. cruzi* ($P=0{\cdot}02$). No individuals aged 0–15 years were positive for these serological markers.

Table 1 shows the seroprevalence of infections according to possible risk factors. There was a statistical association between positive serology for HBsAg and having tattoos (3/37 *vs.* 6/623, $P=0{\cdot}01$) and not having a steady sexual partner (5/141 *vs.* 4/473, $P=0{\cdot}04$). There was also an association between serological reactivity to HIV-1/2 and having tattoos (2/39 *vs.* 4/647, $P=0{\cdot}04$).

DISCUSSION

Infectious diseases represent an increasingly important cause of human morbidity and mortality throughout the world, especially in underdeveloped or developing countries, where it is more challenging to diagnose and treat infections [12–14]. The FHP is an initiative arising from the need to expand healthcare and focuses on preventive measures and establishing links and co-responsibility between health professionals and the population [15]. The locations of the FHP are reference points for health activities in the neighbourhoods where the population has access to primary healthcare services [16].

Of the 780 individuals who participated in this study, 70% were female and 30% were male. The greater female participation is probably due to the fact that women are more attentive to healthcare issues than men and in general receive more frequent health services than men [17, 18].

The seroprevalence rates found in this study were 0·8% (HIV-1/2) 1·3% (HBV), 1·5% (HCV), 3·5% (*T. cruzi*) and 11·5% (*T. pallidum*) (Fig. 1). The only difference between the genders was with respect to infection with *T. pallidum* ($P<0{\cdot}01$) (Fig. 1).

Several Brazilian studies have measured the prevalence of *T. pallidum* as ranging from 0·5 to 8·0% [19–24]. Miranda and colleagues [19] studied a total of 1380 young women (average age 23 years) in the city of Vitoria (Espírito Santo); they found a syphilis seroprevalence in these women of 1·2% [19]. Bartlett and colleagues [20] reported 3·2% seropositivity for *T. pallidum* in 282 Indians of the Brazilian Amazon, and Ribeiro and colleagues [21] found 5·7% seroprevalence of syphilis in a municipal hospital in Duque de Caxias (Rio de Janeiro), where 1087 serum samples were tested.

Notably, most studies of the seroprevalence of syphilis are performed using the Venereal Disease Research Laboratory (VDRL) test, a non-treponemal test that has good correlation with active syphilis. However, in this study, we used an ELISA-type immunoassay for detection of total anti-*T. pallidum* antibodies which does not discriminate between active or past infection. On the other hand, some papers discuss the possibility of false-positives in treponemal tests. All *T. pallidum* subspecies are morphologically identical and cross-react to the same serological tests. Unexplained reactive serological results may occur, particularly in elderly patients. Some false-positive reactions may be due to the failure of the sorbent used

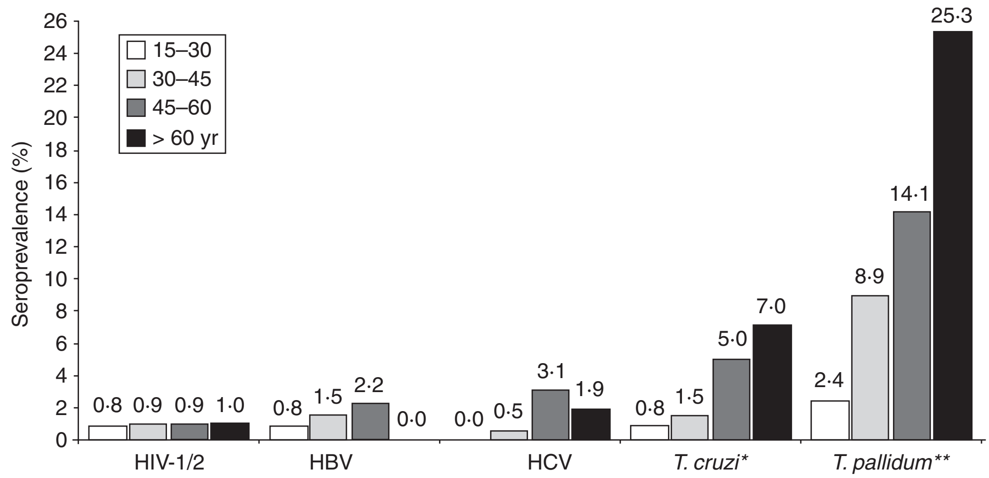

Fig. 2. Seroprevalence according to age group. Data in absolute numbers for age groups 15–30, 30–45, 45–60, >60 years, respectively: HIV-1/2 (1/132, 2/211, 2/232, 1/104); HBV (1/127, 3/203, 5/224, 0/103); HCV (0/129, 1/205, 7/226, 2/103); *Treponema cruzi* (1/126, 3/201, 11/219, 7/100); *T. pallidum* (3/127, 18/203, 31/220, 25/99) (* $P=0{\cdot}02$, ** $P<0{\cdot}01$).

in the tests to remove all cross-reacting group, genus, or family antibodies, e.g. in Lyme disease or yaws [25–27]. There are reports of the WHO from the 1950s that consider various areas of the Brazilian northeast, such as the southern part of Bahia state, endemic for yaws [28].

There are also two important factors that may have contributed to the high seroprevalence of anti-*T. pallidum* found in our study: the social origin and age of the participants. Several studies indicate that STD are more prevalent in populations of lower socioeconomic status [6, 14, 15]. Our samples were obtained from individuals in different districts of Salvador, Bahia, where many people live in precarious socioeconomic conditions. The high seroprevalence of *T. pallidum* in the present study was observed in individuals aged >30 years (Fig. 2), confirming the findings of other researchers who suggest that STD rates are in direct proportion to increasing age of the individuals. The highest rates of STD in individuals aged >30 years may be due to the fact that these individuals have had more time to be exposed to the infectious agent and are more likely to be neglected by public health agencies that focus fewer health education efforts on individuals aged >30 years. Another factor may be the frequency of unprotected sex after age 30 years [24, 29]. The higher seroprevalence of *T. pallidum* found in males ($P<0{\cdot}01$) may be related to the factors mentioned above, or to unprotected extramarital sex (Fig. 1).

The seroprevalence of HIV-1/2, HBV, HCV and *T. cruzi* infection found in this study were similar to those found in other Brazilians cities (Fig. 1) [6, 30, 31]. The Brazilian Health Department estimates that HIV infection ranges from 0·5% to 1% across Brazilian states [6]. Epidemiological studies on the prevalence of HBV or HCV infection are rare and usually conducted in specific populations. Globally, the prevalence of hepatitis B ranges from 0·1% to 30% [31]. A prevalence study for HBsAg in São Paulo city detected reactivity in 1% of studied individuals [32]. Cities where the prevalence of HBsAg is <2% are considered low-prevalence areas [33], which is the case for Salvador (Fig. 1).

Additional information on the background rates of hepatitis B infection (through anti-HBc testing) would be valuable to best characterize our patients; however, it was not possible due to internal difficulties in the logistics of purchasing the kits. HCV infection in the Brazilian population varies between 1% and 2% according to reports from various areas [33], although the national prevalence is not well established.

The seroprevalence of anti-*T. cruzi* antibodies observed in this study was 3·5% and was higher in individuals aged >45 years ($P=0{\cdot}02$) (Fig. 2). There was no difference between males and females (3·4% *vs.* 3·5%, $P>0{\cdot}05$) (Fig. 1). Silveira and colleagues [34] observed a prevalence of Chagas disease in 1·2% of 10 667 blood donors in Rio de Janeiro, but a higher prevalence in individuals aged >40 years, possibly due to interruption of vector transmission of *T. cruzi*.

Some risk factors and behaviours may be associated with seroprevalence for various infectious diseases, including percutaneous exposure (parenteral) to contaminated needles or other instruments, multiple blood transfusions, intravenous drug

Table 1. *Risk factors for bloodborne Infections*

	HIV-1/2+		HIV-1/2−				HBV+		HBV−				HCV+		HCV−				TC+		TC−				TP+		TP−			
Variables	*n*	%	*n*	%	OR	*P*	*n*	%	*n*	%	OR	*P*	*n*	%	*n*	%	OR	*P*	*n*	%	*n*	%	OR	*P*	*n*	%	*n*	%	OR	*P*
Steady sexual partner																														
Yes	5	1·0	491	99·0	1·53	1·00	4	0·8	473	99·2	0·24	0·04	6	1·2	476	98·8	0·6	0·44	11	2·4	455	97·6	0·48	0·16	54	11·5	416	88·5	0·92	0·77
No	1	0·7	150	99·3			5	3·4	141	96·6			3	2·0	144	98·0			7	4·8	139	95·2			18	12·4	127	87·6		
Own manicure kit																														
Yes	2	0·5	367	99·5	0·49	0·66	6	1·7	355	98·3	1·42	0·74	8	2·2	354	97·8	2·93	0·21	15	4·3	337	95·7	2·22	0·17	39	11·0	313	89·0	0·91	0·70
No	3	1·1	269	98·9			3	1·2	253	98·8			2	0·8	259	99·2			5	2·0	249	98·0			31	12·0	226	88·0		
Prior haemodialysis																														
Yes	0	0·0	3	100·0	14·6	1·00	0	0·0	3	100·0	9·62	1·00	0	0·0	3	100·0	8·76	1·00	0	0·0	3	100·0	3·73	1·00	0	0·0	3	100·0	1·06	1·00
No	6	0·9	664	99·1			9	1·4	639	98·6			10	1·5	643	98·5			23	3·6	613	96·3			75	11·8	563	88·2		
Tattoos																														
Yes	2	4·9	39	95·1	8·3	0·04	3	7·5	37	92·5	8·41	0·01	1	2·5	39	97·5	1·78	0·46	0	0·0	39	100·0	0·32	0·39	5	12·8	34	87·2	1·12	0·80
No	4	0·6	647	99·4			6	1·0	623	99·0			9	1·4	625	98·6			23	3·7	594	96·3			72	11·6	547	88·4		
Piercing																														
Yes	0	0·0	19	100·0	2·53	1·00	0	0·0	19	100·0	1·67	1·00	0	0·0	19	100·0	1·52	1·00	0	0·0	18	100·0	0·71	1·00	1	5·6	17	94·4	0·44	0·71
No	6	0·9	643	99·1			9	1·4	617	98·6			10	1·6	622	98·4			22	3·6	592	96·4			73	11·8	544	88·2		
Prior blood transfusion																														
Yes	0	0·0	6	100·0	7·99	1·00	0	0·0	5	100·0	6·96	1·00	0	0·0	5	100·0	5·67	1·00	0	0·0	4	100·0	2·95	1·00	0	0·0	4	100·0	0·87	1·00
No	6	0·9	675	99·1			8	1·2	650	98·8			10	1·5	654	98·5			23	3·6	623	96·4			73	11·2	576	88·8		
Condom use																														
Yes	5	2·3	212	97·7	10·3	0·02	3	1·4	207	98·6	1·00	1·00	4	1·9	210	98·1	1·59	0·49	3	1·4	204	98·6	0·34	0·09	26	12·4	184	87·6	1·08	0·79
No	1	0·2	437	99·8			6	1·4	415	98·6			5	1·2	418	98·8			17	4·1	396	95·9			48	11·6	365	88·4		

HBV, Hepatitis B virus; HCV, hepatitis c virus; TC, *Treponema cruzi*; TP, *Treponema pallidum*; OR, odds ratio.
Data collected in the questionnaire about previous hospitalization, use of daily medications and having lived in other cities in Bahia state were deleted from the table.
When one value is zero, to make calculations possible, 0·5 was added to each value.

use, sexual promiscuity, unprotected anal intercourse, body piercing, tattoos or dental procedures, or unsafe medical and surgical practices [12–14].

This study involved a questionnaire designed to evaluate risk factors for each tested infection (Table 1). A statistical association was observed between positive serology for HBsAg and tattoos (3/37 *vs*. 6/623, $P=0{\cdot}01$) and not having a steady sexual partner (5/141 *vs*. 4/473, $P=0{\cdot}04$). There was also an association between serological reactivity of HIV-1/2 with tattoos (2/39 *vs*. 4/647, $P=0{\cdot}04$) (Table 1), underscoring the importance of achieving better sanitation monitoring of establishments that perform tattoo placement in Salvador, Bahia.

It is worth emphasizing that 83·3% (5/6) of individuals who were seropositive for HIV-1/2 reported using condoms during sexual relations (Fig. 1), thus besides the necessity for public health campaigns to emphasize the importance of using condoms during all sexual relations between seropositive or serodiscordant couples, it is also necessary to adopt continuous preventive actions to reduce the virus dissemination in general population [35, 36].

CONCLUSION

The prevalence of serological markers for HIV-1/2, HBV, HCV and *T. cruzi* in individuals assisted by the FHP in Salvador, Bahia is in agreement with other published data. The high seroprevalence of *T. pallidum*, especially in men aged >45 years, and the association between HIV-1/2 and HBV infection with having tattoos, should be carefully considered by competent public health authorities; however, larger studies are needed to categorically state the relationship of these risk factors with infectious agents. This investigation demonstrates both the local importance of thorough investigation of the various risk factors involved in infectious diseases and the need to conduct ongoing health education in the city of Salvador, Bahia.

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DECLARATION OF INTEREST

None.

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