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ORIGINAL ARTICLE

HIV Seroprevalence in Mogadishu, Somalia: a Retrospective Study between 2015 and 2019

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SUMMARY

Background: **Acquired immunodeficiency syndrome (AIDS) remains a major global public health problem. This study aimed to obtain current epidemiological data on the Human immunodeficiency virus (HIV) infections in Mogadishu, Somalia.**
Methods: **This study included 92,270 anti-HIV test results reported for 82,954 different individuals between 2015 and 2019. HIV tests were performed using the Architect HIV Ag/Ab Combo assay and retested with the Elecsys HIV combi PT assay.**
Results: **HIV seropositivity was found to be 0.32% (269/82,954) in all individuals over a period of four years. Anti-HIV seropositivity in the 0 - 14, 15 - 19, 15 - 24, 15 - 49, and > 15 age groups were as follows: 0.17% (11/6,441), 0.17% (12/7,131), 0.15% (35/24,132), 0.37% (212/56,895), and 0.34% (258/76,513), respectively. In HIV-infected patients, anti-HBs, HBsAg, anti-HCV, and anti-TP (syphilis) seropositivity was found to be 30.3% (56/185), 9.54% (23/241), 1.24% (3/242), and 3.45% (2/58), respectively.**
Conclusions: **The findings from this study provide comprehensive data on the HIV epidemiology in Somalia. We believe that the results presented in this study will contribute to the risk analysis and planning of preventive policies of national and global health organizations.**
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KEY WORDS

Mogadishu, Somalia, anti-HIV prevalence, sexually transmitted infections, stigma, East Africa

INTRODUCTION

Acquired immunodeficiency syndrome (AIDS) continues to be a major global public health problem. According to the 2020 report of the Joint United Nations Pro-

gramme on HIV/AIDS (UNAIDS), it is estimated that there are 38 million HIV-infected people, 1.7 million new cases, and 690,000 AIDS-related deaths in 2019 worldwide [1]. UNAIDS aims to control and even end AIDS disease in the near future with the contributions of international health organizations [2]. Comprehensive determination of HIV serostatus is a critical first step, as well as suppressing viral replication in HIV-positive individuals, in the elimination of the AIDS epidemic [3,4]. Public health programs on HIV and AIDS response in Somalia with the support of national institutions (*National HIV Program Ministry of Health*) and international organizations are at a beginning stage. However, there is strong evidence that the rates of voluntary testing or seeking treatment for HIV infection diagnosis are very low due to rigid and prevalent stigmatization and discrimination, with some people dying without being diagnosed [5-9]. Thus, the high rate of undiagnosed cases of HIV infection is considered a serious obstacle to the execution of these programs. Other factors such as the additional burden of co-infections (especially tuberculosis, hepatitis B and C), the limited data on the epidemiology of transmission in different age groups, the small number of diagnostic and treatment institutions, and economic deficiencies are also important drivers of the spread of HIV infections and obstacles to the goals of AIDS control. Unwillingness of people living with HIV to disclose their status due to the associated stigma and insecurity makes it difficult to conduct a reliable nationwide survey [5]. A civil war started in 1988 shortly after the first discovery of the HIV virus (1983) and the first case (1987) and research reports on HIV infections in Somalia [10-12]. The drought of 2011 and ongoing instability, the effects which have currently diminished, caused many people to migrate out of the country [13-15]. Fleeing from war and famine, as well a massive internal population displacement occurred especially around Mogadishu. Although data from screening studies involving Somali immigrants in different countries provided valuable information on the habits and behavior of the Somali population, there is limited knowledge about HIV prevalence in residents of Somalia, given the security concern that limits any data collection effort [6,16-18]. The HIV prevalence rate for 2019 is estimated as 0.07% across Somalia by UNAIDS, and it is estimated that only one third of HIV-infected people receive antiretroviral therapy [19]. Additionally, a decreasing trend was reportedly observed in HIV prevalence and AIDS-related deaths in Somalia since 2004 - 2006, and new infections have followed a stable course since 2015 [9]. There is no comprehensive study on the prevalence and characteristics of HIV infections in Somalia. This study aimed to present HIV data generated over 4 years by our laboratory, which is the most comprehensive diagnostic laboratory in Somalia, to foster efficient comparison with other data in the literature and reveal epidemiological parameters that can contribute to national and international preventive studies.

MATERIALS AND METHODS

The study was conducted after obtaining approval from the institutional ethics committee (Ethics Committee of Somalia Turkey Recep Tayyip Erdogan Education and Research Hospital, date: 05.12.2019, decision no.: 179, number: MSTH/2720). Our study group consisting of people who apply to our hospital voluntarily, all patient's information was protected with confidentiality, and the study was conducted in accordance with the Declaration of Helsinki.

Study group and design

In the study, all anti-HIV tests were evaluated retrospectively for 82,954 different individuals in the period between June 2015 and November 2019 in the Medical Microbiology Laboratory of Mogadishu Somalia-Turkey Recep Tayyip Erdoğan Training and Research Hospital. Test requests were monitored for a follow-up time close to four and a half years.

Serological tests

HIV serological tests were performed using the Architect HIV Ag/Ab Combo Reagent Kit (Abbott Diagnostics, Wiesbaden, Germany) on the Architect I 2000 SR (Abbott Diagnostics, Abbott Park, IL USA) system. The results were considered as reactive (S/Co $\geq$ 1.00) and non-reactive (S/Co < 1.00). Samples with low-level (< 10.0 S/Co) reactivity in the detection assay were retested using a second screening assay (Elecsys HIV combi PT assay) on a different system (Cobas e 411 analyzers, Roche Diagnostics, Rotkreuz, Switzerland). Test results were defined as a HIV seropositive in the case of repetitive reactive results in both Architect HIV Ag/Ab Combo and Elecsys HIV combi PT assay systems [20,21]. Some cases were retested, and further controls were performed with the OnSite HIV 1/2 Ab Plus Combo Rapid Test (Biotech Inc, Bejing, China). All verification tests for the same sample were evaluated as a single test. Anti-HCV, HBsAg, and anti-HBs tests were performed using the Architect Kits (Abbott Diagnostics, Germany) on the Architect I 2000 SR system (Abbott Diagnostics, USA). For syphilis diagnosis, the Architect Syphilis TP assay was used in the same platform. In addition, a rapid chromatographic immunoassay test (VESRapido Immunochromographic cassette test, Vesta Medical, Ankara, Turkey) was used for the qualitative detection of *Treponema pallidum* IgG and IgM antibodies as an alternative confirmation.

Statistical analysis

At the end of the study, frequency, mean, and standard deviation were calculated, and comparisons were performed using chi-squared test and Fisher's exact probability test. A p-value < 0.05 was considered statistically significant (at the 95% confidence interval). All analyses were performed using SPSS v. 22.0 (IBM Statistics for Windows; IBM Corp., Armonk, NY).

Table 1. HIV seroprevalence in tested individuals during the study period (2015 - 2019).

	HIV seropositive individuals/tested individuals (%)				
Years	**0.003 - 14 years**	**≥ 15 years male**	**≥ 15 years female**	**≥ 15 years male and female**	**All study groups**
2015	**0/200 (0)**	**1/1,037 (0.10)**	**4/743 (0.54)**	**5/1,780 (0.28)**	**5/1,980 (0.25)**
2016	**0/419 (0)**	**14/4,392 (0.32)**	**17/3,388 (0.50)**	**31/7,780 (0.40)**	**31/8,199 (0.38)**
2017	**3/1,208 (0.25)**	**22/7,164 (0.31)**	**18/5,989 (0.30)**	**40/13,153 (0.30)**	**43/14,361 (0.30)**
2018	**4/1,683 (0.24)**	**44/11,616 (0.38)**	**46/9,717 (0.47)**	**90/21,333 (0.42)**	**94/23,016 (0.41)**
2019	**4/2,931 (0.14)**	**46/17,913 (0.26)**	**46/14,554 (0.32)**	**92/32,467 (0.28)**	**96/35,398 (0.27)**
Total	**11/6,441 (0.17)**	**127/42,122 (0.30)**	**131/34,391 (0.38)**	**258/76,513 (0.34)**	**269/82,954 (0.32)**
Age range	**0.003 - 109 (mean: 34.9 ± 24.8, median 29)**				

Table 2. HIV seropositivity in selected age groups with epidemiological importance.

	15 - 19 years (HIV-positive/tested individuals) (%)			15 - 24 years (HIV-positive/tested individuals) (%)			15 - 49 years (HIV-positive/tested individuals) (%)		
Years	**Male**	**Female**	**M + F**	**Male**	**Female**	**M + F**	**Male**	**Female**	**M + F**
2015	**0/113 (0)**	**0/70 (0)**	**0/183 (0)**	**0/318 (0)**	**0/197 (0)**	**0/515 (0)**	**1/689 (0.15)**	**3/522 (0.57)**	**4/1,211 (0.33)**
2016	**0/237 (0)**	**1/235 (0.43)**	**1/472 (0.21)**	**0/962 (0)**	**3/862 (0.35)**	**3/1,824 (0.16)**	**12/3,078 (0.39)**	**16/2,416 (0.66)**	**28/5,494 (0.51)**
2017	**2/542 (0.37)**	**0/437 (0)**	**2/979 (0.20)**	**4/1,990 (0.20)**	**2/1,612 (0.12)**	**6/3,602 (0.17)**	**15/5,060 (0.30)**	**15/4,573 (0.33)**	**30/9,633 (0.31)**
2018	**1/897 (0.11)**	**2/795 (0.25)**	**3/1,692 (0.18)**	**2/3,035 (0.07)**	**5/2,615 (0.19)**	**7/5,650 (0.12)**	**34/7,997 (0.43)**	**38/6,968 (0.55)**	**72/14,965 (0.48)**
2019	**4/2,098 (0.19)**	**2/1,707 (0.12)**	**6/3,805 (0.16)**	**9/7,404 (0.12)**	**10/5,137 (0.19)**	**19/12,541 (0.15)**	**39/14,238 (0.27)**	**39/11,354 (0.34)**	**78/25,592 (0.30)**
Total	**7/3,887 (0.18)**	**5/3,244 (0.15)**	**12/7,131 (0.17)**	**15/13,709 (0.11)**	**20/10,423 (0.19)**	**35/24,132 (0.15)**	**101/31,062 (0.33)**	**111/25,833 (0.43)**	**212/56,895 (0.37)**

M: Male, F: Female.

Table 3. Parameters of further infectious agents in 269 HIV infected patients.

	Anti HBs	HBsAg	Anti HCV total	Syphilis
Seropositivity (%) for related pathogens in HIV seropositive individuals	**30.3% (56/185)**	**9.54% (23/241)**	**1.24% (3/242)**	**3.45% (2/58)**

Table 4. Characteristics and date of seroconversion in the four seroconverters.

	Age *	Gender	First test	Positive test	Polyclinics
Patient 1	**29**	**male**	**Jan. 19th, 2019 negative**	**Jul. 7th, 2019**	**infectious diseases polyclinic**
Patient 2	**52**	**female**	**Nov. 28th, 2015 (also 4 negative tests at 6-month intervals)**	**Dec. 2nd, 2017**	**dialysis patient**
Patient 3	**29**	**female**	**Feb. 28th, 2017 - negative**	**May 2nd, 2019**	**obstetrics (test during childbirth)**
Patient 4	**21**	**male**	**Feb. 10th, 2019 - negative**	**Mar. 24th, 2019**	**infectious diseases polyclinic**

*** Age at which seroconversion was determined.**

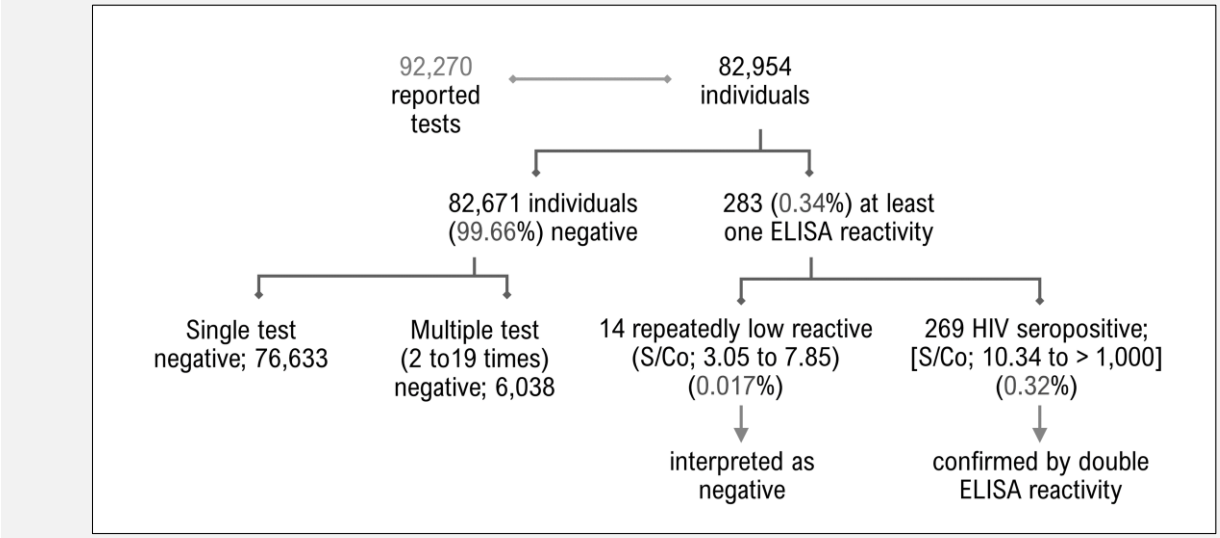

Figure 1. Testing algorithm on the study groups and their HIV seropositivity rates.

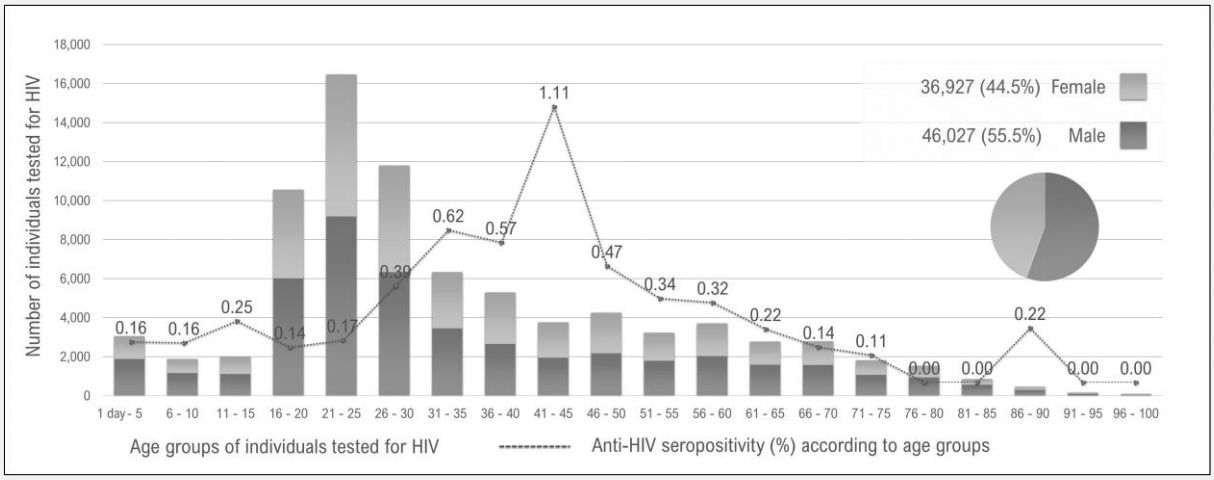

Figure 2. All study group individuals tested for anti-HIV and seropositivity rates (%) according to age groups.

RESULTS

Overall, a total of 92,270 tests were performed and reported for 82,954 different individuals aged 1 day to 109 years (*single test reported for 76,902 individuals and multiple tests with at least a week interval reported for 6,052 individuals*). Among the study group were 5,743 asymptomatic people without any health complaints (those who had tests for candidate student screening, job application and visa permit requirements, many of these individuals had planned travels to Saudi Arabia and Qatar, countries that have HIV-related travel restrictions).

The age range of the 82,954 individuals included in the study group was 1 day - 109 years (mean: 34.9 ± 24.8, median: 29), and the age range of the 269 (0.32%) anti-

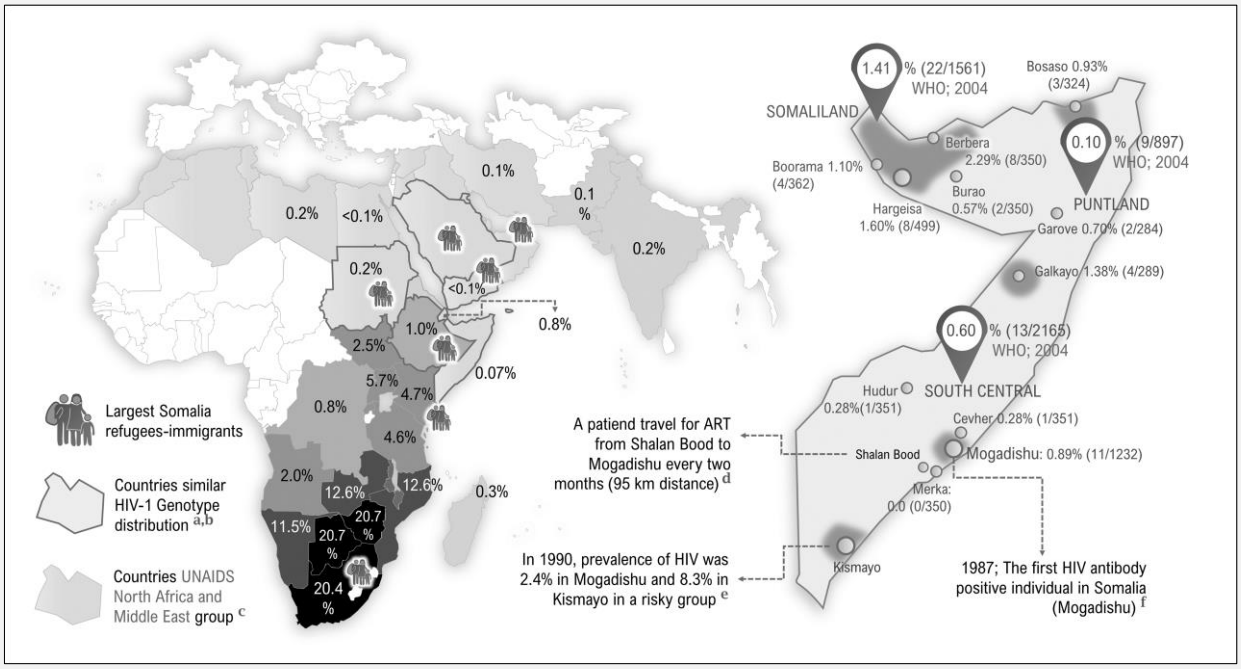

Figure 3. Left: UNAIDS estimated HIV prevalence (%) in 15 to 49-year-old adults in African countries [25]. Right: Regional results (%) for adults in the WHO 2004 HIV Surveillance Survey conducted in Somalia [26]. [a-f] Other important epidemiological data [5,11,27-30].

HIV seropositive individuals was 1 day - 87 (mean 36.1 ± 13.9, median 35). HIV seropositivity was 0.34 (261/77211) and 0.14% (8/5,743), respectively, in two groups: applied for hospital treatment and healthy individuals. Anti-HIV tests of 82,671/82,954 (99.7%) individuals were negative. In addition, low reactivity was detected with both anti-HIV test kits (Architect HIV Ag/Ab Combo and Elecsys HIV combi PT assay) in 14 patients; only one of these patients provided a control sample 2 weeks later which again exhibited low reactivity. In these 14 patients, the results could not be confirmed, and these individuals were not included in the seropositive or seronegative category (Figure 1). Also, during the study period, seroconversion was observed in four patients (Table 4).

The seropositivity rate between the ages of 41 - 45 was 1.1% (20/1818) in females and 1.13% (22/1952) in males, and these rates were significantly higher ($p = 0.0001$) than in all the other age groups in both females (0.33%; 115/35,109) and males (0.25%; 112/44,075) (Figure 2). Although there was no significant difference in the seropositivity rates between males (7/3,905) and females (4/2,536) under 14 years of age ($p = 0.125$), in the 15 - 49 age group, the infection rate was significantly higher in females than in males; 111/25,833 (0.43%) in females and 101/31,062 (0.33%) in males ($p = 0.04$) (Table 2).

HBsAg seropositivity percentage 9.5% (23/241) was significantly higher in HIV-infected patients than in anti-HCV seropositivity 1.24% (3/242) ($p = 0.0001$). Due to the retrospective nature of the study, not all HIV seropositive individuals (269) were tested for anti-HBs, HBsAg, anti-HCV total and syphilis. Furthermore, the rate of those who had an anti-HIV seropositive result and came back for control was only 3.35% (9/269).

DISCUSSION

Although infection rates in Mogadishu are significantly lower than worldwide, estimated AIDS-related deaths are higher than the case rate in Somalia. High mortality rates are mainly related to people's avoidance of diagnosis and treatment due to stigma and discrimination [5,7]. In addition, there are many other important problems, such as the limited number of facilities that provide testing for HIV diagnosis and treatment (only in the central regions of the country), diagnosis-treatment costs, including travel costs, difficulties of pharmacies to procure and deliver HIV antiviral drugs, the hospitals'

concern about economic losses due to openly declaring HIV treatment processes, low knowledge and awareness in residents, emergency medical interventions, and blood transfusions after increased frequency of injuries [5,15,22]. People who come for HIV testing often develop AIDS because of delayed diagnosis, which causes high mortality rates [5]. Given that people with a positive result tend to avoid healthcare and isolate themselves, they rarely come for checkups; thus, it is also important to have screening tests available at the first visit, which may be the only visit for this population [5,13]. The fact that only 3.35% (9/269) of the HIV seropositive patients returned to our hospital for follow-up and control is a strong indicator emphasizing the importance of this situation. Similarly, people generally postpone the treatment process for various diseases due to treatment costs and other reasons and do not apply to hospitals unless there is an emergency or a serious situation. In this study, many people who visited our hospital for different purposes were examined for HIV seropositivity according to different age groups, and the data obtained provide possible results about the general population and the course of infection over more than four years. Seroconversion was observed in four patients during the entire study period (Table 4); we did not have a real follow-up, as most of the patients provided only one sample. In a study conducted nearly 20 years ago, HIV seroconversion was reported as 1.47% (1/68) in 6 months in an at-risk group [23]. The Architect HIV Ag/Ab Combo has proven to be highly reliable for screening; however, the frequency of false-positive results may be a problem in low HIV prevalence settings. Therefore, we minimized possible false positive results by using an additional test as Elecsys HIV combi PT assay and card tests and by keeping the level of S/Co value high [20,21,24].

Similar to the prevalence estimates across Somalia, HIV seropositivity is found to be lower than in neighboring countries (Figure 3); the distribution by age groups and gender was similar to those reported worldwide [1]. Thus, the HIV prevalence is lower in children (0 - 14 years) (0.17%), higher in 15 - 49 years (0.37%) (Table 1 and 2), and higher in women than men (0.43% vs. 0.33%, $p = 0.04$) in the 15 - 49 age group. The seropositivity rate between the ages of 41 - 45 was significantly higher than in other age groups, both in females and males, with 1.1% and 1.13%, respectively ($p = 0.0001$). These data indicate that women of childbearing age and the 41 - 45 age group (women and man) are more affected by HIV infections and that these groups may be the primary target in controlling the spread of the infection.

Institutional reports covering the years between 2006 - 2010 [26,31] and previous studies [8,9] conducted in different groups showed that HIV prevalence was higher in Somaliland located in the north of the country and indicated that the prevalence of infection was decreasing southward (Somaliland > Puntland > South Central Somalia) (Figure 3). The relatively higher HIV prevalence found in Somaliland may be associated with trade-related mobility and conflict-related forced migration [9]. Higher prevalence rates and diversity of HIV genotype distribution are noticeable in Djibouti compared to Somalia, Yemen, Saudi Arabia, and North Sudan [25,27]. In our study, the HIV seropositivity rate was lower than that stated in the 2004 World Health Organization (WHO) report [26], which is the most comprehensive study in the past and included about 4,700 people. This may be related to the larger size (82,954 people) of our study group and the general downward trend of HIV infections since 2004 [19]. However, the rate in our study is higher than current estimates [19], and this may be related to the characteristics of our study group.

Understanding the patterns of HIV/AIDS epidemics is essential for monitoring and tracking the progress of prevention and control efforts in countries [32]. According to WHO, the burden of hepatitis B virus (HBV) and hepatitis C virus (HCV) co-infections is greatest in HIV patients in African and Southeast Asian regions [33]. Although HCV and HIV co-infection rates are estimated in the range of 2 - 15% worldwide (and up to 90% of those are people who inject drugs) [33], the anti-HCV seropositivity rate was lower (1.24%) in HIV-infected patients in this study. This finding indicates that different transmission routes rather than intravenous drug use are reasons for the transmission and spread of HIV infection in Somalia. In addition, common use of plant-derived addictive stimulants such as khat (chat or khat; *Catha edulis Forsskal*) instead of intravenous drugs can affect the spread pattern of the infection and the distribution of co-infections. Even esophageal cancer in Somalia, being the most common type of cancer in both men and women, has also been associated with the use of khat [34]. In a study involving Somali immigrants, it was emphasized that the prevalence rates or modes of transmission of hepatitis B and C should not be assumed to follow United States models [13]. In a study carried out in 1990 in Somalia, it was found that the presence of HCV infection is not associated with age, gender, risk group, positive syphilis serology, or HIV-1 infection, and it has been noted that the likelihood of HCV transmission among Somalians is low, even in populations at high risk of sexually transmitted diseases [35]. However, available data indicate that the dominant transmission route of the HIV virus is heterosexual contact in Somalia [5,9].

WHO estimated that chronic HBV infection affects an estimated 5 - 20% of people living with HIV [33]. In this study, HBV infections (HBsAg positivity of HIV infected patients was determined as 9.54%) in HIV seropositive subjects and was similar in the general population [22]. HBsAg seropositivity (9.5%) was found significantly higher than in anti-HCV seropositivity (1.24%) in HIV-infected patients in this study (Table 3). But considering the low anti-HCV seropositivity (1.41%) in the general population in Mogadishu [36], the result is possibly a reflection of the overall popula-

tion prevalence of these viruses. Considering the burden of the viral disease, the hepatitis B vaccine has recently been included in the childhood vaccination program in Somalia [37], and children and people of different age groups are regularly vaccinated in our hospital. Lastly, the rate of syphilis in HIV-infected persons in this study (3.45%; 2/58) was also not much higher than that found in blood donors in another study (1.85%; 1/54) [22] and in a similar at-risk group with 3.1% in 2008 [9].

The major limitations of the study were as follows: i. infection definitions were not detailed as HIV-1 and HIV-2, because the double ELISA strategy cannot differentiate between HIV-1 and HIV-2 infection; ii. total number of seropositive subjects is only 269 and this should be taken into account when interpreting the calculations due to the small number of subjects; iii. as a result of conditions in the region that made data collection difficult to compare prevalence data with studies that had been performed 20 years ago and interpret changes in the epidemiology.

CONCLUSION

There is limited knowledge about HIV prevalence in Somalia, especially in Mogadishu. Addressing HIV in conflict environments is crucial for AIDS-related programs to achieve their goals. We believe that our data may provide information that can be indicative of the prevalence of HIV infections in different age groups and the trends of the HIV prevalence that change over the years. The presented data may give clues about the situation in the rest of the Mogadishu society and contribute to future measurements of HIV eradication.

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Declaration of Interest:
The authors declare that there is no conflict of interest. Patients or the public were not involved in the design, or conduct, or reporting, or dissemination plans of our research.

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