Seroprevalence of infectious markers HCV, HBV, HIV and the agent of syphilis among blood donors from the blood transfusion center (BTC of Constantine) in a hospital in eastern Algeria

Soroprevalência de marcadores infecciosos HCV, HBV, HIV e o agente da sífilis entre doadores de sangue do centro de transfusão de sangue (BTC de Constantine) em um hospital no leste da Argélia

Seroprevalencia de los marcadores infecciosos VHC, VHB, VIH y del agente de la sífilis entre los donantes de sangre del centro de transfusión sanguínea (BTC de Constantine) de un hospital del este de Argelia

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ABSTRACT
Microbial agents transmitted by blood transfusion, HBV, HCV, HIV and syphilis remain a major problem for transfusion safety. The objective of this study is to determine the seroprevalence of infectious markers in order to contribute to the improvement of the safe and sufficient supply of blood. This is a retrospective study.
cross-sectional study carried out at the BTC SMK laboratory in Constantine covering the period from January 2019 to December 2021. Our sample is mainly composed of voluntary, adult, young and male donors. 9155 donors who underwent a screening examination during the period (2019-2021). The seroprevalence of HBV, HCV, HIV and syphilis was respectively 0.40%, 0.12%, 0%, 0.14%, with a male predominance whose age group [36-45] presents the highest frequency of HCV, HBV and syphilis. Our results justify donor selection and screening tests.

**Keywords:** Seroprevalence. HBV. HCV. HIV. Syphilis. Blood Donors.

**RESUMO**
Os agentes microbianos transmitidos por transfusão de sangue, HBV, HCV, HIV e sífilis, continuam sendo um grande problema para a segurança da transfusão. O objetivo deste estudo é determinar a soroprevalência de marcadores infecciosos a fim de contribuir para a melhoria do suprimento seguro e suficiente de sangue. Este é um estudo transversal retrospectivo realizado no laboratório BTC SMK em Constantine, abrangendo o período de janeiro de 2019 a dezembro de 2021. Nossa amostra é composta principalmente de doadores voluntários, adultos, jovens e do sexo masculino. 9155 doadores que foram submetidos a um exame de triagem durante o período (2019-2021). A soroprevalência de HBV, HCV, HIV e sífilis foi, respectivamente, 0,40%, 0,12%, 0%, 0,14%, com predominância masculina, cuja faixa etária [36-45] apresenta a maior frequência de HCV, HBV e sífilis. Nossos resultados justificam a seleção de doadores e os testes de triagem.

**Palavras-chave:** Soroprevalência. HBV. HCV. HIV. Sífilis. Doadores de Sangue.

**RESUMEN**
Los agentes microbianos transmitidos por transfusión sanguínea, el VHB, el VHC, el VIH y la sífilis siguen siendo un problema importante para la seguridad transfusional. El objetivo de este estudio es determinar la seroprevalencia de los marcadores infecciosos para contribuir a la mejora del suministro seguro y suficiente de sangre. Se trata de un estudio transversal retrospectivo realizado en el laboratorio BTC SMK de Constantina que abarca el período comprendido entre enero de 2019 y diciembre de 2021. Nuestra muestra se compone principalmente de donantes voluntarios, adultos, jóvenes y varones. 9155 donantes que se sometieron a un examen de detección durante el período (2019-2021). La seroprevalencia de VHB, VHC, VIH y sífilis fue respectivamente del 0,40%, 0,12%, 0%, 0,14%, con predominio masculino cuyo grupo de edad [36-45] presenta la mayor frecuencia de VHC, VHB y sífilis. Nuestros resultados justifican la selección de donantes y las pruebas de cribado.

**Palabras clave:** Seroprevalencia. VHB. VHC. VIH. Sífilis. Donantes de Sangre.
1 INTRODUCTION

Blood donation is a voluntary, anonymous and voluntary medical act. It takes place within a very strict legislative framework. It therefore allows modern medicine to treat and save many human lives. A simple blood donation can help save up to four lives. While blood transfusion can save lives, it also carries risks, in particular the transmission of infections through blood which can cause morbidity and mortality in recipients (WHO, 2010). Effective screening for blood-borne agents to exclude donations at risk of transmitting infection can reduce them to very low levels. All donations must satisfy safety standards with respect to so-called major viruses, which are: hepatitis B (HBV) and C (HCV) virus, human immunodeficiency virus (HIV) as well as -vis the agent of syphilis (Babokh et al., 2022). In Algeria, the factors of the difficulties encountered in accessing a secure donation are: the presence of variable frequency rates of viruses. Algeria is a country of average endemicity in HBV and HCV, the latter distributed with different geographical variations from one region to another where local studies indicate that the wilayas of the highlands and the South report the highest rates (Zemour, 2017).

In 2020, the World Health Organization (WHO) estimated 37.7 million people living with HIV. Among the behaviors and situations that increase the risk of contracting the HIV virus, risky blood transfusion (World Health Organisation (WHO, 2021).

Chronic hepatitis B carriage, in 2019, the WHO estimated that 296 million people were living with chronic hepatitis B (WHO, 2021). Currently, there is no effective vaccine against hepatitis C (WHO, 2021).

The main objective of our study is to determine the seroprevalence of infectious markers HCV, HBV, HIV and syphilis in blood donors at the blood transfusion center (BTC SMK) of Constantine in Algeria. This is a cross-sectional survey, where the statistics of the data concerning the population studied and the serological data over a period of three years (2019-2021) were analyzed.
2 MATERIAL AND METHODS

This is a cross-sectional epidemiological study of a descriptive retrospective nature conducted among donors at the Blood Transfusion Center (CTS) of SMK in Constantine. The study was carried out from January 1, 2019 to December 31, 2021.

Voluntary donors, although family donors, are selected beforehand via an interview and a clinical and physical examination under the responsibility of a medical doctor in addition to a health questionnaire to be completed containing their personal history (travels, sexual practices, use drugs, etc.), medical (medication, chronic illnesses, surgical interventions, etc.), essential to determine if the donation is not detrimental to the safety of the donor and recipient.

For each donor two types are collected:

- a tube of ethylene-diamine-tetra-acetic acid (EDTA) with a purple cap for the immunological qualification of the donation (ABO/Rh blood grouping/phenotyping);
- a dry tube with a red cap for microbiological qualification (serological screening tests for HCV, HBV, HIV, Syphilis);
- screening for hepatitis C infection at the CTS SMK was performed by the prestige third-generation anti-HCV ELISA test. The specificity of the kit was 99.97%.

The screening test for HBV infection of blood donors is carried out using the ADVANCED® kit 3rd generation kit which is an enzyme immunoassay (ELISA) for the qualitative determination of the surface antigen of blood. Hepatitis B (HbsAg) in human serum or plasma, with 100% sensitivity, and 100% specificity. For the HIV Virus Screening test, the virus screening in our study is based on the use of the ADVANCED® kit which is a specific and sensitive immuno-enzymatic assay test for the qualitative determination of antibodies directed against the HIV virus. human immunodeficiency HIV type 1 and/or 2 (HIV1/2) in human serum or plasma. Syphilis screening in our study is based on the use of the specific and sensitive ADVANCED® kit for the detection of specific Treponema pallidum antibodies in serum, performed on a microtiter plate. Any blood donation whose serological tests were positive or doubtful was excluded from the donation.
3 RESULTS

9155 blood donors were registered in the period from 01/01/2019 to 31/12/2021. We have recorded a notable drop during these three years. An average of 3052 donations per year, of which we recorded the highest value in 2019 (3415 donation) (Figure 1).

![Figure 1: Distribution of blood donors during the period 2019 – 2021.](source)

Among 9155 donors, 5017 were occasional (54.80%) against 4138 (45.19%) regular donors. 5974 were male (65.25%), 3181 were female (34.74%). Predominance of male blood donors with a male/female sex ratio = 1.9.

- for the three years (2019-2021) we notice that it is always the age group [18-27] which predominates, followed by the age group [27-36]. While the [54-66] years remain the least concerned by blood donation (Figure 2).

![Figure 2: Distribution of blood donors by age group 2019 – 2021.](source)
Out of 9155 blood donors who underwent a screening examination for HCV, HBV, HIV, syphilis markers in the period of our study. The seroprevalence of HBV is the highest 37 cases (0.40%), then the syphilis 13 cases (0.14%), then HCV 11 cases (0.12%).

- no positive cases of HIV-1 and HIV-2;
- no co-infection was recorded in our study.

As shown in the table below, the frequency of HCV serology has increased over 3 years, where it reaches the highest value of (0.21%) in 2021 (Table 1).

<table>
<thead>
<tr>
<th>Year</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of positive cases</td>
<td>02</td>
<td>03</td>
<td>06</td>
<td>11</td>
</tr>
<tr>
<td>Prevalence</td>
<td>0.05%</td>
<td>0.09%</td>
<td>0.21%</td>
<td>The average = 0.12%</td>
</tr>
</tbody>
</table>

Source: Blood Transfusion Center (CTS) of SMK in Constantine (2022)

Among the 11 positive cases of HCV from 2019 to 2021, 9 male cases (81.81%), higher than its value in females, 2 cases (18.18%), with a male/female sex ratio = 4.5.

- the highest frequency of HCV was found in donors who belong to the age group [36-45] (0.26%). We also recorded a high value in the age group [27-36](0.18%). No cases were recorded in the age group [54-66].

The frequency of HBV serology is irregular, where it decreased in 2020 (0.36%) and grows by a small percentage in 2021 when it reached the highest value (0.43%) (Table 2).

<table>
<thead>
<tr>
<th>Year</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of positive cases</td>
<td>14</td>
<td>11</td>
<td>12</td>
<td>37</td>
</tr>
<tr>
<td>Prevalence</td>
<td>0.40%</td>
<td>0.36%</td>
<td>0.43%</td>
<td>The average = 0.40%</td>
</tr>
</tbody>
</table>

Source: Blood Transfusion Center (CTS) of SMK in Constantine (2022)

Among 37 positive cases of HBV recorded during the period 2019-2021, 31 male cases (83.87%), higher than its value for females (16.21%), with a male/female sex ratio = 5.17.

The age group [36-45] was the most affected by HBV (0.69%) 13 cases. We also recorded significant percentages in the two age groups [45-54] and [27-36] respectively (0.65%), (0.34%).
There is an irregular change in the evolution of the seroprevalence of syphilis over three years where it reaches the highest percentage (0.16%) in 2020, on the other hand a similar seroprevalence is recorded in 2019 and 2021 with 4 cases (Table 3).

Table 3: Distribution of Syphilis seroprevalence according to years n = 13

<table>
<thead>
<tr>
<th>The year</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of positive cases</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>13</td>
</tr>
<tr>
<td>Prevalence</td>
<td>0.11%</td>
<td>0.16%</td>
<td>0.14%</td>
<td>The average = 0.14%</td>
</tr>
</tbody>
</table>

Source: Blood Transfusion Center (CTS) of SMK in Constantine (2022)

Among 13 positive cases of syphilis in the period 2019 to 2021. 12 male cases (92.31%) while females register only 1 case (7.69%), with a sex ratio male / female=12. The seroprevalence of syphilis according to age group shows that donors belonging to the age group [36-45] have the highest frequency (0.26%) 5 cases. We also recorded a high value in the age group [27-36] [(0.15%) 4 cases.

4 DISCUSSION

9155 blood donors were registered in the period from 01/01/2019 to 31/12/2021. We recorded a notable drop during these three years. This decrease in the number of blood donors is due to the outbreak of the COVID-19 pandemic which has led to a drop in blood donation activities due to quarantine. compulsory in whole or in part by the authorities, in order to avoid transmission or exposure to infection.

In our study and out of a total of 9155, 5017 were occasional donors (54.80%), exceeding the 4138 regular donors (45.19%). The type of occasional donation is predominant, Among the most important reasons, the lack of awareness of the importance and benefits of giving regularly. These results are consistent with data reported by the WHO showing high rates of voluntary non-remunerated blood donation in low- and middle-income countries (WHO, 2021). A Predominance of male blood donors with a male/female sex ratio = 1.9. Women are poorly represented because they have additional contraindications: menstruation, pregnancy, childbirth, medical or voluntary termination of pregnancy, breastfeeding. As well as certain social requirements (lifestyle of the Algerian woman, most confined to the home). It can be added that most campaigns for blood collection operations in Algeria take place in mosques. Donors who
belong to the age group [18-27] are the majority (21.27%). This age group is the most suitable for donation because it is the most active, the most considered healthy and has fewer contraindications. These results are consistent with WHO data showing that young people are the most generous blood donors in low- and middle-income countries (WHO, 2021). The prevalences obtained in our study were respectively 0.12%, 0.40%, 0%, 0.14% for HCV, HBV, HIV and syphilis. These results are different from the seroprevalences reported by other studies conducted in Algeria: Sidi Bel Abbes: HCV (0.37%), HBV (0.4%), HIV (0.1%), syphilis (0.9%) Beni messous: HCV (0.14%), HBV. (0.28%), HIV (0.05%), syphilis (0.3%) (Ossinga et al., 2018; Bouhalissa et al., 2019). The seroprevalences in our study remain lower than those in some African countries (Batinat & al., 2007). This agrees with WHO data, low-income countries still have limited capacity to provide an effective system for donor education and screening. On the other hand, our result is higher than that of high-income countries (WHO, 2021). This is linked to the specificity of the socio-demographic characteristics essentially composed of mainly regular voluntary donors. In addition, regular donors are regularly subjected to screening tests, so in this group the prevalence of blood-borne infections is the lowest, in addition to the improvement of preventive measures with regard to the selection of donors and screening tests (Zemour, 2017).

4.1 HCV

Among 9155 donors, 11 cases with hepatitis C with a frequency of 0.12%. This result is similar to that found at CHU Beni Messous 0.14% (Bouhalissa & al., 2019), however our frequency is higher than that found in France, 260 cases for 8.8 millions in habitants) (Ossinga et al., 2018). Moreover, our frequency is lower than that found in several Sub-Saharan African countries: Congo 3.5%, Gabon 3.3%, Nigeria 1.2% (2009) (Batina et al., 2007).

Our frequency is lower than that reported by the WHO, in low-income countries the prevalence of HCV is (1.00%) (WHO, 2021).

There is a male predominance of positive cases with a male/female sex ratio = 4.5. While a study carried out in a general population reported the female
predominance with a sex-ratio = 0.43 (Tondaand; Mickala, 2017). This is explained by the fact that the male category is the predominant group among donors.

In our study, the highest frequency of HCV was found in donors belonging to the age group [36-45]. These results are different from those reported in an Algerian national cohort, the average age is 52 years, 70% of patients are >50 years old (Tondaand; Mickala, 2017). According to the Epidemiological Bulletin of France [50-70]. This is explained by the predominance of young donors. According to the WHO, Algeria is among the developing countries in which maternal-fetal and nosocomial transmission (during dental care, tattoos, etc.) are predominant (Ossinga et al., 2018), while HCV is mainly transmitted by drug use in developed countries, in France 55.8% (KallaAouid et al., 2020).

4.2 HBV

Regarding hepatitis B, our study shows a seroprevalence of 0.40%. Our results are lower than those of other studies conducted in Algeria (CHU Benni Messous 0.28%) (Bouhalissa et al., 2019), and five times lower than those recorded in the general population thanks to a national survey which reports a rate of 2, 15% viral hepatitis B (Epidemiological surveillance of blood donors in France – 1992-2018). These results show that Algeria is a country belonging to an area of moderate endemicity for viral hepatitis B (Barin; Pic, 2020). Indeed, medical selection and biological screening has contributed to reducing positive cases in the donor population.

In comparison with studies carried out in France, our population has a high seroprevalence (0.30*104 donation) (Mesbahi, 2008), and remains lower than the seroprevalence found in countries of Sub-Saharan Africa, Gabon 5.6% (2014), 12.2% Nigeria (2015) (Jean et al., 2016). This is explained by the fact that the Sub-Saharan countries are countries of high endemicity for HBV where the residual risk is a major concern. This prevalence is mainly linked to:

- persistence, a phenomenon of reactivation of HBV in chronic carriers of AgHbs. As well as in cured subjects who have developed anti-HBs Abs (Kabembaand; Kabyla, 2022). The serological window period, which is the period preceding the appearance of biological markers of the infection,
during the early phase when an infectious donation was made but the screening test was negative (Tondaand; Mickala, 2017).

4.3 HIV

HIV positive cases were recorded in our study. Our result is similar to that done in Tunisia (0 cases in 2006) (El Omari, 2021). It is lower than that reported in Sub-Saharan Africa, 0.85% (Congo), 3.15% (Kenya) in 2013, (Equatorial Guinea) 7.83% in 2015 (Doungous et al., 2020). Our result is close to that of industrialized countries, in America 0.028% (2012), in France 0.09% (2018) (WHO, 2021). These results are consistent with WHO data that reported HIV prevalence in low-income countries (2-6.02%), in high-income countries (0.002%) (WHO, 2021). This is explained by the high endemicity of HIV in Sub-Saharan countries (WHO, 2021), as well as the persistence of risk linked to this virus, donation collected during the HIV silent window = 21 day, high genetic variability (Tondaand; Mickala, 2017). As well as in these countries the majority of the population does not have access to diagnostic tests due to the high cost and limited availability of screening tests, the limited access is due to the asymptotic characteristic of this infection (Belkacemiand; Merad, 2020). The low prevalence in industrialized countries explained by the fact that there are currently so-called combined fourth-generation tests that simultaneously detect Anti-HIV1/HIV2 Antibodies and p24 Ag, which makes it possible to detect seroconversions instead (https://www.em-consulte.com). As well as the accessibility of systematic screening of the viral genome and the effectiveness of medical selection policy (National Strategic Plan to combat STI/HIV 2008-2012, http://www.africanchildforum.org).

4.4 SYPHILIS

The seroprevalence of syphilis in our study is 0.14% cases. Young adult males are the most affected [36-45]. This seroprevalence agrees with data from other studies conducted in Algeria 0.9% (National Strategic Plan to combat STI/HIV 2008-2012, http://www.africanchildforum.org). But remains lower than that reported by the WHO, in middle-income countries the prevalence of syphilis is
0.39% (Ossinga et al., 2018). This result is lower than those observed in Sub-Saharan countries: 0.6% Gabon, 0.7% Burkina Faso (2013), Ghana 4.36% (2016), Chad 4.9% (2017) (Doungous et al., 2020) but higher than that in the high-income countries 0.01% (Ossinga et al., 2018). These differences are due to geographic variation in the prevalence of Syphilis (https://www.em-consulte.com).

In 2020, the WHO estimated 7.1 million people will contract syphilis. It is mainly concentrated in developing countries, where access to syphilis diagnosis remains limited. In some developing countries the prevalence of this infection in blood donors can reach 25% [25]. In Algeria, there are few data on syphilis in blood donors.

5 CONCLUSION

ST transfusion safety is the set of measures aimed at reducing the infectious risks associated with transfusion. It is positioned in all stages of the transfusion chain, essentially at two levels: the pre-donation medical interview, which is the first stage in donor selection. Microbiological qualification by serological screening. While following simple rules for ST optimization remains essential. In light of the results obtained concerning our study population: our sample is composed of predominantly adult, young and male donors. For the type of donation, predominance of voluntary donors.

The seroprevalence of infectious markers in 9155 blood donors during the study period is respectively for HBs antigen (0.40%), for anti-HCV antibodies (0.12%) and for the agent of syphilis (0.14%). No positive cases for HIV-1 and HIV-2. There is also a male predominance for positive cases of HBV, HCV and the agent of Syphilis. Donors belonging to the age group [36-45] represent the age group having presented the highest frequency of HBV, HCV and the agent of syphilis. The results of our study justify donor selection and screening tests.

This work should allow the study of the specific characteristics of the blood donor population. It is important for the formulation of donor recruitment strategies, to inform them, to retain them, it is an essential step for the improvement of transfusion safety and to develop strict criteria for selecting and excluding donors at potential risk.
Data from serological tests provide epidemiological data on these infections and constitute an element of epidemiological surveillance in order to improve transfusion safety. Raising awareness of the importance and benefits of committing to regular blood donation, encouraging female participation, and the need to supply generations with more sensitive and specific reagents. The implementation of genomic diagnosis to reduce the serological window to very low levels.
REFERENCES


[19] Prévalence des marqueurs infectieux chez les donneurs de sang. Available at:https://www.em-consulte.com

