

## Seroprevalence of HIV and hepatitis B and C virus in blood donors received at the Provincial Hospital of Moundou in Chad

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World Journal of Advanced Research and Reviews, 2025, 25(02), 2752-2760

Publication history: Received on 16 November 2024; revised on 20 February 2025; accepted on 23 February 2025

Article DOI: <https://doi.org/10.30574/wjarr.2025.25.2.3583>

### Abstract

**Introduction:** Blood transfusion is a medical act of great importance but blood can carry countless microorganisms such as hepatitis B and C viruses (HBV and HCV) and Human Immunodeficiency Virus (HIV) which are responsible for various pathologies.

**Methodology:** We carried out a prospective study with an analytical aim from November 2023 to January 2024 among donors received at the blood bank Laboratory at the Provincial Hospital of Moundou (HPM) in southern Chad. The data from the interviews as well as the results of the tested blood bags were analyzed with R Studio software version 4.0.4.2021.

**Results:** The study enrolled 539 donors, including 367 males and 172 females, that is to say sex ratio of 2.1. The mean age was  $34.363 \pm 8.668$  years with extremes of 18 years and 55 years. The overall seroprevalence of HBV was 9.1%, 2.6% for HCV and 4.45% for HIV.

**Conclusion:** The seroprevalence of hepatitis B and C as well as that of HIV remains high among voluntary and family blood donors. This situation remains worrying, hence the need for a new approach which will consist of retaining donors for quality blood.

**Keywords:** Seroprevalence; Hepatitis B; Hepatitis C And HIV; Blood Donors; Moundou Provincial Hospital

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## 1. Introduction

Blood transfusion play a vital role in restoring health in certain disease states and saving countless lives [1]. Of the 118.5 million blood donations collected each year worldwide, 40% come from high income countries, where 16% of the world is population lives. In low income countries, up to 54% of blood transfusions are given to children under 5 years of age, while in high income countries, the most commonly transfused patient group is the over 60 years, who account for up to 76% of transfusion cases. In 2008 and 2018, 10.7 million donations came from voluntary non-remunerated donors. More than 50% of the blood supply comes from compensation donations (family or close relatives) and therefore non-remunerated donations [2].

The risk of transmission of serious infections, including HIV and hepatitis, through unsafe blood and chronic blood shortages have drawn global attention to the importance of blood safety and availability. In order to ensure universal access to safe blood, WHO has been at the forefront of improving blood safety and availability and recommends the integrated strategy of screening and quality of all blood donations to detect transfusion-transmissible infections, including HIV, hepatitis B and hepatitis C [3 ; 2]. In Chad, blood safety is coordinated by the National Blood Transfusion Center (CNTS) in N'Djamena. Its main missions are to organize blood collection activities, distribute blood products and ensure blood safety for the Chadian population. In Chad, 93,594 blood bags were collected out of the expected 120,000, representing a 77.99% target achievement rate. It appears that voluntary blood donation has increased slightly (06.09% in 2020 compared to 05.20% in 2019) [4]. The seroprevalence of HIV, HBV and HCV among voluntary and family donors was 2.61%, 7.87% and 1.44% respectively. These three pathologies are systematically screened for at the CNTS in N'Djamena and in all Provincial Blood Transfusion Centers in Chad [5].

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## 2. Material and methods

### 2.1. Type and area of study

This was a prospective study with an analytical aim conducted among blood donors received at the Blood Bank Laboratory of Provincial Hospital of Moundou (HPM) in Logone Occidental in southern Chad. The HPM blood bank service is located in the city of Moundou, capital of the province of Logone Occidental and economic capital of Chad. It is located 478 km from N'Djamena, the political capital. The HPM is limited to the North by the ADOUM Dallah high school, to the South by the National Electricity Company, to the East by the DIASPORA Hunting Hotel and to the West by the Chad Cigarette Factory. It is public establishment of an administrative and scientific nature which is placed under the supervision of the Ministry of Public Health.

### 2.2. Sampling

The sampling was non-probabilistic and carried out voluntarily. It began with an interview of 601 donors who came to the HPM Blood Bank Laboratory. Among them, 539 donors had consented to participate in this study but 62 donors had refused to participate in this study and were therefore not included in the study.

### 2.3. Study population

The study population consisted mainly of male and female donors aged 18 to 55 years with a weight of  $\geq 50$  kg admitted to the HPM Blood Bank Laboratory with a blood donation examination form and especially consenting to participate in this study. A verbal informed consent was read and explained to each participant. Blood donors are received from Monday to Sunday at any time of the day, that is to say 24 hours a day.

### 2.4. Data collection method

Data collection and donor blood bags were carried out from November 2023 to January 2024. For each sample, several pieces of information were collected in a collection sheet designed for this purpose. These data were: the socio-demographic characteristics of the donors (age, sex, marital status, profession, origin and level of education), the reason for the donation, types of donations, quantity collected, the weight of donors and the serological status of donors for HIV, HBV and HCV.

## 2.5. Analysis technique of collected blood samples

### 2.5.1. HBV screening test

For the search for HBV antigen, we used the Rapid HBsAg Test Cassette from the firm « ALL TEST™ ». It is a rapid test for the qualitative detection of the surface antigen of the hepatitis B virus in blood. The Cassette is a two site sandwich immunoassay in solid phase and qualitative for the detection of HBV. The membrane pre-induced anti-HBsAg antibodies on the line area of the test part of the cassette. After the sample is deposited, the serum reacts with the induced anti-HBsAg antibody particle. The mixture migrates upward on the chromatographic membrane by capillary action to react with anti-HBsAg antibodies on the membrane and generates a colored line. The cassette contains anti-HBsAg particles and anti-HBsAg antibodies that are applied to the membrane. Relative sensitivity of the test: 99.9%, relative specificity: 99.6% and the accuracy is 99.7%. This test has a sensitivity of 99.9% and a specificity of 99.96% for the antibody line and 99.76% for the antigen line. The reference number of the test was REF IHBSG-402 [6].

### 2.5.2. HIV screening test

For the search for antigen and antibodies, we used two tests for the detection of anti-HIV antibodies from the Abbott firm. The Determine™, is an immunochromatographic test for the qualitative in vitro detection with visual reading for the detection of anti-HIV-1 and anti-HIV-2 antibodies in human sera or plasma. The Determine™ HIV-1/2 serum/plasma test, 20 or 100 tests (7D2342) is coated with recombinant HIV-1/2 antigen and synthetic peptide. The specimen is deposited on the deposition area, and the specimen migrates to the conjugate deposition area where it reconstitutes and mixes with the selenium colloid-antigen conjugate. This mixture continues to migrate on the solid phase to the immobilized recombinant antigens and synthetic peptides at the patient window. If anti-HIV-1 or anti-HIV-2 antibodies are present in the specimen, they bind to the antigen in the selenium colloid-antigen conjugate and the patient window antigen, forming a red line at the patient window. If anti-HIV-1 or anti-HIV-2 antibodies are absent, the selenium colloid-antigen conjugate and the patient window antigen do not form a red line at the patient window. A procedural control bar is included with this test to ensure the validity of the test. The Determine™ HIV-1/2 has a sensitivity of 100% and a specificity of 99.75%. The reference number of the test was 7D2342, 7D2343 [7].

### 2.5.3. HCV screening test

For the search for antigen and antibodies, we used the Abbott HCV Antibody Detection Strip. The Bioline™ HCV is a rapid in vitro immunochromatographic assay for the qualitative detection of HCV-specific antibodies in sera. This test consists of a Nitrocellulose membrane strip coated with recombinant HCV capture antigen (capsid, NS3, NS4 and NS5) at the test line (T). The protein A-gold-colloid conjugate and the sample move on the membrane by chromatography to reach the test zone, where the Antigen-antibody-protein A-gold particle complex forms a visible line with a high degree of sensitivity and specificity. The letters "T" and "C" are written on the surface of the test device housing, to indicate the test line and the control line. The test and control line and the result window are not visible before the application of the sample. The control line is used to control the procedure. It systematically appears if the procedure has been carried out correctly and the reagents of the control line are working. The Bioline™ HCV has a sensitivity of 100% and a specificity of 99.4%. The reference number of the test was REF 7D2342 [8].

## 2.6. Data analysis

The data from the interviews as well as the results of the tested blood bags were entered into a Microsoft Office 2016 Excel spreadsheet, then converted into CSV and exported into R Studio software version 4.0.4.2021 for analysis. Regarding analytical statistics, the Chi-square test and the Pearson test were used to determine the prevalence of HBV, HCV and HIV as well as their significance. The significance threshold was set at 5% and the P-value was calculated from the Pearson test.

Following the laboratory serological analyses, the following results were obtained:

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## 3. Results

In this study, 539 donors were included, including 367 male donors and 172 female donors, a sex ratio of 2.1. The mean age was  $34.363 \pm 8.668$  years with extremes of 18 years and 55 years. The overall seroprevalence of HBV was estimated at 9.1%. This seroprevalence was distributed according to the sociodemographic characteristics of the donors, their professions and the types of blood donations.

The seroprevalence of HBV was 11% in male donors and 5.23% in female donors. This seroprevalence is significant (P-value = 0.04).

### 3.1. HBV Seroprevalence in Donors

HBV seroprevalence was very high in the age groups of 18 to 25 years and 26 to 33 years respectively at 13.38% and 13.04%. These results are highly significant (P-value = 0.001).

According to the profession of donors, HBV seroprevalence was 27.11% in students, 20% in civil servants (personnel working in the public service), 12.50% in homemaker and 10.31% in traders. These variables are significant (P-value = 0.05).

According to the level of education, 33.87% of HBV positive donors had a higher education level, a seroprevalence of 33.33% among blood donors with a primary education level and 15.22% were uneducated. These results are very significant with a P-value = 0.007.

For the types of donations, a HBV seroprevalence of 16.28% was observed among outpatient donors and 8.47% among family donors, that is to say. (P-value = 0.05).

**Table 1** Prevalence of HBV among blood donors

Variables	N	HBV +	Prevalence	CI at 95%	P-value	Interpretation
<b>Prevalence of HBV by sex of patients</b>						
Male	367	40	11	[11.09 ; 10.90]	0.04	Significant
Female	172	09	5,23	[5.28 ; 5.17]		
<b>Prevalence of HBV by age group of patients</b>						
18 at 25 years	127	17	13,38	[13.73 ; 13.02]	0.001	Highly Significant
26 at 33 years	138	18	13,04	[13.35 ; 12.72]		
34 at 41 years	116	09	7,76	[7.92 ; 7.59]		
42 at 49 years	106	03	2,83	[2.85 ; 2.80]		
+ 50 years	52	02	3,85	[3.85 ; 3.74]		
<b>Prevalence of HBV according to profession of enrolled patients</b>						
Trader	126	13	10,31	[10.54, 10.07]	0,05	Significant
Agriculturist	127	03	2,36	[2.37 ; 2.34]		
Unemployed or Emptiest	120	09	7,50	[7.64, 7.35]		
Pupil	28	02	7,14	[7.72 ; 6.55]		
Breeder	45	01	2,22	[2.26 ; 2.17]		
Student	59	16	27,11	[29.41 ; 24.80]		
Functionnary	10	02	20	[28.49 ; 11.50]		
Homemaker	24	03	12,50	[14.19 ; 10.80]		
<b>Prevalence of HVB according to the level of education of enrolled patients</b>						
Primary	03	01	33,33	[95.54 ; 28.88]	0,007	Highly Significant
Secondary	428	20	4,67	[4.68 ; 4.65]		
Upper	62	21	33,87	[36.95 ; 30.78]		
Uneducated	46	07	15,22	[16.42 ; 14.01]		
<b>Prevalence of HVB according to the don type</b>						
Familial donor	496	42	8,47	[8.51 ; 8.42]	0.05	Significant
Ambulant donor	43	07	16,28	[17.80 ; 14.75]		

**3.2. HCV seroprevalence in donors**

In this study, HCV seroprevalence was estimated at 2.6%. This seroprevalence was distributed in Table 2.

HCV seroprevalence was 3.54% in male blood donors and 0.61% in female donors. These results are not significant (P>0.05).

According to age groups, HCV seroprevalence was 3.81% in the 42-49 age group, 3.15% in the 18-25 age group and 2.61% in the 34-41 age group. These results are highly significant (P = 0.001).

In relation to the profession of blood donors, the seroprevalence of HCV was 10% among personnel working in the public service (functionnary), 4.16% among homarker, 3.57% among students and a seroprevalence of 3.17% among traders and agriculturist. These results are significant (P-value = 0.03).

The seroprevalence of HCV was 6.45% among blood donors with a higher education level, 2.17% among uneducated blood donors and 2.10% among blood donors with a secondary education level. These results are very significant (P-value = 0.007).

This study revealed a seroprevalence of HCV lower than 3%. It was 2.62% in compensation donors or family donors (donors related to the recipients) and 2.32% in out patient blood donors. These results are not significant (P>0.05).

**Table 2** HCV seroprevalence in blood donors

Variables	N	HCV +	Prevalence	CI at 95%	P-value	Interpretation
<b>Prevalence of HCV by sex of patients</b>						
Male	367	13	3.54	[3.55 ; 3.52]	0.09	Not Significant
Female	172	01	0.61	[0.60 ; 0.61]		
<b>Prevalence of HCV by age group of patients</b>						
18 at 25 years	127	04	3.15	[3.18 ; 3.11]	0.001	Highly Significant
26 at 33 years	138	02	1.45	[1.45 ; 1.44]		
34 at 41 years	116	03	2.61	[2.63 ; 2.58]		
42 at 49 years	106	04	3.81	[3.73 ; 3.88]		
+ 50 years	52	01	1.96	[2.01 ; 1.96]		
<b>Prevalence of HCV according to profession of enrolled patients</b>						
Trader	126	04	3.17	[3.20 ; 3.13]	0.03	Significant
Agriculturist	127	04	3.16	[3.19 ; 3.12]		
Unemployed or Emptiest	120	01	0.83	[0.82 ; 0.83]		
Pupil	28	02	3.57	[3.74 ; 3.39]		
Breeder	45	00	00	[0.0 ; 0.0]		
Student	59	01	1.96	[1.98 ; 1.93]		
Functionnary	10	01	10	[12.84 ; 7.15]		
Homemaker	24	01	4.16	[4.42 ; 3.89]		
<b>Prevalence of HCV according to the level of education of enrolled patients</b>						
Primary	03	00	00	[0.0 ; 0.0]	0.007	Highly Significant
Secondary	428	09	2.10	[2.10 ; 2.09]		
Upper	62	04	6.45	[6.67 ; 6.22]		

Uneducated	46	01	2.17	[2.20 ; 2.13]		
<b>Prevalence of HCV according to the don type</b>						
Familial donor	496	13	2.62	[2.62 ; 2.61]	0.08	Not Significant
Ambulant donor	43	01	2.32	[2.36 ; 2.27]		

### 3.3. HIV seroprevalence in donors

The overall HIV seroprevalence was 4.45% in blood donors. This rate was distributed according to sociodemographic characteristics and types of donations in Table 3.

In this study, HIV seroprevalence in blood donors was 6% in male donors and 1.16% in female donors. This prevalence is not significant (P>0.05).

The age group of 18 to 25 years was the most infected with HIV, with a seroprevalence of 7.11%, a rate of 4.71% in the 42- to 49-year-olds and 3.84% and 3.62% respectively in the 52 and 26- to 33-year-olds age groups. These results are very significant (P-value = 0.007).

According to the profession, the seroprevalence was 5.83% among donors without a permanent job, 5.51% among agriculturist, 5.10% among students and 4% among traders and homemaker. These seroprevalences are significant (P-value = 0.05).

The HIV seroprevalence was 4.84% among blood donors with a higher education level, that is to say university, and a prevalence of 4.44% among donors with a secondary education level and a prevalence of 4.34% among uneducated blood donors. These results are highly significant (P-value = 0.001).

With respect to the type of donations, the HIV seroprevalence was 4.65% among donors received on an outpatient basis and 4.44% among family blood donors. These results relative to the type of blood donations are significant (P-value = 0.03).

**Table 3** HIV seroprevalence in blood donors

Variables	N	HIV +	Prevalence	CI at 95%	P-value	Interpretation
<b>Prevalence of HIV by sex of patients</b>						
Male	367	22	6,00	[6.03 ; 5.96]	0.06	Not Significant
Female	172	02	1,16	[1.16 ; 1.15]		
<b>Prevalence of HIV by age group of patients</b>						
18 at 25 years	127	09	7,11	[7.23 ; 6.98]	0.007	Highly Significant
26 at 33 years	138	05	3,62	[3.65 ; 3.58]		
34 at 41 years	116	02	1,72	[1.72 ; 1.71]		
42 at 49 years	106	05	4,71	[4.78 ; 4.63]		
+ 50 years	52	02	3,84	[3.94 ; 3,73]		
<b>Prevalence of HIV according to profession of enrolled patients</b>						
Trader	126	05	4,10	[4.14 ; 4.05]	0,05	Significant
Agriculturist	127	07	5,51	[5.59 ; 5.42]		
Unemployed or Emptiest	120	07	5,83	[5.92 ; 5.73]		
Pupil	28	00	00	[0.0 ; 0.0]		
Breeder	45	01	2,22	[2.26 ; 2.17]		
Student	59	03	5,10	[5.25 ; 4.94]		

Functionnary	10	00	00	[0.0 ; 0.0]		
Homemaker	24	01	4,20	[4.47 ; 3.92]		
<b>Prevalence of HIV according to the level of education of enrolled patients</b>						
Primary	03	00	00	[0.0 ; 0.0]	0,001	Highly Significant
Secondary	428	19	4,44	[4.45 ; 4.42]		
Upper	62	03	4,84	[4.97 ; 4.70]		
Uneducated	46	02	4,35	[4.50 ; 4.19]		
<b>Prevalence of HIV according to the don type</b>						
Familial donor	496	21	4,44	[4.45 ; 4.42]	0.03	Significant
Ambulant donor	43	02	4,65	[4.86 ; 4.49]		

## 4. Discussion

### 4.1. HBV seroprevalence in donors

In this study, the HBV seroprevalence was 11% in male donors and 5.23% in female donors. The results of this study are higher than those of 6.2% published by Boiro [9] at the Tombouctou Hospital in the Republic of Mali. These results can be explained by the introduction in 2012 of HBV vaccination in women of childbearing age received in prenatal consultation, they are increasingly immunized against HBV unlike men. This could explain this low prevalence in female blood donors.

The HBV seroprevalence was very high in the age groups of 18 to 25 years and 26 to 33 years respectively with 13.38% and 13.04%. These results are significantly lower than those of 4.6% in the 18 to 25 age group and 7.6% in the 18 to 25 age group obtained by Boiro [9] in Tombouctou in northern Mali and 8.8% in donors under 25 years of age and 9.8% in the 25 to 29 age group published by Dray *et al.* [10] among blood donors in the Republic of Djibouti. This increase in seroprevalence in these age groups is due to the fact that this is the most sexually active age group and therefore some blood donors who participated in this study claimed to have risky behavior (multiple sexual partners). This could explain this high prevalence in these age groups in the study. The seroprevalence of HBV was 27.11% among students, 20% among people working in the public service (functionnary), 12.50% among homemaker and 10.31% among traders. The prevalence obtained in this study is much higher than those of 18.5% among students but on the other hand among traders our results are lower than those of 21.4% obtained among traders by Diarra [11] among blood donors in Kati in Mali.

According to the level of education, 33.87% of HBV positive donors had a higher level of education, a rate of 33.33% among blood donors with a primary level of education and 15.22% were not educated. A contrary prevalence was reported by Tandine [12] that is to say 0.73% and 1.10% respectively in those with a primary or secondary level and in the uneducated

Depending on the types of donations, HBV was detected at 16.28% in voluntary blood donors that is to say. unpaid and 8.47% in family donors or compensation donations. Our results are in line with the WHO recommendations [2] on the different types of blood donations. WHO recommends that donors should be voluntary unpaid donors and close relatives or family members. On which the managers in charge of the HPM blood bank, apply resolution WHA63.12. World Health Assembly resolution WHA63.12 calls on all Member States to establish national blood supply systems based on voluntary unpaid donations and to strive to achieve the goal of blood self-sufficiency. This may support our findings [2].

### 4.2. HCV seroprevalence in donors

According to age groups, HCV seroprevalence was 3.81% in the 42-49 age group, 3.15% in the 18-25 age group and 2.61% in the 34-41 age group. The results found in this study are higher than those of 0.5% and 0.7% respectively in the age group of 26 to 35 years, 18 to 25 years and 36 to 45 years obtained by Boiro [9] in Tombouctou in the Republic of Mali.

According to the profession of blood donors, the seroprevalence of HCV was 10% among personnel working in the public service (functionary), 4.16% among homemaker, 3.57% among students and 3.17% among traders and agriculturist. These results obtained are comparable to those of Dao *et al.* [13] in Northern Mali who found a seroprevalence of 2.8% among homemaker but lower than those of 6.6% found by Dao *et al.* among agriculturist [13].

The seroprevalence of HCV was 6.45% among donors with a higher level of education, 2.17% uneducated and 2.10% among donors with a higher level of education. The results of this study call upon the Ministry of Public Health, which must organize screening and awareness campaigns on HCV for the population. Only this campaign can slow down or reduce the viral prevalence of the disease.

#### 4.3. HIV seroprevalence in donors

In relation to the type of blood donations, HIV seroprevalence was 4.65% in voluntary donors and 4.44% in compensation donors or family donors. These results are much higher than those of 0.38% published by Habibou *et al.* [14] in blood donors in the city of Ziguinchor in Senegal and approximate to those of 3.30% in family donors published by Kabamba and Kabyla [15] in blood donors at the General Reference Hospital of Kamina in the Democratic Republic of Congo. The seroprevalences were 7.11% in the 18 to 25 age group, 4.71% in the 42 to 49 age group and 3.84% and 3.62% respectively in the 52 and 26 to 33 age groups. The seroprevalences found in this study are different from those of 1.8% published in blood donors with an age below 25 years, 1.9% in the 25 to 29 age group, 3.62%, in donors obtained in the Republic of Djibouti by Dray *et al.* [10] and higher than those by Dao *et al.* [13] in Gao in northern Mali with a prevalence of 0.53% in the 18 to 25 age group. This difference shows that this very young age group would constitute a high-risk group for sexually transmitted infections. According to the profession of the donors, the seroprevalence was 5.83% among donors who did not have a permanent employee, 5.51% among agriculturist, 5.10% among students and 4% among traders and homemaker. The results obtained in this study show a seroprevalence higher than the prevalence of HIV on the national scale estimated at 1.1% by UNAIDS [16]. This result shows that HIV remains a major public health problem, hence the need to further increase awareness campaigns and voluntary screening within the population. The HIV seroprevalence was 4.84% among blood donors with a higher level of education, that is to say university, and a seroprevalence of 4.44% among donors with a secondary level of education and a prevalence of 4.34% among uneducated blood donors. The prevalence according to the level of study exceeds 4% whatever the level of study and higher than the prevalence of 1.1% published in the report of the National Council for the Fight against AIDS and UNAIDS [16].

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## 5. Conclusion

The overall seroprevalences in donors show a rate of 9.1% for HBV markers, 2.59% for HCV and 4.08% for HIV markers. The seroprevalence of viral markers observed in this study alert on the ineffectiveness of preventive measures concerning the selection of donors. To overcome these measures, the authorities in charge of health must retain donors to guarantee a supply of quality blood for recipients.

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## Compliance with ethical standards

### *Acknowledgments*

This study was made possible thanks to the support of the Deputy General Director of HPM Mr. MAHAMAT Ahmat ADOUM ADJID and the Head of the laboratory department Mrs. Honorine NETALAR who provided us with the kits and the technical platform. We extend our deep gratitude to the patients who agreed to participate in this study.

### *Disclosure of conflict of interest*

The authors declare that they have no conflict of interest related to this present study.

### *Statement of ethical approval*

To respect human rights and research ethics, we filed with the Director of HPM a request for authorization to investigate which was granted to us through his signature and stamp (note N°2030/RT/PLOC/DPSLOC/HPM/SA/SgleSP/2023). During the data collection period, we requested verbal informed consent from the blood donors surveyed.

### *Statement of informed consent*

For this study, verbal informed consent was obtained from all blood donors prior to their inclusion in this study.



### Authors contribution

NKA wrote and revised the protocol. AFO, DM, DYY, BMT, NL and NH performed the manipulations. NKA and BBA supervised the work. NKA performed the statistical analyses. NKA, AFO and DM interpreted the results. All authors contributed to the production of this document.

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