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المجلة الصحية لشرق المتوسط

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المجلة الصحية لشرق المتوسط

هى المجلة الرسمية التى تصدر عن المكتب الإقليمى لشرق المتوسط بمنظمة الصحة العالمية. وهى منبر لتقديم السياسات والمبادرات الجديدة في الصحة العامة والخدمات الصحية والترويج لها، ولتبادل الآراء والمفاهيم والمعطيات الوبائية ونتائج الأبحاث وغير ذلك من المعلومات، وخاصة ما يتعلق منها بإقليم شرق المتوسط. وهى موجهة إلى كل أعضاء المهن الصحية، والكليات الطبية وسائر المعاهد التعليمية، وكذا المنظمات غير الحكومية المعنية، والمراكز المتعاونة مع منظمة الصحة العالمية والأفراد المهتمين بالصحة فى الإقليم وخارجه.

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From health systems to health sovereignty across Africa and the Eastern Mediterranean

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Recently, I attended the African Union Summit in Addis Ababa, which brings together Member States from both the WHO African Region (AFR) and the Eastern Mediterranean Region (EMR). The discussions highlighted a structural shift in global health: health systems are operating within the context of geopolitical fragmentation, prolonged crises and increasingly constrained and volatile external financing (*1*).

Official development assistance (ODA) for health is contracting sharply, decreasing by 9% in real terms in 2024, with the Organisation for Economic Co-operation and Development (OECD) projecting a further decline of 9–17% in 2025 (*2*). At the same time, structural dependence remains high: in half of the low-income countries in sub-Saharan Africa, external financing accounts for one-third or more of total health expenditure (*3*). In parts of the Eastern Mediterranean Region—particularly the conflict-affected settings—essential health services continue to rely heavily on externally financed humanitarian assistance (*4*). These realities heighten the urgency to strengthen national institutions while deepening structured cooperation between regions that share epidemiologic risks.

Health sovereignty, in this context, must be understood as institutional capacity. It is not confined to domestic production of vaccines or medicines. It encompasses the ability to finance and govern essential services sustainably, regulate medical products, maintain resilient supply chains, generate and share surveillance data, and respond to emergencies without systemic collapse. Sovereignty rests on durable systems.

The African and the Eastern Mediterranean regions are experiencing converging crises—conflict, displacement, climate shocks, economic strain and recurrent disease outbreaks, which unfold simultaneously rather than sequentially. In several EMR countries, prolonged conflict and large-scale displacement have placed extraordinary strain on health systems, and in such settings, hospitals and primary care facilities are not only providers of care but also anchors of social stability (*5*). When systems fracture, instability often follows.

The polio incidence illustrates the indivisibility of health security across regions. Although the African Region has been certified as free of wild poliovirus, circulating vaccine-derived poliovirus outbreaks continue in many of the countries (*6*). In the Horn of Africa and Yemen, for example, transmission has demonstrated clear epidemiological linkages between the 2 regions. Whenever cross-border coordination weakens—whether due to insecurity, population movement or immunisation campaign quality gaps—transmission resurges. Viruses exploit fragmentation. WHO has been supporting interministerial coordination across the Horn of Africa and Yemen to strengthen synchronised campaigns, improve surveillance quality and address persistent implementation gaps. Eradication will depend on urgency as well as on sustained improvements in campaign quality, shared environmental surveillance and collective accountability. In this context, cooperation will reduce collective risk while fragmentation will amplify it.

The same logic applies to malaria, neglected tropical diseases and waterborne disease outbreaks. Vector ecology, climate patterns, increasing biological threats, and human mobility do not align with administrative boundaries. In malaria-endemic corridors linking the Sahel, the Horn of Africa and parts of the Arabian Peninsula, cross-border coordination on policies, surveillance, integrated vector control, treatment protocols, and monitoring of drug resistance and biological threats is essential to move towards elimination and prevent resurgence (*7*). Sustainable progress requires embedding disease control within strong primary health care systems, reinforced water and sanitation programmes, effective surveillance, and community ownership and engagement. Vertical gains are fragile without system integration.

Primary health care is central to health sovereignty. For millions of people across AFR and EMR, primary health care remains the first—and often only—point of contact with the health system. Yet, services remain fragmented, with limited integration across the life-course, and there is uneven adoption of digital technologies (*8*). Strengthening primary care through integrated service packages, workforce development, streamlined referral systems and accountable data platforms creates shock absorbers that protect populations when crises converge.

WHO and the Africa Centres for Disease Control and Prevention (Africa CDC) are increasingly aligning support across surveillance, emergency preparedness, workforce development, and regulatory strengthening in countries connected by cross-border transmission—

particularly across the Horn of Africa, the Sahel and the Red Sea corridor linking AFR and EMR Member States. By coordinating across regions, the partnership reduces fragmentation and strengthens collective resilience against transnational health threats.

The ongoing negotiations on pathogen access and benefit-sharing (PABS) under the WHO Pandemic Agreement further illustrate the link between sovereignty and cooperation (9). AFR and EMR countries were among the hardest hit by the COVID-19 pandemic—in terms of health system strain and delayed access to vaccines, diagnostics and therapeutics. The pandemic exposed weaknesses in pathogen and genetic sequence data sharing and revealed profound inequities in access to countermeasures.

For AFR and EMR Member States, active and coordinated participation in the PABS negotiations is essential. The final framework must reflect the realities of countries with limited manufacturing capacity, fragile supply chains and recurrent disease outbreaks, linking rapid pathogen sharing to fair and equitable benefit distribution.

Ultimately, health sovereignty and interregional cooperation are mutually reinforcing. Sovereignty requires strong national institutions, skilled health workforces and accountable governance. Yet in an interconnected world, it is consolidated through deliberate collaboration across regions that share epidemiologic corridors and structural vulnerabilities.

AFR and EMR are not peripheral to global health governance; they are central testing grounds for its resilience. If health systems can withstand compound stress in these regions—conflict, climate shocks, displacement and infectious threats—then the architecture of global health is robust. If not, redesign is required. Health sovereignty can only be achieved through institutional strength aligned with structured and sustained inter-regional cooperation.

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Seroprevalence of hepatitis B, hepatitis C and HIV among male injecting drug users in Afghanistan

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Abstract

Background: Viral hepatitis and HIV infections are common public health concerns among injecting drug users, however, there is limited evidence on their seroprevalence in Afghanistan.

Aim: To determine the seroprevalence of hepatitis B, hepatitis C and HIV among male injecting drug users at Ibn Sina Drug Addiction Treatment Hospital, Kabul, Afghanistan.

Methods: Using a structured questionnaire, we interviewed 397 injecting drug users at Ibn Sina Drug Addiction Treatment Hospital, Kabul, Afghanistan, between November and December 2022. We collected and tested 3–5 ml blood samples from the participants. We analysed the data using Epi Info version 7.2.1 and used binary logistic regression and χ^2 tests to identify potential predictors of blood-borne hepatitis B, hepatitis C and HIV infections.

Results: Of the total participants, seroprevalence of hepatitis B was 3.79%, hepatitis C 2.77% and HIV 0.50%. Syringe reuse (10%), sharing of syringes (18.6%) and history of blood transfusion (20.2%) were common, but there was no statistically significant association between these predictors and infection ($P < 0.05$). However, using shared blades was positively associated with hepatitis B infection.

Conclusion: Although hepatitis B, hepatitis C and HIV seroprevalence were lower in our study than in previous studies, and no significant association was found between the risk factors and these diseases, there is a need to expand harm reduction services beyond needle-syringe programmes to include non-syringe components. The association between shared blade use and hepatitis B infection indicates that harm reduction efforts should also incorporate safe shaving practices.

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Introduction

Hepatitis B virus (HBV), hepatitis C virus (HCV) and HIV are major public health concerns, especially in developing countries (1). Globally, there are > 254 million people with HBV, > 50 million with HCV and > 39.9 million with HIV (*2*,*3*).

Drug addiction is a global problem that affects users' health, leading to disability and premature death (*4*). Recent estimates suggest that 1 in 17 individuals uses drug and there are ~300 million drug users globally (*5*). Injecting drug users (IDUs) have a wide range of complex challenges, including health as well as social, economic and political issues (*6*). Current data suggest that ~13.2 million of the addicts worldwide are IDUs, with male users being 5 times more common than female users (*5*). In addition to life-threatening health issues, including overdose, mental health problems and injection-related diseases (*7*), IDUs are exposed to high-risk behaviour, including sharing needles and high-risk sexual practices (*8*). This puts IDUs at high risk of blood-borne infections (*9*), with HBV, HCV and HIV being particularly important (*10*). Globally, it has been estimated that 15.2% of IDUs live with HIV and 18.5% with HCV (*11*). The unsafe practices around injecting drug use contribute to 23% of new HCV cases worldwide, making them a major driving factor in the ongoing HCV epidemic (*5*).

IDUs are a major problem in low-and-middle income countries because of political instability, funding problems, social and environmental risks and health system coverage (*12*). Afghanistan has been faced with many challenges in recent decades (*13*). The country contributes > 80% of the global production of opium (*14*), and is dealing with several health problems (*15*,*16*), economic difficulties (*17*) and a major increase in unemployment (*18*). Afghanistan has a high level of injecting drug use and high-risk sexual behaviour, with limited access to harm reduction measures and treatment facilities. This increases the risk of blood-borne infection, including HBV, HCV and HIV among IDUs (*19*). A study in Kabul showed 3% prevalence for HIV, 36.6% for HCV and 6.5% for HBV among 464 IDUs; most of whom used shared needles (*20*). Another study among IDUs in Herat, Jalalabad and Mazar-e-Sharif reported a prevalence of 1.8%, 36% and 5.8% for HIV, HCV and HBV, respectively (*21*).

However, the prevalence of HBV, HCV and HIV is lower in Afghanistan than in South Africa (22), Islamic Republic of Iran (23) and Pakistan (24). Hepatitis B is the predominant type of hepatitis in Afghanistan, with prevalence of 1.82% and 7.36 deaths per 100 000 cases (25). The prevalence of HCV is 0.24% with 5.6 deaths per 100 000 cases (26). HIV infection was first reported in Afghanistan in 1989 and has since increased to 11 000 cases nationwide (27).

Although there has been an increase in the number of IDUs in Afghanistan, and a significant burden of blood-borne infections, there are limited current data on the seroprevalence of HBV, HCV and HIV among this population. Therefore, this study aimed to determine the seroprevalence of HBV, HCV and HIV and its associated factors among IDUs in a specialized treatment centre in Kabul, Afghanistan.

Methods

Study design

A cross-sectional study was conducted among IDUs in Ibn Sina Drug Addiction Treatment Hospital, Kabul during November and December 2022. The facility treats drug users from all over the country, but most are from Kabul city. The hospital has an overall capacity of 2500 beds, which are always occupied.

Ibn Sina Drug Addiction Treatment Hospital is currently dedicated only to male drug users for treatment, counselling and follow-up. A sample size of 400 participants was calculated using the Cochrane formula with 95% confidence interval, prevalence 36% (previous studies in Afghanistan), 5% margin of error and adjustment of 10% for nonresponse rate. Participants were aged > 18 years. Three individuals refused to take part in the study, leaving a total of 397 participants.

This study used a structured questionnaire consisting of 4 parts: (1) sociodemographic characteristics of participants, such as age, residence, education, marital status and occupation; (2) history of drug use and risk factors for HBV, HCV and HIV; (3) knowledge of participants about HBV, HCV and HIV; and (4) results of rapid diagnostic tests (RDTs) for each disease. The questionnaire was pre-tested before official data collection and necessary changes were incorporated.

Data collection

Data were collected by 4 trained collectors and a phlebotomist. Data collectors used systematic random sampling to select IDUs from the inpatient (retrospective) and outpatient (prospective) departments using the available register and an interval of 6 patients. The questions were asked in accordance with the literacy level and knowledge differences among the participants, and further explanation was provided in cases of ambiguity. The data collectors explained the study to the participants and assured them of safety and confidentiality before starting the interview. Any missing responses were filled in immediately by the interviewer.

Specimen collection and laboratory procedures

Blood samples of 3–5 ml were taken from participants in compliance with infection prevention and control measures. Samples were stored in tubes, labelled and sent to Central Public Health Laboratories using a triple package system at appropriate temperature in accordance with the standard operating procedures for diagnosis of blood-borne infectious diseases. Rapid diagnostic tests (RDTs) (HEALGEN, Houston, YX, USA) were performed to determine the seroprevalence of HBV, HCV and HIV. RDTs for HCV and HIV detected antibodies, while HBV was assessed by HBV surface (HBs) antigen detection. Positive RDT results for HIV were confirmed by ELISA (performed by HIV Directorate of the Ministry of Public Health), and HBV and HCV positive samples were retested using an RDT from another manufacturer (ACON, Hangzhou, China). The RDTs took an average of 15 minutes, and had specificity of 86% and sensitivity of 76%. The HIV ELISA took 24–48 hours. HIV-positive RDT results were followed up through the National Program for Control of AIDS, Sexually Transmitted Infections, and Hepatitis. There are currently no follow-up procedures or treatment pathways for HBV and HCV in Afghanistan and the data on cases are collected in a routine manner.

Data management and analysis

Questionnaires were checked for any missing or incorrect information. Data were entered into a preconfigured form designed using Epi Info version 7.2.1 software. Descriptive statistics, including frequency assessment and geographical plotting, were utilized. Binary logistic regression and χ^2 tests were used to identify potential predictors of blood-borne HBV, HCV and HIV infections, using an alpha level of 0.05 and confidence level of 95%. Seroprevalence of HBV, HCV and HIV is shown by percentages, and frequency of risk factors, including drug use history, is shown in tables. Data management, including data entry, cleaning and analysis, was conducted using Excel and Epi Info version 7.2.1. The main findings are shown in the figures and tables and STATA/SE version 18 was used for multivariate analysis.

Ethics considerations

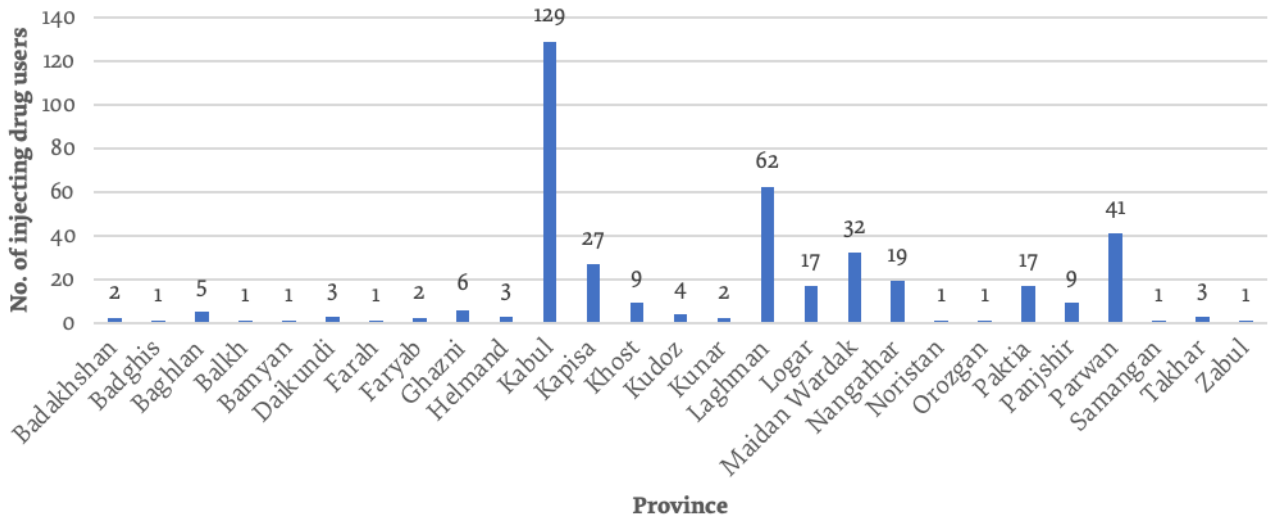
The study was approved by the Institutional Review Board of Afghanistan National Public Health Institute. The IDUs gave their signed consent to the interview and specimen collection process. Due to the cultural and ethical sensitivity of the study, participants were assured of data confidentiality and respect for their rights. Positive results were kept anonymous and only for the purpose of this study.

Results

Participants' sociodemographic characteristics

Among the 397 IDUs, 129 (32.25%) were from Kabul, 62 (15.50%) from Laghman and 41 (10.25%) from Parwan Provinces (Figure 1). Almost two thirds of the IDUs (288, 72.18%) were married and 265 (66.25%) were illiterate

Figure 1 Distribution of study participants by province, 2022



(Table 1). The mean age was 32.7 ± 10.03 years, and 253 (63.41%) were unemployed.

Drug use and risk factors

The average duration of drug use was 8.5 years, with 162 (40.81%) IDUs injecting drugs > 3 times a day. The drug types used are shown in Table 1.

Most IDUs (356, 89.90%) reported using syringes once and disposed of them after injection, 36 (9.09%) used a syringe twice, and 4 (1.01%) used a syringe more than twice (Table 2). Seventy-four IDUs (18.64%) used shared syringes. In addition, 80 (20.15%) had a blood transfusion previously, and 252 (63.48%) reported their wives as their sexual partner. When IDUs were asked about shaving or trimming their head and body hair, 87 (21.97%) reported using blades, 272 (68.69%) went to the barbers, and 36 (9.09%) used scissors. Among all participants, 66 (16.58%) used shared blades for shaving or trimming.

Seroprevalence of HBV, HCV and HIV

Fifteen IDUs (3.79%) tested positive for HBs antigen, 11 (2.77%) for HCV antibodies and 2 (0.50%) for HIV antibodies. This resulted in prevalence of 3.79%, 2.77% and 0.50% for HBV, HCV and HIV, respectively. One patient was positive for HBV and HCV, and another was positive for HCV and HIV. No one had co-infection for all 3 diseases.

Among the 397 IDUs, 226 (56.93%) had knowledge of HBV, 206 (51.89%) had knowledge of HCV and 180 (45.45%) had knowledge of HIV. Different sources of information on HBV, HCV and HIV were reported: 32.50% television, 19% radio, 17.75% friends, 9.50% family members and 3.25% other sources. Binary logistic regression and χ^2 tests were performed to assess the association between the selected predictors and blood-borne HBV, HCV and HIV infection. None of the variables showed a significant association with the outcome ($P < 0.05$) (Table 3). The overall model could not identify predictors for the occurrence of HBV, HCV and HIV.

Table 1 Sociodemographic characteristics and drug use pattern among study participants

Sociodemographic factors	No.	%
Age (years)		
>18–30	209	52.3
>30–45	146	36.5
>45–60	39	9.8
>60	6	1.5
Education		
Illiterate	265	66.3
High school	112	28.0
Bachelor's degree	15	3.8
Above bachelor's degree	8	2.0
Marital status		
Single	108	27.1
Married	288	72.2
Divorced	2	0.5
Others	1	0.3
Occupation		
Employed	146	36.6
Unemployed	253	63.4
Types of drugs used		
Heroine	397	99.5
Shesha	269	67.3
Marijuana (hashish)	208	52.0
Morphine	109	27.3
Opium	57	14.3
Tablet K	42	10.5

Table 2 Risk factors for hepatitis B, hepatitis C and HIV infection

Risk factors	No.	%
Frequency of using one syringe		
Once	356	89.9
Twice	36	9.1
More than twice	4	1.0
Using shared syringes		
Yes	74	18.6
No	323	81.4
Blood transfusion		
Yes	80	20.2
No	317	79.9
Sex partner		
Wife	252	63.5
None	115	29.0
Others	30	7.6
Trimming/shaving hair (head, body parts)		
Blade	87	22.0
Barber	272	68.7
Scissors	36	9.1
Others	1	0.3
Using shared blades for shaving		
Yes	66	16.6
No	332	83.4

Table 3 Factors associated with blood-borne infections among injecting drug users

Variables	OR (95% CI)	P
Education category		
Literate	Ref	
Illiterate	1.78 (0.64–4.96)	0.27
Knowledge of hepatitis B		
Yes	Ref	
No	1.23 (0.42–3.58)	0.699
Knowledge of hepatitis C		
Yes	Ref	
No	0.90 (0.30–2.63)	0.851
Knowledge of HIV		
Yes	Ref	
No	2.75 (0.94–8.08)	0.065
Sharing needle with others		
Yes	1.59 (0.59–4.23)	0.352
No	Ref	
Blood transfusion		
Yes	1.25 (0.44–3.51)	0.663
No	Ref	
Frequency of drug use		
<2 times	Ref	
>2 times	1.30 (0.54–3.15)	0.551

Discussion

This study showed that IDUs in Kabul had been using drugs for an average of 8.5 years, with heroin being the most used substance. While most of them reported using single-use syringes, a notable number engaged in high-risk behaviour such as sharing syringes and blades. The seroprevalence of HBV, HCV and HIV were 3.79%, 2.77% and 0.50%, respectively. Awareness of these infections was moderate, with television serving as the main source of information. Statistical analysis found no significant association between sociodemographic or behavioural variables and infection status, except for shared blade use, which was significantly associated with HBV infection. Importantly, knowledge of HBV, HCV and HIV did not correlate with infection outcomes.

The study population was entirely male, with most participants from Kabul Province. The education level and employment rate were surprisingly low, with over two thirds of the IDUs being illiterate and > 63% unemployed. These factors may have contributed to engagement in high-risk behaviour, as found in other studies (*28*). The mean age of 32.7 years suggested that most IDUs were in their economically productive years, yet they faced high unemployment rates, exacerbating their socioeconomic challenges.

The seroprevalence of HBV (3.79%), HCV (2.77%) and HIV (0.50%) was lower than in other studies, which may be because most IDUs were from Kabul Province, where lower disease prevalence has been reported than in other provinces (*29*). Additionally, the availability of harm reduction programmes in Kabul may have contributed to these lower rates. However, this does not imply that the risk of an HIV epidemic is reduced, as continued risky behaviour can facilitate viral transmission. Co-infection with HBV and HCV was observed in 1 IDU, and co-infection with HCV and HIV was reported in another, indicating the need for integrated screening and treatment programmes.

The average duration of drug use was 8.5 years, with a substantial proportion injecting drugs > 3 times a day. Heroin was the most used drug (99.50%), followed by shesha (67.27%) and marijuana (52%). This highlights the high dependency on opioids; a trend also observed in global studies (*30*). The use of multiple drugs increases the likelihood of risky behaviour, including needle sharing and unsafe injection practices, thereby escalating the risk of infections. Being a female drug user in a conservative country like Afghanistan and seeking treatment adds to stigma. As a result, men are more likely to visit addiction treatment centres and hospitals (*31*). A seroprevalence survey among 196 516 Afghan citizens between 2014 and 2017 showed that significantly fewer women than men tested positive for HBV, HCV and HIV (*32*). A study conducted among 520 female sex workers in Kabul, Jalalabad and Mazar-e-Sharif showed that the prevalence of HIV, HCV and HBV was 0.19%, 1.92% and 6.54%, respectively; again, lower than the rates among male participants in other studies (*33*).

Ibn Sina Drug Addiction Treatment Hospital is a prominent centre for treating drug users in Afghanistan. Most admitted patients are homeless drug users gathered by government authorities from streets and under bridges around the city. However, many drug users remain non-attendees. Various other vulnerable populations who engage in high-risk behaviour for HIV were not included in this study. Therefore, the 0.50% HIV rate may not represent the overall at-risk population. Afghanistan is endemic for HIV, and its prevalence is increasing among IDUs exposed to high-risk factors such as needle and blade sharing, making it likely that the rates will continue to increase (*34*).

It is also important to consider that the low rates of HBV, HCV and HIV reported in this study may be due to the use of a specific RDT kit. Because any exposure to HBV can result in a positive test for antibody to HBV core antigen (*35*), it is possible that more cases would have been detected with additional testing methods. The use of multiple testing methods simultaneously could increase the number of positive cases, as IDUs are exposed to multiple risk factors. Further studies using additional HBV markers, such as anti-HBs and anti-HB core antigens, are needed to more comprehensively explore the correlates of HBV infection among this population, which faces complex exposure pathways from both endemic and parenteral transmission sources.

The IDUs in this study were all outpatients or inpatients of the target hospital, with most of them gathered from different parts of the city through government campaigns. IDUs reported using different types of drugs via inhalation, oral routes and injection, exposing them to multiple risk factors for HBV, HCV and HIV infection. Over 18% reported sharing syringes. Evidence suggests that injecting drug use, needle/syringe sharing and unprotected sex are major risk behaviours for HIV infection among drug users (*36*), which also applies to HBV and HCV.

Among the IDUs, 18.64% reported sharing needles, while 16.58% reported sharing blades for shaving and trimming hair, which was significantly associated with HBV antigen positivity. This finding underscores the need for harm reduction programmes that extend beyond needle and syringe distribution. Additionally, 20% of IDUs reported having undergone blood transfusion previously, but no significant association was detected between blood transfusion history and HBV, HCV or HIV infection. The inconsistency with other studies could be due to participation in harm reduction programmes, which are implemented in Afghanistan, particularly in Kabul, where they are accessible near IDU hotspots. The lack of association between blood transfusion and HBV, HCV and HIV infection was also likely because blood is screened for infection in all transfusion centres in Afghanistan. However, the possibility of receiving injections from nonmedical personnel remains high (*37*). Despite being at high risk, knowledge about HBV, HCV and HIV among the IDUs was suboptimal. While 56.93% of the participants were aware of HBV, and 51.89% knew about HCV, only 45.45% had knowledge of HIV. The primary sources of information were television (32.50%), radio (19%) and peers (17.75%). These findings indicate the need for tailored communication strategies to reach IDUs more effectively. Limited awareness may contribute to continued risky behaviour, underscoring the need for more effective awareness campaigns.

Study limitations

This study had some limitations. The IDUs were exclusively male, reflecting the demography of the treatment centre. As a result, knowledge regarding female IDUs remains limited. The RDT kits used in this study are among the most commonly available in the Afghanistan market. Although their sensitivity and specificity are low, they are recommended by WHO. Testing for surface antigens alone may not have accurately determined the true prevalence of these diseases.

Conclusion

This study found lower seroprevalence for HBV, HCV and HIV among IDUs than previous studies. There was no significant association between risk factors and the target diseases; however, using shared blades was positively associated with HBV. The study highlights the need to expand harm reduction services beyond needle-syringe programmes to include nonsyringe components. The association between shared blade use and HBV infection indicates that harm reduction efforts should also incorporate safe shaving practices. Tailored awareness campaigns are essential to improve knowledge about HBV, HCV and HIV, particularly through high-reach, accessible media, including peer education and the enhancement of existing networking and awareness programmes.

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Séroprévalence des virus de l'hépatite B et C et du VIH chez les consommateurs de drogues injectables de sexe masculin en Afghanistan

Résumé

Contexte : L'hépatite virale et l'infection à VIH sont des problèmes de santé publique répandus chez les consommateurs de drogues injectables, mais les données sur leur séroprévalence en Afghanistan sont limitées.

Objectif : Déterminer la séroprévalence des virus des hépatites B et C ainsi que du VIH chez les consommateurs de drogues injectables à l'hôpital de traitement des toxicomanies Ibn Sina, à Kaboul (Afghanistan).

Méthodes : À l'aide d'un questionnaire structuré, nous avons interrogé 397 consommateurs de drogues injectables à l'hôpital de traitement des toxicomanies Ibn Sina entre novembre et décembre 2022. Nous avons prélevé et testé trois à cinq millilitres d'échantillons de sang chez les participants. Nous avons analysé les données à l'aide du logiciel Epi Info version 7.2.1 et utilisé la régression logistique binaire ainsi que des tests du khi carré pour identifier les facteurs prédictifs potentiels des hépatites B et C ainsi que des infections à VIH transmises par le sang.

Résultats : Sur l'ensemble des participants, la séroprévalence des virus de l'hépatite B et C et du VIH était de 3,79 %, 2,77 % et 0,50 % respectivement. La réutilisation des seringues (10 %), le partage des seringues (18,6 %) et les antécédents de transfusion sanguine (20,2 %) étaient fréquents, mais il n'y avait pas d'association statistiquement significative entre ces facteurs prédictifs et l'infection (p > 0,05). Cependant, l'utilisation de lames communes était positivement associée à l'infection par le virus de l'hépatite B.

Conclusion : La séroprévalence des virus des hépatites B et C ainsi que du VIH était plus faible dans notre étude que dans les études précédentes, et aucune association significative n'a été observée entre les facteurs de risque et ces infections. Cependant, il est nécessaire d'étendre les services de réduction des risques au-delà des programmes d'échange de seringues pour inclure d'autres éléments que les seringues. Le lien entre l'utilisation partagée des lames et l'infection par le virus de l'hépatite B indique que les efforts de réduction des risques devraient également intégrer des pratiques de rasage sans risque.

الانتشار المصلي لالتهاب الكبد B والتهاب الكبد C وفيروس العوز المناعي البشري بين الذكور متعاطي المخدرات بالحَقْن في أفغانستان

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الخلاصة

الخلفية: التهاب الكبد الفيروسي والعدوى بفيروس العوز المناعي البشري من الشواغل الشائعة في مجال الصحة العامة بين متعاطي المخدرات بالحقن، ومع ذلك، هناك دلائل محدودة على معدل انتشارهما المصلي في أفغانستان.

الأهداف: هدفت هذه الدراسة الى تحديد الانتشار المصلي لالتهاب الكبد B والتهاب الكبد C وفيروس العوز المناعي البشري بين متعاطي المخدرات بالحقن من الذكور في مستشفى ابن سينا لعلاج إدمان المخدرات في كابول، أفغانستان.

طرق البحث: أجرينا مقابلات باستخدام استبيان مُنظَّم مع 397 من متعاطي المخدرات بالحقن في مستشفى ابن سينا لعلاج إدمان المخدرات في كابول، أفغانستان، في الفترة بين نوفمبر / تشرين الثاني و ديسمبر / كانون الأول 2022. وجمعنا 3–5 مليلترات من عينات الدم من المشاركين وفحصناها. وحللنا البيانات بالإصدار 7.2.1 من برنامج Epi Info، واستخدمنا نموذج الانحدار اللوجستي الثنائي واختبار مربع كاي لتحديد العوامل المحتملة المنبئة بالتهاب الكبد B والتهاب الكبد C والعدوى بفيروس العوز المناعي البشري المنقولة عن طريق الدم.

النتائج: بلغ معدل الانتشار المصلي لالتهاب الكبد B من إجمالي المشاركين 3.79%، والتهاب الكبد C ما يصل إلى 2.77%، وفيروس العوز المناعي البشري 0.50%. وكان من الشائع إعادة استعمال المحاقن (10%)، وتبادُل المحاقن (18.6%)، وعمليات نقل الدم السابقة (20.2%)، ولكن لم يكن هناك ارتباط ذو دلالة إحصائية بين هذه العوامل المنبِئة وحدوث العدوى (قيمة الاحتمال > 0.05). غير أن الاستخدام المشترك للشفرات ارتبط إيجابيًّا بعدوى التهاب الكبد B.

الاستنتاجات: بالرغم من أن معدلات الانتشار المصلي لالتهاب الكبد B والتهاب الكبد C وفيروس العوز المناعي البشري كانت في دراستنا أقل مما كانت عليه في دراسات سابقة، ولم يُعثَر على ارتباط يُعتد به بين عوامل الخطر وهذه الأمراض، فإن ثمة حاجة إلى توسيع نطاق خدمات الحد من الضرر بما يتجاوز البرامج الخاصة بالإبر والمحاقن لتشمل المكونات الأخرى غير المحاقن. ويشير الارتباط بين الاستخدام المشترك للشفرات والعدوى بالتهاب الكبد B إلى أن جهود الحد من الضرر ينبغي أن تشمل أيضًا ممارسات الحلاقة المأمونة.

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Duration and determinants of delayed diagnosis of pulmonary tuberculosis in Algeria

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Abstract

Background: Delay in the diagnosis and treatment of pulmonary tuberculosis contributes to its transmission and undermines control efforts, however, these delays have not been systematically assessed in Algeria.

Aim: To assess the duration and determinants of delay in the diagnosis of pulmonary tuberculosis in Algeria.

Methods: Between June and December 2019, we reviewed paper-based medical records of, and interviewed, 323 adult patients aged ≥ 15 years at 4 tuberculosis facilities in Blida District of Algeria. The participants were newly diagnosed pulmonary TB patients registered under the revised National Tuberculosis Control Programme. The data were analysed using Epi Info version 7.2.1, and univariable and multivariable logistic regression analyses were performed to identify factors associated with delays at the patient and health system levels.

Results: The median patient delay was 15 days (interquartile range 7–35), median health system delay was 28 days (interquartile range 14–55), and median total delay was 52 days (interquartile range 33–88). Longer patient delays were observed among patients who initially sought care at a pharmacy, while health system delays were longer among those with delayed chest X-ray examination, comorbidities and sputum culture-based diagnosis.

Conclusion: Diagnosis delays among patients with pulmonary tuberculosis in Algeria remains substantial and largely attributable to health system delays. Targeted programmes to minimise or eliminate self-medication and reduce the time spent for pre-diagnosis examinations, including chest X-ray services, are needed to reduce diagnosis delays.

Keywords: tuberculosis, diagnosis delay, patient delay, health system delay, Algeria

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Background

The End TB strategy launched by WHO identifies early diagnosis and prompt treatment as central to tuberculosis (TB) control (*1*). However, this strategy may be undermined when the diagnosis and treatment of TB are delayed. An individual's risk of infection with *Tubercle bacilli* is influenced by the number of active pulmonary TB cases in the community, the duration of their infectiousness and the frequency of contact with active cases. Reducing the period of infectiousness through early diagnosis and prompt treatment is therefore essential for limiting transmission. Thus, early diagnosis and prompt treatment are the most effective control strategy. Delays in TB diagnosis and treatment increase transmission, contribute to the development of drug resistance and are associated with increased mortality (*2*).

Despite the availability of a national TB control programme in Algeria since the 1960s, TB remains a major public health problem. Substantial gains in reducing TB morbidity and mortality were achieved during the 1970s and 1980s. During this period, TB incidence decreased markedly, from 150 cases per 100 000 population in the early 1960s to 47 per 100 000 in 1990. Thereafter, progress slowed and incidence increased slightly, reaching 61 cases per 100 000 in 2006. In response, TB control efforts were reinforced through new directives, including nationwide expansion of the directly observed therapy short-course (DOTS) strategy, which achieved full coverage (*3*). These measures contributed to a subsequent reduction in TB incidence, which declined to 47 cases per 100 000 population in 2019, the same level observed in 1990 (*4*).

Despite these gains, current trends remain insufficient to ensure sustained and effective TB control, highlighting persistent limitations in the national TB control programme. Diagnosis and treatment delays remain major obstacles to effective TB management in the Middle East and North Africa (MENA) Region (*5*). The determinants of such delays are multifactorial and commonly classified as patient-related and health system delays, with substantial variation across countries (*6*). Although diagnosis delay in TB has been widely studied internationally, definitions vary; however, most studies distinguish between patient delay and health system delay. To date, delays in TB diagnosis and initiation of anti-TB treatment have not been systematically assessed in Algeria. This study aimed to assess the duration and determinants of delay in the diagnosis of TB in Algeria.

Methods

Study design

A community-based cross-sectional study was conducted in the 4 TB facilities of Blida District among newly diagnosed pulmonary TB patients registered under the revised National TB Control Programme between June and December 2019.

Under this programme, patients with suspected TB based on clinical, pathological and radiological findings were referred by public or private health care providers for diagnostic confirmation and initiation of anti-TB treatment.

Paper-based medical records of adult patients aged ≥ 15 years were reviewed. To minimise recall bias, only patients registered within 2 months before data collection were included. Patients were excluded if they had recurrent TB, could not be contacted after 2 attempts, were absent during the data collection period, or had cognitive impairments.

The patients were interviewed using a predefined questionnaire adapted from the WHO tool for the assessment of TB diagnosis delay (*7*). The questionnaire was validated by the scientific committee of the Faculty of Medicine of Blida 1 University and pre-tested to ensure clarity, relevance and reliability. Data were collected by trained physicians using the final questionnaire, and interviews were conducted in Arabic. Verbal informed consent was obtained from all participants prior to inclusion, and the study was approved by the ethics committee of the Faculty of Medicine of Blida 1 University.

The sample size was calculated using a single population proportion formula [$n = (Z\alpha/2)^2 \times p(1-p) / d^2$] assuming that 72% of TB patients experience a total delay of ≥ 30 days, based on data from a previous study from Morocco (*9*). A type I error probability (α) of 0.05, a 95% confidence level, and a margin of error (d) of 5% were applied. The minimum required sample size was 310, which was increased to 341 to account for a potential non-response rate of 10%.

Definitions

Patients were considered to have pulmonary TB on the basis of clinical, pathological and radiological findings, with bacteriological confirmation where available. The interval between the onset of respiratory symptoms and confirmation of TB diagnosis was assessed. The diagnosis of pulmonary TB was defined by a positive acid-fast bacillus (AFB) sputum smear, a positive sputum culture, and/or the clinical judgement of a TB specialist in the presence of compatible symptoms and radiographic findings.

Under the revised National TB Control Programme, sputum smear microscopy was conducted in the local laboratories of the selected TB facilities. For patients with at least 2 sputum specimens negative for AFB, sputum culture was conducted at the national reference laboratory in Algiers.

All sputum analyses were conducted in accordance with international guidelines (*8*). Molecular testing, such as the Xpert MTB/RIF assay, was not available at the time of the study.

Delays were divided into 3 types. Patient delay was defined as the number of days from the onset of TB-related symptoms to first presentation to a health care provider (not necessarily a TB facility). Healthcare system delay was defined as the number of days from first presentation to a health care provider to initiation of TB treatment. Total delay was calculated as the sum of patient delay and healthcare system delay.

Comorbidity was defined as the presence of underlying cardiovascular, gastrointestinal, pulmonary, immunologic or malignant disease. Antibiotics and other medications were available over the counter in Algeria. Under the revised National TB Control Programme, anti-TB treatment was initiated promptly after diagnosis.

Data collection and analysis

The questionnaire captured sociodemographic characteristics, TB risk factors, comorbidities and TB knowledge. Follow-up data included the diagnostic investigation process, initial symptoms perceived by the patient, and health-seeking actions. Medical records were reviewed to extract diagnostic dates and laboratory results.

Data were entered into Microsoft Excel and analysed using Epi Info™ version 7.2.1. Univariable and multivariable logistic regression analyses were performed to identify factors associated with delays at the patient and healthcare system levels. Delays were dichotomised into delay versus no-delay categories using the median values observed in the study. Variables with $P < 0.2$ in univariate analysis were included in multivariable models using a backward conditional approach. Results were presented as adjusted odds ratios (aORs) with 95% confidence intervals. Statistical significance was assessed using Wald tests, with $P < 0.05$ considered significant.

TB knowledge was assessed using 7 questions addressing contagiousness, curability and modes of transmission. Each correct response was scored as 1 and each incorrect response as 0. Patients with a total score ≥ 5 were classified as having adequate core knowledge of TB.

Results

Baseline patient characteristics

We assessed 350 newly diagnosed pulmonary TB cases. Ten patients had recurrent TB and 17 declined participation. None of the patients had cognitive impairments. The final sample comprised 323 patients, of whom 184 (57.0%) resided in rural areas.

The mean age was 40 years. There was no statistically significant difference in TB notification by sex. However, the number of cases was slightly higher among men, with the highest prevalence observed in those aged 15–49 years. Married individuals accounted for 46.8% (*n*

= 151) of participants and 15.8% (*n* = 51) had a low level of education. Almost half of the patients (48.9%) reported a monthly income of less than US$150 and were classified as having low socioeconomic level.

Most of the patients (77.1%, *n* = 249) consulted a pharmacist at the onset of respiratory symptoms, and 181 of these patients (72.7%) reported self-treatment with antibiotics. At the first medical visit, 72.4% of the participants (*n* = 234) did not undergo chest X-ray examination. In addition, 56.0% of patients (*n* = 181) had inadequate TB knowledge and were unaware that their symptoms could be related to TB.

All included patients had bacteriologically confirmed TB. The proportion of patients with AFB sputum smear-positive results was 93.5% (*n* = 302), while 6.5% (*n* = 21) were AFB smear-negative and culture-positive. The baseline characteristics are summarised in Table 1.

Patient and health system delays

The median total diagnostic delay was 52 days (interquartile range [IQR] 33–88 days), and 79 of 323 patients (24.5%) experienced a delay of at least 3 months. The median patient delay was 15 days (IQR: 7–35 days), while the median healthcare system delay was 28 days (IQR: 14–55 days). Patient delay (> 30 days) and healthcare system delay (> 30 days) were observed in 34.7% of patients (*n* = 112) and 49.2% (*n* = 159), respectively. Results of univariable analyses identifying factors associated with patient delay and healthcare system delay are presented in Table 2.

Multivariable logistic regression analysis showed that initial consultation at a pharmacy was independently associated with patient delay. Healthcare system delay was associated with delayed chest X-ray examination, the presence of one or more underlying comorbidities, and bacteriological diagnosis based on AFB sputum culture rather than smear microscopy (Table 3).

Discussion

WHO has identified TB as a major global public health priority. One of the key contributors to the persistent global TB burden is inadequate case detection, diagnosis and treatment (*10*). In this study, the median total delay from symptom onset to diagnosis and initiation of anti-TB treatment was 52 days, largely attributable to a healthcare system delay of 28 days. The median patient delay of 15 days was significantly shorter than the median healthcare system delay.

These findings are similar to those reported in several studies from Sub-Saharan countries, Turkey and India (*8*). However, most published studies have reported shorter healthcare system delays than patient delays. A systematic review of 40 studies from low- and middle-income countries showed interquartile ranges of 44–77.8 days for patient delay and 12–34 days for healthcare system delay (*6*).

Compared with neighbouring countries, the median diagnostic delay observed in this study was similar to those reported in Tunisia and Morocco. However, in those studies, healthcare system delay was either comparable to or shorter than patient delay (*11,9*).

The main factors associated with healthcare system delay after multivariable adjustment were delayed chest X-ray examination, the presence of at least one underlying disease, and bacteriological diagnosis based on AFB sputum culture. In contrast to findings from other settings, female sex was not associated with healthcare delay in this study. A systematic review including 20 studies from MENA countries found that being female was significantly associated with longer delays (*5*).

Patients diagnosed by sputum culture experienced longer healthcare system delays. This is explained by the diagnostic pathway in Algeria, whereby sputum specimens from patients with 2 negative smear results are referred to the national reference laboratory in Algiers for culture, a process that may take several weeks. However, this applied to only 21 of the 323 patients included in the study.

The presence of at least one underlying disease was also associated with prolonged healthcare system delay. This may reflect the nonspecific nature of TB symptoms, which may be attributed by patients to pre-existing chronic conditions, such as chronic lung disease. Few studies have reported a similar association between comorbidities and healthcare system delay (*6*).

Chest X-ray examination is an important screening tool for TB among patients with respiratory symptoms, and timely access to chest X-ray has been associated with shorter diagnosis delays (*12*). In Algeria, many private healthcare providers lack access to chest X-ray equipment. Although the national TB control programme has improved the availability of chest X-ray equipment in public healthcare facilities, many units remain non-functional for long periods due to poor maintenance.

Several studies have reported an association between delayed chest X-ray examination and prolonged healthcare system delay. In a cross-sectional study from China, cough and availability of chest X-ray were identified as protective factors, and the median healthcare system delay (7 days) was shorter than the median patient delay (23 days) (*13*). In another study from a high-income country, delayed chest X-ray examination was associated with medical delay exceeding 30 days (*14*).

Some private and public practitioners may have limited awareness of TB symptoms. When managing patients with respiratory symptoms, viral or bacterial infections may be prioritised, leading to antibiotic prescription. Such practices may contribute to delays in TB diagnosis. In this study, patients who initially sought treatment from a pharmacy had higher odds of experiencing patient delay (aOR = 3.32; 95% CI: 1.70–6.47). Similar findings have been reported elsewhere, with initial consultation at pharmacies identified as a major independent predictor of the patient delay (*15*). In a study from Georgia, self-medication was associated with prolonged patient delay, whereas antibiotic use before

Table 1 Demographic and clinical characteristics of pulmonary TB patients, Algeria

Characteristics	Patients (N = 323)	
	n	%
Gender		
Male	167	57.9
Female	136	42.1
Age (years)		
≥ 50	80	24.8
< 50	243	75.2
Marital status		
Currently married	151	46.8
Not currently married	172	53.2
Level of education		
Illiterate and primary	51	15.8
Lower than primary	272	84.2
Occupation		
Unskilled	126	39.0
Other occupations and unemployed	197	61.0
Socioeconomic class		
Lower	158	48.9
Middle and upper	165	51.1
Residence		
Rural	184	57.0
Urban	139	43.0
Core knowledge of tuberculosis[a]		
No	181	56.0
Yes	142	44.0
Primary symptoms		
Cough or fever	261	80.8
Other symptoms[b]	62	19.2
Comorbidity		
Yes	145	44.9
No	178	55.1
First treatment preference		
Pharmacy	249	77.1
Doctor	74	22.9
Distance from the nearest health care facility (km)		
≥1	112	34.7
<1	212	65.3
First health care provider		
Public sector	133	41.2
Private sector	190	58.8
Chest X-ray at the first health care provider		
No	234	72.4
Yes	89	27.6
Inpatient admission before diagnosis		
Yes	70	21.7
No	253	78.3
Sputum bacteriological results		
Culture-positive	21	6.5
Smear-positive	302	93.5

[a] *Correct response to at least 5 out of 7 knowledge questions.*
[b] *Included weight loss, night sweats, shortness of breath and haemoptysis.*

Table 2 Univariable analysis of factors associated with patient and health system delays, Algeria

Factors	Patient delay (≥ 15 days)			Healthcare system delay (≥ 28 days)		
	Yes *n* (%)	No *n* (%)	*P*	Yes *n* (%)	No *n* (%)	*P*
Sex						
Male	96 (51.3)	91 (48.7)	0.50	87 (46.5)	100 (53.5)	0.03
Female	75 (55.2)	61 (44.8)		80 (58.8)	56 (41.2)	
Age (years)						
≥ 50	52 (65.0)	28 (35.0)	0.09	48 (60.0)	32 (10.0)	0.09
< 50	119 (49.0)	124 (51.0)		119 (49.0)	124 (51.0)	
Marital status						
Currently married	73 (48.3)	78 (51.7)	0.12	74 (49.0)	77 (51.0)	0.36
Not currently married	98 (57.0)	74 (43.0)		93 (54.1)	79 (45.9)	
Level of education						
Illiterate and primary	35 (68.6)	16 (31.4)	0.01	27 (52.9)	24 (47.1)	0.85
> primary	136 (50.0)	136 (50.0)		140 (51.5)	132 (48.5)	
Occupation						
Unskilled	68 (54.0)	58 (46.0)	0.77	56 (44.4)	70 (55.6)	0.03
Others and unemployed	103 (52.3)	94 (47.7)		111 (56.4)	86 (44.7)	
Socioeconomic class						
Lower	83 (52.5)	75 (47.5)	0.89	75 (47.5)	83 (52.5)	0.13
Middle and upper	88 (53.3)	77 (46.7)		92 (55.8)	73 (44.2)	
Residence						
Rural	98 (53.3)	86 (46.7)	0.89	98 (53.3)	86 (46.7)	0.52
Urban	73 (52.5)	66 (47.5)		69 (49.6)	70 (50.4)	
Core knowledge of tuberculosis[a]						
No	99 (54.7)	82 (45.3)	0.48	92 (50.8)	89 (49.2)	0.72
Yes	72 (50.7)	70 (49.3)		75 (52.8)	67 (47.2)	
Primary symptoms						
Cough or fever	142 (54.4)	119 (45.6)	0.28	140 (53.6)	121 (46.4)	0.15
Other symptoms[b]	29 (46.8)	33 (53.2)		27 (43.6)	35 (56.5)	
Comorbidity						
Yes	76 (52.4)	69 (47.6)	0.86	88 (60.7)	57 (39.3)	< 0.01
No	95 (53.4)	83 (46.6)		79 (44.4)	99 (55.6)	
First treatment preference						
Pharmacy	151 (60.6)	98 (39.4)	< 0.01	124 (49.8)	125 (50.2)	0.21
Doctor	20 (27.0)	54 (73.0)		43 (58.1)	31 (41.9)	
Distance from the nearest healthcare facility (km)						
≥ 1	63 (56.3)	49 (43.7)	0.39	63 (56.3)	49 (43.7)	0.23
< 1	108 (51.2)	103 (48.8)		104 (49.3)	107 (50.7)	
First healthcare provider						
Public sector	73 (54.9)	60 (45.1)	0.56	72 (54.1)	61 (45.9)	0.46
Private sector	98 (51.6)	92 (48.4)		95 (50.0)	95 (50.0)	
Chest X-ray at the first health care provider						
No	N/A	N/A		142 (60.7)	92 (39.3)	< 0.01
Yes	N/A	N/A		25 (28.1)	64 (71.9)	
Inpatient admission before diagnosis						
Yes	N/A	N/A		42 (60.0)	28 (40.0)	0.12
No	N/A	N/A		125 (49.4)	128 (50.6)	
Sputum bacteriological results						
Culture-positive	N/A	N/A		16 (76.2)	5 (23.8)	0.02
Smear-positive	N/A	N/A		151 (50.0)	151 (50.0)	

N/A: not applicable
Significant at P < 0.05
[a] *Correct response to at least 5 out of 7 knowledge questions.*
[b] *Included weight loss, night sweats, shortness of breath and haemoptysis.*

Table 3 Multivariable logistic regression of factors associated with patient and health system delays, Algeria

Factors	Category	Patient delay; [a] OR (95% CI)	Healthcare system delay; [a] OR (95% CI)
First treatment preference	Pharmacy	4.68 (2.58–8.50)	
	Doctor	1	
Comorbidities	Yes		1.81 (1.08–3.03)
	No		1
X-ray chest at the first health provider	No		4.33 (2.47–7.61)
	Yes		1
Sputum bacteriological results	Culture-positive		4.15 (1.35–12.80)
	Smear-positive		1

aOR = adjusted odds ratio, CI = confidence interval

TB diagnosis was related to prolonged healthcare system delay but not to patient delay (*16*). Comparable findings were reported in a study from Uzbekistan, where self-medication was the first health-seeking action for 43% of patients and a significant predictor of patient delay. Antibiotic self-medication was also linked to healthcare system delay in that study (*17*).

Almost half of the patients in our study used unprescribed antimicrobials before TB diagnosis and treatment. Antibiotic use is known to delay or mask the diagnosis of infectious diseases (*18*). Several studies have shown that prior antibiotic exposure can delay TB diagnosis and initiation of treatment. One study reported a patient-delay of 34 days among patients with TB who received a fluoroquinolone before diagnosis (*19*).

To our knowledge, no published studies from Algeria have assessed pharmacy medical advice and drug dispensing practices. Available evidence suggests that only 14% of pharmacies appropriately refer patients with suspected TB to healthcare facilities without dispensing medicine.

Study limitations

This study has several limitations. First, participants were recruited exclusively from the Blida area, which may limit the generalisability of the findings. The results are therefore more likely to reflect the situation in large Algerian cities rather than the entire country. Second, the sample size may not have been sufficient to identify all factors associated with patient delay and healthcare system delay, and some potential confounders could not be fully addressed. Third, unmeasured variables may have influenced the observed delays.

Conclusion

This study is the first to investigate delays in TB diagnosis and treatment in Algeria. Despite recent progress in TB control efforts in the country, diagnostic delays remain common, consistent with reports from other low- and middle-income countries. These delays were largely attributable to healthcare system delay, highlighting the need for targeted interventions to improve the timely diagnosis of TB.

Self-medication and delayed chest X-ray examination were associated with an increased risk of diagnostic delay. To reduce these delays and limit ongoing TB transmission, policies should regulate access to over-the-counter medications, including antibiotics, and strengthen the education of health care practitioners and pharmacy staff regarding the risks of inappropriate medication use. Improving the availability and functionality of chest X-ray equipment in primary health care centres, including private facilities, can reduce diagnostic delay. Decentralising sputum culture testing to TB facilities could substantially shorten diagnostic delay among patients with smear-negative disease.

These findings highlight the importance of strengthening awareness of TB among public and private primary health care providers and promoting early referral to specialised TB services. Such measures are critical to improving timely diagnosis and reducing the burden of TB in Algeria.

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Durée et déterminants du retard dans le diagnostic de la tuberculose pulmonaire en Algérie

Résumé

Contexte : Les retards dans le diagnostic et le traitement de la tuberculose pulmonaire contribuent à sa transmission et sapent les efforts de lutte. Toutefois, ces retards n'ont pas fait l'objet d'une évaluation systématique en Algérie.

Objectif : Évaluer la durée et les déterminants du retard dans le diagnostic de la tuberculose pulmonaire en Algérie.

Méthodes : Entre juin et décembre 2019, nous avons examiné les dossiers médicaux papier de 323 patients adultes âgés de 15 ans et plus dans quatre centres de lutte contre la tuberculose du district de Blida, et nous les avons interrogés. Les participants étaient des patients atteints de tuberculose pulmonaire nouvellement diagnostiqués enregistrés dans le cadre du Programme national révisé de lutte contre la tuberculose. Les données ont été analysées à l'aide du logiciel Epi Info version 7.2.1 et des analyses de régression logistique univariable et multivariable ont été réalisées pour identifier les facteurs associés aux retards au niveau des patients et du système de santé.

Résultats : Le retard médian était de 15 jours pour les patients (intervalle interquartile : 7-35) et de 28 jours pour les systèmes de santé (intervalle interquartile : 14-55) ; le retard médian total s'élevait à 52 jours (intervalle interquartile ; 33-88). Des retards plus longs ont été observés parmi les patients qui consultaient initialement dans une pharmacie, tandis que les retards liés au système de santé étaient plus longs chez ceux ayant subi un examen radiographique thoracique tardif, présentant des comorbidités ou dont le diagnostic reposait sur la mise en culture des expectorations.

Conclusion : En Algérie, les retards de diagnostic chez les patients atteints de tuberculose pulmonaire restent importants et sont en grande partie dus à des retards liés au système de santé. Des programmes ciblés visant à réduire au minimum ou à éliminer l'automédication et le temps consacré aux examens réalisés avant le diagnostic, y compris les services de radiographie thoracique, sont nécessaires pour raccourcir les retards de diagnostic.

مدة ومحددات التشخيص المتأخر بالسل الرئوي في الجزائر

لطفي ناصف، عطيف محمد لمين، تاريغت سامية

الخلاصة

الخلفية: يسهم التأخير في تشخيص وعلاج السل الرئوي في سريانه وتقويض جهود مكافحته، غير أن هذا التأخير لم يُقيَّم على نحو منهجي في الجزائر.

الأهداف: هدفت هذه الدراسة الى تقييم مدة التأخير في تشخيص السل في الجزائر ومحدداته.

طرق البحث: في المدة ما بين يونيو/ حزيران وديسمبر/ كانون الأول 2019، استعرضنا السجلات الطبية الورقية لعدد من المرضى بلغ 323 مريضًا بالغًا، تتراوح أعمارهم بين 15 عامًا أو أكثر في أربعة مرافق لعلاج السل في منطقة البليدة بالجزائر، وأجرينا مقابلات معهم. وكان المشاركون قد شُخِّصوا حديثًا بالسل الرئوي وسُجلوا في إطار "البرنامج الوطني المنقح لمكافحة السل". وجرى تحليل البيانات باستخدام الإصدار 1.2.7 من برنامج Epi Info، وأُجريت تحليلات الانحدار اللوجستي الأحادي المتغيرات والمتعدد المتغيرات لتحديد العوامل المرتبطة بالتأخير على مستوى المرضى ومستوى النظام الصحي.

النتائج: بلغ متوسط التأخير في تشخيص السل على مستوى مرضاه 15 يومًا (المدى بين الرُّبعين الأعلى والأدنى 7–35)، وعلى مستوى النظام الصحي 28 يومًا (المدى بين الرُّبعين الأعلى والأدنى 14–55)، ومتوسط التأخير الكلي 52 يومًا (المدى بين الرُّبعين الأعلى والأدنى 33–88). كما لوحظت تأخيرات أطول للمرضى الذين التمسوا الرعاية من احدى الصيدليات في البداية، في حين كانت تأخيرات النظام الصحي أطول للمرضى الذين تأخر فحصهم بالأشعة السينية، والذين كانت لديهم أمراض مصاحِبة، والذين شُخِّصوا اعتمادًا على مزرعة البلغم.

الاستنتاجات: لا يزال هناك تأخير ملحوظ في تشخيص حالات المرضى المصابين بالسل الرئوي في الجزائر، وهو ما يعزى إلى حد كبير إلى حالات التأخير على مستوى النظام الصحي. وثمة حاجة إلى وضع برامج تستهدف خفض الاعتماد على التطبيب الذاتي إلى أدنى حد أو إنهاءه تمامًا، وتقليل الوقت الذي تستغرقه الفحوص السابقة على التشخيص، لا سيما خدمات تصوير الصدر بالأشعة السينية، للحد من التأخير في التشخيص.

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A cross-sectional study of scorpion stings in high-risk areas of Islamic Republic of Iran

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Abstract

Background: Scorpion sting is one of the most serious health problems in Islamic Republic of Iran.

Aim: To investigate the epidemiology and clinical characteristics, as well as the knowledge, attitude and practices of health workers, physicians and residents regarding scorpion stings in the scorpion-prone southern areas of Kerman Province, Islamic Republic of Iran.

Methods: Using SPSS version 20, we analysed the 2021 annual epidemiological report of scorpion stings for the southern counties of Kerman Province, including the clinical features of scorpion sting patients.

Results: A total of 3106 scorpion stings were recorded in 2021, with an average incidence of 390.3 per 100 000. Most (37.5%) stings occurred during the summer months, among children less than 10 years old (22.2%), in rural areas (82.6%), and in the hands (42.3%) and feet (41.2%). Localized reactions included immediate pain and redness (52%), severe pain (8.7%), local burning pain (17.4%), swelling (4.3%) at the site of envenomation, and no reaction (17.6%). Knowledge of health workers and physicians about scorpion stings was generally weak. Health workers were significantly more knowledgeable about the biology of dangerous scorpions (P = 0.003) while physicians were more knowledgeable about black scorpion venom compounds (P = 0.01).

Conclusion: Efforts should be made to ensure safe housing designs and provide comprehensive education to health workers and community members to help reduce scorpion sting incidence and enhance the management of cases in the province.

Keywords: scorpion sting, scorpion venom, envenomation, health worker, physician, Iran

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Introduction

Scorpion stings are commonly reported in tropical and subtropical regions of the world. A national health data estimates the annual global incidence at about 1.5 million with 2600 deaths (*1–3*). Scorpion stings are the most important venomous bites in Islamic Republic of Iran, accounting for an average 50 000 cases and 20 deaths annually (*4–8*). Over 80% of these scorpion stings occur in the southern provinces of the country. The differences in morbidity and mortality rates due to scorpion stings worldwide can be attributed to factors such as climate, biodiversity, the presence of dangerous scorpions, lifestyle of residents, social and economic status, health care services, availability of medical facilities, as well as the knowledge, attitude and practices of residents, health care professionals and physicians in high-risk areas (*4–7*).

The special ecological and climatic characteristics of the southern provinces of Islamic Republic of Iran have contributed to the variety of scorpion species and suitability of habitats for scorpions (*9–11*). Marginalization, rural lifestyle and uncontrolled expansion of cities are also important factors to consider (*7,9,11*). The distribution of medically important scorpions in this region necessitates the study of scorpion stings (*1,9,10*).

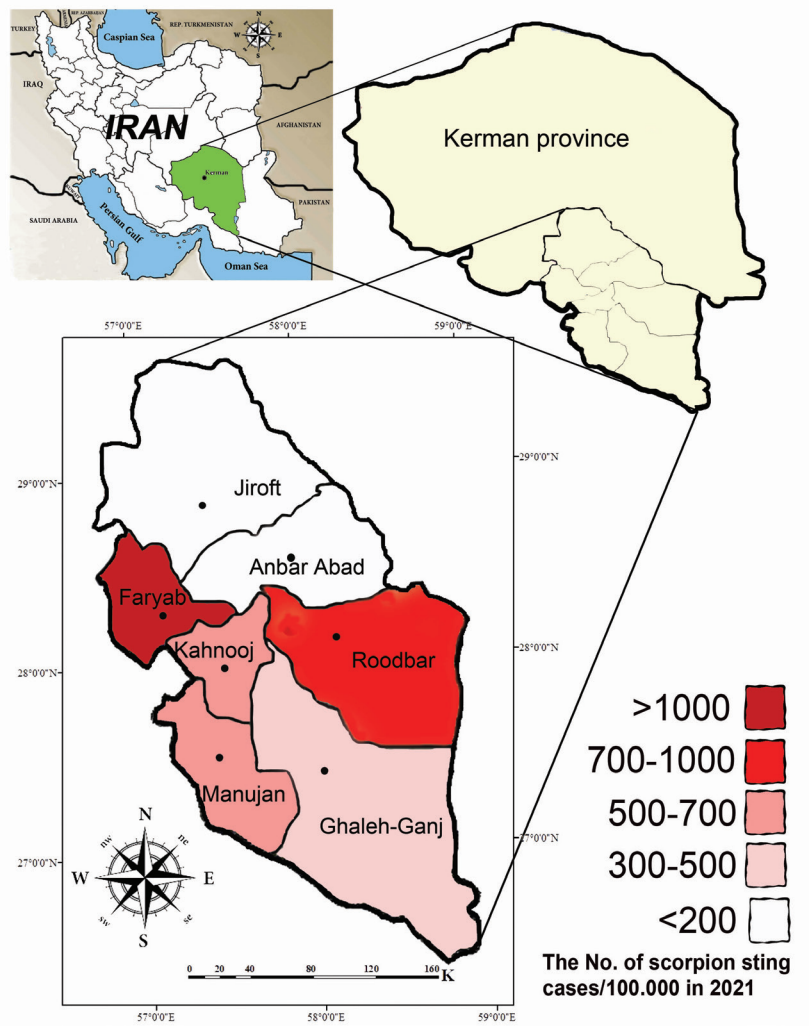
This study examined the epidemiologic status, clinical characteristics and knowledge, attitude and practices of health care workers, physicians and residents about scorpion stings in the scorpion-prone southern areas of Kerman Province in Islamic Republic of Iran. It describes the clinical features of patients who had been stung by scorpions.

Methods

Study area

This study was conducted in the southern areas of Kerman Province, including Jiroft, Kahnooj, Anbarabad, Manujan, Roodbar, Faryab, and Ghaleh-Ganj counties, under the healthcare supervision of Jiroft University of Medical Sciences (JMU) (Figure 1). The area had a population of 795 812 in 2022 and the climate is cold and dry in the highlands, hot and humid in the plains, and hot and dry in the southern parts. The temperature in the

Figure 1 Distribution of scorpion stings in the southern counties of Kerman Province, Islamic Republic of Iran



highlands reaches a maximum of 33°C during summer and minimum of -15°C during winter (12). The JMU healthcare system reported 3106 scorpion sting cases in the area from March 2021 to 2022.

Study design

This community-based cross-sectional study was conducted from March to August 2022. It assessed the knowledge, attitude and practices of residents regarding scorpion stings, as well as the environmental and human factors contributing to the problem in 7 counties. The study population was selected using multi-stage sampling and random selection of health centres, health houses and households. In the first stage, the health centre of each county was visited. In the second stage, a list of comprehensive health centres was obtained. In the third stage, one rural comprehensive health centre and one urban comprehensive health centre were randomly selected. In the fourth stage, the number of health houses and health bases covered by each comprehensive health centre was collected and listed. In the final stage, a simple random sampling was conducted, selecting 2 health houses from each rural comprehensive health centre and 2 health bases from each urban comprehensive health centre until the desired sample size was reached. Ultimately, in the entire southern region of Kerman, 14 comprehensive health centres (rural and urban) and 28 health houses and health bases were randomly selected.

The sample size for residents was calculated as 384 using the sample size formula, 95% confidence, and P = 0.5. The sample size was divided proportionately between the populations of the studied counties. Accordingly, in Jiroft 132 (population: 273 337), Anbarabad 43 (population: 89 167), Manujan 36 (population: 75 372), Faryab 18 (population: 36 835), Roodbar 63 (population: 131 174), Kahnooj 50 (population: 103 225), and Ghaleh-Ganj 42 (population: 86 702) households were considered in the study.

$$n = \frac{(1.96)^2\ 0.5(0.5)}{(0.05)^2} = 384 \qquad n=\frac{(z)^2\ p(q)}{(d)^2}$$

For the health workers and physicians, the sample size was calculated to be 151, after health centres were selected and available sampling was considered in the 7 counties.

Data collection

Two questionnaires, one for the residents and the other for health workers and physicians, were developed and used for data collection through face-to-face interviews conducted by trained research assistants, under the supervision of the chief investigator. The questionnaires were designed and revised by 10 epidemiology, health education and medical entomology experts.

For the residents, the questionnaire was pretested in 7 villages and revised based on the feedback received. Its validity was 0.78% using Cronbach's Alpha coefficient. It contained 33 close-, open-, and semi-open-ended questions in 4 sections: demographic characteristics and residents' knowledge of scorpions (6 questions), assessment of scorpion exposure (18 questions), attitude after exposure to scorpion and scorpion stings (6 questions), and knowledge of initial actions in dealing with scorpion stings (3 questions). The inclusion criteria were: being a permanent member of the community, a head of the household, a resident in a rural area, attending a health centre in the covered area, and living in that area for at least 2 years. Individuals who could not communicate normally or were not willing to provide the requested information were excluded from the study.

For health workers and physicians, the questionnaire was pretested among 30 health workers and physicians and revised based on the feedback received. Its validity was found to be 0.78% using Cronbach's Alpha coefficient. It had 2 parts: knowledge (39 questions) and practice (6 questions). Questions in the first part collected information on the abundance of dangerous scorpions based on digging burrow and non-digging burrow types (2 questions), knowledge of the morphological features of extremely dangerous scorpions (black fat-tailed and *gadim* scorpions) (10 questions), knowledge of the morphology of extremely dangerous scorpions (5 questions), knowledge of the venom compounds of extremely dangerous scorpions (10 questions), knowledge of the symptoms of extremely dangerous scorpion stings (10 questions), and knowledge of the age group of those most exposed to scorpion stings (2 questions). The second part of the questionnaire (practice section) asked questions about recommendations for first aid after a scorpion sting (5 questions) and the ability to recognize dangerous scorpions (1 question).

The questionnaire used 3-point Likert scale (0 = disagree, 1 = neutral, 2 = agree). Scores for the age groups in which scorpion stings occurred more often ranged from 0 to 4 including 0–1, 1–3 and 3–4 indicating weak, moderate and strong knowledge, respectively. For other questions, the scores ranged from 0–10. A score of 0–4, 4–6 and 6–10 indicated weak, moderate and strong knowledge, respectively.

Clinical characteristics of patients

Using a checklist, clinical features and other characteristics of 48 patients who were stung by scorpions were recorded during hospitalization at a referral hospital in Jiroft County in August 2023. The checklist comprised 2 sections. The first section included demographic information of the patients, the location of the scorpion sting, the pre-hospital measures, the timing of medical assistance received, the time of the scorpion sting and the name of scorpion that caused the sting (if the patient or their companion could identify the scorpion using pictorial representations). The representations illustrated the discriminate characteristics of *Hemiscorpious* (local name: *gadim*), *Androctonus* (local name: *haft-boog*) and other common buthid scorpions (local name: yellow scorpions or *zartook*). The second section contained a comprehensive inventory of systemic clinical symptoms, local clinical symptoms resulting from scorpion stings and details of the administration of antivenoms and medications.

Statistical analysis

All analyses were conducted using SPSS version 20, Pearson correlation and chi-square test. The qualitative data were expressed as percentages.

Results

Epidemiologic characteristics

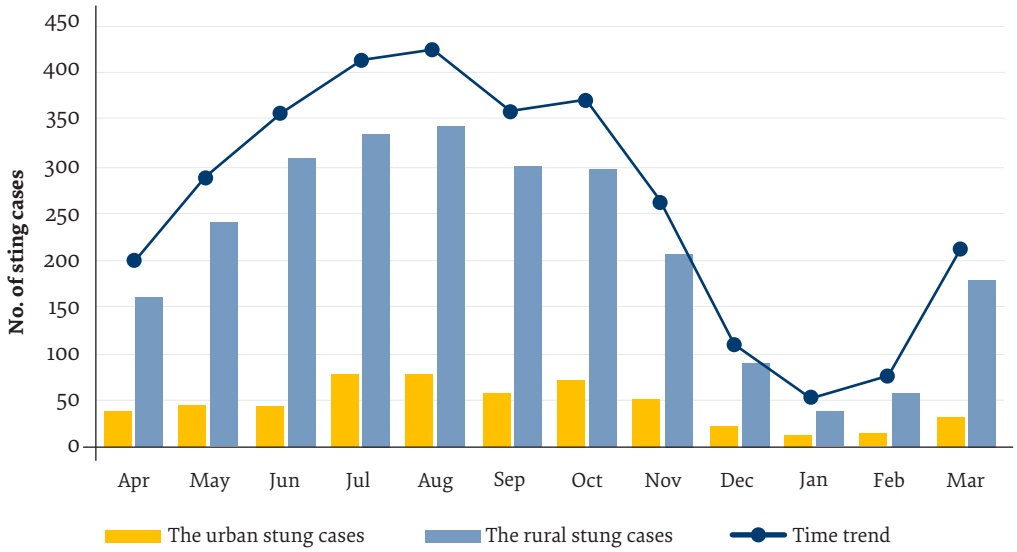
The Health Department of JMU reported 3106 cases of scorpion stings in 2021. Demographic analysis of the stings showed a higher frequency of scorpion stings among women than men, with a male to female ratio of 1.12. The ratio among the <10 years age group was 1.23 and in other age groups, more stings were reported among women. Most cases of scorpion stings were reported among children less than 10 years old (689 cases, 22.18%); in rural areas (95.5%) (rural:urban ratio 3.93); at night (87.5%) during spring and summer (January to October) or during the day in winter; and in the hands (1314 cases, 42.30%) and feet (1278 cases, 41.15%) (Figure 2). The lowest frequency was in the head and neck (151 cases, 4.46%). Faryab and Roodbar counties were the highest risk areas, with 1200 per 100 000 and 723 per 100 000, respectively (Figure 1).

Demographic characteristics and knowledge of residents

Of those interviewed, 243 households (72.1%) had under-5 children and most respondents worked in livestock or agriculture sectors. Thirty-one (8.1%) of the respondents had no knowledge of scorpion shelters. Most of them (83.6%) shook their clothes before wearing them, shook their shoes before use (86.2%), shook their beds before sleeping (96.1%), and left their shoes on the floor outside the door (63.5%).

Of the households, 36.7% experienced scorpion stings and most cases (64.0%) occurred indoors. Most of the respondents (60.4%) went to the hospital after exposure to scorpion sting and 31.2% applied traditional treatment (Table 1). Most of them (73.5%) were exposed to scorpions at home or observed scorpions indoors (55.0%). Most

Figure 2 Monthly reported scorpion sting cases by residence (urban vs rural), south Kerman Province, Islamic Republic of Iran, March 2021 to 2022



houses had no walls and were unsafe (74.8%) with no barrier to prevent scorpions from entering (78.3%).

Knowledge of health workers and physicians

Physicians were significantly more knowledgeable about black scorpion sting symptoms (P = 0.001) and black scorpion venom compounds (P = 0.01) than health workers (Table 2), but the health workers were significantly more knowledgeable about the biology of dangerous scorpions (P = 0.003) than physicians (Table 2). Respondents were knowledgeable about the age group most likely to be stung by a scorpion (physicians 68.8%, health workers 73.9%) but only few of them had adequate knowledge about the morphological characteristics of black fat-tailed (17.6% health workers, 12.5% physicians) and *gadim* scorpions (13.4% health workers, 31.3% physicians). Conversely, 41.2% of health workers and 56.3% of physicians knew the external characteristics of the *gadim* and black fat-tailed scorpions.

Their knowledge of the properties of scorpion venom (neurotoxic, cytotoxic and hemotoxic effects) was inadequate; only 3.4% of health workers and 3.1% of physicians knew. Health workers had inadequate

Table 1 Response by residents to a scorpion sting in high-risk areas of Kerman Province

Action type	Response	Frequency (%)
Actions and suggestions after scorpion sting	Quick referral to the hospital	232 (60.4)
	Applying a cold compress	50 (12.8)
	Moving away from the scene of the sting	33 (8.5)
	Covering the sting site with a cloth	14 (3.6)
	Washing the sting site	12 (3.2)
	Pressing the sting site	10 (2.7)
	Holding the injured limb up	8 (2.2)
	Use of herbal medicines	8 (2.2)
	Others	17 (4.4)
Belief in traditional treatment	Yes	120 (31.2)
	No	264 (68.8)
Type of traditional treatments	Use of opium	41 (34.1)
	Use of leaves/juice of milkweed	38 (31.7)
	Putting eggplant on the sting site	26 (21.7)
	Shaving the sting site	8 (6.7)
	Praying of Mullah	3 (2.5)
	Others	4 (3.3)
Materials/methods used in controlling scorpions	Spraying insecticide	207 (53.8)
	Preventing the accumulation of scum and garbage	97 (25.3)
	Using petroleum products	62 (16.2)
	Keeping poultry in the residential area	18 (4.7)

Table 2 Knowledge of health workers/physicians about dangerous scorpions and scorpion stings in high-risk areas of Kerman Province

Variable		Physicians		Health workers	
		%	No.	%	No.
Age group most exposed to scorpion stings	Weak	31.3	10	14.3	17
	Medium	0	0	11.8	14
	Strong	68.8	22	73.9	88
P value 0.150					
The biology of dangerous scorpions	Weak	34.4	11	36.1	43
	Medium	28.1	9	21.0	25
	Strong	37.5	12	42.9	51
P value 0.003					
Morphological features of black scorpion	Weak	37.5	12	31.1	37
	Medium	50	16	51.3	61
	Strong	12.5	4	17.6	21
P value 0.250					
Morphological features of gadim scorpion	Weak	9.4	3	31.1	37
	Medium	59.4	19	55.5	66
	Strong	31.3	10	13.4	16
P value 0.180					
Characteristic of the stinger (telson) of dangerous scorpions (gadim and black scorpion)	Weak	12.5	4	26.9	32
	Medium	31.3	10	31.9	38
	Strong	56.3	18	41.2	49
P value 0.370					
Gadim scorpion venom compounds	Weak	34.4	11	37.8	45
	Medium	62.5	20	58.8	70
	Strong	3.1	1	3.4	4
P value 0.350					
Black scorpion venom compounds	Weak	9.4	2	8.4	10
	Medium	62.5	20	67.2	80
	Strong	28.1	9	24.4	29
P value 0.010					
Black scorpion sting symptoms	Weak	18.8	6	24.4	29
	Medium	53.1	17	68.1	81
	Strong	28.1	9	7.6	9
P value 0.001					
Gadim sting symptoms	Weak	25	8	26.9	32
	Medium	53.1	17	54.6	65
	Strong	21.9	7	18.5	22
P value 0.190					

knowledge of the symptoms of black fat-tailed scorpion stings (7.6%) (Table 2).

Physicians were significantly more knowledgeable than health workers about the management of scorpion stings ($P < 0.001$) (62.5% physicians, 39.5% health workers), and 15.6% of physicians and 50.4% of health workers knew the diagnosis of very dangerous scorpions stings (black fat-tailed and *gadim* scorpions) (Table 3).

Clinical and other characteristics of patients

A total of 48 patients participated in this study, male to female ratio 1:1.03. Most of the patients (33.3%) were less than 10 years old and had gone to the hospital without any pre-hospital measures, although 2 cases used a constricting band above the sting site to limit the venous flow. The time between scorpion sting and receiving medical care (patient delay) varied: 55% < 1 hour, 40.1% 1–3 hours and 5.0% <3 hours. Some patients or their companions were able to identify the scorpion that stung

Table 3 **Health workers/physician practices for dangerous scorpions and scorpion stings in high-risk areas of Kerman Province**

Variable		Physicians		Health workers	
		%	No.	%	No.
First aid is recommended after a scorpion sting	Weak	12.5	4	5.9	7
	Medium	25	8	54.6	65
	Strong	62.5	20	39.5	47
***P* < 0.001**					
Recognizing the dangerous scorpions	Weak	84.4	27	49.6	59
	Medium	0	0	0	0
	Strong	15.6	5	50.4	60
***P* value 0.247**					
Total		**100**	**32**	**100**	**119**

them: *Hemiscorpious* (*gadim* scorpion) 23.0%, *Androctonus* (black scorpion) 30.7% and other buthid scorpion 46.3%.

Localised reactions included immediate pain and redness (52.0%), severe pain (8.7%), local burning pain (17.4%), swelling (4.3%) at the site of envenomation, and no reaction. Stings were mainly at the upper extremities (37.5%) and lower limbs (33.3%) with some in the trunk (16.7%) or head/neck (12.5%). The systemic symptoms included fever, lethargy, abdominal pain, chills, xerostomia and thirst, malaise, nausea, drowsiness, tachycardia, insomnia, xerostomia, headache, dyspnoea, dizziness, stress, chest pain, fatigue, sweating, vomiting, muscle weakness, swelling orthostatic hypotension, agitation, and anaesthesia. Local symptoms included burning, pain or painlessness at the bite site, local necrosis, tenderness, erythema, oedema, warmth, tingling in the limbs, bruises on the body, and severe diffuse pain.

Antivenom, chloramphenicol and hydrocortisone had been suggested as the first-line drugs for the management of severe scorpion envenomation, however, some cases (29.2%) were treated with only antivenom. Twenty percent of cases were managed with hydrocortisone without antivenom to reduce the pain, swelling, itching, and redness that occurred at the sting site.

Discussion

Faryab, Roodbar, Manujan, and Kahnooj counties had >500 scorpion sting cases per 100 000 population, indicating the need for urgent actions especially during the warm seasons. Children aged <10 years were at high-risk and children generally had the highest mortality rate.

Epidemiologic data showed that most scorpion sting cases were reported during summer, similar to other studies in Islamic Republic of Iran (*13–15*). Temperatures in the study areas reach 50°C during summer and non-digging scorpions, especially *Hemiscorpius acanthocercus*, *Androctonus crassicauda* and *Mesobuthus* spp., most frequently enter houses (*11,14,16*), resulting in increased contact with residents (*13*).

Most scorpion stings (82.6%) occurred in rural areas, similar to reports from Islamic Republic of Iran and other countries (*2,11,17*). The ecological conditions make rural areas appropriate habitats for scorpions. Resting and sleeping on the ground, walking barefooted outside the house, putting on clothing, and laying beddings on the floor can increase scorpion stings in rural areas (*13*).

Although the knowledge of respondents about scorpion shelters and sting symptoms was high, the findings indicate the need for awareness and education among the study population. For example, there were debris, tree trunks and other scorpion habitats in 64% of residents' homes, houses were unsafe in terms of scorpion entry because of seams around the walls and doors in 78% of homes, and the custom of putting shoes outside the doors provide appropriate shelter for scorpions.

This study revealed that residents prioritised referral to the hospital (60.4%) and application of cold compress (12.8%) after a scorpion sting. Albuquerque et al reported low awareness among indigenous people of Pernambuco, Mexico, about appropriate first aid after a scorpion sting; 35.3% of sting cases did not seek medical care (*1*). Knowledge by high-risk individuals of the early symptoms of scorpion sting, especially stings by *Hemiscorpius* spp. and quick referral to a medical centre for antidote after exposure could be helpful in the management of sting cases. If residents lack knowledge of dangerous scorpions, such as the gadim scorpion, they may not seek medical service for scorpion sting cases.

Understanding by physicians of dangerous scorpions could play a crucial role in effectively treating scorpion sting cases (*18–20*). Jaberhashmi et al investigated the understanding of health workers and rural residents of Hormozgan Province, south Islamic Republic of Iran and found that participants had sufficient knowledge about scorpion stings, with most of the residents obtaining their information from health workers (*21*). In our study, knowledge of health workers and physicians about the morphology, biology and other characteristics of dangerous scorpions was inadequate. *Hemiscorpius acanthocercus*, with the local name of gadim/almas/almasak, is a dangerous and deadly scorpion found in southern areas of Islamic Republic of Iran (*4,11,22*). Scorpions of this species are non-diggers with thin bodies

and can easily enter human buildings. The delicate and small shape of the stinger and the low neurotoxic effects of the venom cause only mild pain and make people to delay referral to medical centres. Because of the painless and cytotoxic effect of the venom, the possibility of death is very high, particularly among children with serious clinical symptoms such as haemoglobinuria, proteinuria, haematuria, haemolysis of blood cells and increased creatinine excretion (*4,22–26*).

Because of the biodiversity, wide distribution and medical significance of Hemiscorpius in southern Iran, it is essential to understand the species diversity, geographical distributions and differences in venom compounds among the species of this genus. This knowledge is vital for implementing effective medical response to envenomation caused by these scorpions (*28*).

Conclusion

Preventive measures are needed to minimise cases and mortality due to scorpion stings in southern areas of Islamic Republic of Iran. In this regard, negotiating and consulting with regional officials to identify solutions and design comprehensive educational programmes could be helpful. Training should be provided to physicians, nurses, pre-hospital emergency personnel, and health workers on the subject matter. Previous studies in southeastern Islamic Republic of Iran have shown that 64% of scorpion stings occurred inside the homes, and that most rural buildings (78.3%) in rural areas had no walls or favourable fencing to prevent the entry of scorpions (*11,27*). This calls for actions by municipalities to reduce scorpion exposure inside houses by monitoring the construction of houses and ensuring that they are made with standard materials and design. Municipalities could also reduce people's exposure to scorpions by asphalting the alleys and streets in rural areas, destroying possible scorpion shelters within human habitation and building safe playgrounds for children. Non-government organizations can help improve housing by providing financial support to residents in high-risk areas. As the occupation of rural residents is mainly agriculture, agricultural organizations can educate farmers on ways to prevent scorpion stings. During summer, due to power outages and the inability to cool their homes, people in rural areas often rest outside their homes at night, and this could increase their contact with scorpions. Permanent electricity supply, especially in rural areas, could help reduce the need to rest outside and in turn the incidence of scorpion stings.

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Conflict of interest: None declared.

Étude transversale des piqûres de scorpions dans les zones à haut risque de la République islamique d'Iran

Résumé

Contexte : Les piqûres de scorpion comptent parmi les problèmes de santé les plus graves en République islamique d'Iran.

Objectif : Étudier les caractéristiques épidémiologiques et cliniques ainsi que les connaissances, les attitudes et les pratiques des agents de santé, des médecins et des résidents concernant les piqûres de scorpions dans les zones méridionales affectées par des scorpions de la province de Kerman (République islamique d'Iran).

Méthodes : À l'aide de la version 20 du logiciel SPSS, nous avons analysé le rapport épidémiologique annuel 2021 des piqûres de scorpion dans les comtés méridionaux de la province de Kerman, incluant les caractéristiques cliniques des patients ayant été piqués par des scorpions.

Résultats : Au total, 3106 piqûres de scorpions ont été enregistrées en 2021, avec une incidence moyenne de 390,3 pour 100 000 habitants. La plupart des piqûres (37,5 %) se sont produites pendant les mois d'été, chez des enfants de moins de 10 ans (22,2 %), dans des zones rurales (82,6 %) ; les parties touchées étaient les mains (42,3 %) et les pieds (41,2 %). Les réactions localisées comprenaient une douleur immédiate et une rougeur (52 %), une douleur sévère (8,7 %), une douleur localisée avec brûlure (17,4 %), un œdème (4,3 %) au site de l'envenimation et l'absence de réaction (17,6 %). Les connaissances des agents de santé et des médecins sur les piqûres de scorpions étaient généralement faibles. Les connaissances des agents de santé sur la biologie des scorpions dangereux (p = 0,003) étaient meilleures tandis que les médecins avaient davantage d'informations sur les composés du venin de scorpion noir (p = 0,01).

Conclusion : Des efforts devraient être déployés pour concevoir des logements sûrs et fournir une éducation complète aux agents de santé et aux membres de la communauté afin de contribuer à réduire l'incidence des piqûres de scorpions et d'améliorer la prise en charge des cas dans la province.

دراسة مقطعية للسعات العقارب في المناطق الشديدة الخطورة في جمهورية إيران الإسلامية

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الخلاصة

الخلفية: تُعد لسعات العقارب واحدة من أخطر المشكلات الصحية في جمهورية إيران الإسلامية.

الأهداف: هدفت هذه الدراسة الى استقصاء الخصائص الوبائية والسريرية، فضلاً عن معلومات العاملين الصحيين والأطباء والمقيمين ومواقفهم وممارساتهم بشأن لسعات العقارب في المناطق الجنوبية المعرَّضة للعقارب في مقاطعة كرمان، جمهورية إيران الإسلامية.

طرق البحث: أجرينا تحليلاً للتقرير الوبائي السنوي لعام 2021 عن لسعات العقارب في المناطق الجنوبية من مقاطعة كرمان، بما يشمل الخصائص السريرية للمرضى الذين تعرَّضوا للسعات العقارب، وذلك باستخدام الإصدار 20 من برمجية SPSS.

النتائج: سُجِّل ما مجموعه 3106 لسعة عقارب في عام 2021، بمتوسط معدل حدوث قدره 390.3 لكل 100000. وحدثت معظم اللسعات (37.5٪) خلال أشهر الصيف، في أوساط الأطفال الذين تقل أعمارهم عن 10 سنوات (22.2٪)، وفي المناطق الريفية (82.6٪)، وفي اليدين (42.3٪) والقدمين (41.2٪). وشملت التفاعلات الموضعية الألم والاحمرار الفوريين (52٪)، والألم الشديد (8.7٪)، والألم الحارق الموضعي (17.4٪)، والتورُّم (4.3٪) في موضع التَّأثُّر بزُعاف الحشرات، وعدم حدوث أي تفاعل (17.6٪). وكانت معلومات العاملين الصحيين والأطباء عن لسعات العقارب ضعيفة بوجه عام. وكان العاملون الصحيون أكثر دراية إلى حد كبير ببيولوجيا العقارب الخطرة (القيمة الاحتمالية = 0.003)، في حين كان الأطباء أكثر دراية بمركبات سم العقرب الأسود (القيمة الاحتمالية = 0.01).

الاستنتاجات: ينبغي بذل جهود لضمان وضع تصاميم سكنية مأمونة وتوفير التعليم الشامل للعاملين الصحيين وأفراد المجتمع المحلي للمساعدة في الحد من حالات لسع العقارب وتعزيز علاج الحالات التي تحدث في المقاطعة.

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Prevalence of dental caries among schoolchildren in Saudi Arabia

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Abstract

Background: Dental caries is common among children, however, there is limited data on its prevalence among schoolchildren in the rural areas of Saudi Arabia.

Aim: To determine the prevalence of dental caries and its association with selected demographic factors among schoolchildren in rural areas of Riyadh Province, Saudi Arabia.

Methods: We extracted dental clinic data of 2864 schoolchildren aged 6–17 years for January 2021 to June 2022, from the electronic medical records of selected rural public hospitals and primary health centres in Riyadh Province, Saudi Arabia. We analysed the data using SPSS version 26 and used chi-square tests and logistic regression to analyse the associations with sex, age and schooling level. $P < 0.05$ was considered statistically significant.

Results: Of all the 2864 schoolchildren, 13.9% (95% confidence interval: 12.6–15.1) had dental caries. Prevalence was higher among males (22.4%) than females (10.3%) ($P < 0.001$) and was more common among high school students (20.0%) than among elementary (12.9%) and intermediate (10.3%) school students.

Conclusion: Our findings have important implications for oral health policy, prevention and research in Saudi Arabia. The high prevalence indicates a high burden of dental caries among rural populations in the country and the need for stronger and more extensive preventive interventions, including school-based education and early screening for children.

Keywords: dental caries, oral health, schoolchildren, rural area, Saudi Arabia

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Introduction

Dental caries is a common oral health condition among children. It is a chronic disease that leads to progressive destruction of tooth structure (*1*). Dental caries results from the metabolic activity of cariogenic bacteria that produce acids, leading to demineralisation of tooth enamel (*2,6*). It is a leading cause of oral morbidity and tooth loss (*3*). Dental caries affects individuals across the life course (*4,5*). Caries development reflects an imbalance between oral bacteria and tooth mineralisation processes. If untreated, dental caries may progress to pulpal and periapical infections and serious complications.

Dental caries is influenced by several factors, including biological, behavioural and socioeconomic determinants. Key risk factors include poor oral hygiene, inadequate fluoride exposure, increased levels of cariogenic bacteria, and low socioeconomic status (*7*). Dietary practices, particularly the frequency of sugar intake, play an important role in caries development. High consumption of sugary foods and beverages and sugar-containing oral medications increases the risk of dental caries (*8,9*).

Oral hygiene and nutritional habits are among the most frequently reported risk factors for dental caries in children, alongside maternal and bacterial factors (*10*). Untreated dental caries may adversely affect general health, learning, and growth (*11*). Schoolchildren are generally defined as children aged 6–17 years enrolled in primary, intermediate and secondary education (*12*). Dental caries is more prevalent among children with a family history of the condition (*13*).

Dental caries is not self-limiting but may be prevented or reversed in its early stages. Preventive interventions are therefore central to oral health promotion (*14,15*). Globally, dental caries remains a major public health concern (*16*). Untreated dental caries affects more than 2 billion people worldwide, making it the most common health condition. Approximately 514 million children have untreated caries in deciduous teeth (*17*). Dental caries continues to affect the well-being of individuals and communities and has a substantial impact on quality of life, including reduced oral function and loss of school or work days (*17,20,21*).

Saudi Arabia has a high prevalence of dental caries, estimated at 76% among elementary schoolchildren (*18*). High prevalence has been reported among adults and older populations, although most published studies focus on the prevalence of dental caries among preschool and elementary schoolchildren (*16,19*). In Saudi Arabia, studies have examined the prevalence and severity of dental

caries among children across different administrative regions (*16*). However, evidence-based policies addressing dental caries among school-aged children, particularly in rural areas, remain limited.

Therefore, this study aimed to determine the prevalence of dental caries among schoolchildren in rural areas of Saudi Arabia and examine its association with demographic factors.

Methods

Study design

This study was conducted in rural areas of the Riyadh Province in Saudi Arabia. A retrospective cross-sectional design was used, with data extracted from dental clinic records in public hospitals and primary health care centres between January 2021 and June 2022. The study included all available records of school-aged children attending public dental clinics in hospitals and primary health care centres during the study period, all of whom attended schools in the same rural areas. A convenience sampling approach was used. Based on the Cochran formula, the minimum required sample size was 385. The final sample included 2864 participants.

Data collection and variables

Data were extracted from electronic medical record systems used in participating hospitals and primary health care centres. The research team coordinated with health information management departments to facilitate data access. A standardised data collection form was developed based on the variables of interest.

Dental caries diagnosis was based on WHO diagnostic criteria, which are routinely used by dental professionals at the participating facilities. Trained data abstractors reviewed records to ensure completeness and accuracy. Records were included if they contained a confirmed diagnosis of dental caries and relevant demographic information.

Calibration sessions were conducted for data abstractors to ensure consistent application of WHO diagnostic criteria for dental caries, which are routinely used by dental professionals across the participating institutions (*22*). To minimise variability, only records with complete documentation and diagnoses made by licensed dentists were included. Ambiguous or incomplete records were excluded.

Data were used to assess the prevalence of dental caries and its association with factors, such as age, sex and school level.

Inclusion and exclusion criteria

The inclusion criteria were children aged 6–17 years, enrolled in primary, intermediate or secondary schools, availability of complete dental records within the study period, and residence in rural areas of Saudi Arabia. The exclusion criteria were children younger than 6 years or older than 17 years at the time of data collection, incomplete or missing dental records, and residence outside rural areas.

Statistical analysis

The data were analysed using SPSS version 26. Categorical variables were summarised using frequencies and percentages. Dental caries was the dependent variable. The independent variables included sex, age, and school level (elementary school: 6–11 years, intermediate: 12–14 years, high school: 15–17 years).

Associations between independent variables and dental caries were assessed using the chi-square test. A value of $P < 0.05$ was considered statistically significant. Binary and multivariable logistic regression analyses were conducted to estimate adjusted odds ratios for associations between independent variables and dental caries.

Ethics considerations

Ethics approval was obtained from the Institutional Review Board at King Abdullah International Medical Research Center. The approval number was SP22R/048/04. The study was conducted in accordance with applicable ethical standards and regulations. All data were anonymised before analysis, and no personally identifiable information was accessed or recorded.

Results

Table 1 presents the baseline characteristics of the study participants (2864 schoolchildren), 70.7% of whom were female. More than half of the schoolchildren were enrolled in elementary school (51.1%), followed by intermediate (26.0%) and high school (22.8%). Age distribution was relatively even across the 6–17-year age groups.

Table 2 shows the prevalence of dental caries among schoolchildren by sex, school level and age. The overall prevalence of dental caries was 13.9% (95% CI: 12.6–15.1). Prevalence was higher among males than females (22.4% versus 10.3%; $P < 0.001$). Schoolchildren enrolled in high school had a higher prevalence of dental caries than those in elementary and intermediate school (20.0% versus 12.9% and 10.3%, respectively; $P < 0.001$). The prevalence of dental caries was higher in older age groups ($P < 0.001$).

Table 3 shows the association between dental caries and baseline characteristics of schoolchildren. The male study population had higher odds of dental caries than female schoolchildren (odds ratio [OR] = 2.50; 95% CI: 2.02–3.11; $P < 0.001$). Schoolchildren enrolled in high school had higher odds of dental caries than those in elementary school (OR = 1.69; 95% CI; 1.32–2.16; $P < 0.001$), whereas no statistically significant difference was observed between intermediate and elementary schoolchildren. Compared with 17-year-old schoolchildren, lower odds of dental caries were observed among several younger age groups, particularly those aged 10–14 years.

Table 1 **Sociodemographic characteristics of study participants**

Variable	Category	Total N (%)	Schoolchildren with caries N (%)	Schoolchildren without caries N (%)
Gender	Male	840 (29.3)	188 (47.4)	652 (26.4)
	Female	2024 (70.7)	209 (52.6)	1815 (73.6)
Schooling level	Elementary	1464 (51.1)	189 (47.6)	1275 (51.7)
	Intermediate	746 (26.0)	77 (19.4)	669 (27.1)
	High school	654 (22.8)	131 (33.0)	523 (21.2)
Age (years)	6	213 (7.4)	38 (9.6)	175 (7.1)
	7	217 (7.6)	26 (6.5)	191 (7.7)
	8	264 (9.2)	36 (9.1)	228 (9.2)
	9	210 (7.3)	33 (8.3)	177 (7.2)
	10	251 (8.8)	25 (6.3)	226 (9.2)
	11	309 (10.8)	30 (7.6)	279 (11.3)
	12	229 (8.0)	24 (6.0)	205 (8.3)
	13	253 (8.8)	23 (5.8)	230 (9.3)
	14	264 (9.2)	30 (7.6)	234 (9.5)
	15	172 (6.0)	38 (9.6)	134 (5.4)
	16	215 (7.5)	38 (9.6)	177 (7.2)
	17	267 (9.3)	56 (14.1)	211 (8.6)

Table 2 **Prevalence of dental caries among schoolchildren by sex, schooling level and age**

Variable	Category	Prevalence (%)	95% CI		*P*
			Lower	Upper	
Gender	Male	22.4	19.6	25.2	< 0.001
	Female	10.3	9.0	11.7	
Schooling level	Elementary	12.9	11.2	14.6	< 0.001
	Intermediate	10.3	8.1	12.5	
	High school	20.0	17.0	23.1	
Age (years)	6	17.8	12.3	22.4	< 0.001
	7	12.0	7.3	15.9	
	8	13.6	9.1	17.3	
	9	15.7	10.2	19.9	
	10	10.0	5.9	13.2	
	11	9.7	6.1	12.6	
	12	10.5	6.1	13.8	
	13	9.1	5.2	12.1	
	14	11.4	7.0	14.5	
	15	22.1	14.3	26.3	
	16	17.7	11.5	21.4	
	17	21.0	14.9	24.5	
Total		**13.9**	**12.6**	**15.1**	

Table 3 **Association between dental caries and sociodemographic characteristics of schoolchildren**

Variable	Category	Caries		No caries		OR (95% CI)	*P*
		N	%	N	%		
Sex	Male	188	22.4	652	77.6	2.50 (2.02–3.11)	< 0.001
	Female	209	10.3	1815	89.7	1	
Schooling level	High school	189	20.0	1275	80.0	1.69 (1.32–2.16)	< 0.001
	Intermediate	77	10.3	669	89.7	0.78 (0.59–1.03)	0.078
	Elementary	131	12.9	523	87.1	1	
Age	6	38	17.8	175	82.2	0.82 (0.52–1.29)	0.391
	7	26	12.0	191	88.0	0.51 (0.31–0.85)	0.010
	8	36	13.6	228	86.4	0.60 (0.38–0.94)	0.026
	9	33	15.7	177	84.3	0.70 (0.44–1.13)	0.144
	10	25	10.0	226	90.0	0.42 (0.25–0.69)	0.001
	11	30	9.7	279	90.3	0.41 (0.25–0.65)	< 0.001
	12	24	10.5	205	89.5	0.44 (0.26–0.74)	0.002
	13	23	9.1	230	90.9	0.38 (0.22–0.63)	< 0.001
	14	30	11.4	234	88.6	0.48 (0.30–0.78)	0.003
	15	38	22.1	134	77.9	1.07 (0.67–1.70)	0.780
	16	38	17.7	177	82.3	0.81 (0.51–1.28)	0.364
	17	56	21.0	211	79.0	1	

Discussion

This study found that 13.9% of schoolchildren in rural areas of Saudi Arabia had dental caries. Although lower than estimates reported in national and regional studies, this prevalence has important implications for oral health policy and prevention strategies targeting rural populations. A meta-analysis of studies conducted across Saudi Arabia reported a pooled dental caries prevalence of 80% (*19*). Differences in study design, data sources and population coverage are likely to contribute to this variation. Unlike examination-based studies, clinic-based records primarily capture diagnosed or symptomatic cases. This study therefore provides a recent, region-specific estimate based on routine care data from rural settings.

Our findings also indicate that dental caries prevalence was higher among older schoolchildren than among younger age groups, extending patterns reported in previous studies from Saudi Arabia (*23*). Comparable burdens have been reported in other settings. For example, in the United Arab Emirates, a cohort study among 11–17-year-old students reported dental caries among 75% of participants (*24*). In China, a cross-sectional study among students aged 12–14 years reported a dental caries prevalence of 44%, with higher prevalence among females (*25*). Together, these findings underscore the substantial global burden of dental caries among schoolchildren.

Dental caries remains a major public health condition. Changes in dietary patterns associated with modernisation have increased access to sugar-rich products. Tooth decay, particularly in children, is accelerated by frequent consumption of sweetened foods and beverages. Variations in prevalence across population groups reflect differences in lifestyle, dietary habits and broader social determinants of health (*26*). Dental caries is a multifactorial condition influenced by biological, behavioural and social factors (*33*).

Our findings show that males were approximately 2.5 times more likely to have dental caries than females. Sex differences in prevalence of dental caries have been reported previously, although findings are not consistent across settings. The higher prevalence among males observed in this study is consistent with findings reported in a study conducted in Costa Rica (*27*). In contrast, higher prevalence among females has been reported in other studies (*28*).

Proposed explanations for sex differences include biological and behavioural factors, such as differential exposure to cariogenic oral environments (*29*). Similar patterns have been observed in other settings (*30*). Behavioural factors may also contribute, as females generally demonstrate higher oral health literacy and more favourable oral hygiene practices (*31,32*). In this study, the higher prevalence observed among male schoolchildren may reflect differences in oral hygiene behaviours, dietary practices and patterns of dental care utilisation.

The prevalence of dental caries was highest among adolescents aged 15–17 years. These findings are

consistent with evidence from a Swedish prospective cohort study, which reported higher incidence and faster progression of carious lesions during adolescence than in early adulthood (*34*). Age-related changes in diet and health behaviours may contribute to this pattern. Previous studies have reported reduced consumption of fruits, vegetables and milk and increased intake of refined carbohydrates with increasing age (*24*). Commercial determinants of health may further influence oral health outcomes, including the marketing of sugar-sweetened products targeting children and adolescents.

Taken together, these factors may contribute to the higher prevalence of dental caries observed among schoolchildren. Strengthening preventive interventions, including school-based oral health education and early screening delivered through coordination between education and health sectors, may help reduce the burden of dental caries in rural populations.

These findings could inform future research on dental caries across different demographic groups in Saudi Arabia.

Study limitations

Several factors may affect the generalisability of the study findings. First, data were collected only from rural areas in Riyadh Province and not from all provinces in Saudi Arabia. As a result, the prevalence estimates and demographic associations may reflect the oral health situation in rural Riyadh rather than the national context.

Second, the study focused on the prevalence of dental caries and its association with demographic characteristics among schoolchildren. Key determinants of oral health, including exposure to fluoride, access to oral health care, dietary habits, and parental perceptions of dental care services, were not examined. The exclusion of these factors may limit interpretation of the observed associations.

Third, reliance on retrospective data from dental clinics may have introduced selection bias. Children attending dental clinics may not be representative of all schoolchildren and may differ in symptom severity, health-seeking behaviour or socioeconomic characteristics.

Conclusion

Dental caries remains prevalent among schoolchildren in rural areas of Saudi Arabia, with higher prevalence observed among males and older schoolchildren. These findings indicate a persistent burden of dental caries in rural populations and support the need for strengthened preventive oral health interventions, including school-based education and early screening delivered through coordination between education and health sectors. Further research is needed to assess the prevalence of dental caries among schoolchildren across all provinces in Saudi Arabia and to examine key determinants of oral health, such as exposure to fluoride, access to oral health care, dietary habits, and parental perception of dental care services and socioeconomic factors.

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Competing interests: None declared.

Prévalence des caries dentaires chez les enfants d'âge scolaire en Arabie saoudite

Résumé

Contexte : Les caries dentaires sont courantes chez les enfants, mais les données sur leur prévalence parmi les enfants d'âge scolaire dans les zones rurales d'Arabie saoudite sont limitées.

Objectif : Déterminer la prévalence des caries dentaires et leur association avec certains facteurs démographiques chez les enfants scolarisés dans les zones rurales de la province de Riyad (Arabie saoudite).

Méthodes : Nous avons extrait les données cliniques dentaires de 2864 enfants âgés de 6 à 17 ans entre janvier 2021 et juin 2022 dans les dossiers médicaux électroniques de certains hôpitaux publics ruraux et centres de santé primaires de la province de Riyad. Nous avons analysé les données à l'aide du logiciel SPSS version 26 et avons utilisé des tests du khi carré et une régression logistique pour analyser les associations avec le sexe, l'âge et le niveau de scolarité. Une valeur *p* inférieure ou égale à 0,05 était considérée comme statistiquement significative.

Résultats : Sur l'ensemble des 2864 enfants scolarisés, 13,9 % (intervalle de confiance à 95 % : 12,6-15,1) avaient des caries dentaires. La prévalence était plus élevée chez les garçons (22,4 %) que chez les filles (10,3 %) [$p < 0,001$] et était plus fréquente chez les élèves du lycée (20,0 %) que chez ceux des niveaux primaire (12,9 %) et intermédiaire (10,3 %).

Conclusion : Nos conclusions ont des implications importantes pour les politiques, la prévention et la recherche en santé bucco-dentaire en Arabie saoudite. La forte prévalence indique un fardeau élevé des caries dentaires dans les populations rurales du pays et la nécessité de mettre en œuvre des interventions de prévention renforcées et plus étendues, notamment des programmes d'éducation en milieu scolaire et de dépistage précoce des enfants.

انتشار تسوس الأسنان بين أطفال المدارس في المملكة العربية السعودية

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الخلاصة

الخلفية: يشيع تسوس الأسنان بين الأطفال، لكن هناك بيانات محدودة عن انتشاره بين أطفال المدارس في المناطق الريفية بالمملكة العربية السعودية.

الأهداف: هدفت هذه الدراسة الى تحديد مدى انتشار تسوس الأسنان وارتباطه بعوامل سكانية مختارة بين أطفال المدارس في المناطق الريفية من محافظة الرياض بالمملكة العربية السعودية.

طرق البحث: استخلصنا بيانات 2864 من أطفال المدارس ممن تتراوح أعمارهم بين 6 و17 عامًا من عيادات طب الأسنان في الفترة من يناير/ كانون الثاني 2021 إلى يونيو/ حزيران 2022، مأخوذة من السجلات الطبية الإلكترونية لمجموعة مختارة من المستشفيات العامة ومراكز الصحة الأولية الريفية في محافظة الرياض، المملكة العربية السعودية. وقد حللنا البيانات بالإصدار السادس والعشرين من برنامج SPSS، واستخدمنا اختبار مربع كاي والانحدار اللوجستي لتحليل الارتباط بين نوع الجنس والسن ومستوى التعليم. وقد عُدت قيمة الاحتمال < 0.05 ذات دلالة إحصائية.

النتائج: من بين جميع أطفال المدارس البالغ عددهم 2864، كان لدى 13.9% (فاصل ثقة 95% : 12.6–15.1) تسوس أسنان. وكان معدل الانتشار أعلى بين الذكور (22.4%) منه بين الإناث (10.3%) (قيمة الاحتمال < 0.001)، وكان أكثر شيوعًا بين طلاب المدارس الثانوية (20.0%) منه بين طلاب المدارس الابتدائية (12.9%) والمتوسطة (10.3%).

الاستنتاجات: للنتائج التي توصلنا إليها أثر مهم على نطاق سياسات صحة الفم والوقاية والبحوث في المملكة العربية السعودية. إذ يشير ارتفاع معدل الانتشار إلى زيادة العبء الناجم عن تسوس الأسنان بين سكان المناطق الريفية في البلاد، وإلى الحاجة إلى تنفيذ تدخلات وقائية أقوى وأوسع نطاقًا، بما في ذلك التثقيف المدرسي والفحص المبكر للأطفال.

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Smartphone addiction and motor-cognitive performance among adolescents in Tunisia

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Abstract

Background: Smartphone addiction among adolescents has emerged as a significant public health concern, with potential consequences for motor and cognitive development.

Aim: To examine the associations between smartphone addiction and motor-cognitive performance among adolescents in Tunisia, using validated digital tools.

Methods: Between December 2023 and March 2024, we examined 270 students in 3 public middle schools in urban Tunisia. We assessed smartphone addiction using the validated Arabic version of the smartphone addiction scale short version; motor function using the Takei Grip-D dynamometer, MySprint app and the Flamingo balance test; and cognitive function using the Vienna test system. Group comparisons were conducted using nonparametric tests; associations were examined using Spearman's correlations; and predictive effects were assessed using separate linear regression analyses adjusted for age, sex and body mass index ($P > 0.05$).

Results: Adolescents classified as addicted ($n = 120$) demonstrated significantly higher daily smartphone use (454.8 ± 104.8 vs 172.1 ± 108.6 minutes, $P < 0.001$), slower sprint time (6.09 ± 0.70 vs 5.63 ± 0.54 seconds, $P < 0.001$), reduced grip strength (22.3 ± 3.5 vs 25.7 ± 4.1 kg, $P < 0.001$), and lower cognitive accuracy despite faster reaction time ($P < 0.01$). Addiction severity independently predicted slower sprinting ($\beta = 0.32$) and poorer postural stability ($\beta = 0.35$, both $P < 0.001$).

Conclusion: Smartphone addiction is linked to significant motor and cognitive impairment among adolescents in Tunisian schools, with addiction severity predicting slower sprinting and poorer postural stability. Early school-based interventions to promote healthy smartphone habits and physical activity may help prevent long-term motor-cognitive decline among adolescents in Tunisia.

Keywords: adolescent health, smartphone addiction, motor skills, cognitive function, Tunisia

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Introduction

Smartphone use is deeply embedded in adolescents' daily lives, supporting entertainment, socialization and academic tasks (*1*). However, excessive use has created public health concerns, particularly around smartphone addiction, a compulsive, uncontrolled pattern of use that leads to psychological, physical and functional impairments. Similar to other behavioural addictions, smartphone addiction involves withdrawal, tolerance and disruption to everyday functioning (*2,3*). Smartphone addiction is increasing rapidly among adolescents; particularly in urban areas with high digital access and limited supervision (*4*). This pattern is troubling given the strong associations between smartphone overuse and reduced physical activity, increased sedentary behaviour and elevated risk of obesity and metabolic syndrome (*5*). The American Academy of Pediatrics recommends limiting recreational screen time to 1 hour daily for children aged 2–5 years and 2 hours for those aged ≥ 6 years, emphasizing offline activities such as sleep and play (*6*). However, adolescents often exceed these limits. Beyond health and behavioural effects, smartphone addiction is also linked to emerging motor and cognitive deficits during adolescence, which is a key stage of neurological and sensorimotor maturation.

Smartphone addiction may impair motor function by decreasing overall physical activity, diminishing neuromuscular efficiency and compromising motor performance (*2*). Neuroimaging links these impairments to decreased cerebellar grey matter volume and reduced activity in sensorimotor regions. Excessive screen exposure is associated with declines of up to 14% in proprioceptive accuracy among adolescents with smartphone addiction (*7,8*). Excessive smartphone use impairs dynamic balance by altering cervical posture, increasing neck pain and causing upper-body muscle fatigue, which disrupts proprioceptive input and postural reflexes, leading to gait and coordination issues (*9*).

Handgrip strength, a key indicator of motor development, may decrease with excessive smartphone use due to sedentary behaviour and reduced resistance activity. Although repetitive use can enhance endurance,

it may diminish maximal strength and increase the risk of overuse injuries such as tendonitis (*10*). Prolonged smartphone use is associated with reduced hand- and pinch-grip strength, suggesting that it is a contributing factor to muscle weakness (*11*).

Smartphone addiction may impair locomotor performance, as shown by slower sprint speeds in adolescents with high night-time phone use (*12*). This decline is likely due to reduced anaerobic capacity and underuse of fast-twitch muscle fibres linked to sedentary behaviour (*13*). However, some studies support these effects, while others report minimal impact, likely due to differences in screen activity type, such as active gaming compared to passive browsing, as well as regional usage patterns (*14*).

Smartphone addiction is associated with alterations in executive functioning, particularly in tasks demanding attention, response inhibition and decision-making (*15*). This behavioural profile reflects impulsivity and weakened top-down control, as neuroimaging links it to heightened striatal activity and reduced dorsolateral prefrontal cortex activation, which are key for error monitoring and inhibition (*16*). Emerging evidence indicates that habitual smartphone use induces neural adaptations, with visuomotor tasks such as scrolling or tapping, altering electroencephalography coherence patterns, particularly in the gamma band, reflecting adaptation to delayed temporal feedback (*17*).

During early adaptation, smartphone-related tasks engage frontal executive regions to inhibit dominant motor responses. Over time, decreased prefrontal activation suggests neural efficiency gains (*18*), yet this may come at the cost of reduced cognitive flexibility and impaired error monitoring. This pattern raises concerns about cognitive trade-offs, as frequent smartphone use may boost reaction speed but impair key executive functions including attention, working memory and emotional control (*19*). Beyond that, dual-task interference, common during multitasking on digital platforms, places a heavy load on executive control networks and can degrade performance accuracy (*20*).

Despite these challenges, adolescents may exhibit some degree of neuroplastic compensation. Short-term deprivation from smartphones can partially reverse attention and impulse control deficits, indicating an adaptive capacity of the adolescent brain (*7,19*). However, prolonged exposure to multitasking environments may disrupt prefrontal development, especially given the extended maturation window of this region (*21*). During adolescence, a phase of high brain plasticity, excessive smartphone use may foster sensorimotor gains but often impairs cognitive control due to overstimulation and poor regulation.

Despite increasing interest, most research isolates variables like grip strength or screen time, rarely examining how motor and cognitive domains interact in addiction contexts (*22*). The directionality of these links remains uncertain, whether addiction drives decline, or existing deficits increase vulnerability (*23*). Cultural patterns, such as gaming in East Asia versus social media in North Africa, further complicate generalizability (*24*). Previous research has primarily depended on self-reported screen time, which may be biased by recall inaccuracies or social desirability. Few studies have integrated objective assessments of motor-cognitive function, particularly in low- and middle-income countries. In North Africa, such cross-sectional investigations remain rare, despite increasing smartphone penetration and limited adolescent access to physical activity resources (*25*). This indicates the urgent need for context-specific, performance-based data to support culturally tailored intervention strategies.

This study examined the association between smartphone addiction and motor–cognitive performance in Tunisian adolescents. It incorporated objective assessments, including sprinting, balance, grip strength and cognitive accuracy, to explore the extent to which smartphone addiction may compromise physical and mental functioning. We hypothesized that smartphone addiction would be associated with slower and less accurate reaction times, as well as reduced physical fitness, characterized by impaired balance, decreased grip strength and slower sprint times. We expected an inverse association between screen time and motor proficiency and cognitive accuracy, with prolonged exposure exacerbating sensorimotor deficits through neurobehavioural mechanisms.

Methods

Study design

This cross-sectional study aimed to examine the relationship between smartphone addiction and motor–cognitive performance in adolescents. Validated, culturally adapted psychometric tools were used alongside objective physical fitness assessments and device-based smartphone usage tracking to ensure methodological rigour.

This study was conducted between December 2023 and March 2024 in 3 Tunisian public middle schools during routine health screenings. A total of 960 adolescents (aged 14–16 years) were initially recruited. Smartphone addiction was assessed using the validated Arabic Smartphone Addiction Scale–Short Version (SAS-SV), with sex-specific cutoffs (≥ 31 for males, ≥ 33 for females) (*26*). Exclusion criteria included: absence of personal smartphone use; low physical activity (International Physical Activity Questionnaire - Short Form < 25th percentile); > 1 year of organized sports, tobacco use, sensory or motor impairments; and irregular sleep (< 7 or > 9 hours/night). After applying these criteria, 350 participants remained (145 addicted, 205 nonaddicted). Following additional exclusions due to attrition (n = 23) and outlier body mass index (BMI) values (< 16.3 or > 23.5 kg/m2 according to WHO standards; n = 57), the final sample comprised 270 adolescents. BMI Z-scores were calculated using WHO AnthroPlus, with no significant

group differences in age, height, weight or BMI ($P > 0.05$). See Figure 1 for recruitment flow.

Participants were selected using a convenience sampling approach from co-operating secondary schools. Data collection was conducted over 4 weeks in a controlled school laboratory between 08:00 and 11:00 hours to minimize circadian variability (27). Anthropometric data (height and weight) were recorded using a calibrated stadiometer and digital scale. Motor performance was assessed using standardized tests: Flamingo Balance Test for static balance; handgrip strength with a Takei Grip-D dynamometer; and sprint speed via a 30-m sprint using the MySprint app. Each participant performed 2 trials per motor test, with a 3-minute rest between attempts; the best result was retained for analysis (28).

Cognitive performance was measured using the Vienna Test System, including both simple and choice reaction time tasks administered via computer. Participants were instructed to abstain from caffeine and vigorous activity for 12 hours prior to testing (29). All assessments were conducted by trained, blinded examiners to ensure unbiased data collection.

Ethics considerations

Ethics approval was obtained from the Regional Ethics Committee (Anonymized Institution; Ref. No. 0554/2023). Written informed consent was secured from school

Figure 1 Flowchart experimental design and participant progression

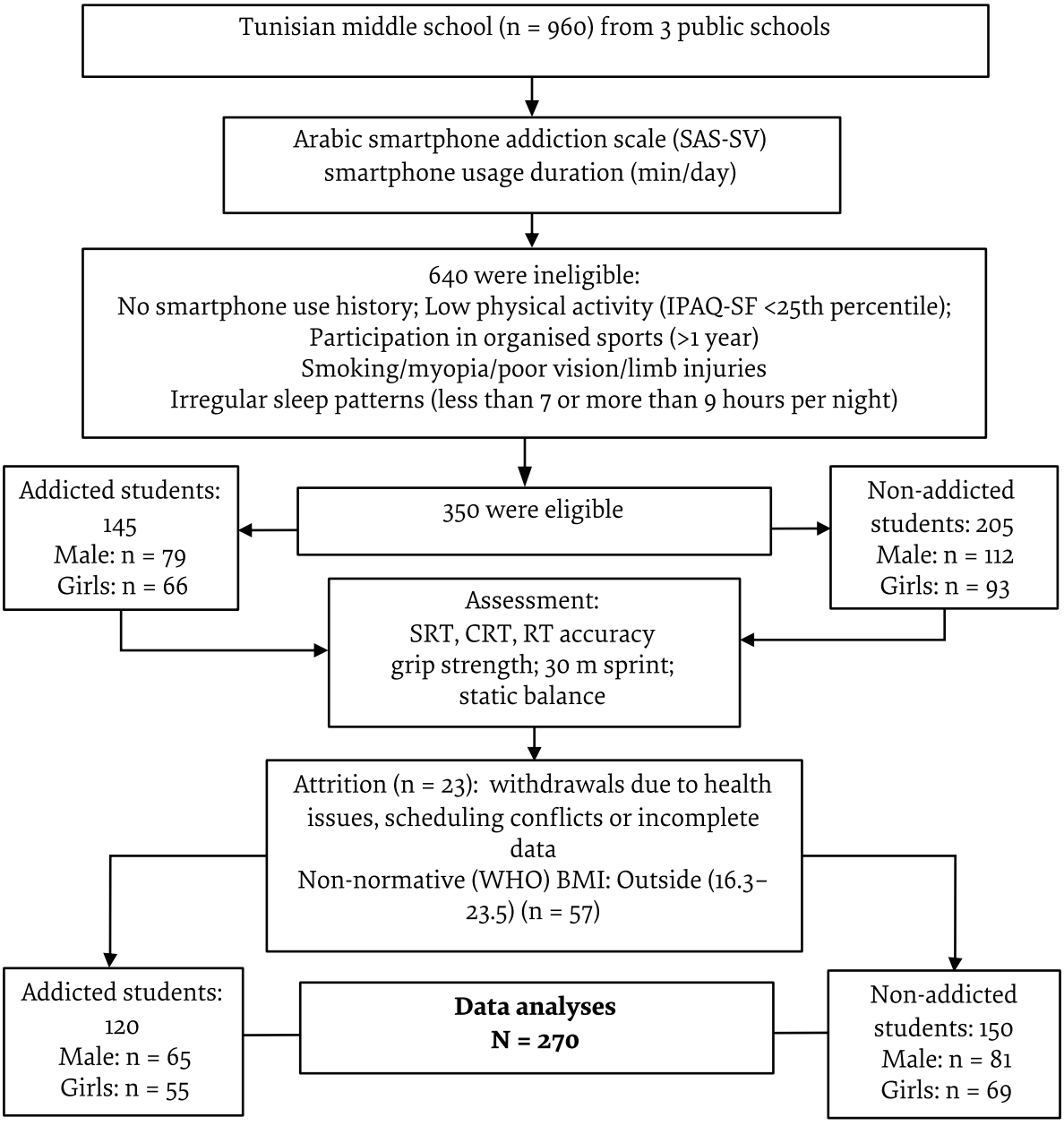


Table 1 Comparison of smartphone use and motor and cognitive performance between addicted and non-addicted adolescents

Parameter	AS (*n* = 120)	NAS (*n* = 150)	U	ES (r) (95% CI)	*P*
Smartphone use					
SAS-SV score	46.25 ± 8.23	17.85 ± 9.74	1	0.86 (0.81–0.91)	<0.001
SUD (min/d)	454.8 ± 104.8	172.1 ± 108.6	443.5	0.82 (0.76–0.88)	<0.001
Motor performance					
FBT (falls/min)	10.92 ± 7.51	10.03 ± 6.52	8670.5	0.03 (-0.04, 0.10)	0.603
DH grip (kg)	28.71 ± 6.77	28.81 ± 8.13	8928.5	0.01 (-0.06, 0.08)	0.911
NDH grip (kg)	24.83 ± 7.15	24.85 ± 8.27	8873	0.01 (-0.06, 0.08)	0.842
30 m Sprint (s)	6.09 ± 0.70	5.63 ± 0.54	5553	0.33 (0.25–0.40)	<0.001
Cognitive performance					
SRT (ms)	309.6 ± 63.0	349.1 ± 87.4	6694.5	0.22 (0.15–0.29)	<0.001
CRT (ms)	469.6 ± 87.5	526.3 ± 109.0	6015	0.28 (0.21–0.35)	<0.001
Accuracy (errors)	3.62 ± 3.53	2.52 ± 2.77	7372	0.16 (0.09–0.23)	0.010

AS = addicted students; CI = confidence interval; CRT = choice reaction time; DH/NDH = dominant/non-dominant hand grip; FBT = Flamingo Balance Test; NAS = nonaddicted students; SAS-SV = Smartphone Addiction Scale–Short Version; SRT = simple reaction time; SUD = smartphone usage duration.

authorities, parents and participants, in line with the ethics standards of the 2013 Declaration of Helsinki.

Measurements

Smartphone addiction

Smartphone addiction was measured by the validated Arabic SAS-SV, comprising 10 Likert-scale items (1, strongly disagree to 6, strongly agree). Cutoffs (males: ≥ 31; females: ≥33) categorized participants as addicted to smartphone (AS) or nonaddicted to smartphone (NAS) (*26*).

Smartphone usage duration

Smartphone usage duration was assessed using self-reports verified by iOS Screen Time and Android Digital Wellbeing, enhancing accuracy despite self-report limitations (*30*).

Simple reaction time

Participants were instructed to press a designated keyboard key as quickly as possible upon the appearance of a visual stimulus, measured using OpenSesame software (v3.3.12) (*31*).

Choice reaction time

Participants responded to coloured visual stimuli by pressing key "A" for green and key "P" for pink. Accuracy and reaction time were recorded, with higher error rates reflecting reduced cognitive control (*31*).

Static balance

The Flamingo Balance Test required standing on a 50 × 3 × 4 cm beam for ≤ 60 seconds, with shoes removed and arms extended (*32*).

Grip strength

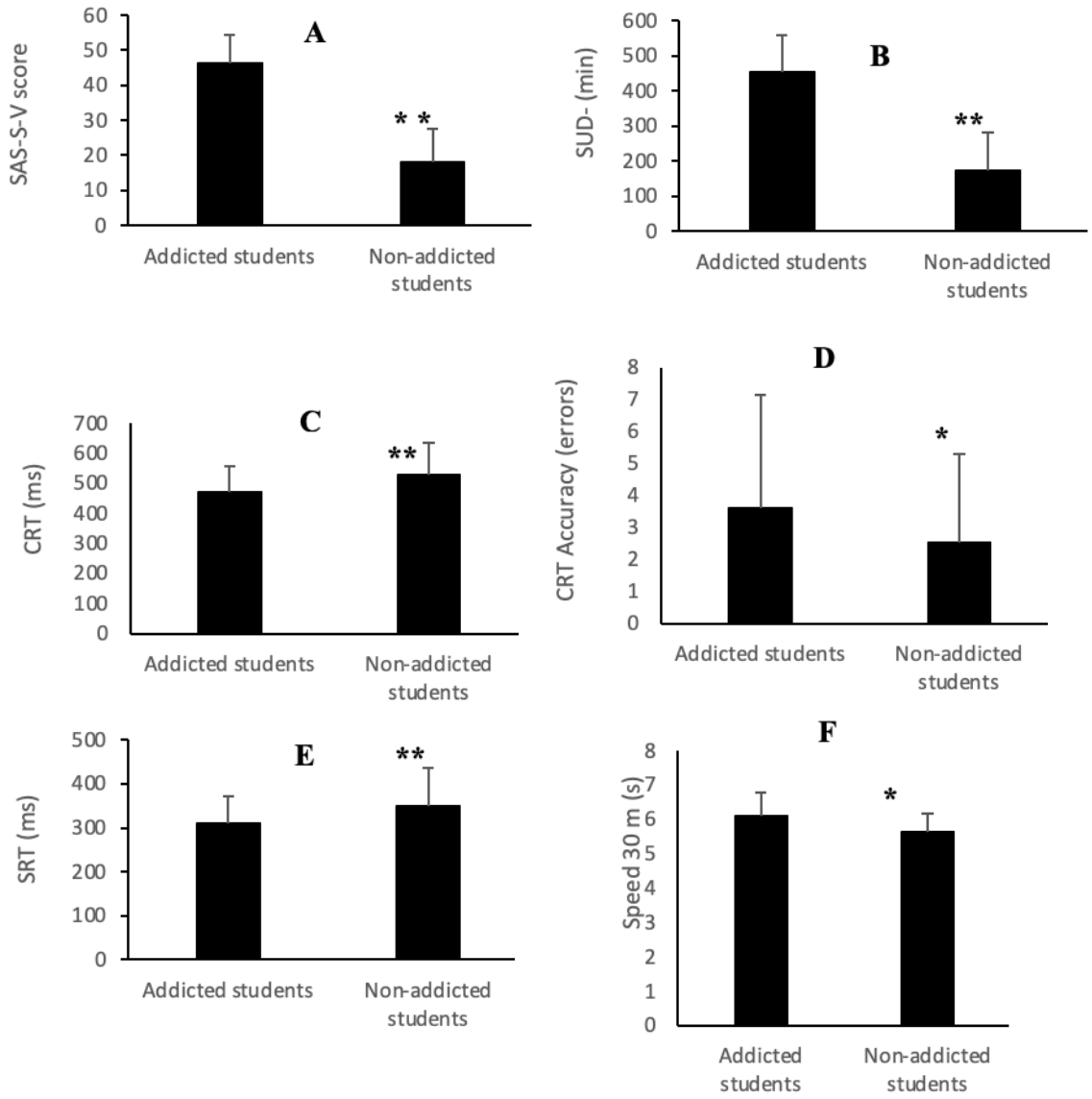
A Takei Grip-D dynamometer (5–100 kg) measured dominant and nondominant hand strength. Handles were adjusted for comfort, with 90° elbow flexion during testing (*33*).

Table 2 Spearman correlations between smartphone use, cognitive and motor performance

Variable	SAS-SV score [ρ (95% CI)]	*P*	SUD (min/d) [ρ (95% CI)]	*P*
Cognitive performance				
SRT (ms)	-0.12 (-0.22, -0.02)	0.044	-0.11 (-0.21, 0.01)	0.072
CRT (ms)	-0.18 (-0.28, -0.08)	0.003	-0.19 (-0.29, -0.09)	0.002
Accuracy (errors)	0.33 (0.23–0.43)	<0.001	0.34 (0.24–0.44)	<0.001
Motor performance				
FBT (falls/min)	0.38 (0.28–0.47)	<0.001	0.45 (0.36–0.53)	<0.001
DH grip (kg)	-0.15 (-0.25, -0.05)	0.013	-0.19 (-0.29, -0.09)	0.002
NDH grip (kg)	-0.15 (-0.25, -0.05)	0.015	-0.18 (-0.28, -0.08)	0.003
30m sprint (s)	0.37 (0.27–0.47)	<0.001	0.38 (0.28–0.48)	<0.001

Nonsignificant correlations (e.g., SRT vs SUD) are retained for transparency. AS = addicted students; CI = confidence interval; CRT = choice reaction time; NAS = nonaddicted students; DH/NDH = dominant/non-dominant hand grip; FBT = Flamingo Balance Test; SAS-SV = Smartphone Addiction Scale–Short Version; SRT = simple reaction time; SUD = smartphone usage duration.

Figure 2 Comparisons between addicted students and non-addicted students groups for smartphone addiction score (A: SAS S-V); smartphone usage duration (B: SUD); choice reaction time (C: CRT) reaction time accuracy (D: RT accuracy); simple reaction time (E: SRT); and (F: 30 m speed)



**P < 0.05, **P < 0.001: significantly different compared with AS. AS = addicted students; CRT = choice reaction time; NAS = nonaddicted students; SAS-SV = Smartphone Addiction Scale–Short Version; SRT = simple reaction time; SUD = smartphone usage duration*

The 30-m sprint

Sprint times were recorded using the MySprint app on an iPad positioned at a height of 1.5 and 10 m laterally, following the protocol validated in school-based adolescent populations (34).

Statistical analysis

Data were analysed using SPSS, version 26.0. Normality was tested with the Shapiro–Wilk test, necessitating nonparametric analyses due to non-normal distributions (W = 0.92–0.97, $P < 0.05$). The Mann–Whitney U test was used for comparison between the AS and NAS groups, with effect sizes calculated via Rosenthal's r. Bootstrapped 95% confidence intervals were generated using 1000 resamples. Correlations were examined using Spearman's rank correlation coefficient. To address potential multicollinearity (VIF = 8.2), separate linear regression models were fitted for SAS-SV scores and smartphone usage duration as predictors. Models controlled for age, sex and BMI to reduce confounding effects. Model assumptions, including residual normality and homoscedasticity, were verified. A priori power analysis via G*Power 3.1 determined that a minimum of 230 participants was necessary to achieve $\alpha = 0.05$ and 80% power, confirming the adequacy of the sample size for statistical analyses (35).

Results

Group comparison

The addicted students group showed significantly higher SAS-SV scores (46.25 ± 8.23) and longer screen time

Table 3 Regression models predicting physical performance outcomes (adjusted for age, sex and body mass index)

Outcome variable	Predictor	β (95% CI)	P	R^2
Balance (FBT falls/min)	SAS-SV score	0.35 (0.27–0.43)	<0.001	0.15
Balance (FBT falls/min)	SUD (min/day)	0.33 (0.25–0.41)	<0.001	0.15
30m sprint (s)	SAS-SV score	0.32 (0.24–0.40)	<0.001	0.13
30m sprint (s)	SUD (min/day)	0.30 (0.22–0.38)	<0.001	0.11

Separate models were adjusted for age, sex, and body mass index. AS = addicted students; CI = confidence interval; CRT = choice reaction time; DH/NDH = dominant/non-dominant hand grip; FBT = Flamingo Balance Test; NAS = nonaddicted students; SAS-SV = Smartphone Addiction Scale–Short Version; SRT = simple reaction time; SUD = smartphone usage duration.

(454.8 ± 104.8 min/day) compared to the non-addicted students group (17.85 ± 9.74; 172.1 ± 108.6 min/day) (both $P < 0.001$), with large effect sizes (r = 0.86 and r = 0.82) (Table 1). Sprint performance was significantly slower in the addicted students group (6.09 ± 0.70 s vs 5.63 ± 0.54 s in non-addicted students group) ($P < 0.001$, r = 0.33), indicating reduced anaerobic motor performance. No significant group differences were found for balance or grip strength. In cognitive tests, the addicted students group responded faster (simple reaction time and choice reaction time; both $P < 0.01$) but committed significantly more errors (3.62 vs 2.52; $P < 0.01$), suggesting a speed–accuracy trade-off and impaired cognitive control.

Correlations between smartphone use and performance

Higher smartphone addiction scores (SAS-SV) and smartphone usage duration were moderately correlated with poorer balance (ρ = 0.38 and 0.45), slower sprinting (ρ = 0.37 and 0.38) and lower grip strength (ρ = -0.15 to -0.19; all $P < 0.05$), suggesting a negative impact on physical performance (Table 2). Cognitive measures also showed associations: smartphone addiction correlated negatively with choice reaction time (ρ = -0.18) and positively with error rates (ρ = 0.33–0.34), indicating reduced cognitive accuracy in more complex tasks.

Regression analyses

Adjusted linear regression models (controlling for age, sex and BMI) confirmed that SAS-SV and smartphone usage duration were significant predictors of sprint speed and balance scores (β = 0.30–0.35; R^2 = 0.11–0.15; all $P < 0.001$), reinforcing their contribution to physical performance deficits (Table 3). SAS-SV scores strongly predicted screen time (R^2 = 0.935; $P < 0.001$), supporting the convergent validity of the scale with objective usage data.

Visual comparisons

Graphic comparisons highlight that the addicted students group scored significantly higher for smartphone addiction (Figure 2A) and daily screen time (Figure 2B). They also demonstrated faster choice reaction time (Figure 2C) and simple reaction time (Figure 2E), but lower accuracy (Figure 2D), reinforcing the observed cognitive impulsivity. Sprint times were significantly slower in the addicted students group (Figure 2F), visually underscoring motor performance impairments.

Discussion

This study examined how smartphone addiction relates to motor and cognitive performance in Tunisian adolescents. Those identified as addicted reported longer screen time, slower sprint speeds and more cognitive errors. Static balance did not differ significantly between the addicted students and non-addicted students groups, although there was a moderate correlation between higher screen time and postural instability, suggesting an emerging effect. Regression analysis confirmed that smartphone addiction predicted reduced sprint performance and compromised balance, indicating the behavioural consequences of excessive digital use. Our findings align with recent research highlighting the negative impact of smartphone addiction on neuromuscular function, motor coordination and attention in adolescents (*2*).

The slower 30-m sprint time observed in the addicted students group than the non-addicted students group may reflect early neuromuscular decline associated with excessive screen use, particularly when it replaced vigorous physical activity. Prolonged sedentary behaviour contributes to the deconditioning of type IIb fast-twitch muscle fibres, essential for explosive, anaerobic efforts like sprinting (*13*). A recent Tunisian study supports this view, reporting that night-time smartphone use correlates with reduced sprint performance, potentially due to circadian rhythm disruption and impaired physiological recovery (*12*).

These motor deficits may also arise from neuro-structural alterations, including reduced cerebellar grey matter and diminished activation in parietal–occipital sensorimotor regions, which are crucial for visual–motor coordination and lower-limb control. Such changes likely compromise central motor planning, particularly in high-speed tasks like sprinting (*8*).

The Flamingo Balance Test results did not differ significantly between the addicted students and non-addicted students groups; however, adolescents with excessive smartphone use showed signs of emerging postural instability. This discrepancy may be due to the limited sensitivity of the test to detect subtle neuromotor deficits under static conditions. Neuroimaging evidence supports this, linking high screen exposure to reduced cerebellar grey matter and hypoactivation of parietal–occipital sensorimotor regions, which are essential for proprioceptive integration and spatial orientation. These areas are still developing during adolescence, and may be disrupted by chronic digital posture, such as “text neck”,

which compromises cervical proprioception. Ghosh found up to a 14% decline in joint position sense among adolescents with high screen time (*7*). This suggests that postural instability develops progressively (*32*), potentially preceding overt balance dysfunction. These impairments may remain subclinical on static tasks but manifest during dynamic or reactive postural demands.

Smartphone use is associated with altered gait, neck pain, and muscle fatigue (*9*), which may further erode balance. Regression analysis confirmed that smartphone addiction significantly predicted poorer balance, reinforcing concerns about subtle but progressing neuromotor effects in adolescent users. Narayan et al (*36*) demonstrated that interventions combining screen-time reduction with proprioceptive and balance training can partially restore postural control, highlighting adolescent neuroplasticity. Thus, although group-level static balance appears preserved, correlational and neurophysiological evidence indicates emerging subclinical deficits that may progress into functional impairments with continued overuse. Regression analyses further identified smartphone addiction as a significant predictor of slower sprint speed and reduced balance, highlighting the behavioural cost of excessive screen exposure during key developmental stages.

Handgrip strength showed a weak inverse correlation with smartphone use, suggesting that increased screen time reduces muscle strength, in line with similar global findings (*11*). These subtle associations may reflect adolescent neuromuscular resilience. Electromyography suggests that repetitive smartphone use fosters maladaptive muscle co-contraction, reducing force efficiency despite higher superficial strength (*10*). Thus, even modest decreases in grip strength may signal early musculoskeletal strain linked to excessive screen exposure.

Adolescents with smartphone addiction showed faster reaction times but 36% more errors, indicating impulsive responding and weakened executive control (*15*). Neuroimaging links this to striatal hyperactivity and prefrontal hypoactivation, reflecting a trade-off favouring motor speed over cognitive regulation (*16*). Electroencephalography data confirm reduced prefrontal engagement with habitual tapping/swiping, suggesting increased automaticity at the cost of control. The dual-task cost is due to neural interferences disrupting the optimal spatiotemporal dynamics of the competing tasks. These adaptations may impair attention, memory and emotional regulation, especially during critical phases of prefrontal development (*20*).

The nearly balanced gender distribution (52% male, 48% female) in our study minimized the risk of sex bias in the overall findings. However, the literature reports sex-specific patterns in smartphone behaviour, with girls often exhibiting higher addiction severity and boys demonstrating greater usage time and impulsivity (*37*). The strong correlation between SAS-SV scores and tracked screen time (R^2 = 0.935) supports the convergent validity of the scale.

Our study improved measurement accuracy by combining self-reported screen time with device-based tracking (iOS Screen Time/Android Digital Wellbeing), which reduced recall bias. However, some degree of self-reporting bias may have persisted despite using digital tools. Excluding low-activity adolescents clarified smartphone-related effects, and standardized tests strengthened methodological rigor. The strong correlation between SAS-SV and screen time may reflect shared method variance, as both assessed related behaviours. Although device-based validation was used, construct overlap and potential inflation remain concerns. Socioeconomic status and nutritional factors were not directly assessed, limiting interpretation of potential confounders. Consequently, our findings mainly apply to urban Tunisian adolescents and may not be generalized to rural areas or regions beyond the Middle East and North Africa.

Future research should use objective device analytics to better characterize smartphone use patterns, including time of use and posture during device interaction, to clarify their impact on neuromotor outcomes. Longitudinal and neuroimaging studies can clarify causal pathways. Interventions should combine posture-focused apps, community activities and culturally relevant messaging (e.g. comics and videos). Reinforcing regular physical activity, adequate rest and posture awareness should be integral components of these strategies to counteract the sedentary and musculoskeletal consequences of excessive screen use. Tailored programmes and school-based, active-play initiatives may offer cost-effective ways to curb adolescent sedentary habits and support healthy neuromotor development.

Conclusion

This study demonstrated that adolescents with high smartphone addiction scores exhibit slower sprint speeds, impaired postural control, and a speed-accuracy trade-off in cognitive tasks, characterized by faster but less-accurate responses, with addiction severity predicting slower sprinting and poorer postural stability. Although static balance and handgrip strength were less affected, these findings indicate measurable changes in motor and cognitive performance linked to excessive smartphone use. Evidence-based, multimodal interventions are critical to safeguarding adolescent physical and cognitive health. Priority actions include integrating posture-awareness tools and educational programmes, promoting structured physical activity, and using culturally relevant media to enhance engagement. These initiatives should be complemented by systematic screen-time limits, device-free routines, and comprehensive education on digital wellness and musculoskeletal health.

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Addiction au smartphone et performances cognitives et motrices chez les adolescents en Tunisie

Résumé

Contexte : L'addiction aux smartphones chez les adolescents est devenue un problème de santé publique majeur, entraînant des conséquences potentielles sur le développement moteur et cognitif.

Objectif : Examiner les associations entre l'addiction au smartphone et les performances cognitives et motrices chez les adolescents en Tunisie, à l'aide d'outils numériques validés.

Méthodes : Entre décembre 2023 et mars 2024, nous avons examiné 270 élèves dans trois collèges publics en zone urbaine en Tunisie. Nous avons évalué l'addiction au smartphone à l'aide de la traduction arabe validée de la version courte de l'échelle d'addiction au smartphone ; la fonction motrice en utilisant un dynamomètre numérique à main Takei, l'application MySprint et le test d'équilibre de Flamingo ; et la fonction cognitive à l'aide du système de test de Vienne. Les comparaisons de groupes ont été effectuées en recourant à des tests non paramétriques. Les associations ont été examinées au moyen de corrélations de Spearman et les effets prédictifs ont été évalués à l'aide d'analyses de régression linéaire distinctes, ajustées pour l'âge, le sexe et l'indice de masse corporelle ($p > 0,05$).

Résultats : Les adolescents classés comme dépendants ($n = 120$) présentaient une durée quotidienne d'utilisation du smartphone significativement plus élevée (454,8 ± 104,8 contre 172,1 ± 108,6 minutes, $p < 0,001$), un temps de sprint plus lent (6,09 ± 0,70 contre 5,63 ± 0,54 secondes, $p < 0,001$), une force de préhension réduite (22,3 ± 3,5 contre 25,7 ± 4,1 kg, $p < 0,001$) ainsi qu'une précision cognitive inférieure malgré un temps de réaction plus rapide ($p < 0,01$). La gravité de l'addiction a permis de prédire indépendamment un sprint plus lent ($\beta = 0,32$) et une moins bonne stabilité posturale ($\beta = 0,35$), la valeur p étant inférieure à 0,001 pour les deux.

Conclusion : L'addiction au smartphone est associée à des déficits moteurs et cognitifs importants chez les adolescents dans les écoles tunisiennes, la gravité de l'addiction prédisant un sprint plus lent et une moins bonne stabilité posturale. Des interventions en milieu scolaire précoces visant à promouvoir des habitudes saines en matière d'utilisation du smartphone et de pratique d'activité physique pourraient contribuer à prévenir un déclin cognitif et moteur à long terme chez les adolescents en Tunisie.

إدمان الهواتف الذكية والأداء الحَرَكي المعرفي بين المراهقين في تونس

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الخلاصة

الخلفية: برز إدمان الهواتف الذكية بين المراهقين بوصفه شاغلاً مهمًّا من شواغل الصحة العامة، مع احتمال تأثيره على نموهم الحركي والمعرفي.

الأهداف: هدفت هذه الدراسة الى دراسة الروابط بين إدمان الهواتف الذكية والأداء الحركي المعرفي لدى المراهقين في تونس، باستخدام أدوات رقمية معتمدة.

طرق البحث: في الفترة بين ديسمبر/ كانون الأول 2023 ومارس/ آذار 2024، قمنا بفحص 270 طالبًا في 3 مدارس متوسطة عامة في المناطق الحضرية بتونس. كما أجرينا تقييماً لإدمان الهواتف الذكية باستخدام النسخة العربية المُعتمدة من مقياس إدمان الهواتف الذكية – النسخة المختصرة؛ والوظائف الحركية باستخدام جهاز دينامومتر Takei Grip-D، وتطبيق MySprint واختبار توازن Flamingo؛ والوظائف المعرفية باستخدام نظام اختبار Vienna. وأُجريت مقارنات بين المجموعات باستخدام اختبارات غير مُتثابتة؛ وفُحصت الارتباطات باستخدام معاملات ارتباط Spearman؛ كما قُيِّمت التأثيرات التنبؤية باستخدام تحليلات انحدار خطي منفصلة جرى تعديلها حسب العمر والجنس ومنسب كتلة الجسم (قيمة الاحتمال < 0.05).

النتائج: أظهر المراهقون المصنَّفون على أنهم مدمنون (العدد = 120) استخدامًا يوميًّا أعلى بكثير للهاتف الذكي (454.8 ± 104.8 مقابل 172.1 ± 108.6 دقيقة، قيمة الاحتمال < 0.001)، ووقت أبطأ للجري (6.09 ± 0.70 مقابل 5.63 ± 0.54 ثانية، قيمة الاحتمال < 0.001)، وقبضة أقل قوة (22.3 ± 3.5 مقابل 25.7 ± 4.1 كيلوجرامات، قيمة الاحتمال < 0.001)، ودقة معرفية أقل على الرغم من زمن التفاعل الأسرع (قيمة الاحتمال < 0.01). كذلك ارتبطت شدة الإدمان بشكل مستقل ببطء أكبر في سرعة الجري ($\beta = 0.32$) وضعف في القدرة على ثبات الوضع ($\beta = 0.35$)، وقيمة الاحتمال لكليهما < 0.001).

الاستنتاجات: يرتبط إدمان الهواتف الذكية بحدوث ضعف حركي معرفي ملحوظ لدى المراهقين في المدارس التونسية، إذ تنبئ شدة الإدمان عن تباطؤ في الجري وضعف في القدرة على ثبات الوضع. ومن شأن التدخلات المبكرة في المدارس التي تستهدف تعزيز العادات الصحية لاستخدام الهواتف الذكية والنشاط البدني أن تساعد في الوقاية من التدهور الحركي المعرفي على المدى الطويل بين المراهقين في تونس.

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A review of access of persons with disabilities to health care services in the Eastern Mediterranean Region

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Abstract

Background: The World Health Organization estimates that 14.7% of the Eastern Mediterranean Region population has significant disabilities, and this figure could increase due to aging, the burden of noncommunicable disease, war, and disaster.

Aim: To identify and document the facilitators and barriers to accessing health care services by persons with disabilities in the Eastern Mediterranean Region.

Methods: We searched Medline and Web of Science for peer-reviewed literature published in English or Arabic on health equity for persons with disabilities in the Eastern Mediterranean Region, from 2011 to July 2023.

Results: Thirty-six of the 23 284 publications identified met the inclusion criteria. Disability inclusion in health service provision varied across several countries in the region. Financial barriers, inaccessible or unaffordable transportation, and lack of training of health professionals were the most reported challenges to accessing health care for persons with disability. The most reported facilitators of access were application of spatial accessibility models for severe disabilities, improvements in communication with caregivers, and online training courses to improve the attitude of health care providers and reduce stigma.

Conclusion: Persons with disabilities in the Eastern Mediterranean Region still face health care barriers. To improve access to services, there is a need to improve health communication with and among them; train health care providers on inclusive care; provide financial, transportation and telehealth support; and formulate and implement inclusive evidence-based policies and programmes.

Keywords: disability, health care, health access, inclusive care, disability inclusion, Eastern Mediterranean

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Introduction

Approximately 16% of the global population and 14.7% in the Eastern Mediterranean Region (EMR) lives with significant disability (*1*), and this figure could increase due to aging, noncommunicable disease, and the impact of war, conflict and natural disasters. Disability is a result of the interplay between impairment or health conditions and personal or environmental factors, including personal attitude, physical access to infrastructure, discriminatory legislation, gender, and age (*1*).

Progress has been made in the EMR with the ratification of the Convention on the Rights of Persons with Disabilities (CRPD) by 21 of the 22 countries and territories, alongside increasing self-advocacy and government commitment (*2,3*). The United Nations Universal Health Coverage declaration and Sustainable Development Goal (SDG) 3.8 emphasise equitable health access without catastrophic costs, but evidence indicates that this goal is unmet for many (*1,3*). Persons with disabilities remain one of the most marginalised and underserved groups in the EMR, who face disproportionate barriers due to conflict, displacement, poverty, and fragmented health systems (*3*). Hence, disability inclusive health care service is a priority in the region.

This scoping review aims to contribute to available literature on the attainment of Universal Health Coverage (UHC) by persons with disabilities in the EMR (*3,4*). It examines access to health care services, an essential yet under-researched element of health equity for persons with disabilities. It explores the facilitators and barriers to health care access and highlights gaps and opportunities for advancing health equity for persons with disabilities in the region.

Methodology

We searched available published literature on access to health by persons with disabilities in the EMR. Access

is defined as the alignment of health services with the needs and expectations of health users across multiple components, including availability, accommodation, accessibility, acceptability, awareness, and affordability (5,6). This definition overlaps with the commonly used availability, accessibility, acceptability, quality (AAAQ) framework (7). We used the population concept and context framework as agreed in consultation with the WHO internal advisory panel set up specifically to provide oversight and guidance to the consultants on this review (8). Using this concepts, we followed Arksey & O'Malley's methodological framework (Table 1) (9).

Results

Of the 23 284 records identified from the 2 databases and 30 records from grey literature (Figure 1), 36 studies were included: Saudi Arabia (11), Islamic Republic of Iran (8), Jordan (5), Pakistan (4), Afghanistan (3), Kuwait (3), Sudan (1) and Egypt (1) (Table 3). Awareness was the most reported access element, with a total of 16 studies

Table 1 Methodology based on Arksey & O'Malley's methodological framework

Step	Description
Identify the research question(s)	• What are the barriers and facilitators of access to healthcare services experienced by persons with disabilities worldwide? • What are interventions applied in EMR countries that have an effect on removing these barriers?
Identify relevant studies	**Search strategy** MEDLINE (Ovid) and Web of Science databases were searched given that they were also used in the scoping review of the WHO Global report on health equity for persons with disabilities. Databases were searched using medical subject headings (MeSH) terms, proximity, truncation, and Boolean operators. **Selection criteria** Studies published in English or Arabic from 2011 (when the first WHO-World Bank world report on disability was published) until 13 July 2023, excluding those focusing on mental illness due to construct differences (10,11). Papers were excluded if they lacked relevant data on health care access for persons with disabilities. Studies unrelated to the EMR, or not meeting inclusion criteria regarding language and publication dates were also excluded. The review adhered to the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guidelines for evidence synthesis (12). Grey literature and websites of key organisations of persons with disabilities and international organisations were searched (Table 2).
Select study	All studies derived from the 2 databases were deduplicated and then a reviewer screened all the 21 468 titles and abstracts. Eighty-four publications eligible for full-text review were independently assessed for eligibility by 2 authors (Figure 1). Disagreements were discussed and unresolved cases were reviewed by a third author for a final decision. Thirty records from grey literature were identified but they were rejected because they did not meet the eligibility criteria as they did not assess health equity.
Chart the data (including interpretation and synthesis)	Information about the author(s), year of publication and country in which the study was conducted was extracted for each included article.
Collate, summarise and report the results	Findings of the scoping review were narratively synthesised and structured according to the 6 access dimensions (5,6).

Table 2 Scoping review search strategy

Search step	Search block
1	exp Disabled Persons/
2	Disabilit* OR impair*
3	exp Health Services Accessibility/OR Universal Health Coverage OR Primary Care
4	exp Healthcare Disparities/
5	(Access* OR Inclus* OR barrier* OR facilitator* OR barrier* OR challeng* OR inaccess* OR obstacle* OR uptak* OR equal* OR equit* OR utili$* OR determinant* OR affordab* OR availab* OR accomm* OR accepta* OR awareness OR stigma* OR help*seeking OR attitud* OR training)
6	Iran OR Egypt OR "Saudi Arabia" OR Tunisia OR Pakistan OR Morocco OR Lebanon OR Jordan OR Kuwait OR United Arab Emirates OR Oman OR Qatar OR Iraq OR Sudan OR Syria OR Palestine OR Bahrain OR Libya OR Yemen OR Afghanistan OR Djibouti OR Somalia
7	1 or 2
8	3 or 4 or 5

Table 3 Summary of included studies by country, author and population

Country	Lead author and year	Study population
Jordan	Aburahma 2021	83 children with cerebral palsy and 84 healthy children were included as comparators
Pakistan	Ahmad 2013	245 rural men and women with physical disabilities
Saudi Arabia	Akeely 2022	166 emergency physicians working in different centres in Riyadh
Kuwait	Al-Daihani 2022	240 parents of people with disabilities attending a special educational school in Kuwait
Jordan	Al-Zboon 2016	54 dentists
Saudi Arabia	Aldharman 2023	613 people with neurological disorders
Kuwait	Alduhaim 2020	21 parents of children with hearing loss attending the Sheikh Salem Al-Ali Centre for Hearing and Speech in Kuwait
Kuwait	Alduhaim 2021	6 employees of the Sheikh Salem Al-Ali Centre for Hearing and Speech in Kuwait
Saudi Arabia and USA	Alkahtani 2014	131 dental students at King Abdulaziz University in Saudi Arabia and 76 at Tufts University School of Dental Medicine, USA
Saudi Arabia	Alkawai 2017	235 persons with physical disability at King Abdul Aziz Medical City, Riyadh
Jordan	Almhdawi 2022	198 undergraduate medical students
Saudi Arabia	Alodaibi 2022	12 physiotherapists
Saudi Arabia	Aloola 2023	303 pharmacists working in the Saudi Arabia community and outpatient pharmacies
Saudi Arabia	AlQahtani 2017	1000 dentists with various areas of specialisation who were proficient in English and eligible for practice in Saudi Arabia
Saudi Arabia	Alqassim 2022	289 persons with auditory and physical disabilities
Saudi Arabia	Alwadi 2022	10 children aged 9–15 years with intellectual disabilities and physical impairments attending special centres in Riyadh
Islamic Republic of Iran	Azadnia 2022	548 people with disabilities
Sudan, Namibia, Malawi and South Africa	Eide 2015	9307 individuals in Sudan, Namibia, Malawi, and South Africa
Saudi Arabia	Elkholi 2023	316 caregivers of children with disabilities from Riyadh
Jordan	Hassona 2021	26 parents of 26 individuals with intellectual disabilities (10 males and 6 females)
Austria, Egypt, Greece, India and Serbia	Isaksen 2022	Academics and health care professionals
Islamic Republic of Iran	Jafarabadi 2021	202 participants, including families of and children with ASD aged 2–16 years with an ASD diagnosis in the North-West of Islamic Republic of Iran
Pakistan	Khan 2017	People with disabilities
Iran	Kiani 2022	16 186 records of people living with disability
Pakistan	Mahmood 2022	6711 women aged 15–49 years with a live birth in the 5 years preceding the survey, with and without disabilities
Jordan	Masri 2023	Parents of children with ASD aged 2.5–17 years and who attended paediatric neurology clinics in 3 different university affiliated hospitals in 3 geographic areas in Jordan from February to December 2018
Islamic Republic of Iran	Matin 2019	403 adults with physical and/or intellectual disabilities
Islamic Republic of Iran	Mohebbi 2014	59 final year dental students
Afghanistan	Nasiri 2023	14 520 households across all 34 provinces. The adult tool of the survey was administered to a randomly selected household member aged ≥18 years.
Islamic Republic of Iran	Shirozhan 2022	18 persons including 12 nurses in clinical and managerial positions, an occupational therapist, a physical medicine specialist, a patient, and an informal caregiver
Islamic Republic of Iran	Soltani 2016	50 participants including people with disability, health care services providers and policymakers
Islamic Republic of Iran	Soltani 2019	56 individuals including people with disability, health care providers and policymakers
Afghanistan	Trani 2012	2696 people with disabilities or their caregivers
Afghanistan	Trani 2022	1861 newly recruited CBR participants with disabilities from 169 villages between July 2012 and December 2013, and 1132 controls screened with disabilities
Pakistan	Yawar 2022	Seven occupational therapists (5 females and 2 males)
Saudi Arabia	Zahran 2023	602 caregivers of children with autistic spectrum disorder (ASD), Down syndrome, cerebral palsy, and developmental delay

reporting data, followed by 12 studies on affordability, 11 studies on accessibility, 9 studies on availability, 8 studies on accommodation and 5 studies on acceptability. The following is a thematic overview of the studies reviewed:

Availability

Nine studies reported data on the availability of health care services. In Sudan, more than 40% of persons with disabilities reported lack of services as a major barrier to accessing health care, while 30% noted insufficient drugs and equipment (*14*). More than half of 548 persons with disabilities in Islamic Republic of Iran reported unmet outpatient care needs, with gaps largest in rehabilitation (73%) and dentistry (70%) (*15*).

Disparities between urban and rural services emerged across multiple countries. In Pakistan, funding and infrastructure deficits were reported, especially in rural areas (*16,17*), and rehabilitation services remain underdeveloped (*16*).

The COVID-19 pandemic exacerbated accessibility issues; a regional report found only 4 of 18 assessed EMR countries had disability-inclusive response plans (*18*). In Saudi Arabia, caregivers of children with disabilities reported rehabilitation service reductions, negatively impacting development (*19*) and telemedicine emerged as a potential solution to address accessibility problems at the time (*1,19*).

Facilitators of availability

There were barriers to telehealth adoption especially in rural and low-resource areas, due to internet access issues. Asynchronous solutions like web applications offered alternatives (*20*). A government-run rehabilitation centre in Karachi, Pakistan, implemented a low-cost telehealth system to facilitate therapy-related communication between caregivers and therapists. One user reported that remote support reduced travel burdens and improved home care (*21*).

An initiative aimed to enhance accessibility through community-based rehabilitation (CBR) programmes in Afghanistan enhanced access to physical therapy; however, disparities in wealth continued to contribute to unmet health care needs (*22*).

Accommodation

A common theme from the 8 studies reporting on accommodation was dissatisfaction with the physical environment and unsuitability of hospitals waiting areas for persons with disabilities.

A survey of 235 persons with physical disabilities in Saudi Arabia found high dissatisfaction with hospital facilities: over 52% with parking, 50% with waiting areas, 51% with wheelchair services, and 45% with toilets (66% reported a lack of emergency buttons or phones in toilet facilities) (*23*). Consequently, over 88% required accompaniment for hospital visits. In this study, wheelchair users reported lower satisfaction with physical accessibility. In another study in Saudi Arabia, over half found health care facilities unaccommodating, with one participant noting that the limitations were exhausting, prompting them to seek service from traditional healers instead (*24*).

Reasonable adjustments, such as priority or extended appointments, may help mitigate access barriers for persons with disabilities (*1*).

In Afghanistan, individuals with moderate to severe disabilities rated waiting time poorly (*25*). Parents of children with disabilities in Jordan expressed frustration due to overcrowded hospitals, lack of elevators and unsuitable waiting rooms (*26*). Children with disabilities in Saudi Arabia described long waiting time as a barrier in dental care clinics (*27*). In Kuwait, short session time and restricted parental presence during service delivery for children with hearing loss hindered relationships with service providers and opportunities for home care guidance (*28*).

Accessibility

Eleven studies reported on accessibility of health care services. Barriers identified were cultural, financial and logistic with transportation emerging as a critical issue (*29-31*).

In Pakistan, persons with disabilities noted that inaccessible approach roads, entrances, waiting places and toilets were barriers to accessing health care (*32*). Poor health care access may reflect the broader systemic challenges. For example, a national household survey in Afghanistan reported low overall health service utilisation largely due to service inaccessibility (*33,34*).

Facilitators of accessibility

In Islamic Republic of Iran, a network analysis was conducted to model spatial accessibility of hospitals for persons with disabilities. Less than one-third of persons with disabilities had appropriate access to hospital services (*35*). The study reported that spatial accessibility can improve physical accessibility for persons with disabilities.

Acceptability

Five studies reported on acceptability. Public stigma towards persons with disabilities remains a global issue, affecting individuals at personal, family, public, and structural levels (*36*). A multicountry study reported negative attitudes in the EMR, often reinforcing self and family stigma (*37*).

In Jordan, dentists in general hospitals exhibited highly positive attitudes toward persons with intellectual disabilities, but social desirability bias and small sample size may have influenced the results (*38*). Conversely, a study in Islamic Republic of Iran showed that health care providers displayed negative attitudes and were sometimes reluctant to treat, leading to a cycle of fear and distrust towards the health system among persons with disabilities (*29*).

Women with disabilities face complex barriers, including restricted access to sexual and reproductive

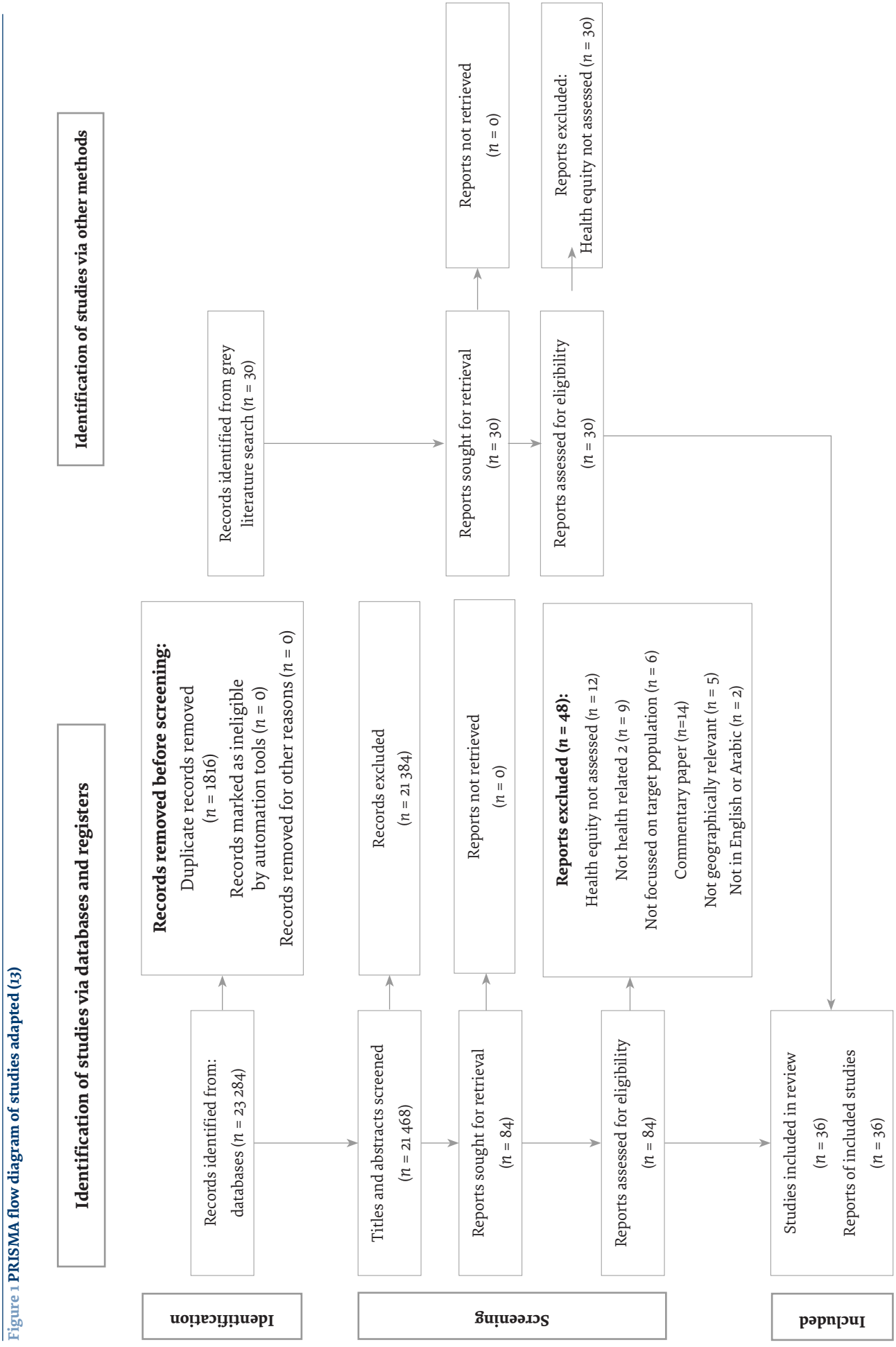

Figure 1 **PRISMA flow diagram of studies adapted (13)**

health information, limited or no family planning choices, forced sterilisation, and higher rates of intimate partner violence (*39,40*). In Islamic Republic of Iran, it was reported that women with disabilities may feel ashamed to talk about their issues with health care providers (*29*). Similar findings were reported in Pakistan, hindering reproductive health care access for women with disabilities (*32*). However, a more recent secondary analysis of a Pakistan health survey reported no statistically significant differences in the use of reproductive health services between women with and without disabilities, after adjusting for covariates (*41*).

Awareness

Sixteen studies reported on awareness. Health care providers in Islamic Republic of Iran showed a lack of awareness about disability and related health needs (*29*). A study in Saudi Arabia reported that a high proportion of emergency physicians lacked the skills to communicate effectively with deaf patients. Research recommended structured education, clear policies and access to specialised interpreters to improve response by physicians to deaf patients (*42*). Pharmacists in Saudi Arabia also expressed the need for training (*43*). More than half of 289 participants with hearing impairments and physical disabilities struggled to find specialised doctors or dentists in Saudi Arabia (*24*).

Persons with disabilities experience poorer oral health than the general population (*44,45*). In Saudi Arabia, 602 children with disabilities identified fear of the dentist (61%) and child uncooperativeness (38%) as the most common barriers to accessing dental care. Twenty-nine percent of parents reported that dentists were unwilling to treat their children, because they were not trained or had inadequate facilities (*46*). Similar challenges were reported in Jordan, where parents expressed concerns that primary dental care providers were not adequately equipped to manage children with disabilities (*26*).

Globally, disability-related training in health care remains inadequate (*47*). In Saudi Arabia, only 12% of dental students agreed that their training has equipped them to communicate effectively with individuals with developmental disabilities (*48*). In another Saudi Arabia study, only 14% of dentists reported high confidence in treating adults with disabilities, with paediatric dentists demonstrating significantly higher self-efficacy than non-paediatric specialists (*49*). This training gap extends beyond dentistry; physiotherapists in Saudi Arabia reported limited preparation to promote health care among persons with disabilities (*50*).

In addition to effective communication, effective information strategies are key components of awareness. In Kuwait, parents were less likely to seek health care information due to limited Arabic language resources, insufficient social agencies websites as well as printed and electronic resources. (*51*). In Saudi Arabia, online health information-seeking behaviours varied by region, suggesting targeted educational campaigns to improve access to services (*52*).

Facilitators of awareness

Some training initiatives have improved service provider responsiveness. In Kuwait, a training package enhanced confidence and communication during early intervention for children with hearing loss (*53*). Another study in Kuwait found that most parents of children with hearing disabilities preferred a variety of communication methods to maximise understanding and comprehension of their child's diagnosis and treatment (*28*).

Communication partner training in Egypt aimed to improve interactions between persons with aphasia and health care professionals (*54*). Communication partner training is an umbrella term for interventions that aim to optimise communication between people with aphasia and a range of communication partners, including health care professionals, volunteers and family members, through components that include education, strategy identification, feedback and practice delivered to individuals, dyads and groups with/without the person with aphasia present, across a range of health and social care settings (*54*). In Islamic Republic of Iran, a 4-session disability management programme significantly improved the knowledge and attitudes of dental students (*55*). One study proposed integrating rehabilitation principles, teamwork skills and proper workplace design into nursing education to enhance disability care (*56*). A study from Jordan found that an 8-week elective improved the understanding and attitudes of medical students about disabilities, with no difference in effectiveness between online and in-person formats (*57*).

Affordability

Affordability emerged as a crosscutting issue. Disability imposes financial burdens, including transportation, assistive devices and long-term rehabilitation costs, which are often excluded from national health systems or insurance (*58*). UHC aims to ensure health care access without financial hardship, yet global reviews highlight income as a major determinant of access (*59,60*).

Persons with disabilities struggle with navigating health insurance and funding systems (*1*). In Islamic Republic of Iran, 42% of study participants who received rehabilitation services reported borrowing money for health care, with higher-income individuals having better access. Rehabilitation services, such as occupational therapy and assistive devices, were not covered by insurance (*31*).

Lower socioeconomic status among children with autism correlated with reduced health care access in Islamic Republic of Iran (*61*). In Jordan, children with cerebral palsy may have faced dental care barriers due to cost, fear and parental knowledge and attitude regarding the importance of oral care (*62*), while in Saudi Arabia, financial constraints were ranked third among barriers to accessing dental care for children with disabilities (*46*). Cost was reported as the primary barrier to autism

services in Jordan, with therapy expenses consuming up to a third of household income (*63*).

In Islamic Republic of Iran, persons with disabilities reported better access to health care services when they had supplemental insurance, highlighting the importance of expanding insurance coverage to improve service utilisation. However, gaps in insurance coverage persist, particularly for essential services such as rehabilitation and dental care, resulting in limited access to care or exposure to catastrophic health expenditures (*15*).

Four financial barriers to health care were identified in Islamic Republic of Iran: lack of insurance coverage for key services, low income among persons with disabilities, inadequate pensions, and high transportation costs (*30*). In Saudi Arabia, monthly income correlated with increased willingness to seek online health information (*52*).

Public transport remains largely inaccessible to persons with physical disabilities, forcing them to rely on expensive taxis (*30,32*). Among 274 parents of children with autism spectrum disorders in Jordan, nearly 40% cited transportation difficulty as a barrier to health care access (*63*). Similarly, health care costs prevented persons with moderate and severe disabilities in Afghanistan from seeking care (*24*). However, a national household survey in Afghanistan found no wealth-based disparity in health care utilisation due to widespread poverty (*34*). However, persons with disabilities reported higher medical expenses than persons without disabilities. Persons with disabilities in Sudan reported significant barriers to health care, with affordability cited as the top concern (*14*).

Discussion

This scoping review presents a regional overview of barriers faced by persons with disabilities in accessing health care and highlights interventions that have been valuable in improving access.

Stigma and discrimination

Acceptability is a core factor affecting access to health care. Surveys show lower acceptability scores among those with physical disabilities in the EMR, different from countries in other regions where persons with intellectual disabilities are more likely to report acceptability issues (*23*). This is probably because persons with intellectual disabilities have difficulties articulating their experiences during traditional surveys, emphasising the need for accessible, co-developed instruments for inclusive health policy research (*31,64*) in the EMR.

It is encouraging to note that some studies focused on certain groups of persons with disabilities at a higher risk of discrimination. Women with disabilities face complex exclusion (*65*). Our findings suggest that women experience shame, have difficulty with disclosure and experience persistent provider misconceptions which contribute to discrimination (*29,32*). Some studies show no significant differences in reproductive health service use between women with and without disabilities (*41*).

Enhancing awareness and training

In comparison to dental students in the USA, dental students in Saudi Arabia felt less equipped to communicate effectively with and treat individuals with developmental disabilities, often citing lack of training (*48*). Short-term training has been shown to improve the knowledge and attitude of dental and medical students towards persons with disabilities, even online (*55,57*). Enhancing the awareness of health care providers is vital in countering self-stigma, public stigma and reluctance to treat persons with disabilities, which contributes to mistrust and reduced health care engagement (*26,29,38*).

Educational programmes to improve attitudes towards persons with disabilities should be embedded in the medical training curricula, and online and in-person training formats have shown similar effectiveness (*57,66*). Global evidence confirms that social contact alongside education significantly reduces stigma (*67*), with similar results observed in the EMR (*48*).

Accommodating service users

Regional research highlights the importance of using mixed communication methods by providers (*28*) and the need for health care information to be provided in the first language of the health seeker and other accessible formats (*51,63*), in line with the global evidence review (*1*). Telehealth services increase availability of and access to some services (*1*), and international standards are available for increasing accessibility of telehealth services in promoting equitable access (*22*). Researchers should investigate the effectiveness of such initiatives in increasing acceptability in the EMR.

Cost of health care services

Financial barriers emerged as a major crosscutting theme. Limited coverage of services and insufficient supply of medicines and medical equipment drive high expenditures for persons with disabilities in the EMR. Inadequate subsidies further exclude them from formal health care (*32*). Poor health subsidies or lack of insurance limit access (*68*) and further exclude persons with disabilities from formal health care (*1,10,31*). Closely linked to this barrier in the EMR was transportation, consistent with reports in literature globally that non-existent or unaffordable transportation barriers hinders accessibility up to 15 times among persons with disabilities more than the general population (*1*). Regional advocacy calls for improved affordability and access to essential health services for persons with intellectual disabilities (*69*).

Regional gaps and challenges

Research in the EMR have consistently highlighted the need for further research on disability-related issues (*70*). Stigma remains prevalent and it renders persons with disabilities hidden from society. Recommendations from our studies highlight the need for research on the

impact of programmes on the responsiveness of health care professionals and financial barriers, considering alternative payment mechanisms and subsidies, and for elaboration on universal access to information on puberty, family planning, pregnancy, and menopause (*4*).

Another challenge is the dearth of inclusive and accessible methodology to capture the perceptions of persons with disabilities (*71*). Engaging persons with disabilities in research is a key action for disability inclusion (*1*). Some researchers who have reported using inclusive methodology to work with children with disabilities have noted that the children want to be listened to, respected, valued, and given truthful information (*27*). This approach can be adapted and adopted across the EMR. Health care professionals should be trained in different types of communication methods, tailored to different types of disabilities. Collecting feedback through participatory approaches can be effective in identifying barriers and context-specific adaptations (*1*).

Although many countries in the EMR are in conflict and emergency settings, only a few published studies have captured the access of persons with disabilities to health care services, despite evidence that persons with disabilities are at higher risk during conflicts, which reduce the availability of assistive devices and access to basic services while increasing abuse and stigma (*1,72*).

Strengths and limitations of this review

This review is among the first to examine peer-reviewed literature on health care access for persons with disabilities across the EMR, including all access components, diverse health care contexts and perspectives from key stakeholders. Although the authors carefully selected 2 of most relevant scientific databases, it would be desirable to run the search in more databases. Only articles published in English and Arabic were included, perhaps limiting representation from certain countries like the francophone EMR countries.

Conclusion

This review presents an overview of published literature on access to health services by persons with disabilities in the Eastern Mediterranean Region. Despite efforts by governments across the EMR to increase access to health care for all, persistent barriers remain. These include gaps in training of health care providers and the resulting inability to communicate well with persons with disabilities. Financial and transportation barriers limit access, while telehealth and targeted training interventions show promise and need to be evaluated. The limited availability of data on disability impedes the formulation and refinement of inclusive, evidence-based policies and programmes to improve health care for persons with disabilities across the region. Greater representation of the voices of persons with disabilities in research on access to health care services in conflict-affected and emergency settings are essential in achieving Universal Health Coverage.

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Examen de l'accès des personnes en situation de handicap aux services de soins de santé dans la Région de la Méditerranée orientale

Résumé

Contexte : L'Organisation mondiale de la Santé estime que 14,7 % de la population de la Région de la Méditerranée orientale souffre d'importants handicaps, et ce chiffre pourrait augmenter en raison du vieillissement, de la charge des maladies non transmissibles, des guerres et des catastrophes.

Objectif : Identifier et documenter les facilitateurs et les obstacles à l'accès des personnes en situation de handicap aux services de soins de santé dans la Région de la Méditerranée orientale.

Méthodes : Nous avons effectué une recherche dans MEDLINE et Web of Science pour recenser la littérature évaluée par des pairs, rédigée en anglais ou en arabe, portant sur l'équité en santé des personnes en situation de handicap dans la Région de la Méditerranée orientale, couvrant la période de 2011 à juillet 2023.

Résultats : Trente-six des 23 284 publications répertoriées répondaient aux critères d'inclusion. La prise en compte du handicap dans la prestation de services de santé varie d'un pays à l'autre dans la Région. Les obstacles financiers, les difficultés liées à des transports inaccessibles ou inabordables, ainsi que le manque de formation des professionnels de santé figuraient parmi les principaux freins à l'accès aux soins pour les personnes en situation de handicap. Les principaux facilitateurs de l'accès aux soins les plus fréquemment signalés concernaient la mise en œuvre de modèles d'accessibilité spatiale pour les handicaps sévères, l'amélioration de la communication avec les aidants, ainsi que la mise en place de formations en ligne visant à améliorer les attitudes des professionnels de santé et à réduire la stigmatisation.

Conclusion : Les personnes en situation de handicap dans la Région de la Méditerranée orientale continuent de se heurter à des obstacles en matière de soins de santé. Afin d'améliorer l'accès aux services, il est nécessaire de renforcer la communication en santé avec les personnes en situation de handicap et entre elles, de former les professionnels de santé aux soins inclusifs, de fournir un soutien financier, en matière de transport et de télésanté, ainsi que d'élaborer et de mettre en œuvre des politiques et des programmes inclusifs fondés sur des données probantes.

استعراض لإمكانية حصول الأشخاص ذوي الإعاقة على خدمات الرعاية الصحية في إقليم شرق المتوسط

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الخلاصة

الخلفية: تشير تقديرات منظمة الصحة العالمية إلى أن 14.7% من سكان إقليم شرق المتوسط لديهم إعاقات كبيرة، وقد يزيد هذا الرقم بسبب الشيخوخة، وعبء الأمراض غير السارية، والحرب، والكوارث.

الأهداف: تحديد وتوثيق العوامل التي تُيسِّر حصول الأشخاص ذوي الإعاقة على خدمات الرعاية الصحية في إقليم شرق المتوسط، والعوائق التي تحول دون حصولهم عليها.

طرق البحث: بحثنا في موقعَي Medline و Web of Science عن المؤلفات المُحكَّمة المنشورة باللغة الإنجليزية أو العربية بشأن الإنصاف الصحي للأشخاص ذوي الإعاقة في إقليم شرق المتوسط في المدة من 2011 إلى يوليو/ تموز 2023.

النتائج: استوفى 36 منشورًا من أصل 23284 منشورًا مُحدَّدًا معايير الشمول في الدراسة. وتباينت مراعاة ذوي الإعاقة عند تقديم الخدمات الصحية في عدة بلدان بالإقليم. وكانت العقبات المالية، ووسائل النقل التي يتعذر الوصول إليها أو التي لا يمكن تحمُّل تكلفتها، ونقص تدريب المهنيين الصحيين أكثر التحديات المُذكورة التي تحول دون حصول الأشخاص ذوي الإعاقة على الرعاية الصحية. وكانت أكثر العوامل المُيسِّرة المذكورة هي تطبيق نماذج تيسير وصول ذوي الإعاقات الشديدة إلى أماكن تقديم الخدمات، وإدخال تحسينات على التواصل مع مقدمي الرعاية، وعقد دورات تدريبية عبر الإنترنت لتحسين موقف مقدمي الرعاية الصحية والحد من الوصم.

الاستنتاجات: لا يزال الأشخاص ذوو الإعاقة في إقليم شرق المتوسط يواجهون عقبات في تلقِّي الرعاية الصحية. ولتحسين حصولهم على الخدمات، لا بد من تحسين التواصل الصحي معهم وفيما بينهم، وتدريب مقدمي الرعاية الصحية على الرعاية الشاملة للجميع، وتوفير الدعم المالي والدعم الخاص بالنقل وبالخدمات الصحية المُقدمة عن بُعد، وصياغة سياسات وبرامج شاملة للجميع ومُسندة بالبيِّنات وتنفيذ تلك السياسات والبرامج.

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Progress towards elimination of leprosy in the Eastern Mediterranean Region

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Abstract

Background: Although leprosy ceased to be a global public health problem in 2000, some countries are still reporting new cases.

Aim: To evaluate progress towards the interruption of leprosy transmission, and its elimination, in the Eastern Mediterranean Region.

Methods: We extracted and analysed leprosy data for 2012–2023 for the Eastern Mediterranean Region countries from the WHO Global Health Observatory. We calculated the new case detection rates, the Grade 2 disabilities case rates and the new child cases per million population.

Results: New case detection rate increased from 3.7 per million population in 2012 to 6.0 in 2018 and then decreased to 3.6 in 2023. Among children aged < 15 years, new case detection rate increased from 0.6 cases per million in 2012 to 1.3 in 2017 and then decreased to 0.5 in 2023. The proportion of females among new cases increased from 34.4% in 2012 to 42.0% in 2023. Grade 2 disability rate decreased from 0.5 cases per million population in 2012 to 0.3 in 2023. By 2023, Egypt, Pakistan, Somalia, Sudan, and Yemen accounted for 94% of cases. Thirteen countries reported 0–10 new autochthonous cases annually. The proportion of non-autochthonous cases increased from 3.4% in 2016 to 4.2% in 2023.

Conclusion: Some Eastern Mediterranean Region countries are progressing towards the elimination of leprosy. The decrease in leprosy cases among children in the region indicates a reduction in active transmission. Continuous investment by all the countries will enhance early diagnosis and detection, ensure effective disease management and promote social inclusion as outlined by the WHO global leprosy strategy.

Keywords: leprosy, leprosy transmission, leprosy elimination, case detection, early diagnosis, disease management, Eastern Mediterranean

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Introduction

Leprosy is an ancient disease that continues to be burdened by stigma, discrimination and prejudice. Despite being curable through early detection and treatment, these barriers continue to hinder control and elimination efforts. Late diagnosis resulting in visible deformities perpetuates more suffering, causing patients to be rejected by their own communities and from healthcare settings, further compromising health-seeking behaviour (*1*).

Leprosy is caused by *Mycobacterium leprae* and primarily affects skin, peripheral nerves, upper respiratory tract mucosa and eyes (*2*). WHO categorizes leprosy as one of the 21 neglected tropical diseases and its risk is linked to poor socioeconomic status, including poverty, low level of education, and food insecurity. Immunity and genetic predisposition also play a role in disease progression and pattern (*3*). Leprosy is a slowly progressing disease; the average incubation period is 5 years and might extend beyond 10 years. Patients who are diagnosed late or who lack access to treatment are at higher risk for prolonged nerve damage and the resultant impairments referred to as Grade 2 disability (G2D) such as claw hand, foot drop and lagophthalmos. In addition to causing chronic pain and subjecting patients to social stigma, these disabilities can limit mobility and performance of normal physical activities, thereby severely diminishing quality of life (*4*).

From 1982 to 1991, the globally registered prevalence of leprosy decreased by 90% due to the use of multidrug therapy (*5*). Encouraged by this success, the 44th World Health Assembly passed a resolution urging countries to improve early case detection and set a target of elimination of leprosy as a public health problem, defined as registered prevalence of < 1 case per 10 000 population (*6*). Elimination at the global level was achieved in 2000 but new cases continue to be detected at country levels. In 2021, WHO published *The global leprosy strategy 2021–2030 towards zero leprosy* to accelerate progress and redefine the key long-term vision: zero infection and disease, zero disability, and zero stigma and discrimination (*7*).

Early case detection and treatment are crucial in halting the progression of leprosy and preventing disabilities. Globally, the new case detection has shown a gradual reduction over the past 20 years from 600 000

to < 175 000. Nearly 45 countries reported no new cases in 2022 (*8*). To refocus on interruption of transmission and disease elimination, WHO developed The Leprosy Elimination Framework as a standardized method that can be applied at subnational level upwards to the national level, to gradually reach nonendemic status (*9*). Supported by modelling analysis, the framework proposes 3 elimination phases: interruption of transmission, elimination of leprosy disease and post-elimination surveillance (*10*). Once a subnational area, a country or region achieves the defined milestone of a particular phase, it progresses to the next phase. The epidemiologic cut-off for interruption of transmission phase is achieved when no new autochthonous cases have been detected among children for ≥ 5 consecutive years (*11*). The disease elimination phase is reached when no autochthonous cases (of any age) have been detected for the subsequent 3 years, in addition to having no paediatric cases for the previous 5 years. In the post-elimination surveillance phase, countries have to report 0 or sporadic autochthonous cases for ≥ 10 years. After these 3 phases, countries reach nonendemic status, in which sporadic cases may still occur among the autochthonous population due to the long incubation period of leprosy.

The WHO Eastern Mediterranean Region (EMR) consists of 22 Member States with a total population of 745 million. The Region is diverse, with a sharp contrast in social and economic indicators between and sometimes within Member States. The EMR is facing health challenges due to population growth, disparity in terms of health system functioning, and risk of epidemics. Political insecurity, resulting in unrest, conflict and population movement place further strain on health systems. These conditions need to be considered when moving towards disease elimination.

In this review, we analysed country leprosy programme implementation during 2012–2023 to evaluate progress made by EMR Member States towards interruption of transmission and elimination of leprosy.

Methods

WHO collects statistics and information related to leprosy programme implementation from national programmes on an annual basis using standardized indicators, definitions and templates through an online DHIS2-based platform. Data are reviewed for consistency and completeness before analysis and final publication on the WHO Global Health Observatory (GHO). We extracted quantitative data for countries within the EMR from 2012 to 2023.

The new case detection rates were calculated using mid-year medium variant estimates of total population from United Nations Department of Economic and Social Affairs (UNDESA) data base as denominators (*12*). New G2D case rates were also calculated with the same denominator.

Ethics statement

This manuscript did not require ethics approval. The analysis was conducted exclusively on aggregated data and already publicly available. No individual-level or identifiable information was collected or reported.

Results

Case detection trends

The new case detection rate in the EMR increased from 3.7 per million population in 2012 to 6.0 in 2018 before decreasing to 3.6 in 2023 (Figure 1, Table 2). Similar trends in case detection rates were reported by Somalia: case detection rate increased from 44.3 per million population in 2016 to 129.6 in 2022 and decreased to 82.7 in 2023. The case detection rate among children aged < 15 years increased from 0.6 cases per million in 2012 to 1.3 in 2017 before decreasing to 0.5 in 2023 (Table 1).

Demographic characteristics

The proportion of females among new cases increased from 34.4% in 2012 to 42.0% in 2023 (Figures 2&3). In 2023, 15 Member States reported 1187 females among new cases. More than 97.8% of these cases were reported from Egypt, Pakistan, Somalia, Sudan and Yemen. The proportion of children among new cases decreased from 5.4% in 2012 to 4.5% in 2023 (Table 1). In 2023, 6 Member States reported 127 cases among children. Egypt and Somalia had detection rate among children higher than one per million child population (1.3 and 5.5 cases per million child population).

Disability

The G2D rate decreased from 0.5 cases per million population in 2012 to 0.3 in 2023 (Figure 1). The proportion of new cases with G2D also decreased from 14.0% in 2012 to 7.9% in 2023 (Table 3). In 2023, 223 cases with G2D at the time of diagnosis were reported. Qatar and Somalia reported G2D rate > 1 case per million (3.0 and 2.3). All the cases reported from Qatar were non-autochthonous cases. The highest proportion of G2D among new cases was reported from Iraq (2/3, 66.6%). Seven countries, Afghanistan, Egypt, Islamic Republic of Iran, Morocco, Pakistan, Qatar and Sudan reported G2D proportion > 10% among new cases in 2023. From 2012 to 2023, 29 cases among children with G2D at the time of diagnosis were reported. The highest number of children with G2D was reported in 2023 (5 cases): 3 in Egypt and 1 each in Somalia and Sudan.

Geographical distribution

All EMR countries demonstrated a declining case detection rate. From 2012 to 2023, 3 countries (Afghanistan, Morocco and Islamic Republic of Iran) reported between 11 and 100 new cases annually (Table 2). Egypt, Pakistan, Sudan and Yemen reported between 300 and 900 new cases per year. Somalia reported a sharp increase in the number of cases from 139 in 2012 to 2307 in 2022. By 2023, Egypt, Pakistan, Somalia, Sudan and

Figure 1 Rate of newly detected leprosy and grade 2 disability cases per million population in the Eastern Mediterranean Region, 2012–2023

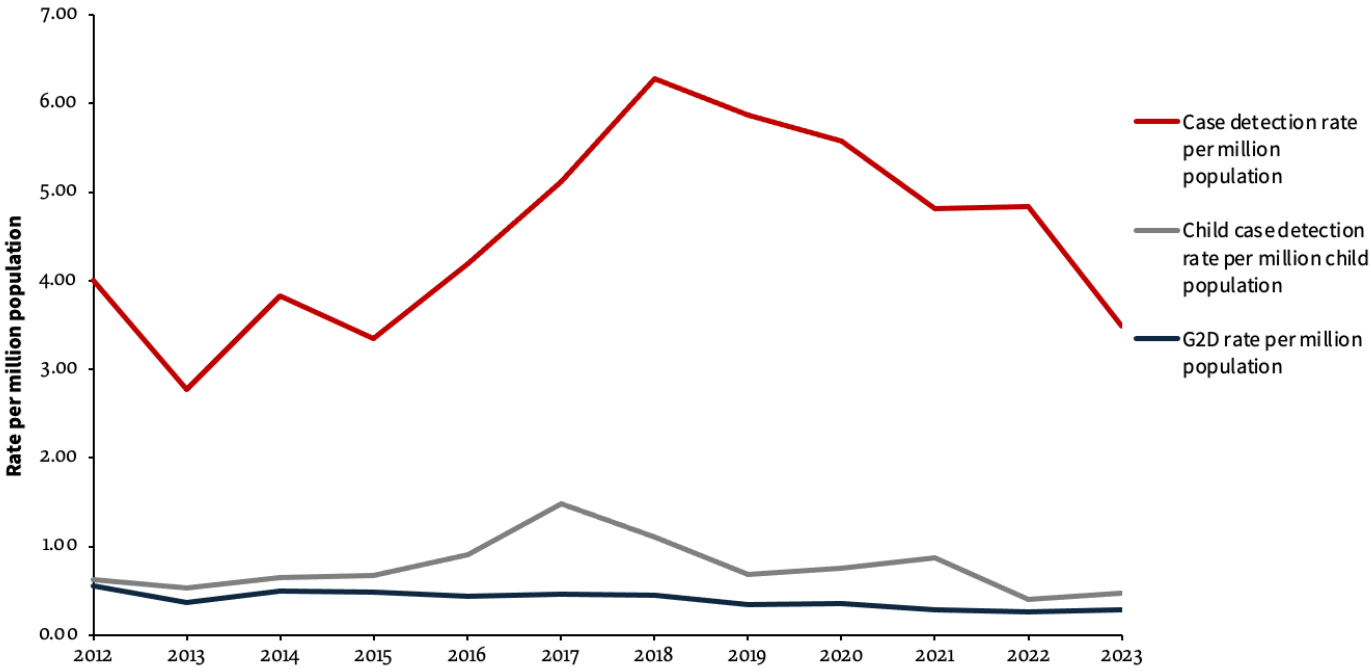


Table 1 New leprosy cases among children aged <15 years in the EMR Member States, 2012–2023

Country	2023	2022	2021	2020	2019	2018	2017	2016	2015	2014	2013	2012
Afghanistan	1	ND	1	2	0	3	6	2	4	3	3	3
Bahrain	0	0	0	0	0	0	0	ND	0	ND	ND	ND
Djibouti	0	0	ND	0	ND	ND	ND	ND	0	ND	ND	0
Egypt	48	21	24	19	26	19	32	43	45	22	ND	29
Iran (Islamic Republic of)	0	0	0	0	0	1	0	0	0	1	0	1
Iraq	0	0	0	0	0	ND	ND	ND	0	0	0	0
Jordan	0	0	0	0	0	0	0	0	0	0	0	0
Kuwait	0	0	0	0	ND	0	0	0	ND	0	0	0
Lebanon	0	0	0	0	0	0	0	0	0	0	ND	0
Libya	0	ND	0	0	0	ND	ND	0	0	0	ND	0
Morocco	0	1	0	0	0	2	0	0	0	2	1	1
Oman	0	0	0	0	0	ND	0	0	0	0	0	0
Occupied Palestinian Territories	0	0	0	0	0	ND	ND	ND	0	ND	0	0
Pakistan	16	19	25	14	23	26	32	38	31	35	49	26
Qatar	0	0	0	0	0	0	0	0	0	0	0	0
Saudi Arabia	0	0	5	0	0	ND	0	0	0	0	0	0
Somalia	47	33	106	108	35	138	187	44	9	2	ND	21
Sudan	3	8	11	10	13	15	20	19	21	22	14	15
Syrian Arab Republic	0	0	0	0	1	1	0	0	0	ND	ND	ND
Tunisia	0	0	0	0	0	ND	0	0	0	0	ND	0
United Arab Emirates	0	0	0	0	0	0	ND	ND	ND	ND	0	ND
Yemen	12	21	38	27	51	53	61	58	38	55	47	36

ND – data not reported. Data are aggregated at the country-level.
Source: World Health Organization, 2024

Table 2 Number of new leprosy cases among EMR Member States, 2012–2023

Country	2023	2022	2021	2020	2019	2018	2017	2016	2015	2014	2013	2012
Afghanistan	12	7	19	22	31	43	45	48	42	38	39	37
Bahrain	0	1	3	2	ND	1	2	3	6	ND	ND	ND
Djibouti	0	0	ND	0	ND	ND	ND	ND	12	ND	ND	2
Egypt	583	395	361	316	537	407	543	651	583	564	ND	644
Iran (Islamic Republic of)	7	6	10	5	18	29	19	10	17	22	21	21
Iraq	3	3	0	2	2	ND	ND	ND	0	3	3	1
Jordan	0	0	0	0	0	0	0	0	0	0	0	0
Kuwait	6	8	8	10	ND	9	6	6	ND	10	18	16
Lebanon	0	0	0	0	0	0	0	1	3	0	ND	1
Libya	1	ND	1	2	2	5	1	8	8	7	ND	4
Morocco	8	14	14	7	15	22	13	25	27	25	38	38
Oman	1	0	1	2	0	1	1	0	4	6	5	7
Occupied Palestinian Territories	0	0	0	0	0	ND	ND	ND	0	ND	0	0
Pakistan	236	259	285	225	347	342	403	397	446	501	431	377
Qatar	33	17	23	28	22	0	21	36	26	48	26	24
Saudi Arabia	26	19	25	16	17	18	9	13	3	7	8	4
Somalia	1519	2307	2030	2638	2425	2610	1576	635	107	14	ND	139
Sudan	188	472	499	526	478	509	551	624	624	684	677	727
Syrian Arab Republic	0	0	0	0	1	2	2	0	3	ND	ND	ND
Tunisia	2	0	0	2	0	ND	2	1	1	0	0	0
United Arab Emirates	57	38	41	78	ND	0	0	40	ND	ND	31	ND
Yemen	147	224	268	196	316	358	357	367	255	413	383	392

Data represent the total number of newly reported leprosy cases (all ages, male and female) aggregated at the country level.
Source: World Health Organization, 2024

Figure 2 Proportion of newly detected leprosy cases by gender, Eastern Mediterranean Region, 2012–2023

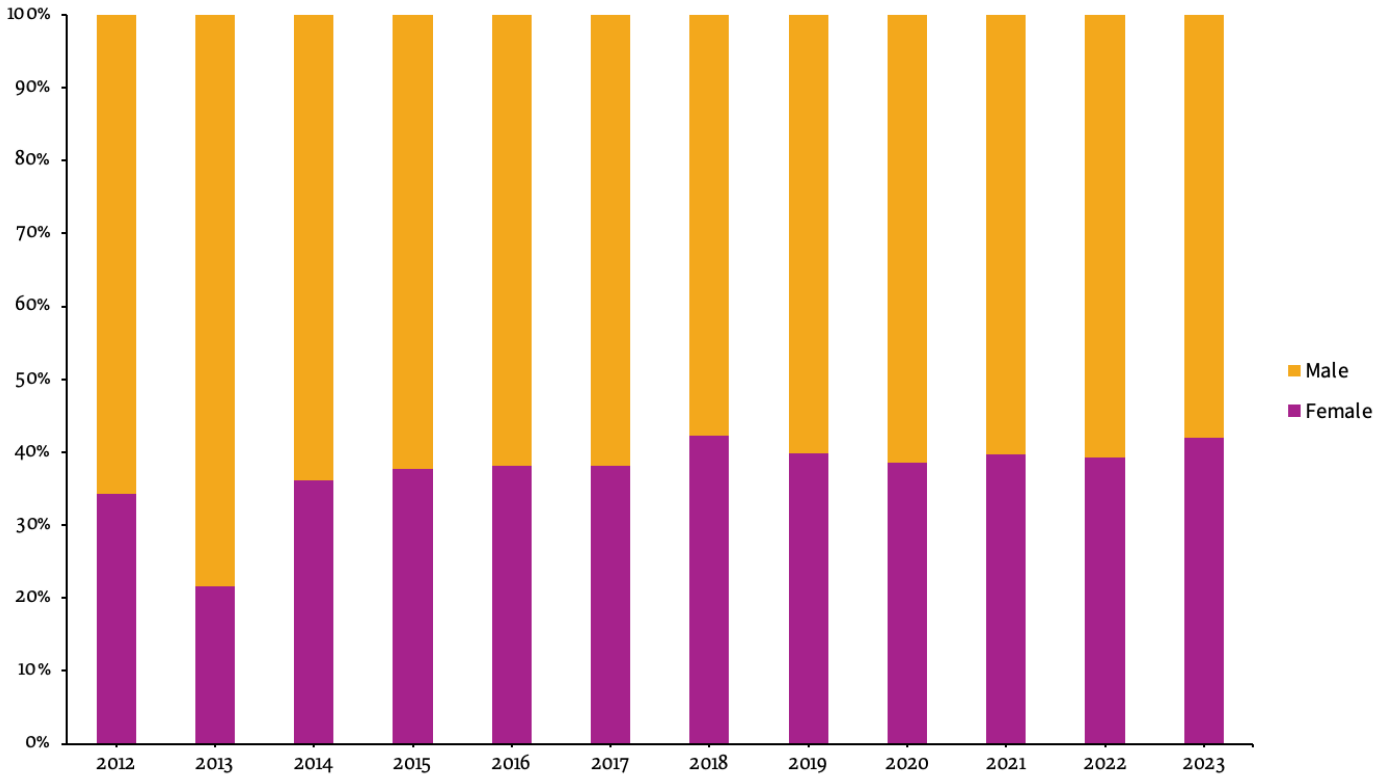


Table 3 Number of new leprosy cases with grade 2 disability among the EMR Member States, 2012–2023

Country	2023	2022	2021	2020	2019	2018	2017	2016	2015	2014	2013	2012
Afghanistan	2	1	2	0	1	1	2	2	2	1	2	1
Bahrain	0	0	ND	0	0	0	ND	0	0	ND	ND	ND
Djibouti	0	ND	ND	0	ND	ND	ND	ND	ND	ND	ND	ND
Egypt	90	40	38	29	47	40	45	51	45	47	ND	68
Iran (Islamic Republic of)	2	2	5	1	6	5	9	3	6	8	9	6
Iraq	2	1	0	0	ND	ND	ND	ND	0	0	0	0
Jordan	0	0	0	0	0	0	0	0	0	0	0	0
Kuwait	0	0	0	0	ND	0	0	0	ND	0	2	3
Lebanon	0	0	0	0	0	0	0	0	0	0	ND	1
Libya	0	ND	0	ND	0	ND	0	0	0	0	ND	0
Morocco	1	2	0	1	1	4	0	0	0	2	0	8
Oman	0	0	0	ND	0	ND	0	0	0	0	0	1
Occupied Palestinian Territories	0	0	0	0	ND	ND	ND	ND	0	ND	0	0
Pakistan	50	45	48	31	54	50	72	61	85	90	66	89
Qatar	9	8	0	0	0	ND	0	0	0	0	0	0
Saudi Arabia	0	0	0	0	ND	ND	0	3	0	0	2	1
Somalia	43	21	48	68	60	129	93	74	45	5	ND	15
Sudan	24	74	53	115	64	66	79	82	120	118	110	121
Syrian Arab Republic	0	0	0	0	1	0	0	0	3	ND	ND	ND
Tunisia	0	0	0	0	0	ND	0	0	0	0	ND	0
United Arab Emirates	0	0	0	0	ND	0	ND	0	ND	ND	0	ND
Yemen	0	6	15	7	20	21	16	23	9	29	28	26

Data represent the total number of new leprosy cases with grade 2 disability at the time of diagnosis aggregated at the country level. As per WHO Classification, Grade 2 disability is defined as visible deformity or damage present in hands, feet, or eyes.
Source: World Health Organization, 2024.

Yemen accounted for 94% of cases in the region. Bahrain, Djibouti, Iraq, Kuwait, Jordan, Lebanon, Libya, Oman, Occupied Palestine Territory, Qatar, Saudi Arabia, Syrian Arab Republic and Tunisia reported between 0 and 10 new autochthonous cases annually. Jordan reported no autochthonous cases for 2012–2023.

Origin of infection

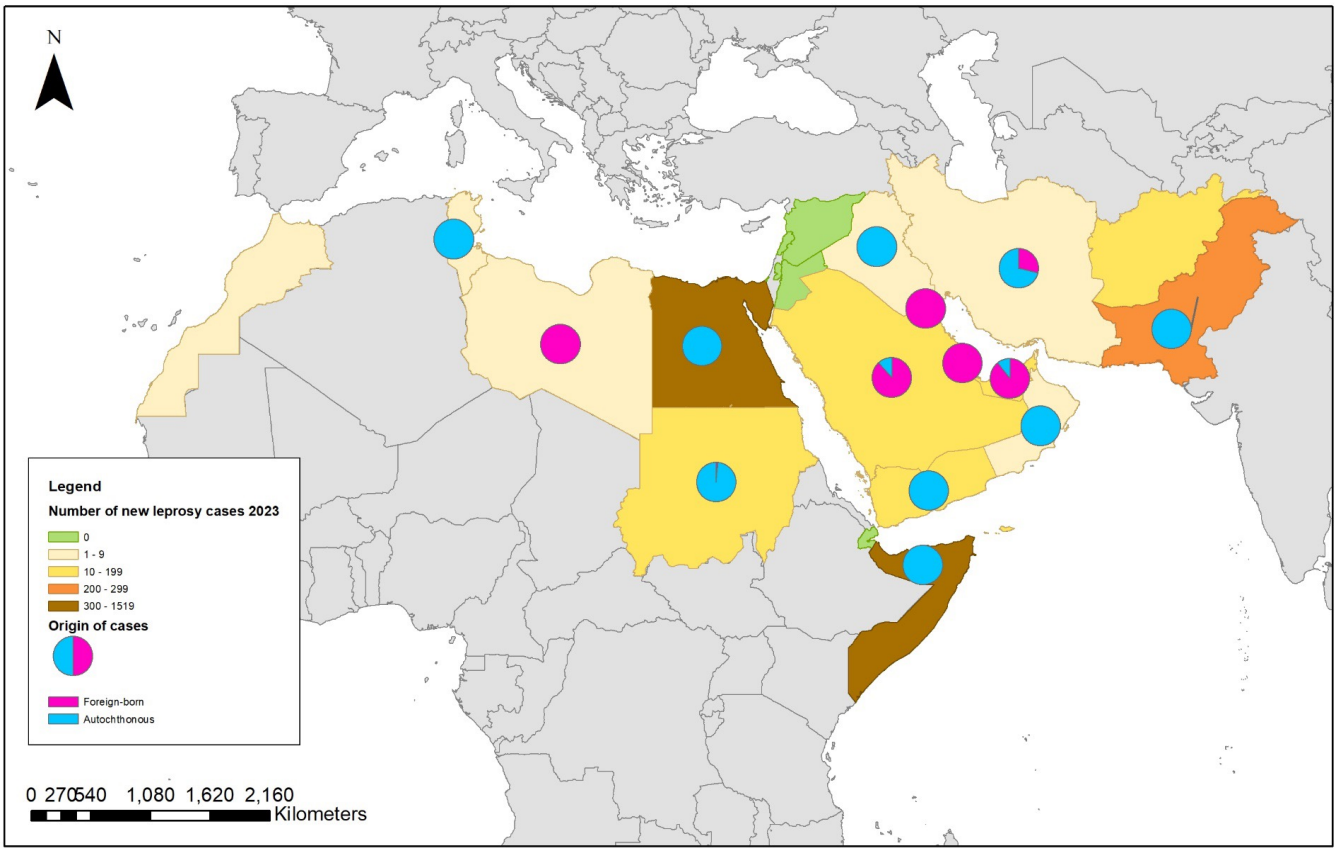
The proportion of non-autochthonous cases increased from 3.4% in 2016 to 4.2 % in 2023 (Table 4). From 2019 to 2023, Bahrain, Kuwait and Qatar reported all new leprosy cases to be non-autochthonous. Between 2019 and 2023, Bahrain, Islamic Republic of Iran, Iraq, Lebanon, Oman, Occupied Palestinian Territory, Qatar, United Arab Emirates and Tunisia reported no autochthonous leprosy cases among children less than 15 years.

Discussion

Although only representing 2% of new global leprosy cases reported in 2022, the EMR reported an increase in leprosy case detection from 2012 to 2023, indicating improvement in case detection and reporting. However, our review highlights the stark contrast in leprosy burden among Member States in the EMR, from 8 reporting mostly 0 autochthonous cases annually and a single country reporting a burden of > 2000 cases. Countries that continue to report high burdens generally have fragile health systems, widespread poverty and persistent stigma, which delay diagnosis and sustain transmission. In contrast, countries with a low burden often face the opposite challenge of under-detection due to limited clinical capacity and reduced programme prioritization. The sharp increase in regional figures reported between 2015 and 2023 was mainly due to enhanced active case finding in Somalia and improved efforts in several countries for early case detection with the support of partners (*13,14*). In contrast, the armed conflict in Sudan led to destruction of healthcare institutions and resulted in shortage of healthcare services affecting management of several diseases (*15,16*). Specifically for leprosy, there was a 60.2% reduction in number of leprosy cases reported from Sudan in 2023 compared to the previous year. These examples characterize the dichotomy of leprosy programme implementation in the region, with some national programmes continuing to expand, and others failing due to prevailing emergency situations.

The region is facing multiple emergencies – disease outbreaks, conflicts and natural disasters – all exerting a heavy toll on the population, with an estimated 140 million requiring humanitarian assistance in 2023, and more than a third of Member States classified by the

Figure 3 Number of leprosy cases reported (autochthonous and foreign-born) by countries in the Eastern Mediterranean Region, 2023



World Bank as fragile, conflict-affected and vulnerable in 2024 (*17,18*). Emergencies have a direct negative impact on health system performance and result in wider socioeconomic issues, such as food insecurity and poor access to water and sanitation (*19*). Within the EMR, only 59% of healthcare facilities provided basic hand hygiene services and 29% had basic sanitation services (*20*). The proportion of people living below the international poverty line (less than US$ 1.90 per day) in reporting countries in the EMR is > 25%, with the highest proportion in Yemen, where almost half the population live below the poverty line (*2*). These risk factors can facilitate leprosy transmission, which has been reported to increase up to 2 times in correlation with lower income, educational levels and unfavorable living conditions (*3*).

The overall decrease in number and proportion of new paediatric cases from 2012 to 2023 indicates a decrease in active leprosy transmission in the region. This is further supported by the reduction of new cases with G2D and increased detection among females during the same period, suggesting earlier diagnosis, enrolment on treatment and expanded programme scope. However, some countries continuously report cases among children with G2D at the time of diagnosis, suggesting persistent pockets of active new transmission and gaps in programme reach, delaying timely diagnosis. Low public investment in health has been reported in the region, resulting in high out-of-pocket expenditure at ≈40% for the general population in the EMR between 2005 and 2014 (*22*). Lack of knowledge and awareness among healthcare practitioners about leprosy has also been reported, which may have led to underdiagnosis, especially among lower burden countries (*23,24*). Coupled with leprosy-specific stigma including fear of diagnosis and of being ostracized from their communities, these factors could have reduced health-seeking behaviour and impeded effective service delivery to leprosy patients (*1, 25,26*).

Another distinguishing feature of leprosy programme management in the EMR is the detection and management of non-autochthonous leprosy cases. From 2016, countries started to differentiate between new local/autochthonous and non-autochthonous cases, which was highlighted by the elimination framework. Migration has resulted in an increase in leprosy prevalence and countries such as Kuwait and Saudi Arabia examine migrants upon arrival and periodically during check-ups, which facilitates early diagnosis and treatment (*27*). As the region hosts 64% of the world's refugees, and unless managed successfully, this could pose a challenge for elimination of leprosy (*28,29*). Additional efforts are necessary to reduce prejudice, stigma and discrimination. There are currently 108 laws globally that allow discrimination on the basis of leprosy. Countries should abandon policies that permit discrimination, as was done in Japan, which outlawed their life-long quarantine policy, and ensure that leprosy patients have equal rights with regard to citizenship, education, work and marriage (*30-32*).

Table 4 Proportion of new non-autochthonous leprosy cases among EMR Member States, 2016–2023

Country	2023	2022	2021	2020	2019	2018	2017	2016
Bahrain	*	100	100	100	100	100	100	NA
Iran (Islamic Republic of)	29	33	20	20	39	7	26	10
Kuwait	100	100	100	100	NA	100	100	100
Lebanon	*	0	0	0	0	0	0	100
Libya	100	ND	0	0	0	ND	0	ND
Morocco	ND	0	14	0	NA	0	15	0
Oman	0	0	100	100	100	75	67	100
Pakistan	0	NA	2.8	0.9	0.6	2	0.7	0.3
Qatar	100	100	100	0	100	NA	0	100
Saudi Arabia	89	84	60	94	78	89	100	85
Sudan	2	3	8	3	4	4	2	NA
United Arab Emirates	90	100	0	100	100	100	NA	100
Yemen	0	0	0	0	1.3	0	NA	0

Data represent the number of newly reported leprosy cases classified as non-autochthonous, defined as a case not presumed to have acquired infection following local transmission within the reporting area. Data are aggregated at the country level.
Source: World Health Organization, 2024.

Our review draws on more than a decade of surveillance data and applies WHO-standardized indicators, enabling comparability across time and between countries. The analysis highlights contextual factors particular to the region such as conflict, migration and stigma that influence leprosy control. However, the review also had limitations. National reporting may have underestimated true disease burden due to underdiagnosis, stigma, weak surveillance or even disrupted health services in fragile settings. Aggregated data do not capture subnational heterogeneity and the persistence of pockets with high transmission despite overall national-level progress. Further analysis can disaggregate data to investigate these pockets and target interventions accordingly.

Conclusion

Some of the countries in the EMR are progressing towards reduction of disease burden and elimination of leprosy. All countries need to continue investing in measures to enhance early diagnosis, ensure effective disease management, and promote social inclusion, as outlined by The WHO Global Leprosy Strategy. More specifically to the region, countries need to address barriers in accessing leprosy-related care and maintain sufficient capacities. In May 2024, WHO convened a mission to Jordan with an independent team of global experts and verified elimination of leprosy. Jordan was the first country in the world to have achieved that status. This brings a powerful message on leprosy and impulse to other countries in the region and worldwide to revitalize efforts towards interruption of transmission and elimination of leprosy.

In applying the elimination framework to the rest of the region, Bahrain, Islamic Republic of Iran, Iraq, Kuwait, Lebanon, Oman, Qatar, Tunisia and United Arab Emirates have reached the first phase of leprosy elimination. The health ministries in these countries have to evaluate their systems and ensure that a lack of case detection among children is not an artifact or an absence of awareness of leprosy, lack of training of health workers or a lack of access to diagnostic services. Once this has been confirmed in a given administrative area, the health ministry can formally acknowledge that interruption of transmission has been achieved. Bahrain, Kuwait, Lebanon and Qatar have reached the second phase of leprosy elimination and have not reported autochthonous cases. After addressing any data gaps, these countries can use the Transmission Assessment Tool and compile sufficient evidence to submit their country dossiers for validation.

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Progrès réalisés en vue d'éliminer la lèpre dans la Région de la Méditerranée orientale

Résumé

Contexte : Bien que la lèpre ne constitue plus un problème de santé publique mondial depuis 2000, certains pays continuent de notifier de nouveaux cas.

Objectif : Évaluer les progrès accomplis en vue de l'interruption de la transmission de la lèpre et de son élimination dans la Région de la Méditerranée orientale.

Méthodes : Nous avons extrait et analysé les données relatives à la lèpre de l'Observatoire mondial de la santé de l'OMS pour la période 2012-2023, concernant les pays de la Région de la Méditerranée orientale. Nous avons calculé les taux de dépistage des nouveaux cas, les taux de cas d'incapacité de degré 2 et les nouveaux cas pédiatriques par million d'habitants.

Résultats : Le taux de dépistage des nouveaux cas a augmenté, passant de 3,7 cas par million d'habitants en 2012 à 6,0 cas en 2018, puis est redescendu à 3,6 cas en 2023. Chez les enfants de moins de 15 ans, le taux de dépistage des nouveaux cas est passé de 0,6 cas par million en 2012 à 1,3 cas en 2017 ; il est ensuite retombé à 0,5 cas en 2023. La proportion de femmes parmi les nouveaux cas a augmenté, passant de 34,4 % en 2012 à 42,0 % en 2023. Le taux d'incapacité de degré 2 a diminué, d'un niveau de 0,5 cas par million d'habitants en 2012 à 0,3 cas en 2023. En 2023, l'Égypte, le Pakistan, la Somalie, le Soudan et le Yémen concentraient 94 % des cas. Treize pays ont notifié 0 à 10 nouveaux cas autochtones chaque année. La proportion de cas non autochtones est passée de 3,4 % en 2016 à 4,2 % en 2023.

Conclusion : Certains pays de la Région de la Méditerranée orientale progressent sur la voie de l'élimination de la lèpre. La diminution des cas de lèpre parmi les enfants de la Région indique un recul de la transmission active. Un investissement continu de la part de tous les pays permettra d'améliorer le diagnostic et le dépistage précoces, de garantir une prise en charge efficace de la maladie et de promouvoir l'inclusion sociale, tel que le prévoit la Stratégie mondiale OMS de lutte contre la lèpre.

التقدم المحرز نحو القضاء على الجذام في إقليم شرق المتوسط

صوبرية واروسافيتانا، منى عثمان، بسمة صالح، نيفين ويلسون، فيفيك لال، فينكاتا بيمارا جو

الخلاصة

الخلفية: رغم أن الجذام توقف عن كونه مشكلة صحية عامة عالمية في عام 2000، مع ذلك فإن بعض البلدان لا تزال تبلغ عن حالات جديدة للإصابة به.

الأهداف: هدفت هذه الدراسة الى تقييم التقدم المحرز نحو وقف سريان الجذام والقضاء عليه في إقليم شرق المتوسط.

طرق البحث: استخلصنا بيانات الجذام وحللناها في الفترة من عام 2012 حتى عام 2023 لبلدان إقليم شرق المتوسط، من المرصد الصحي العالمي التابع لمنظمة الصحة العالمية. وحسبنا معدلات اكتشاف الحالات الجديدة، ومعدلات حالات الإعاقة من الدرجة الثانية، والحالات الجديدة بين الأطفال لكل مليون نسمة.

النتائج: ارتفع معدل اكتشاف الحالات الجديدة من 3.7 لكل مليون نسمة في عام 2012 إلى 6.0 في عام 2018، ثم انخفض إلى 3.6 في عام 2023. وارتفع معدل اكتشاف الحالات الجديدة بين الأطفال الذين تقل أعمارهم عن 15 عامًا من 0.6 حالة لكل مليون في عام 2012 إلى 1.3 حالة في عام 2017، ثم انخفض إلى 0.5 حالة في عام 2023. وارتفعت نسبة الإناث في الحالات الجديدة من 34.4% في عام 2012 إلى 42.0% في عام 2023. وانخفض معدل الإعاقة من الدرجة الثانية من 0.5 حالة لكل مليون نسمة في عام 2012 إلى 0.3 حالة في عام 2023. وبحلول عام 2023، أبلغت 94% من الحالات من باكستان والصومال والسودان ومصر واليمن. كما أبلغ ثلاثة عشر بلدًا عن 0–10 حالات جديدة محلية الأصل سنويًا. وارتفعت نسبة الحالات غير المحلية الأصل من 3.4% في عام 2016 إلى 4.2% في عام 2023.

الاستنتاجات: تحرز بعض بلدان إقليم شرق المتوسط تقدمًا نحو القضاء على الجذام. ويشير الانخفاض في حالات الجذام بين الأطفال في الإقليم إلى تحقيق انخفاض في معدل السريان النشط للمرض. وسيؤدي استمرار الاستثمار من جانب جميع البلدان إلى تحسين عمليات التشخيص والكشف في وقت مبكر، وضمان العلاج الفعال للأمراض، وتعزيز الإدماج الاجتماعي على النحو المبين في الاستراتيجية العالمية للمنظمة بشأن الجذام.

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