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Acid-Fast Bacilli Smear Positivity and HBV, HCV, HIV, and Syphilis Co-infections between 2016 and 2019 in Mogadishu, Somalia

Somali Mogadişu'da 2016 ve 2019 arasında Aside Dirençli Basil Yayma Pozitifliği ve HBV, HCV, HIV ve Sifiliz Ko-enfeksiyonları

Kemal TEKİN¹ [ID], Mohamed ABDI OSMAN² [ID], Faduma NUR ADAN² [ID],
Ahmed Muhammad BASHIR³ [ID], Hilmi Erdem SÜMBÜL³ [ID], Fatih ŞAHİNER⁴ [ID]

¹Medical Microbiology Laboratory, Gulhane Training and Research Hospital, University of Health Sciences, Ankara, Türkiye.

²Department of Infectious Disease and Clinical Microbiology, Mogadishu Somalia-Turkey Recep Tayyip Erdoğan Training and Research Hospital, University of Health Sciences, Mogadishu, Somalia.

³Department of Internal Medicine, Mogadishu Somalia-Turkey Recep Tayyip Erdoğan Training and Research Hospital, University of Health Sciences, Mogadishu, Somalia.

⁴Department of Medical Microbiology, Mogadishu Somalia-Turkey Recep Tayyip Erdoğan Training and Research Hospital, University of Health Sciences, Mogadishu, Somalia.

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Correspondence: Tekin K; MD., Medical Microbiology Laboratory, Gulhane Training and Research Hospital, University of Health Sciences, Ankara, Türkiye. E-mail: ktekin1978@gmail.com

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Abstract

Although tuberculosis (TB) is a treatable disease, it continues to be an important health problem affecting societies worldwide. TB is one of the 10 most common causes of death worldwide today, despite the efforts of national organizations and the global struggle efforts of the World Health Organization (WHO), that have continued since its first establishment and exceeded seventy years. Somalia faces many negative factors that hinder the success of TB eradication programs, such as limitation of economic resources, lack of adequate infrastructure systems in the urban and rural regions, inadequacies in sheltering and nutrition, as well as instability, conflicts, and difficulties in accessing health care services. However, the country has been located in a rapidly developing region where socio-economic development and transformation has been experienced in many fields in recent years. This study includes the analysis of acid-fast bacilli (AFB) smear examination results of patients admitted to a tertiary health center in the region where public health surveillance, screening programs, and treatment interventions have been disrupted for the last 30 years due to the aforementioned reasons. A total of 5,160 AFB test results of 3,909 patients admitted to the hospital with different medical reasons during the 4-year period between July 2016 and November 2019 were included in the study. The mean age was 43.3±21.8 years, with a range of <1 to 97 years and the AFB test positivity rate was found to be %5.63 (220/3,909) in the study group. The positivity rate was 6.70% (158/2,199) in males and 3.99% (62/1,490) in females (p<0.001). The group most affected by the infection (TB) were young and adult men between the ages of 10-40. HBsAg, anti-HCV and anti-HIV tests were also performed for approximately half of the patients who requested AFB test and the co-infection rates for hepatitis B, hepatitis C, and human immunodeficiency virus (HIV) were found as 9.68%, 2.46%, and 0.0%, respectively. These rates are

compatible with the seroepidemiological situation of the mentioned viral infections in the region. The results also reveal the low frequency of HIV-TB co-infections in the Somali population, unlike other regions of sub-Saharan Africa. The co-infection rate for syphilis, in which fewer patients were tested, was found to be 2.27%. It was found that AFB positivity rates changed as 5.31%, 6.44%, and 5.63% between 2017-2019 and did not increase or decrease according to years; with the exception of 2016 (11.2%) when a small number of patients were admitted. Early diagnosis and early treatment of active cases are critical for the effectiveness of TB control programs. Despite certain limitations, the data presented in the study can be considered as a reference point for future studies.

Keywords: Tuberculosis, AFB smear, Somalia, Hepatitis B, Hepatitis C, HIV, Syphilis.

Özet

Tüberküloz (TB) tedavi edilebilir bir hastalık olmasına rağmen dünya genelinde toplumları etkileyen önemli bir sağlık sorunu olmaya devam ediyor. Ulusal kuruluşların çabaları ve Dünya Sağlık Örgütü'nün (DSÖ) ilk kurulduğu yıllardan itibaren devam eden ve yetmiş yılı aşan global mücadele sürecine rağmen, TB günümüzde dünya genelinde en yaygın 10 ölüm nedeninden biridir. Somali ekonomik kaynakların kısıtlılığı, kentsel ve kırsal bölge altyapı sistemlerindeki zayıflıklar, barınma ve beslenmedeki yetersizlikler gibi TB eradikasyon programlarının başarısı önündeki birçok olumsuz etkenin varlığı yanında istikrarsızlık, çatışmalar ve sağlık bakım hizmetlerine ulaşımındaki güçlükler ile karşı karşıyadır. Ülke aynı zamanda son yıllarda birçok alanda sosyoekonomik gelişmenin ve dönüşümün yaşandığı hızlı gelişmekte olan bir bölgede konumlanmıştır. Bu çalışma, son 30 yıllık dönemde toplum sağlığı surveyansının, tarama programlarının ve tedavi süreçlerinin bahsedilen nedenler ile aksadığı bölgede bir üçüncü basamak sağlık merkezine başvuran hastaların aside dirençli basil (*acid-fast bacilli*, AFB) yayma inceleme sonuçlarını içermektedir. Çalışmaya Temmuz 2016 - Kasım 2019 tarihleri arasındaki 4 yıllık süreçte çeşitli tıbbi gerekçelerle hastaneye başvuran 3909 hastaya ait toplam 5160 AFB test sonucu dahil edilmiştir. Ortalama yaşın 43.3 ± 21.8 yıl (<1 ile 97 aralığında) olduğu çalışma grubunda AFB test pozitifliği oranı %5.63 (220/3909) olarak bulundu. Pozitiflik oranı erkeklerde 6.70% (158/2199) ve kadınlarda 3.99% (62/1490) idi ($p < 0.001$). Enfeksiyondan (TB) en çok etkilenen grup 10-40 yaş arası genç ve erişkin erkeklerdi. AFB test istemi olan hastaların yaklaşık yarısı için HBsAg, anti-HCV ve anti-HIV testleri de çalışılmıştı ve hepatit B, hepatit C ve insan immün yetmezlik virusu (*human immunodeficiency virus*, HIV) için ko-enfeksiyon oranları sırasıyla %9.68, %2.46 ve %0.0 olarak bulundu. Bu oranlar ilgili viral enfeksiyonların bölgedeki seroepidemiolojik görünümü ile uyumlu olup, bu sonuçlar ayrıca Afrika'nın diğer bölgelerinden farklı olarak Somali popülasyonunda HIV-TB ko-enfeksiyonlarının düşük sıklığını göstermektedir. Daha az sayıda hastanın test edildiği sifiliz için ko-enfeksiyon oranı ise %2.27 olarak bulundu. Az sayıda hastanın kabul edildiği 2016 yılı (%11.2) hariç olmak üzere, AFB pozitiflik oranlarının yıllara göre artma veya azalma eğiliminde olmadığı ve 2017-2019 yılları arasında yıllara göre %5.31, %6.44 ve %5.63 olarak değiştiği bulundu. Aktif olguların erken tanı ve tedavisi TB kontrol programlarının etkinliği için kritik öneme sahiptir. Bazı sınırlılıklara rağmen, çalışmada sunulan veriler daha ileri çalışmalar için bir referans noktası olarak kabul edilebilir.

Anahtar Kelimeler: Tüberküloz, AFB yayma, Somali, Hepatit B, Hepatit C, HIV, Sifiliz.

Introduction

Tuberculosis (TB), viral hepatitis and human immunodeficiency virus (HIV) infections are defined as common public health problems worldwide and TB is one of the 10 most common causes of death worldwide [1,2]. According to the World Health Organization (WHO) data, tuberculosis has been the leading cause of death in Somalia for decades (2000 and 2019) [3]. WHO has focused on fighting against infectious diseases, especially malaria and tuberculosis,

since its foundation (1948) [4], and today, this struggle continues to be maintained by updating the targets [5].

Geographical regions with medium and low levels of social and economic development facing deficiencies in hygiene, income, shelter, and nutrition problems are under a more serious burden in terms of TB cases and deaths compared to other parts of the world [5]. Somalia has the lowest Universal Health Coverage (UHC) index in the world in 2019 and only 27% of the population

had access to basic health services without financial difficulties [3].

Despite the disruptions and difficulties encountered in TB surveillance due to the COVID-19 outbreak, it is estimated that approximately 10 million new TB cases (best estimate; 127 cases per 100,000 population) and 1.5 million TB-related deaths (1.3 million among HIV negative people and an additional 214,000 among HIV positive people) occurred in 2020 (*WHO Global tuberculosis report 2021*) [5]. According to WHO estimates, the TB-related death rate per 100,000 people in Somalia in 2019 was 226.2, significantly higher than the world average [3].

According to the WHO 2021 report; in 2020, most TB cases were in WHO's geographical regions of Southeast Asia (43%), Africa (25%), and the Western Pacific (18%) [5]. It is estimated that 8.0% of all TB cases are individuals living with HIV and HIV co-infected TB cases have the highest rates in countries in the WHO African Region, and in some parts of southern Africa it exceeds 50% [5]. In Somalia, HIV seroprevalence is relatively low [6] and the major obstacles to TB eradication efforts are conflict and vulnerability, low tuberculosis detection rates, difficulties in accessing treatment, and multi-drug resistant TB cases [5,7]. Previous WHO report revealed that the proportion of tuberculosis cases that are treated %42 in 2019 Somalia [3]. In a nationwide survey conducted in 2011, the rates of multidrug-resistant tuberculosis in patients with new and previously treated tuberculosis were found to be 5.2% and 40.8%, respectively [8], and these drug resistance levels were among the highest documented in Africa and the Middle East [8].

Microscopic examination of acid-fast bacilli (AFB) with Ehrlich-Ziehl Neelsen (EZN) staining, which is a fast, inexpensive, and first-line method in the diagnosis of tuberculosis, is a widely used screening method [9]. Due to limited laboratory facilities and the absence of comprehensive prevalence studies, it is currently difficult to determine the true prevalence of TB cases in Somalia. In this screening study, it was aimed to reveal the basic demographic profiles and co-infection characteristics of active TB patients in our region (Mogadishu, Somalia) by investigating

AFB positivity rates over a four-year period. Thus, it is aimed to raise awareness about taking preventive measures against the spread of tuberculosis infection throughout the society, especially among healthcare workers.

Material and Method

The study was conducted after obtaining approval from the institutional ethics committee (Ethics Committee of Mogadishu Somalia-Turkey Recep Tayyip Erdoğan Training and Research Hospital, date: 05.12.2019, decision no: 182, number: MSTH/2723). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Study group and design

All patients who applied to Mogadishu Somali Turkey Recep Tayyip Erdoğan Training and Research Hospital with suspected complaints or findings of TB and who tested for AFB in the Medical Microbiology laboratory during the 4-year period between July 2016-November 2019 were included in the study. AFB positivity rates were determined in different age and gender groups and the changes of the rates according to years by retrospectively investigating of the hospital electronic information record system. In the next step, HBsAg, anti-HCV, anti-HIV, and *Treponema pallidum* serologic tests were retrospectively investigated for the study group.

Microscopic evaluation

Only respiratory tract samples were included in the study, and a small number of other clinical materials (urine, cerebrospinal and pleural fluid samples) were excluded. Homogenization and decontamination processes were applied to clinical samples by sodium hydroxide-N-acetyl-L-cysteine (NAOH-NALC) method. All samples were concentrated by centrifugation at 3500 rpm for 15 minutes and a smear preparation was prepared for microscopy. Preparations evaluated as positive by the observation of red bacilli on a blue background. According to CDC criteria patients' samples were classified as follows; 1-9 bacilli observation in 100 areas was determined as +, 1-9 bacilli in 10 areas as ++, 1-9 bacilli in each area as +++, and over 9 bacilli observed in each area as ++++ [10]. Microscopic examination results of

the same patient within a three-day period were accepted as a single test request and three examinations were reported as a single report.

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. 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).

Anti-HCV and HBsAg 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 Immunochromatographic 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 values were calculated, and comparisons were performed using the chi-square

and/or Fisher's exact probability test. A p value of <0.05 was considered statistically significant (at the 95% confidence interval). All analyses were undertaken using SPSS v. 22.0 (IBM SPSS Statistics Version 22.0., IBM Corp., Armonk, New York, USA).

Results

A total of 5,160 test results from 3,909 different patients were evaluated in the present study; 3,125 patients had a single sample, while 784 patients had multiple test requests at different times. The mean age of the participants was 43.3±21.8 years, with a range of <1 to 97 years. The positivity rate in the study group was found to be %5.63 (220/3,909).

Of 220 AFB positive patients, 71.8% were male and 28.2% were female. The rate of positive test results was 6.70% (158/2,199) in males and 3.99% (62/1,490) in females (p=0.0003). Young and adult men between the ages of 10 and 40 were the group most affected by the infection (Table 1).

The distribution of smear examinations was as follows: + 4.09% (9/220), ++ 4.55% (10/220), +++ 68.2% (150/220), and ++++ 23.2% (51/220). For 220 AFB-positive cases, the majority of the patients had TB-compatible findings on chest X-ray (~75%) and/or computed tomography examinations (~25%).

Table 1. Distribution of AFB-positive patients according to years, age groups, and gender.

age groups →		<1-10		11-20		21-30		31-40		41-50		51-60		61-70		≥71		Total	%*
years / results		F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	n (F+M)	
2016	positive	0	0	0	1	3	6	0	4	0	1	2	0	0	2	0	1	20	11.2
	negative	4	6	6	17	11	14	9	8	7	7	15	11	14	9	6	14	158	
2017	positive	0	1	2	9	6	12	4	7	2	3	0	3	1	6	0	3	59	4.52
	negative	24	34	71	87	85	148	78	81	72	87	69	88	68	87	58	110	1,247	
2018	positive	0	0	2	8	7	20	4	9	2	4	1	3	1	4	1	5	71	5.31
	negative	25	49	56	89	91	176	59	94	65	98	66	94	62	99	51	93	1,267	
2019	positive	0	0	2	7	4	16	3	9	2	5	6	4	3	2	4	3	70	6.44
	negative	15	16	44	69	83	124	55	89	48	69	73	67	60	81	40	84	1,017	
Total 3,909	positive	0	1	6	25	20	54	11	29	6	13	9	10	5	14	5	12	220	5.63
	negative	68	105	177	262	270	462	201	272	192	261	223	260	204	276	155	301	3,689	
	%	0.00	0.94	3.28	8.71	6.90	10.5	5.19	9.63	3.03	4.74	3.88	3.70	2.39	4.83	3.13	3.83	5.63	

F: Female. M: Male. AFB: Acid-fast bacilli. *Percentage of AFB-positive patients by years.

When the retrospective data were examined, it was found that HBsAg, anti-HCV, and anti-HIV tests were performed for approximately half of the patients who requested AFB test, and co-infection rates for the related diseases were 9.68%, 2.46%, and 0.0%, respectively (Table 2). The co-infection rate for syphilis, in which fewer patients were tested, was found to be 2.27%. Only 18 HIV-

seropositive patients (6.69%; 18/269) were screened for acid fast bacilli in sputum, and all had negative AFB screening. It was found that AFB positivity rates did not increase or decrease according to years with the exception of 2016 (11.2%) when a small number of patients were admitted, and positivity rates changed as 5.31%, 6.44% and 5.63% between 2017-2019.

Table 2. Acid-fast bacilli smear positivity and anti-HIV, anti-HCV, HBsAg, and syphilis seropositivity.

age groups →		1-10		11-20		21-30		31-40		41-50		51-60		61-70		≥71		Total		Co-I %*
	AFB →	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	
HBV	positive	0	1	1	3	2	24	6	24	0	35	2	24	0	26	1	37	12	174	9.68
	negative	0	73	21	216	35	350	17	221	11	214	7	262	11	239	10	235	112	1,810	
HCV	positive	0	0	1	0	0	1	0	1	0	1	0	7	2	13	0	17	3	40	2.46
	negative	0	74	20	221	36	376	23	238	10	251	9	277	9	255	12	259	119	1,951	
HIV	positive	0	0	0	1	0	3	0	2	0	3	0	1	0	2	0	0	0	12	0.00
	negative	0	76	12	176	39	339	19	203	9	209	10	234	8	224	11	242	108	1,703	
Syp.	positive	0	0	0	0	0	1	0	4	0	5	0	6	0	11	1	19	1	46	2.27
	negative	0	1	9	68	17	151	6	68	5	85	1	76	2	79	3	61	43	589	

Co-I: Co-infection. HBV: Hepatitis B virus. HCV: Hepatitis C virus. HIV: Human immunodeficiency virus. Syp: Syphilis. AFB: Acid-Fast Bacilli. *Seropositivity rate for related infection in AFB positive cases.

Discussion

Somalia is one of the countries with the most limited data on the epidemiology of infectious diseases. Accessible and reliable data on the incidence, prevalence, or mortality rates for most communicable diseases almost non-exist in the last 30 years. One of the two main reasons for this situation is that surveillance and public health practices, which are largely disrupted due to the conflict environment, another reason is economic inadequacies and the absence of a strong health infrastructure, especially in rural areas, and problems in access to health care services. In a recent study, delayed diagnosis of tuberculosis patients in Mogadishu was reported as one of the longest reported in developing countries, while exceeding two years for some patients [11]. This situation has been stated as an important public health problem that causes the continuation of the tuberculosis transmission cycle in the community [11]. However, it is promising that an increasing number of data has been added to the literature in recent years on the prevalence of infectious diseases in Somalia [6,12-15].

TB case detection rate in Somalia is estimated at 42%, which is much lower than the WHO target of detecting 70% of new TB cases [11]. TB control programs in Somalia are based on passive case detection, in which infectious cases applying to health institutions are only diagnosed [11]. Our study, which includes TB screening results of a large group of patients, includes data from nearly 4000 patients who applied to our hospital for various reasons in a long period of 4 years. In this study, in which the rate of patients with at least one positive AFB result was 5.63%. Culture confirmation was performed for a small number of these patients, while diagnosis and typing by PCR was performed only in national TB centers where infected patients detected by screening tests were referred.

Although the lack of confirmatory laboratory diagnosis was the major limitation of the study, the majority (91.3%) of the patients were highly (+++ or +++) AFB positive and TB compatible findings were found in radiological (CXR and CT) examinations for almost all AFB positive patients. Another limitation of the study is the possibility

that seropositivity is an indicator of past infection, especially for syphilis. However, while HBsAg positivity is most likely associated with active infection, anti-HCV and anti-HIV positivity are also a high probability indicator of chronic infection in a country where treatment opportunities are limited. Another important point is that low-positive results for all infections were excluded in the study and not included among co-infections.

Co-infection rates in AFB-positive patients were 9.68%, 2.46% and 0.0% for hepatitis B (HBV), hepatitis C (HCV), and HIV, respectively, according to HBsAg, anti-HCV, and anti-HIV testing results. These rates are compatible with the seroepidemiological situation of the mentioned viral infections in the region. In the comprehensive studies conducted in our hospital recently, anti-HCV and anti-HIV seropositivity were found as 1.41% (1,447/102,601) and 0.32% (269/82,954), respectively [6,16]. Also in another study recently conducted in our hospital, HBsAg seropositivity was found as 8.2% (6,893/84,505) [17]. Our results indicate that HIV-TB co-infections are less common in Mogadishu, one of the most populated cities in Somalia, unlike sub-Saharan Africa countries. Of the 1,715 patients tested for anti-HIV serology in our study, only 12 (0.7%) were HIV positive, also all HIV positive patients were AFB negative. In a study conducted between 2019-2020 and including 3,061 TB patients, 46 (1.5%) of the patients were found to be HIV/TB co-infected [15]. In the mentioned study, it was found that 78.2% of HIV-TB co-infected cases were between the ages of 20-49 ($p=0.00048$). In another study that included 385 people under TB treatment, the HIV co-infection rate was found to be 2.6% (10/385) [18].

In the afore-mentioned study conducted with 3,061 patients, 63% of the patients were reported as male and 37% as female [15]. Similarly, in another study that included 385 patients under TB

treatment, the female-male ratio was reported as 33.5/66.5 ($p<0.001$). While these two studies included patients under treatment, our study included only screening tests for suspected patients. Nevertheless, in the present study the gender distribution was similar to the other two studies; AFB positivity rates were found higher in male patients than female patients, 71.8% and 28.2% respectively. As a reflection of this situation regarding gender distribution, according to WHO data for 2019, TB-related deaths in Somalia were reported to be 177.8 for women and 290.8 for men per 100,000 people [3].

In this study, it was also found that "the group most affected by the infection" are young and adult men between the ages of 10-40. Similarly, a 2017 study conducted in Mogadishu reported that three-quarters of 385 patients under treatment were young adults (18-37 years old) [18].

Although WHO data has reported a decrease in TB-related deaths in Somalia from 2000 to 2019 [3], TB has ranked first among all causes of death in the intervening 20 years. In our study, which included data from a single center in a relatively short period of 4 years, no remarkable decrease was observed in positive cases.

Conclusion

Our study provides up-to-date data on the prevalence by years and co-infection characteristics of TB infections (*in a wide age range including children*) in Somalia where there is limited information on the epidemiology of infectious diseases in the literature, including TB. We think that presented data of this study conducted in the shadow of socioeconomic inadequacies, deficiencies in health infrastructure, and ongoing conflicts, can be considered as a reference point for future studies.

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