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Seroprevalence of hepatitis C among blood donors at the National Blood Transfusion Center (NBTC) of N'Djamena in 2022: a cross-sectional and analytical study

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Abstract

Background: In Africa, hospital blood demand is important; but inadequately managed and hence hazardous. So far, only a few studies in Chad have reported hepatitis C among blood donors and examined its influence on their clinical state. The goal of our study was to assess hepatitis C seroprevalence among blood donors at the National Blood Transfusion Center (NBTC) in Ndjamena, identify risk factors, and analyze the biochemical profile.

Methods: A descriptive and cross-sectional study was conducted at the NBTC for three months, from July to October 2022. Following the distribution of a structured questionnaire to participants to collect information on socio-demographic and clinical factors, blood was obtained and tested for anti-HCV antibodies using an immunochromatographic method. Transaminases, bilirubin, total cholesterol (TC), triglycerides, and glycemia were also assessed.

Results: The majority of donors had never donated blood (56.1%), never been tested against hepatitis C (89.88%), and were healthy (86.20%). In this study, a seroprevalence of 7.12% (31/435) for hepatitis C was found. The level of study, the clinical symptoms, and the previous blood donation were significantly associated with the presence of the hepatitis C virus (P<0.001). The majority of HCV+ subjects showed elevated ALT values (48.96 IU/L), total (43.53 µmol/L), and conjugated (17.5 µmol/L) hyperbilirubinemia. Hyperglycemia (1.37 g/L) and hypertriglyceridemia (1.60 g/L) were also noted in these subjects. However, the TC remained relatively normal.

Conclusion: These results suggest that hepatitis C seroprevalence is relatively high among blood donors in N'djamena and presents a risk of liver injury and metabolic disorder. Clinical monitoring is therefore necessary.

Keywords: donors, hepatitis C, biochemical parameters, Ndjamena.

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Background

Blood transfusion is a medical procedure that involves giving unwell people blood or blood derivatives to save their lives. According to the World Health Organization (WHO), around 118.5 million blood bags are collected globally each year [1] and 60% of these donations originate from poor countries, which account for almost 84% of the world's population. In Chad, as in many other Sub-Saharan African nations, blood demands are significant and not always met by the number of blood bags available. According to some reports, voluntary blood donation (VDD) accounts for less than 5% of total blood collected in the United States [2]. Previous research in N'Djamena found that VDD accounted for 18% of blood obtained at the National Center for Blood Transfusion [3]. Fear of blood, needles, viral transmission, and a lack of understanding, are among the issues restricting VDD. Furthermore, there are major hazards of biological contamination during this process, particularly when it is not secure. According to a previous study from the WHO Africa regional office, several African nations do not conduct proper blood donor screening, which is a challenge in haemovigilance [4]. Similar reports indicate that 20% of blood donations are poorly screened in Africa and 5% of syringes are reused [5]. As a result, the WHO recently recommended comprehensive screening of blood donors before their usage. This screening is mostly for diseases such as HIV, hepatitis B and C, and treponema pale, a recognized syphilis germ [1]. Hepatitis C is a liver illness caused by the hepatitis C virus (HCV), an enveloped RNA virus that is a member of the Flaviviridae family and belongs to the genus Hepacivirus. It is a significant contributor to cirrhosis and liver cancer. According to a recent WHO assessment, around 91 million individuals in Africa are infected with this virus [5], and blood transfusion remains an open door for the spread of this infection. Hepatitis C was found in 1% of blood donors in low-income countries [1]. Prior research in N'djamena (Chad) found that 48% of blood donors carried anti-HCV antibodies [6]. However, this is 30-year-old research. There is very little information on the spread of HCV in the Chadian population, particularly among blood donors, as well as the influence of this virus on the metabolic profile of the blood donor. In light of the foregoing, this study was conducted to assess the seroprevalence of hepatitis C in blood donors recruited at the National Center for Blood Transfusion (NBTC) in Ndjamena (Chad) and analyzing biochemical characteristics, in order to improve national public health data on hemovigilance.

Methods

Study site

The research was conducted at the National Blood Transfusion Center (NBTC) in Ndjamena, which is located in the Gardolé area of the municipality's second arrondissement. The central market borders it to the east, the Centre Hospitalier Universitaire de Référence National (CHU-RN) to the west, the Ministry of Foreign Affairs to the North, and the US Embassy in Chad to the South.

Sample size determination

The Lorentz method was used to calculate the minimum sample size (384 participants) based on the prior HCV prevalence in blood donors (48%) in Ndjamena (Chad) [6]. A 0.05 margin of error and a 95 % confidence level were used. However, a larger sample size (435 participants) was employed to improve the accuracy of our results.

Selection of participants and sample collection

This was a descriptive and cross-sectional study that lasted three (3) months, from July 18 to October 24, 2022. All consenting donors admitted to the NBTC throughout the research period, aged 18 to 65 years, and weighing at least 50 kg, were recruited. All donors who declined to participate in the study, as well as those who do not fit the criteria for blood donation, were excluded (under 18, weight under 50 kg, over 65, etc.). All donors who had previously undergone hepatitis C therapy were barred. Eligible patients were initially given an informed consent form, which they had to fill out and sign. Then, a survey form was used to collect various sorts of information, such as socio-demographic data, medical history, and clinical symptoms. Blood was drawn from volunteers who had fasted for 10 hours. Using a sterile syringe, blood was drawn from the crease of the elbow and collected in dry tubes. It was then allowed to remain at room temperature for 10-20 minutes before being centrifuged at room temperature at a speed of 2000 rpm for 5 minutes. Following this, the serum was collected with a micropipette in additional tubes and kept in the refrigerator (between 2 and 8°C) until use.

Ethical Considerations

The Department of Biomedical Sciences of the University of Ngaoundéré (Cameroon) gave research permission (022/1020/UN/R/DFS/CD-SBM) and the NBTC of N'djamena issued an ethical approval for this work in Chad. Each participant provided their agreement for blood collection and was told of the study's aims and their rights. To maintain confidentiality, participants' information was kept private and encrypted. No samples were evaluated above the limits specified in our investigation.

Sample analysis

Serological diagnosis of HCV infection

Serum samples were first screened for anti-HCV antibodies using the ALL-TEST kits provided by Hangzhou All test Biotech Co. Ltd (Hangzhou, China). Briefly, 25µL of the serum was placed in the well (S) of the test cassette and then, two drops of buffer (about 80uL) were added. The results were read after 10 min. After this time, two distinct colored lines appear. One line in the control area (C), and the other line in the test area (T). The color intensity in T varies depending on the concentration of anti-HCV antigens present in the sample. Therefore, any red shade in the test region is considered positive. When a colored line appears in C and no apparent red or pink line appears in T, then the test is negative. The kit had very strong relative sensitivity (98.8%), relative specificity (99.1%), and accuracy, according to the provider (99%). Furthermore, there was no cross-reactivity with specimens positive for rheumatoid factor, HBs and HBe antigens and antibodies, as well as HBc, HIV, syphilis, Helicobacter pylori, CMV, rubella, and toxoplasmosis. Acetaminophen, aspirin, vitamin C, creatinine, bilirubin, caffeine, gentamicin, albumin, haemoglobin, and oxalic acid did not cause any interference.

Analysis of biochemical parameters

Serum transaminases (AST, ALT), total and conjugated bilirubin, triglycerides, total cholesterol, and glycemia were measured using commercial kits provided by BioSystems Diagnostics Pvt Ltd (Tamil Nadu, India) according to the manufacturer's instructions.

Statistical analysis

Data were analyzed using Excel and GraphPad Prism software version 8.01. (San Diego, USA). The survey form was prepared using Sphinx software. Statistical association tests were performed using the chi-square test. Significant differences were set at $P < 0.05$.

Results

Distribution of the study population according to socio-demographic characteristics

The total distribution of the study population according to socio-demographic parameters is shown in Table 1 below. It reveals that the majority of those polled are male (84.13%, with a sex ratio M/F of 5.3:1 in favor of men) and reside in cities (92.65%) than in rural regions (17.35%). In terms of marital status, this population is led by married people (62.29%), followed by single people (34.71%). Participants with a university degree are the most numerous (40.68%), followed by those in secondary school (34.48%) and those with another level of education (16.09%). Young subjects are likewise the most numerous, with those aged 18-30 accounting for 45.51% and those aged 31-40 accounting for 38.16%. The average age in the country is 32.15 years.

Distribution of the study population according to medical history

Concerning the medical history of these participants (Figure 1), 89.88% have never had a hepatitis C test, 56.1% have never had a blood donation test and 86.20% have no previous infection. In terms of diseases diagnosed in participants, 7.35% positive cases for HBs Antigen, 3.44% positive cases for syphilis, 2.06% positive cases for HIV were found as well as lower percentages of co-infection.

Overall profile of clinical symptoms in sampled patients

Table 2 shows the overall clinical symptom profile of the sampled cohort. According to the table, 4.60% (20/435) of the applicants examined had jaundice, 8.05% (35) had a fever, 4.83%t (21) had nausea, 6.21% (27) had stomach discomfort, 3.68% (16) abnormal stools, and 12.87% had dark yellow urine.

Overall profile of alcohol and tobacco consumption in the surveyed population

Table 3 presents the profile of alcohol and tobacco consumption. According to this table, 25.75% of the subjects surveyed consume alcohol of which 3.91% (17) reported consuming alcohol daily, 16.32% (71) moderately and 4, 83% (21) rarely. Regarding tobacco consumption, it concerns 12.64% (55) of our population. The majority of smokers (11.26%, or 11/435) consume it daily.

Prevalence of anti-HCV antibodies among blood donors

Figure 2 presents the overall seroprevalence of hepatitis C in the study population. This figure shows that 7.12% (31/435) of the subjects were exposed to hepatitis C.

Statistical associations between HCV seropositivity and the parameters studied

Association with sociodemographic parameters

Statistical correlations were developed between HCV status and several characteristics to explore risk factors for hepatitis C in the patients assessed. The connections with socio-demographic characteristics are shown in Table 4 below. Based on the results in this table, it appears that sex, age, location of residence, marital status, and professional position are not statistically linked with hepatitis C. On the other hand, certain types of patients appear to be significantly more vulnerable than others in these many factors. This is especially true for participants who live in rural areas (RR=2.422; 15.62%), who are more affected by hepatitis C than those who live in urban areas (RR=1, 6.45%); farmers (RR= 3.625; 12.5%), traders (RR=2.63; 9.09%), and other workers (RR=2.401; 8.28%) who are more vulnerable to the disease.

Association with clinical symptoms

Hepatitis C is a viral infection that can cause symptoms or remain asymptomatic. To determine the symptoms most closely associated with this condition in our study, we looked at the relationship between HCV status and various clinical indications (Table 5). The lack of jaundice, the presence of fever, nausea, stomach discomfort, the color of the stools, and the color of the urine all appear to be statistically linked with hepatitis C ($P<0.0001$). Surprisingly, patients without jaundice were more exposed (RR=21.20; 100%) than subjects with jaundice (RR=1; 4.71%). Feverish participants were more exposed (RR=20.78; 57.14%) than non-feverish patients (RR=1; 2.75%). Participants who experienced nausea (RR=18.48; 71.42%) or stomach discomfort (RR=8.31; 40.74%) were shown to be more exposed than those who did not experience nausea (RR=1).

Association with alcohol and tobacco use

Both alcohol and cigarettes have the potential to harm the liver. It is known that their presence in HCV-positive subjects accelerates the progression of liver disease to chronic stages such as cirrhosis and liver cancer. The goal of studying the connection was, above all, to forecast the likelihood of cirrhosis in the people assessed. We can conclude from the data in Table 6, that neither alcohol nor tobacco consumption, nor their respective frequency of consumption, are significantly related to the presence of the virus ($P>0.05$). The chance of discovering positive instances, however, was shown to be higher in participants who claimed to use alcohol moderately.

Association with the medical history

Still, to identify the risk factors, the association with the medical history of the patients was investigated (Table 7). This table shows that patients who have never donated blood have a significantly higher relative risk of being positive for hepatitis C than those who have already donated blood (RR = 3.262 and 1; 10.24% and 3.14; $P=0.0043$). On the other hand, the presence of a previous infection

and the fact of having taken a pre-donation hepatitis C test are not associated with hepatitis C seropositivity.

Biochemical profile of HCV-positive blood donors

Figure 3 depicts the mean values of certain biochemical markers evaluated in HCV+ patients. ALT levels in HCV+ patients are twice as high (48.96 ± 7.63 IU/L) as AST levels (24.90 ± 1.95 IU/L). Mean ALT levels are above the normal range (> 40 IU/L), while mean AST levels are normal. In terms of bilirubin profile, these participants' total bilirubin (43.54 ± 4.34 mol/L > at the threshold value of 34 mol/L) and conjugated (17.50 ± 2.54 mol/L > at the threshold value of 5 mol/L) levels were determined to be higher than normal. In terms of metabolic markers, total cholesterol was determined to be normal (0.63±0.60 g/L <2g/L), although triglycerides (1.60±0.42 g/L >1, 3g/L) and blood glucose (1.37± 0.13 g/L > 1.2 g/L) were somewhat higher than normal. A detailed examination of the frequency of biochemical anomalies in these donors (Table 8) reveals that 54.84% (17/31) and 9.68% (3/31) of these patients have respectively elevated ALT and AST. Regarding the lipid profile markers, 22.58% showed abnormally high TGs. In addition, 80.65% (25/31) had high conjugated bilirubin against 61.29% (20/31) for too high total bilirubin. About 52% (16/31) of these patients had abnormally high fasting blood glucose values.

Discussion

Hepatitis C is one of the viral illnesses spread by blood transfusions. It is critical to get an early diagnosis in blood donors to avoid this transmission. As a result, in this investigation, we conducted a cross-sectional, descriptive analysis to assess hepatitis C seroprevalence and investigate biochemical parameters in blood donors recruited at the National Center for Blood Transfusion (NCBT) in N'Djamena (Chad). All, 435 people took part in the study.

First, we described the target population's socio-demographic features. The majority of those polled were men, with an M/F ratio of 5.3. This is consistent with the previous findings in Democratic Republic of Congo [7], and Mali [8] that reported ratios of 16.8 and 15.63 respectively. The existence of some contraindications to blood donation that are particular to women, such as pregnancy, delivery, breastfeeding, and the menstrual cycle, might explain why there are fewer female donors [9]. Furthermore, some authors claim that societal pressure and personal commitments are the primary motivators for males to donate blood, as opposed to women. do things only for the sake of altruism [10]. Indeed, about 61 % of participants are married, and the obligations that they bear may be one of the factors that drive them to blood transfusion centres.

Donors ranged in age from 18 to 60 years old, with an average age of 32.15 years. This average age is comparable to the Malian study by Bah et al. (2019) [8] and Maiga (2022) [9] who described an average of 31.21 ± 8.7 years and 31.15 years respectively. On the other hand, it is more than that of Francesca et al., 2020 (27 years) in Sierra Leone [11] and Kabinda et al. (2014) in the Democratic Republic of the Congo (26 years) [12]. This disparity may be explained by the significantly greater sample size and the comparatively long research duration.

Regarding professional status, our study showed that the majority of subjects practice a profession other than those listed (36.09%). It is followed by students (18.65%), traders (17.10%) and civil servants (14.26%). The bottom of the table is occupied by the military, housewives and farmers. This finding is similar to that of Study et al. (2022), who found that in a large-scale cross-sectional study of blood donors in Yemen, the military (14.8%) was underrepresented compared to students (20.2%) and professional and manual employees [13]. It might be explained by the fact that the target population, particularly the employees, understand the significance of blood donation. Indeed, 40.68% of the target population has a university-level education. Previous research has found that awareness of blood donation is connected to employment and a degree of education. That is, the more educated and employed people are, the more likely they are to donate blood. Previous research has found that awareness of blood donation is connected to employment and degree of education [14]. That is, the more educated and employed people are, the more likely they are to donate blood

We then examined our subjects' medical histories and clinical symptom profiles. We discovered that most of the participants had never donated blood before, had never had a hepatitis C test previously, and had never been infected. These findings demonstrate that the study was conducted on a naïve but fundamentally healthy population. The findings are comparable to those of Li et al., who discovered in research conducted in four blood transfusion centres in China that 60% of blood donors were new [15]. This predominance of new donors can be explained by the fact that they are mainly family donors than voluntary donors. Indeed, a prior study in Mali showed that 80.99% of donors identified belonged to the category of new donors and more than 90% of these were family donors [8]. The scientists did remark, however, that it is these donors that often carry the most illnesses since they do not have their screening tests. Similarly, research done in Cameroon found a nearly similar proportion of new (48.6%) and aged (51.6%) blood donors. Blood was collected at Yaoundé's central hospital, and the vast majority of donors were family members (98.7%) [16].

The healthy nature of our population is also reflected in the low frequency of clinical signs. The most common clinical signs were dark yellow urine (12.87%), fever (8.05%) and abdominal pain (6.21%). Indeed, Van den Hurk et al. (2017) demonstrated, in a recent study, that pre-donation clinical symptoms could be postponed in only 3% of blood donors in Amsterdam (Holland) [17]. Our result is also similar to those of an American study that reported a weak presence of symptoms such as fever (between 5 and 10%) in blood donors, although other symptoms such as fatigue (61%), headache (54%), and anxiety (54%) were much more present [18].

Our analysis revealed a seroprevalence of 7.12 % among the subjects surveyed for hepatitis C. This result is higher than those found in previous studies of blood donors in the Democratic Republic of the Congo (0.7%) [7], Sierra Leone (1.2%)[11], Mali (2.32%) [19], and Kano in Nigeria (3.4%) [20]. On the other hand, it is consistent with the findings of Sarah et al. (2015) in Hail in Saudi Arabia (7.2l%) [21]. Aurélie et al. (2019) discovered a higher prevalence (9.7%) in this population in Cameroon at the Central Hospital of Yaoundé [16]. This disparity in seroprevalences could be explained by the type of study, sample size, intrinsic sociodemographic and clinical characteristics of the participants, study period, and location. Furthermore, a previous study in Chad found that anti-HCV antibodies were present in 48 % of blood donors in N'Djamena [6]. However, this is a 30-year-old study. The current data has evolved significantly. We believe that because the technique used was a rapid diagnostic test, the prevalence of occult hepatitis C may have been underestimated.

Gender, age, marital status, and place of residence, as well as occupational status, were not significantly associated with hepatitis C in the participants, according to statistical associations

with the various parameters assessed. Only farmers, traders, and other workers had a higher risk of infection than the military, though this was not statistically significant. This finding contrasts with the findings of Aurelie et al. (2019) in Cameroon, who discovered that men were more susceptible to infection than women [16]. However, it comes close to those Mulubwa et al. in the DRC [7] who drew similar conclusions on age and sex in a retrospective study. In contrast to a place of residence and age, Study et al. discovered that professional occupation was significantly correlated (P<0.001) with hepatitis C among blood donors in Yemen [13]. Furthermore, in our study, the level of study was found to be statistically associated with hepatitis C, with main participants from other levels of study being the most vulnerable. It is actually about those who have done Koranic studies from a young age without attending a traditional school. According to a study carried out by Li et al. (2010) on blood donors recruited in the blood Centre of Nanjing (China), between 2000 and 2010, the more the level of education of the participants increases, the more they have chances of contracting hepatitis C [15]. On the other hand, Aurelie et al. (2019) in Cameroon showed that the lower the level of study of blood donors, the greater the chances of being exposed to the infection [16].

In terms of medical history, no statistical relationship was found between hepatitis C seropositivity and the presence of a prior hepatitis C test or infection prior to diagnosis. Hepatitis C, on the other hand, was found to be significantly more prevalent among new blood donors than among former blood donors (RR=3.262 and 1; 10.24% and 3.14%; P=0.0043). This finding is consistent with the findings of Al-Waleedi and Khader in the Yemeni city of Aden, who discovered that people who have previously donated blood have a much lower risk (Odds Ratio = 0.05) of being positive for anti-HCV antibodies than those who have never donated blood (0.3% and 3.2%, P=0.01) [22]. This can be explained by the fact that new donors are more numerous in this study (56.1% versus 43.9%) or by the fact that the majority of them, despite having risk behaviors, have never had the opportunity to be diagnosed earlier, unlike former donors. These findings differ from those of Karki et al. (2008) in Nepal, who found no statistical difference between the two groups (0.65% for new and 0.67%for old, P>0.05), most likely due to the low overall prevalence [23].

In terms of clinical symptoms, all of the symptoms identified (fever, nausea, abnormal stool and urine color, and the absence of jaundice) were strongly associated with the presence of hepatitis C. These findings indicate that the subjects who tested positive have symptomatic hepatitis C that is not associated with jaundice. These findings are consistent with previous research that found a low seroprevalence of hepatitis C (2%) in subjects with acute jaundice in Chad [24]. The presence of these symptoms would suggest active hepatitis C that has already created liver damage. It could also suggest that patients are at the chronic infection stage. Indeed, people aged 41-50 were found to be more numerous compared to other age groups.

In bivariate analysis, we found no statistical association between the consumption of alcohol, and tobacco and the presence of HCV among blood donors in N'Djamena. This suggests that the presence of these factors does not sufficiently expose the virus. These results are different from those of Tserenpuntsag et al. which showed that alcohol consumers (15.5%, P=0.002) were significantly more exposed to HCV among blood donors in Mongolia, unlike tobacco users (11.7%, P=0.024) [25].

Analyzes of biochemical parameters in HCV+ subjects showed that the majority (54.84%) had abnormally high ALT values with an overall mean of 48.96 ± 7.63 IU/L. Proof that these subjects would suffer from hepatic cytolysis in response to chronic inflammation. These results are different to those reported by Kamcev et al. who found increased values of transaminases in particular ALT in 2.22% (3/132) of anti-HCV positive donors in Spain [26]. In our study, hyperbilirubinemia was also observed, with nearly 81% having high conjugated bilirubin. This abnormal increase in conjugated bilirubin reflects bilirubin stagnation in the blood, which could be caused by biliary obstruction (cholestasis) or the presence of hepatic viruses. Surprisingly, in this study, jaundice was not significantly associated with the presence of HCV. This condition could thus be linked to the presence of other hepatic viruses than the hepatitis B virus, or to the subjects' consumption of alcohol or medication. These findings are in line with the findings of Khan et al. in Pakistan, who found increased ALT and bilirubin in HCV+ individuals [27].

In addition, HCV+ subjects showed hypertriglyceridemia in 22.58% of cases and fasting hyperglycemia in 51.61% of cases. These results suggest that the presence of HCV may be associated with the presence of metabolic abnormalities. Several studies have attempted to analyze the link between diabetes mellitus and HCV infection by showing that HCV has a direct action on insulin signalling pathways by inhibiting enzymes involved in the synthesis and transfer of VLDL, and by stimulating glucogenic and lipid accumulation genes [28-29].

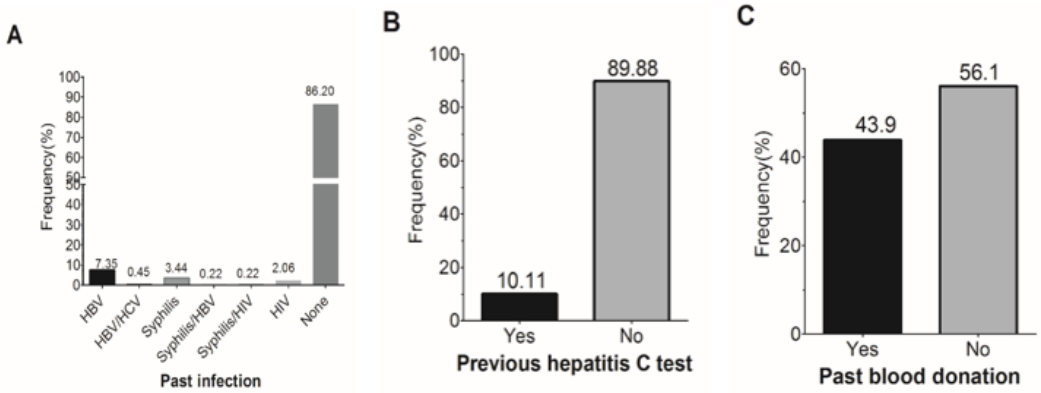

Figure 1. Distribution of the surveyed population according to the occurrence of a past infection (A), previous hepatitis C test (B) and past blood donation (C)

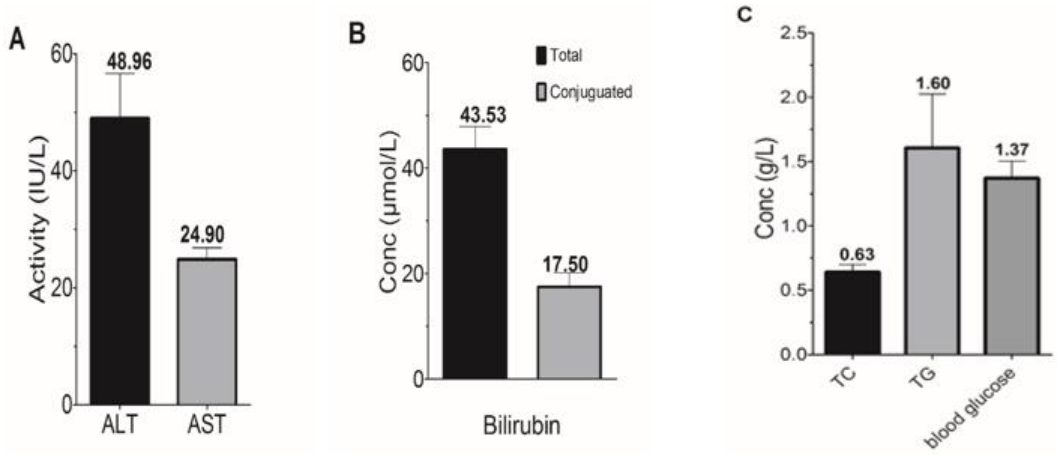

Figure 2. Mean values of some biochemical parameters in HCV+ blood donors.
A: Activity of serum ALT and AST transaminases, B: Concentration of total and conjugated bilirubin; C: Concentration of total cholesterol, triglycerides and glucose.

Table 1. Overall distribution of the study population according to socio-demographic characteristics

Variables		Number	Frequency (%)
Gender	Male	366	84.13
	Female	69	15.87
	Total	435	100
Place of residence	Rural	32	7.35
	Urban	403	92.65
	Total	435	100
Marital status	Singles	151	34.71
	Married	271	62.29
	Divorced	10	2.30
	Widowers	3	0.7
	Total	435	100
Study level	Others	70	16.09
	Primary	38	8.75
	Secondary	150	34.48
	University	177	40.68
	Total	435	100
Age (years)	18-30	198	45.51
	31-40	166	38.16
	41-50	60	13.79
	51-60	11	2.54
	Total	435	100
Professional status	Farmers	8	1.83
	Traders	77	17.70
	Students	82	18.86
	Civil servants	62	14.25
	Housewives/Househusband	20	4.59
	Military	29	6.68
	Others	157	36.09
	Total	435	100

Table 2. Overall profile of clinical symptoms in Chadian patients surveyed.

		Number	Frequency (%)
Jaundice	Yes	20	**4.60**
	No	415	95.40
Fever	Yes	35	**8.05**
	No	400	91.95
Nausea	Yes	21	**4.83**
	No	414	95.17
Abdominal pain	Yes	27	**6.21**
	No	408	93.79
Saddles colors	Abnormal	16	**3.68**
	Normal	419	96.32
Appearance of urines	Dark-yellow	56	**12.87**
	Normal	379	87.13
	Total	**435**	

Table 3. overall profile of alcohol & tobacco consumption in the surveyed group.

		N	Frequency (%)
Alcohol consumption	Yes	112	**25.75**
	No	323	74.25
Frequency of alcohol consumption	Daily	17	3.91
	Moderated (weekend)	71	**16.32**
	Rare	21	4.83
	None	326	74.94
Tobacco consumption	Yes	55	**12.64**
	No	380	87.36
Frequency of tobacco consumption	Daily	49	**11.26**
	Moderated (weekend)	5	1.15
	None	381	**87.59**

Table 4. Statistical association between the HCV status and socio-demographic parameters

		HCV+	HCV-	Total	Frequency (%)	Relative risk	P-value
Sex	M	25	341	366	6.83	1	
	F	6	63	69	8.69	1.273	0.58
	Total	31	404	435			
Age (years)	[18-30]	14	184	198	7.07	**-**	0.361
	[31-40]	10	156	166	6.02	**-**	0.40
	[41-50]	7	53	60	11.66	-	0.23
	[51-60]	0	11	11	0	1	-
	Total	31	404	435			
Place of residence	Rural	5	27	32	15.62	**2.422**	0.052
	Urban	26	377	403	6.45	1	
	Total	31	404	435			
Matrimonial statute	Single	10	141	151	6.62	-	0.644
	Married	20	251	271	7.38	-	0.62
	Divorced	1	9	10	10	-	0.56
	Widowed	0	3	3	0	1	
	Total	31	404	435			
Professional status	Farmers	1	7	8	12.5	**3.625**	0.316
	Traders	7	70	77	9.09	**2.63**	0.329
	Students	5	77	82	6.09	1.76	0.587
	Civil servants	3	59	62	4.83	1.403	0.763
	Housewife	1	19	20	5.00	1.45	0.785
	Military	1	28	29	3.44	1	
	Other	13	144	157	8.28	**2.401**	0.364
	Total	31	404	435			
Study level	Elementary	2	36	38	5.26	1.316	0.73
	Secondary	6	144	150	4.00	1	
	University	12	165	177	6.77	1.695	0.272
	Others	11	59	70	15.71	**3.92**	**0.0024**
	Total	31	404	435			

Table 5. Statistical association between the HCV status and clinical symptoms

		HCV+	HCV-	Total	Frequency (%)	Relative risk	P-value
Jaundice	Yes	20	404	424	4.71	1	**<0.0001**
	No	11	0	11	100	21.20	
	Total	31	404	435			
Fever	Yes	20	15	35	57.14	20.78	**<0.0001**
	No	11	389	400	2.75	1	
	Total	31	404	435			
Nausea	Yes	15	6	21	71.42	18.48	**<0.0001**
	No	16	398	414	3.88	1	
	Total	31	404	435			
Abdominal pain	Yes	11	16	27	40.74	8.31	**<0.0001**
	No	20	388	408	4.90	1	
	Total	31	404	435			
Saddles colors	Abnormal	14	2	16	87.5	21.57	**<0.0001**
	Normal	17	402	419	4.05	1	
	Total	31	404	435			
	Dark-yellow	28	28	56	50	63.17	**<0.0001**
Appearance of urines	Normal	3	376	379	0 .79	1	
	Total	31	404	435			

Table 6. Statistical relationship between HCV seropositivity and tobacco and alcohol consumption

		HCV+	HCV-	Total	Frequency (%)	Relative risk	P-value
Alcohol consumption	Yes	11	101	112	9.82	1.58	0.198
	No	20	303	323	6.60		
	Total	31	404	435			
Frequency of alcohol consumption	Daily	**1**	16	17	5.88	1	
	Moderated (weekend)	**7**	64	71	9.85	1.68	0.608
	Rare	3	18	21	14.28	2.43	0.40
	None	20	306	326	6.13	1.04	0.966
	Total	31	404	435			
Tobacco consumption	Yes	4	49	53	7.54	1.06	0.898
	No	27	355	382	7.06	1	
	Total	31	404	435			
Frequency of tobacco consumption	Daily	4	45	49	8.16		0.926
	Moderated (weekend)	0	4	4	0		
	None	27	354	381	7.08		
	Rarely	0	1	1	0		
	Total	31	404	435			

Table 7. Statistical link between HCV status and the medical history

		HCV+	HCV-	Total	Frequency (%)	Relative Risk	P-value
Previous hepatitis test	Yes	2	42	44	4.5	1	
	No	29	362	391	7.41	1.63	0.482
	Total	31	404	435			
Previous blood donation	Yes	6	185	191	3.14	1	**0.0043**
	No	25	219	244	10.24	3.262	
	Total	31	404	435			
Past infection	HIV	0	10	10	0		0.91
	HBV	2	32	34	5.88		
	Syphilis	1	17	18	5.55		
	None	28	347	375	7.46		
	Total	31	404	435			

Table 8. Frequency of the biochemical abnormalities in the HCV+ group

Variables		HCV +	
	Modalities	N	Frequency (%)
ALT	<40 UI/L	14	45.16
	>40 UI/L	17	**54.84**
AST	<40 UI/L	28	90.32
	>40 UI/L	3	**9.68**
Total cholesterol	Normal (< 2g/L)	31	100.00
Triglycerides	High (>130 mg/dL)	7	**22.58**
	Normal (34-130 mg/dL)	24	77.42
Conjugated bilirubin	Normal (<5 µmol/L)	6	19.35
	High (>5 µmol/L)	25	**80.65**
Total bilirubin	Normal (<34 µmol/L)	11	35.48
	High (>34 µmol/L)	20	**61.29**
Glycemia	Normal (0.71-1.2 g/L)	15	48.39
	High (>1.2 g/L)	16	**51.61**

Conclusion

The overall goal of this study was to detect the seroprevalence of hepatitis C and biochemical characteristics in blood donors at the NBTC in Ndjamena. Hepatitis C is moderately prevalent in the community of recruited blood donors. The level of study, the clinical symptoms, and the previous blood donation were significantly associated with the presence of the hepatitis C virus. The majority of the HCV+ subjects showed elevated ALT values and hyper-bilirubinemia. Blood glucose and triglyceride abnormalities were also noted in these subjects. Therefore, the presence of HCV in blood donors is associated with an increased risk of liver damage and metabolic disorders that are important to monitor shortly.

Abbreviations

NBTC: National Blood Transfusion Center; HCV: Hepatitis C Virus; WHO: World Health; Organization; HIV: Human Immunodeficiency Virus; HBV: Hepatitis B Virus; CHU-RN: National Reference University Hospital; AST: Aspartate Aminotransferase

(Transaminase); ALT: Alanine Aminotransferase (Transaminase); TC: Total Cholesterol; IU/L: International Unit per Liter; VDD: Voluntary Blood Donation; CI: Confidence Interval; RR: Relative Risk; IU: International Units; UN: United Nations; RNA: Ribonucleic Acid; CSR: Corporate Social Responsibility; S: Serum.

Authors' Contribution

AHG: Participated in study design, data collection, statistical analysis, and manuscript writing. AHM: supervised the research, critically revised the manuscript, and interpreted the results. ASNA: was responsible for biochemical analysis and sample management and contributed to writing and review. AAF: participated in field data collection, data entry, and data verification. RN: provided methodological support and statistical advice and contributed to the discussion of results. FBA: contributed to questionnaire development, logistical management, and data collection. and NYN: provided overall scientific supervision, final manuscript review, and validation of the analyses. All authors read and approved the final version of the manuscript and contributed significantly to the entire research process.

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Conflict of interest

The authors declare no conflict of interest

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