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Prevalence of anti HBC antibodies in blood donors from different centers in Lebanon

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Abstract
Background: Hepatitis B virus (HBV) is a major cause of the liver disease that could lead to acute and chronic inflammation of the liver. In this study we collected anti HBC antibodies (anti hepatitis B core) results done as screening of blood donors from three hospital centers in Lebanon between Jan.2016to Jan.2019. The aim of this study is to collect epidemiological data on the prevalence of positive anti HBC antibodies in blood donors of different nationalities.
Method: Blood donation records from the three hospitals were collected from Jan. 2016 till Jan. 2019 and they included 16000 volunteers for blood donation and all these donors were tested for anti HBC antibodies.
Results: The total number of donors was 16000, 1224 volunteers (7.65%) had positive anti HBC test. The prevalence of anti HBC antibodies was higher in Syrian population with a prevalence of 12.9% as compared to the Lebanese donors with prevalence of 6.6%. Age was found to have a statistically significant relationship with the prevalence of hepatitis B. blood group was found not to have a statistically significant relationship with hepatitis B.
Conclusion: Our study stressed the immediate need for implementing anti HBC testing, besides the routine screening for hepatitis B surface antigen (HBs Ag), to avoid the devastating undesirable effect of transfusion transmitted HBV during the window period and to highlight the evidence to make more educational events to further decrease the prevalence of the hepatitis B mainly in Syrian population. More studies should be done in Lebanon to have a better evidence of the importance of HBC antibodies to prevent infection through blood transfusion.

Keywords: hepatitis B virus, HBC-antibodies, HBs AG, blood donor screening

Introduction

Although blood and blood products could not be separable from the treatment in the medical field, the availability of adequate safe blood and blood products remains a major concern in health care system and transfusion practice [1].

As a routine practice, screening tests are performed to prevent transmission of important infectious agents via blood transfusion such as Hepatitis B Virus (HBV), Hepatitis C Virus (HCV), Human Immunodeficiency Virus (HIV) and syphilis. However, in spite of the development of screening methods and the improvements in eligibility criteria for blood donation, transfusion transmitted infectious agents like hepatitis B virus is considered as a threat for blood safety [2].

Hepatitis B virus (HBV) is a major cause of the liver disease that could lead to acute and chronic inflammation of the liver. It can cause late-term complications such as chronic hepatitis, cirrhosis and hepatocellular carcinoma; that's why, it is still one of the important global health problems [3, 4]. Almost half the world's population lives and inhabits HBV endemic areas and the percentage of hepatitis B surface antigen (HBs Ag) seroprevalence exceeds 8% [5]. As shown in the figure below that describes the distribution of the world's population based on the global HBV prevalence (Figure 1) [6].

Lebanon is the fourth country with the least prevalence for hepatitis B infection (1.69%), preceded by Iraq (0.6%), Morocco (1.3%) and Jordan (1.4%). He belongs to the category of country with low prevalence (<2%) as stated by Abou Rashed A *et al* [7].

No data could be found on the prevalence of HBV chronic infection among the Syrian general population apart from a report by Lavanchy, in which he classified the region as 'intermediate' in endemicity [8] and estimated by WHO as mentioned in Gasim, G *et al* to have a prevalence of 2-7% [9].

In this study we tried to answer many questions concerning the prevalence of hepatitis B in Lebanon and the higher prevalence in Syrian refugee by screening of blood donors in three centers in Lebanon (one in Beirut, one in south of Lebanon and one in Bekaa) by the anti HBC test continued if negative by the routine hepatitis B surface antigen test (HBs Ag) to increase the sensitivity of detecting infected blood mainly during the window period in which the only positive marker of hepatitis B is anti HBC antibodies.

Literature Review

Hepatitis B virus (HBV) infects more than 300 million people worldwide and is a common cause of liver disease and hepatocellular carcinoma. It is a small DNA virus with unusual features similar to retroviruses [10]. It is a prototype virus of the Hepadnaviridae family.

Based on sequence comparison, there are eight genotypes of hepatitis B virus classified from A to H. Each one of these has a different geographic distribution.

Pre and post transfusion

The risk of HBV transmission in blood transfusion depends

on the HBV screening strategy used. The first-line screening test is the HBV surface antigen (HBs Ag) test.
The immune status of the recipient is a factor affecting transfusion transmission of HBV. The exposure to a high viral load can overcome the neutralizing capacity of low anti-HBs. The exposure to low viral load can cause infection in immune deficient elderly patients and in patients who are receiving immunosuppressive treatments [11].
Antibodies against the core antigen (anti HBc) indicate a history of infection. Anti HBc appear in the acute phase of the infection, they persist for the entire life of the individual independently of the stage (acute, chronic, or recovered). The transmission of HBV can be potentially done in individuals with only a serological anti HBc pattern, the same way that can be done in HBs Ag reactive individuals. This correlates with the chronic carrier status of the infection [12].
Consequently, the use of a single serological marker such as HBs Ag cannot eliminate the residual risk of HBV transmission [13], as the figure 4 shows according to T. Jake Liang. In his article: Hepatitis B: The Virus and Disease.

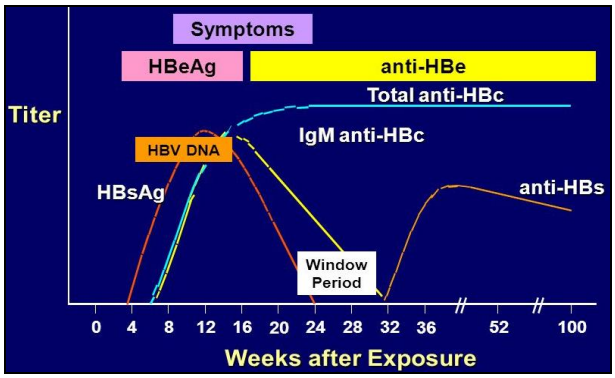

Fig 1: Acute Hepatitis B Virus Infection with Recovery Typical Serological Course (14)

There is Occult HBV Infections (OBI), as it was mentioned, even HBs Ag negative individuals might be infected, and upon transfusion there is a chance of transmission of HBV in apparently healthy blood donors. This is attributed to the inability of the screening tests to detect HBs Ag, during a period of infection called window period or it can be named as occult HBV infections (OBIs).
OBI is defined when the HBV DNA is detected, thus HBs Ag remaining undetectable. Mutated HBs Ag, the low-level expression of HBs Ag or the entrapment of antigen in the circulatory immune complexes are several factors that may be involved in OBI. The OBIs can also be characterized by very low HBV DNA plasma load, below 1,000 IU/ml or even below 100 IU/ml [15].
Therefore, there is a possibility of low-level HBV viremia in HBs Ag negative and anti HBc positive cases. This study is conducted in order to determine the incidence of anti HBc in blood donors prior to Blood transfusion.

The infectivity of HBV depends on many factors that include
Viral dose (number of HBV genome copies/ml)
Blood component (fresh frozen plasma and platelet concentrates suspended in plasma are considered more infectious than red cell concentrates)
The presence of anti-HBs
The recipient immune status.

Although the OBI infectivity potential is low, especially if anti-HBs is present, many studies showed that rare transmissions causing acute liver failure have been reported in immunosuppressed patients.

Objectives
Primary objective
The main objective of this study is to determine the prevalence of positive HBC antibodies during blood donation screening prior to blood transfusion in Lebanon between Jan.2016 and Jan.2019.

Secondary objectives
To compare the incidence of anti HBc Ab positive between Lebanese and other nationalities in Lebanon.
To identify the incidence of HBs Ag positive test in anti HBc Ab negative blood donors.
To prove the cost effectiveness of the anti HBc Ab test as being the first test to do

Subjects and Methods
Inclusion and Exclusion Criteria
Inclusion Criteria
Gender: Both Male and Female
Age: from 18 to 60 years' old
Weight: Exceeding 60 kg
Special Conditions: Satisfy the requirements of Blood Bank at the hospitals centers.
Previously healthy, not taking any medications and not addicted to alcohol or any drugs.
Neither suffering now nor in the past from malaria, Tb, typhoid, hepatitis or any malignancy.
Haven't been exposed during the last 12 months to any vaccine, blood transfusion, sudden weight loss, fever of unknown origin or tattooing.

Exclusion Criteria
Females that are currently pregnant or had been pregnant during the last year.
Males and Females who had donated blood in the last 3 months.

Methods of Data Collection
Data was collected from computerized medical records of the three hospitals between Jan. 2016 and Jan. 2019. After obtaining the approval to access the medical records from the IRB at each hospital a total number of 16000 volunteers were noted between these years.
The medical records of these volunteers were analyzed thoroughly and make sure that all the volunteers fitted the inclusion criteria. A descriptive analysis of the data collected was carried out and results obtained were converted to the form of tables, graphs and column charts using the Microsoft Office Excel program. Finally, the data was analyzed using the statistical program SPSS (statistical package for the Social Science) version 22.

Data Analysis
Statistical analysis will be performed with R x64.3.1.2. Ink software with two-tailed significance level of 5 %. Descriptive analyses will be based on frequencies, percentages and ratios for qualitative variables and minimums, maximums, ranges, medians, interquartile ranges, and modes for quantitative variables.

Relationships with qualitative variables will be investigated through the chi-square test or Fisher's exact test, depending on the expected sample size. Relationships with quantitative variables will be determined through the Mann Whitney test, Wilcoxon test or Kruskal-Wallis test. Bivariate logistic regression will be performed to analyze the associations of potential explanatory variables. Independent variables that could affect the dependent variable with a p-value lower than 25 % in bivariate logistic regression will be considered in stepwise backward multivariate logistic regressions.

Descriptive Analysis

Demographic characteristics of blood donors

Age

The volunteers in the study had different age groups.

Table 1 show that the maximum age was 77 while the minimal age was 17 with mean age of 31.28.

Table 1: The Age Range of the Volunteers

Age	N	Missing	Accepted	Min	Max	Mean	SD	Median
HBC Test	16000	3052	12948	17	77	31.28	8.84	30.00

Gender

The table below shows the distribution of gender of the volunteers that took the test. As mentioned in the limitations, there are some missing records yet will be included in the table and graph below (Table 2):

Table 2: Distribution of the Volunteers According to the Gender

Gender	N	Records Present	Missing	Male	Female
HBC Test	16000	12968	3032	12938	30
Percentage	100%	81.04%	18.96%	80.85%	0.19%

Nationality

The table below shows the distribution of nationality of the patients that took the test. As mentioned in the limitations, there are some missing records yet will be included in the table and graph below (Table 3):

Table 3: Distribution of the Volunteers According to the Nationality

Nationality	Number	Percentage
Lebanese	9446	59.04%
Syrian	2476	15.47%
Other	1052	6.57%
Missing	3026	18.91%
Total	16000	100%

Blood Group

The table below shows the distribution of blood group of the volunteers that took the test. As mentioned in the limitations, there are some missing records yet will be included in the table and graph below (Table 4).

Table 4: Distribution of the Volunteers According to Blood Group

Blood Group	Number	Percentage
A+	4600	28.76%
A-	616	3.85%
B+	2974	18.59%
B-	480	3.01%
O+	4730	29.56%
O-	1025	6.40%
AB+	1045	6.52%
AB-	240	1.50%
Missing	290	1.81%
Total	16000	100%

Tests and Test Results of Blood Donors

The table 5 below shows the tests taken and the results for the 16000 patients. As mentioned in the limitations, a minimal number of test takers refused to share their results, but they were included in the calculation below to keep the total sample size. The results of the HBC test, however, are complete and have no missing records.

1224 patients had positive HBC test. Those patients did not perform HBS, HIV, VDRL, IAT and HCV tests except one patient performed HCV test with positive result, one patient performed HBS positive results with positive results and one patient performed HIV test with positive result.

Table 5: The Results of the Hep B, Hep C, VDRL and IAT tests

Tests	Result	Number	Percentage
HBC	Negative	14776	92.35%
	Positive	1224	7.65%
	Missing	-	0.00%
Total		16000	100.00%
HBS	Negative	15980	99.86%
	Positive	8	0.05%
	Missing	12	0.08%
Total	1224 HBC positive	14756	100.00%
HCV	Negative	14756	99.85%
	Positive	16	0.11%
	Missing	6	0.04%
Total	1224 HBC positive	14756	100.00%
HIV	Negative	14752	99.82%
	Positive	4	0.03%
	Missing	22	0.15%
Total	1224 HBC positive	14795	100.00%
VDRL	Negative	14762	99.91%
	Positive	2	0.01%
	Missing	12	0.08%
Total	1224 HBC positive	14778	100.00%
IAT	Negative	14762	99.89%
	Positive	2	0.01%
	Missing	14	0.09%
Total	1224 HBC positive	14778	100.00%

The tests below were conducted on the 16000 patients. The tests were carried out in the three General Hospital Laboratory within the conditions and limits of acceptable test administration. As mentioned in the limitations, some patients refused to share their records and were registered as missing, but included in the calculations to maintain the total N = 16000 patients.

Table 6: Blood Test Administered by the Volunteers

Blood Test Administered	Number	Percentage
Blood Unit Withdrawn	8	0.05%
FFP	1888	11.81%
Whole Blood	258	1.61%
RBC	7622	47.63%
Platelets	812	5.06%
Missing	5412	33.83%
Total	16000	100.00%

Distribution of anti HBC Results

Distribution by Age

The total population size was 16000 patients. As mentioned above and in the limitations, some patients refused to share their age group records and were registered as missing, but included in the calculations to maintain the total N = 16000 according to the data collection 17.77% of the HBC negative and 1.30% of the HBC positive were missing records. The distribution of the patients and results by age group is detailed in the table below.

Null Hypothesis H_0: Age Group has no link and influence on anti HBC results.

Table 7: Age Distribution of Donors and their Test Results

	HBC NEGATIVE		HBC Positive			P-Value
Age group	**Number**	**%**	**Number**	**%**	**Total**	
less than or equal 20	1016	98.45%	16	1.55	1032	
Between 21and 30	5625	95.63	258	4.37	5883	
between 31and 40	3500	90.77	356	9.23	3856	<0.001
More than 40	1764	82.05	386	17.95	2150	
Missing	2844	93.18	208	6.82	3052	
Total	14776	93.35	1224	7.65	16000	N=16000

It is noticed that the prevailing ager group with HBC positive results is that of the patients above 40 years old, followed by the age group between 31 and 40. This is also consistent with the negative HBC results which had the prevailing age group less than or equal 20 and between 21 and 30.

Since p-value < 0.001, there is strong evidence against the null hypothesis, which indicates the rejection of the null hypothesis, i.e., age group has high link and influence on HBC positive or negative results.

Distribution by Nationality:

The total population size was 16000 patients. As mentioned above and in the limitations, some patients refused to share their nationality records and were registered as missing, but included in the calculations to maintain the total N = 16000 patients. Regarding the distribution by nationality, 17.66% of the HBC negative and 1.25% of the HBC positive were missing records. The distribution of the patients and results by nationality is detailed in the table below.

Null Hypothesis H_0: Nationality has no link and influence on HBC results.

Table 8: Distribution of Donors and their Test Results according to their Nationalities

	HBC Negative		HBC Positive			P-Value
Nationality	**Number**	**%**	**Number**	**%**	**Total**	
Lebanese	8821	93.37%	625	6.63	9446	
Syrian	2156	87.08	320	12.92	2476	
Other nationality	974	92.59	78	7.41	1052	<0.001
Missing	2826	93.39	200	6.61	3026	
Total	14777	92.35	1223	7.65	16000	N=16000

In terms of Nationality, it is noticed that the percentage of HBC positive within the Lebanese nationality is 6.63% of the total (625of 8821), and 7.41% within other nationalities (78 of 1052) while within the Syrian nationality it is almost double at 12.92% of the total (320 of 2476), which indicates a significant increase in percentage within patients of the Syrian nationality.

Since p-value < 0.001, there is strong evidence against the null hypothesis, which indicates the rejection of the null hypothesis, i.e., Nationality has high link and influence on HBC positive or negative results.

Distribution by Blood Group

The total population size was 16000 patients. As mentioned above and in the limitations, some patients refused to share their nationality records and were registered as missing, but included in the calculations to maintain the total N = 16000 patients. Regarding the distribution by blood group, 0.41% of the HBC negative records and 1.4% of the HBC positive records were missing.

Null Hypothesis H_0: Blood group has no link and influence on HBC results.

Overall Findings

After the introduction of reliable serologic screening of blood donations, post transfusion hepatitis has become rare [16]. However, the identification of blood donors with occult HBV infection (donors who are negative for HBs Ag but has detectable circulating HBV DNA) has created some concern with regards to the safety of blood supply [17].

It is generally accepted that the diagnosis of infection by HBV is based on the presence of the HBs Ag in the bloodstream [18]. However, screening of blood bank donors for HBs Ag does not totally eliminate the risk of HBV infection through blood transfusion [19], since the absence of this marker in the serum does not exclude the presence of HBV DNA [20].

A marker which would be indicative of hepatitis B infection during the window period, is therefore of paramount importance in blood banking. Anti HBc has been found to be an excellent indicator of occult HBV infection during the window period [21]. The transmission of hepatitis B following transfusion of blood / blood products containing antibody to the hepatitis B core antigen was first described by Hoofnagle in 1978 [22].

EL BANNA *et al* study showed the importance of this sero-marker when stating the higher prevalence of anti HBc antibodies compared with HBs Ag in all nationalities so when screening the blood donors with HBs Ag only we have significant numbers of donors with HBs Ag negative but with positive anti HBc antibodies which could have active hepatitis B and transmit the virus through the donated blood [22].

Knowing the seroprevalence rate of the core antibody will provide an idea about the usefulness of the implementation of routine core antibody testing for blood donor screening; for this purpose, we have studied the seroprevalence of hepatitis b core antibodies among blood donors in these three General Hospital in three years interval.

With the displacement of Syrians to Lebanon following the crisis in Syria, two populations with different endemicity levels started to co-exist in Lebanon. In 2015, infections

were reported from Syrian refugees (with a high proportion of children) and among the Lebanese population (with a higher proportion of older age groups). The reported rate was three times higher for Syrian refugees in general than Lebanese [23].

This study addresses the prevalence of anti HBc antibodies among blood donors from different nationalities mainly between the Lebanese and the Syrian countries. This remains an important issue because of the huge number of Syrian refugees to Lebanon in last years after the Syrian crisis.

During this study we collected data from three medical center; 16000 files of blood donors between Jan. 2016 and Jan. 2019 were collected. They were first tested for anti HBC antibodies in their serum and those with positive tests were excluded from blood donation without any further test.

The age of blood donors in this study range between 17-year-old and 77-year-old with a mean age of 31,28. The majority were of male gender with a percentage of 80.85%. Lebanese blood donors constitute 59.04% with the others distributed with 15.47% Syrians, 6.57% other nationalities and18.91% with missed data about their nationalities. The major blood group of blood donors in our study was of O+ group with 29.56% followed by A+ group with 28.76%.

Year by year the prevalence varied between 5.73% to 9.22% with an average of 7.65%. This average prevalence is higher than that of previous study when Anti HBc was screened during a 20-month period in 1 major center of Beirut between Jan.2016 and Jan.2019 that found 341 blood donors who were anti HBc positive (N = 341/7437, 4.6%) [22].

This may be due to the different geographical distribution of donors between the two blood banks proved by previous study that showed a highest prevalence of hepatitis B of Lebanese people in south Lebanon of 4.7% in [M Nabulsi *et al*] [24] explained by religious rituals (Ashura) (poor sanitation, low socio-economic status), large family size and high immigration rates to areas with high endemicity such as African countries [24, 25]. Also, the southern population witnessed consistent wars and injuries, which required urgent transfusions in the absence of adequate testing. And this category of people constitutes a majority of Lebanese blood donors of the three general hospitals due to the migration of the southern population to this region searching for more job opportunities and better life conditions [7]; in addition to the higher number of donors of other nationalities in our study compared to [El Banna N *et al*] [22].

In our study it is noticed that the prevailing ager group with anti HBc positive results is that of the patients above 40 years old with a prevalence of 17.95%, followed by the age group between 31 and 40 with a prevalence of 9.23% and the lowest prevalence is in those younger than 20 years having a prevalence of 1.55%. Also, it has been shown in [Al Romaihi *et al*] [26] that lower HBV infection rates were detected among young age groups, whereas individuals between 25 and 50 years old were the most affected age group. This observation is partially attributed to the early hepatitis B vaccination of newborns since 1998, and the mandatory premarital screening implemented by the Lebanese government since 1994 [7]. And this is proved by our study with the decreasing prevalence of anti HBC antibodies mainly in the youngest age group reaching a null value in the category younger than 21 years in Jan.2019 after starting by a prevalence of 2.9% in Jan.2016.

When the prevalence was measured based on the nationality, 12.92% of Syrian and 6.63% of Lebanese were anti HBc positive, respectively. Similarly, a higher prevalence of anti HBc antibodies in Syrian donors was found in [El Banna N *et al*] (51) but with higher overall prevalence in our study in the 2 nationalities. In [El Banna N *et al*] 9.2% of Syrian and 3.2% of Lebanese were anti-HBc positive. to mention also the higher prevalence of anti HBC antibodies compared with HBs Ag in the same group of blood donors in ElBanna *et al* with 1.07% and 0.05% of positive HBs Ag in the two nationalities respectively [22].

Although a variable prevalence of OBI was reported in few countries of the MENA region and showed anti HBc prevalence of 12% in Syrian in 2011 [27] higher than that in Lebanese between 2013 and 2015 with a prevalence of 4.6 % [22]. In addition to a prevalence of 10.9% in Egypt in 2005 [28], 11.5% in Saudi Arabia between 2005 and 2007 [29], and 9.9% in Irian in 2008 [30].

In terms of blood group, it is noticed that the percentage of HBC positive and HBC negative is highest in groups AB- and O+, but not significantly higher than other groups, which, coupled with the high p-value attained, proves the low relationship between blood group and HBC positive or negative results.

There are many challenges that investigators face but one of them is the follow-up of patients with OBI, which can provide additional information regarding the patient's status. In our study the donor who was found to have positive anti HBc antibody was deferred from the donation without further workup on the other markers of hepatitis B infection to know the infectivity of this blood. But this study aims to be more cost effective in the screening of blood donors in the same time as preventing the transmission of hepatitis B in received blood.

[M. Abdelaziz H *et al*] estimated that the total costs of anti HBc tests to prevent one case of transfusion-based HBV transmission is much lower than the average costs required for HBV diagnosis, treatment and follow-up for one patient [32]. Thus, employing anti HBc test as a preventive measure was shown to be cost-effective, though a proportion of anti HBc-positive donations might be non-infectious due to past HBV infection [33] or minimal cross-reactivity [34, 35].

The reduction of blood unit's pool is insignificant compared to the risk of HBV transmission and its serious consequences particularly among immune compromised recipients [36].

Study Limitations

This study has few limitations;

The prevalence of occult HBV infection was studied from 3 blood donor centers in Lebanon, which does not represent the prevalence in all the country. A multicenter study from different Lebanese regions would better represent the country prevalence.

The donors with anti HBc antibodies were not further investigated for HBs Ag to show the gap of detection of hepatitis B in blood during the window period in the absence of anti HBc screening and the importance of the latest test to prevent hepatitis B virus transmission in blood.

In addition, this study measured the total anti HBc antibodies and didn't perform anti HBc IgM which is the antibody specific of the window period and the infectivity of blood during this period.

Anti HBc antibodies positive tests and HBs Ag negative blood should be further investigated for PCR of hepatitis B

to prove the infectivity of the blood and the importance of implementing the anti HBc as screening test in all blood banks.

This study took mainly the comparison between the Lebanese and Syrian blood donors and didn't enter in detail for the prevalence of the anti HBc antibodies in other nationalities mainly Palestinian which encountered for a significant number in our country mainly in the region where the study was done.

Perspectives

Hepatitis B transmission through blood transfusion is a major concern in blood banks and the different epidemiologic population in Lebanon should be taken into consideration while recruiting a blood donor in any case.

To be more vigilant in blood banks every donor should be investigated for anti HBC antibody to eliminate the risk of transmission during the window period and if negative to continue this test with HBsAg to eliminate any further risk.

We had a lot of difficulties when conducting this study mainly in review of literature because of the deficiency in our data for the other markers of hepatitis B specially in anti HBc antibodies positive patients which were not further investigated for the HBs Ag and the PCR test to verify the infectivity of the blood with anti HBc antibodies alone.

With the higher prevalence found in the other nationalities mainly those from Syrian country, more vigilance and regulatory actions targeting this group, whether by immunization or other preventive methods are required including the vaccination of all newborn babies and screening for the virus in all immigrants that enter the country.

We think that cooperation between different medical institutions is a very important matter in Lebanon; we hope in the future that more hospitals will aid researchers in obtaining medical data to have a bigger number of people who will represent the epidemiology of the whole country and not for a single region in Lebanon.

More studies should be taken to screen all immigrants in Lebanon for the hepatitis B and other contagious infections to decrease the burden of diseases in our country and protect the citizens from any additional risk of infection.

To the best of our knowledge, this is the first large study to examine the prevalence of hepatitis B sero-markers in blood donors in Lebanon.

Our study stressed the immediate need for implementing anti HBc testing, besides the routine screening for HBs Ag, to avoid the devastating undesirable effect of transfusion transmitted HBV.

In the other hand it showed the higher prevalence of hepatitis b marker in non-Lebanese donors a point to consider in all blood banks to be more restrictive and careful when the donor is from other nationalities and to defer any donor who would be at any risk of exposure to hepatitis b virus.

In addition, the age group play a significant role in transmission and more restrictive age should be taken as inclusion criteria for blood donation and defer adults more than 40 years who have higher risk of exposure to hepatitis virus during their life and to me not immune in infancy to prevent further risk of transmission.

Finally,

Awareness should be enhanced in all nationalities present in Lebanon on the contagious diseases and the ways of exposure and transmissions of the viral infections and to implement centers for the free screening of people to facilitate early detection and treatment of these diseased and to prevent further burden of epidemics in our country

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