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المجلة الصحية لشرق المتوسط

La Revue de Santé de la Méditerranée orientale


In the WHO Eastern Mediterranean Region, over 100 million people fall ill every year from foodborne diseases. Of these, an estimated 37 000 die annually. In addition, a number of studies have identified a clear relationship between occupational exposure to pesticides and a number of noncommunicable diseases. To mitigate this, WHO supports a strengthening of the implementation, strict governance and enforcement of existing food safety regulations and international agreements in order to protect populations in the Region.

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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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# The dilemma of pesticide residues in fruits and vegetables in the Eastern Mediterranean Region

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In the World Health Organization Eastern Mediterranean Region (EMR), over 100 million people fall ill every year from foodborne diseases, of whom an estimated 37 000 die annually (disproportionally children). A number of studies have identified a clear relationship between occupational exposure to pesticides and a number of noncommunicable diseases (NCDs). For example, respiratory symptoms were reported in 65.9% of farmers exposed to pesticides in Pakistan (*1*); lymphoproliferative disorders following exposure to pesticides in Egypt (*2*); and hepatocellular carcinoma in Yemen with 73.7% of farmers having a history of chemical contact with insecticides or fertilizers (*3*). However, a challenging task regarding the burden of foodborne disease is the attribution to chemicals in food as a source for NCDs, since this requires long-term epidemiological and exposure monitoring data.

The World Health Organization Regional Office for the Eastern Mediterranean (WHO/EMRO) Centre for Environmental Health Action (CEHA) conducted a literature review regarding exposure to pesticides through diet. The review identified 25 studies carried out between 2005 and 2019 in the EMR that reported analytical results for pesticide residues in fruit and vegetables (*4*). As a first result, the review reported that international Maximum Residue Limits (MRLs) were exceeded in up to 61% of the samples. In addition, 87% of the 6727 samples analyzed saw the exceeded MRL rate higher than 7%; as a comparison, only 0.78% and 1.4% of samples tested in the United States of America (*5*) and in the European Union (*6*) exceeded the regulatory limits, respectively. The second issue revealed is the repeated detection of old organo-chlorine pesticides, such as aldrin/dieldrin, chlordane, DDT, endrin and heptachlor, all of which have been banned by the international community and listed in the Stockholm Convention (*7*) as Persistent Organic Pollutants (POPs).

The traditional approach of controlling and managing the disease burden of environmental risks, including foodborne diseases, relied on treating the symptoms rather than emphasizing deterrence and mitigation of the root causes. Therefore, a multisectoral shift in the approach is needed to focus on upstream preventive and corrective interventional actions for minimizing environmental risks. Since many aspects of food safety services are situated outside the mandate of a single agency and the health sector per se, the integrated cross-sectional framework is steered by the Health in All Policies (HiAP) and Health for All by All principles (*8*). Within the overarching approach of the "Farm-to-Fork" strategy (*9*), the work of CEHA shall focus on supporting the leadership role of the public health sector in regulating and monitoring environmental health factors (*10*), promoting preventive interventions, and in particular catalyzing adequate food safety services and actions by pertinent sectors (e.g. agriculture, water, trade, transport, etc.).

WHO, in collaboration with Food and Agricultural Organization (FAO) of the United Nations, organized in 2020 an expert consultation to discuss the results of the literature review and to provide UN partners and national authorities with recommendations on the way forward to tackle this dilemma. A regional panel of multi-sectoral experts coming from versatile relevant back grounds such as laboratory experts, chemical exposure experts, researchers, NCDs and other specialists, was formed to assess the situation and magnitude of pesticides and insecticide residues on fruits and vegetables, and the potential short and long-terms public health impacts. Major gaps were identified due to the lack of harmonization of regulations within the Region; in particular, the participation of EMR countries in the Codex Alimentarius (*11*) and the implementation of codex standards, which appeared ad hoc and inadequate.

At national levels in most countries in the EMR, it was noted that there was evidence of poor traceability systems and a shortage of resources and efforts to implement an integrated pesticide management involving farmers, food exporters, retailers, and importers of pesticides. An additional obstacle to improving farmer practices was the absence of chemicals' safety awareness, the distribution of small farm-holdings within EMR countries, and the deficient organization/coordination between stakeholders to ensure sufficient support.

Thus, it is recommended that EMR countries and international organizations undertake several measures to mitigate these obstacles, namely: implement an effective legal framework; improve health workforce recruitment; implement monitoring, surveillance and response functions; effective interaction with

stakeholders; and implement an evidence/risk base policy.

Populations in the Region are often exposed to pesticide residues. Exposure to pesticides may include illegal (banned and or restricted internationally) or obsolete pesticides, as well as legal pesticides evaluated by international organizations. Excessive human exposure to certain types of pesticides may lead to adverse health effects, such as increased cancer risk, reproductive disorders, alteration of the immune system, neuro-behavioural impairment, endocrine disruption, geno-toxicity and an increase in birth defects, among others.

The responsibility to govern pesticide production, usage and management of health effects is often shared by several government offices, including ministries of industry, environment, agriculture and health. It is therefore necessary to maintain a high level of coordination between all involved ministries in order to establish a coherent and comprehensive regulatory framework to fully control human exposure to pesticides used in agriculture (*12*,*13*). Data from monitoring programmes should be used to perform human exposure assessment (including occupational health) and lead to regulatory enforcement mechanisms governing specific pesticide lifecycle within the "Farm to Fork" strategy. A regional action plan to strengthen food safety systems (2017-2022) (*10*) was developed by WHO and accepted by Member States to support this process.

However, while WHO continues to advocate a healthy and balanced diet for all, based on increasing portions of fresh fruits and vegetables, focus should also remain on the issue of pesticides residues. Moreover, adverse health effects of such chemicals are not immediately apparent but rather materialize over a human lifetime (from the moment of reproductive conception to the moment of demise, and perhaps even beyond when considering hereditary genetic mutation and distortion). An implementation and strict governance and enforcement of existing regulations and international agreements would be necessary to protect populations in the Region. Strengthening farmer education and proposing incentives to producers to implement good agricultural practices and integrated pesticide management remain the cornerstone to improving the situation in a sustainable way. Given the diverse mixtures of toxic substances, microbial agents and harmful compounds embedded within the pesticide application in agriculture, the risk of adverse health exposures throughout the production process cycle and beyond is very high. The role of national health and agricultural authorities must be concentrated on the health aspects of integrated chemicals and food safety throughout the life cycle, the safe and sound management of pesticides, as well consumers safety and well-being.

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# COVID-19 in Gaza: a pandemic spreading in a place already under protracted lockdown

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Gaza is a densely populated area that forms part of the Occupied Palestinian Territories, and inhabited by approximately 2 million Palestinians of whom the majority are registered refugees living in overcrowded camps (*1*). The prolonged blockade imposed since 2007 has severely impacted the socioeconomic and health conditions of Gazans (*2*). The longstanding movement restrictions have undermined Gaza's economy, resulting in high levels of unemployment, food insecurity, aid dependency and poor standards of hygiene and sanitation. The Palestinian Ministry of Health swiftly declared a state of emergency in early March 2020 following the report of 5 cases of COVID-19 in Gaza, and subsequently shifted public health efforts and medical supplies to respond to the emergency. To prevent the spread of COVID-19, both the Israeli and Palestinian authorities in Gaza and the West Bank now request that patients do not leave Gaza, except for emergency cases and certain cancer patients.

However, these new movement restrictions are increasing inequity in access to health care for patients with noncommunicable diseases, particularly cancer, as well as other vulnerable groups. This policy so far has caused a 40% reduction in the number of medical referrals for patients in Gaza (901 referrals from Gaza in May 2020 compared to an average 2000 referrals per month in the first quarter of 2020). Moreover, a 5% decline in Israeli travel permit approval rates for referred patients has been reported in May 2020 compared with the first quarter of 2020 (*3*). The Palestinian Government in Gaza has also discouraged travel permit applications that could be delayed, and the compulsory 21-day quarantine for everyone entering or re-entering Gaza has been a further deterrent to patients applying for treatments outside of Gaza.

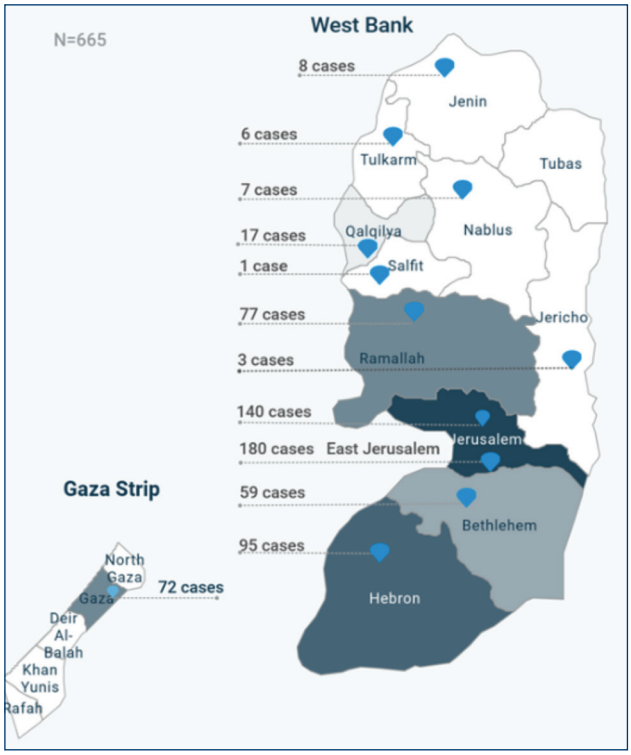
Nearly 4000 elective surgeries have been postponed due to the COVID-19 preparedness and response plan (*4*). Secondary cancer prevention programmes have also been interrupted, and in the coming months this could mean that delays in cancer diagnosis in Gaza may become even more common. In addition, Several major challenges are increasing the threat of COVID-19 infection in Gaza, including 1) overstretched health-care system; 2) inadequate access to safe water, sanitation and hygiene (WASH) services, which are essential to infection prevention; and 3) high density of population, especially in refugee camps where self-isolation is almost impossible (*5*). Currently, there are only 63 adult intensive care unit beds with ventilators in governmental hospitals in Gaza, which are barely enough for routine cases, along with a limited number of available donated personal protective equipment (PPE) (*6,7*). Nearly half of the essential drugs list, including cancer chemotherapy, are at a zero stock levels (*8*).

As of June 11, 2020, there have been 72 confirmed cases of COVID-19 in Gaza with a case fatality rate (CFR) of 0.81%. These figures appear very low compared to elsewhere in the Occupied Palestinian Territories (547 cases in the West Bank including East Jerusalem) and the rest of the world (Figure 1) (*6*)

However, the numbers are expected to rise exponentially and therefore it is imperative to start thinking strategically of what can realistically be done before losing control over the current situation. Unlike the 'one size fits all' approach, measures that have proven successful in other countries might not be effective in densely populated and disadvantaged environments such as Gaza. Avoiding social gatherings or observing the two-metre distancing measure could well be viewed as foreign concepts and its effectiveness will be limited among Palestinian extended families living in overcrowded refugee camps.

With this in mind, proactive and proven public health interventions of 'test, trace and isolate' must be implanted at a large-scale. So far, and despite international funding, there continues to be a very limited testing capacity in Gaza due to the lack of laboratory testing kits. Nevertheless, strict safety regulations, including a mandatory 21-day home quarantine for all people coming through the two passenger crossings with Israel (Erez) and Egypt (Rafah), have significantly reduced the virus transmission to the population in Gaza. The Palestinian Authority in Gaza has agreed with Egypt to keep the Rafah crossing closed in both directions since May 15, and only allow occasional return to Gaza on a case-by-case

**Figure 1 Geographical locations of COVID-19 in the Occupied Palestinian Territories (adapted from the WHO Situation Report 32) (6)**




basis in order to regulate the capacity in their quarantine facilities. Access to health care in and out of Gaza through the Erez crossing, which has been extremely limited due to COVID-19, is now stopped by the decision of the Gazan Authority to suspend security coordination in response to Israel's annexation plans.

COVID-19 has resulted in high levels of uncertainty, anxiety, social isolation, and further inequity in health care for Palestinians in Gaza. Thus, it is important to maintain the availability and access to essential health care and WASH services, and to scale up testing and tracing capacities, all of which are needed during this period to reduce potential health consequences. There may be no way to prevent a COVID-19 outbreak in Gaza, but whenever COVID-19 treatments or vaccines become available, equal allocation to Gaza and other disadvantaged environments might be problematic. Meanwhile, it is essential to focus efforts on testing, tracing and isolating, awareness and advocacy interventions about the disease, immediate access to handwashing, more training in infection prevention and control for Palestinian healthcare workers, more compliance to mitigation procedures, as well as improved access to health care for chronically ill patients in Gaza.

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# Halat Bu Maher: the past and present use of quarantine in Bahrain

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In December 2019, the first case of COVID-19 was reported in the Chinese city of Wuhan and within months had resulted in an unprecedented global pandemic. Transmitted through close contact and via droplets, a cornerstone of the global efforts adopted against the virus has been social distancing and various forms of quarantine (*1*). The word 'quarantine' comes from the Italian word 'quaranta' for '40'. This originated in 1377 when the Rector of the Venetian-controlled city of Ragusa declared a 40-day isolation period for land travellers during a plague epidemic (*2*). However, the origin of quarantining as a practice to control the spread of disease can be traced much earlier, with examples seen in the Old Testament of the Bible (regarding the separation of people afflicted with leprosy), and 2500 years ago during the time of the Greek physician, Hippocrates (*3*).

Quarantine has consistently shown to be effective in mitigating the mortality and incidence of pandemic diseases, more recently confirmed with the current COVID-19 pandemic. In particular, the early utilization of quarantine in conjunction with other public health measures have been advocated (*4*). However, the psychological impact from mass mandatory quarantines worldwide should also be considered. Previous studies of quarantined patients had revealed varying prevalence of stress, depression, irritability and post-traumatic stress disorder. Prominent stressors such as prolonged periods of isolation, disease-related anxieties, loss of normal life routine, insufficient information from public health authorities in addition to socioeconomic factors such as unemployment have been identified (*5*).

Bahrain is an island nation situated in the Gulf Region consisting of 33 natural islands, the most notable being Bahrain Island which hosts the capital city Manama, and Muharraq Island, which is home to the airport. Bahrain's modern health-care system dates back to the establishment of the Mason Memorial Hospital in 1903 by American missionaries, widely believed to be the first Western hospital in the country and one of the earliest in the Gulf Region (*6*). The country was a British protectorate until it achieved independence in 1971. In the first half of the 20th century, the country experienced numerous outbreaks of smallpox, cholera, plague, and typhoid fever – necessitating the arrangement of quarantine facilities by the British (*7*).

Prior to 1930, a quarantine camp was built on the sea shore close to the suburb of Gudaibiya, located to the southeast of Manama. Due to increasing urbanization and the construction of residential houses close to the quarantine site, the State Medical Officer during the late 1920s declared the site to be unsuitable (*8*). After lengthy negotiations, the Bahraini government sold the site to the British Royal Air Force (RAF) for 13 000 Gulf Rupees, which included the foreshore between the camp and the sea. The RAF converted the site into a rest camp, since it was very conveniently situated opposite the flying boat anchorage for commercial and military uses (*8*).

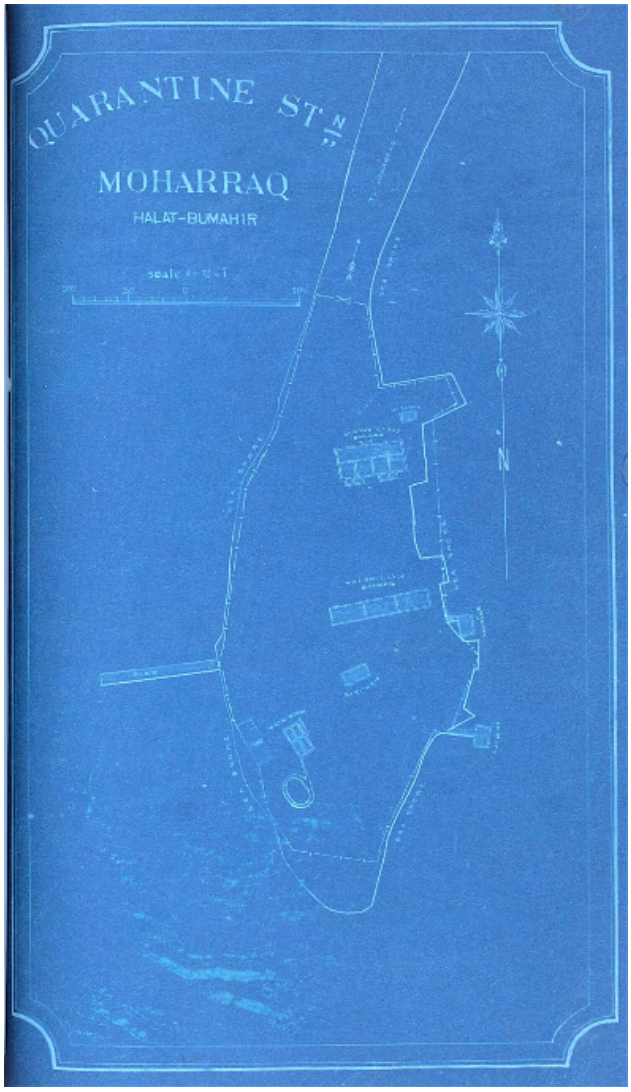
Shaikh Hamad bin Isa Al Khalifa, son of the ruling Shaikh Isa Bin Ali Al Khalifa, leased to the government a small peninsula on the southern shore of Muharraq island, known as Halat Bu Maher, as a site for the new quarantine camp. Built at the cost of 9000 Gulf Rupees in the Islamic Hijri year of 1348 (1929-1930), and with a rent of 4800 Gulf Rupees per annum, the position was very well suited for its purpose. It could be reached by boats during all tides and is connected to the Muharraq mainland by a narrow isthmus. An artesian well was already present on site and a large amount of stone was available for use to construct new buildings, from the ruins of the Bu Maher fort (Figure 1) (*8*). The site was mostly utilized for quarantining new arrivals by sea or air.

The site was previously inhabited by Baluchis who only moved after being compensated with land elsewhere on Muharraq island. After they moved, the site was cleared and new buildings were erected (Figures 2 and 3), consisting of one large stone bungalow for the second class passengers, containing four rooms each with an attached bathroom opening into a veranda, and a long stone building divided into three compartments for deck passengers. Adjacent to the buildings there are latrines for men and women, cook houses and bathrooms (*9*).

The tower of the old fort was repaired and made accessible. Interestingly, the reason cited in British sources was not because it was in any way needed, but rather it was felt that the conspicuous tower - the only one remaining in a place of considerable historical interest - should not be allowed to fall (*9*). The Bu Maher fort is currently recognized as a UNESCO World Heritage Site (*10*).

A rough stone pier has been built reaching into deep water and the whole camp is surrounded by a strong

**Figure 1** **Blueprint of the Bu Maher quarantine site (*9*)**




barbed wire fence with a gate at the neck of the narrow causeway, which joins the promontory to the town of Muharraq, and another one on the pier. The work was carried out by the government under the supervision of K.S. Mohamed Khalil of the Muharraq municipality. The new site was considered superior in quality compared to the previous RAF quarantine site, which has since been converted to a resting area (*9*).

With the advent of effective vaccines to prevent and eradicate diseases such as smallpox and typhoid fever, coupled with massive improvements in public health, the need for quarantine facilities declined over time and the camp was eventually shut down at some point in the latter half of the 20th century to be reused as a housing project. The last reported outbreak of smallpox in Bahrain was in 1956 and the country was certified smallpox-free in 1978 (*11*).

Bahrain reported its first confirmed case of COVID-19 on 24 February 2020 in a traveller from the Islamic Republic of Iran (*12*). Within the weeks that followed, the country implemented a series of precautionary measures including the shutting down of educational institutions, restricting entry to the country to Bahrainis and residents only, and prohibition of public gatherings of more than 5 persons (*13*). Additionally, Bahrain implemented an extensive contact-tracing programme, utilized location-tracking bracelets to enforce home quarantines, and provided free COVID-19 testing and treatment for all suspected patients irrespective of nationality (*14*). As of 6 May 2020, Bahrain had conducted more than 160 000 tests yielding at least 3900 confirmed cases of COVID-19 (*15*).

Echoing the lesson of Halat Bu Maher, the Bahraini authorities designated a new man-made island as a quarantine camp for suspected COVID-19 cases in

**Figure 2** **One of the newly constructed buildings in the quarantine site at Bu Maher (*8*)**

Figure 3 **Photograph of Bu Maher Fort, taken from the west, during the 1930s (*18*)**

March 2020. The camp site, built off the coast of Sitra island, has a capacity for 3000 patients and, as with its predecessor, has a narrow isthmus leading to a controlled access point of the camp (*16*). In May 2020, a 154-bed field intensive care unit was opened adjacent to the quarantine camp, staffing over 300 health-care professionals (*17*).

In conclusion, as worldwide efforts to develop effective vaccines and medications for COVID-19 continue, social distancing measures, good hand hygiene, and the early utilization of quarantine remain the only effective methods of controlling the COVID-19 pandemic at this stage.

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# Epidemiology of SARS-CoV-2 in Egypt

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## Abstract

**Background:** On 30 January 2020, the World Health Organization declared the novel severe acute respiratory syndrome coronavirus-2 to be a Public Health Emergency of International Concern. Egypt is among the five countries reporting the highest number of cases in Africa.

**Aims:** We aimed to provide an overview of the epidemic features of COVID-19 in Egypt in order to help guide an effective lockdown-exit strategy.

**Methods:** The incidence proportions, case fatality rates (CFR), growth rates, doubling time (Td), basic reproductive number ($R_0$) and Herd Immunity Threshold (HIT) were calculated weekly and reviewed.

**Results:** As of 21 May 2020, the epidemic growth rate and $R_0$ have decreased significantly; the averages (±SD) were 0.35 (±0.33) and 2.6 (±1.55) respectively. However, the incidence proportion has increased to 14 cases /100 000 population.

**Conclusion:** COVID-19 transmissibility has declined but the incidence rate has increased, underscoring that any lockdown-exit strategy should include measures to strengthen physical distancing, and case-based interventions to prevent an uncontrolled upsurge of COVID-19 cases.

Keywords: COVID-19, basic reproductive number, epidemic growth rate, doubling time, case fatality rate

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## Introduction

On 30 January 2020, the World Health Organization (WHO) declared the novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which causes COVID-19, to be a Public Health Emergency of International Concern. SARS-CoV-2 is spreading from person to person primarily via direct contact or through direct droplets spread by coughing or sneezing from an infected individual (*1*). It has been estimated that the median incubation period of SARS-CoV-2 is 5.1 days (*2*) and SARS-CoV-2 patients are the main source of infection (*3,4*). The average basic reproductive number and doubling time were estimated to be 3.28 (*5*) and 2.5 days (*6*) respectively. It has been reported that more than 80% of infected individuals are asymptomatic or show mild symptoms, 15% develop more severe symptoms, and 5% become critically ill. The case fatality rate is estimated at 2–3% (*7,8*).

By 25 May 2020, 5 371 700 cases of COVID-19 had been reported globally, including 344 815 deaths. Egypt is among the five countries reporting the highest number of cases in Africa with a total of 17 265 cases as of 25 May 2020 (*3*). The aim of the current study is to provide an overview of the epidemic features of COVID 19 in Egypt to guide effective lockdown exit strategies.

## Methods

We analyzed available data on COVID-19 cases and deaths published in the daily governmental reports (*9*). Data was entered on Excel and was used to plot the epidemic curves for cases and deaths. Key epidemic indicators were calculated using the following formulas (*10,11*):

### Cumulative Incidence (CI) proportion (per 100 000 population)

CI = total number of cases up to certain date/ population at start of time interval (population in 1 January 2020)

### Case Fatality Rate (CFR)

CFR = total number of deaths up to certain date/total number of diagnosed cases up to certain date

### Epidemic Growth Rate (between time 2 and time 1) is the rate at which the number of cases increases

$r(t_2 - t_1) = \ln(I_2) - \ln(I_1)$ *(I is the cumulative incidence)*

### Epidemic Doubling Time (the time it takes for the incidence to double)

$T_d = \ln(2)/ [\ln(I2) - \ln(I1)]$

### The Basic Reproductive Number ($R_0$) (the expected number of secondary cases generated by one infected case)

$R_0 = 1 + r\,Tg$ *(Tg is the mean generation time/serial interval)*

### Herd Immunity Threshold (HIT) (the proportion of a population that needs to be immune in order for an infectious disease to become stable in that community)

$HIT = 1 - 1/R_0$

The incidence proportions, growth rates, doubling times and CFR were calculated on days 7, 14, 21 and

28 from February till May 2020 (as only one case was reported prior to 28 February 2020). We used the median serial interval calculated by Nishiura H., et al. (2020) to calculate the basic reproductive number in Egypt (12). The median serial interval was estimated at 4.6 days.

## Results

The COVID-19 epidemic curve looks flattened, although it indicates that Egypt is still in the rising phase of the epidemic (Figure 1). The first case in Egypt was recorded 15 February and the largest number of cases was recorded on 23 May (783). The daily number of deaths is also on the rise with little fluctuations over the specified time period. largest number of deaths was 29, recorded 25 May.

The epidemic growth rates and doubling time are shown in Figure 2. It reveals a steady and slow decline in the growth rates during the months of April and May when compared to rates in March. The highest level was in the first week of March (1.8). However, the shortest epidemic doubling time was during the first week of March, after which it gradually increased during April and May. The most recent data indicate that the number of cases will double every 15 days

Table 1 shows that there was a sharp increase in the weekly incidence proportion, starting in May, and reaching 14 cases / 100 000 population. Additionally, there was a sudden increase in $R_0$ in the period between 28 February and 7 March. $R_0$ reached the highest value of 6.5, when every infected person was able to transmit the infection to 6.5 persons.

As the epidemic progresses in Egypt, the $R_0$ shows a steady and slow decline, reaching 1.6 during the third week of May. Herd Immunity Threshold (HIT) showed the same pattern as for the $R_0$; the level was high in the early stages and declined to reach 39% by 21 May. This indicates that currently less than half of the Egyptian

**Figure 1 Daily number of COVID-19 cases and deaths in Egypt**

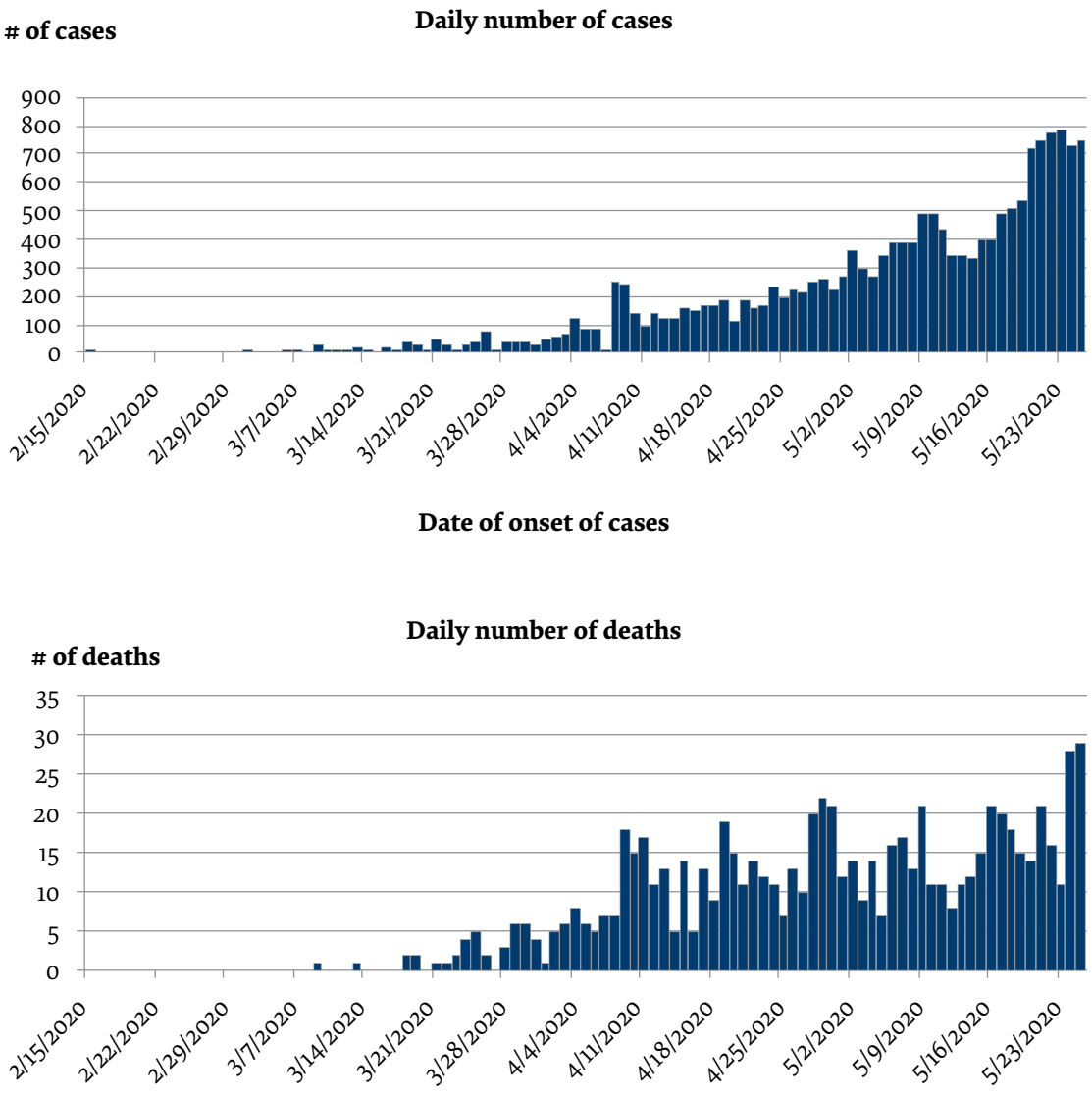


**Figure 2 Epidemic growth rate (r) and doubling time of COVID-19**

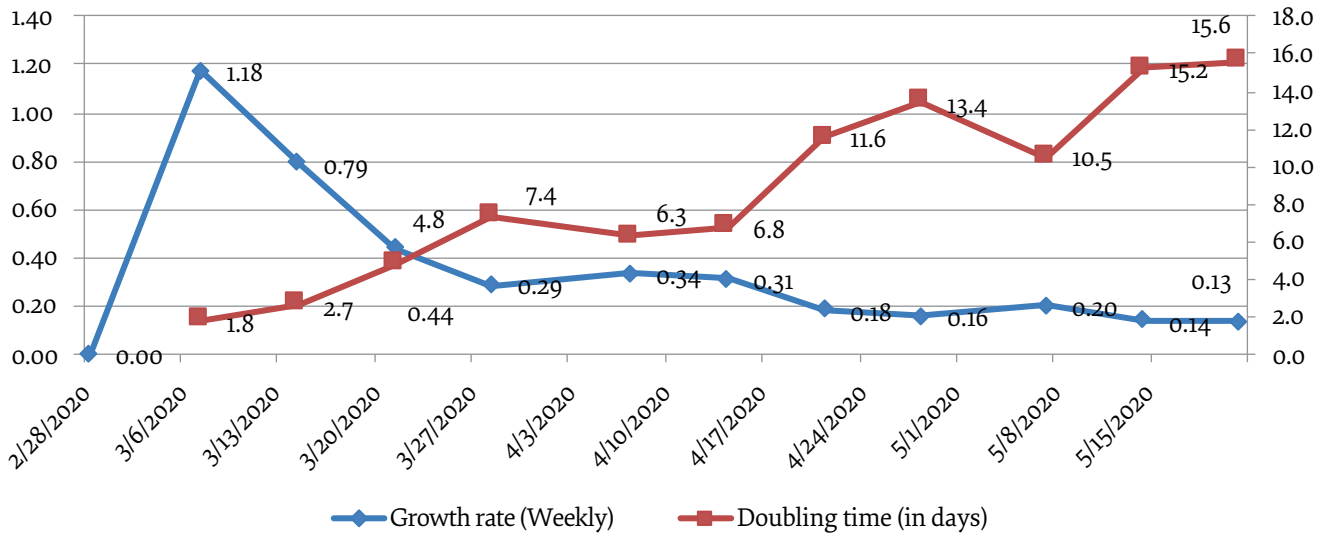



**Table 1 Reproductive number ($R_0$) and corresponding Herd Immunity Threshold (HIT) of COVID-19 in Egypt, February-May 2020**

| Date | Incidence /100 000 | Growth rate | Doubling time (days) | $R_0$ | HIT (%) |
|---|---|---|---|---|---|
| 28/02/2020 | 0 | 0 | | 1 | 0% |
| 07/03/2020 | 0.02 | 1.18 | 1.8 | 6.5 | 85% |
| 14/03/2020 | 0.09 | 0.79 | 2.7 | 4.7 | 79% |
| 21/03/2020 | 0.26 | 0.44 | 4.8 | 3.1 | 67% |
| 28/03/2020 | 0.5 | 0.29 | 7.4 | 2.3 | 57% |
| 07/04/2020 | 1.07 | 0.34 | 6.3 | 2.6 | 61% |
| 14/04/2020 | 2.19 | 0.31 | 6.8 | 2.5 | 59% |
| 21/04/2020 | 3.34 | 0.18 | 11.6 | 1.9 | 46% |
| 28/04/2020 | 4.79 | 0.16 | 13.4 | 1.7 | 42% |
| 07/05/2020 | 7.6 | 0.2 | 10.5 | 1.9 | 49% |
| 14/05/2020 | 10.45 | 0.14 | 15.2 | 1.6 | 39% |
| 21/05/2020 | 14.25 | 0.13 | 15.6 | 1.6 | 39% |
| **Mean** | **3.71** | **0.35** | **8.73** | **2.60** | **52%** |
| **SD** | **4.72** | **0.33** | **4.85** | **1.55** | **22%** |

population needs to be infected in order to halt the spread of COVID 19. The averages of the incidence proportion, growth rate, doubling time, $R_0$ and HIT over the period from the first week of March until the third week of May were estimated to be 3.7/ 100 000, 0.35, 8.7 days, 2.6 and 52%, respectively.

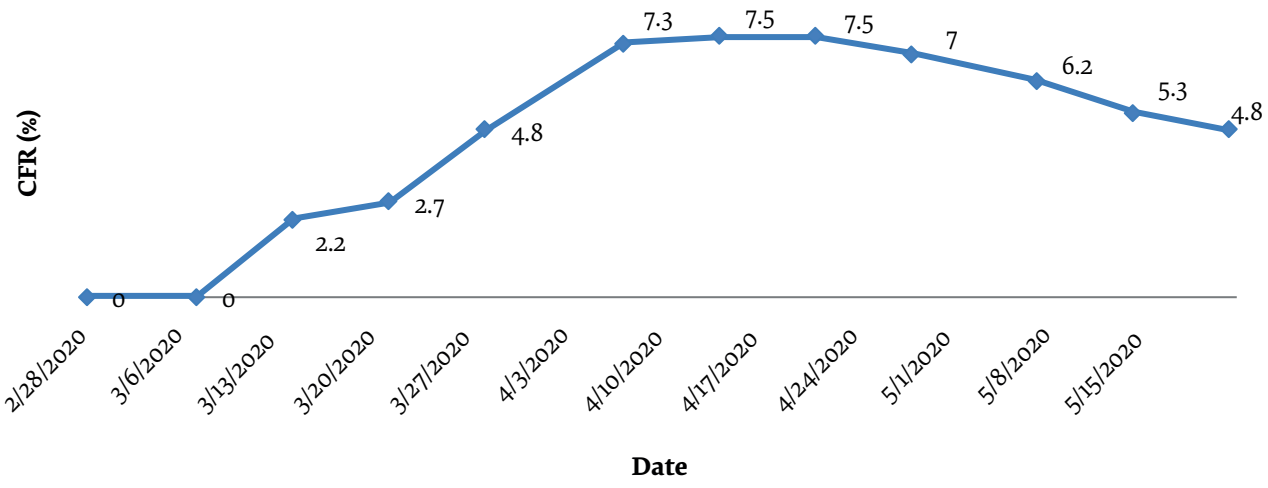
Finally, the case fatality rates has increased from 2.2% in the second week of March to reach its highest level after a 1-month period (7.5%), following which there was a slow decline to reach the latest level of 4.8% (Figure 3).

## Discussion

This study provided a summary description of the COVID-19 epidemic in Egypt, which can provide insights on future prevention and control measures planned to contain the epidemic, as well as the lockdown-exit strategies. Additionally, future data analysis using statistical time series methods can assist in the building of statistical models for COVID-19 epidemic forecasting.

Findings have confirmed the lockdown as an effective strategy to reduce the spread of COVID-19 in Egypt. This was demonstrated by the slow increase in the incidence proportion until mid-May, which was followed by a sharp increase coinciding with the relaxation of lockdown measures during the period of Ramadan. However, COVID-19 transmissibility is declining in Egypt and has currently reached its lowest level; $R_0$ value is 1.6. This implies that each infected person can transmit the infection to an average of 1.6 persons, which is consistent with previous studies (*13*).

**Figure 3 Case fatality rate (%) of COVID-19 in Egypt**




CFR = case fatality rate

Reduced $R_0$ might be attributed to the increased compliance with physical distancing and other mitigation measures applied since March 2020. This notion is supported by the fact that the majority of models have shown that, in the absence of physical distancing, COVID-19 has a reproduction rate between 2 and 3 (or even higher rates). Furthermore, it was suggested that in absence of an effective vaccine, physical distancing measures combined with case-based interventions such as testing and contact tracing, are the key tools to lower the $R_0$ to levels below 1 (*14*).

Consistent with these findings are the results of the doubling time that have also witnessed an increase from values less than 2 days to the current level of over 15 days. An increase in the doubling time indicates a slowdown in transmission if the underlying reporting rate remains unchanged (*6*).

Given the assumption that COVID-19 infection gives long-lasting immunity, findings revealed that on average half of the Egyptian n population needs to be immune to halt the spread of COVID-19. Kwok et al. (*13*) indicated that one likely source to novel SARS-CoV-2 partial immunity might be the presence of antibody cross-reactivity from previous infections with other common coronaviruses. They further attributed mild or asymptomatic infections to the same reason. In Egypt, limited screening and widespread testing hinders the accurate measurement of herd immunity levels, as well as evidence-informed decisions regarding the shift from community-wide interventions that focus on large populations to case-based interventions for prevention of COVID-19 (*15*).

In Egypt, the case fatality rate (CFR) increased from 2.2% during the second week of March to reach its highest level after a 1-month period (7.5%), and then started to slowly decline to reach the latest level of 4.8%. The sudden increase in case fatalities in the early stages of the epidemic in Egypt might be attributed to the 'censoring effect' – during the early epidemic stages, a substantial proportion of cases were still hospitalized and it was not known whether they would eventually recover or die from the disease. Therefore, in the method used to calculate CFR, these patients were included in the denominator but not in the numerator of the CFR, which lowers the early CFR estimates compared to later estimates of CFR. Furthermore, it is noteworthy to point out that CFR depends on the number of diagnosed cases, which in turn depends on the testing rates, which are currently low in Egypt and limited to suspected cases that seek medical care.

## Conclusion

The notable decrease in the growth rate and $R_0$, as well as the increase in the doubling time of COVID-19, are indicative of reduced transmissibility and were most likely due to effective lockdown measures in Egypt. However, increasing incidence is an important criterion that should not been overlooked when governments decide to lift the lockdown measures. Reopening of businesses and sectors should be only considered when the number of new cases declines for 14 consecutive days; a condition that is not met in Egypt. Additional criteria for reopening should include testing capacity, health-care system preparedness, and public health capacity for contact tracing (*14*). Finally, lockdown-exit strategies should emphasize physical distancing and case-based interventions such as testing, contact tracing, and self-isolation for cases and contacts, in order to reduce COVID-19 transmission and prevent an uncontrolled upsurge of the epidemic (*14,16*).

**Funding:** None.

**Competing interests:** None declared.

## Épidémiologie du SARS-CoV-2 en Égypte


### Résumé

**Contexte :** Le 30 janvier 2020, l'Organisation mondiale de la Santé a déclaré que le nouveau coronavirus 2 du syndrome respiratoire aigu sévère constituait une urgence de santé publique de portée internationale. L'Égypte figure parmi les cinq pays notifiant le plus grand nombre de cas en Afrique.

**Objectifs :** Nous avions pour objectif de fournir un aperçu des caractéristiques épidémiques de la maladie à coronavirus (COVID-19) en Égypte afin d'aider à orienter une stratégie efficace de confinement-déconfinement.

**Méthodes :** Les chiffres de l'incidence, les taux de létalité, les taux de croissance, le temps de doublement, le taux de reproduction de base ($R_0$) et le seuil d'immunité collective ont été calculés et revus chaque semaine.

**Résultats :** Au 21 mai 2020, le taux de croissance épidémique et le $R_0$ ont nettement diminué ; les moyennes (±ET) étaient respectivement de 0,35 (±0,33) et de 2,6 (±1,55). Toutefois, l'incidence a augmenté, passant à 14 cas pour 100 000 habitants.

**Conclusion :** La transmissibilité de la COVID-19 a diminué mais l'incidence a augmenté, soulignant que toute stratégie de confinement-déconfinement devrait inclure des mesures pour renforcer la distanciation physique et des interventions basées sur les cas pour prévenir une recrudescence non contrôlée des cas de COVID-19.


## الخصائص الوبائية لفيروس كورونا سارس-2 في مصر

غادة نصر رضوان


### الخلاصة

**الخلفية:** في 30 يناير/ كانون الثاني 2020، أعلنت منظمة الصحة العالمية أن فيروس كورونا المستجد المسبب للمتلازمة التنفسية الحادة الوخيمة-2 طارِئة صحية عامة تسبب قلقاً دولياً. ومصر من ضمن البلدان الخمسة التي أبلغت عن أكبر عدد من حالات الإصابة في أفريقيا.

**الأهداف:** هدفت هذه الدراسة إلى تقديم نبذة عامة عن الخصائص الوبائية لمرض كوفيد-19 في مصر من أجل المساعدة على توجيه استراتيجية فعالة للخروج من الحظر.

**طرق البحث:** حُسبت نسب الإصابات، ومعدلات الوفيات بين الحالات، ومعدلات الزيادة، وزمن التضاعف، وعدد التكاثر الأساسي، والحد الأدنى للمناعة الجَماعية أسبوعياً وجرت مراجعتها.

**النتائج:** منذ 21 مايو / أيار 2020، انخفض بشدة معدل زيادة الوباء وعدد التكاثر الأساسي، فكان متوسطهما 0,35 (±0,33) و2,6 (±1,55) على التوالي. ورغم ذلك، زادت نسبة الإصابة إلى 14 حالة لكل 100 000 نسمة.

**الاستنتاج:** تراجعت سراية مرض كوفيد-19 لكن معدل الإصابة به ازداد، مما يشدد على ضرورة اشتمال أي استراتيجية لحظر الخروج على تدابير لتعزيز التباعد البدني، والتدخلات المستندة إلى الحالات لمنع أي ارتفاع مفاجئ خارج عن السيطرة لحالات كوفيد-19.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# Avian influenza surveillance at the human–animal interface in Lebanon, 2017

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## Abstract

**Background:** Avian influenza viruses (AIVs) cause severe diseases in poultry and humans. In Lebanon, AIV H9N2 was detected in 2006 and 2010 and H5N1 was detected in 2016.

**Aim:** To evaluate the current circulating AIVs in Lebanon at the human–animal interface.

**Methods:** A total of 1000 swabs were collected from poultry from 7 Lebanese governorates between March and June 2017. Swabs were screened for influenza infection. Haemagglutinin and neuraminidase AIV subtypes were determined for positive samples. Gene segments were cloned and sequenced. Blood was collected from 69 exposed individuals. Serological studies were performed to test sera for antibodies against AIV.

**Results:** In chickens, 0.6% were positive for AIV H9N2. Sequences obtained clustered tightly with those of Israeli origin as well as Lebanese H9N2 viruses from 2010. All human samples tested negative.

**Conclusion:** We recommend regular surveillance for AIVs in poultry using a One Health approach.

Keywords avian influenza virus, endemic disease, epidemiology, virus surveillance, Lebanon

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## Introduction

Avian influenza (AI) is considered to be one of the most important viral diseases in the poultry industry. Both domesticated and wild birds can be infected with AI virus (AIV) (*1*). AIVs are divided into 16 haemagglutinin (HA) subtypes (H1–H16) and 9 neuraminidase (NA) subtypes (N1–N9) (*2*). All influenza A subtypes have been isolated from wild bird species (*3*). However, highly pathogenic AI (HPAI) has been restricted to H5 and H7 subtypes in susceptible bird species (*4*), although not all H5 and H7 viruses are highly pathogenic. AIVs of all HA subtypes circulate in wild birds mostly as lowly pathogenic AI (LPAI) with few or no clinical signs (*5*).

Spillover from wild birds to poultry is not uncommon (*6*). The first AI case was isolated from poultry in 1878 in Italy (*7*). Since then, AI has been expanding worldwide in poultry. The occurrence and spread of LPAI or HPAI viruses in poultry vary depending on the levels of biosecurity and concentration of poultry in outbreaks or the emergence of HPAI virus (*1*).

Several human infections with avian influenza A viruses, including H5N1, H9N2, H7N3, H7N7, H7N9 and H10N8, have been reported among poultry-exposed persons in several countries, with Egypt reporting the highest number of H5N1 infections and China the highest number of H7N9 infections (*8–13*). Therefore, avian to human transmission has become an important public health issue. The spread of AIV from East Asia to the Middle East, Europe and Africa has raised the alarm that an influenza pandemic may be imminent (*14*). The burden of influenza in middle eastern countries is now of considerable concern. This agrees with the World Health Organization (WHO) alerts highlighting a major public health threat due to this adaptable virus that is capable of escaping vaccines or producing novel viral strains through antigenic drift or shift (*15–17*). Several middle eastern countries have reported human infections with AIV, including Egypt, Iraq, Djibouti and Pakistan (*18*). This pandemic potential has emphasized the importance of intensive surveillance and control measures at the human–animal interface.

In Lebanon, an H9N2 outbreak occurred in 2006 in chickens in different provinces, leading to a remarkable drop in egg production. In 2010, H4 and H11 antibodies were detected in backyard growers from Bekaa and South Lebanon Governorates respectively (*19*). An outbreak of H5N1 HPAI was first described in Lebanon in April 2016, in a farm in Baalbek in East Lebanon, leading to high mortality among chickens (*20*) that required the intervention of the Lebanese Ministry of Agriculture for monitoring and controlling. Culling of sick birds, decontamination of infected farms, and surveillance within the vicinity of infected farms were applied and the outbreak was resolved in June 2016 (*21*). H9N2 influenza vaccines have been licensed and used in all Lebanese

farms. However, H5 and H7 vaccines are not licensed by the Lebanese Ministry of Agriculture.

To identify the current circulating AIV at the human–animal interface in Lebanon, we conducted a nationwide, cross-sectional survey among Lebanese poultry and poultry-exposed individuals from March to June 2017. This was performed by adapting a One Health approach jointly between involved governmental institutions and nongovernmental research entities.

## Methods

One thousand chickens (breeders, broilers and layers) were randomly sampled (cloacal and oropharyngeal swabs for each) from poultry production sectors from 7 Lebanese governorates: North (n = 200), Akkar (n = 200), South (n = 150), Nabatiyeh (n = 50), Mount Lebanon (n = 150), Baalbek (n = 100), and Beqaa (n = 200) depending on poultry density, from March to June 2017. The timing was because many farms are not accessible during the winter due to weather conditions. We selected farms near the borders, farms with low biosecurity measures designed to prevent infectious diseases, and farms with high biosecurity measures (access restriction, decontamination troughs, and indoor-housing of birds). Between 5 and 30 samples were collected per farm according to the size of the farm, the number of pens per farm, and the farm's biosecurity level.

Each sample pool (cloacal and oropharyngeal swabs) was used to inoculate 10-day-old specific-pathogen-free embryonated chicken eggs that were incubated at 37°C for 30 hours. The allantoic fluid was harvested and tested for HA. Viral RNA was extracted from each HA-positive allantoic fluid and subjected to reverse transcription polymerase chain reaction (RT-PCR) to amplify 244 bp of the M segment of influenza A viruses according to a WHO protocol (22). Samples positive for the M segment were then subjected to additional RT-PCR to determine the HA and NA subtypes (23). The first-strand cDNA was synthesized using Superscript III Reverse Transcriptase (Invitrogen, Carlsbad, CA, USA) and Uni-12 primer (5′-AGCRAAAGCAGG-3′). Using a Phusion Master Mix kit (New England Biolabs, Ipswich, MA, USA), the full genomes of three isolates were amplified using universal primers (24) and then sequenced using a 96-capillary 3730xl DNA Analyzer (Applied Biosystems, Foster City, CA, USA). Sequences were assembled using SeqMan DNA Lasergene 7 software (DNASTAR, Madison, WI, USA). The HA nucleotide sequences obtained in this study are available from GenBank under accession numbers MG882007, MG882008 and MG882009. MegAlign (DNASTAR) and BioEdit 7.0 were used for multiple sequence alignment (25). MEGA 5.0 was used for phylogenetic tree construction of gene segments by applying the neighbour-joining method with Kimura's 2-parameter distance model and 1000 bootstrap replicates (26). The trees included all Lebanese H9N2 virus sequences available in the GenBank database, and closely related H9N2 viruses from other middle eastern countries as shown by a BLAST search.

Summary statistics were calculated and plotted using Excel (Microsoft, Redmond, WA, USA). Proportions of positive results were calculated with a 95% confidence interval (CI).

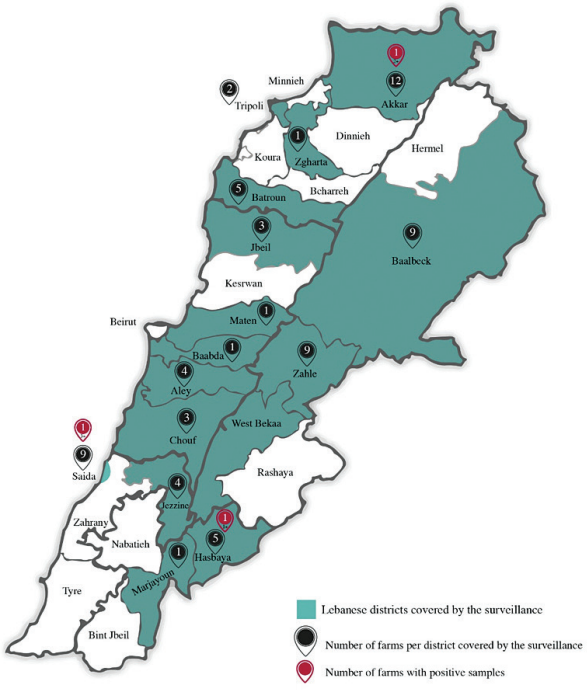
Between March and June 2017, 69 adult (aged > 18 years), male Lebanese farm workers with direct contact with poultry (i.e., feeding, handling, and cleaning pens) who agreed to participate were enrolled from sampled farms from the 7 governorates. Blood specimens were collected. Sera were tested for antibodies against AIVs (G1-like H9N2 and clade 2.3.2.1 H5N1) using microneutralization assay (27). Sera were tested in duplicate and were considered positive if titres were positive at ≥ 1:10 dilutions (28–30).

The study was approved by the Institutional Review Board of the Lebanese Ministry of Health. Informed consent was obtained from all individual participants.

## Results

None of the chickens at sampling sites exhibited signs of disease. None of the sampling sites were reported by the Ministry of Agriculture surveillance systems as an outbreak area. All sites reported using the H9N2 vaccine as verified by the sampling team. Six samples were positive for influenza A viruses and were spread in various governorates as follows: 4 from South Governorate (3 from within the same farm with 12 000 chickens and 1 from another farm with 10 000 chickens) and 2 from North Governorate from the same farm with 20 000 chickens (Figure 1). Subtyping of the 6 positive samples indicated

**Figure 1 Map of Lebanon showing the location of farms positive for avian influenza**



circulation of H9N2 virus. Three of the 6 isolates were subjected to sequencing; 1 from each of the positive farms. None of the human sera tested positive for antibodies against H9N2 or H5N1.

Three H9N2 subtype influenza viruses were isolated from 3 chickens and were named A/chicken/Lebanon/61/2017, A/chicken/Lebanon/182/2017 and A/chicken/Lebanon/503/2017. Analysis of the HA genes showed that the nucleotide sequence similarities among the detected strains ranged from 97 to 99%. In addition, alignment analysis showed that the 3 isolates were related to A/chicken/Israel/1167/2010(H9N2) (nucleotide homology 96–97%). Based on phylogenetic analysis, the Lebanese H9N2 viruses clustered tightly with those of Israeli origin as well as Lebanese H9N2 viruses from 2010, and were related to G1-like viruses (Figure 2, available online).

## Discussion

As a result of the zoonotic potential of poultry AIV, this study required a One Health approach that studied animal and human health simultaneously, and a collaborative effort between public health, animal health and private sectors. It came as a follow-up to the response to the H5N1 outbreak reported in Lebanon in 2016 (*31*). Furthermore, Lebanon completed the joint external evaluation for international health regulations core capacities and AI was declared as one of the top zoonotic disease priorities for the country (*32*).

Our phylogenetic analysis showed that the Lebanese H9N2 viruses were closely related to H9N2 viruses from neighbouring middle eastern countries. In Lebanon, H9N2 has been detected since 2006. The viruses sequenced for this study indicated a close relationship with Lebanese viruses from 2010, suggesting that H9N2 viruses are enzootic in Lebanon and that genetic drift, and potentially antigenic shift, is occurring.

The presence of H9N2 infection in Lebanese poultry despite the use of vaccine su ggests that the protection induced by AI vaccines is limited by the continuous antigenic changes of the viruses. This may result in influenza viruses causing outbreaks occasionally.

No antibodies against H9N2 or H5N1 AIV were detected in the poultry-exposed individuals. However, this does not mean that exposed humans are not at risk of infection, especially given that this study was cross-sectional, and hence provides a slim chance to detect human infection.

The detection of H9N2 and the H5N1 outbreaks of 2016 highlight the fact that AI is an important zoonotic disease of concern to Lebanon. These results can aid Lebanon's preparedness to prevent, detect and respond to AI.

Our study had some limitations. Sampling was performed over the spring months, which may have led to underestimating the incidence of AI among poultry, as AI infections are more frequent over the winter months. Furthermore, our findings may have been affected by bias in relation to the sampling schemes and sample sizes used for both poultry and humans. If sampling or seasonality biases occurred, the findings would likely be an underestimation of the burden of AI in humans and animals in Lebanon.

## Conclusion

Regular active surveillance at the human–animal interface and characterization of circulating influenza viruses in farmed poultry is highly recommended to monitor the evolution of the genetic and antigenic characteristics of influenza viruses. The One Health approach should be adapted and involvement of multisectoral governmental and nongovernmental institutions is required. Public health, animal health, and other involved sectors should establish joint formal surveillance and response mechanisms to deal with AIV threats. Such programmes allow early detection of the virulent strains and obtain more information on their virulence and antigenic properties.

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**Competing interests:** None declared.

## Surveillance de la grippe aviaire à l'interface homme-animal au Liban, 2017

## Résumé

**Contexte** : Les virus de la grippe aviaire causent des maladies graves chez les volailles et l'homme. Au Liban, le virus de la grippe aviaire H9N2 a été détecté en 2006 et 2010, et le sous-type H5N1, en 2016.

**Objectifs** : Examiner les virus de la grippe aviaire circulant actuellement au Liban à l'interface homme-animal.

**Méthodes** : Au total, 1 000 prélèvements par écouvillonnage ont été effectués sur des volailles provenant de sept gouvernorats libanais de mars à juin 2017. Les prélèvements ont été soumis au dépistage de la grippe. Les sous-types hémagglutinine et neuraminidase des virus de la grippe aviaire ont été déterminés pour les échantillons positifs. Les segments des gènes ont été clonés et séquencés. Un prélèvement de sang a été réalisé sur 69 personnes exposées. Des

études sérologiques ont été effectuées pour tester les sérums à la recherche d'anticorps contre le virus de la grippe aviaire.

**Résultats** : Chez les poulets, les résultats du test de recherche du virus de la grippe aviaire H9N2 étaient positifs pour 0,6 %. Les séquences obtenues se regroupaient étroitement avec celles d'origine israélienne et avec les virus H9N2 libanais de 2010. Les résultats étaient négatifs pour tous les échantillons humains.

**Conclusion** : Nous recommandons une surveillance régulière des virus de la grippe aviaire chez les volailles à l'aide d'une approche « Une seule santé ».

## ترصد إنفلونزا الطيور في أوساط اختلاط البشر بالحيوانات في لبنان، 2017

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### الخلاصة

**الخلفية**: تتسبب فيروسات إنفلونزا الطيور في الإصابة بأمراض وخيمة في الدواجن والبشر. وقد اكتُشف فيروس إنفلونزا الطيور H9N2 في لبنان في عامي 2006 و2010، بينما اكتُشف فيروس إنفلونزا الطيور H5N1 في عام 2016.

**الأهداف**: هدفت الدراسة إلى تقييم فيروسات إنفلونزا الطيور المتداولة حالياً في لبنان في أوساط اختلاط البشر بالحيوانات.

**طرق البحث**: بلغ إجمالي المسوحات التي جُمعت من الدواجن 1000 مسحة من 7 محافظات لبنانية في الفترة بين مارس/ آذار ويونيو/ حزيران 2017. وفُحصت المسحات لتحري عدوى الإنفلونزا. وصُنفت فيروسات إنفلُونزا الطيور في العينات الإيجابية إلى النمطين الفرعيين: الهيماجُلوتينين والنيورامنيديز. واستُنسخت الأجزاء الجينية وحُددت متواليا تها. وجُمعت عينات الدَّم من 69 شخصاً تعرضوا للفيروس. وأجريت دراسات مصلية لاختبار الأمصال للكشف عن الأجسام المضادة لإنفلونزا الطيور.

**النتائج**: جاءت نتائج اختبار فيروس إنفلونزا الطيور H9N2 إيجابية في 0.6% من الدجاج. وجُمّعت المتواليات التي حُصل عليها جنباً إلى جنب مع تلك الإسرائيلية المنشأ وكذلك فيروسات H9N2 اللبنانية المنشأ منذ عام 2010. وجاءت نتائج تحليل كل العينات البشرية سلبية.

**الاستنتاج**: نوصي بترصد فيروسات إنفلونزا الطيور في الدواجن بصفة منتظمة باستخدام نهج الصحة الواحدة.

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# Levels and predictors of happiness in the south of the Islamic Republic of Iran

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## Abstract

**Background:** Happiness is considered an index of the development of human society and well-being in the world.

**Aims:** The aim of this study was to measure the level of happiness in a middle sized Iranian city (Kerman) using 2 instruments and the predictor factors.

**Methods:** In a cross-sectional study, 1000 adults were questioned using multi-stage cluster sampling in 2016. The LoH was assessed using the Oxford Happiness Inventory (OHI) and a self-report questionnaire. The level of physical activity and the religion index were assessed using standard questionnaires.

**Results:** The results of 2 questionnaires had a statistically significant correlation with measuring level of happiness (Pearson correlation coefficient 0.69; *P*-value < 0.001). Around 90% of participants stated that they had moderate to high LoH, but the mean happiness score based on the OHI was 43.2 (43.7 in men, 42.7 in women). Illiteracy, unemployment, divorce, living in deprived areas, high level of stress, weak religious beliefs and practice, lower income, and poor health significantly decreased the LoH score.

**Conclusion:** Level of happiness is relatively low in Kerman. There are effective evidence-based interventions that might promote the LoH of the population, including promoting the level of community health, educating for stress management and improving access to urban facilities in deprived areas.

Keywords: happiness; mental health; risk factor; subjective well-being; oxford happiness

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## Introduction

Today, mental health is an essential component of health and an increase in the level of happiness (LoH) is one of the most important strategies for improving mental health (*1,2*). Happiness is equal to subjective well-being and is described as a positive feeling composed of 3 main elements: a feeling of pleasure, satisfaction with life, and absence of negative feelings such as depression and anxiety (*3*). Taking into account its importance, happiness is considered an index of the development of human society and well-being (*4*). Previous studies have shown that the frequency of depression, anxiety, drug addiction, suicide, and cardiovascular disease is higher in people with insufficient LoH and life satisfaction, and this group experiences higher mortality rates (*5,6*).

According to the available literature, many factors affect happiness (*7,8*):

- individual, e.g. genetics, age, sex, education, marital, employment, health status;
- psychological, e.g. life satisfaction, stress, personality, self-esteem;
- behavioural, e.g. addiction, alcohol use, tobacco use, physical activity, diet, sleep;
- social, e.g. social norms and values, social support, social engagement, community safety;
- environmental, e.g. urban fabric, natural disasters, weather;
- workplace, e.g. access to water and food, nature, lighting, ergonomic.

An international study in 2017 showed that happiness is a genetic-based sense and the influence of genetic factors and climate on the LoH is stronger than the economic and social situations (*9*).

International reports have indicated that different countries have different LoH. Based on 2017 statistics, the highest and lowest happiness scores were for Norway (score 7.53) and the Central African Republic (score 2.69). The happiness score of the Islamic Republic of Iran was 4.69, ranking it 108th among 155 countries that were studied (*10*). The international study asked the people to estimate their LOH on a 4-point Likert scale as "very happy", "rather happy", "not very happy" and "not at all happy". The mean percentages of "very happy" answers in 2000–2014 varied between 7.6% in Moldova to 60.8% in Mexico. Approximately 20% of the Iranian population estimated their LOH as "very happy" (*9*). Also, a national

study revealed that the country in general, and the city of Kerman in particular, do not have satisfactory LoH (*11*), indicating that the LoH situation in the Islamic Republic of Iran is not promising.

Several studies have measured the LoH and its determinant factors by the Oxford Happiness Inventory (OHI) among different population groups in the Islamic Republic of Iran. A 2018 study among an elderly population estimated the mean LoH score at 41.17, and concluded that social support is one of the important predictors of happiness among elders (*12*). A 2015 population-based study among 30–50-year-olds in Tehran measured mean LoH at 47.26 (*13*). A 2013 study estimated mean LoH among married women in Shahroud at 45.11 (*5*).

We need to identify the vulnerable subgroups and the causes of low LoH. However, existing studies and scientific works examining this issue are limited in the Islamic Republic of Iran, especially in Kerman. This historical city is situated in the south-east of the country on the fringes of the Loot desert. It has experienced many conflicts and natural disasters throughout its history. In addition, Kerman has encountered a prolonged drought with potential impacts on social, economic and health status. Apart from these, due to its proximity to the border with Afghanistan, the province has faced the challenges of drug trafficking and addiction. This has caused many social problems, including an increased number of divorces.

The aim of this study was to determine the average level and predictor factors of happiness among adults in the city of Kerman.

## Methods

This population-based, cross-sectional survey was carried out during September–December 2016 in Kerman. Kerman city, the capital of Kerman province, is the largest city in the south-east of Iran, with a population around 700 000.

All individuals aged 18 and above, residing in Kerman for at least the previous 5 years were eligible to enter the study. Considering the standard deviation of the LoH as 0.97 in the previous study in the Islamic Republic of Iran (*11*), the confidence interval as 0.95 and the degree of precision as 0.09, sample size was calculated as 447. According to the multistage sampling method, the design effect was considered as 2 and sample size was calculated as 894. Allowing for a 10% withdrawal rate, sample size was calculated at 994. In the end, 1000 participants were selected to increase the power of the study.

A multi-stage cluster sampling method was used. The city of Kerman was divided into 4 regions based on municipality areas. In each region, 5 blocks were selected randomly using the random numbers table. Then a number of households (approximately 50) were selected in each block using a systematic sampling method. All adults in each household were selected until the sample was complete. Taking into consideration the male:female ratio in the reference population of Kerman, an equal sample size was estimated for males and females. Trained interviewers selected the eligible population through a door-to-door process and face-to-face interviews. Verbal informed consent was obtained from the participants. Just under 10% of those selected refused to participate; in these cases, the next household replaced the original selection.

Through valid questionnaires, we assessed LoH, levels of physical activity, and religious beliefs and practice. Three questionnaires were used:

- The OHI was used to assess LoH. The OHI includes 29 questions with 4-item answers with scores ranging from 0 to 3. The minimum and maximum scores in this questionnaire ranged from zero to 87. This questionnaire was developed in 1989 by Hills and Argyle (*14*). Reliability of the Farsi version of the OHI in Iranian society using Cronbach's alpha and test–retest was 0.92 and 0.73, respectively (*15*).
- A short form of the International Physical Activity Questionnaire was used to assess level of physical activity. Physical activity in the previous 7 days was measured by this valid and reliable questionnaire. The reliability and validity of the Persian version of this questionnaire were assessed by Moghadam and et.al with Cronbach's alpha as 0.85 (*16*). This questionnaire contained 7 questions covering 4 different areas, including vigorous physical activity, moderate physical activity, walking, and sitting. Energy intensity of total activities in the last 7 days was estimated based on the metabolic equivalents (METs) unit. Then METs were categorized as weak (< 600 MET-minutes/week), moderate (600–3000 MET-minutes/week), and vigorous (> 3000 MET-minutes/week).
- The Duke University Religion Index (DUREL) was used to assess religious beliefs and practice. The DUREL has 3 dimensions: organizational religiosity (1 item), nonorganizational religiosity (1 item), and intrinsic religiosity (3 items). Organizational religiosity and nonorganizational religiosity used a 6-point Likert-type scale while the 3 intrinsic religiosity items are scored on a 5-point Likert-type scale. The minimum and maximum scores in this questionnaire ranged from 5 to 27. In the Iranian setting, Cronbach's alpha for the Farsi version of the DUREL was 0.921 (*17*).

We need to find a valid, simple, and applicable instrument for measuring LoH in Iranian society. Therefore, according to a national survey, researchers used 1 self-report question to measure LoH with a 5-point Likert-type scale ranging from very high to never (*11*). This question was: "Do you feel happy?"

Sociodemographic questions covered age, sex, level of education, income, employment, marital status, place of residence, drug addiction, and alcohol and tobacco use. Stress level and health status were self-assessed.

We applied simple and multivariate (backward method) linear regression analyses to assess the correlation between independent variables and LoH.

Also, we used the Pearson correlation coefficient to assess the agreement between 2 instruments for measuring LoH. The level of significance was set at 0.05. This study was registered by the Ethical Committee of Kerman University of Medical Sciences (Ethical code: IR.KMU.REC.1394.497).

## Results

The age range of our participants was 18–88 years (mean 34.07; SD 12.56). About half the participants were men (51.8%); the majority were married (56.3%), employed (50.7%), university educated (51.0%), and earned less than US$ 450 per month (56.2%) (Table 1).

According to the OHI, the mean and (mean ± SD) of the happiness score was 43.24 [standard deviation (SD) 15.8] [(men: 43.71 (SD 15.8); women: 42.73; SD 15.8)]. According to the self-report question, 2.7%, 7.4%, 52.2%, 27.2%, and 10.5% of participants estimated their LoH as none, low, moderate, high, and very high, respectively.

Comparison of the OHI and self-report question results showed a significant correlation between the 2 instruments for determining LoH (Pearson coefficient: 0.69; $P < 0.001$).

The adjusted linear regression model showed a significant positive correlation between happiness and religious beliefs and practice (β = 0.58). Also, married people had a significantly higher happiness score than divorced or widowed people (β = 4.10), and people living in deprived areas had a significantly lower score of happiness than others (β = −2.95). People with a medium level of income had significantly lower LOH than people with a high level of income. (β = −6.38) The highest level of health (β = 19.31), the lowest level of stress (β = 11.77), university education (β = 3.20) and being retired (β = 6.32) were significantly associated with high LoH. According to this model, health status and religion had the highest and lowest association with LoH, respectively and R2 was 0.30. Despite higher scores of happiness in men and in people who did not use alcohol or tobacco, sex ($P = 0.155$), alcohol use ($P = 0.364$), tobacco use ($P = 0.072$), and age ($P = 0.058$) were not statistically significantly associated with LoH (Table 2).

**Table 1 Sociodemographic characteristics of the study participants (n = 1000), Kerman, 2016**

| Characteristics | No. | % |
|---|---|---|
| ***Sex*** | | |
| Men | 518 | 51.8 |
| Women | 482 | 48.2 |
| ***Marital status*** | | |
| Married | 562 | 56.3 |
| Single | 384 | 38.4 |
| Divorced/widowed | 53 | 5.3 |
| ***Level of education*** | | |
| Illiterate | 17 | 1.7 |
| < High school | 153 | 15.3 |
| High school diploma | 319 | 32.0 |
| University | 508 | 51.0 |
| ***Employment status*** | | |
| Housewife | 173 | 17.3 |
| Retired | 63 | 6.3 |
| Employed | 506 | 50.7 |
| Student | 190 | 19 |
| Unemployed | 66 | 6.6 |
| ***Income (US$ per month)*** | | |
| < 150 | 148 | 15 |
| 150–450 | 407 | 41.2 |
| 450–750 | 260 | 26.3 |
| > 750 | 172 | 17.4 |

## Discussion

### *Level of happiness*

According to the OHI, the score of happiness was 43.24 (SD 15.8) [men: 43.71 (SD 15.8); women: 42.73 (SD 15.8)] in Kerman. Considering that 87 is the highest score of happiness, this score is not high enough comparing with other studies in the Islamic Republic of Iran. The happiness score in Kerman was similar to that of Tehran in 2007: 42.07 (SD 12.98) (*18*) and Tehran in 2015: 47.26 (SD 15.2) (*13*), but it was higher than in Bam in 2014: 32.7 (SD 11.02) (*19*). Bam had a poor score due to a disaster that its citizens experienced after the catastrophic 2003 earthquake. The score of happiness in our study was lower than in Esfahan in 2012 (66.5) (*20*).

From the one question, there was a notable difference between our results and the results of a national survey in 2009 (*11*), which found that the LoH was lower. According to an international study, approximately 20% of the Iranian population estimated their LoH as "very happy" (*9*), while only 10.5% estimated their LoH as "very happy" in our study.

### *Predictor factors*

#### *Age and happiness*

The results of various studies are contradictory when it comes to examining the relationship between age and happiness. Some research has shown a significant and positive relationship (*1*) but other studies have shown opposite results (*11,21*). Some studies suggest that the relationship between age and happiness is a U-form model. In this model, the highest LoH is for ages 20–29 years and after age 50 years (*22,23*). Yet others have shown that there is no meaningful relationship (*24,25*). Our study showed that there was no statistically significant association between age and LoH.

#### *Marital status and happiness*

In our study, married people had on average 4.10 [95% confidence interval (CI) 0.15–8.05] higher LoH compared with divorced or widowed people but there was no significant difference between single and divorced or widowed

Table 2 **Linear regression analysis for predictor variables of happiness, Kerman, 2016**

| Variable | Score of happiness | Diff | Crude | | Diff | Adjusted | |
|---|---|---|---|---|---|---|---|
| | | | *P*-value | 95% CI | | *P*-value | 95% CI |
| Age | – | 0.05 | 0.190 | −0.03; 0.13 | 0.09 | 0.058 | −0.003; 0.19 |
| Religion | – | 0.72 | < 0.001 | 0.51; 0.93 | 0.58 | < 0.001 | 0.38; 0.78 |
| ***Sex*** | | | | | | | |
| Male | 43.71 | – | – | – | – | – | – |
| Female | 42.73 | −0.98 | 0.327 | −2.94; 0.98 | – | – | – |
| ***Level of education*** | | | | | | | |
| Illiterate | 37.01 | – | – | – | – | – | – |
| < High school | 39.81 | 2.80 | 0.487 | −5.09; 10.68 | −0.46 | 0.895 | −7.32; 6.40 |
| High school diploma | 42.56 | 5.55 | 0.156 | −2.13; 13.23 | 2.51 | 0.081 | −3.11; 5.31 |
| University | 44.87 | 7.86 | 0.043 | 0.25; 15.47 | 3.20 | 0.025 | 0.41; 5.98 |
| ***Employment status*** | | | | | | | |
| Unemployed | 35.22 | – | – | – | – | – | – |
| Housewife | | 5.04 | 0.026 | 0.60; 9.47 | 4.36 | 0.039 | 0.21; 6.51 |
| Student | 43.77 | 8.55 | < 0.001 | 4.17; 12.92 | 5.32 | 0.009 | 1.34; 9.30 |
| Employed | 44.75 | 9.52 | < 0.001 | 5.51; 13.53 | 6.30 | 0.001 | 2.57; 10.03 |
| Retired | 46.14 | 10.92 | < 0.001 | 5.52; 16.31 | 6.32 | 0.021 | 0.94; 11.70 |
| ***Marital status*** | | | | | | | |
| Divorced/ widowed | 35.88 | – | – | – | – | – | – |
| Single | 43.12 | 7.24 | 0.002 | 2.72; 11.76 | 4.07 | 0.066 | −0.27; 8.41 |
| Married | 43.99 | 8.11 | < 0.001 | 3.68; 12.55 | 4.10 | 0.042 | 0.15; 8.05 |
| ***Living in a deprived area*** | | | | | | | |
| No | 44.25 | – | – | – | – | – | – |
| Yes | 38.97 | −5.28 | < 0.001 | −7.74; −2.28 | −2.95 | 0.010 | −5.19; −0.71 |
| ***Income (US$ per month)*** | | | | | | | |
| > 750 | 49.66 | – | – | – | – | – | – |
| 450–750 | 44.19 | −5.47 | < 0.001 | −8.47; −2.47 | −3.70 | 0.008 | −6.41; −0.98 |
| 150–450 | 41.14 | −8.52 | < 0.001 | −11.30; −5.47 | −6.38 | < 0.001 | −8.96; −3.60 |
| < 150 | 39.88 | −9.78 | < 0.001 | −13.20; −6.36 | −3.13 | 0.064 | −6.46; 0.18 |
| ***Health status*** | | | | | | | |
| Weak | 26.11 | – | – | – | – | – | – |
| Moderate | 34.94 | 8.83 | 0.002 | 3.29; 14.37 | 4.80 | 0.081 | −0.50; 10.19 |
| Good | 43.15 | 17.03 | < 0.001 | 11.70; 22.37 | 10.24 | < 0.001 | 4.92; 15.56 |
| Excellent | 53.40 | 27.29 | < 0.001 | 21.77; 32.80 | 19.34 | < 0.001 | 13.76; 24.85 |
| ***Chronic disease*** | | | | | | | |
| Yes | 39.62 | – | – | – | – | – | – |
| No | 43.65 | 4.02 | 0.018 | 7.35; 0.70 | – | – | – |
| ***Stress level*** | | | | | | | |
| High | 34.98 | – | – | – | – | – | – |
| Moderate | 39.38 | 4.40 | 0.010 | 1.04; 7.77 | 3.14 | 0.049 | 0.04; 6.28 |
| Low | 45.79 | 10.81 | < 0.001 | 7.57; 14.06 | 6.21 | < 0.001 | 3.08; 9.34 |
| No | 53.83 | 18.85 | < 0.001 | 14.51; 23.19 | 11.77 | < 0.001 | 7.63; 15.89 |
| ***Living situation*** | | | | | | | |
| Alone | 37.99 | – | – | – | – | – | – |
| With friends | 41.10 | 3.11 | 0.388 | −3.96; 10.18 | – | – | – |
| With family | 43.56 | 5.57 | 0.010 | 1.32; 9.83 | – | – | – |
| ***Physical activity*** | | | | | | | |
| Low | 40.18 | – | – | – | – | – | – |
| Moderate | 43.26 | 3.07 | 0.038 | 0.17; 5.97 | – | – | – |
| High | 44.56 | 4.38 | < 0.001 | 1.98; 6.77 | – | – | – |

**Table 2 Linear regression analysis for predictor variables of happiness, Kerman, 2016 *(concluded)***

| Variable | Score of happiness | Diff | Crude | | Diff | Adjusted | |
|---|---|---|---|---|---|---|---|
| | | | *P*-value | 95% CI | | *P*-value | 95% CI |
| ***Alcohol use*** | | | | | | | |
| Yes | 43.11 | – | – | – | – | – | – |
| No | 43.28 | 0.16 | 0.915 | −3.13; 2.81 | – | – | – |
| ***Tobacco use*** | | | | | | | |
| Yes | 42.21 | – | – | – | – | – | – |
| No | 43.53 | 1.32 | 0.275 | −1.05; 3.69 | – | – | – |
| ***Addiction*** | | | | | | | |
| Yes | 38.07 | – | – | – | – | – | – |
| No | 43.58 | 5.51 | 0.007 | 1.48; 9.55 | – | – | – |

*Dif = difference; CI = confidence interval.*

people. Although the results of a national survey in Iran showed that single people had higher happiness than married people (*11*), most studies revealed that marriage is associated with a higher happiness level and divorced and widowed people had the lowest the score of happiness (*24,26*). In a national cohort of Thai adults, married people had a higher LoH than single people and single people had a higher LoH than divorced or widowed people (*26*). The effect of marital status on happiness was minimal among older women and maximal among younger men. The reason for this is that married people have healthier lifestyles and better health status than single people. Also, married people have better support systems than others, especially divorced and widowed people.

***Employment status and happiness***

Our research revealed that unemployment was a significant factor associated with low LoH. The retired and employed people had 6.32 and 6.30 higher LoH respectively than unemployed people. The results of a national survey showed that unemployed people had the lowest LoH in the Islamic Republic of Iran (*11*). Many studies have shown that unemployment can reduce happiness (*26–28*). Unemployment can lead to unhappiness through poverty, crime, mental illness, feelings of worthlessness and bad decision-making.

***Income and happiness***

One of the most important factors affecting happiness is income deprivation (*11,24,25,29*). Our data also revealed that a middle level of income has an association with unhappiness. It seems that people with middle levels of income are always worried about poverty. They also compare themselves to rich people and try to increase their levels of income. This leads to increased anxiety and unhappiness in this group.

***Health status and happiness***

Our findings indicated a strong positive relationship between health and happiness. People with an excellent health status had on average 19.34 (95% CI 13.76–24.85) higher LoH compared with those with poor health status. Several other studies have shown that health status is one of the most important factors affecting happiness (*11,24,30*). People with low levels of health are unable to achieve their goals. Thus, their LoH goes down.

***Stress and happiness***

In this study, there was a significant inverse relationship between stress and happiness. Individuals who did not have stress had an 11.77 (95% CI 7.63–15.89) higher LoH than individuals with a high level of stress. Based on results of other studies, not only does increase in stress levels reduce feelings of happiness significantly, but the frequency of depression, anxiety, drug addiction and suicide are also higher in people with insufficient LoH and life satisfaction; this group is also likely to have higher mortality rates (*5,8*). High levels of stress lead to a lack of compliance with new conditions and thus, reduce LoH. Stress is also a major risk factor for communicable and noncommunicable diseases and can lead to reduced LoH through disease.

***Living in deprived areas and happiness***

This study found that living in deprived areas is an important factor in low happiness. A number of studies have shown that people living in deprived areas experience less happiness (*31,32*). Social deprivation, poor health status and lack of access to urban facilities in deprived areas have led to low LoH in people living in these areas.

***Religion and happiness***

This study found a significant positive correlation between religious attitude and behaviour and happiness. A unit increase in the religion score led to an increase of 0.58 in the happiness score. Previous research conducted in Muslim societies corroborates this relationship (*33*), but the results of another Iranian study revealed that dogmatism, especially religious dogmatism, had negative effects on LoH (*13*). Religious beliefs lead to spiritual relaxation and increased happiness. Also, organized religious practices lead to an increase in happiness through an increase in social engagement.

***Sex and happiness***

There was no significant association between sex and LoH. Other studies have shown inconsistent results. In most studies happiness was higher in men than in women (*11,21*). In some studies, there was no significant relation-

ship between LoH and sex (*1,25*), or LoH was higher in women (*24*). However, results can differ in the Islamic Republic of Iran. A national survey indicated that men were happier than women (11) but studies in Esfahan and Ilam showed that the score of happiness was higher in women although the difference was not statistically significant (*1,20*). It seems that other social factors may be involved, including women's participation in the community.

***Level of education and happiness***

People with university education had on average a 3.20 (95% CI 0.41 to 5.98) higher LoH compared with illiterate people in the present study. Results of most studies demonstrated that people with high education levels have higher LoH (*24*). However, in a national Iranian survey and in other studies, there was no significant association between education and happiness. (*1,11,25*). People with a high level of education have a high level of self-confidence and self-esteem, which may lead to a high LOH.

***Lifestyle and happiness***

Most studies showed that an unhealthy lifestyle is a risk factor for low LoH (*7,21,30,34,35*). Although in our study LoH was lower in participants with an unhealthy lifestyle (such as tobacco, alcohol and drug use) and low levels of physical activity, there was no statistically significant relationship between LoH and unhealthy lifestyle according to the adjusted regression model. Perhaps lifestyle has an indirect effect on LoH by impacting health.

To the best of our knowledge, no study has been conducted on LoH and associated factors based on a large sample size of adults in the south of the Islamic Republic of Iran. Due to the cross-sectional nature of this study, we cannot examine causal relationships. Because of bias related to social desirability, it is possible that the frequency of some behaviours, including alcohol consumption, was underestimated. Considering the $R^2$ of the final model, the goodness of fit in this linear regression model was poor. The authors suggest that future studies should be conducted to examine the relationship between happiness and factors such as social capital and urban fabric.

## Conclusions

Our findings showed that LoH is relatively low in Kerman. Considering the relationship between several sociodemographic factors and the LoH, policy-makers should design targeted interventions in Kerman on vulnerable subgroups, such as those who are illiterate, unemployed, divorced and living in deprived areas and those who have low income, poor health, high levels of stress and weak religious beliefs.

Due to the increasing marginalization in Kerman, policy-makers should pay more attention to these deprived areas and provide better welfare facilities.

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**Competing interests:** None declared.

## Niveau et facteurs prédictifs de bonheur dans le sud de la République islamique d'Iran

## Résumé

**Contexte** : Le bonheur est considéré comme un indice de développement de la société humaine et du bien-être dans le monde.

**Objectifs** : La présente étude avait pour objectif de mesurer le niveau de bonheur dans une ville iranienne de taille moyenne (Kerman) au moyen de deux instruments et de facteurs prédictifs.

**Méthodes** : Dans une étude transversale, 1000 adultes ont été interrogés en 2016 dans le cadre d'un échantillonnage en grappes à plusieurs degrés. Le niveau de bonheur a été évalué à l'aide de l'*Oxford Happiness Inventory* (OHI) et d'un questionnaire d'auto-évaluation. Le niveau d'activité physique et l'indice de religiosité ont été évalués à l'aide de questionnaires types.

**Résultats** : Les résultats des deux questionnaires étaient corrélés de manière statistiquement significative avec la mesure du niveau de bonheur (coefficient de corrélation de Pearson : 0,69 ; valeur $p < 0,001$). Près de 90 % des participants ont déclaré être modérément ou tout à fait heureux, mais le score de bonheur moyen selon l'OHI était de 43,2 (43,7 chez les hommes, 42,7 chez les femmes). L'analphabétisme, le chômage, le divorce, le fait de vivre dans des zones défavorisées, le niveau élevé de stress, les croyances et les pratiques religieuses faibles, les revenus peu élevés et un mauvais état de santé faisaient nettement baisser le niveau de bonheur.

**Conclusion** : Le niveau de bonheur est relativement faible à Kerman. Il existe des interventions efficaces, fondées sur des bases factuelles, qui pourraient améliorer le niveau de bonheur de la population, y compris la promotion du niveau de santé communautaire, l'éducation à la gestion du stress et l'amélioration de l'accès aux infrastructures urbaines dans les zones défavorisées.

## مستويات ومؤشرات السعادة في جنوب جمهورية إيران الإسلامية

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### الخلاصة

**الخلفية:** تُعتبر السعادة، في جميع أنحاء العالم، مؤشراً على تطور المجتمع البشري وعافية سكانه.

**الأهداف:** هدفت هذه الدراسة إلى قياس مستوى السعادة في مدينة كرمان الإيرانية المتوسطة الحجم، باستخدام أداتين والعوامل المُنبِّئة.

**طرق البحث:** في عام 2016، أُجريت دراسة مقطعية شملت 1000 بالغ، حيث وُجهت إليهم أسئلة باستخدام طريقة أخذ العينات العنقودية خلال مراحل متعددة. وقُدر مستوى السعادة باستخدام مقياس أكسفورد للسعادة واستبيان ذاتي التبليغ. كما قُدر مستوى النشاط البدني ومؤشر الدين باستخدام استبيانات معيارية.

**النتائج:** أوضحت نتائج استبيانين وجود ترابط ذي دلالة إحصائية في قياس مستوى السعادة (معامل ارتباط بيرسون: 0.69؛ والقيمة الاحتمالية <0.001). وأفاد 90% من المشاركين أن مستوى السعادة لديهم يتراوح بين متوسط إلى مرتفع، إلا أن متوسط درجة السعادة حسب مقياس أكسفورد للسعادة كان 43.2 (43.7 في الرجال، و42.7 في النساء). وقد تسببت كلٌ من الأمية، والبطالة، والطلاق، والعيش في المناطق المحرومة، وارتفاع مستوى الضغوط، وضعف المعتقدات الدينية، والدخل الأقل، وتدني الصحة في انخفاض درجة مستوى السعادة بشكلٍ كبيرٍ.

**الاستنتاج:** يُعتبر مستوى السعادة منخفضاً نسبياً في مدينة كرمان. وتوجد بعض التدخلات المُسندة بالبيّنات التي قد يكون من شأنها تعزيز مستوى السعادة للسكان، ويشمل ذلك تعزيز مستوى صحة المجتمع، والتوعية بشأن كيفية إدارة الضغوط، وتحسين إمكانية وصول سكان المناطق المحرومة إلى المرافق الحضرية.


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# Prevalence and factors associated with stunting among school children in Egypt

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## Abstract

**Background:** Stunting adversely affects children's health and development. Few studies on the prevalence of stunting and factors associated with stunting have been done in Upper Egypt.

**Aims:** This study aimed to determine the prevalence of and factors associated with stunting in schoolchildren in Sohag, Egypt.

**Methods:** This was a cross-sectional study conducted in 2017 in Sohag governorate. Two public schools were randomly selected (one urban, one rural) and all children in these schools aged 4–12 years whose parents consented were included in the study. Parents were interviewed to collect data on child and family characteristics. The children were examined for vitamin deficiency, anaemia and parasitic infection, and body mass index was calculated. Multivariate logistic regression analysis was done to determine factors significantly associated with stunting; odds ratios (ORs) and 95% confidence intervals (CIs) are given.

**Results:** A total of 1786 children were included (response rate 69%), of whom 329 (18.4%) were stunted (–2 z-score and below). Factors significantly associated with stunting were: parasite infestation (OR = 1.8, 95% CI: 1.3–2.5), anaemia (OR = 1.7, 95% CI: 1.3–2.7), low body mass index (OR = 1.2, 95% CI: 1.1–1.3), frequent gastroenteritis (OR = 1.1, 95% CI: 1.06–1.2), first-cousin consanguinity of parents (OR = 1.3, 95% CI: 1.2–1.6) and familial short stature (OR = 1.5, 95% CI: 1.2–2.1).

**Conclusion:** Screening and treatment of parasitic infestation, provision of iron/multivitamin supplementation and education on healthy nutrition should be part of school health programmes to prevent stunting in schoolchildren in Sohag.

Keywords: Stunting, schoolchildren, Egypt

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## Introduction

Stunted growth is defined as a height-for-age z-score of 2 standard deviations (SDs) or more below the global median according to the World Health Organization (WHO) references (*1*). Stunting affects up to 32% of children living in developing countries; it is hence an important public health problem with a great impact on child health and development in these countries (*2*). Stunting has been declared a global health priority with WHO calling for a 40% reduction in the number of children who are stunted by 2025 (*3*).

In stunted children, short stature is not just the problem in itself, but rather stunting syndrome (*4*) in which various pathological changes happen that result in a suppression of linear growth, impairment of a child's cognitive development and reduced physical capacity of a child. The long-term consequences of stunting include decreased work capacity and an increased risk of poor health in adult life – childhood stunting is positively associated with obesity, metabolic syndrome and cardiac diseases in adult life. Moreover, stunting has also a transgenerational effect as mothers who were themselves stunted as children tend to have offspring with stunted growth, leading to an intergenerational cycle of growth impairment (*4*).

Several risk factors for childhood stunted growth have been identified. Maternal malnutrition during pregnancy affects future child growth (*5*). Childhood malnutrition either as inadequate overall caloric intake or deficiency in certain micronutrients is associated with growth failure (*6*). Recurrent infections such as diarrhoea and parasitic infestations as a result of poor sanitary living conditions are main risk factors for stunted growth in children in developing countries (*7,8*). Despite numerous identifiable risk factors for childhood stunting, the effect of different risk factors varies in different regions and even in the same country (*9,10*). Therefore, identification of local and environmental factors is important to establish local preventive strategies against stunted growth. Few studies on the prevalence of stunted growth and local factors associated with it have been done in Upper Egypt. To address this gap, we aimed to determine the prevalence of stunting and identify factors associated with stunting in schoolchildren in Sohag district, Upper Egypt.

## Methods

### *Study design and sample*

This was a cross-sectional study carried out from January

2017 to May 2017 in Sohag district, Upper Egypt. Two public schools, one urban and one rural, were randomly selected.

All children aged between 4 and 12 years in these two schools were invited to participate, after obtaining parental consent. The exclusion criteria were: short stature children because of a known syndrome (e.g. Turner, Noonan, Russel–Silver and Prader–Willi syndromes, ascertained from the parents and examination by a paediatrician), children with contractures and kyphoscoliosis in whom accurate standing height could not be measured, and children whose parents did not agree to their participation in the study.

### Data collection

The parents were interviewed at the schools by the researchers using a standardized questionnaire with two sections (*11*). The first section sought information on sociodemographic characteristics (age, residence, parental level of education, parental occupation, consanguinity between parents, family history of short stature, and child's birth order), and frequency of gastroenteritis in the child. Socioeconomic status of the family was estimated (*11*). All difficult or scientific terminology was explained to the parents. The second section recorded data from the examination of the children for signs of vitamin deficiency (angular stomatitis, cheilitis, bleeding gums, dry skin, brittle hair or nails, bruising, petechiae and seborrhoeic dermatitis). Laboratory investigations (haemoglobin level and stool analysis) were done to identify children with anaemia (haemoglobin level less than 10 g/dL and children with parasitic infestations. Examinations were done by a nurse from the paediatric department at Sohag Faculty of Medicine.

Weight and standing height were measured by trained personnel with the child bare-footed and wearing only underwear. Measurements were recorded to the nearest 0.5 kg for weight and the nearest 1 cm for height. Body mass index (BMI) was calculated as the weight in kilograms divided by the height in metres squared (kg/m$^2$). Stunting was defined as height for age and sex that is two standard deviations (SDs) or more below the WHO standard median (–2 z-score or below) (*1*).

### Statistical analysis

Data were analysed using SPSS, version 22.0. Quantitative data are given as means and SDs, medians and ranges. Qualitative data are given as numbers and percentage. We tested the data for normality with the Shapiro–Wilk test but, as they were not normally distributed, we used nonparametric tests such as the Mann–Whitney test. The chi-squared test was used to compare qualitative variables. We considered the factors associated with short stature to include (i) family factors – parental eduction and employment, familial short stature, degree of consanguinity between parents, child's birth order in the family and socioeconomic status, and (ii) child factors – presence of anaemia, parasite infestation and signs of vitamin deficiency, frequency of gastroenteritis and BMI. Variables that were statistically significant in the univariate analysis, were included in a multivariate logistic regression analysis, and odds ratios (ORs) and 95% confidence intervals (CIs) are given. All P-values were two-sided and the significance level was set at less than 0.05.

### Ethical considerations

The study was approved by the Ethical Committee of the Faculty of Medicine, Sohag University. We explained all the study details to the children's parents/guardians before taking informed consent.

## Results

Of 2581 children aged 4–12 years in the two schools, 795 parents declined to give consent, giving a response rate of 69%. Thus, 1786 children were enrolled in the study, of whom 329 (18.4%) were stunted (–2 z-score or below), 95% CI: 17.98–18.48%. Of these 329 children, 76 (4.3%) children had more severe stunting (–3 z-score or below). The characteristics of the studied children and their parents according to stature, excluding the 76 more severely stunted children, are shown in Table 1: 127 (14.6%) of the boys and 126 (15.0%) of the girls were stunted. The mean age of the children with stunting was 8.01 (SD 2.9) years with age range between 4 and 12 years. As regards residence, 135 (15.4%) of the children in the rural area and 118 (14.1%) in the urban area were stunted. No statistically significant differences were found between the stunted and normal-stature children for sex, age, place of residence, parental level of education and parental job.

The sociodemographic characteristics the children with more severe stunting (–3 z-score or below) are shown in Table 2. These children were excluded from further analysis because many cofounders were likely for the severely stunted children. In addition, there may have been an underlining pathological cause for their short stature. We therefore advised the parents to visit a paediatrician for examination and assessment of possible causes for their child's short stature.

Univariate analyses of associations between family and child characteristics and stunting showed that anaemia ($P < 0.001$), parasite infestation ($P < 0.001$), familial short stature ($P < 0.001$), signs of vitamin deficiency ($P = 0.04$), BMI ($P < 0.001$), first-cousin consanguinity ($P = 0.002$) and frequent gastroenteritis ($P = 0.002$) were significantly associated with stunting (Table 3). However, socioeconomic status and birth order were not ($P > 0.05$).

Factors significantly associated with stunting in the univariate analysis were evaluated in a multivariate logistic regression analysis (Table 4). Parasite infestation (OR = 1.8, 95% CI: 1.3–2.5; $P < 0.001$), anaemia (OR = 1.7, 95% CI: 1.3–2.7; $P < 0.001$), BMI (OR = 1.2, 95% CI: 1.1–1.3; $P < 0.001$), frequent gastroenteritis (OR = 1.1, 95% CI: 1.06–1.2; $P = 0.003$), first-cousin consanguinity (OR = 1.3, 95% CI: 1.2–1.6; $P = 0.02$) and familial short stature (OR = 1.5, 95% CI 1.2–2.1; $P = 0.04$) were independent factors associated with stunting in the children.

**Table 1 Sociodemographic characteristics of the studied children and their parents, by stature**

| Variable | Short stature (–2 z-score) | Normal stature | *P*-value |
|---|---|---|---|
| ***Age (years)*** | | | 0.23 |
| Mean (standard deviation) | 8.01 (2.9) | 8.5 (5.9) | |
| Median(range) | 8 (4–12) | 8 (4–12) | |
| ***Sex, no. (%)*** | | | 0.830 |
| Male | 127 (14.6) | 742 (85.4) | |
| Female | 126 (15.0) | 715 (85.0) | |
| ***Residence, no. (%)*** | | | 0.450 |
| Rural | 135 (15.4) | 740 (84.6) | |
| Urban | 118 (14.1) | 717 (85.9) | |
| ***Father's education, no. (%)*** | | | 0.834 |
| Illiterate | 24 (12.6) | 166 (87.4) | |
| Read and write | 67 (14.7) | 388 (85.3) | |
| Basic education | 46 (20.1) | 183 (97.9) | |
| Secondary school | 85 (13.4) | 550 (86.6) | |
| Higher education | 31 (15.4) | 170 (84.6) | |
| ***Mother's education, no. (%)*** | | | 0.484 |
| Illiterate | 23 (12.2) | 166 (87.8) | |
| Read and write | 66 (14.2) | 399 (85.8) | |
| Basic education | 35 (12.5) | 245 (87.5) | |
| Secondary school | 105 (17.6) | 491 (82.4) | |
| Higher education | 24 (13.3) | 156 (86.7) | |
| ***Father's job, no. (%)*** | | | 0.347 |
| Not working | 21 (13.2) | 138 (86.8) | |
| Unskilled manual worker | 23 (17.8) | 106 (82.2) | |
| Skilled manual worker/farmer | 77 (15.9) | 408 (84.1) | |
| Trade/business | 93 (14.4) | 555 (85.6) | |
| Semi-professional/clerk | 25 (13.4) | 161 (86.6) | |
| Professional | 14 (13.6) | 89 (86.4) | |
| ***Mother's job, no. (%)*** | | | 0.223 |
| Working | 92 (13.5) | 589 (86.5) | |
| Not working | 161 (15.6) | 868 (84.4) | |
| **Total** | **253 (14.8)** | **1457 (85.2)** | |

**Table 2 Sociodemographic characteristics of the more severely stunted children (–3 z-score or below)**

| Sociodemographic characteristic | Value |
|---|---|
| ***Age (years)*** | |
| Mean (standard deviation) | 8 (2.2) |
| Median (range) | 8 (4–12) |
| ***Sex, no. (%)*** | |
| Male | 36 (47) |
| Female | 40 (53) |
| ***Residence, no. (%)*** | |
| Rural | 41 (54) |
| Urban | 35 (46) |
| ***Father's education, no. (%)*** | |
| Illiterate | 8 (11) |
| Read and write | 21 (28) |
| Basic education | 36 (47) |
| Secondary school | 4 (5) |
| Higher education | 7 (9) |
| ***Mother's education, no. (%)*** | |
| Illiterate | 8 (11) |
| Read and write | 10 (13) |
| Basic education | 42 (55) |
| Secondary school | 7 (9) |
| Higher education | 9 (12) |
| ***Father's job, no. (%)*** | |
| Working | 65 (85.5) |
| Not working | 11 (14.5) |
| ***Mother's job, no. (%)*** | |
| Working | 26 (34) |
| Not working | 50 (66) |
| **Total** | **76 (100.0)** |

## Discussion

Children's growth is a complex process in which several genetic, nutritional and environmental factors are involved (*12*). The current study tried to assess the prevalence of stunting, and to explore some of the factors associated with stunting in schoolchildren in Sohag district.

We found that 329 (18.4%) of the children had a height-for-age z-score less than 2 SD. Although this prevalence is lower than that found in a study in 2011 on preparatory-school children aged 11–14 years in Cairo, Egypt, which found a prevalence of stunting of 34.1% (*13*), our finding is consistent with other studies in developing countries: 17.4% in a Nigerian study conducted on 570 children aged 5–19 years (*14*), 24.5% in a Kenyan study on 208 children aged 4–11 years (*15*) and 11.3% in an Indian study on 755 children aged between 4–16 years (*16*).The difference in the prevalence of stunting in different countries and even in different districts in the same country might be due to the effect of socioeconomic factors (*15,17,18*). In line with the findings of the study conducted on preparatory-school children in Cairo (*13*), we found that stunting was associated with a family history of short stature.

Age, sex, place of residence and parental education and job were not significantly associated with childhood stunting in our study. We also did not find an association between childhood stunting and the socioeconomic status of the family, which is in line with the result of the 2014 Egypt Demographic and Health Survey (*19*). These results indicate that stunting may not be a reflection of poverty and unavailability of food, but rather an indirect result of unhealthy nutritional habits and lack of family awareness about healthy nutrition required for growth of children.

Good nutrition is vital for children's growth. A balanced diet, containing adequate calories from carbohydrates, fats and proteins, together with sufficient amounts of vitamins and minerals, is important for growth. Malnutrition is a main risk factor for stunting syndrome

**Table 3 Univariate analysis of factors associated with stunting**

| Variable | Participants (%) | β coefficient (SE) | OR (95% CI) | *P*-value |
|---|---|---|---|---|
| ***Consanguinity between parents*** | | | | |
| No consanguinity | 43.1 | | 1[a] | |
| First cousin | 23.7 | 0.345 (0.035) | 1.4 (1.1–1.7) | 0.002 |
| Second cousin | 27.7 | 0.264 (0.012) | 1.1 (0.78–1.4) | 0.215 |
| Other relative | 5.5 | −0.127 (0.143) | 0.92 (0.67–1.5) | 0.652 |
| ***Familial short stature*** | | | | |
| Yes | 51.8 | 0.513 (0.137) | 1.7 (1.43–2.2) | < 0.001 |
| No | 48.2 | | 1[a] | |
| Birth order | n/a | −0.044 (0.059) | 0.96 (0.86–1.1) | 0.453 |
| ***Anaemia*** | | | | |
| Yes | 50.6 | 0.791 (0.138) | 2.2 (1.5–2.9) | < 0.001 |
| No | 49.4 | | 1[a] | |
| ***Parasite infestation*** | | | | |
| Yes | 57.3 | 0.751 (0.140) | 2.1 (1.6–2.7) | < 0.001 |
| No | 42.7 | | 1[a] | |
| ***Signs of vitamin deficiency*** | | | | |
| Yes | 52.6 | 0.275 (0.136) | 1.3 (1.1–1.7) | 0.04 |
| No | 47.4 | | 1[a] | |
| Frequency of enteritis | n/a | 0.233 (0.042) | 1.3 (1.2–1.4) | 0.002 |
| Body mass index | n/a | 0.186 (0.013) | 1.2 (1.1–1.3) | < 0.001 |
| ***Socioeconomic status*** | | | | |
| Very low | 6.7 | −0.543 (0.123) | 0.3 (0.1–1.2) | 0.437 |
| Low | 41.6 | | 1[a] | |
| Middle | 38.3 | −0.348 (0.254) | 0.5 (0.2–1.4) | 0.215 |
| High | 13.4 | 0.217 (0.247) | 1.8 (1.3–2.2) | 0.652 |

*SE: standard error, OR: odds ratio, CI: confidence interval, n/a: not applicable.*

[a]*Reference category.*

in children in developed countries, where malnourished children usually have multiple macronutrient and micronutrient deficiencies that predispose them to impaired immunity and recurrent infections, resulting in stunting (*6*,*20*,*21*).

Our results show that stunted children had lower BMI. As BMI is a measure of nutritional status in children, this finding suggests that malnutrition is an important risk factor for stunting in children. We also identified that anaemia in our schoolchildren was associated with stunted growth (*22*). Several studies have found that multiple micronutrient deficiencies such as iron, zinc and vitamin A deficiency, are associated with short stature and stunting syndrome in children (*5*,*21*,*23*). However, there is no strong evidence that correction of these micronutrients deficiencies increases the height of children suggesting that the relationship between micronutrient deficiencies and stunting is not causal.

Our findings provide evidence that parasitic infestation is one of the factors associated with stunting in children. Unhygienic living condition, especially in rural areas in developing countries like Upper Egypt,

**Table 4 Multivariate logistic regression analysis of factors associated with stunting**

| Variable | β coefficient (SE) | Adjusted OR (95% CI)[a] | *P*-value |
|---|---|---|---|
| Parasite infestation | 0.606 (0.158) | 1.8 (1.3–2.5) | < 0.001 |
| Anaemia | 0.564 (0.155) | 1.7 (1.3–2.7) | < 0.001 |
| Body mass index | 0.193 (0.015) | 1.2 (1.1–1.3) | < 0.001 |
| Frequent gastroenteritis | 0.247 (0.053) | 1.1 (1.06–1.2) | 0.003 |
| First-cousin consanguinity | 0.276 (0.017) | 1.3 (1.2–1.6) | 0.02 |
| Familial short stature | 0.440 (0.152) | 1.5 (1.2–2.1) | 0.04 |
| Signs of vitamin deficiency | 0.298 (0.142) | 1.2 (.89–1.7) | 0.261 |

*SE: standard error, OR: odds ratio, CI: confidence interval.*

[a]*Adjusted for all other variables.*

is still a main cause for recurrent gastroenteritis and parasitic infestation in children. In a previous study in Sohag governorate, 38.5% of children had parasitic infestations, 31.6% of whom had stunted growth (*24*). The relationship between parasitic infestation and stunting has been shown in studies conducted in other countries (*25*,*26*). Intestinal parasitic infestations affect children's digestive and absorptive capacity and prevent them from obtaining essential nutrients required for growth.

We found childhood stunting was associated with frequent gastroenteritis episodes. Gastroenteritis is a common childhood infection, especially in areas with poor hygiene and sanitation. Although gastroenteritis has a short-term effect on growth after acute episodes, some studies have found that recurrent episodes of gastroenteritis have a cumulative effect and lead to a small but measurable effect on growth (*7*,*27*). Moreover, frequent exposure to enteric pathogens, even if asymptomatic, may have a long-term effect on gut structure and function leading to villous atrophy with chronic intestinal inflammation and a mild form of malabsorption (*28*). In the context of poverty where the diet may lack or contain reduced amounts of essential nutrients, this modest malabsorption may exacerbate growth failure and result in stunting (*28*,*29*).

Consanguineous marriage, especially first-cousin marriage, is common in our community. We found that first-cousin consanguineous marriage was associated with stunting in the offspring. In line with our results, an Egyptian study in 2006 found a small but statistically significant reduction in all investigated anthropometric measurements in the children of consanguineous parents (*30*). Similarly, the Cairo study in 2011 reported that positive parental consanguinity was a significant risk factor for low growth status in schoolchildren and the risk was greater in case of first-cousin parents.

Our study has some limitation. Because of time constraints, only two schools in one district were included, which reduced the sample population. To be able to generalize the results to larger groups, more schools in different districts would need to be included.

## Conclusion

The prevalence of stunting in Sohag district is a considerable problem in comparison with developed countries which have a lower prevalence of stunting; for example, United States of America (2.1% stunting), Australia (1.8%) and Germany (1.3%) (*31*). Family history of short stature, first-cousin consanguinity, anaemia, parasitic infestations, frequent gastroenteritis and low BMI were the most important factors associated with stunting in our sample of schoolchildren in Sohag. Therefore, we suggest that screening and treatment of parasitic infestation, provision of iron and multivitamin supplementations as well as education of children and parents about healthy nutrition should be a part of school health programmes to prevent stunting in schoolchildren.

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**Competing interests:** None declared.

## Retard de croissance chez les écoliers en Égypte : prévalence et facteurs associés

## Résumé

**Contexte :** Le retard de croissance nuit à la santé et au développement de l'enfant. Peu d'études sur la prévalence du retard de croissance et les facteurs qui y sont associés ont été menées en Haute Égypte.

**Objectifs :** La présente étude avait pour objectif de déterminer la prévalence du retard de croissance chez les écoliers de Sohag (Égypte), ainsi que les facteurs qui y sont associés.

**Méthodes :** La présente étude transversale a été menée en 2017 dans le gouvernorat de Sohag. Deux écoles publiques ont été sélectionnées de manière aléatoire (la première en zone urbaine et la seconde en zone rurale) et tous les enfants de ces établissements qui étaient âgés de 4 à 12 ans et dont les parents avaient donné leur consentement ont été inclus dans l'étude. Les parents ont été interrogés afin de recueillir des données sur les caractéristiques de l'enfant et de la famille. Les enfants ont été examinés pour détecter toute carence en vitamines, anémie ou parasitose, et leur indice de masse corporelle a été calculé. Une analyse de régression logistique multivariée a été réalisée pour déterminer quels facteurs étaient significativement corrélés au retard de croissance ; les odds ratios (OR) et les intervalles de confiance (IC) à 95 % sont indiqués.

**Résultats :** Au total, 1786 enfants ont participé à l'étude (taux de réponse de 69 %), dont 329 (18,4 %) souffraient d'un retard de croissance (correspondant à la valeur du Z, fixée à −2, ou à une valeur inférieure). Les facteurs significativement corrélés au retard de croissance étaient les suivants : infestation parasitaire (OR = 1,8 ; IC à 95 % : 1,3-2,5), anémie (OR = 1,7 ; IC à 95 % : 1,3-2,7), faible indice de masse corporelle (OR = 1,2 ; IC à 95 % : 1,1-1,3), gastro-entérites fréquentes (OR = 1,1 ; IC à 95 % : 1,06-1,2), consanguinité des parents avec un cousin de premier degré (OR = 1,3 ; IC à 95 % : 1,2-1,6) et petite taille des membres de la famille (OR = 1,5 ; IC à 95 % : 1,2-2,1).

**Conclusion :** Le dépistage et le traitement des infestations parasitaires, la supplémentation en fer et en multivitamines et l'éducation en faveur d'une alimentation saine devraient faire partie des programmes de santé mis en œuvre par les établissements scolaires pour prévenir le retard de croissance chez les écoliers de Sohag.

## معدل انتشار التقزُّم بين تلاميذ المدارس في مصر والعوامل المرتبطة به

أحمد حامد النحاس، أحمد حجاب، إيمان محمد

### الخلاصة

**الخلفية:** يؤثر التقزُّم بصورة سلبية على صحة الأطفال ونمائهم. وقد أُجريت دراسات قليلة في صعيد مصر حول انتشار التقزُّم والعوامل المُرتبطة به.

**الأهداف:** هدفت هذه الدراسة إلى تحديد مدى انتشار التقزُّم بين تلاميذ المدارس في محافظة سوهاج، مصر، والعوامل المُرتبطة بذلك.

**طرق البحث:** أُجريت هذه الدراسة المقطعية في محافظة سوهاج في عام 2017. واخُتيرت مدرستان حكوميتان عشوائياً (إحداهما في منطقة حضرية، والأخرى في منطقة ريفية) وتراوحت أعمار جميع الأطفال في هذه المدارس بين 12–4 عاماً، وقد وافق آباؤهم على المشاركة في هذه الدراسة. وأُجريت مقابلات مع الآباء لجمع بيانات بشأن خصائص كل طفل وأسرته. وفُحص الأطفال للتحقق مما إذا كان لديهم نقص فيتامينات، أو إذا كانوا مصابين بفقر الدَّم والأمراض الطفيلية، كما حُسب منسب كتلة الجسم لديهم. وأُجري تحليل الارتداد اللوجستي المتعدد المتغيرات للوقوف على العوامل المرتبطة أساساً بالتقزُّم؛ وأُعطيت قيمة نسبة الأرجحية وفاصل ثقة قدره 95%.

**النتائج:** بلغ إجمالي الأطفال الذين شملتهم الدراسة 1786 طفلاً (بمعدل استجابة 69%) 329 طفلاً منهم (18.4%) كانوا مُصابين بالتقزُّم (z-score 2–). وكانت العوامل التي ترتبط أساساً بالتقزُّم هي: الإصابة بالأمراض الطفيلية (OR = 1.8, 95% CI: 1.3–2.5)، وفقر الدم (OR = 1.7, 95% CI: 1.3–2.7)، ومنسب كتلة الجسم المنخفض (OR = 1.2, 95% CI: 1.1–1.3)، والتهاب المعدة والأمعاء المُتكرر (OR = 1.1, 95% CI: 1.06–1.2)، وكون الأبوين أولاد عم من الدرجة الأولى (OR = 1.3, 95% CI: 1.2–1.6) وقصر القامة في الأسرة (OR = 1.5, 95% CI: 1.2–2.1).

**الاستنتاج:** ينبغي أن تتضمن برامج الصحة المدرسية تحري الإصابة بالأمراض الطفيلية، وتوفير الحديد/ المكملات التغذوية المتعددة الفيتامينات، والتثقيف بشأن التغذية الصحية، وذلك لوقاية تلاميذ المدارس في سوهاج من الإصابة بالتقزُّم.

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# Effect of serum 25-hydroxyvitamin D level on lung, breast, colorectal and prostate cancers: a nested case–control study

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## Abstract

**Background:** Published studies show that vitamin D deficiency is widespread and it has been suggested that it increases the risk of lung, breast, colorectal and prostate cancers.

**Aims:** To investigate prospectively the effect of serum 25-hydroxyvitamin D (25(OH)D) level on lung, breast, colorectal and prostate cancers in people aged 30+ years.

**Methods:** In this nested case–control study, the data and collected serum samples from a cohort study, the Balçova Heart Study, during 2007–09, were used. Additional data were collected using a questionnaire in the follow-up. We determined incident lung, breast, colorectal and prostate cancer cases during 2008 and 2013. Serum 25(OH)D levels of 606 persons (179 cases and 427 controls) from the Balçova Heart Study were measured. Odds ratio (OR) and 95% confidence interval (CI) were calculated using logistic regression analysis.

**Results:** Serum 25(OH)D levels did not show a significant association with breast, colorectal and prostate cancers. There was an inverse association between 25(OH)D level and lung cancer risk, where the OR values for the first, second and third quartiles, compared with the fourth quartile (1.00), were 2.92 (CI: 0.82–10.35), 3.76 (CI: 1.14–12.37) and 3.55 (CI: 1.04–12.08) respectively.

**Conclusion:** It was seen that low 25(OH)D levels were associated with a greater than threefold increased risk of lung cancer; no association was detected for breast, colorectal and prostate cancers. Cohort studies with larger populations are needed to better understand the effect of vitamin D level on cancer risk.

Keywords: cancer; vitamin D; 25-hydroxyvitamin D; nested case–control

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## Introduction

Breast cancer, colorectal cancer and lung cancer in women and lung cancer, prostate cancer and colorectal cancer in men are among the 5 most common cancer types. Among the various risk factors, micronutrients and vitamins are also studied. The active form of vitamin D, 1,25(OH)2D, has antineoplastic properties. In studies on human malignant cell lines, 1,25(OH)2D has been shown to decrease cell proliferation and increase cell differentiation (*1*).

The vitamin D deficiency rate is stated to be 40–100% among the elderly living in the United States of America (USA) and Europe (*2,3*). Evidence linking vitamin D deficiency with increased cancer risk and mortality has been found in studies conducted over the last 20–30 years (*2,4*). Although epidemiologic studies indicate that vitamin D levels are inversely associated with colorectal cancer (*5–12*), several studies found inconsistent results for this association (*13,14*). The findings of epidemiologic studies investigating the relationship between vitamin D and breast cancer have been inconsistent. Some nested case–control studies reported no association (*8,15–17*), whereas others reported inverse associations (*7,18–20*). Results suggesting that high vitamin D level increases prostate cancer risk were found in studies investigating the relationship between vitamin D and prostate cancer risk (*21–24*). In other studies, low vitamin D level was found to increase prostate cancer risk (*7,25*), although no significant association has also been reported (*26–28*). The number of studies investigating the relationship between vitamin D and lung cancer is limited. Cohort and nested case–control studies show no relationship between the vitamin D level and lung cancer risk (*29–31*), while some show that a low vitamin D level increases lung cancer risk (*7,32*).

The aim of this study was to investigate the effect of serum 25(OH)D levels on lung, breast, colorectal and prostate cancer prospectively in a population cohort.

## Methods

### *Study population*

The present study has a nested case–control design and was conducted in İzmir Province (38.25° N), located in the west of Turkey. The first active surveillance cancer registry in Turkey was established in Izmir. The Balcova Heart Study, a cohort study, was performed in collaboration with Dokuz Eylül University Medi-

cal School and the Municipality of Balcova District in İzmir. The baseline data collection for this study was carried out between October 2007 and May 2009. This cohort was originally set up to investigate risk factors and determine cardiovascular disease incidence. The participants comprise the largest population cohort study for chronic diseases in Turkey. In the Balçova Heart Study, questionnaires were completed and blood samples were taken from 12 915 individuals aged 30+ years; serum samples were stored under appropriate conditions (–80 °C) (33). In this study, 25(OH)D levels were measured using these serum samples. For each case and control, the 25(OH)D measurement was performed only once.

Using OpenEpi software, the sample size of the study, for OR 0.60 with 95% CI, 80% power and a case:control ratio of 1:2, was calculated as 254 cases and 508 controls, a total of 762 individuals.

The case group in this study consisted of individuals who were diagnosed with lung, breast, colorectal, prostate and ovarian cancer between 2008 and 2013. However, the ovarian cancer cases were not analysed as a separate group as only 6 cases were detected. The data for the people with cancer living in Balcova during the study period were obtained from Izmir Cancer Registry to determine the case group. In this surveillance system, quality control is carried out in line with International Association of Cancer Registries criteria (34). Among these cases, those included in the Balçova Heart Study cohort constituted the case group of the study. Those who had been diagnosed with cancer before the project were not included in the case group or the control group. Cancer cases diagnosed between 2008 and 2013 were found and included in the case list consisting of 288 individuals. However, 21 individuals were excluded since the period between diagnosis and blood sampling (0–3 months) was too short (10,11). The maximum time between sampling for 25(OH)D measurement and cancer reporting was 5 years and 3 months. For each cancer case (267), 2 individuals with no cancer diagnosis (534) were selected randomly from the cohort. Controls were frequency matched to cases in terms of age (±3 years), sex, neighbourhood and date of blood sampling (±10 days). None of the cancer cases nor the controls took a vitamin D supplement prior to blood sampling. The samples from 88 cases and 107 controls were insufficient to measure 25(OH)D levels. Frequency matching was rechecked after excluding these individuals. The laboratory analysis was carried out on samples from 179 cases and 427 controls, a total of 606 individuals. Other covariates addressed within the scope of the study were collected using an additional survey during face-to-face interviews.

Written approval for the study was obtained from the Non-Interventional Clinical Research Ethics Committee of Dokuz Eylül University (Decision No. 2012/01-24). Previously, the Balçova Heart Study Project had received approval from the Ethics Committee of Dokuz Eylül University (Decision No. 2007/337). Participants gave written consent regarding the use of serum samples in future studies within the scope of the project.

## Laboratory measurements

The best indicator of vitamin D status is serum 25(OH) D level due to its relatively long half-life (approximately 2–3 weeks) (2,3). Serum 25(OH)D level was measured using the radioimmunoassay method. Total serum vitamin D (D2 and D3) was examined using a Siemens Advia Centaur XP immunology analyser. Serum 25(OH)D measurement was performed in the Dokuz Eylül University Hospital Laboratory, which has international quality and accreditation certificates. During the serum 25(OH)D measurement, laboratory personnel were blinded. Blood samples were analysed in random sequence. Serum 25(OH)D levels were reported as ng/mL.

## Data analysis

Categorical variables were presented as numbers and percentages. Mean and standard deviation, median, first quartile (Q1), fourth quartile (Q4), minimum and maximum values of the 25(OH)D level were calculated for case and control groups. When comparing the 25(OH)D levels, the independent samples t-test was used under parametric conditions and the Mann–Whitney U test was used under non-parametric conditions. The chi-squared test for trend was used to determine the association between the case and control groups in terms of 25(OH)D quartiles. Other categorical variables were analysed using Pearson's chi-squared test.

Multinomial logistic regression analysis was used to obtain risk estimates according to serum 25(OH) D level quartiles. The variables were adjusted using cancer-specific risk factors for each cancer according to the Harvard Cancer Risk Index (35). Logistic regression analysis was done, adjusting for age, sex and body mass index (BMI) in the colorectal cancer group, plus smoking in the lung cancer group, and age and BMI in the breast and prostate cancer groups. In the control group, 25(OH)D quartiles were used as reference in grouping (1st quartile: ≤ 8.61 ng/mL, 2nd quartile: 8.62–13.67 ng/mL, 3rd quartile: 13.68–19.14 ng/mL, 4th quartile: ≥ 19.15 ng/mL). All cases ($n$ = 179), lung cancer cases ($n$ = 42) and colorectal cancer cases ($n$ = 22) were compared with all controls ($n$ = 427) in the study. For prostate cancer, only males ($n$ = 211) and for breast cancer only females ($n$ = 216) in the control group were included in the analysis.

After data analysis, using these cases and control numbers, post-hoc power calculations were made for each cancer and for all cases. The power was 95% for the lung cancer, 40% for the prostate cancer, 10% for the colorectal cancer, 4% for the breast cancer cases and 60% for all cases. $P$-value < 0.05 was accepted as the statistical significance level. Statistical analyses were performed using SPSS, version 15.0s.

**Table 1 Demographics and baseline characteristics at time of blood collection in cancer cases and controls, Izmir, 2008-2013**

| Characteristic | Cases (n = 179)[a] | Controls (n = 427) | Cancer type | | | |
|---|---|---|---|---|---|---|
| | | | Lung (n = 42) | Colorectal (n = 22) | Breast (n = 57) | Prostate (n = 52) |
| | Mean (SD) | Mean (SD) | Mean (SD) | Mean (SD) | Mean (SD) | Mean (SD) |
| Age (years) | 60.5 (0.8) | 60.6 (0.5) | 64.4 (10.4) | 61.9 (12.3) | 56.0 (11.3) | 62.9 (6.8) |
| | No. (%) | No. (%) | No. (%) | No. (%) | No. (%) | No. (%) |
| ***Sex*** | | | | | | |
| Female | 89 (49.7) | 216 (50.6) | 14 (33.3) | 12 (54.5) | 57 (100.0) | – |
| Male | 90 (50.3) | 211 (49.4) | 28 (66.7) | 10 (45.5) | – | 52 (100.0) |
| ***Educational status*** | | | | | | |
| Illiterate | 13 (7.3) | 31 (7.3) | 5 (12.5) | 3 (13.6) | 5 (8.8) | – |
| Literate | 6 (3.4) | 28 (6.6) | 3 (7.5) | 1 (4.5) | – | 2 (3.8) |
| Primary | 83 (46.9) | 209 (49.3) | 18 (45.0) | 10 (45.5) | 28 (49.1) | 23 (44.2) |
| Secondary | 23 (13.0) | 45 (10.6) | 4 (10.0) | 3 (13.6) | 9 (15.8) | 7 (13.5) |
| High school | 33 (18.6) | 69 (16.3) | 8 (20.0) | 2 (9.1) | 11 (19.3) | 11 (21.2) |
| University | 19 (10.7) | 42 (9.9) | 2 (5.0) | 3 (13.6) | 4 (7.0) | 9 (17.3) |
| ***BMI (kg/m²)*** | | | | | | |
| < 25.00 | 37 (20.7) | 63 (14.8) | 12 (28.6) | 3 (13.6) | 11 (19.3) | 9 (17.3) |
| 25.00–29.99 | 81 (45.3) | 189 (44.4) | 19 (45.2) | 9 (40.9) | 20 (35.1) | 30 (57.7) |
| ≥ 30.00 | 61 (34.1) | 174 (40.8) | 11 (26.2) | 10 (45.5) | 26 (45.6) | 13 (25.0) |
| ***Smoking status*** | | | | | | |
| Current | 60 (33.9) | 110 (25.9) | 20 (50.0) | 7 (31.8) | 18 (31.6) | 14 (26.9) |
| Former | 55 (31.1) | 127 (30.0) | 14 (35.0) | 5 (22.7) | 11 (19.3) | 23 (44.2) |
| Never | 62 (35.0) | 187 (44.1) | 6 (15.0) | 10 (45.5) | 28 (49.1) | 15 (28.8) |
| ***Physical activity*** | | | | | | |
| Yes | 60 (72.3) | 201 (77.0) | 1 (50.0) | 9 (75.0) | 11 (32.4) | 27 (79.4) |
| No | 23 (27.7) | 60 (23.0) | 1 (50.0) | 3 (25.0) | 23 (67.6) | 7 (20.6) |
| ***Family history of cancer (lung, colorectal, breast, ovarian, prostate)*** | | | | | | |
| Yes | 27 (32.5) | 63 (24.1) | 1 (50.0) | 4 (33.3) | 12 (35.3) | 9 (26.5) |
| No | 56 (67.5) | 198 (75.9) | 1 (50.0) | 8 (66.7) | 22 (64.7) | 25 (73.5) |

[a]*Ovarian cancer included.*

## Results

The total number of all cancer cases was 179 and the total number of controls was 427. The mean age of all cases and controls was 60.5 years; 50.3% of cases and 49.4% of controls were male (Table 1). We found that 34.1% of cases and 40.8% of controls were obese (BMI ≥ 30.0 kg/m²). 33.9% of cases and 25.9% controls were smokers at the time of the study. Around a quarter of cases and controls were physically inactive (cases: 27.7%, controls: 23.0%). A family history of cancer was reported in 32.5% of cases and 24.1% of controls (Table 1).

The mean 25(OH)D level in cancer cases included in the study was 14.8 ng/mL (inter quartile range: 8.8–18.6 ng/mL) and the mean level in controls was 14.3 ng/mL (inter quartile range: 8.6–19.1 ng/mL). When all cancer cases were assessed together, no significant difference was found between cases and controls in terms of mean 25(OH)D level ($P > 0.05$). The mean 25(OH)D level in lung cancer cases was statistically significantly lower compared with the control group ($P < 0.05$). No significant difference was found between colorectal cancer cases and controls in terms of median 25(OH)D level ($P > 0.05$). Also, no significant difference was found between breast and prostate cancer cases and controls in terms of mean 25(OH)D level ($P > 0.05$) (Table 2).

Comparing the highest quartile of 25(OH)D level with the lower quartiles, the 25(OH)D level was not found to be associated with colorectal and breast cancer risk ($P > 0.05$). An inverse and significant relationship was found between the 25(OH)D level and lung cancer risk. When the 25(OH)D level was adjusted according to smoking, age, sex and BMI, risk increased in the first, second and third quartiles compared with the fourth quartile [2.92 (95% CI 0.82–10.35); 3.76 (95% CI 1.14–12.37); 3.55 (95% CI 1.04–12.08)] respectively. However, statistically significant risk increase was detected only in the second and third quartiles ($P < 0.05$) (Table 3).

In univariate analysis (chi-squared test for trend) prostate cancer risk increased as vitamin D level increased ($P < 0.05$, not shown in table). When the 25(OH)D level was adjusted according age and BMI in logistic regression analysis, prostate cancer risk decreased in first and second quartiles and increased in the third quartile compared

**Table 2 Serum levels of 25 (OH)D concentration among cancer and control groups, Izmir, 2008-2013**

| Group | No. | Serum level of 25 (OH)D (ng/mL) | | | | Effect size (Cohen's d) |
|---|---|---|---|---|---|---|
| | | Mean (SD) | Median (Q1, Q4)[a] | Min | Max | |
| ***All*** | | | | | | |
| Cases | 179 | 14.85 (8.51)[b] | 14.36 (8.80,18.68) | 4.20 | 77.06 | 0.07 |
| Controls | 427 | 14.31 (7.09) | 13.67 (8.61,19.14) | 4.20 | 38.48 | |
| ***Lung*** | | | | | | |
| Cases | 42 | 12.36(5.35) [b]* | 11.40 (8.00, 16.12) | 4.20 | 27.37 | 0.31 |
| Controls | 427 | 14.31 (7.09) | 13.67 (8.61,19.14) | 4.20 | 38.48 | |
| ***Colorectal*** | | | | | | |
| Cases | 22 | 13.56(6.25) | 12.78 (7.52, 18,55)[c] | 4.40 | 24.80 | 0.11 |
| Controls | 427 | 14.31 (7.09) | 13.67 (8.61,19.14) | 4.20 | 38.48 | |
| ***Breast*** | | | | | | |
| Cases | 57 | 14.48 (11.69)[b] | 11.73 (7.05, 18.62) | 4.20 | 77.06 | 0.19 |
| Controls | 216 | 12.71 (6.83) | 11.45 (6.67, 17.27) | 4.20 | 38.49 | |
| ***Prostate*** | | | | | | |
| Cases | 52 | 18.01 (6.73)[b] | 17.47 (14.25, 21.05) | 6.45 | 47.14 | 0.30 |
| Controls | 211 | 15.95 (7.01) | 14.78 (10.46, 20.54) | 4.20 | 36.26 | |

*SD = standard deviation.*

**P < 0.05*

*[a]Q1 = quartile 1, Q4 = quartile 4.*

*[b]Independent samples t-test.*

*[c]Mann–Whitney U test.*

with the fourth quartile. However, these results were not statistically significant ($P > 0.05$) (Table 3).

## Discussion

### All cancers

In light of the fact that vitamin D deficiency is common in Turkey, as in most parts of the world, this study examined the effect of serum 25(OH)D levels of individuals aged ≥ 30 years on lung, breast, colorectal and prostate cancer. When all cancer cases were examined together, no increase was observed in cancer risk for the lower quartiles compared with the highest quartile of the 25(OH)D level.

### Lung cancer

Mean 25(OH)D level of lung cancer cases was significantly lower compared with the control group. Similar results were found in a case–control study conducted in the Czech Republic (7), while no significant difference was found between cases and controls in a nested case–control study from Finland (*30*).

Compared with the highest quartile of the 25(OH)D level, cancer risk increased in the lower quartiles. Lung cancer risk significantly increased in the second quartile and third quartiles compared with the highest vitamin D quartile. However, the 95% confidence intervals in the results were very large due to there being only 4 cases in the reference group. Therefore, the results should be considered with these limitations in mind. The results of the meta-analyses published in 2015 support our findings, reporting that vitamin D level and lung cancer incidence were inversely associated (*36*).

In a cohort study conducted in Finland, no significant relationship was found for men in the lowest vitamin D level compared with the highest, whereas a high vitamin D level was significantly protective against lung cancer in women (*29*). In an ecological study comparing lung cancer incidence data and geographical location for 111 countries, it was shown that lung cancer incidence varied according to proximity to the equator. Lung cancer incidence was found to decrease in countries with higher UVB exposure. When adjusted for the effect of smoking, lung cancer incidence continued to decrease (*37*). Also, in nested case–control studies conducted in the USA and Finland, a relationship was found between vitamin D and lung cancer risk (*30,31*).

### Colorectal cancer

In meta-analyses performed in 2009 and 2011, it was seen that vitamin D level and colorectal cancer incidence were inversely associated (*13,38*). In a more recent meta-analysis published in 2017, it was found that a higher 25(OH) D level was associated with a lower risk for colorectal cancer; however, this advantage is gradually lost as levels increase beyond 50–60 ng/mL (*39*). In several nested case–control studies conducted between 2009 and 2012, the relationship between colorectal cancer and vitamin D level was not consistent (*6,8,10,11*).

In our study, there was no difference between mean level of 25(OH)D in the colorectal cancer and control groups. In 2 nested case–control studies conducted using the Nurses' Health Study and the Prostate, Lung, Colorectal and Ovarian Cancer Screening Trial, vitamin

**Table 3 Lung, colorectal, breast and prostate cancer risk according to serum 25-hydroxyvitamin D level quartiles, Izmir, 2008-2013**

| Group | Quartile 1 | Quartile 2 | Quartile 3 | Quartile 4 |
|---|---|---|---|---|
| *Quartile values, ng/mL* | ≤ 8.61 | 8.62–13.67 | 13.68–19.14 | ≥ 19.15 |
| ***All cancers*** | | | | |
| No. cases/controls | 44/107 | 40/107 | 54/107 | 41/106 |
| OR (95% CI) | 1.06 (0.64–1.75) | 0.96 (0.57–1.61) | 1.30 (0.80–2.12) | 1.00 (ref) |
| OR (95% CI)[a] | 1.09 (0.64–1.87) | 1.01 (0.60–1.70) | 1.36 (0.83–2.24) | 1.00 (ref) |
| ***Lung*** | | | | |
| No. cases/controls | 11/107 | 15/107 | 12/107 | 4/106 |
| OR (95% CI) | 2.72 (0.84–8.82) | 3.71 (1.19–11.56) | 2.97 (0.92–9.50) | 1.00 (ref) |
| OR (95% CI)[b] | 2.92 (0.82–10.35) | 3.76 (1.14–12.37) | 3.55 (1.04–12.08) | 1.00 (ref) |
| ***Colorectal*** | | | | |
| No. cases/controls | 7/107 | 5/107 | 5/107 | 5/106 |
| OR (95% CI) | 1.38 (0.42–4.50) | 0.99 (0.27–3.52) | 0.99 (0.27–3.52) | 1.00 (ref) |
| OR (95% CI)[a] | 1.33 (0.384.70) | 1.01 (0.27–3.69) | 0.96 (0.26–3.53) | 1.00 (ref) |
| ***Breast*** | | | | |
| No. cases/controls | 22/75 | 10/52 | 12/48 | 13/41 |
| OR (95% CI) | 0.92 (0.42–2.02) | 0.60 (0.24–1.52) | 0.78 (0.32–1.91) | 1.00 (ref) |
| OR (95% CI)[c] | 0.93 (0.41–2.08) | 0.60 (0.23–1.55) | 0.79 (0.32–1.97) | 1.00 (ref) |
| ***Prostate*** | | | | |
| No. cases/controls | 3/32 | 8/55 | 22/59 | 19/65 |
| OR (95% CI) | 0.32 (0.08–1.16) | 0.49 (0.20–1.22) | 1.27 (0.62–2.58) | 1.00 (ref) |
| OR (95% CI)[c] | 0.35 (0.09–1.31) | 0.56 (0.22–1.41) | 1.35 (0.65–2.82) | 1.00 (ref) |

*OR = odds ratio; CI = confidence interval.*

[a]*Adjusted according to smoking, age, sex and body mass index (BMI).*

[b]*Adjusted according to age, sex and BMI.*

[c]*Adjusted according to age and BMI.*

D levels of cases were found to be lower compared with controls (*5*,*11*). In the nested case–control study from the European Prospective Investigation into Cancer and Nutrition cohort, a lower mean vitamin D level was significant in the colon cancer group, but not significant in rectum cancer group (*6*).

As a result of a pooled analysis using the Health Professionals Follow-up Study and the Nurses' Health Study performed in the USA, a significant relationship was found for colorectal cancer in higher levels compared with the lowest quintile (*5*). In a nested case–control study from the Prostate, Lung, Colorectal and Ovarian Cancer Screening Trial, colorectal cancer risk was significantly lower in the highest vitamin D quintile compared with the lowest quintile (*11*). In contrast, vitamin D level had no significant effect on colorectal cancer risk in a 2011 case–control study conducted in the USA (*13*) nor in a 2015 cross-sectional study conducted in South Korea (*14*). Similar results were obtained in our study, however, the sample size was too low to detect a small effect.

In studies which identified a relationship between vitamin D level and colorectal cancer, further studies on the biological effect of the vitamin D–colorectal cancer relationship and the genetics of vitamin D receptors are recommended as well as randomized clinical trials to evaluate whether supplementation can prevent colorectal cancer (*6*).

## Breast cancer

In epidemiological studies, it is suggested that maintaining vitamin D level in the normal range has a protective effect against breast cancer (*2*). In some reviews published between 2005 and 2013, it was noted that there is insufficient evidence to suggest that a high vitamin D level decreases risk of breast cancer, and studies to date have not been able to find adequate evidence (*2*,*4*). However, in meta-analyses performed between 2010 and 2013, vitamin D level and breast cancer were found to be inversely associated (*40*,*41*).

In our study, no significant difference was found between the breast cancer and control groups in terms of mean vitamin D level. The results of the Malmö Diet and Cancer Study (nested case–control study) support our findings (*15*). In a nested case–control study conducted in France (*20*), and in case–control studies conducted in Germany (*18*) and the Czech Republic (*7*), mean vitamin D values in breast cancer cases were found to be lower than in controls.

Although a lower breast cancer risk was seen in the lower quartiles compared with the highest 25(OH) D quartile in our study, this was not statistically

significant. The results of some other nested case–control studies also support our findings (*8,15–17*). In a nested case–control study in postmenopausal women, Green et al. found that breast cancer risk was 34% lower in the highest vitamin D quartile compared with the lowest (*42*). In another nested case–control study, it was determined that breast cancer risk was 48% lower in the highest vitamin D quartile (19). In the French E3N cohort, breast cancer risk was 27% lower in the highest vitamin D quintile compared with the lowest quintile (*20*).

### *Prostate cancer*

In studies conducted in recent years, new evidence has been obtained related to vitamin D and prostate cancer. It is noted that a low or high vitamin D level is a risk factor for prostate cancer, and vitamin D has a U-shaped effect on prostate cancer risk (*22,43,44*).

Mean vitamin D level in prostate cancer cases was not different from that of controls in our study. The vitamin D–prostate cancer relationship is still a controversial topic. There have been studies suggesting a higher vitamin D level for prostate cancer cases compared with controls (*21–24,26,28*) as well as studies suggesting the exact opposite, (*7,25*). It is noted in the current literature that experts need to be more careful in relation to vitamin D supplementation, since a high vitamin D level might increase prostate cancer risk (*43,44*).

In trend analysis, prostate cancer risk increased as vitamin D level increased. However, this relationship was not observed in the logistic regression analysis. In our study, the power was 40% for prostate cancer, which may be the reason for the lack of a significant association between vitamin D and prostate cancer. There have been case–control studies which found a trend with vitamin D levels (*23,24*). In a case–control study, Shui et al. found that when the lowest vitamin D level (14.4 ng/mL) was accepted as the reference, prostate cancer risk decreased by 13% in the second quartile, 21% in the third quartile and 14% in the fourth quartile, however this decrease was not statistically significant (*27*). In a nested case–control study, it was found that when the lowest vitamin D quintile was taken as the reference, aggressive prostate cancer risk was raised 1.12 times in the second quintile, 1.61 times in the third quintile, 1.42 times in the fourth quintile and 1.32 times in the fifth quintile (*21*). Our findings parallel the results from the meta-analysis of observational studies (3956 cases in 11 studies), showing no relationship between 25(OH)D level and risk of prostate cancer (*45*).

### *Strengths and limitations*

An important strength of this study is that it is a nested case–control study derived from a cohort study in order to evaluate the vitamin D-cancer relationship. However, the size of the cohort was rather small, which was a limitation, since it was planned in order to examine cardiovascular disease. Although it was sufficient when all cancer types are considered, it has a low power for the individual cancer types; this may be the reason for the lack of a statistically significant association between vitamin D and cancer, especially for colorectal cancer cases. Another limitation was that the 25(OH)D measurements were performed only once. Single measurements may not accurately reflect vitamin D status. However, it has been demonstrated that serum 25(OH)D concentration at a single point in time may be a useful biomarker of vitamin D status over a 5-year period (*46*). In our study, the maximum time between sampling for 25(OH)D measurement and cancer reporting was 5 years 3 months.

A recent systematic review comparing results of studies from Turkey and Europe found that 25(OH)D level was lower in the Turkish group compared with the Europeans (*3*). In our study, 81.1% of healthy controls had a vitamin D level suggesting deficiency (≤ 20 ng/mL). Although the mean 25(OH)D level in controls was lower, it was not significantly different from the cases. These low levels of vitamin D are reported in almost all population studies in Turkey, which makes it more difficult to demonstrate risk differences between groups in terms of vitamin D level.

The strengths of our study include the fact that the serum samples used to determine vitamin D level were taken before individuals were diagnosed with cancer and kept under appropriate conditions. This is the first nested case–control study investigating vitamin D and cancer relationship in Turkey. The fact that cancer cases were obtained from the Izmir Cancer Registry contributed to the certainty of cases. Vitamin D measurement was performed in a laboratory with international quality and accreditation certificates. The study was well powered (95%) to examine the lung cancer group, which showed a strong association between vitamin D and lung cancer.

## Conclusion

We found that a low vitamin D level was associated with an increased lung cancer risk. Vitamin D level and prostate cancer showed an inverse association although the relationship was not statistically significant and no relationship was found between vitamin D level and breast and colorectal cancer. Cohort studies with larger populations are required to better understand the relationship between vitamin D and cancer. Low levels of vitamin D in cases and controls might hinder the demonstration of differences in risk between groups in terms of vitamin D level. In addition, because of low vitamin D levels seen generally in the Turkish population, it is recommended to investigate the relationship between other diseases and vitamin D level.

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**Competing interests:** None declared.

# Effet du taux de 25-hydroxyvitamine D sérique sur les cancers du poumon, du sein, du côlon et du rectum et de la prostate : une étude cas-témoin nichée dans une cohorte


## Résumé

**Contexte** : Les études publiées montrent que la carence en vitamine D est répandue et laissent penser qu'elle augmente le risque de cancers du poumon, du sein, du côlon et du rectum et de la prostate.

**Objectifs** : Examiner de manière prospective l'effet du taux de 25-hydroxyvitamine D sérique (25(OH)D) sur les cancers du poumon, du sein, du côlon et du rectum et de la prostate chez les personnes âgées de 30 ans et plus.

**Méthodes** : La présente étude cas-témoin nichée dans une cohorte a utilisé les données et les échantillons de sérum recueillis dans le cadre d'une étude de cohorte la « Balçova Heart Study », réalisée au cours de la période comprise entre 2007 et 2009. Des données supplémentaires ont été recueillies à l'aide d'un questionnaire lors du suivi. On a déterminé les cas incidents de cancer du poumon, du sein, du côlon et du rectum et de la prostate en 2008 et 2013. Les taux de 25(OH)D sérique de 606 personnes (179 cas et 427 témoins) obtenus lors de l'étude « Balçova Heart Study » ont été mesurés. Les odds ratio (OR) et les intervalles de confiance (IC) à 95 % ont été calculés à l'aide de l'analyse de régression logistique.

**Résultats** : Les taux de 25(OH)D sérique n'ont pas montré d'association significative avec les cancers du sein et de la prostate, ni avec le cancer colorectal. Il y avait une association inverse entre le niveau de 25(OH)D et le risque de cancer du poumon pour lequel les valeurs OR pour les premier, deuxième et troisième quartiles, par rapport au quatrième quartile (1,00), étaient de 2,92 (IC : 0,82-10,35), 3,76 (IC : 1,14-12,37) et 3,55 (IC : 1,04-12,08) respectivement.

**Conclusion** : Il a été constaté que de faibles taux de 25(OH)D étaient associés à un triplement au minimum du risque de cancer du poumon ; aucune association n'a été détectée pour les cancers du sein et de la prostate, ainsi que pour le cancer colorectal. Des études de cohorte avec des populations plus importantes s'avèrent nécessaires pour mieux comprendre l'effet du taux de vitamine D sur le risque de cancer.


# تأثير مستوى مصل 25–هيدروكسي فيتامين د على أمراض سرطان الرئة، والثدي، والقولون والمستقيم، والبروستاتا: دراسة متداخلة للحالات الإفرادية المقترنة بحالات ضابطة

ايلا اشيكقوز، ديليك شيمرن، جول إرجور


## الخلاصة

**الخلفية**: بيّنت الدراسات المنشورة انتشار نقص فيتامين د، وأشارت إلى أنه قد يكون أحد أسباب زيادة مخاطر التعرض للإصابة بأمراض سرطان الرئة، والثدي، والقولون والمستقيم، والبروستاتا.

**الأهداف**: هدفت الدراسة إلى تحري الأثر المتوقع لمستوى مصل 25–هيدروكسي فيتامين د على أمراض سرطان الرئة، والثدي، والقولون والمستقيم، والبروستاتا في الأشخاص الذين يبلغون من العمر 30 عاماً فأكثر.

**طرق البحث**: في هذه الدراسة المتداخلة للحالات الإفرادية المقترنة بحالات ضابطة، استُخدمت البيانات وعينات المصل المُجمَّعة من دراسة أترابية أُجريت في الفترة بين عامي 2007 و2009 عن أمراض القلب في منطقة بالكوفا. وجُمعت بيانات إضافية باستخدام استبيان في مرحلة المتابعة. وقد حُددت حالات الإصابة بأمراض سرطان الرئة، والثدي، والقولون والمستقيم، والبروستاتا في الفترة بين عامي 2008 و2013. وفي هذه الدراسة، خضع 606 أشخاص لقياس مستويات مصل 25–هيدروكسي فيتامين د (179 حالة إفرادية و247 حالة ضابطة). وحُسبت نسبة الأرجحية وفاصل ثقة قدره 95% باستخدام تحليل الانحدار اللوجستي.

**النتائج**: لم تثبت الدراسة وجود أي علاقة جوهرية بين مستوى مصل 25–هيدروكسي فيتامين د وبين أمراض سرطان الثدي، والقولون والمستقيم، والبروستاتا. ولكن، تبين وجود علاقة عكسية بين مستوى مصل 25–هيدروكسي فيتامين د ومخاطر الإصابة بسرطان الرئة؛ حيث أن قيم نسبة الأرجحية في الربعيات الأولى والثانية والثالثة مقارنة بالربعية الرابعة كانت 2.92 (بفاصل ثقة: 0.82–10.35)، و3.76 (بفاصل ثقة: 1.14–12.37) و3.55 (بفاصل ثقة: 1.04–12.08) على التوالي، على الرغم من أنها لم تكن أمراً جوهرياً بالنسبة للربعية الأولى.

**الاستنتاج**: اتضح ارتباط مستويات مصل 25–هيدروكسي فيتامين د المنخفضة بازدياد مخاطر الإصابة بسرطان الرئة بحوالي ثلاثة أضعاف؛ بينما لم تثبُت أي علاقة بين هذه المستويات وأمراض سرطان الثدي، والقولون والمستقيم، والبروستاتا، والمبيض. وهناك حاجة إلى إجراء مزيدٍ من الدراسات الأترابية التي تشمل عدداً أكبر من السكان، بحيث يمكن فهم أثر مستوى فيتامين د على مخاطر الإصابة بالسرطان بصورة أفضل.

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# Estimating the incidence rate of hepatitis B and C in East Azerbaijan, Islamic Republic of Iran

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## Abstract

**Background:** The World Health Organization (WHO) has aimed for a 30% reduction in hepatitis B (HBV) and hepatitis C (HCV) incidence by 2020. To achieve this goal, it is important to have updated information about trends in the hepatitis incidence rate. However, there is a lack of up-to-date data from East Azerbaijan province in the Islamic Republic of Iran.

**Aims:** This study aimed to estimate the HBV and HCV incidence rate from 2011 to 2016 in East Azerbaijan, Islamic Republic of Iran.

**Methods:** Hepatitis data and population data were obtained respectively from the national notifiable disease surveillance system and the national Iranian census for 2016. For quantifying the rate of changes in incidence rate from baseline, the average annual rate of reduction (AARR) was calculated. For this, the linear regression model was used for estimating the beta coefficient. SPSS V25 was used for statistical analysis.

**Results:** Over the 6-year period, 3119 hepatitis cases in East Azerbaijan province were reported, of which 94.7% were hepatitis B. The majority of the affected individuals were 25–44 years old. HBV incidence was reduced by 12.71% annually between 2011 and 2016. However, the number of HCV patients increased during 2014–2016, and HCV incidence rate increased insignificantly ($\beta = 0.109$, $P = 0.39$).

**Conclusion:** There is a significant downward trend of HBV in East Azerbaijan due to mass vaccination programmes. In the case of HCV, when considering the availability of effective treatment regimens in addition to education and prevention programmes, policy-makers should focus on HCV screening and diagnosis, especially in the 25–44 age group.

Keywords: Hepatitis B, Hepatitis C, incidence, infection, Iran

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## Introduction

Viral hepatitis is a public health problem worldwide (1). According to the World Health Organization (WHO), in 2015 about 325 million people worldwide were affected by acute viral hepatitis, from which 275 million cases were related to chronic hepatitis B (HBV) and 71 million cases were related to hepatitis C (HCV) (2,3). Considering the high burden of hepatitis, WHO has aimed for a 30% reduction in the incidence of HBV and HCV by 2020 and a 90% reduction by 2030 (3).

The Eastern Mediterranean Region (EMR) countries have more than 15 million affected people and had the highest prevalence of HCV infection (4). Moreover, in this Region 21 million people had HBV (4). However, the Islamic Republic of Iran has a relatively low endemicity (5).

The prevalence of HBV varied across the Iranian provinces; the highest prevalence was reported in Golestan province (6.1%, 95% CI: 3.5–8.7%) (6) and the lowest prevalence was reported in Kermanshah (0.7%, 95% CI: 0.4–1.1%) (6). According to a recent systematic review, the pooled estimated prevalence of HBV infection was 2.2 % in the general Iranian population from 1990 to 2016 (6). By initiating HBV vaccination programmes from 1993 and blood donor screening programmes from 1996, the improvement in incidence and prevalence rate of viral hepatitis has been expected. There are limited studies in the Islamic Republic of Iran that assess the HBV and HCV incidence trend. In a study in Ilam, Khazaei et al. reported the incidence of HBV and HCV during 2008–2013 and showed an increasing trend in HBV and HCV incidence (7). However, in a study in Hamadan during 2004–2009, a decreasing trend of HBV and HCV was reported (8). In East Azerbaijan, one of the most populous Iranian provinces, the prevalence of HBV and HCV was reported to be 1.2% in 2000 (9). However, no updated report about its prevalence or incidence is available.

Considering the importance of having updated information about the prevalence and incidence of hepatitis for the planning of prevention and treatments programmes, and the lack of studies in this regard in East Azerbaijan, this study was conducted with the aim of evaluating the trend of incidence rate of HBV and HCV during 2011–2016 in East Azerbaijan, Islamic Republic of Iran.

## Methods

The data for this retrospective cohort study were obtained from the national notifiable disease surveillance system in East Azarbaijan province, which is the northwestern

province in the Islamic Republic of Iran, and consists of 19 counties with a population of 3.909 million and borders the Republic of Azerbaijan and Armenia.

According to hepatitis management guidelines, monthly reporting of hepatitis cases (positive for HBsAg, HBeAg, anti-HBC and anti-HCV positive) from all laboratories, blood transfusion organizations, hospitals, health centres and district health centres are compulsory since 2004. Moreover, a questionnaire that includes demographic characteristics, risk factors, examination cause and disease status was completed by health staff based on the patient's interview data. Finally, all data were registered in the province health centre database. For the present study, all subjects with positive HBsAg and anti-HCV serological markers who registered between 2011 and 2016 in East Azerbaijan province were included.

For estimating the incidence rate, the total population of East Azerbaijan, population of each county and also age-specific population for each year were obtained from the national Iranian census for 2016. The incidence rate for each year was calculated by the number of cases reported in a particular calendar year per 100 000 total population. The age-specific and also county-specific incidence rate was calculated as follows: (number of new cases) / (person-time at risk). Person-time at risk is calculated as follows: [(number of people at risk at the beginning of the time interval + number of people at risk at the end of the time interval) / 2] × (number of years in the time interval).

### Statistical analysis

SPSS V25 and Microsoft excel 2013 were used for statistical analysis. The normality of distribution of continuous variables was tested by using the Kolmogorov-Smirnov test. Continuous variables were presented as mean ± standard deviations (SD) and the categorical variables were presented as frequency (%). For determining the average annual rate of reduction or increase (AARR), the regression model was used for estimating beta coefficient and P-value. The log incidence rate and time were considered as dependent and independent variables respectively. Then AARR was calculated based on the following formula: AARR= (1-antilog beta)*100. The sign of beta indicates the direction of the trend. This method was adapted on the basis of information provided in a UNICEF technical note (*10*).

## Results

Over the 6-year period (2011–2016), 3119 hepatitis cases in East Azerbaijan province were reported to the national notifiable diseases surveillance system; of these, 94.7% were HBV, 4.9% were HCV, and 0.4% were HBV and HCV co-infection. The mean age of the participants was 39.52 ± 14.76 years. The baseline characteristics of participants are shown in Table 1. The frequency of HBV was higher in females. However, the frequency of HCV and HBV–HCV co-infection was higher in males. As indicated, 89.31% of the cases were married and 55.47% were living in suburban areas. The frequency of HBV was higher in suburban areas; however, the frequency of HCV was higher in urban areas, and 87.81% of cases were chronic.

**Table 1 Sociodemographic characteristics of the study participants (n = 1000), Kerman, 2016**

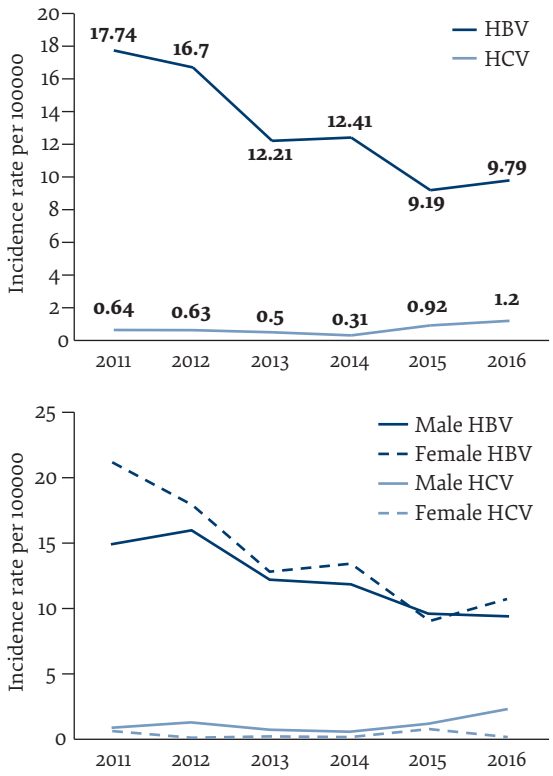
| Variable | Total (n=3119) | HBV (n=2957, 94.7%) | HCV (n=151, 4.9%) | HBV+ HCV (n=11, 0.4%) |
|---|---|---|---|---|
| ***Sex*** | | | | |
| Male | 1517 (48.6) | 1390 (47.0) | 111 (77.0) | 9 (81.8) |
| Female | 1602 (51.3) | 1567 (53.0) | 33 (22.9) | 2 (18.1) |
| ***Marital status*** | | | | |
| Married | 2776 (89.3) | 2669 (90.6) | 97 (63.3) | 10 (90.9) |
| Single | 250 (8.0) | 210 (7.1) | 39 (26.7) | 1 (9.0) |
| Divorced | 15 (0.4) | 7 (0.3) | 8 (5.2) | - |
| Widow | 65 (2.0) | 58 (1.9) | 7 (4.5) | - |
| ***Location*** | | | | |
| Capital city | 1374 (44.5) | 1296 (43.8) | 74 (49) | 4 (36.4) |
| Suburban areas | 1712 (55.4) | 1661 (56.2) | 77 (51) | 7 (63.6) |
| ***Risk factors*** | | | | |
| Infection in other family members | 644 (20.6) | 639 (24.6) | 4 (2.6) | 1 (9.1) |
| Blood transfusion | 57 (8.1) | 51 (1.7) | 6 (4) | - |
| Sexual contact | 35 (1.1) | 11 (0.4) | 7 (4.6) | - |
| Intravenous drug users | 53 (1.7) | 11 (0.4) | 27 (17.9) | 1 (0.9) |
| Dialysis | 36 (1.2) | 16 (0.5) | 20 (13.2) | - |
| Mother to child | 7 (0.2) | 7 (0.2) | - | - |
| Health worker | 11 (0.4) | 11 (0.4) | - | - |
| Others | 2250 (72.1) | 387 (13.1) | 68 (45) | 8 (72.7) |
| Non responders | 40 (1.3) | 37 (1.3) | 2 (1.3) | 1 (0.9) |
| ***Clinical spectrum*** | | | | |
| Chronic | 2718 (87.8) | 2580 (87.9) | 129 (86) | 10 (83.3) |
| Carrier | 408 (13.1) | 385 (13.3) | 20 (13.3) | 2 (16.6) |
| Acute | 108 (3.4) | 99 (3.3) | 8 (5.3) | 1 (8.3) |
| ND | 269 (8.6) | 255 (8.6) | 13 (8.6) | 1 (8.3) |

*HBV=Hepatitis B virus; HCV=Hepatitis C virus; ND=Not defined*

Figure 1 depicts the incidence rate of HBV and HCV stratified by year. According to this figure, there was a steady decrease in frequency and incidence rate of HBV between 2011 and 2016. The results of the regression analysis showed that the incidence rate of HBV decreased significantly ($R^2$ = 0.89; β = -0.136, $P$ = 0.005). HBV incidence rate was reduced by 12.71% annually from 2011 to 2016 (AARR = 12.71%). However, the number of HCV patients increased from 2014 to 2016. According to the regression analysis results, the incidence rate of HCV increased insignificantly ($R^2$ = 0.18; β = 0.109, $P$ = 0.39).

Figure 2 presents the frequency and incidence rate of hepatitis by age. The majority of individuals with HBV and HCV infections were 25-44 years old and the lowest frequency was seen in those under 5 years of age.

**Figure 1 The incidence rate of hepatitis B (HBV) and hepatitis C (HCV) by year**




The frequency of HBV and HCV by counties is shown in Figure 3. The highest incidence rate of HBV was observed in Bonab county (28.33/100 000) followed by Hashtrood (26.54/100 000) and Malekan (22.99/100 000). The lowest incidence rate of HBV was observed in Varzagan county (2.03/100 000). In the case of HCV, the highest incidence rate was reported in Mianeh county (1.98/100 000). In Charoimag, Heris, Khodafarin and Varzagan no case of HCV was reported.

## Discussion

In the present study, we aimed to determine the 6-year incidence rate of HBV and HCV in East Azerbaijan province. In total, from 2011 to 2016 there were 3119 hepatitis cases in East Azerbaijan reported to the national notifiable diseases surveillance system. The rate of HBV incidence in East Azerbaijan was similar to the incidence rate of HBV in Hamedan province (2004–2009) (*8*); however, it is lower than the reported incidence rate in Ilam province (200–2013). Moreover, we showed the downward trend in HBV incidence from 2011 to 2016 [17.74/100 000 (2011) to 10.22/100 000 (2016)], which may be due to the implementation of the vaccination programme in the country from 1993 (*11*). Previously, a decrease in HBV incidence after initiation of a vaccination programme had been reported in Italy (*12*). In addition to the vaccination programme, all blood donors were screened for hepatitis infection in the Islamic Republic of Iran from 1996 (*13*) and high-risk donors were eliminated; therefore, the transmission route was excluded. Furthermore, screening of pregnant women for hepatitis infection decreases the vertical transmission of hepatitis virus (*14*).

Considering the AARR = -12.71%, we are expecting that the incidence rate of HBV will reach 5.00/100 000 in 2020, which is in accordance with the WHO target for 2020 (30% reduction in HBV incidence compared with the 2015 baseline). The decreasing trend of HBV incidence has also been reported in previous studies; in Hamadan province the decrease in HBV incidence was reported from 2004 to 2009 (19.6 to 7.70) (*8*). Moreover, in studies conducted among blood donors in the Islamic Republic of Iran, the decline in the frequency of HBV infection has been reported (*15–17*). However, contrary to these results, Khazaei et al. (2018) showed an increase in HBV incidence from 2008 to 2013 in Ilam province (*7*). A similar increase was reported in Poland from 2005 to 2013 (*18*). The differences between the results of various studies may be due to the differences in region and also the time of the studies.

**Figure 2 The frequency and incidence of hepatitis B (HBV) and hepatitis C (HCV) by age group**

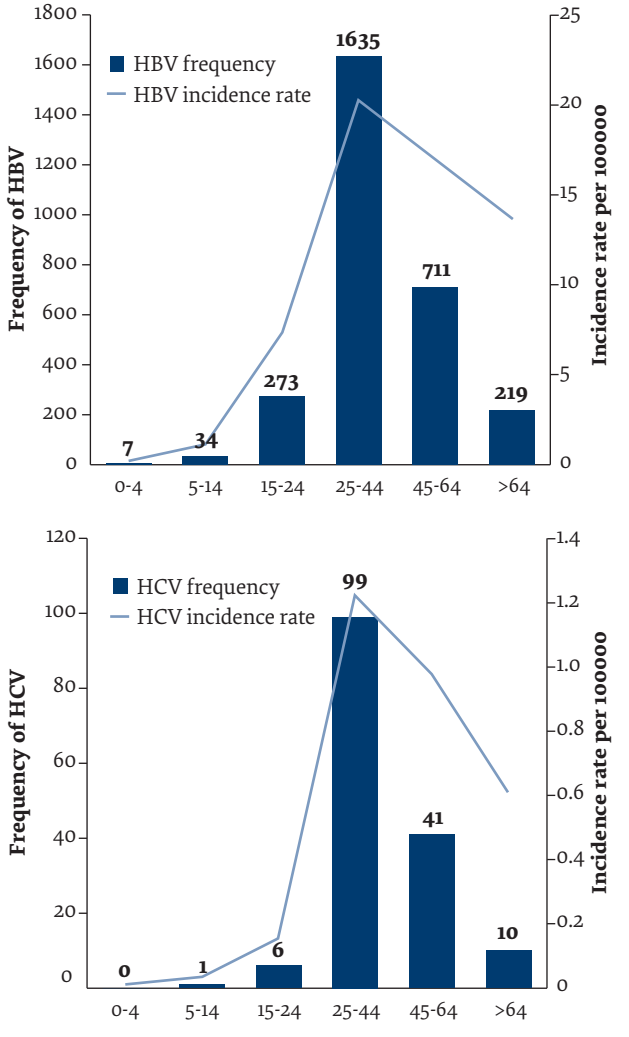
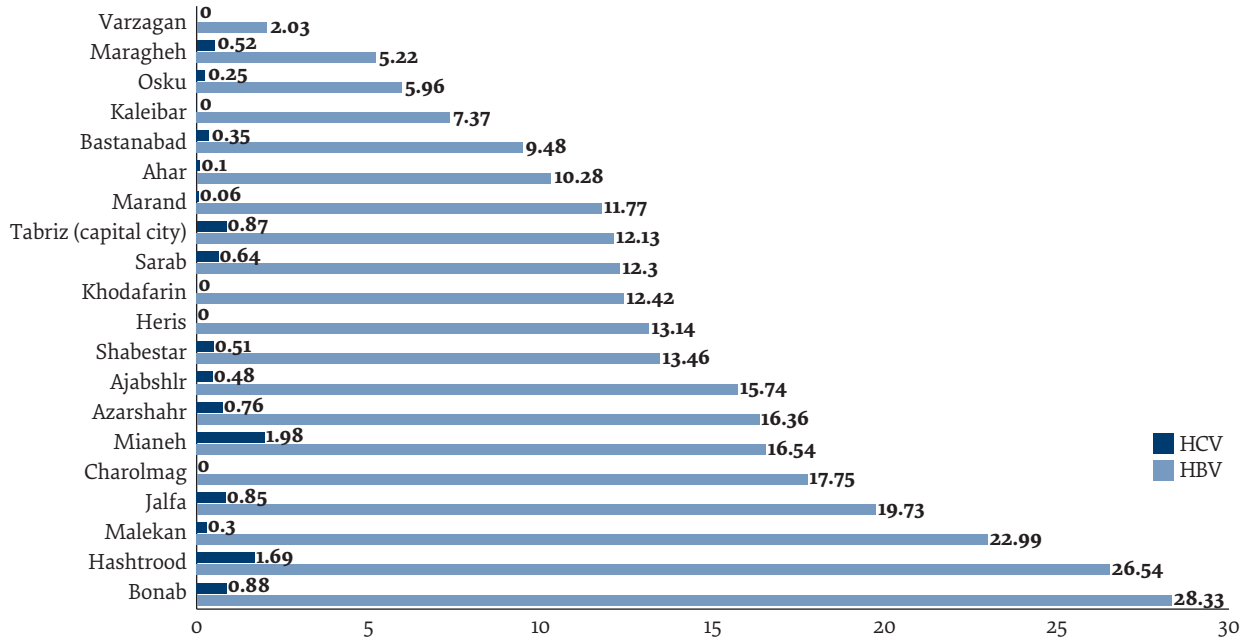


**Figure 3 The incidence of hepatitis B (HBV) and hepatitis C (HCV) by county**




According to the results, the incidence rate of HCV had a decreasing trend from 2011 to 2013. However, the number of HCV patients increased from 2014 to 2016. A similar increase in HCV incidence has been reported in other studies in the Islamic Republic of Iran. In a study in Ilam province, the increasing trend in HCV incidence was reported from 2008 to 2013 (*7*). Moreover, Merat et al. reported an increase in HCV seroprevalence in the country (*19*). All Iranian HCV patients were treated using SOVODAK – a single pill containing Sofosbuvir and Daclatasvir – which has been shown to provide a 98% sustained virologic response (SVR) in HCV patients (*20*). Therefore, it is expected in this case that the WHO target for 2020 will be reached.

Unlike previous studies conducted in the Islamic Republic of Iran (*7,8*), the results of this study showed the higher incidence rate of HBV in females. Moreover, Merat et al. in a study in three Iranian provinces showed that there are no sex differences in the HBV prevalence rate. The differences between the results of different studies may be due to the compulsory screening of hepatitis in pregnant women. On the other hand, in line with the results of the previous study (*19*), the incidence rate of HCV was higher in males than females. This can be attributed to the higher frequency of injecting drug use among males.

In accordance with the findings of earlier studies conducted in the Islamic Republic of Iran (*7,8*), the peak age for both HBV and HCV incidence was 25-44 years old. As a result of the initiation of the HBV vaccination programme in 1993, most of the under 25-year-old population was immunized for hepatitis B in 2016. Thus, as expected the incidence rate in these groups is very low. However, most of the people in the 25-44 years old age group were not immunized. On the other hand, people in this age group are of reproductive age and the frequency of marriage and consequently sexual contact between couples is high, which may affect hepatitis transmission. Moreover, the pregnancy rate in this age group is high. Therefore, the higher incidence rate in this age group could partly be attributed to implementing compulsory screening programmes of HBV in pregnant women.

More than 70% of participants in the present study did not define the exact risk factor for hepatitis transmission. In a study conducted by Centers for Diseases control and Prevention (CDC), more than 45% of cases did not report any known exposure risk (*21*). Considering that the main means of hepatitis transmissions are illegal (such as drug injection), most of the patients are unwilling to indicate the main route of transmission. In the present study about 20% of subjects had a positive HBV or HCV case in their household. The higher prevalence of hepatitis in family members, especially immediate relatives, had been reported in previous studies (*7,22,23*) that may be due to the horizontal mode of transmission and also the exposure to the same risk factors in the household (*7*).

According to the results, the prevalence of HBV was higher in certain counties including Bonab, Hashtrood and Malekan, which may be due to using unsterilized equipment for activities such as dental procedures, acupuncture, shaving, and hair cutting.

## *Limitations*

In the present study we used the data of the national notifiable diseases surveillance system in East Azerbaijan. The limitations of this system, including underreporting due to the passive model of surveillance model, also apply to the present study. Moreover, the data for HCV

were reported based on HCV anti-bodies in the present study that may prove to be false positive results. In addition, due to the asymptomatic nature of hepatitis, most patients were diagnosed accidentally. Therefore, the actual incidence of hepatitis may be higher. However, in the present study, we aimed to elucidate the trend of incidence over 6 years and it appears that this system could provide a valuable means to achieve this aim.

## Conclusion

The results of the present study showed the downward trend of HBV in East Azerbaijan, which is in accordance with the WHO target for 2020. Moreover, the low incidence of HBsAg among people aged under 25 years demonstrates the effectiveness of national vaccination programmes for neonates in reducing HBV infection. However, the incidence of HCV has insignificantly increased in recent years. Thus, considering the availability of effective treatment regimens for hepatitis C, policy-makers should focus on HCV screening and diagnosis in addition to implementing education and prevention programmes.

**Funding:** East Azerbaijan Provincial Health Center and Liver and Gastrointestinal Diseases Research Center, Tabriz University of Medical Sciences, Islamic Republic of Iran.

**Competing interests:** None declared.

## Estimation du taux d'incidence de l'hépatite B et C en Azerbaïdjan oriental (République islamique d'Iran)

### Résumé

**Contexte** : L'Organisation mondiale de la Santé (OMS) a pour objectif de réduire de 30 % l'incidence de l'hépatite B (VHB) et de l'hépatite C (VHC) à l'horizon 2020. Pour y parvenir, il est important de disposer d'informations actualisées sur l'évolution du taux d'incidence de l'hépatite. Cela dit, les données actualisées émanant de la province d'Azerbaïdjan oriental en République islamique d'Iran font défaut.

**Objectifs** : La présente étude avait pour objectif d'estimer le taux d'incidence du VHB et du VHC de 2011 à 2016 en Azerbaïdjan oriental (République islamique d'Iran).

**Méthodes** : Des données sur l'hépatite et des données populationnelles ont été obtenues respectivement à partir du système national de surveillance des maladies à déclaration obligatoire et du recensement national iranien de 2016. Afin de déterminer le pourcentage de variation du taux d'incidence par rapport à la base de comparaison, on a calculé le taux de réduction annuel moyen. Pour ce faire, le modèle de régression linéaire a été utilisé pour estimer le coefficient bêta. Le logiciel SPSS V25 a été utilisé pour l'analyse statistique.

**Résultats** : Sur la période de six ans, 3 119 cas d'hépatite dans la province d'Azerbaïdjan oriental ont été signalés, dont 94,7 % étaient des cas d'hépatite B. La majorité des personnes touchées étaient âgées de 25 à 44 ans. L'incidence du VHB a été réduite de 12,71 % par an entre 2011 et 2016. En revanche, le nombre de patients infectées par le VHC a augmenté entre 2014 et 2016 et le taux d'incidence du virus a très légèrement baissé ($\beta = 0{,}109$, $p = 0{,}39$).

**Conclusion** : On observe une tendance à la baisse marquée concernant le VHB en Azerbaïdjan oriental du fait des programmes de vaccination de masse. Dans le cas du VHC, en envisageant la disponibilité de protocoles thérapeutiques efficaces ainsi que de programmes d'éducation et de prévention, les responsables de l'élaboration des politiques devraient privilégier surtout le dépistage et le diagnostic du VHC, en particulier dans le groupe d'âge 25-44 ans.

## تقدير معدل الإصابة بالتهاب الكبد B والتهاب الكبد C في أذربيجان الشرقية، جمهورية إيران الإسلامية

محمد حسين صومي، سيمين خياط زاده، محمد نعلنبدي، شهناز نقاشي، زينب نيكنياز

### الخلاصة

**الخلفية**: هدفت منظمة الصحة العالمية إلى خفض معدلات الإصابة بالتهاب الكبد B والتهاب الكبد C بنسبة 30% بحلول عام 2020. وفي سبيل تحقيق هذه الأهداف، كان من الضروري أن تتوافر معلومات مُحدَّثة بشأن الاتجاهات في معدل الإصابة بالتهاب الكبد. ولكن، يوجد نقصٌ في البيانات المُحدثَّة من أذربيجان الشرقية الواقعة في جمهورية إيران الإسلامية.

**الأهداف**: هدفت هذه الدراسة إلى تقدير معدلات الإصابة بالتهاب الكبد B والتهاب الكبد C في الفترة بين عامي 2011 و2016 في أذربيجان الشرقية، جمهورية إيران الإسلامية.

**طرق البحث**: تم الحصول على البيانات الخاصة بالتهاب الكبد وتلك الخاصة بالسكان من النظام الوطني لترصد الأمراض التي يجب التبليغ بها، ومن التعداد الوطني الإيراني للسكان لعام 2016 على التوالي. وحتى يتسنى تحديد معدل التغييرات التي تطرأ على معدل الإصابة من خط الأساس،

حُسب متوسط الانخفاض السنوي في معدل الإصابة. واستُخدم لهذا الغرض نموذج الانحدار الخطي لتقدير مُعامل البيتا. واسْتُخدمت برمجية SPSS V25 لإجراء التحليل الإحصائي.

**النتائج:** على مدار ست سنوات، أُبلغ عن 3119 حالة إصابة بالتهاب الكبد في أذربيجان الشرقية، 94.7% منها كانت حالات التهاب الكبد B. وتراوحت أعمار غالبية المُصابين بين 44–25 عاماً. وقد خُفضت حالات الإصابة بالتهاب الكبد B بحوالي 12.71% سنوياً في الفترة بين عامي 2011 و2016. ولكن زاد عدد المرضى المصابين بفيروس التهاب الكبد C خلال الفترة بين عامي 2014 و2016، كما ارتفع معدل الإصابة بفيروس التهاب الكبد C بنسبة كبيرة ($\beta$ = 0.109، القيمة الاحتمالية = 0.39).

**الاستنتاج:** يوجد تراجع ملحوظ في معدلات الإصابة بفيروس التهاب الكبد B في أذربيجان الشرقية بسبب برامج التطعيم الجموعي. وبالنسبة لفيروس التهاب الكبد C وبالنظر إلى مدى إتاحة تدابير العلاج بالإضافة إلى برامج التعليم والوقاية، فينبغي أن يركز راسمو السياسات على تحري حالات فيروس التهاب الكبد C وتشخيصها، خاصة في الفئة العمرية التي تتراوح بين 44–25 عاماً.

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# Developing health accounts following SHA 2011: a situational analysis of countries in WHO Eastern Mediterranean Region

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## Abstract

**Background:** National health accounts provide data for health-financing policy analysis, reforms and strategies to attain national health development goals and objectives such as universal health coverage. However, in the World Health Organization (WHO) Eastern Mediterranean Region there are many challenges, making it difficult for health accounts teams to provide timely reports and for policy-makers to use them to inform policy change.

**Aim:** To undertake a situational analysis of health accounts in the Region and assess the health accounts production process. Additionally, the study looked at challenges facing health accounts teams in institutionalizing the health accounts process.

**Methods:** The WHO Regional Office for the Eastern Mediterranean has been conducting country missions to its 22 countries to assist health accounts teams and assess the status of health accounts production and institutionalization. A survey administered at a regional training workshop in October 2018 examined the challenges and successes in health accounts production.

**Results:** Three countries in the Region produce annual health accounts but most take several years between reports. Only 55% of the countries use System of Health Accounts (SHA) 2011 methodology while 27% still use SHA 1.0. The main challenges facing countries include a high turnover of employees involved in health accounts production, and time lag of data. Notable successes include policy changes based on health accounts findings.

**Conclusions:** Few countries in the Region produce annual health accounts and many still use SHA 1.0. The commitment of a country's top management is vital to ensure successful health accounts production.

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## Introduction

Health accounts (HA) are an important tool to map the flow of funds in the health sector and can provide countries with the evidence they need for reform. Better understanding of how funds are allocated in the health sector can help policy-makers and senior management locate problems in the health sector. HA also provide data on how funds are raised and used, and are useful to foster routine questioning and analysis of trends in health system resources. They enable us to know if the allocation of resources is effective or not, making HA play a vital role in evidence-based decision-making (*1*). HA are valuable to policy-makers and senior management, as well as researchers, showing where priorities should be in health systems research (*2*). The final product of a country's health accounts are called national health accounts (NHA) (*3*).

NHA show a triaxial framework of healthcare financing using the International Classifications for Health Accounts (ICHA). Specifically, the 3-core classifications are the functions of health care (ICHA-HC), health-care provision (ICHA-HP) and financing schemes (ICHA-HF). By definition, provision equals consumption and is financed. System of Health Accounts (SHA) 2011 expands on this initial framework to provide more detailed coverage by including consumption by population groups (divided by age, disease burden, income quintile, etc.), factors of provision, and revenues from financing schemes. Two other new additions are global burden of disease (GBD) classification and current health expenditure. GBD classification cross-references expenditure on diseases with sociodemographics, while current health expenditure represents final consumption excluding capital expenditure from total health expenditure, which is now separately tracked. Capital expenditure is also tracked separately (*4*). Using GBD to classify expenditure with characteristics, such as age, sex or socioeconomic status will lead to greater policy application of interest to a wider stakeholder group.

In the World Health Organization (WHO) Eastern Mediterranean Region, there are still only limited data to inform policy-makers about the health sector. The Region includes 10 of the world's 35 most fragile and conflict-affected states, as defined by the World Bank, based on financial and security status (*5,6*). It is important for countries to institutionalize a process for producing HA, preferably using the latest SHA 2011 methodology, so that results can be generated on a regular basis and identify needs. SHA 2011 makes it easier for countries to map expenditure regularly in the appropriate categories and to track and code disease expenditure. It also offers

an international standard framework that helps ensure consistency and comparability of results (7).

The purpose of the present study was to undertake a situational analysis of HA in the Region, gathering data on the methods that HA teams use and the staff and departments involved in HA production. We also looked at the main challenges NHA teams faced and what prevented some from switching to SHA 2011.

## Methods

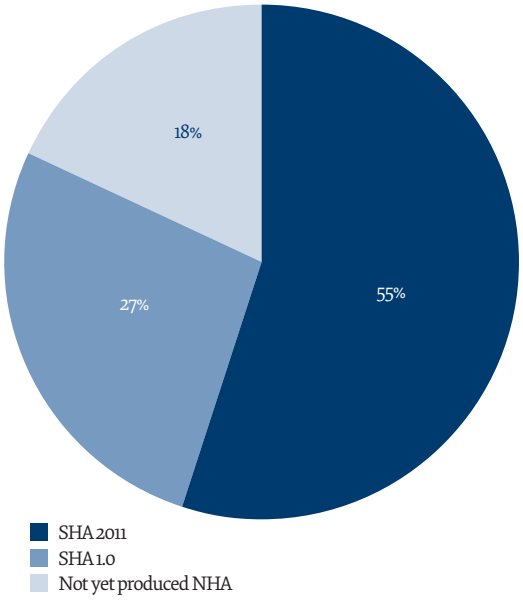
WHO Regional Office for the Eastern Mediterranean has been engaged in technical cooperation with countries to develop, review and validate their HA data, and provide technical consultation on updating previous health expenditure databases. In addition, during a regional training workshop on HA in Tunis, Tunisia, on 21–25 October 2018, WHO staff conducted face-to-face interviews with HA team members and the main focal persons on HA production. One to three official HA focal persons from each member state were invited to share the successes and challenges they encountered during the production of HA. The survey was prepared based on several international surveys on HA using the format of SWOT (strengths, weaknesses, opportunities, and threats) analysis and several international HA experts were consulted for the validity and reliability of the survey. Pilot interviews with 2 member states were also conducted to revise the questionnaire. The first part of the survey was about the methodology of data collection and information about the country's HA team, while the second part invited team members to discuss the strengths and weaknesses in HA production as well as any future opportunities to help the process, and the priorities of what needs to be addressed. All the interviews were recorded, transcribed into an Excel data sheet, and validated by focal persons in WHO country offices. Sixteen of the 22 member states participated in the interviews but some were not able to attend the regional workshop. The member states whose experts participated in the survey were Afghanistan, Bahrain, Egypt, Islamic Republic of Iran, Iraq, Jordan, Lebanon, Libya, Morocco, Oman, Palestine, Saudi Arabia, Sudan, Syrian Arab Republic, Tunisia, and the United Arab Emirates (UAE). See the Appendix for the questionnaire used in the study.

## Results

The countries of the WHO Eastern Mediterranean Region have varying levels of experience in the production of HA. About 55% of the countries currently use SHA 2011, 27% of the countries use SHA 1.0 and 18% have not yet started HA production (Figure 1). Before 2011, some HA teams in the Region such as those in Egypt, Lebanon, Morocco, Jordan and Tunisia already had experience from using SHA 1.0, with Egypt being one of the first lower–middle-income countries to have started the HA production process.

Afghanistan, Egypt, Sudan and Tunisia use SHA 2011 with diseases; Bahrain, Djibouti, Iraq, Jordan, Oman,

**Figure 1 Percentage of countries in the World Health Organization Eastern Mediterranean Region currently using SHA 2011 versus SHA 1.0.**



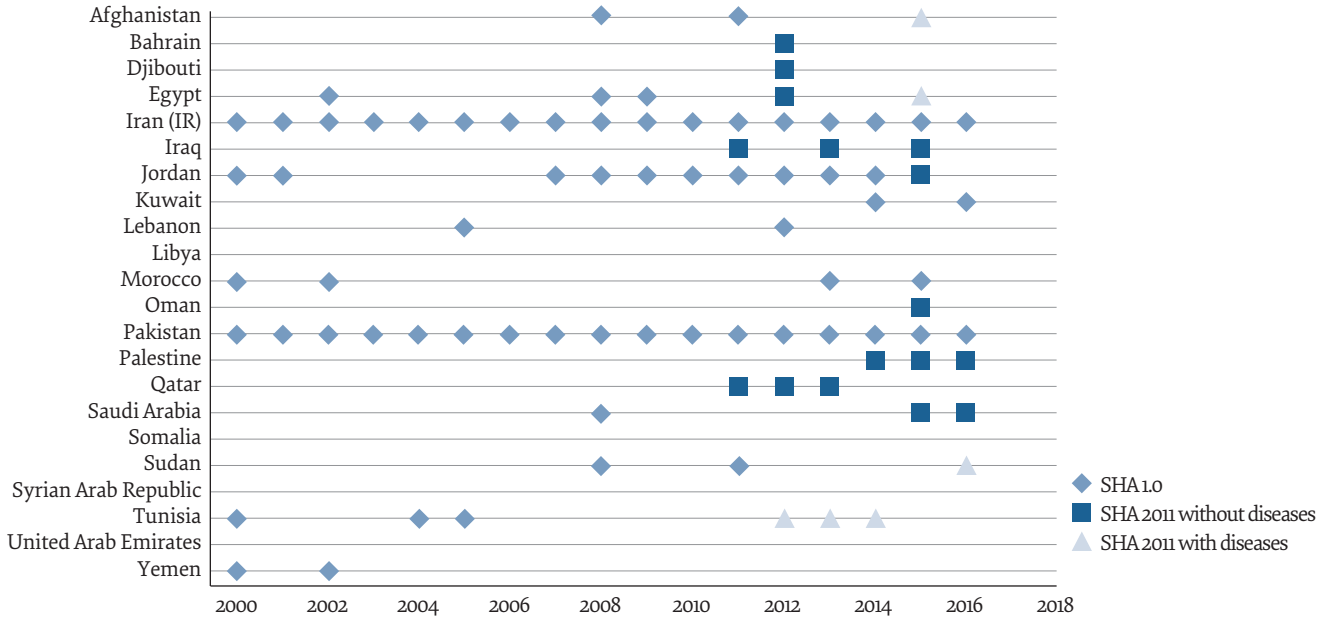

Palestine, Qatar and Saudi Arabia currently use SHA 2011 without diseases; and the Islamic Republic of Iran, Kuwait, Lebanon, Morocco, Pakistan and Yemen still use SHA 1.0. Libya, Somalia, Syrian Arab Republic and UAE have not yet started NHA. Some of the Emirates, such as Dubai, have created sub-NHA (*8*). Figure 2 illustrates how often each country produces HA and the methodology used.

The Islamic Republic of Iran, Jordan and Pakistan are currently the only member states that have an institutionalized HA process. Even though Bahrain and Oman have yet to institutionalize the HA process, their governments are committed to HA institutionalization in the future, and have set up a timeline and plan for HA production.

Many stakeholders are involved in producing HA. For the majority, the Ministry of Health is the main entity in charge of the country's HA production. In a few countries, an institution has been established to set the health reform goals, and is responsible for regular HA production, such as the High Health Council in Jordan and the Ministry of Public Health in Qatar. In some countries, such as Djibouti and Sudan, there is collaboration between the Ministry of Health and other ministries and government institutions. Although countries successfully collaborate with stakeholders throughout the process, many challenges impede the institutionalization of the regular production of HA; for example, high employee turnover, issues with data collection and analysis, and lack of government commitment. These issues were highlighted during the interviews conducted at the workshop.

Afghanistan, Iraq, Jordan, Lebanon, Sudan and UAE were all found to have high turnover rates in their HA

**Figure 2 How often countries in the World Health Organization Eastern Mediterranean Region produce national health accounts and which methodology they have used**




teams. In Iraq, high turnover among policy-makers made it challenging to raise stakeholders' awareness of the importance of HA and to facilitate data collection. The combination of turnover among policy-makers and low interest from stakeholders made the HA production process particularly difficult. For instance, Jordan has a difficult time in institutionalization due to high turnover of the HA team with about 3 or 4 members changing annually. In addition, most countries need help creating better capacity building, providing better training, and support from the government financially. To have a sustainable HA production, it is vital to have a consistent team. Most countries' teams only work part time, with the lack of staff lengthening the production process. It took about 1 year to produce an HA report for most countries in the Region, while Afghanistan and Morocco took 2 or more years.

While data were available, it was challenging to retrieve them in a timely manner and to obtain quality data. This reduced the potential attraction and value of HA to donors and policy-makers because reports were often based on data from several years ago. Egypt, Morocco, Tunisia and Yemen all had time lags in their data (*9*). The Islamic Republic of Iran, Oman, Pakistan and Palestine had recent data (*10*). Having to choose between time and accuracy affected the quality of HA, and progress on this issue requires more resources and political will (*7,11*). It was found that Yemen lacked quality data and when they did have data, they were delivered late. Collaboration with the stakeholders to obtain data also proved to be a challenge for many countries. Bahrain, Islamic Republic of Iran, Oman and Pakistan, however, did well in collaborating with stakeholders and ministries to obtain the data they needed for policy-makers (*12,13*).

Another challenge many countries mentioned was that the Health Accounts Production Tool (HAPT), which takes HA teams through the entire production process, as well as increasing capacity for HA production, was not user friendly (*14*). Egypt stated that the HAPT process was lengthy and the team often had to make secondary sheets or nonstandard Excel sheets to obtain the data that they needed to fulfil the core SHA aggregates. In Palestine, while team members were generally able to use HAPT, they faced difficulties in importing their data into the program. The challenges regarding HA production are shown in Appendix Table 1.

HA teams are either sponsored by government or WHO or both, or funded by donors. Egypt and Tunisia were fully sponsored by WHO while the Islamic Republic of Iran, Iraq, Jordan, Libya, Oman, Palestine and Saudi Arabia were fully sponsored by their governments. Bahrain was sponsored by both WHO and its government. Afghanistan, Djibouti and Sudan were primarily funded by donors with some government funding. This lack of government commitment and having to rely on external funding greatly affected the sustainability of HA production. Appendix Table 2 shows which entities funded HA production in each country.

The main successes found were reforms based on HA findings. When government commitment was strong, results generated from HA helped change countries' policies. For example, from Egypt's second NHA, the country developed the Family Health Model and in 2016, Egypt spent 10 billion Egyptian pounds in their ambulance sector. In Jordan, a health sector reform was put in place in 1995 because of results from their 1994 HA. In Lebanon, the results of the HA report led to the Ministry of Public Health earmarking budgets

for additional health resources (*15*). According to the participants of the survey during the regional training workshop, in Afghanistan, HA reports convinced policy-makers to rebuild the health sector and in 2016, the Ministry of Health decided to develop an expenditure system to collect expenditure data, allowing the HA team direct access to data. In Bahrain, Egypt, Morocco, Palestine and Sudan, out-of-pocket expenditure was found to be too high. The World Health Report 2010 noted that it is difficult to get close to universal health coverage at less than 4–5% of Gross Domestic Product, and such a ratio is required to limit the proportion of out-of-pocket payments to 20% of current health expenditure, which in turn is needed to achieve low rates of catastrophic and impoverishing health expenditure (*16*). According to the HA workshop interviews, policy-makers have reformed their countries' health insurance policies to provide universal health coverage and protect households from financial catastrophe.

According to survey respondents, another success mentioned was data collection. Many countries could collect data from multiple sources. In Palestine, data collection was said to be standardized and they collected from several sources such as surveys and administrative records, and estimated household survey data from the Expenditure and Consumption Survey by the Palestine Central Bureau of Statistics. Afghanistan was able to gather about 85% of the data they needed, other than data from the military because it had its own structure and setting. In Egypt, they had a consistent HA team that made the process run smoother, and they are currently trying to enhance the data collection process by collecting from more than one source. Officials in Bahrain, Egypt, Oman and Saudi Arabia reported that they could successfully collect data from all parts of the health sector except for the private sector. However, many of the countries were working with stakeholders to change this.

## Discussion

One of the priorities for health accounting in the WHO Eastern Mediterranean Region is for all countries to produce yearly HA through a well-institutionalized process. As shown above, the countries of the Region have widely varying levels of experience of producing HA, and some have yet to produce any. The next priority is for countries to switch to the SHA 2011 methodology, especially with diseases. Most countries, who still use SHA 1.0, mentioned the importance of switching to SHA 2011 as it is more useful for policy-makers.

Although 12 countries have already switched to using SHA 2011, regardless of which methodology the countries are using, most countries still do not have an institutionalized process for their HA in place. While there are many factors that contribute to this, one of them was the fact that many countries in the region faced high staff turnover rates. It was found that Afghanistan, Lebanon and UAE had difficulties in recruiting and retaining employees. The causes of high turnover included meagre financial incentives, poor working environment, low job satisfaction, and the fact that qualified professionals could find better opportunities in other countries (*17–19*). In order to have sustainable and institutionalized HA production, it is important to have a consistent team. To make this happen and prevent the brain drain, more funds should be allocated to healthcare employees involved in HA production and provide them with better facilities. The need to repeatedly train new staff due to the high turnover also likely leads to increased costs in institutionalizing and producing HA.

Many countries found that HAPT was not a user-friendly tool, which deterred them from switching to SHA 2011. Although HAPT provides many benefits, the downside is that survey templates for the data sources as donors, nongovernmental organizations, employers, and insurance are too long, and some countries do not fill them in. These templates need to be redesigned, or made shorter, focusing on the important data.

Although countries generally had access to many sources of data, time lags were a major issue. An active steering committee and engaged stakeholders are crucial to oversee timely data collection from each sector and solve problems raised by HA teams. It is important to institutionalize a system for data collection. In most countries of the Region, data are limited, restricted and of poor quality. Rahim et al. reported that data for public health expenditure were available for under half the countries of the Region, and most data were estimated or outdated (*20*). Saleh et al. found that each country's data are kept private or there are strict guidelines when it comes to sharing the information (*10*). The Region could benefit when it comes to policy planning by sharing data among the countries. This lack of cooperation also makes it difficult for HA teams to gather data. Although this has started to change, stronger efforts should be made to bring about more transparency and give everyone access to quality data in the Region. It is important, however, to focus on making the current system stronger, more efficient, and more transparent, rather than building an entire new data collection system.

HA create evidence for countries based on total health expenditures, health prioritization, and fiscal space. Fiscal space for health is a government's ability to spend more on the health sector without affecting other sectors or endangering the economy (*21*). Asbu et al. found that if a government spends < 20% of its general expenditure on health, it indicates that fiscal capacity for the country is low (*22*). However, if one looks at the Global Health Expenditure Database, many countries spend on health 10–15% of general government expenditure, or even less. How much a country spends on health also depends on political will and government priority given to health. According to the WHO report on "New Perspectives on Global Health Spending for Universal Health Coverage", low-income countries often obtain 33% of their funding from external resources. However, instead of the governments using the money to invest more in their health sector, this only ends up with them allocating

the money to areas other than the health sector (*23*). In Djibouti, for every 100 Djibouti francs that are invested into the health sector, 27 of them come from foreign funding. External funding can be unreliable and one cannot depend on it, hence people in Djibouti are trying to convince the government to put more into funding the health sector to become more self-sufficient (*24*). For some countries, such as Somalia and Sudan, it is difficult to obtain external funding in the first place. The African Development Bank provides Sudan with a limited number of loans, and Somalia is not even eligible due to war and political instability (*25*). WHO does its best to provide financial support, but it is important for governments to realize the importance of HA to create sustainability regarding HA and hence institutionalize the process in the country.

In many countries, government commitment is still lacking. Governments must be made aware of the importance of the production of HA and be committed to improving their countries' healthcare systems based on evidence. More accountability and transparency will facilitate the need for production of HA, and in turn lead to implementation of reform based on the results (*26*). These results cannot be achieved without the cooperation of top management and policy-makers.

Limitations of the study included the fact that some countries were not able to fully discuss the challenges posed by their governments' restrictive data laws. In addition, during the regional training workshop on health accounts in Tunisia, we were only able to interview 16 of the Region's 22 countries.

## Conclusions

Only 3 countries in the Region have been producing regular HA and 6 are just beginning to produce regular HA. It is vital that all countries in the Region begin to produce annual HA. There are many stakeholders involved in the process with the main entities being the Ministry of Health, Ministry of Finance, High Health Council and Department of Statistics. However, many countries still face significant challenges in institutionalizing the production process, including high employee turnover, data collection difficulties and a lack of commitment from government. Once the process is institutionalized, all countries in the Region should move to the new SHA 2011 methodology, and especially to SHA 2011 with diseases, to track disease expenditure in each country and provide better coverage.

## Acknowledgement

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**Competing interests:** None declared.

## Élaboration de comptes de la santé conformément au SCS 2011 : analyse de la situation des pays de la Région OMS de la Méditerranée orientale

### Résumé

**Contexte** : Les comptes nationaux de la santé fournissent des données utiles pour l'analyse des politiques de financement de la santé et la mise en place de réformes et de stratégies visant à atteindre les cibles et les objectifs nationaux de développement dans le domaine de la santé, tels que la couverture sanitaire universelle. Cependant, face aux nombreux défis auxquels se heurte la Région OMS de la Méditerranée orientale, les équipes responsables des comptes de la santé ont des difficultés à soumettre leurs rapports en temps voulu et les responsables de l'élaboration des politiques peinent à utiliser ces rapports pour éclairer les changements de politiques.

**Objectifs** : Entreprendre une analyse situationnelle des comptes de la santé dans la Région et évaluer le processus de production de ces comptes. En outre, l'étude a examiné les défis auxquels sont confrontées les équipes responsables des comptes de la santé dans l'institutionnalisation du processus d'établissement de ces comptes.

**Méthodes** : Le Bureau régional de l'Organisation mondiale de la Santé pour la Méditerranée orientale a mené des missions dans les 22 pays de la Région afin de prêter assistance aux équipes responsables des comptes de la santé et d'évaluer l'état de la production et de l'institutionnalisation de ces comptes. Une enquête menée lors d'un atelier de formation régional en octobre 2018 a permis d'examiner les défis et les succès rencontrés dans la production de comptes de la santé.

**Résultats** : Trois pays de la Région produisent des comptes de la santé chaque année, tandis que la majorité des autres pays établissent des rapports espacés de plusieurs années. Seuls 55 % des pays utilisent la méthodologie préconisée par le Système de comptes de la santé (SCS) 2011 et 27 % suivent encore le modèle du SCS 1.0.

Les principaux problèmes auxquels se heurtent les pays sont la forte rotation des employés chargés de la production de comptes de la santé et le décalage temporel des données. Parmi les réussites qui méritent d'être notées, l'on peut citer les changements de politiques qui ont été inspirés par les résultats des comptes de la santé.

**Conclusions** : Peu de pays de la Région produisent des comptes de la santé chaque année et beaucoup suivent encore les recommandations du SCS 1.0. Il est capital que les pouvoirs publics des pays prennent des engagements au plus haut niveau pour garantir le succès de la production de ces comptes.

## إعداد الحسابات الصحية عقب نظام الحسابات الصحية 2011: تحليل الوضع في البلدان بإقليم منظمة الصحة العالمية لشرق المتوسط

نيلا ناثان، ألكر دشتان، عوض مطرية

### الخلاصة

**الخلفية**: توفر الحسابات الصحية الوطنية بيانات حول تحليل سياسة تمويل الصحة، والإصلاحات والاستراتيجيات اللازمة لبلوغ الأهداف والغايات الوطنية للتنمية الصحية، مثل التغطية الصحية الشاملة. ولكن يواجه إقليم شرق المتوسط العديد من التحديات، مما يجعل من الصعب تقديم التقارير في حينها من جانب الفرق المعنية بالحسابات الصحية، واستخدام هذه التقارير من جانب راسمي السياسات للاسترشاد بها في تغيير السياسة.

**الأهداف**: هدفت هذه الدراسة إلى إجراء تحليل لأوضاع الحسابات الصحية في الإقليم، وتقييم عملية إعداد هذه الحسابات. كما أخذت هذه الدراسة بعين الاعتبار التحديات التي تواجه الفرق المعنية بالحسابات الصحية في إضفاء الطابع المؤسسي على عملية إعداد الحسابات الصحية.

**طرق البحث**: نظَّم مكتب منظمة الصحة العالمية الإقليمي لشرق المتوسط بعثات قُطرية إلى بلدانه البالغ عددها 22 بلداً بغية مساعدة الفرق المعنية بالحسابات الصحية، وتقييم أوضاع إعداد الحسابات الصحية وإضفاء الطابع المؤسسي عليها. وأُجري مسحٌ كان قد أُعد في حلقة عمل إقليمية في أكتوبر/ تشرين الأول 2018 بهدف استعراض التحديات والوقوف على النجاحات في عملية إعداد الحسابات الصحية.

**النتائج**: تُعِدُّ ثلاثة بلدان في الإقليم حسابات صحية سنوية، إلا أن أغلب البلدان تستغرق سنوات عديدة بين كل تقرير وآخر. ويستخدم 55% فقط من البلدان منهجية نظام الحسابات الصحية 2011، بينما يستخدم 27% من البلدان نظام الحسابات الصحية 1.0. وتتضمن التحديات الرئيسية التي تواجه البلدان ارتفاع معدل تنقُّل الموظفين المشاركين في إعداد الحسابات الصحية، بالإضافة إلى الفارق الزمني بين البيانات. ويُعتبر إجراء تغييرات في السياسات وفقاً لنتائج الحسابات الصحية من أهم النجاحات المحققة في هذا الشأن.

**الاستنتاجات**: يُعِدُّ عددٌ قليلٌ من البلدان حسابات صحية وطنية، ولا يزال كثيرٌ من البلدان يستخدم نظام الحسابات الصحية 1.0. ولن يتسنى إعداد الحسابات الصحية بطريقة ناجحة دون التزام من جانب الإدارة العليا في كل بلد.

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# Appendix

## *Questionnaire:*

NAME OF COUNTRY.....

**PART ONE**

**1.** What is the health accounting methodology used? (SHA 1.0/SHA 2011/SHA 2011 with disease/any other)

.....

**2.** When was the last NHA exercise done? |__|__|__|__|

a. Approximately how much time does it take for the production and dissemination of results of HA? |__|__| months

b. Approximately how much time does it take for analysis and use of HA? |__|__| months

**3.** How many NHA exercises have been done so far? |__|__|

**4.** How many years of NHA data are available? (SHA 1.0/SHA 2011/SHA 2011 with disease/any other) |__|__|

**5.** Who paid the cost of the last NHA?

a. Government |__|

b. Development partner or donor |__|

c. Part government part donor |__|

i. If the government met the cost fully or in part, was it provided through governmental budget? How much and what proportion of total cost?

.....

**6.** Were any other sources of support provided for the production of HA?

.....

**7.** What is the total number of staff that worked on the last NHA? How long have they been working?

a. Number of full-time staff |__|__|

b. Number of full-year part-time staff |__|__|

c. Number of part-year part-time staff |__|__|

d. Number of full-time consultants |__|__|

e. Number of part-time consultants |__|__|

**8.** What is the institute or department of staff (the team of NHA)

.....

**9.** Has the most current NHA helped you identify any need for additional spending on health and the potential fiscal space areas that could help meet this identified need? (Ask to elaborate more in strengths or weakness section)

.....

.....

**PART TWO**

*STRENGTHS/SUCCESSES:*

**1.** To what do you attribute the successes in the production of HA?

a. How does your government's commitment to the production of NHA play a part in the success?

.....

b. Was the NHA activity institutionalized?

.....

c. How are data efficiently collected?

.....

d. Have you standardized the method for data collection, reporting and analysis?

.....

How data from household surveys are used, e.g., is adjustment made for possible underestimation of PHE?

e. Can you elaborate on how financial resources or other support helped implement your NHA?

.....

f. How were NHA results successfully translated into reports that met your country's policy goals?

.....

g. Did the NHA finding affect the policy-makers' decision? If yes, how?

.....

h. Does the NHA team have access to microdata of household survey?

.....

*WEAKNESSES/CHALLENGES:*

**2.** What were some challenges that you faced in the production of HA?

.....

a. How do you make sure the data collected are effectively disseminated and translated?

.....

b. Has there ever been a reason why data collection for NHA was problematic?

.....

**3.** Has your country been having any difficulties in using HAPT?

.....

**4.** What is the top health sector weakness according to your most recent HA?

a. What do you think can contribute to resolving this weakness?

i. More commitment from the government.....

ii. More funding .....

iii. Better institutionalization of staff.....

**5.** Does the capacity building on how to implement NHA as a source of information used on a daily basis a challenge in your country?

.....

**6.** Have there been any recent sociocultural or socioeconomic changes that could have potentially affected the latest NHA data?

.....

.....

**7.** How did your department coordinate and collaborate to produce primary and secondary data?

.....

***OPPORTUNITIES:***

**8.** What opportunities has the production of NHA been able to provide to the country?

.....

**9.** Are there any current trends that you feel could affect the country's HA? (Could be either threat or opportunity)

a. (If opportunity) What specifically may benefit as a result: demand and use, production, dissemination, or translation of data?

.....

b. (If threat) In what way does this concern you about the future of your country's NHA?

.....

**10.** Are there any new technologies that you would like to implement in the future, but are currently unable to do so?

.....

.....

**11.** Do you think data found about generational shifts could affect future NHA? (Could be threat or opportunity depending on answer)

a. In what way?

.....

.....

***THREATS:***

**12.** What are some of the threats that the production of NHA have brought to the government's attention?

.....

.....

**13.** Is there anything specific that could be a risk to your country's sustainability of NHA?

a. In what way will this affect how it is translated into policy?

.....

b. Will it affect future data collection?

.....

***PRIORITIES:***

From your recent NHA, what did you find to be priorities that needed to be addressed?

c. How is your country is dealing with this or plans to do so if not already?

.....

d. If it is something that has not been able to be addressed, why?

.....

Is there anything else that you would like to add about the successes or challenges of HA your country has faced thus far?

.....

.....

**Appendix Table 1 Challenges regarding health accounts production**

| Challenges | Turnover | Data collection | Quality of data | SHA 2011 or HAPT | Lack of funding or government commitment | Political or geographical problems |
|---|---|---|---|---|---|---|
| Countries | Afghanistan, Djibouti, Iraq, Lebanon, Saudi Arabia, Sudan, UAE, Yemen | Afghanistan, Bahrain, Djibouti, Egypt, Lebanon, Palestine, Saudi Arabia, Yemen | Bahrain, Djibouti, Palestine, Saudi Arabia, Yemen | Afghanistan, Djibouti, Jordan, Iran, Morocco, Pakistan, Saudi Arabia | Afghanistan, Libya, Somalia, Sudan, Syria, Yemen | Jordan, Libya, Palestine, Somalia, Syria |

*SHA = System of Health Accounts; HAPT = Health Accounts Production Tool; UAE = United Arab Emirates.*

**Appendix Table 2 Health accounts funding in World Health Organization Eastern Mediterranean Region**

| | AFG | BAH | DJI | EGY | IRA | IRQ | JOR | LEB | LIY |
|---|---|---|---|---|---|---|---|---|---|
| **Responsible institution** | MOH | MOH | MOH | MOH | MOH | MOH | High Health Council | MOH | MOH |
| **Funding source** | MOH, Donors | Govt budget | Govt budget, Donors | MOH | MOH | Govt budget | Govt budget | Govt budget, Donors | Govt budget |
| | **MOR** | **OMA** | **PAK** | **PSE** | **SAA** | **SUD** | **SYR** | **TUN** | **UAE** |
| **Responsible institution** | MOH | MOH | PBS | PCBS | Supreme Council | MOH | MOH | MOH | MOH |
| **Funding source** | MOH, WHO | Govt budget | Govt budget | Govt budget, Donors | Govt budget | Govt budget, Donors | Govt budget, Donors | Govt budget | Govt budget |

*AFG = Afghanistan; BAH = Bahrain; DJI = Djibouti; EGY = Egypt; IRA = Islamic Republic of Iran; JOR = Jordan; LEB = Lebanon; MOR = Morocco; OMA = Oman; PAK = Pakistan; PSE = Palestine; SAA = Saudi Arabia; SUD = Sudan; SYR = Syrian Arab Republic; TUN = Tunisia; MOH = Ministry of health; PBS = Pakistan Bureau of Statistics; PCBS = Palestine Central Bureau of Statistics; WHO = World Health Organization.*

*List of countries that attended Regional Health Account Training Workshop: Afghanistan, Bahrain , Egypt, Islamic Republic of Iran, Iraq, Jordan, Lebanon, Libya, Morocco, Oman, Palestine, Saudi Arabia*

# Socioeconomic-related inequalities in self-rated health status in Kermanshah city, Islamic Republic of Iran: a decomposition analysis

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## Abstract

**Background:** Socioeconomic-related inequalities in health are a major public health challenge in both developed and developing countries. Little evidence is available on socioeconomic-related inequalities in health in different regions of the Islamic Republic of Iran.

**Aims:** This study aimed to determine socioeconomic-related inequality in poor self-rated health in adults in Kermanshah city, western Islamic Republic of Iran.

**Methods:** This cross-sectional study with stratified sampling obtained data on socioeconomic status, demographic characteristics, behavioural risk factors and self-rated health of 2040 adults (≥ 18 years) in Kermanshah city. A self-administrated questionnaire was used to collect data from the participants. The concentration (C) index and C curve were used to determine the socioeconomic-related inequality in poor self-rated health. A decomposition analysis of the C index was done to identify the factors explaining socioeconomic-related inequality in poor self-rated health.

**Results:** The crude and age-adjusted prevalence of poor self-rated health was 13.8% and 18.1%, respectively. The estimated C for the whole sample was −0.295, indicating that poor SRH was concentrated in the poor. The decomposition results suggested that socioeconomic status (45.5%), having a chronic health condition (11.9%) and smoking (7.3%) were the main factors contributing to the concentration of poor self-rated health among those of lower socioeconomic status.

**Conclusion:** The concentration of poor self-rated health among the poor in Kermanshah city warrants policy attention. Policies aimed at reducing inequality in wealth distribution and risky health behaviour and preventing chronic health conditions among the poor may mitigate socioeconomic-related inequalities in poor self-rated health in Kermanshah.

Keywords: Self-rated health, socioeconomic inequalities, decomposition analysis, Islamic Republic of Iran

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## Introduction

The overall health status of the general population worldwide has improved significantly in the 21st century. However, in spite of this improvement and the increasing resources spent on health care services globally, socioeconomic-related inequalities in health are one of the main public health challenges (*1–4*) and reducing such inequalities is a key priority in both developed and developing countries (*5*). It has been widely argued that socioeconomic differences can lead to inequalities in health status in society through inequalities in resources and access to material opportunities such as employment, continuing education, nutrition and housing (*6,7*).

Self-rated health (SRH) is a comprehensive measure of people's well-being and quality of life (*8*). It is a single-item measure where respondents are asked to assess and rate their own health status (*9*). SRH is a well-validated and commonly-used measure of health status (10), which is associated with several factors, including sociodemographic status, economic status, and behavioural, psychosocial and chronic health conditions. Understanding and identifying the main factors affecting SRH are needed to explain variations in SRH, and thus suggest strategies to improve SRH in different social groups (*11–13*).

To date, several studies have reported socioeconomic inequalities in various indicators of health in the Islamic of Iran (*2,14*) and worldwide (*8,15,16*). However, to the best our knowledge, there is little evidence on socioeconomic-related inequalities in health in different regions of the Islamic Republic of Iran (*2*), and no study has measured and done a decomposition analysis of socioeconomic-related inequality in SRH in western Islamic Republic of Iran. To fill this gap in the literature, we used the concentration index approach to measure socioeconomic-related inequalities in poor-SRH in adults aged 18 years and older in Kermanshah city. We also did a decomposition analysis of socioeconomic inequality in poor SRH to determine key factors that explain the observed inequality in health. Measuring and monitoring social inequalities in health can provide useful information to identify effective interventions to reduce these inequalities in different subgroups of the population, especially vulnerable subgroups (*17*).

# Methods

## Study setting

This study was carried out in Kermanshah city, western Islamic Republic of Iran from January to April 2018. The population of the Kermanshah province was estimated to be approximately one million in 2016 (*18*).

## Study population, sample size and sampling method

This was a cross-sectional study using data on socioeconomic status, demographic characteristics, behaviour (smoking and obesity) and SRH of 2040 adults (aged 18 years and more) in Kermanshah city. Multistage sampling was used to select the study participants. We first divided Kermanshah city into five areas (strata) of central, western, eastern, southern and northern; then an equal number of participants was selected from each area. Because of funding constraints, a convenience sampling method was used to select study participants.

The following formula was used to calculate the sample size: $n = z^2(p(1-p))/d^2$, where $z$ = 1.96 (95% level of significance), $p$ = prevalence of poor SRH and $d$ = precision, set at 0.5 and 0.03, respectively. The final calculated sample size was 1537. We added 35% to the required sample size to increase the power of the study.

## Data collection and variables

A self-administrated questionnaire was used for data collection. The questionnaire consisted of questions on age, sex, marital status, years of education, health insurance coverage, presence of chronic health condition(s), SRH, smoking behaviour, obesity status and household durable assets – number of rooms per capita, type of house ownership, house size (number of square metres), ownership of a car, computer/laptop, freezer, dishwasher and television, and access to the Internet. The outcome variable, poor SRH, was measured using the question: "How do you rate your current general health status?" Response choices were on a five-point Likert scale: 5 = very good, 4 = good, 3 = moderate, 2 = poor and 1 = very poor. Similar to previous studies (*2,19,20*), participants were classified as having poor SRH if they rated their health status poor or very poor. The reliability of this categorization was 0.85 based on the intraclass correlation coefficient.

## Statistical analysis

The frequency and 95% confidence interval (CI) were used to present descriptive characteristics of study population and the crude and age-adjusted prevalence of poor SRH, respectively.

The concentration (*C*) index and *C* curve were used to measure and illustrate socioeconomic-related inequalities in poor SRH (*21,22*). The C curve plots the cumulative percentage of the outcome variable (poor SRH) on the y-axis against the cumulative percentage of the respondents ordered by socioeconomic status on the x-axis. If the C curve lies above the 45-degree line of perfect equality, poor SRH is concentrated in the poorer people; if the *C* curve lies the below the 45-degree line of perfect equality, poor SRH is concentrated in the wealthier people. The *C* index is defined as twice the area between the 45-degree line and the *C* curve. The index ranges between –1 and +1, with zero indicating perfect equality. A negative value for the index suggests that the outcome variable (poor SRH) is more prevalent in poorer people. A positive value for the index suggests that poor SRH is more prevalent in richer people. The *C* index was estimated using the following convenient regression formula (*22*). As poor SRH is a binary variable, as per Wagstaff (*23*), we normalized *C* by multiplying the index by 1/(1–μ) (i.e. $C_n = C/(1-\mu)$) where μ is the mean (proportion) of poor SRH for the sample.

We used the principal component analysis technique to construct the socioeconomic status score of participants (*24*). We included years of schooling, number of foreign and domestic trips, income and ownership of durable assets (number of rooms per capita, type of house ownership, house size per square metre, possession of a mobile telephone, access to the Internet, and ownership of a car, television, computer/laptop, freezer, dishwasher, microwave and vacuum cleaner) in the principal component analysis. The socioeconomic status scores obtained from the principal component analysis were used to rank the respondents in the computation of *C* index.

We did a decomposition analysis of the *C* index to identify the contribution of each explanatory variable to the socioeconomic-related inequality in poor SRH (*25*). If the linear regression relates the outcome variable y (poor SRH) to a set of explanatory variables, $x_k$ as follows:

$$y=\alpha+\sum_k \beta_k x_k+\varepsilon$$

then $C_n$ for poor SRH can be decomposed using the following equation:

$$C_n = \frac{C}{1-\mu} = \frac{\sum_k \left(\frac{\beta_k \bar{x}_k}{\mu}\right) C_k}{1-\mu} + \frac{\frac{GC_\varepsilon}{\mu}}{1-\mu}$$

where the $C_n$ is the concentration index for poor SRH, $\bar{x}_k$ is the mean of each determinant, and $C_k$ and $\beta_k$ are the concentration index and coefficient for the explanatory variables, respectively.

The component $\frac{\beta_k \bar{x}_k}{\mu}$ shows the elasticity of poor SRH with regard to the explanatory variables.

$\sum_k \left(\frac{\beta_k \bar{x}_k}{\mu}\right) C_k$ shows the contribution of factor $\bar{x}_k$ to $C_n$ for poor SRH. A negative (positive) absolute contribution of an independent factor to $C_n$ suggests that socioeconomic-related variation of the factor $C_k$ and the relationship between the independent factor and poor SRH contributes to the concentration of poor SRH in the poor (rich). $GC_e/\mu$ denotes the residual component and reflects the socioeconomic-related inequality in poor SRH that cannot be explained by the explanatory variables included in the model. As poor SRH is a binary variable, the marginal effects obtained from a logit model were used in the decomposition analysis.

STATA version 14.2 software was used for all data analyses.

### Ethical considerations

Verbal consent was obtained from each participant after explaining the purpose of the study. All the participants were also informed that they had the right to withdraw from the data collection process at any point. Those who did not provide consent to participate were excluded from the survey. Data were collected anonymously and were only used for research purpose. The study was approved by the Ethics Review Committee of the Deputy of Research at Kermanshah University of Medical Sciences (KUMS) (IR.KUMS.REC.1396.714).

## Results

A total of 2040 adults, aged 18 years and more, participated in the study (no one declined to participate). The mean age was 36.5 years (standard deviation = 12.4). Table 1 summarizes the characteristics of the adult participants and the prevalence of poor SRH according to sociodemographic, socioeconomic and behavioural characteristics in adults in Kermanshah city. As shown in Table 1, 1247 (61.1%) of the sample were men. Most (1622, 79.5%) of the sample had health insurance coverage; 267 (13.1%) of the sample had a chronic health condition, and 379 (18.6%) were current smokers. Of the total sample, 283 respondents – 13.9% (95% confidence interval (CI): 12.4–15.4%) – rated their health status as poor or very poor. The prevalence of poor SRH adjusted for age was 18.1% (95% CI: 16.0–20.3%). The crude and adjusted prevalence of poor SRH in participants with a chronic health condition was 8.5% (95% CI: 7.3–9.9) and 11.4% (95% CI: 9.4–13.9), respectively.

The results of the principal component analysis suggest that the first principal component explained most of the variation (24.1%). Thus, we used scoring factors of the first principal component to construct the socioeconomic status score of participants. Based on the estimated socioeconomic status scores using the principal component analysis technique, we categorized participants into five socioeconomic status groups (quintiles) from poorest (first quintile) to richest (fifth quintile). The crude and adjusted prevalence of poor SRH for the lowest socioeconomic status quintile were 28.2% (95% CI: 24.0–32.8%) and 28.9% (95% CI: 24.8–33.4%), respectively. The corresponding figures for the highest socioeconomic status quintile were 6.4% (95% CI: 4.4–9.2%) and 9.7% (95% CI: 7.1–13.0%), respectively.

Table 2 shows the *C* indexes for the whole sample and by sex. The *C* index for the whole sample was −0.295. The *C* indexes for males and females were −0.223 and −0.377, respectively. These results illustrated that poor SRH is concentrated in poorer people ($P < 0.001$). In addition, the *C* curves of poor SRH lay above the line of perfect equality, indicating that poor SRH was more prevalent in socioeconomically disadvantaged adults (Figure 1).

The results of the decomposition analysis of the *C* index for poor SRH are shown in Table 3. The estimated marginal effects obtained from model estimations suggest that lower socioeconomic status, being female, lack of health insurance, being married, presence of a chronic health condition, smoking and obesity were associated with higher probability of poor SRH. The *C* index for the explanatory variables shows that adults aged 40 years and older (*C* = −0.041), those who were married (*C* = −0.049), smokers (*C* = −0.216) and those with a chronic health condition (*C* = −0.035) were more likely to be poor. On the other hand, people with health

**Table 1 Prevalence of poor self-rated health (SRH) according to characteristics of the participants, Kermanshah, Islamic Republic of Iran, 2017**

| Characteristic | No. (%) (*n* = 2040) | Prevalence of poor SRH (%) | |
|---|---|---|---|
| | | Crude (95% CI) | Age-adjusted (95% CI) |
| ***Age group (years)*** | | | |
| < 40 | 1326 (65.0) | 7.8 (6.4–9.4) | 8.1 (6.6–9.6) |
| ≥ 40 | 714 (35.0) | 25.2 (22.1–28.5) | 27.3 (23.6–31.3) |
| ***Sex*** | | | |
| Male | 1247 (61.1) | 11.6 (8.6–9) | 13.8 (8.4–8.8) |
| Female | 793 (38.9) | 17.4 (14.9–20.2) | 25.2 (22.1–28.6) |
| ***Marital status*** | | | |
| Single | 717 (35.1) | 5.7 (4.2–7.7) | 10.7 (8.6–13.2) |
| Married | 1215 (59.6) | 17.5 (15.5–19.7) | 18.1 (15.8–20.6) |
| Divorced/widowed | 108 (5.3) | 26.8 (19.2–36.1) | 18.2 (15.1–21.8) |
| ***Socioeconomic status*** | | | |
| 1 (poorest) | 408 (20.0) | 28.2 (24–32.8) | 28.9 (24.8–33.4) |
| 2 | 409 (20.1) | 11.2 (8.5–14.7) | 13.4 (10.7–17.8) |
| 3 | 407 (20.0) | 12.8 (9.8–16.4) | 16.9 (13.4–21.1) |
| 4 | 408 (20.0) | 10.8 (8.1–14.2) | 19.2 (16.3–22.5) |
| 5 (wealthiest) | 408 (20.0) | 6.4 (4.4–9.2) | 9.7 (7.1–13) |
| ***Health insurance*** | | | |
| Yes | 1622 (79.5) | 13.6 (12.4–15.4) | 17.4 (15.2–19.9) |
| No | 418 (20.5) | 14.8 (11.7–18.6) | 19.3 (16.1–23) |
| ***Smoking status*** | | | |
| Smoker | 379 (18.6) | 17.9 (14.4–22.1) | 16.7 (13.1–21) |
| Non-smoker | 1661 (81.4) | 12.9 (11. 4–14.6) | 19.6 (17.3–22.2) |
| ***Obesity status*** | | | |
| Obese | 178 (8.7) | 28.1 (21.9–35.2) | 30.2 (25.7–35.1) |
| Not obese | 1862 (91.3) | 12.5 (11.1–14.1) | 16.7 (14.5–19.1) |
| ***Chronic health condition*** | | | |
| Yes | 267 (13.1) | 49.4 (43.4–55.4) | 45.6 (40.3–51) |
| No | 1773 (86.9) | 8.5 (7.3–9.9) | 11.4 (9.4–13.9) |

*CI: confidence interval.*

**Table 2 Normalized concentration index for poor self-rated health in Kermanshah, Islamic Republic of Iran, 2017**

| Sample | Concentration index | 95% confidence interval | *P*-value |
|---|---|---|---|
| Male | −0.223 | −0.320 to −0.126 | < 0.001 |
| Female | −0.377 | −0.477 to −0.276 | < 0.001 |
| **Total** | **−0.295** | **−0.365 to −0.225** | **< 0.001** |

**Figure 1 Concentration curve for poor self-rated health (SRH) in men, women and in the total sample**


insurance coverage ($C$= 0.051) and obese adults ($C$ = 0.135) were more concentrated in the better-off. The total contribution percentage for each determinant is given in the last column of Table 3, which shows that the main factors contributing to socioeconomic-related inequality in poor SRH were socioeconomic status (45.50%), having a chronic health condition (11.90%) and smoking status (7.26%). The results suggest that 47.70% of socioeconomic-related inequality in poor SRH is explained by the determinants included in the study and the remaining of 52.30% is explained by the residuals (i.e. variables not included in our decomposition model).

## Discussion

The findings of our study show that poor SRH was higher in women than men. A higher proportion of poor SRH in women compared with men was found in studies in China (*26*), Greece (*27*) and Syria (*16*). The reported prevalence of poor SRH in the literature varies widely, ranging from 7% to 80% (*2,8,16,28–30*). For example, according to the 2008 Turkish Health Survey, 7% of men assessed their general health status as poor (*8*). The prevalence of poor SRH in adults was 9.1% in a study similar to ours in Syria (*16*). In contrast, a study in the Islamic Republic of Iran reported that 80% of women rated their health as poor (*29*). One of the possible explanations for this discrepancy could be because of demographic, cultural and regional differences in reporting general health status (*31*).

Our findings indicate that some socioeconomic and behavioural characteristics were statistically significantly associated with poor SRH. Age, sex, smoking status, obesity, the presence of a chronic health condition and socioeconomic status of individuals were the main predictors of poor SRH. We found that lower socioeconomic status was associated with a higher prevalence of poor SRH in our sample. This may be because rich people have access to better nutrition and health care services compared with poor people. Studies in other countries also show a negative correlation between socioeconomic status and poor SRH (*2,26,32*). In our study, being female was associated with a higher probability of poor SRH. These findings are consistent with other studies that reported the prevalence of poor SRH in women and men (*2,8,28,29,33,34*).

Similar to other studies, we found a higher prevalence of poor SRH in older adults (*2,13,16,35*). In addition, poor SRH was significantly associated with smoking and having a chronic disease in our study and other studies (*8,29*).

Poor SRH was more prevalent in individuals of lower socioeconomic status in our study. Similarly, a study in Turkey in 2012 found that the C index for poor SRH was −0.15 indicating a clear inequality in SRH with those categorized as poor more likely to have poor SRH (*8*). Another study in China found a similar inequality in SRH (*26*), and a study in Tehran also showed that poor SRH was more prevalent in poor people (*2*).

Our decomposition analysis of socioeconomic-related inequality in poor SRH showed that socioeconomic status, the presence of a chronic health condition and smoking status were the main contributors to socioeconomic-related inequality in health in Kermanshah city. While lower socioeconomic status and presence of chronic health condition increased the concentration of poor SRH in poor people, a higher prevalence of obesity in the rich increased the concentration of poor SRH in the rich. These findings are consistent with the results of other studies that reported socioeconomic status as the most important factor contributing to socioeconomic inequality in health (*14,36,37*). For example, the study in Tehran found that economic status (47.8%), level of education (29.2%) and age (23.0%) were the main

**Table 3 Decomposition analysis of socioeconomic inequality in poor self-rated health**

| Variable | Marginal effects | Mean | Elasticity | $C_k$ | Contribution | | |
|---|---|---|---|---|---|---|---|
| | | | | | Absolute | Percentage | Summed percentage |
| ***Age group (years)*** | | | | | | | |
| < 40 | Ref | 0.65 | Ref | Ref | Ref | Ref | 2.4 |
| ≥ 40 | 0.069 | 0.35 | 0.174 | −0.041 | −0.007 | 2.4 | |
| ***Sex*** | | | | | | | |
| Male | Ref | 0.61 | Ref | Ref | Ref | Ref | 0.27 |
| Female | 0.040 | 0.39 | 0.112 | −0.007 | −0.000 | 0.27 | |
| ***Marital status*** | | | | | | | |
| Single | Ref | 0.35 | Ref | Ref | Ref | Ref | 2.56 |
| Married | 0.032 | 0.60 | 0.138 | −0.049 | −0.007 | 2.31 | |
| Divorced/widowed | 0.011 | 0.05 | 0.004 | −0.168 | −0.000 | 0.23 | |
| ***Socioeconomic status*** | | | | | | | |
| 1 (poorest) | 0.124 | 0.20 | 0.179 | −0.800 | −0.143 | 48.5 | 45.50 |
| 2 | 0.029 | 0.21 | 0.044 | −0.399 | −0.017 | 5.9 | |
| 3 | 0.065 | 0.19 | 0.088 | 0.000 | 0.000 | 0.00 | |
| 4 | 0.046 | 0.20 | 0.066 | 0.400 | 0.026 | −9.00 | |
| 5 (wealthiest) | Ref | 0.20 | Ref | Ref | Ref | Ref | |
| ***Health insurance*** | | | | | | | |
| Yes | 0.14 | 80 | 0.081 | 0.051 | 0.004 | −1.40 | −1.40 |
| No | Ref | 20 | Ref | Ref | Ref | Ref | |
| ***Smoking status*** | | | | | | | |
| Smoker | 0.017 | 0.81 | 0.099 | −0.216 | −0.021 | 7.26 | 7.26 |
| Non-smoker | Ref | 0.19 | Ref | Ref | Ref | Ref | |
| ***Obesity status*** | | | | | | | |
| Obese | 0.069 | 0.91 | 0.453 | 0.135 | 0.061 | −20.72 | −20.72 |
| Not obese | Ref | 0.9 | Ref | Ref | Ref | Ref | |
| ***Chronic health condition*** | | | | | | | |
| Yes | 0.300 | 0.13 | 0.281 | −0.035 | −0.035 | 11.90 | 11.90 |
| No | Ref | 0.87 | Ref | Ref | Ref | Ref | |
| Total observed | | | | | −0.141 | | 47.7 |
| Residual | | | | | −0.154 | | 52.3 |
| *C* index for total sample | | | | | −0.295 | | 100 |

*$C_k$: concentration index, Ref: reference category in the regression analysis.*

determinants of socioeconomic inequality in SRH (*2*). The study in Turkey also suggested education level (70.7%) and household wealth (9.7%) were the two main contributing factors to inequality in SRH (*8*).

Our study has some limitations that should be considered when interpreting the findings. First, we used a convenience sampling method to select study participants in Kermanshah city. Thus, the generalizability of our findings may be limited. Second, although SRH status is a valid measure of health status (*10*), participants may have interpreted the question on SRH differently and therefore we should be aware of the potential problem of using poor SRH to measure inequality in health. Third, our study was cross-sectional and therefore we cannot establish causal relationships between the determinants of socioeconomic inequality in health and poor SRH in our decomposition analysis.

## Conclusion

Socioeconomic status of adults, the presence of a chronic health condition and smoking were the largest contributors to socioeconomic inequality in poor SRH. Thus, policies aimed at reducing smoking and preventing chronic diseases among poorer people may mitigate some of the socioeconomic inequalities in poor SRH in Kermanshah.

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## Inégalités socio-économiques liées à l'état de santé auto-évalué dans la ville de Kermanshah (République islamique d'Iran) : une analyse de décomposition

### Résumé

**Contexte** : Les inégalités socio-économiques en matière de santé constituent un défi de santé publique majeur dans les pays développés tout comme dans les pays en développement. Il existe peu de données factuelles sur les inégalités socio-économiques en matière de santé dans les différentes régions de la République islamique d'Iran.

**Objectifs** : La présente étude avait pour objectif de déterminer l'inégalité socio-économique de l'état de santé auto-évalué comme mauvais chez les adultes de la ville de Kermanshah, dans la partie occidentale de la République islamique d'Iran.

**Méthodes** : La présente étude transversale, basée sur un échantillonnage stratifié, a permis d'obtenir des données sur le statut socio-économique, les caractéristiques démographiques, les facteurs de risque comportemental et l'état de santé déterminé par auto-évaluation de 2 040 adultes âgés de 18 ans et plus de la ville de Kermanshah. Un auto-questionnaire a été utilisé pour recueillir des données auprès des participants. L'indice de concentration (C) et la courbe C ont été utilisés pour déterminer l'inégalité socio-économique de l'état de santé auto-évalué comme mauvais. Une analyse de décomposition de l'indice C a été effectuée afin d'identifier les facteurs expliquant l'inégalité socio-économique de l'état de santé auto-évalué comme mauvais.

**Résultats** : La prévalence brute et ajustée sur l'âge d'un état de santé auto-évalué comme mauvais était de 13,8 % et de 18,1 %, respectivement. L'indice C estimé pour la totalité de l'échantillon était de −0,295, ce qui indique que l'état de santé auto-évalué comme mauvais était concentré chez les pauvres. Selon les résultats de la décomposition, le statut socio-économique (45,5 %), un problème de santé chronique (11,9 %) et le tabagisme (7,3 %) étaient les principaux facteurs contribuant à la concentration d'une mauvaise santé auto-évaluée parmi ceux qui ont un statut socio-économique inférieur.

**Conclusion** : La concentration d'une mauvaise santé auto-évaluée parmi les pauvres dans la ville de Kermanshah mérite une attention politique. Les politiques visant à réduire les inégalités dans la répartition des richesses et les comportements à risque en matière de santé et à prévenir les problèmes de santé chroniques parmi les pauvres permettent d'atténuer les inégalités socio-économiques en matière de mauvaise santé auto-évaluée à Kermanshah.

## مظاهر انعدام المساواة الاجتماعية الاقتصادية في وضع الصحة المُقدرة ذاتياً في مدينة كرمانشاه، جمهورية إيران الإسلامية: تحليل تفكيكي

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### الخلاصة

**الخلفية**: تُعتبر مظاهر انعدام المساواة الاجتماعية الاقتصادية في مجال تقديم الرعاية الصحية من أكبر التحديات التي تواجه الصحة العامة في كل من البلدان المتقدِّمة والنامية. وغير مُتاح سوى قدرٌ ضئيلٌ من الدلائل على مظاهر انعدام المساواة الاجتماعية الاقتصادية في مجال تقديم الرعاية الصِّحية في مختلف مناطق جمهورية إيران الإسلامية.

**الأهداف**: هدفت هذه الدراسة إلى تحديد مظاهر انعدام المساواة الاجتماعية الاقتصادية في اعتلال الصحة المُقدرة ذاتياً في صفوف البالغين في مدينة كرمنشاه، الواقعة غرب جمهورية إيران الإسلامية.

**طرق البحث**: اشتملت هذه الدراسة المقطعية على عينة طبقية من البيانات الخاصة بالوضع الاجتماعي الاقتصادي، والخصائص السكانية، وعوامل الخطر السلوكية، والصحة المُقدرة ذاتياً بين 2040 بالغاً (≤18 عاماً) في مدينة كرمنشاه. واستُخدم استبيان ذاتي الإجابة لجمع البيانات من المشاركين. واستُخدم مؤشر ومنحنى التركيز لتحديد مظاهر انعدام المساواة الاجتماعية الاقتصادية في اعتلال الصحة المُقدرة ذاتياً. كما أُجري تحليل تفكيكي لمؤشر التركيز لتحديد العوامل التي توضح أسباب مظاهر انعدام المساواة الاجتماعية الاقتصادية في اعتلال الصحة المُقدرة ذاتياً.

**النتائج**: بلغت نسبتا الانتشار الأولي والمعدل حسب العمر لاعتلال الصحة المُقدرة ذاتياً 13.8% و18.1% على التوالي. وقُدر مؤشر التركيز بحوالي 0.295–، مما يدل على تركز اعتلال الصحة المُقدرة ذاتياً في أوساط الفقراء. ووفقاً لنتائج التحليل التفكيكي، تمثلت العوامل الرئيسية التي ساهمت في تركيز اعتلال الصحة المقدرة ذاتياً في صفوف هؤلاء الذين ينتمون إلى مستوى اجتماعي واقتصادي أقل في: الوضع الاجتماعي الاقتصادي (45.5%)، والإصابة بحالة صحية مزمنة (11.9%)، والتدخين (7.3%).

**الاستنتاج**: إن تركز اعتلال الصحة المُقدرة ذاتياً في صفوف الفقراء في مدينة كرمنشاه يستدعي اهتمام السياسات بهذا الوضع. ومن شأن السياسات التي تهدف إلى الحد من مظاهر انعدام المساواة في توزيع الثروات والسلوكيات الصحية الخطرة والوقاية من الحالات الصحية المزمنة في صفوف الفقراء أن تُخفف من مظاهر انعدام المساواة الاجتماعية الاقتصادية في اعتلال الصحة المُقدرة ذاتياً في مدينة كرمنشاه.

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# Information provided to customers about over-the-counter medications dispensed in community pharmacies in Libya: a cross-sectional study

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## Abstract

**Background:** Adherence to pharmacy practice guidelines for dispensing medications in pharmacy settings is important to ensure the safe use of medications.

**Aims:** This study assessed the pattern and adequacy of information given to consumers on over-the-counter medications dispensed in community pharmacies in Tripoli, Libya, and compared the performance of pharmacists and non-pharmacists.

**Methods:** This was a cross-sectional survey of private community pharmacies conducted in 2018 . Trained simulated patients were used to collect data on over-the-counter medications dispensed for hypothetical common cold symptoms and the information given by the pharmacy staff on the medication. This information included: name and the strength of the medication, indication for use, duration of use, dosage, how often to take the medicine, timing (before/after/with food), storage, expiry date, and side-effects of the medicine. Time taken to deliver the information was recorded. The adequacy of information provided by the pharmacists and non-pharmacists was compared.

**Results:** A total of 169 pharmacies were surveyed. There were no significant differences between pharmacists and non-pharmacists in information given on the dispensed medications, except for information on taking the medication with food or not (84.5% of pharmacists gave this information versus 57.1% of non-pharmacists; $P = 0.001$) and on potential side-effects (39.4% of pharmacists versus 20.3% of non-pharmacists; $P = 0.014$). Significantly more pharmacists (85.9%) than non-pharmacists (61.2%) provided the medication-related information in less than 1 minute (P = 0.001).

**Conclusion:** The inadequate information on medications provided by pharmacists is a concern for patient safety. Health regulatory organizations need to promote safe medication practices.

Keywords: pharmacies, pharmacists, patient safety, dispensing, Libya

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## Introduction

Good dispensing practices ensure that the medicine are given to consumers with detailed directions to prevent the occurrence of medication errors (*1*). However, there is considerable evidence of poor dispensing practices in pharmacies and inadequate information and advice given on the use of the prescribed medicines in developing countries (*1*). Accurate information about the name of a medication and directions for use should be provided to consumers, particularly for over-the-counter medications. Such dispensing practice is one of the most important sources of information available to consumers (*2*). The medication instruction given to consumers by community pharmacists may be inadequate or difficult for the consumer to understand. Lack of appropriate information on medication given to consumers is a potential cause of medication errors (*3,4*).

There is an increasing demand for consumers to self-medicate with non-prescription medications for common illnesses and pharmacy personnel are the health care specialists available who have knowledge of drug safety and rational use of medications (*5–7*).

According to the American Pharmacists Association, pharmaceutical care should be patient-centred and outcomes-oriented, rather than medication-centred, which requires pharmacists to take responsibility as direct care providers for patients. Thus, proper instruction when dispensing medication by community pharmacists could prevent the incidence of medication errors and probably reduce hospitalization rates among consumers (*8,9*).

In Libya, medicines for symptoms of the common cold, such as decongestants and antihistamines, can be sold by community pharmacists as a dispensed medicine without the need for a prescription from a doctor (*10*). Hence, the objective of this study was to explore the quality and quantity of information provided by pharmacists to consumers when dispensing over-the-counter medications.

## Methods

### *Study design and sample*

This was an exploratory cross-sectional study conducted from February to May 2018 in Tripoli, Libya.

For the purpose of this study, 169 private community pharmacies in the city of Tripoli were visited based on their accessibility to the researchers. The sample size was estimated using an online calculator (confidence interval of 3, and margin of error of 95%) (*11*). Of the 169 pharmacy staff members who assisted the simulated patient, 71 were qualified pharmacists and 98 were non-pharmacists.

### Data collection

A simulated patient method was used, involving 13 seventh semester undergraduate pharmacy students from Tripoli University who visited selected private community pharmacies in the city of Tripoli; each student visited 13 pharmacies. The students were trained as simulated patients and instructed to report having common cold symptoms at the pharmacies to assess the medication dispensing practices of the staff. The case scenario used for this study was that of a 22-year-old female patient who presented to the pharmacy with primary symptoms of a common cold (sneezing, runny nose, no cough or sore throat) for the past few day, and was visiting the pharmacy to request a sedative medication for her symptoms. The reason for requesting sedative antihistamine was because it is cheaper than the second-generation non-sedative antihistamines such as desloratadine that are available in the Libyan pharmacies. The information presented by the simulate patient to the community pharmacy staff is shown in Table 1.

Data collected by the simulated patient during the pharmacy visit were recorded on a standardized data collection checklist. This checklist included five elements. The first three related to information that would be expected to be given to the consumer: name and the strength of the medication, information on the medication (indication for use, duration, dosage, frequency, timing (before or after food), storage and expiry date) and side-effects of the medicine. The remaining two were: qualification of pharmacy staff member consulted (pharmacist, non-pharmacist) and time taken to deliver the information.

For the first three elements, each type of information was assigned a score of "1" if delivered or "0" if not. We expected that the pharmacy staff would give the simulated patients the essential cautionary warnings, such as not to drive when taking this sedative medication.

### Data analysis

Microsoft Excel, 2013 and SPSS, version 22.0 were used for data analysis. Descriptive statistics (frequencies and percentages) were recorded. The chi-squared test was used to compare the information given by the pharmacists versus non-pharmacists. The Mann–Whitney test was used to compare the time taken by the pharmacists and the non-pharmacists to give the information on the medication. A P-value less than 0.05 was considered statistically significant.

### Ethical considerations

The study was approved by the Department of Pharmacy, University of Tripoli, Libya. All data gathered were kept confidential by the investigators. Because of the nature of the study, the pharmacies included in the study and their staff were not informed beforehand and hence had not given consent to participate.

## Results

More non-pharmacists dispensed more than one medication (62.2%, $n$ = 61) at the visited pharmacies than pharmacists did.

Most of the personnel in the pharmacies did not provide adequate information on the use of the dispensed medications to the simulated patient. As shown in Table 2, only 8 (11.3%) pharmacists and 13 (13.3%) non-pharmacists provided the simulated patient with the name and strength of medicines dispensed. However, 68 (95.8%) pharmacists and 95 (96.9%) non-pharmacists provided information on how often to take the medication. More pharmacists (84.5%) than non-pharmacists (57.1%) provided the simulated patient with information on when the medications should be taken (before, after or with food) ($P$ = 0.001). Only 39.4% of the pharmacists and 20.3% of the non-pharmacists told the simulated patient about the side-effects of the medicine, although this was a statistically significant difference ($P$ = 0.001). In addition, only about 40% of the pharmacists and non-pharmacists told the patients how long to take the medication for ($P$ = 0.174). Very few pharmacists and non-pharmacists told the patients the expiry date of the medicine (8.4% and 10.2%, respectively; $P$ = 0.174). None of the pharmacy personnel provided information on medication storage.

**Table 1 Simulated patient information for a common cold**

| Enquiry by pharmacy personnel | Simulated patient response |
|---|---|
| Patient information | Female patient aged 22 years |
| Symptoms | Sneezing and a runny nose and. No cough or sore throat |
| Duration of symptoms | A few days |
| Previous habit of using the requested medicine | Previous use of a sedative drug which was good for a common cold. Have forgotten the name of the product |
| Used of any medication for the current symptoms | Nothing taken yet |
| History of allergy | Not allergic to anything |
| Other relevant medication? | Request a sedative medication |

Table 2 **Information provided by pharmacy staff on the use of the dispensed medications, by staff qualification**

| Information | No. (%) | | *P*-value[a] |
|---|---|---|---|
| | Pharmacist (*n* = 71) | Non-pharmacist (*n* = 98) | |
| ***Name and strength of medication*** | 8 (11.3) | 13 (13.3) | 0.943 |
| ***Information on medication*** | | | |
| Frequency of use | 68 (95.8) | 95 (96.9) | 0.598 |
| Duration | 29 (40.8) | 41 (41.8) | 0.174 |
| Dosage | 37 (52.1) | 57 (58.2) | 0.321 |
| Before or after food | 60 (84.5) | 56 (57.1) | 0.001 |
| ***Indication*** | 31 (43.7) | 47 (48.0) | 0.785 |
| ***Storage of medication*** | 0 (0.0) | 0 (0.0) | – |
| ***Expiry date*** | 6 (8.4) | 10 (10.2) | 0.174 |
| ***Side-effects*** | 28 (39.4) | 22 (22.4) | 0.001 |

[a]*Chi-square test; P < 0.05 was considered statistically significant.*

Most pharmacy personnel provided medication-related information to the simulated patient in less than 1 minute (Table 3) but a significantly greater proportion of pharmacists (85.9%) took less than a minute than non-pharmacists (61.2%) (*P* = 0.001).

## Discussion

This is the first study to examine the pattern and amount of medication-related information provided to consumers by pharmacists or non-pharmacists in Libyan private sector pharmacies. Most pharmacy personnel gave information on frequency of taking the medication. This is perhaps due to the awareness of community pharmacy staff that medication frequency is one of the most important pieces of information to be provided in the dispensing process to ensure that consumers take the medicine appropriately.

It is useful for pharmacy personnel to give the name and strength of the medication during dispensing (*12*). In our study, few of the personnel in the community pharmacies visited provided the simulated patient with this information (11.2% and 13.2% of pharmacists and non-pharmacists, respectively). This finding is consistent with the results of studies conducted in 10 primary health care centres in Alexandria, Egypt and in 10 health centres in the eastern province of Saudi Arabia, where medication name and dose were not mentioned (*13*,*14*). Medication name is a fundamental piece of information that should be given to consumers when they receive the drug, especially for non-prescription medication (*15*). Even though most of the over-the-counter medications dispensed in this study were in original packaging on which the name of the medication is printed, pharmacy personnel should still inform consumers what medication is actually given. Consumers should know the name of the medication they are taking so that if questioned by another pharmacy, they would be able to answer. This is to prevent consumers being given the same medication by different pharmacies, thus avoiding accidental medication errors.

The World Health Organization (WHO) recommends that each drug label should contain the dose regimen (how often to take the medicine), patient name and drug dose (drug concentration) (*16*). Consumer awareness of the correct dosage is important to avoid drug misuse and prevent adverse effects that would be harmful to the consumer's health (*14*). Only 37 (52.1%) of our pharmacist participants and 57 (58.1%) of the non-pharmacist participants provided this information to the simulated patient. A study conducted in Saudi Arabia reported that the frequency and number of doses were not stated in 6.9% and 7.6% of total prescriptions, respectively (*17*).

In spite of their essential role in pharmaceutical care, medicines can also be a substantial source of harm to consumers, either through preventable medication errors or non-preventable drug side-effects (*18*). Nevertheless, only 39.4% of pharmacists and 20.3% of non-pharmacists in our study mentioned the possible side-effects of the dispensed medication to the simulated patient. The poor instruction about adverse effects is similar to the results of a study in Ethiopia (*19*).

An average dispensing time of less than 60 seconds is considered to be insufficient by WHO criteria to clarify the dosage regimen and other instructions on the dispensed drugs (*20*). A consumer's understanding of

Table 3 **Time taken by pharmacy staff to provide medication-related information, by staff qualification**

| Length of time during dispensing | Pharmacist (*n* = 71) | Non-pharmacist (*n* = 98) | *P*-value[a] |
|---|---|---|---|
| | No. (%) | No. (%) | |
| Less than 1 minute | 61 (85.9) | 60 (61.2) | 0.001 |
| 1–5 minutes | 10 (14.1) | 38 (38.8) | |

[a]*Mann–Whitney test; P < 0.05 was considered statistically significant.*

a drug dispensed depends directly on their knowledge of the drug; therefore, sufficient dispensing time is an essential step in successful patient care (*20*). In the current study, the average consultation time of 85.9% of pharmacists and 61.2% of non-pharmacist was less than 60 seconds. Similarly, the average dispensing time of pharmacists reported in other developing countries was also low; 47.4 seconds in Egypt and 28.8 seconds in Jordan (*13,21*).

The differences between the pharmacists and non-pharmacists visited in our study in providing the appropriate information when dispensing medication were statistically significant for potential drug-related side-effects and how the medications should be taken with regard to food. The pharmacists performed better that the non-pharmacists, even though more pharmacists spent less than a minute in dispensing the medication. Most of the non-pharmacists who work in private sector pharmacies in Libya have not taken a course on over-the-counter medicines or managing minor illnesses (*22*). Hence, it would be expected that pharmacists could supply more information when dispensing medicines. However, the adequacy of most of the required instruction given by pharmacists and non-pharmacists was not significantly different.

Our study has some limitations. The study was carried out in Tripoli, thus the setting was limited; no other Libyan cities were considered. In addition, only over-the-counter medications were considered. The study also did not investigate instructions related to allergies and concomitant therapies (drug–drug interactions).

The findings from this study show that most of the community pharmacists and non-pharmacists visited by the simulated patients delivered inadequate and inconsistent information on the dispensed medications and did not adhere to WHO recommendations (*20*). The Ministry of Health in Libya plans to educate and increase awareness among the community on dispensed medications (*9*). Therefore, this survey provides some initial data on medication-related information given to the public by community pharmacists. Governmental health care regulatory organizations need to play a strong and leading role in promoting safe medication practices and ensuring the enforcement of laws.

## Acknowledgment

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**Competing interests:** None declared.

## Informations fournies aux clients lors de la distribution de médicaments en vente libre dans les pharmacies d'officine de Tripoli (Libye) : étude transversale

## Résumé

**Contexte :** Il est important de respecter les recommandations de pratique pharmaceutique en ce qui concerne la distribution de médicaments en pharmacie pour garantir une utilisation sûre des médicaments.

**Objectifs :** La présente étude visait à évaluer le profil et la qualité des informations fournies aux consommateurs au sujet des médicaments distribués en vente libre dans les pharmacies d'officine de Tripoli (Libye), puis à comparer les résultats entre les pharmaciens et les non-pharmaciens.

**Méthodes :** Elle a pris la forme d'une enquête transversale menée en 2018 auprès des pharmacies d'officine privées. Des personnes formées à simuler le rôle de patients ont permis de recueillir des données sur les médicaments distribués en vente libre pour d'hypothétiques symptômes de rhume, ainsi que sur les informations données par le personnel des pharmacies au sujet des médicaments. Ces informations comprenaient les éléments suivants : le nom et la concentration du médicament, l'usage indiqué, la durée d'utilisation, le dosage, la fréquence de prise du médicament et le moment approprié (avant, après ou pendant le repas), le stockage, la date d'expiration et les effets secondaires. Le temps consacré à la communication de ces informations a été enregistré. La qualité des informations fournies a été comparée entre les pharmaciens et les non-pharmaciens.

**Résultats :** Au total, 169 pharmacies ont été visitées dans le cadre de cette enquête. Aucune différence significative n'a été constatée entre les pharmaciens et les non-pharmaciens pour les informations données au sujet des médicaments distribués, à l'exception des explications concernant le moment où le médicament doit être pris par rapport au repas (84,5 % des pharmaciens ont donné cette information contre 57,1 % des non-pharmaciens ; $p$ = 0,001) et les effets secondaires potentiels (39,4 % des pharmaciens contre 20,3 % des non-pharmaciens ; $p$ = 0,014). Les pharmaciens (85,9 %) étaient nettement plus nombreux que les non-pharmaciens (61,2 %) à fournir les informations relatives aux médicaments en moins d'une minute ($p$ = 0,001).

**Conclusion :** L'insuffisance des informations relatives aux médicaments fournies par les pharmaciens est une source de préoccupation pour la sécurité des patients. Les organismes de réglementation sanitaire doivent promouvoir des pratiques de médication sûres.

# المعلومات التي تُقدم للعملاء عند صرف الأدوية التي تُباع دون وصفة طبية في الصيدليات المجتمعية في ليبيا: دراسة مقطعية

أحمد عطية

## الخلاصة

**الخلفية:** من الضروري الالتزام بالمبادئ التوجيهية للممارسات الصيدلانية في ما يتعلق بصرف الأدوية من الصيدليات، وذلك لضمان الاستخدام المأمون للأدوية.

**الأهداف:** هدفت هذه الدراسة في تقييم نمط وكفاية المعلومات التي تُقدم إلى المستهلكين بشأن الأدوية التي تُباع دون وصفة طبية في الصيدليات المجتمعية في طرابلس، ليبيا، ومقارنة أداء الصيادلة وغير الصيادلة.

**طرق البحث:** أُجري مسح مقطعي من فبراير/ شباط إلى مايو / أيار 2018 شمل 169 صيدلية مجتمعية خاصة في مدينة طرابلس. وتمت الاستعانة بأشخاص مُدرَبين لمحاكاة المرضى من أجل جمع بيانات بشأن الأدوية التي تُباع دون وصفة طبية لعلاج الأعراض الافتراضية لنزلات البرد العادية، والمعلومات التي يُقدمها العاملون في الصيدلية بشأن التداوي. وتضمنت هذه المعلومات على سبيل المثال: اسم الدواء وقوة فعاليته، ودواعي الاستعمال، ومدة تعاطي الدواء، والجرعة، والوتيرة اليومية لتعاطي الجرعات، والتوقيت (قبل/ بعد/ مع الطعام)، وكيفية تخزينه، وتاريخ انتهاء صلاحيته، والآثار الجانبية لتعاطيه. كما سُجل الوقت المستغرق في تقديم هذه المعلومات. وكذلك استُعرض مدى كفاية المعلومات المُقدَّمة من الصيادلة مقارنةً بتلك المُقدَّمة من غير الصيادلة.

**النتائج:** لم تكن هناك فروق جوهرية بين المعلومات التي قدمها الصيادلة وتلك التي قدمها غير الصيادلة حول الأدوية التي تُباع دون وصفة طبية، ما عدا المعلومات الخاصة بتوقيت تعاطي الدواء بالنسبة لمواعيد الطعام (قدم هذه المعلومات 84.5% من الصيادلة مقابل 57.1% من غير الصيادلة؛ (القيمة الاحتمالية = 0.001)، وبشأن الآثار الجانبية المرجح حدوثها: قدم هذه المعلومات 39.4% من الصيادلة مقابل 20.3% من غير الصيادلة؛ (القيمة الاحتمالية = 0.014). وفي ما يتعلق بتقديم معلومات بشأن الأدوية في أقل من دقيقة، فقد كانت نسبة الذين قاموا بذلك من الصيادلة (85.9%) أعلى بكثير من نسبة غير الصيادلة (61.2%)، (القيمة الاحتمالية = 0.001).

**الاستنتاج:** يُشكل عدم كفاية المعلومات التي تُقدم حول الأدوية في الصيدليات مصدراً للقلق بشأن سلامة المرضى. وعلى السلطات التنظيمية الصحية أن تعمل على تعزيز الممارسات المأمونة للتداوي.

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# Differences in identification of attention deficit hyperactivity disorder in children between teachers and parents

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## Abstract

**Background:** The worldwide prevalence estimates for attention deficit hyperactive disorder (ADHD) are extremely heterogeneous. Diagnosis in children demands symptoms be present in at least 2 different settings, mainly school and home. The proportion of children estimated to have ADHD can vary based on whether the symptoms are evaluated by parents or teachers.

**Aims:** This study determined whether ADHD and its subtypes are better recognized by parents or teachers.

**Methods:** Our study included 1326 schoolchildren (boys = 712, girls = 614; age range: 6–12 years). We prepared 2 questionnaires for each student enrolled in the study; one was completed by the student's parents and the other by the teacher. We included students who attended 3 selected schools in the cities of Amman and Karak in Jordan during the first term of 2017. The Arabic version of the Diagnostic and statistical manual of mental disorders, 4th edition, was used for the diagnosis and classification of ADHD.

**Results:** Of the 1326 students included in this study, 254 (19.2%) were considered to have ADHD by the teachers and 172 (13.0%) by the parents. The Wilcoxon signed-ranks test showed that teachers gave statistically higher scores on the questionnaire than parents. However, overall agreement between parents and teachers, as measured by the κ-value, reached 77.2%.

**Conclusions:** Although both teachers and parents recognized ADHD symptoms, they were generally more recognized by teachers than by parents.

Keywords: ADHD, Jordan, students, symptom recognition

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## Introduction

Attention deficit hyperactivity disorder (ADHD) is the most common neurobehavioral disorder among children. Estimates of the worldwide prevalence of ADHD are extremely heterogeneous (*1*), ranging from 2.2% to 17.8% (*2*). According to the American Psychiatric Association, however, 5% of children have ADHD (*3*). An overall pooled prevalence estimate of 7.2% was reported in a 2015 meta-analysis of 175 studies (*4*).

Previous research has provided various explanations of the variations among estimations of ADHD prevalence (*5*). It has been suggested that ADHD is an over-diagnosed and over-treated condition, citing as evidence the rise in parent-reported diagnosis from 6.9% in 1997 to 7.8%, 9.5% and 11% in 2003, 2007 and 2011 respectively (*6,7*). The debate on diagnosis and treatment continues among medical professionals, parents, and educational authorities (*8–10*).

As ADHD symptoms typically affect school performance and disrupt class, teachers are often the first to suggest that a child may have the condition (*11*). This may also be attributable to the fact that teachers observe children on most days for several months of the year.

As children are usually unable to reliably report their own behaviour, confirming a supposition of ADHD requires not only examining the child in question but also interviewing parents and obtaining data from the school. Some studies have demonstrated that the correlation between parents' and teachers' reports is only modest (*12*). Further, assessments made by the 2 parties have been shown to often disagree on the subtype classification (*13*). Thus, acquiring information from only 1 source (i.e. parents or teachers) strongly influences the apparent prevalence of the disorder (*14*).

To the best of our knowledge, the first evaluation of ADHD prevalence in Jordan was conducted in 2010 (*15*). The current study aimed to assess whether the symptoms of ADHD among students are better recognized by parents or by teachers.

## Methods

This cross-sectional study included all students aged 6–12 years (1st through 6th grades) from 3 different schools that were selected because of their diverse student population: half came from rural areas and half from urban areas. The required sample size based on Kish's formula was 164; however, all eligible students were included in this study for increased reliability and to simplify the randomization task. Of the 1390 eligible students, 64 were excluded because of a lack of parental response. The first school, accounting for 621/1326 students, was in Am-

man, the capital of Jordan. The school psychologist sent out and collected the questionnaires from students' parents and teachers. The other 2 schools were in Karak city, 120 km south of Amman, with 233 students in one (co-educational official school) and 472 in the other (university campus school), a total of 705 students. In the Karak schools, the study aim was explained to teachers and parents and questionnaires were distributed and collected by the staff of Queen Rania Centre for Childhood Studies at Mutah University. Screening and data collection were performed from the beginning of the first semester in the academic year 2016–2017. Parents and teachers used the Arabic version of the DSM-IV rating scale for the diagnosis and classification of ADHD (3). This tool contains 18 items: the first 9 assess attention deficit symptoms and the next 9 assess hyperactive-impulsive symptoms. Each item is rated by selecting 1 of 4 possible answers, "never," "rarely," "often," or "very often." Students who obtain positive scores for at least 6 items (i.e. "often" or "very often" ratings) for attention deficit are considered positive for the attention deficit (AD) subtype and those who obtain positive scores for 6 or more of the items that assess hyperactivity and impulsiveness are considered positive for the hyperactive-impulsive (HI) subtype. If students obtain positive scores for 6 of both types of items, they are considered positive for the combined subtype.

Ethical approval was obtained from the Faculty of Medicine, Reference No. 201820, and further approval was obtained from Mutah University through the Queen Rania Centre for Childhood Studies. Written informed consent was obtained from all parents.

Data analysis was performed by using SPSS, version 16. A simple frequency table was used to display the number and percentage of ADHD subtype occurrences. Cohen's kappa coefficient (κ) was used to measure agreement between the 2 raters (i.e. parent and teacher). A paired analysis was also performed; given that the data were not distributed normally, a Wilcoxon signed-ranks test was used rather than a paired t-test. The level of significance was set at $P < 0.05$.

## Results

This study included a total of 1326 students (712 boys, 614 girls), of whom 254 (19.2%) and 172 (13%) were considered to have ADHD by teachers and parents, respectively. The boy:girl ratio was nearly 1:1. The ratios in both the co-educational school in Amman and the university campus school in Karak were both 1:1.2, and the ratio in the last school was 1.8 to 1. The mean age was 9.0 (standard deviation 2.6) years. The proportions of ADHD subtypes (AD, HI, and combined) in the study population were 7.3%, 7.8%, and 4.2% respectively. These proportions were significantly higher than those reported by the parents (4.5%, 6.4%, and 2.1%, respectively). Therefore, it is evident that teachers were better than parents at recognizing ADHD symptoms and the corresponding subtypes (Table 1). Table 2 shows the results of the Wilcoxon signed-ranks test. It can be seen that for all types of ADHD, teachers assigned children significantly higher scores than their parents ($P < 0.001$ for all 3 subtypes). Similar results were found when the data were analysed by sex.

**Table 1 Prevalence of attention deficit hyperactive disorder (ADHD) and subtypes among the study population ($n$ = 1326 schoolchildren) as identified by teachers and parents**

| Subtype | Teachers | | Parents | |
|---|---|---|---|---|
| | No. | % | No. | % |
| Attention deficit | 97 | 7.3 | 60 | 4.5 |
| Hyperactive-impulsive | 103 | 7.8 | 85 | 6.4 |
| Combined | 54 | 4.2 | 27 | 2.1 |
| ADHD | 254 | 19.2 | 172 | 13.0 |

Table 3 shows the overall agreement between teacher and parent responses. Concordance was high (κ = 0.772). The HI subtype featured the highest agreement between the 2 parties (89.7%), followed by AD (75%) and the combined subtype (66.5%).

## Discussion

Despite ADHD being one of the most common and well-studied neurodevelopmental and psychiatric disorders in the paediatric population (16), its prevalence remains controversial. The wide variability in prevalence estimates confounds evaluations of the public health impact of ADHD. Thus, accurate prevalence data and improved estimates are needed to determine whether the incidence of ADHD is increasing or it is merely being detected more effectively.

Some of the variability in prevalence estimates can be attributed to differences in study methods; for example, some prevalence studies using population samples have relied on information obtained from parents (17), while others have used data provided by teachers (18). Few surveys have collected reports from both parents and teachers.

However, disagreement occurs not only between teachers and parents but also between the parents themselves. As clinically evidenced by studies examining parental agreement on broadband rating

**Table 2 Wilcoxon signed ranks tests of teachers' vs parents' ratings for attention deficit hyperactive disorder (ADHD) subtypes**

| ADHD subtype | Rank | Z-value | P |
|---|---|---|---|
| Attention deficit: teacher–parent | Negative: 641<br>Positive: 439<br>Tied: 246 | −4.21 | < 0.001 |
| Hyperactive–impulsive: teacher–parent | Negative: 763<br>Positive: 398<br>Tied: 165 | −8.93 | < 0.001 |
| Combined: teacher–parent | Negative: 737<br>Positive: 456<br>Tied: 133 | −7.75 | < 0.001 |

*Ranks were obtained from questionnaire scores. The number of negative ranks equals the number of teachers who gave higher scores than their parent counterparts and vice versa.*

**Table 3 Agreement between teachers' and parents' ratings of attention deficit hyperactive disorder (ADHD) and ADHD subtypes**

| Agreement | | Teachers | |
|---|---|---|---|
| | | Yes | No |
| ***Overall agreement for ADHD*** | | | |
| Parents | Yes | 172 | 0 |
| | No | 82 | 1067 |
| *Kappa = 0.772; SE kappa = 0.024; 95% CI: 0.726–0.819* | | | |
| ***Attention deficit agreement*** | | | |
| Parents | Yes | 60 | 0 |
| | No | 37 | 1224 |
| *Kappa = 0.750; SE kappa = 0.039; 95 CI 0.674–0.827* | | | |
| ***Hyperactive–impulsive agreement*** | | | |
| Parents | Yes | 85 | 0 |
| | No | 18 | 1218 |
| *Kappa = 0.897; SE kappa = 0.024; 95% CI: 0.850–0.944* | | | |
| ***Combined subtype agreement*** | | | |
| Parents | Yes | 27 | 0 |
| | No | 27 | 1267 |
| *Kappa = 0.665; SE kappa = 0.060; 95% CI: 0.548–0.783* | | | |

*SE = standard error; CI = confidence interval.*

scales, such as DSM-based ADHD symptom-specific ratings, mothers and fathers often disagree in their ratings of child behaviour (*19*).

Some studies have shown that parent and teacher ratings of ADHD behaviours are only weakly to moderately correlated (*20*). A study from Australia posited that low parent–teacher agreement may indicate that ADHD symptoms are situation-specific (*21*). In contrast, when ADHD symptoms are treated, parent- and teacher-based ratings of symptom change are in high agreement (*22*). The estimated prevalence of ADHD in our study population was higher than expected based on international studies.

In evaluating ADHD symptomatology, it is important to obtain independent reports concerning the child's behaviour at school and home (*23*). We consider the most important strength of our study to be its population-base, which allowed us to screen almost the entire student population in grades 1 through 6 from 3 different schools, and from urban as well as rural areas. There have been only a few studies on ADHD and its subtypes in Jordan. A recent study reported the prevalence to be 20.21% (*24*), which is similar to our findings obtained from teachers. Further, our study is among the few to have examined differences between parents and teachers in how they report ADHD symptoms. Our results demonstrate that teachers recognize both ADHD symptoms and subtypes significantly better than parents.

The agreement between parents and teachers was greatest for the HI subtype. The fact that hyperactivity is easily observed in the classroom setting may account for the high agreement.

The current criteria for the diagnosis of ADHD include onset before age 7 years, persistence of symptoms for more than 6 months, presence of symptoms in 2 settings (home and school), and behaviour-rating scales describing home and school functioning. The first step is the parent interview. This should include presenting problems, developmental history and family history. By combining such information, the clinician can reliably perform the diagnosis. Up to now, there are no laboratory or radiological tests for specifically diagnosing ADHD. In future, genetic tests may be developed to ensure greater specificity of the diagnosis. The novelty of this study lies not only in comparing the awareness of parents and teachers regarding the symptoms but also in highlighting the recognition of the subtypes and comparing the evaluation of parents and teachers for each of the subtypes.

A limitation of this study is that it only covered 2 areas of Jordan and was thus not representative of the entire Jordanian population. Moreover, none of the children were interviewed, and since no family history was collected, it is not known whether any of these children were receiving medical advice or treatment for ADHD. It is also not known whether the questionnaire for each student was completed by the mother, father, or both.

This study highlights the importance of teachers' evaluations for the diagnosis of ADHD. We recommend organization of specialized workshops for school teachers to educate them regarding ADHD and to guide them as to when the students should be referred for further medical evaluation or psychological advice, particularly to manage those students who have failed in school or exhibit learning difficulties.

## Conclusions

Although both parents and teachers are able to recognize ADHD symptoms, there was a significant difference between the estimations of ADHD prevalence made by the 2 groups: teachers demonstrated a significantly better ability to recognize these symptoms.

## Acknowledgement

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# Identification du trouble déficitaire de l'attention avec hyperactivité chez l'enfant : différences entre les enseignants et les parents


## Résumé

**Contexte :** Les estimations de la prévalence mondiale du trouble déficitaire de l'attention avec hyperactivité (TDAH) sont extrêmement hétérogènes. Chez l'enfant, le diagnostic ne peut être établi que si les symptômes sont présents dans au moins deux environnements différents, généralement l'école et la maison. La proportion d'enfants considérés comme ayant un trouble déficitaire de l'attention avec hyperactivité peut varier en fonction de la personne qui évalue, à savoir les parents ou les enseignants.

**Objectifs :** La présente étude a permis de déterminer qui, des parents ou des enseignants, reconnaît mieux le TDAH et ses sous-types.

**Méthodes :** Notre étude a porté sur 1326 écoliers (garçons = 712, filles = 614 ; groupe d'âge : 6-12 ans. Nous avons mis au point deux questionnaires pour chaque élève participant à l'étude ; un à remplir par les parents de l'élève et un autre par l'enseignant. L'échantillon se composait d'élèves scolarisés dans trois écoles sélectionnées, situées dans les villes d'Amman et de Karak (Jordanie), au cours du premier trimestre de 2017. La version en langue arabe de la quatrième édition du Manuel diagnostique et statistique des troubles mentaux a été utilisée pour le diagnostic et la classification des cas de TDAH.

**Résultats :** Sur les 1326 élèves examinés dans le cadre de cette étude, 254 (19,2 %) ont été considérés comme ayant un TDAH par les enseignants et 172 (13,0 %) par les parents. Le test des rangs signés de Wilcoxon a révélé que les enseignants donnaient des scores statistiquement plus élevés que les parents dans le questionnaire. Cependant, la concordance globale entre les estimations des parents et des enseignants, telle que mesurée par la valeur de l'index Kappa, a atteint 77,2 %.

**Conclusions :** Les enseignants et les parents reconnaissent tous les deux les symptômes du TDAH, mais les enseignants repèrent généralement plus souvent ces signes que les parents.


# أوجه التباين بين المدرسين والآباء في تحديد اضطراب نقص الانتباه مع فرط النشاط في الأطفال

عمر نافع، عوني شاهين، أحمد طراونه، زيد سمحان


## الخلاصة

**الخلفية:** يوجد تباين كبير للغاية بين تقديرات انتشار الإصابة «باضطراب نقص الانتباه مع فرط النشاط» على مستوى العالم أجمع. ويتطلب تشخيص الأطفال بإصابتهم بهذا الاضطراب ظهور أعراضه عليهم في محيطين مختلفين على الأقل، وهما المدرسة والمنزل. وقد تختلف نسبة الأطفال المُقدر إصابتهم «باضطراب نقص الانتباه مع فرط النشاط» استناداً إلى ما إذا كان الآباء أم المدرسون هم من يقومون بتقييم الأعراض.

**الأهداف:** هدفت هذه الدراسة إلى تحديد ما إذا كان الآباء أم المدرسون هم الأقدر على التعرف بصورة أفضل على اضطراب نقص الانتباه مع فرط النشاط وأنواعه الفرعية.

**طرق البحث:** شملت الدراسة 1326 تلميذاً من تلاميذ المدارس (الفتيان = 712، والفتيات = 614؛ وتراوحت أعمارهم بين 6–12 عاماً). وأُعد استبيانان لكل تلميذ من التلاميذ المشاركين في الدراسة؛ أحدهما تُستكمل بياناته بواسطة الأبوين، والآخر تُستكمل بياناته بواسطة المدرسين. وتضمنت الدراسة التلاميذ الذين كانوا يدرسون في 3 مدارس مُختارة في مدينتي عَمان وكرك في الأردن خلال الفصل الأول من عام 2017. وقد استُخدمت الطبعة الرابعة من النسخة العربية للدليل التشخيصي والإحصائي للاضطرابات النفسية في تشخيص «اضطراب نقص الانتباه مع فرط النشاط» وتصنيفه.

**النتائج:** من بين التلاميذ الذين شملتهم الدراسة وعددهم 1326 تلميذاً، حدد المدرسون والآباء نسبة التلاميذ المصابين «باضطراب نقص الانتباه مع فرط النشاط» بما يبلغ 254 تلميذاً (19.2%) و172 تلميذاً (13.0%)، على التوالي. وأظهر اختبار ويلكوكسُن للمَرْتَبة والمجموع أن المدرسين قد أحرزوا درجات أعلى من الآباء في الاستبيان من الناحية الإحصائية. وعلى الرغم من ذلك، بلغت نسبة التوافق العام بين الآباء والمدرسين حوالي 77.2%، حسب قياس معامل كابا.

**الاستنتاجات:** على الرغم من أنه بإمكان كل من المدرسين والآباء التعرف على أعراض «اضطراب نقص الانتباه مع فرط النشاط»، إلا أن المدرسين بصفة عامة كانوا أقدر من الآباء على التعرفً على هذه الأعراض.

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# Auditing of the phlebotomy system in medical laboratories in Port Sudan City, Sudan

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## Abstract

**Background:** Phlebotomy is one of the most ignored techniques in laboratory medicine and health care. It is a complicated practice that requires wide knowledge and high-level skills. Mistakes in phlebotomy can influence laboratory results (diagnosis) and affect patient care.

**Aims:** To appraise phlebotomists' practice and assess the extent of compliance with the guidelines and determine the frequency of errors in hospital laboratories in Port Sudan, Sudan.

**Methods:** A cross-sectional observational study was conducted using a structured observation scheme in 8 Sudanese public hospitals between August and September 2017. A structured questionnaire was used to assess the venepuncture procedures. Five diverse blood collections by each phlebotomist were observed at each session. We monitored 120 blood collections by 24 phlebotomists, 16 (66.7%) male, and 8 (33.3%) female, with a mean age of 31.1 years.

**Results:** Three of 8 phlebotomy sites were not covered by standard operating procedures (SOPs). Furthermore, phlebotomists lacked appropriate training plans. At 33.3% of the sessions, phlebotomists did not wear gloves at all, and in 69.2% sessions, they did not use new gloves for each patient. There was a significant correlation between phlebotomists' expertise and the duration of tourniquet application.

**Conclusion:** This study demonstrates that SOPs were not available in some phlebotomy sites. Phlebotomists did not follow Clinical and Laboratory Standards Institute guidelines. Ongoing assessment and improvement of procedures are fundamental to ensure that the phlebotomy service operates effectively.

Keywords: phlebotomy, Port Sudan, standard operating system, tourniquet, venepuncture

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## Introduction

Phlebotomy is a technique of blood drawing in which the needle is temporarily inserted into a suitable vein (*1*). Phlebotomy is an ancient procedure, dating back for 3500 years to the time of ancient Egypt. The word phlebotomy is derived from Greek phlebo from phleps (vein), and tomy from tomia (to make an incision) (*2*). Today, phlebotomy is available primarily for enhancing diagnosis and monitoring patients' disease status. It calls for rigorous adherence to test procedures and guidelines to ensure patient safety and integrity of blood samples (*3*). Previously, medical technicians were responsible for blood sample collection, but in recent decades, this practice has changed and the responsibility is now shared with other health professionals (*4*).

Compliance in phlebotomy is challenging because there are many errors associated with the procedure (*5*). Quality control in the laboratory includes 3 main phases: preanalytical, analytical, and postanalytical. The preanalytical phase is the most important for phlebotomists. Every laboratory makes efforts to ensure that the routine procedure produces reliable results and that service quality is maintained (*6*). Agency accreditation is motivating laboratories to go beyond the standardization and quality required for pre-and postanalytical quality control to minimize errors (*7*). For that, most of the effort in laboratory medicine has been to raise quality and improve patient safety (*8*). The accreditation system of clinical laboratories based on ISO 15189 has been implemented in many countries to improve quality and competence (*9*). Bolenius et al. (*10*) and Saurav et al. (*11*) reported that the preanalytical phase had 46–68% of the total laboratory errors, and most of those errors were encountered during blood sample collection. In the preanalytical stage, venous blood collection is critical because it affects laboratory results. Many errors affect patient safety and health, such as patient identification, incorrect equipment use, lack of knowledge of tourniquet usage, improper skin puncturing, and no disinfectant use (*12*). Many factors are likely to influence the laboratory outcome, including phlebotomy education, understanding anatomy, training, and inspection of infection control procedures (*13*).

To the best of our knowledge, assessment of phlebotomy services in Sudan has not been reported. In this study, we aimed to assess the feasibility of phlebotomy by focusing on phlebotomists' practice and identifying the most frequently encountered errors during venous blood collection in public hospital laboratories in Port Sudan City.

## Methods

### Study design

This was a hospital-based, cross-sectional observational study conducted during August to September 2017. A structured questionnaire was used (Table 1) (*14*) for assessment of the phlebotomy service practice. The layout of the questionnaire was intended to be simple to read with a limited number of pages, to ensure that it could be completed within the shortest possible time. The data collection was qualitative and quantitative. Confidentiality was maintained and data were solely for research purposes. Results were reported as yes/no for all phlebotomists in each setting.

### Study area and population

The Red Sea Province has 16 hospitals, and 8 were chosen for this study: 4 government sector hospitals (Port Sudan Teaching Hospital, Police Hospital, Prince Osman Digna Hospital, and Seaport Corporation Hospital), 3 private sector hospitals, and a national blood bank.

### Study sample

The Kish formula was used to determine the sample size for the cross-sectional study (*15*). We included 24 phlebotomists (16 male, 8 female), with a mean age of 31.1 years (range 19–48) years. Only permanently registered phlebotomists employed at the laboratory were considered for inclusion. There were 3 phlebotomists from each of the 8 hospitals. Sixteen phlebotomists had the experience [mean 6.6 (5.3) years] and competence to gain patient confidence in the venepuncture process. The checklist had 24 criteria that the phlebotomists conducted during venepuncture. The sociodemographic characteristics are summarized in Table 2. Five different venepuncture collection sessions were assessed for each phlebotomist, giving a total of 120 venous blood collections.

### Study performance

Phlebotomy performance was assessed in patients who received the service after verbal consent was obtained from phlebotomist volunteers participating in the study. According to Clinical and Laboratory Standards Institute (CLSI) recommendations (*7*), phlebotomists were monitored for 5 different blood sample collection practices. The remarks were reviewed by independent expert evaluators and scored against a criterion-based CLSI checklist to identify preanalytical technical errors made by the phlebotomists.

### Study dependents

To assess the phlebotomists' venepuncture practice performed in the laboratory, the dependents were: identification of patients; usage of tourniquet (application, and time); sterilization of the puncture sites; correct use of anticoagulant tube during blood collection; mixing blood samples for the correct time; and labelling of samples.

### Statistical analysis

The findings were presented as mean (standard deviation, SD). The observational variables were estimated

**Table 1 Questionnaire scheme used in this study**

Evaluator .....

Date .....

Phlebotomist .....

Specimen no. .....

Age .....

Graduation .....

Sex .....

Religion .....

Marital status .....

Type of sector .....

| Experience | Yes | No |
|---|---|---|
| Q1. Was the patient identified according to CLSI? | | |
| Q2. Did the phlebotomist ask for permission before blood collection? | | |
| Q3. Was the tourniquet placed correctly? | | |
| Q4. Did the phlebotomist select a suitable venepuncture site? | | |
| Q5. Did the phlebotomist know how to apply the tourniquet? | | |
| Q6. Was the phlebotomist wearing gloves for each patient? | | |
| Q7. Was the venepuncture site disinfected according to guidelines? | | |
| Q8. Was alcohol allowed to evaporate before venepuncture? | | |
| Q9. Did the venepuncture site remain untouched after disinfection? | | |
| Q10. Did the phlebotomist ask the patient to clench their fists during collection? | | |
| Q11. Was the tourniquet time within CLSI recommendations? | | |
| Q12. Was the tourniquet released immediately after blood flow began? | | |
| Q13. Were the tubes used labelled in the presence of the patient? | | |
| Q14. Did the phlebotomist use a syringe to transfer blood to a vacutainer? | | |
| Q15. Did the phlebotomist used vacutainer tubes with multisampling needles? | | |
| Q16. Did the phlebotomist use a syringe to transfer blood to a vacuum tube by opening the cover? | | |
| Q17. Did the phlebotomist mix the blood gently to avoid haemolysis? | | |
| Q18. Did the phlebotomist have knowledge about sample kinds? | | |
| Q19. Were the blood coagulation samples collected according to guidelines? | | |
| Q20. Was a cotton or adhesive bandage placed over the venepuncture site after sampling? | | |
| Q21. Did the phlebotomist recap the needles and syringes? | | |
| Q22. Was the anticoagulated blood tube mixing time accepted or not? | | |
| Q23. Was there any needle stick injury? | | |
| Q24. Were syringes and needles disposed correctly after sampling? | | |

**Table 2 Phlebotomists' characteristics**

| Characteristics | Phlebotomists (n = 24) |
|---|---|
| *Age, mean (SD)* | 31.1 (8.1) yr |
| ***Sex*** | |
| Male | 16 |
| Female | 8 |
| *Education, mean (SD)* | 2.79 (1.95) |
| Secondary school | 12 |
| Primary school | 1 |
| Graduated college | 1 |
| Diploma 2 years | 10 |
| *Experience, mean (SD)* | 6.6 (5.3) yr |
| Trained | 16 |
| Untrained | 8 |
| ***Marital status*** | |
| Single | 14 |
| Married | 10 |
| ***Sector*** | |
| Government | 18 |
| Private | 6 |
| ***Training course*** | |
| Yes | 0 |
| No | 24 |
| ***Workshops*** | |
| Yes | 0 |
| No | 24 |

stepwise by comparing means by Student's *t* test and $\chi^2$ test. $P \leq 0.05$ represented the minimum level of significance. Major errors were compared by $\chi^2$ test using SPSS version 24. Two independent expert evaluators used the same criterion-based observational evaluation checklist before and after venepuncture, to assess the phlebotomist-recorded remarks. The total scores referred to compliance with the procedural standards. Feedback from the performing laboratory on the quality of all samples collected during the study period provided additional quality control.

## Ethical approval

Permission for the study was granted by the Department of Hematology, Port Sudan Ahlia College and approval was obtained from the Ministry of Health, Red Sea State, Sudan (Letter No. 44/b/1- date: 25 September 2017) and the health laboratories administration. Informed consent was obtained from all study respondents.

# Results

In 5 of 8 (62.5%) hospitals, the phlebotomy area had enough space for phlebotomists to carry out their work and met the minimum requirements for the materials needed. Unfortunately, during the study period, the standard operating procedures (SOPs) were not considered a part of quality control in 3 of the 8 (37.5%) phlebotomy sites. Furthermore, most of the phlebotomists were not specialized according to their education. They worked by shift system and had no plan for future training.

## Findings before venepuncture session

Sixteen of the 24 (66.6%) phlebotomists received in-service training and 8 were untrained (according to the mean experience). Eleven of the 16 (68.8%) trained phlebotomists worked in the government sector and 5 (31.3%) worked in the private sector. Seven of the 8 (87.2%) untrained phlebotomists worked in the government sector. This indicated that phlebotomists working in government hospitals had fewer skills and needed an intensive training programme. Nine of the 16 (56.2%) trained phlebotomists were married and the remainder were single. This indicated that marital status had a psychological effect on the work ($P < 0.042$). Nineteen of 24 (79.2%) phlebotomists had some idea of how to use the tourniquet (time and application), but 5 (20.8%) of them did not know the time of tourniquet application. Twenty-three of 24 (99.2%) phlebotomists knew about the types of specimens and anticoagulants used.

Table 3 highlights the findings of 24 phlebotomists performing 5 venepuncture procedures. In 53 of 120 (44.2%) sessions, phlebotomists did not use 70% alcohol disinfectant. In 40 (33.3%) sessions, phlebotomists did not wear gloves at all. In 83 (69.2%) sessions, phlebotomists did not renew their gloves for each patient ($P< 0.042$). In 45 (37.5%) sessions, 9 phlebotomists collected blood

**Table 3 Checklist remarks of phlebotomists in venepuncture sessions**

| Steps | Yes (n = 120) | No (n = 120) |
|---|---|---|
| Phlebotomist easily identified patients | 107 | 13 |
| Phlebotomist asked permission before collecting blood | 105 | 15 |
| Wearing gloves | 80 | 40 |
| Wearing a new glove for each patient | 37 | 83 |
| Cleaning the puncture site with 70% alcohol | 67 | 53 |
| Collecting blood after alcohol drying | 61 | 59 |
| Retouching of the cleaned site | 51 | 69 |
| Request to clenching fist during collection | 80 | 40 |
| Labelling of test tube before collection | 98 | 22 |
| Using a syringe to transfer blood to test tube | 108 | 12 |
| Using multisampling needle with holder | 66 | 54 |
| Release the tourniquet when the blood starts flowing | 73 | 47 |
| Duration of tourniquet based on CLSI | 75 | 45 |
| Adding blood by opening the vacuum tube | 72 | 48 |
| Gentle mixing to avoid haemolysis | 119 | 1 |
| Mixing time of the specimen | 108 | 12 |
| Apply cotton or adhesive bandage | 105 | 15 |
| Collect the coagulation sample properly | 92 | 28 |
| Needle stick injury | 11 | 109 |

samples using a tourniquet for an inappropriate time (CLSI recommends 1 minute). In 75 (62.5%) sessions, 15 phlebotomists used a tourniquet based on CLSI recommendations. The mean (SD) tourniquet time was 59.22 (14.37) seconds. There was a significant correlation between phlebotomists' expertise and duration of tourniquet application ($P < 0.011$).

### *Findings during venepuncture*

Ninety-eight (81.7%) of 120 blood specimen collection tubes were labelled before collection and checking the patients (Table 3). The procedure for collecting blood specimens varied among the hospitals. In 108 (90%) of 120 sessions, phlebotomists used a syringe to collect the blood and transferred it to vacutainer tubes. In 66 (55%) of 120 sessions, phlebotomists used multisampling needles and holders with evacuated tubes. In 72 (60.8%) of 120 sessions, phlebotomists released the tourniquet when blood appeared in the syringe or test tube, demonstrating full awareness of the use of the tourniquet.

### *Findings after venepuncture*

In 105 (87.5%) of 120 sessions, phlebotomists applied cotton or an adhesive bandage to the blood collection site (Table 3) and 85.8% of them, especially the trained were careful in recapping the needles or syringes ($P < 0.001$), which considerably minimized exposure to needle injury. In 119 (99.2%) sessions, phlebotomists immediately gently mixed the blood samples after collection. In 12 (10%) sessions, after collecting blood, phlebotomists placed the samples in a rack without mixing or with an unacceptable mixing time. The major errors demonstrated during phlebotomy are shown in Table 4.

## Discussion

Poor performance of phlebotomy has adverse effects on patient safety and health. Thus, this research was conducted to assess phlebotomy practice and identify the major errors during venepunctures in public laboratories in Port Sudan City.

**Table 4 Major errors observed during phlebotomy**

| Error | Phlebotomist (n = 24) | | |
|---|---|---|---|
| | Public laboratory (n = 18) | Private laboratory (n = 6) | *P* |
| Did not renew the glove for each patient | 13 (72.2%) | 4 (66.6%) | 0.042 |
| Did not use 70% alcohol for cleaning site of puncture | 12 (66.6%) | 1 (16.7%) | 0.048 |
| Retouching of the cleaned site | 12 (66.6%) | 3 (50.0%) | 0.079 |
| Collecting blood samples before alcohol, dried | 8 (44.4%) | 1 (16.7%) | 0.238 |
| Applying a tourniquet for prolonged time | 9 (50.0%) | 0 (0.0%) | 0.037 |
| Needle stick injury | 4 (22.2%) | 1 (16.7%) | 0.634 |

Phlebotomy is one of the most neglected procedures, particularly in Red Sea State. It is reported that 80% of errors occur in the preanalytical stage in clinical laboratories (*4,17,18*). The present study showed that phlebotomists working in government hospitals had fewer skills and needed an intensive training programme. This finding agrees with Ernst (*19*), who proposed that the phlebotomist is stressed during work. Importantly, this study revealed that lack of planning and continuous training of the phlebotomists has a negative impact, and this may limit their career prospects. WHO also emphasized the significance of training and regular evaluation of venepuncture techniques because ineffective training and evaluation increases mistakes and lawsuits (*20*). Therefore, training is indispensable and motivates phlebotomists to become experts in their field committed to lifelong learning, caring for their patients, and ensuring high-quality blood specimen collection. ISO 15189 accreditation has been accepted by the laboratory personnel, because it is an internationally approved standard of laboratory medicine (*21*). Accreditation systems have only recently started in Red Sea State, due to a shortage of resources.

We found that 62.5% of phlebotomists had sufficient space to perform their work, which is similar to a study by Mekonon et al. (*17*), and both studies agree with the WHO phlebotomy guidelines (*20*). Regrettably, SOPs were developed in only 5 of 8 laboratories and this led to poor quality.

General safety measures should be present throughout all laboratory work, including venepuncture (*7*). In our study, in 40 of 120 sessions, phlebotomists did not wear gloves at all, and in 83 (69.2%) sessions, phlebotomists did not renew their gloves for each patient. In 53 (44.2%) sessions, venous blood collections were performed without using 70% alcohol or any disinfectant agent. These findings are not in accordance with the CLSI guidelines and other previous studies (*7,17*). In 80 of 120 (66.7%) sessions, phlebotomists requested the patient to clench their fist. This finding is inconsistent with Lima-Oliveria et al. (*18*), who have argued that this practice could contribute to changes in electrolyte concentration and skin pH. WHO guidelines recommend that the blood puncture site must be compressed to inhibit bleeding (20); this action was achieved in 105 (87.5%) sessions by applying an adhesive bandage. Lack of knowledge is considered to be a risk for errors. Twenty-three of 24 (99.2%) phlebotomists knew about the types of specimens and anticoagulants used. However, they did not have full knowledge of the order in which to collect the samples, according to the CLSI guidelines (*7*).

Blood samples collected in tubes containing anticoagulant should be mixed by inverting gently several times to create homogeneity of anticoagulant and blood (*7*). In the present study, 10% of blood samples were inappropriately mixed, although this was less than the average reported by Mekonon et al. (*17*) and Lima-Oliveria et al. (*18*).

Our study highlights the errors made by phlebotomists during venepuncture. These errors included not wearing new gloves for each patient, not using 70% alcohol for cleaning the puncture site, retouching the cleaned site, collecting blood samples prior to alcohol drying, and applying tourniquets for a prolonged time, thereby not complying with CLSI guidelines. However, similar findings were observed in previous studies (*22–24*). The duration of tourniquet application of 59.2 (14.4) seconds in our study was within the recommended time. Our finding is consistent with that of Mekonon et al. [ 51.6 (12.5) seconds] (*17*), but not with that of Lima-Oliveria et al. [84.4 (14.1) seconds] (*18*).

The current study has some limitations. We had difficulty finding literature on phlebotomists' performance of venepuncture. Moreover, we were unable to find any studies on phlebotomy in laboratories in Sudan. Eventually, we recommended a longitudinal intervention study to assess phlebotomy practice before and after an in-service training programme. We also recommend establishing a regular standardized training programme within the fields of anatomy and pathology to develop practical skills and implement the CLSI and ISO 15189 guidelines in some public hospital laboratories and expand the training gradually to other laboratories in Red Sea State.

## Conclusion

Our study shows that there is a lack of SOPs in some phlebotomy practice in Port Sudan City. Also, there is some deficit in phlebotomists' skills. None of the phlebotomists undertook any training course or workshop and this reflects the extent of the negligence of phlebotomists by health administrations. However, the phlebotomists did not follow the CLSI guidelines. Ongoing assessment and improvement are fundamental to ensure that the phlebotomy service is effective. The shortage of resources is a major hurdle to improving health facilities and providing training to phlebotomy staff.

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**Competing interests:** None declared.

## Audit du système de phlébotomie dans les laboratoires médicaux de la ville de Port-Soudan (Soudan)

### Résumé

**Contexte** : La phlébotomie est l'une des techniques de médecine de laboratoire et de soins de santé les plus délaissées. Il s'agit d'une pratique complexe nécessitant de vastes connaissances et des compétences de haut niveau. Des erreurs en phlébotomie peuvent influencer les résultats des analyses de laboratoire (diagnostic) et avoir une incidence sur la prise en charge des patients.

**Objectifs** : Évaluer la pratique des phlébotomistes ainsi que le degré de conformité avec les lignes directrices et déterminer la fréquence des erreurs commises dans les laboratoires hospitaliers de Port-Soudan (Soudan).

**Méthodes** : Entre août et septembre 2017, une étude d'observation transversale a été menée dans huit hôpitaux publics soudanais à l'aide d'un système d'observation structuré. Un questionnaire structuré a été utilisé pour évaluer les procédures de ponction veineuse. Lors de chaque session, cinq prélèvements de sang différents effectués par chacun des phlébotomistes ont été observés. On a surveillé 120 prélèvements de sang effectués par 24 phlébotomistes, 16 (66,7 %) étant des hommes et 8 (33,3 %) femmes, dont l'âge moyen était de 31,1 ans.

**Résultats** : Trois des huit sites de phlébotomie n'étaient pas couverts par des modes opératoires normalisés. De plus, les phlébotomistes ne disposaient pas de plans de formation adéquats. Dans 33,3 % des sessions, les phlébotomistes ne portaient pas du tout de gants, et dans 69,2 % des sessions, ils ne portaient pas de nouveaux gants pour chaque patient. Une forte corrélation a été observée entre l'expertise des phlébotomistes et la durée d'application du garrot.

**Conclusion** : La présente étude met en évidence la non-disponibilité de modes opératoires normalisés dans certains sites de phlébotomie. Les phlébotomistes ne suivaient pas les lignes directrices du *Clinical and Laboratory Standards Institute*. L'évaluation continue et l'amélioration des procédures sont essentielles pour garantir le bon fonctionnement du service de phlébotomie.

## مراجعة نظام فصد الدم في المختبرات الطبية في مدينة بورتسودان في السودان

بشير عبدالرحمن بشير، أحمد عبد ربه


### الخلاصة

**الخلفية:** إن فصد الدم هو إحدى أكثر التقنيات التي تعاني من الإهمال في طب المختبرات والرعاية الصحية. وهو من الممارسات المُعقدة التي تتطلب معرفة واسعة ومهارات رفيعة المستوى. وقد تؤثر الأخطاء التي تحدث أثناء فصد الدم على نتائج الفحوص المختبرية (التشخيص)، مما يؤثر بدوره على الرعاية المُقدَّمة للمرضى.

**الأهداف:** هدفت الدراسة إلى تقييم ممارسة أخصائيي فصد الدم وتقدير مدى امتثالهم للمبادئ التوجيهية، وتحديد وتيرة حدوث الأخطاء في مختبرات المستشفيات في بورتسودان، السودان.

**طرق البحث:** أُجريت دراسة رصدية مقطعية باستخدام خطة رصد مُنظَمة في 8 مستشفيات عامة في السودان في الفترة بين أغسطس/ آب وسبتمبر/ أيلول 2017. واستُخدم استبيان مُنسق لتقييم مستوى إجراءات بَزْل الوَريد. كما رُصدت خمس عمليات لجمع الدَّم قام بها كل فرد من أخصائيي الفصد. ورصدنا 120 عملية لجمع الدَّم قام بها 24 أخصائي فصد، 16 منهم من الذكور (66.7%)، و8 من الإناث (33.3%)، وكان متوسط عمرهم 31.1 عاماً.

**النتائج:** لم تشمل إجراءات التشغيل الموحدة ثلاثة من مواضع فصد الدَّم الثمانية. وعلاوةً على ذلك، لم تتوافر الخطط التدريبية الملائمة لأخصائيي فصد الدَّم. وفي 33.3% من الجلسات، لم يرتدِ أخصائيو الفصد قفازات على الإطلاق، كما أنهم في 2 , 69% من الجلسات، لم يرتدوا زوجاً جديداً من القفازات لكل مريض. وتبيَّن وجود ترابط وثيق بين خبرة أخصائيي الفصد ومدة وضع العاصِبَة.

**الاستنتاج:** تُوضح هذه الدراسة عدم توافر إجراءات التشغيل الموحدة بشأن بعض مواضع فصد الدَّم، وعدم اتباع أخصائي الفصد للمبادئ التوجيهية الخاصة بمعهد المعايير السريرية والمختبرية. وعليه، فإنه لا غنى عن تقييم الإجراءات وتحسينها باستمرار لضمان تشغيل خدمات فصد الدَّم بفعالية.


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# Prevalence of self-medication in university students: systematic review and meta-analysis

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## Abstract

**Background:** Self-medication can lead to serious consequences but its overall prevalence in students is not known.

**Aims:** The aim of this study was to determine the prevalence of self-medication in students through a systematic review and meta-analysis of studies on the prevalence of self-medication in students across the world.

**Methods:** PubMed/MEDLINE, EMBASE, ISI/Web of Science and Google Scholar were searched up to October 2017. Studies reporting the prevalence of self-treatment in university students were selected. Data recorded included year of publication, country where the study was conducted, sample size, prevalence of self-medication, sex and mean age of students, and faculty of students (medical or non-medical). A random-effect model was used to determine effect size with a 95% confidence interval (CI). Heterogeneity across studies was assessed with the $I^2$ test. A sensitivity analysis assessed stability of the findings.

**Results:** A total of 89 studies were included in the analysis, which comprised 60 938 students. The overall prevalence of self-medication in university students was 70.1% (95% CI: 64.3–75.4%). Female students self-medicated more often than male students: odds ratio = 1.45 (95% CI%: 1.17–1.79). The prevalence of self-medication in medical students (97.2%) was higher than in non-medical students (44.7%). The $I^2$ test indicated high, statistically significant heterogeneity. The sensitivity analysis showed that the results were stable.

**Conclusion:** The prevalence of self-medication among students worldwide is high. Programmes on the risks of self-medication and increasing control and monitoring of the sale of drugs are recommended. Facilitating students' access to doctors and health centres could reduce self-medication in students.

Keywords: self-medication, students, prevalence, meta-analysis

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## Introduction

Self-medication is the self-administration of a treatment (either pharmacological or behavioural) without a prescription from a physician or a caregiver (*1*). Self-medication is an umbrella term, which includes a variety of behaviours, ranging from self-care to disease prevention and disease management. As such, self-medication is not limited to drug intake, but includes also interventions aimed at modifying lifestyle (*2*). Self-medication is occurring increasingly and is a serious public health concern, both in developing and developed countries (*3*). Self-medication can lead to serious consequences such as delay in diagnosis of illness, drug resistance, development of co-morbidities and, in some cases, death (*4,5*).

The number of people reported to self-medicate varies greatly depending on the country in which a study has been conducted and the study design. For instance, in the United States of America (USA) in a period of 6 months, about 71% of men and 82% of women had self-medicated at least once (*6*). In the United Kingdom of Great Britain and Northern Ireland, 41.5% of people had used drugs without a doctor's prescription (*7*). In Spain, 27% of people suffering from pain self-medicated (*8*). The rise in the prevalence of self-medication is a serious issue for health decision-makers and policy-makers. This increase could be due to higher costs of consulting a doctor, greater availability of drugs and easier access to medications, lack of access to health care facilities and services, and patients' experiences of previous treatments (*9*).

Determinants of self-medication include the type of physical/psychological illness, the social, cultural and economic status of the patients, and the national laws regulating drug use and sales (*10–13*). Self-medication may also have its root in the illegal sale of medicines (*14*).

Young people are among the most vulnerable to self-medication. In particular, students, because of their higher educational level and ability to find information about

medications through the Internet, are more likely to self-medicate (*15,16*). A precise and reliable estimate of the self-medication rate is important for health decision-makers and policy-makers so they can design and implement programmes aimed at preventing self-medication. Therefore, we aimed to investigate the prevalence of self-medication in university students worldwide through a systematic review and meta-analysis of studies published on self-medication in students.

## Methods

We did a two-stage literature search in order to identify the relevant studies. In the first stage, scholarly electronic databases, namely PubMed/MEDLINE via Ovid, EMBASE, ISI/Web of Science and Google Scholar, were searched up to November 2017 using Boolean operators and Medical Subject Headings (MeSH) where appropriate, and restricting the search to articles with full text and/or abstract published in English. The full texts of papers written in languages other than English, were translated by professional translators. The search strategy was as follows: ("prevalence" OR "epidemiology" OR "frequency") AND ("self-medication" OR "self-administration" OR "self-care" OR "illicit use" OR "self-prescription" OR "without doctor's prescription") AND ("university students" OR "medical students" OR "college students" OR "undergraduates").

In the second stage, we also checked the reference lists of the studies retrieved for possible relevant related studies. We included studies that reported the prevalence of self-treatment in students, or those that had the necessary data for calculation of the prevalence. We excluded letters to editor, reviews, case reports or case series, interventional studies, conference proceeding or studies with no available full text. After identification of relevant studies, we examined their titles and abstracts for inclusion based on the above-mentioned inclusion and exclusion criteria. Then, two authors independently reviewed the full text of the articles and extracted the relevant information: surname of first author, year of publication, country where the study was conducted, and then information about the participants including sample size, reported prevalence of self-medication, average age and sex, and type of university where the students studied. If there was disagreement between the reviewers, a third reviewer was consulted as the final referee.

We used the Hoy checklist for evaluation of research quality (risk of bias) for critical appraisal of studies retained in the meta-analysis (*17*). The checklist includes 10 items, the first four investigate external validity of the studies and the remaining ones relate to internal validity.

To calculate the overall prevalence, we used a random-effect model, computing effect sizes with a 95% confidence interval of (CI). We examined heterogeneity across studies using the $I^2$ test (*18*). To investigate the effect of the different variables on heterogeneity, we did a subgroup analysis stratifying participants by income (based on the country in which the study was carried out and retrieved from the World Bank website), region of the study, type of student (medical or non-medical), sample size, study quality and publication year. To assess the stability of the findings, we did a sensitivity analysis examining the effect of removing studies one at a time on the overall outcome (prevalence). To assess publication bias, we used the Egger linear regression test (*19*). Furthermore, we did a meta-regression analysis to assess the role of year of publication, sample size and mean age of the participants of the included studies: we used these parameters as co-variates, while the dependent variable was the effect size of the studies.

We used Comprehensive Meta-Analysis, version 2.0 (CMA v2.0, Biostat, New Jersey, USA) software for all statistical analyses.

## Results

We report our results according to the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines (*20*).

We initially retrieved 519 studies: 438 were found through database searching and 81 through additional sources. After removing duplicates, the titles and abstracts of 341 articles were examined. After screening the remaining studies based on the inclusion and exclusion criteria, we excluded 135 articles. We then reviewed the full text of the remaining 206 articles for eligibility, after which we excluded 117 studies with reason (not being relevant to the aim of our systematic review and meta-analysis and/or not providing sufficiently detailed information). We thus retained 89 studies in the final analysis. Figure 1 and Table 1 show the process of study selection and the main characteristics of the studies included, respectively.

The total sample size analysed comprised 60 938 students (*21–109*). Studies were published between 1995 and 2017, the mean age of the students ranged from 17 to 26 years, and sample sizes from 120 to 9161 participants. Thirty-seven (41.6%) studies recruited ≤ 400 participants, while 52 (58.4%) had > 400 participants. As regards region where the studies were done, 54 (60.7%) studies were done in Asia, 14 (15.7%) in Africa, 11 (12.4%) in South America, 7 (7.9%) in Europe, 2 (2.2%) in the USA, and 1 (1.1%) in Australia. Most studies (62, 69.7%) were done in middle-income countries, 19 (21.3%) in high-income countries and 8 (9.0%) in low-income countries. Forty-six (51.7%) studies explored self-medication in medical students, and 25 in non-medical students; information on students' faculty was not provided in the 18 remaining studies. As regards study quality, 52 (58.4%) articles were judged of high (score 16–22) quality, 28 (31.5%) of medium (7–15) quality and 9 (10.1%) of low (1 to 6) quality.

The overall prevalence of self-medication in university students was 70.1% (95% CI: 64.3–75.4), ranging from 7.9% to 99%, as shown in the forest plot (Figure 2, available online). The $I^2$ test revealed a high, statistically significant heterogeneity of 99.39%.

**Table 1 Main characteristics of the studies included**

| First author (Reference) | Year | Country | Mean age of students (SD), years | Sample size | Reported prevalence of self-medication % | Study quality score |
|---|---|---|---|---|---|---|
| Lau (21) | 1995 | China, Hong Kong SAR | 20.5 (SD 2.2) | 563 | 94.0 | 7–15 |
| Burak (22) | 2000 | USA | NA | 471 | 89.0 | 16–22 |
| Cabrita (23) | 2004 | Portugal | NA | 1145 | 7.9 | 16–22 |
| Aguado (24) | 2005 | Argentina | NA | 216 | 85.0 | 7–15 |
| McCabe (25) | 2005 | USA | NA | 9161 | NA | 16–22 |
| James (26) | 2006 | Bahrain | 18.01 (SD 0.78) | 134 | 44.8 | 7–15 |
| Awad (27) | 2007 | Sudan | NA | 1121 | 79.5 | 1–6 |
| Castronuovo (28) | 2007 | Argentina | NA | 462 | 95.0 | 16–22 |
| Hussain (29) | 2008 | Pakistan | NA | 200 | 42.0 | 7–15 |
| Sawalha (30) | 2008 | Palestine | 20 (SD 1.7) | 1581 | 66.1 | 7–15 |
| Zafar (31) | 2008 | Pakistan | 21 (SD 1.8) | 572 | 76.0 | 1–6 |
| Sawalha (32) | 2008 | Palestine | 19.9 (SD 1.7) | 1581 | 98.0 | 7–15 |
| Sarahroodi (33) | 2009 | Iran (IR) | NA | 160 | 53.0 | 1–6 |
| Abay (34) | 2010 | Ethiopia | NA | 213 | 38.5 | 7–15 |
| de Aquino (35) | 2010 | Brazil | NA | 223 | 65.5 | 16–22 |
| Marine (36) | 2010 | Argentina | NA | 5170 | 50.1 | 16–22 |
| Sapkota (37) | 2010 | Nigeria | NA | 706 | 24.0 | 7–15 |
| Sarahroodi (38) | 2010 | Iran (IR) | 21.5 (SD 0.25) | 195 | NA | 16–22 |
| Verma (39) | 2010 | India | 20.13 (SD 2.32) | 1022 | 87.0 | 7–15 |
| Chowdhury (40) | 2011 | Bangladesh | NA | 1107 | 16.0 | 7–15 |
| El Ezz (41) | 2011 | Egypt | 19.1 (SD 1.5) | 300 | 55.0 | 7–15 |
| Gutema (42) | 2011 | Ethiopia | 21.5 | 148 | 43.2 | 7–15 |
| Klemenc-Ketis (43) | 2011 | Slovenia | NA | 410 | 94.9 | 16–22 |
| Klemenc-Ketis (44) | 2011 | Slovenia | 22.4 (SD 3.24) | 1294 | NA | 16–22 |
| Mumtaz (45) | 2011 | Pakistan | 22 | 207 | 80.4 | 1–6 |
| Souza (46) | 2011 | Brazil | 21 (SD 1.95) | 196 | 38.8 | 16–22 |
| Auta (47) | 2012 | Nigeria | NA | 188 | 53.2 | 1–6 |
| Banerjee (48) | 2012 | India | 21.03 (SD 4.82) | 468 | 57.1 | 7–15 |
| da Silva (49) | 2012 | Brazil | 22 (SD 6.17) | 789 | 86.4 | 16–22 |
| da Silva (50) | 2012 | Brazil | 21.5 | 200 | 92.0 | 16–22 |
| Donkor (51) | 2012 | Ghana | NA | 600 | 70.0 | 7–15 |
| Galato (52) | 2012 | Brazil | 22.9 (SD 4.2) | 342 | 37.0 | 7–15 |
| Ibrahim (53) | 2012 | United Arab Emirates | 19.5 (SD 2.4) | 169 | 86.0 | 16–22 |
| Murtaza (54) | 2012 | Pakistan | NA | 450 | 78.7 | 16–22 |
| Osemene (55) | 2012 | Nigeria | NA | 2000 | NA | 7–15 |
| Pan (56) | 2012 | China | NA | 1300 | 47.8 | 16–22 |
| Suaifan (57) | 2012 | Jordan | NA | 570 | NA | 16–22 |
| Tabiei (58) | 2012 | Iran (IR) | NA | 1048 | 86.7 | 16–22 |
| Angamo (59) | 2012 | Ethiopia | 18–24 | 403 | 45.9 | 16–22 |
| Betancourt (60) | 2013 | Puerto Rico | NA | 275 | 27.6 | 1–6 |
| Imtiaz (61) | 2013 | Pakistan | NA | 300 | 83.0 | 7–15 |
| Kumar (62) | 2013 | India | 20.3 (SD 61.5) | 440 | 78.6 | 16–22 |
| Purreza (63) | 2013 | Iran (IR) | NA | 600 | 35.7 | 16–22 |
| Ullah (64) | 2013 | Pakistan | NA | 256 | 95.5 | 16–22 |
| Al Hussaini (65) | 2014 | Kuwait | NA | 837 | 97.8 | 1–6 |
| Brlic (66) | 2014 | Croatia | NA | 389 | NA | 16–22 |
| Damian (67) | 2014 | Romania | NA | 281 | 41.0 | 16–22 |
| Flaiti (68) | 2014 | Oman | 22.3 | 450 | 36.7 | 16–22 |
| Ghafouri (69) | 2014 | Iran (IR) | 22.84 (SD 4.19 | 590 | 41.9 | 7–15 |
| Lukovic (70) | 2014 | Serbia | NA | 1295 | 79.9 | 16–22 |

**Table 1 Main characteristics of the studies included *(concluded)***

| First author (Reference) | Year | Country | Mean age of students (SD), years | Sample size | Reported prevalence of self-medication % | Study quality score |
|---|---|---|---|---|---|---|
| Lv (71) | 2014 | China | NA | 731 | 40.2 | 16–22 |
| Martinez (72) | 2014 | Brazil | 22.09 (SD 9.94) | 498 | NA | 16–22 |
| Pirzadeh (73) | 2014 | Iran (IR) | 22.00 (SD 2.77) | 197 | 85.0 | 16–22 |
| Saeed (74) | 2014 | Saudi Arabia | 21.95 (SD 3.43) | 354 | 86.2 | 16–22 |
| Shah (75) | 2014 | Pakistan | 20.04 (SD 1.74) | 431 | 47.6 | 7–15 |
| Sharif (76) | 2014 | United Arab Emirates | 20.4 (SD 2.6) | 200 | 59.0 | 7–15 |
| Patil (77) | 2014 | India | 20.4 (SD 1.22 | 440 | 88.2 | 16–22 |
| Alam (78) | 2015 | Bangladesh | NA | 500 | NA | 7–15 |
| Chiribagula (79) | 2015 | Democratic Republic of the Congo | 23 | 510 | 99.0 | 16–22 |
| Ghaieth (80) | 2015 | Libya | NA | 363 | NA | 7–15 |
| Gholipour (81) | 2015 | Iran (IR) | NA | 320 | 48.0 | 16–22 |
| Gunawardhana (82) | 2015 | Sri Lanka | NA | 175 | 85.1 | 1–6 |
| Ibrahim (83) | 2015 | Saudi Arabia | NA | 504 | NA | 16–22 |
| Sharma (84) | 2015 | India | NA | 624 | NA | 7–15 |
| Aashi (85) | 2016 | Saudi Arabia | NA | 507 | 74.0 | 16–22 |
| Ahamdi (86) | 2016 | Iran (IR) | 21.63 (SD 1.92) | 364 | 33.7 | 16–22 |
| Albasheer (87) | 2016 | Saudi Arabia | NA | 300 | 87.0 | 16–22 |
| Ali (88) | 2016 | Pakistan | 23.5 (SD 3.6) | 150 | 52.7 | 16–22 |
| Alkhatatbeh (89) | 2016 | Jordan | NA | 1317 | 78.5 | 16–22 |
| Banerjee (90) | 2016 | Nepal | NA | 488 | 81.4 | 16–22 |
| Birru (91) | 2016 | Ethiopia | 21 (SD 1.61) | 464 | 77.6 | 16–22 |
| Ibrahim (92) | 2016 | Malaysia | 22 (SD 1.7) | 363 | 46.6 | 7–15 |
| Iuras (93) | 2016 | Brazil | NA | 180 | 89.0 | 1–6 |
| Jamshed (94) | 2016 | Malaysia | 19.55 (SD 1.761 | 461 | 57.2 | 16–22 |
| Jimenez-Nunez (95) | 2016 | Spain | NA | 249 | 72.7 | 16–22 |
| Johnson (96) | 2016 | India | 17–26 | 736 | NA | 16–22 |
| Juibari (97) | 2016 | Iran (IR) | 21.01 (SD 1.46) | 175 | 45.7 | 16–22 |
| Kumar (98) | 2016 | India | NA | 664 | NA | 16–22 |
| Morowatisharifabad (99) | 2016 | Iran (IR) | 21.9 (SD 2.41) | 237 | 45.1 | 16–22 |
| Noor (100) | 2016 | Pakistan | 20.64 (SD 1.68) | 413 | 96.9 | 7–15 |
| Saleem (101) | 2016 | Pakistan | 21.2 (SD 2.2) | 380 | NA | 16–22 |
| Williams (102) | 2016 | Australia | NA | 120 | 91.7 | 16–22 |
| Yadav (103) | 2016 | Nepal | NA | 570 | 90.1 | 7–15 |
| Zhu (104) | 2016 | China | 21 | 660 | 47.9 | 16–22 |
| Al-Ameri (105) | 2017 | Iraq | 19.8 (SD 1.6) | 1435 | 92.4 | 16–22 |
| Gelayee (106) | 2017 | Ethiopia | 21.26 (SD 1.76) | 385 | 32.7 | 7–15 |
| Haroun (107) | 2017 | Syrian Arab Republic | NA | 436 | NA | 16–22 |
| Helal (108) | 2017 | Egypt | 20 (SD 0.7) | 800 | 62.9 | 16–22 |
| Jakaria (109) | 2017 | Bangladesh | NA | 439 | 52.2 | 7–15 |

*SD: standard deviation, SAR: Special Administrative, Region, USA: United States of America, NA: not available, IR: Islamic Republic of*

Results of the subgroup analysis based on income level, geographical region, sample size, study quality, year of publication, type of students (medical or non-medical) and sex are shown in Table 2. Heterogeneity as assessed by the $I^2$ statistic was high, statistically significant for all these subgroup analyses and ranging from 87.77% to 99.89%. Stratifying according to the income level of the country in which the study was conducted, the prevalence of self-medication was 65% (95% CI: 44.8–80.9%), 71.8% (95% CI: 66.8–76.3%) and 67.2% (95% CI: 46.5–82.9%) in high-, middle- and low-income countries, respectively. Based on region, the highest prevalence of self-medication was 91.7% (95% CI: 85.2–95.5%) in Oceania and the lowest was 55.8% (95% CI: 28–80.4) in Europe. The prevalence of self-medication was higher in female students (76.6% (95% CI: 65.0–85.2%)) than male students (66.9% (95% CI: 56.4–75.9%)), and in medical students (97.2% (95% CI: 95.4–98.3%)) than non-medical students

**Table 2 Results of subgroup analysis of self-medication in university students**

| Variable | No. studies | No. participants | Prevalence (95% CI), % | Q test | $I^2$, % | *P*-value |
|---|---|---|---|---|---|---|
| ***Income*** | | | | | | |
| High | 19 | 17 532 | 65.0 (44.8–80.9) | 4976.93 | 99.63 | < 0.001 |
| Middle | 62 | 40 225 | 71.8 (66.8–76.3) | 5523.91 | 98.89 | < 0.001 |
| Low | 8 | 3 181 | 67.2 (46.5–82.9) | 1 006.87 | 99.30 | < 0.001 |
| ***Region*** | | | | | | |
| Asia | 54 | 29 371 | 71.7 (66.6–76.4) | 4 082.90 | 98.70 | < 0.001 |
| Europe | 7 | 5063 | 55.8 (28–80.4) | 1 485.80 | 99.59 | < 0.001 |
| Americas | 13 | 18 183 | 65 (38.8–84.5) | 4 901.85 | 99.75 | < 0.001 |
| Africa | 14 | 8 201 | 71.6 (56.7–83.0) | 2 050.22 | 99.36 | < 0.001 |
| Oceania | 1 | 120 | 91.7 (85.2–95.5) | – | – | – |
| ***Sample size*** | | | | | | |
| ≤ 400 | 37 | 9 104 | 61.9 (55.1–68.3) | 2 752.36 | 98.69 | < 0.001 |
| > 400 | 52 | 51 834 | 75.3 (66.7–82.2) | 11 739.21 | 99.56 | < 0.001 |
| ***Quality of study*** | | | | | | |
| High (16–22) | 52 | 40 864 | 68.7 (60.2–76) | 10 794.22 | 99.52 | < 0.001 |
| Medium (7–15) | 28 | 16 359 | 72.3 (63–80) | 2 780.98 | 99.02 | < 0.001 |
| Low (1–6) | 9 | 3 715 | 71.2 (58.7–81.1) | 481.24 | 98.33 | < 0.001 |
| ***Year of publication*** | | | | | | |
| 1995–2001 | 2 | 1 034 | 91.7 (85.4–95.5) | 8.18 | 87.77 | < 0.001 |
| 2002–2006 | 4 | 10 656 | 30.2 (8.9–65.6) | 582.55 | 99.48 | < 0.001 |
| 2007–2011 | 20 | 16 868 | 68 (56.4–77.7) | 2 894.05 | 99.33 | < 0.001 |
| 2012–2017 | 63 | 32 380 | 71.8 (66.66–76.4) | 5 061.25 | 98.77 | < 0.001 |
| ***Type of students***[a] | | | | | | |
| Medical | 46 | 15 497 | 97.2 (95.4–98.3) | 1 802.02 | 97.5 | < 0.001 |
| Non-medical | 25 | 23 799 | 44.7 (29.7–60.7) | 8 431.75 | 99.71 | < 0.001 |
| ***Sex***[b] | | | | | | |
| Female | 23 | 9 392 | 76.6 (65.0–85.2) | 1 956.78 | 98.87 | < 0.001 |
| Male | 23 | 7 021 | 66.9 (56.4–75.9) | 1 177.13 | 98.13 | < 0.001 |

[a]*The faculty of the students was not given in 18 studies.*

[b]*The sex of the students was not given in 43 studies.*

(44.7% 95% CI: 29.7–60.7%)). Between 2012 and 2017, the later studies included, the prevalence of self-medication was 71.8% (95% CI: 66.66–76.4%).

The effect of moderator variables (i.e. predictors of self-medication) – publication year, sample size of studies and the mean age of participants – was evaluated using meta-regression analyses (Table 3). All these moderator variables were statistically significantly associated with the prevalence of self-medication ($P < 0.001$).

The odds ratio of self-medication in female versus male students was 1.45 (95 CI%: 1.17–1.79), that is to say self-medication was significantly more prevalent in females (Figure 3, available online).

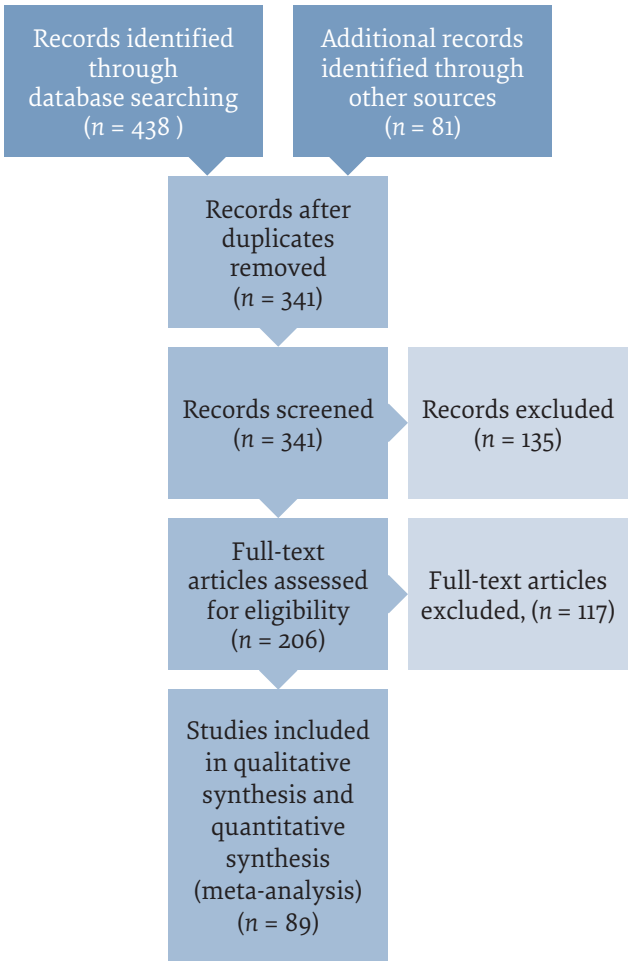
**Table 3 Meta-regression analysis of effect of variables on the prevalence of self-medication**

| Moderator | No. studies | Coefficient | *z*-value | *P*-value | $I^2$ |
|---|---|---|---|---|---|
| Year of publication | 89 | 0.11 | 42.48 | < 0.001 | 1.46 |
| Sample size of studies | 89 | −0.00 | −66.12 | < 0.001 | 1.22 |
| Mean age of participants | 40 | −0.34 | −19.28 | < 0.001 | 0.94 |

The sensitivity analysis showed the stability of the results (Figure 4, see Supplement 1, available online). We sorted studies according to the year of publication and did a cumulative meta-analysis. The results showed that the prevalence of self-medication did not generally change, confirming once again the robustness of our findings (Figure 5, see Supplement 1, available online). In addition, we sorted studies by sample size and again the prevalence of self-medication did not generally change (Figure 6, see Supplement 1, available online). This confirms the reliability and robustness of our findings.

Finally, we found evidence of publication bias based on the Egger linear regression test. The intercept was 12.57 (95% CI: 7.24–17.90), $t = 4.68$, degrees of freedom = 87, $P < 0.001$). Publication bias was confirmed by the visual inspection of the funnel plot, which is shown in Figure 7 (see Supplement 1, available online).

**Figure 1 Flow diagram of selection of studies for inclusion in the systematic review and meta-analysis**




## Discussion

Our results show that the prevalence of self-medication in students worldwide was 70.1%. The range of prevalence of self-medication in students (7.9–99.0%) was higher than self-medication in adolescents aged 13–18 years (prevalence rate ranging from 2% to 92%) (*110*). In addition, the prevalence of self-medication in students was higher than non-student adults (for instance 35.0% (95% CI: 29.0–40.0%) in Brazil) (*111*). A possible factor for such a high prevalence of self-medication in students could be the high level of education. Indeed, awareness and knowledge of drugs among students has been reported as a key factor in students' behaviour in seeking health care. Students are much more likely to read books and materials on different medications and their benefits for treating illnesses (*15,16*). This knowledge may lead to them self-prescribe treatment rather than seeing a physician. Furthermore, in some cases, living on campus may change students attitudes and make them more prone to self-medication (*112*). We found that the prevalence of self-medication in students in medical sciences (97.2%) was more than twice the prevalence of self-medication in non-medical students (47.7%), which, as hypothesized before, could be because medical students generally have a greater awareness and knowledge about drugs (*113*). Students of medical sciences sometimes try different drugs which they will use in their future profession. In addition, the frequent use of medicines during their training in health centres and their easy access to medications could make them more likely to use medications to treat themselves (*77,96*).

Our subgroup analyses showed that the prevalence of self-medication was lower in high-income countries than middle- and low-income countries. More up-to-date knowledge on the consequences of self-medication, as well as the health counselling against self-medication by health care professionals and the easier access to health care in high-income countries could explain such difference (*114*). At the same time, lower socioeconomic status could lead people to self-medicate, because they cannot afford to go to a doctor. Today, most people have easier access to drugs than before, which can be dangerous for health, especially if poor-quality and inadequate medications are used (*115*).

Moreover, we found that the prevalence of self-medication was higher in women than men (OR = 1.45). This could be because women may use medications before they get ill (*116*). Female use more drugs because of menstruation and gynaecological problems, and usually they look for information about their illnesses (*117*). However, some studies found different results (*118,119*).

Asian students were more likely to self-medicate compared with students in other regions. Cultural, ethnic, economic and social factors can explain such differences in prevalence. Poor supervisory structures for purchase of medications, easy access to medicine, lack of insurance coverage for some students and misconceptions about taking medications without referring to a doctor can increase the prevalence of self-medication (*11,120*).

We found a statistically significant time trend in self-medication worldwide. Despite efforts made by countries to reduce self-medication in students, this practice is still rising; therefore new and more effective measures are urgently needed (*9*). In addition, based on the result of our meta-regression analyses, the mean age of participants was associated with the prevalence of self-medication, with younger students being more likely to self-medicate. This may be due to negative effects of self-medication experienced when students were younger. When someone suffers from complications of self-medication, fear of suffering from other physical or mental problems may prevent him/her from self-medicating again (*77*).

The strengths of our study include: its large sample size, the subgroup analysis, sensitivity analysis, cumulative meta-analysis and meta-regression analyses. All these analyses indicate the methodological rigor of our systematic review and meta-analysis. On the other hand, our review has some limitations. We observed high, statistically significant heterogeneity across the studies included, which could be due to methodological differences in the different studies. Publication bias

was also statistically significant so the results should be interpreted/generalized with caution. In addition, the quality of the studies included differed and the inclusion of some poor-quality investigations might have affected the final estimation.

## Conclusion

The results of this study showed that the prevalence of self-medication in students worldwide was high. We recommend that health decision-makers and policy-makers consider developing and implementing programmes about the risks of self-medication, and increasing control and monitoring of the sale of drugs. Facilitating students' access to doctors and health care centres could be effective in reducing self-medication among students.

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## Prévalence de l'automédication chez les étudiants universitaires : examen systématique et méta-analyse

### Résumé

**Contexte** : L'automédication peut avoir de graves conséquences, mais sa prévalence globale chez les étudiants n'est pas connue.

**Objectifs** : La présente étude avait pour objectif de mesurer la prévalence de l'automédication chez les étudiants au moyen d'un examen systématique et d'une méta-analyse des études portant sur la prévalence de l'automédication chez les étudiants à travers le monde.

**Méthodes** : Les bases de données PubMed/MEDLINE, EMBASE, ISI/Web of Science et Google Scholar ont été consultées jusqu'au mois d'octobre 2017. Les études portant sur la prévalence de l'automédication chez les étudiants universitaires ont été sélectionnées. Les données enregistrées comprenaient l'année de publication de l'étude, le pays où l'étude avait été menée, la taille de l'échantillon, la prévalence de l'automédication, le sexe et l'âge moyen des étudiants, ainsi que la faculté de ces derniers (discipline médicale ou non). Un modèle à effet aléatoire a été utilisé pour déterminer la taille de l'effet avec un intervalle de confiance (IC) de 95 %. L'hétérogénéité des résultats entre les différentes études a été évaluée à l'aide du test $I^2$. Une analyse de sensibilité a permis d'évaluer la stabilité des résultats.

**Résultats** : Au total, 89 études ont été incluses dans l'analyse, qui comprenait 60 938 étudiants. La prévalence globale de l'automédication chez les étudiants universitaires était de 70,1 % (IC à 95 % : 64,3-75,4 %). Les étudiantes s'auto-médicamentent plus souvent que les étudiants : odds ratio = 1,45 (IC à 95 % : 1,17-1,79 %). La prévalence de l'automédication chez les étudiants en médecine (97,2 %) était plus élevée que chez les étudiants des filières non médicales (44,7 %). Le test $I^2$ a révélé une hétérogénéité élevée et statistiquement significative. L'analyse de sensibilité a permis de conclure que les résultats étaient stables.

**Conclusions** : La prévalence de l'automédication chez les étudiants du monde entier est élevée. Il est recommandé de mettre en place des programmes sur les risques liés à l'automédication et renforcer le contrôle et la surveillance de la vente de médicaments. Le fait de faciliter l'accès des étudiants à des médecins et à des centres de santé pourrait permettre de réduire l'automédication chez les étudiants.

## انتشار التداوي الذاتي بين طلاب الجامعات: استعراض منهجي وتحليل تلوي

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### الخلاصة

**الخلفية:** يُمكن أن يُسفر التداوي الذاتي عن عواقب وخيمة، ولكن من غير المعلوم المعدل الكلي لانتشاره بين الطلاب.

**الأهداف:** هدفت هذه الدراسة إلى تحديد معدل انتشار التداوي الذاتي بين الطلاب من خلال إجراء استعراض منهجي وتحليل تلوي للدراسات المعنية بمعدل انتشار التداوي الذاتي بين الطلاب في جميع أنحاء العالم.

**طرق البحث:** بُحث في برامج Google Scholar، ISI /Web of Science، EMBASE، PubMed /MEDLINE، وذلك حتى أكتوبر/ تشرين الأول 2017. واختيرت الدراسات التي أفادت انتشار المعالجة الذاتية بين طلاب الجامعات. وتضمنت البيانات المُسجلة سنة النشر، والبلد الذي أجريت به الدراسة، وحجم العينة، ومعدل انتشار التداوي الذاتي، ونوع الجنس، ومتوسط أعمار الطلاب، وطبيعة الدراسة في الكلية الملتحقين بها (طبية أم غير طبية). واستُخدم نموذج ذو تأثير عشوائي لتحديد حجم التأثير بفاصل ثقة (CI) قدره 95%. وقُدر عدم التجانس بين الدراسات باستخدام اختبار $I^2$. وقدَّر تحليلٌ الحساسية ثبات النتائج.

**النتائج:** بلغ إجمالي الدراسات التي تضمنها التحليل 89 دراسة شملت 60 938 طالباً. وبلغ المعدل الكلي لانتشار التداوي الذاتي بين طلاب الجامعات 70.1% (بفاصل ثقة (CI) قدره 95%: 64,3–75,4%). وكانت نسبة التداوي الذاتي في الطالبات أعلى منها في الطلاب الذكور:

(95% CI: 1.17–1.79) وكان معدل انتشار التداوي الذاتي بين طلاب الطب (97.2%) أعلى منه بين طلاب الكليات الأخرى (44.7%). وقد بيَّن اختبار $I^2$ عدم التجانس بين الدراسات بنسبة كبيرة من الناحية الإحصائية. وقدَّر تحليلُ الحساسية ثبات النتائج.

**الاستنتاج:** يُعتبر معدل انتشار التداوي الذاتي بين الطلاب مرتفعاً. ويُوصى بإعداد برامج للتوعية بمخاطر التداوي الذاتي، وإحكام الرقابة على بيع الأدوية ورصد ذلك. وقد يساعد تيسير إمكانية وصول الطلاب إلى الأطباء والمراكز الصحية على الحد من انتشار التداوي الذاتي بينهم.

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# Combating tobacco use in Saudi Arabia: a review of recent initiatives

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## Abstract

**Background:** The tobacco use epidemic is one of the major global public health challenges and causes > 7 million deaths each year, including ~70 000 Saudis who die from smoking-related diseases.

**Aims:** To present recent government initiatives in Saudi Arabia that have been designed to combat tobacco use in the country.

**Methods:** This was a review based on secondary data sources such as published reports, articles in newspapers, and research studies published in various journals.

**Results:** We present initiatives taken from June 2017 to April 2019 by the Saudi government to combat tobacco use, including value-added tax on tobacco, antismoking campaigns, antismoking clinics, mobile apps and other initiatives.

**Conclusion:** The study suggests that the government should evaluate the impact of these initiatives on tobacco control in Saudi Arabia.

Keywords: anti-smoking campaign, anti-smoking clinics, mobile app, Saudi Arabia, tobacco

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## Introduction

The government of Saudi Arabia is determined to enhance the quality of preventive and therapeutic health care services as a part of its Vision 2030. The public sector is focusing on promoting preventive care and on reducing infectious diseases in the country (*1*). The tobacco use epidemic, one of the world's major public health challenges, is resulting in more than 7 million deaths per year according to the World Health Organization (WHO). Out of this total, more than 6 million deaths are the result of direct tobacco use, while some 890 000 deaths are the result of non-smokers being exposed to second-hand smoke (*2*). The prevalence of tobacco use and the dangers posed to those users, as well as 'second-hand smokers', is one of the major public health concerns in Saudi Arabia. The control of tobacco use is imperative since the numbers of smokers and deaths from smoking in the country are rising rapidly (*3*), with a reported 70 000 Saudis dying annually from smoking-related diseases (*4*).

Saudi Arabia has been striving to control the use of tobacco. In the Gulf Cooperation Council (GCC), tobacco control activities started in January 1979, when Saudi Arabia presented an initial scientific proposal at the 6th GCC Health Ministers' Council Conference on combating smoking in the Region. The WHO Framework Convention on Tobacco Control (FCTC) has subsequently been signed by the majority of the GCC member states, including Kuwait, Qatar, Saudi Arabia and United Arab Emirates, with every single member state endorsing it (*5*). Thus, the government of Saudi Arabia has become a signatory of the WHO FCTC launched in May 2003, as well as initiating its own anti-smoking campaign for the first time in the same year.

All GCC member states possess a national level agency to control tobacco use. In 2008, WHO presented the MPOWER measures (Monitor tobacco use and prevention policies, Protect people from tobacco smoke, Offer help to quit tobacco use, Warn about dangers of tobacco, Enforce bans on tobacco advertising, promotion and sponsorship, Raise taxes on tobacco) to GCC member states in fulfilment of their WHO FCTC commitments. The MPOWER measures provide useful support in the process of implementing tobacco control initiatives in Saudi Arabia (*5*). The Saudi government has banned any marketing efforts by tobacco companies and also launched a 6-month anti-smoking drive in May 2010 (*6*).

The country's national anti-smoking committee is working towards stricter tobacco control in Saudi Arabia, and passed an anti-smoking law in 2015 to combat tobacco use (*7*). As a result, anti-tobacco regulations were implemented during 2016 (*8*) and smoking is now prohibited in a variety of areas and public spaces, such as mosques; ministries, government-owned factories, public authorities and their branches; educational, health, sports, cultural and social institutions; the work place, such as companies and organizations; public transport; facilities for the production and processing of food and beverages; sites for the production, transportation and distribution of petroleum, including fuel stations; and warehouses, elevators and lavatories. However, if specific areas and places are dedicated to allow smoking, then such facilities must be set apart and access denied to persons under 18 years of age (*7*).

In 2017, Saudi Arabia joined other WHO Member States in the campaign to increase public awareness about the dangers of tobacco use (*3*), and its Ministry

of Health allocated a sizable budget to fund the various tobacco control programmes in the country. In this context, the main objective of this current study is to present the recent initiatives by Saudi Arabia in its fight against tobacco use from 2017 to 2019.

## Methods

The design of the study was a review based on secondary data sources, which included published reports, articles in newspapers and research studies published in various journals. The relevant literature regarding tobacco control in Saudi Arabia was searched from three scientific databases: PubMed, Scopus and Google Scholar from January to April 2019. Key phrases such as 'tobacco use in Saudi Arabia', 'smoking in Saudi Arabia' and 'tobacco control in Saudi Arabia' were used. The main inclusion criterion for selection was that the article had to discuss tobacco control programmes in Saudi Arabia. Articles that were not available in English with free full text were excluded from the study. Table 2 provides the selected list of studies on tobacco use in Saudi Arabia.

## Results

The prevalence of tobacco use in Saudi Arabia is detailed in the WHO report on the global tobacco epidemic 2017 (Table 1). The data on young people were taken from the Global Youth Tobacco Survey 2010, and adult data from the Saudi Health Information Survey 2014. The total prevalence of tobacco use was 14.9% among young people, and 12.2% among adults. Moreover, the prevalence of cigarette smoking was found to be 8.9% among young people, whereas the prevalence of smokeless tobacco use was 3.4%, but only 0.9% among adults in Saudi Arabia (*9*).

The findings of the Saudi Health Information Survey 2014 revealed that 17.2% of Saudis were exposed to second-hand smoke at home and 14.8% were exposed in the work place. The survey also found that 14.6% of smokers were aged 35–44 years. Moreover, the survey identified that the prevalence of smoking increased among those aged 25–64 years, rising from 12.2% in 2005 to 15.3% in 2013 (*10*). Recent statistics from the Ministry of Health also revealed that the total number of smokers in the country had reached 5.5 million, i.e., 23% of the population (*11*).

### *Initiatives*

Saudi Arabia has undertaken several initiatives to reduce tobacco use among its population since 2017. These include sales taxes and fines, anti-smoking campaigns, establishing smoking cessation clinics, introducing related mobile applications, among other initiatives.

### *Sales tax and fines*

A recent policy initiative has been the implementation of a sales tax (excise duty) on tobacco, introduced 11 June 2017, and saw 100% excise duty imposed on tobacco products in the country (*12*). As a result, the number of people seeking help from smoking cessation clinics increased by 213% (*13*), rising to 302% during 2018 (*14*). The government was also stringent with any commercial organizations violating the new anti-tobacco policies, with fines of up to 5000 Saudi riyals (US$ 1330) imposed (*15*). The implementation of the 100% excise duty on tobacco products also resulted in a significant decrease in tobacco imports to Saudi Arabia, dropping by 43.1% during 2017–2018, to 1.78 billion Saudi riyals (US$ 474 710 960). According to the Saudi Customs Authority, the country imported tobacco products worth 500 million Saudi riyals (US$ 133 345 775) during the first quarter of 2019 (*16*).

### *Anti-smoking awareness campaigns*

During the Islamic religious month of Ramadan in 2017, the Ministry of Health launched an anti-smoking drive that coincided with World No Tobacco Day (31 May), under the theme called "Help us – We will help you" (*3*). The awareness campaigns served to inform smokers on how to quit tobacco use and the help available, namely smoking cessation clinics opened across the country; training for service providers; and provision of free anti-smoking medication to citizens (*17*).

In 2019, the Ministry of Health started a campaign to monitor the spread of tobacco use among adult men and women in 12 800 households across the country, and undertaken by the Saudi government's General Authority for Statistics under the supervision of the World Health Organization (WHO). This survey initiative, which is being conducted for the first time in Saudi Arabia, is a unified international measure to assess the prevalence of tobacco use among adult men and women and the development of strategies to reduce tobacco consumption (*18*). However, the smoking prevention programs in the country need to reinforce non-smoking attitudes, address how to resist pressure to smoke, and how to develop high self-efficacy towards non-smoking in various situations (*19*).

### *Anti-smoking clinics*

Besides anti-smoking campaigns to increase the awareness among the population, the government has also fo-

**Table 1 Prevalence of tobacco use in Saudi Arabia**

| Prevalence (%) | Youth tobacco use | | Adult tobacco smoking | Youth smokeless use | Adult smokeless use |
|---|---|---|---|---|---|
| | Current tobacco use | Current cigarette smoking | Current | Current smokeless tobacco use | Current smokeless tobacco use |
| **Total** | **14.9** | **8.9** | **12.2** | **3.4** | **0.9** |

*Source: World Health Organization report on the global tobacco epidemic 2017, Country Profile: Saudi Arabia, p. 2.*

Table 2 **Selected list of studies on Smoking in Saudi Arabia**

| S.no. | Author (s) and year | Study |
|---|---|---|
| 1 | Almotairi, H. M. (2012) | Smoking in Saudi Arabia and its control measures |
| 2 | Al-Zalabani A, Kasim K. (2015) | Prevalence and predictors of adolescents' cigarette smoking in Madinah, Saudi Arabia: a school-based cross-sectional study |
| 3 | Mansour AY (2017) | Predictors of smoking among Saudi dental students in Jeddah. |
| 4 | Jradi H.(2017) | Awareness, practices, and barriers regarding smoking cessation treatment among physicians in Saudi Arabia |
| 5 | Algabbani AM, Almubark R, Althumiri N, Alqahtani A, BinDhim N (2018) | The Prevalence of Cigarette Smoking in Saudi Arabia in 2018 |
| 6 | Alrabah, M., Gamaleddin, I. & Allohidan, F (2018) | International Approaches to Tobacco-Use Cessation Programs and Policy for Adolescents and Young Adults in Saudi Arabia |
| 7 | Awan KH, Hussain QA, Khan S, Peeran SW, Hamam MK, Al Hadlaq E, Al Bagieh H.(2018) | Accomplishments and challenges in tobacco control endeavors–Report from the Gulf Cooperation Council countries. |
| 8 | Alotaibi SA, Alsuliman MA, Durgampudi PK. (2018) | Smoking Tobacco Prevalence Among College Students in the Kingdom of Saudi Arabia: Systematic Review and Meta-Analysis |
| 9 | Mohammed, M., Eggers, S. M., Alotaiby, F. F., de Vries, N., & de Vries, H. (2018) | Reasons and motivations for cigarette smoking and barriers against quitting among a sample of young people in Jeddah, Saudi Arabia |

cused on providing treatment services to people affected by smoking. The Ministry of Health has established anti-smoking clinics in different regions of the country. The aim of these clinics is to provide therapeutic and awareness services for the target smokers and non-smokers, highlighting anti-smoking regulations, providing counseling and health education, as well as reducing the overall percentage of smoking and passive smoking (17).

It was reported in 2017 that there were 160 anti-smoking clinics that provided free awareness services, medical consultations and therapeutic services to smokers of both genders in order to help them to quit smoking. It was noteworthy that anti-smoking clinics in health care centers and hospitals in Riyadh have received more than 7,000 patients since the beginning of 2017 (3). The people seeking help from clinics increased by 213 percent from July to September 2017. According to the head of the ministry's smoking cessation clinics, the taxes were the most effective way to help people, especially youths, who wanted to quit smoking (13). But, some of the reasons for not quitting smoking, like: a) lack of willpower, b) the other smokers around a person and c) stress at home/work are posing challenges to the nation's fight against tobacco use (20).

There was an increase in the number of anti-smoking clinics and the people visiting these clinics in 2018. The Ministry of Health has activated its 262 anti-smoking clinics and it found that the anti-smoking campaign launched by Ministry at the beginning of last Ramadan (2017) increased the number of visitors to anti-smoking clinics by 321 percent (17). However, the establishment of anti-smoking clinics has been continued in various parts of the nation and in 2019 reached a total of 542 (18). These clinics are run by trained medical staff to help people who want to quit their smoking habit by providing counseling and follow-up services as well as the free medication initiatives already mentioned above (14). However, the smoking cessation counseling and therapy provided by physicians can play an important role in helping smokers to quit smoking (21). The working hours of these clinics are from 9 p.m. to 12 a.m. and total capacity of the patients treated are 20 patients/per clinic. In addition to these measures, the website of the Ministry of Health displays anti-smoking clinics' locations on Google Map as well as the Anti-Smoking Clinics Directory for the public domain. People should be able to easily find the location of clinics and also can download clinics' dictionary as and when required (22). According to the Ministry of Health, the anti-smoking clinics have helped 11,441 smokers to give up smoking during the first half of 2019 (23).

## *Mobile app to catch violators of anti-smoking regulations*

mHealth, the use of mobile computing and communication technologies in health care and public health, is a rapidly expanding area of research and practice (24). Mobile technologies have the potential to bridge systemic gaps needed to improve access to, and use of, health services (25). The government of Saudi Arabia has taken the initiative to use the potential of mHealth in the battle against smoking. The Ministry of Health has launched a mobile application as a part of its anti-smoking drive in the Kingdom (17). This novel initiative is very helpful for reporting and monitoring the violations of anti-smoking regulations such as smoking in public places, selling tobacco to the children less than 18 years of age and advertising cigarette or shisha smoking on any local television channels. The mobile app is available for all and the violations can be informed to the concerned officials (15).

## *Other initiatives*

Apart from the above initiatives, the Ministry of Health has been publishing various health educational materials. They include books and pamphlets explaining the dangers of smoking, as well as providing free medicines to smokers who want to quit the habit (18). The Ministry has also developed a range of awareness-raising materials via films and publishing in the mass media and social media platforms (17). The influence of friends and parents smoking plays an important role in the increased risk of smoking in the adolescents (26). Factors such as gender and family influence were identified as the main pro-smoking risk factors, while at the same time an im-

proved knowledge of health risks was found to be a protective factor (*27*). Hence, the pro-smoking risk factors need to be given a greater priority and could be included in anti-smoking education programs targeting youth and adults of the country.

## Discussion

The Ministry of Health and the National Tobacco Control Committee have both been playing key roles in controlling the tobacco use with time to time policies and initiating novel programs. However, there is still a long way to go to achieve the desired results. The tobacco control initiatives of the government of Saudi Arabia are in line with the World Health Organization's MPOWER measures. As per the World Health Organization's 2017 report on the global tobacco epidemic, the total prevalence of tobacco use, as well as smokeless tobacco use, among youth were found to be greater than the adults in Saudi Arabia. Despite the robust efforts of tobacco control agencies in the Kingdom of Saudi Arabia to combat smoking, in a recent study (*28*), prevalence rates among youth were found to be around 12.1% with no indications of a decline. In a latest study, the meta-analysis results revealed that the pooled estimate of smoking prevalence among college students in the KSA was 17% (*29*). Moreover, another contemporary work on the prevalence of cigarette smoking in Saudi Arabia in 2018 found that the prevalence of cigarette smoking was 21.4% of the population (*30*). In the light of these findings, it can be argued that the prevalence of tobacco use is still high though the county has run several anti-smoking initiatives. This is an alarming situation facing the country's policy makers in which they need to reassess anti-smoking initiatives in order to take necessary actions to effectively control the tobacco use in the nation. The antismoking awareness programs can focus more on youth, without neglecting the adults.

The implementation of excise tax on tobacco products has been presenting positive results in the process of controlling tobacco use. In addition, it has become one of the reasons to quit smoking in the country. The anti-smoking clinics have been playing a crucial role in the fight against smoking in the country. The increase in the number of anti-smoking clinics, and the number of people using t he services provided by these clinics, shows a positive sign towards the control of tobacco use in the country. The introduction of a mobile app is one of the novel initiatives by the Ministry of Health and it is time to utilize this app in the battle against tobacco use by increasing people's participation.

The study, however, is subject to couple of limitations. The reader should bear in mind that the study is based on secondary data. It considers only the recent initiatives of tobacco control in the country.

## Conclusion

The present study has made an attempt to present the recent initiatives of the Saudi Arabian government to combat the use of tobacco. These initiatives include i) increased value-added tax on tobacco, ii) the launch of anti-smoking campaigns, iii) the establishment of anti-smoking clinics iv) introducing a mobile app and v) other initiatives. Although there are various initiatives undertaken by the Saudi Arabian government to reduce tobacco use, the study suggests that the government should evaluate the impact of these initiatives on tobacco control in the country.

**Funding:** None.

**Competing interests:** None declared.

## Lutte contre le tabagisme en Arabie saoudite : examen des initiatives récentes

### Résumé

**Contexte** : L'épidémie de tabagisme constitue l'un des défis majeurs de santé publique à l'échelle mondiale, avec plus de sept millions de décès par an, parmi lesquels environ 70 000 Saoudiens qui meurent chaque année de maladies liées au tabagisme.

**Objectifs** : Présenter les initiatives récentes du gouvernement saoudien en matière de lutte antitabac.

**Méthodes** : L'étude a passé en revue les sources de données secondaires, telles que les rapports publiés et les articles de journaux ainsi que les études de recherche parus dans différentes revues.

**Résultats** : Nous avons présenté les initiatives prises par le gouvernement saoudien entre juin 2017 et avril 2019 afin de lutter contre le tabagisme, notamment la mise en place d'une taxe sur la valeur ajoutée pour tabac, l'organisation de campagnes antitabac, l'ouverture de cliniques de sevrage tabagique et la création d'applications mobiles parmi d'autres initiatives.

**Conclusion** : L'étude propose que le gouvernement examine rigoureusement l'impact de ces initiatives sur la lutte antitabac dans le pays afin d'évaluer leur efficacité.

## مكافحة تعاطي التبغ في المملكة العربية السعودية: استعراض للمبادرات الأخيرة

رامايا إتومالا، بدر الضمادي


### الخلاصة

**الخلفية:** يعد تعاطي التبغ من أكبر التحديات أمام الصحة العامة العالمية، إذ يتسبب في وفاة ٧ ملايين شخص كل عام، من بينهم قرابة ٧٠ ألف مواطن سعودي ممن يلقون حتفهم بسبب أمراض تتعلق بالتدخين كل عام.

**الأهداف:** تهدف هذه الدراسة إلى عرض أحدث مبادرات حكومة المملكة العربية السعودية لمكافحة تعاطي التبغ داخل حدودها.

**طرق البحث:** استعرضت هذه الدراسة مصادر بيانات ثانوية، بما فيها تقارير منشورة، ومقالات صحفية، ودراسات بحثية منشورة في مجلات أكاديمية مختلفة. تم البحث في الأدبيات ذات الصلة المتعلقة بمكافحة التبغ في المملكة العربية السعودية من ثلاث قواعد بيانات علمية: PubMed و Scopus و Google Scholar من يناير إلى أبريل 2019.

**النتائج:** استعرضت الدراسة المبادرات التي اتخذتها حكومة المملكة العربية السعودية من يونيو/ حزيران 2017 إلى أبريل/ نيسان 2019 لمكافحة تعاطي التبغ، وتشمل فرض ضريبة المبيعات على التبغ، وحملات مكافحة التدخين، وعيادات مكافحة التدخين، وتطبيقات الهاتف من بين مبادرات أخرى.

**الاستنتاج:** يُقترح أن تُجري الحكومة تقييماً سليماً لأثر هذه المبادرات على مكافحة التبغ في البلد من أجل تقييم فاعليتها.


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# Twenty-first intercountry meeting for directors of poliovirus laboratories in the WHO Eastern Mediterranean Region[1]

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## Introduction

The twenty-first intercountry meeting for directors of poliovirus laboratories in the World Health Organization (WHO) Eastern Mediterranean Region was held by the WHO Regional Office for the Eastern Mediterranean in Muscat, Oman, on 22–24 January 2020 (1). The meeting was attended by directors of poliovirus laboratories in 12 countries, including: Egypt, Iraq, Islamic Republic of Iran, Jordan, Kuwait, Morocco, Oman, Pakistan, Saudi Arabia, Syrian Arab Republic, Sudan and Tunisia. Participants also included experts from: Centers for Disease Control and Prevention (CDC), United States of America; National Institute for Biological Standards and Control (NIBSC), United Kingdom; National Institute of Public Health and the Environment (RIVM), Netherlands; Kenya Medical Research Institute (KEMRI), Kenya; and the National Virology Laboratory, Zimbabwe. The meeting's secretariat included staff from WHO headquarters, Geneva, Switzerland, and the WHO Regional Office for the Eastern Mediterranean, Cairo, Egypt.

The specific objectives of the meeting were to:

- review the regional polio laboratory network performance;
- provide technical information on issues related to the global polio eradication initiative;
- discuss the role of poliovirus laboratories in the polio end-game strategy, Global Action Plan III (GAPIII) phase 1 activities and environmental surveillance; and
- develop recommendations for further improvement in laboratory performance.

The meeting was attended by over 45 regional and international experts, including officials from sister United Nations (UN) agencies, representatives of humanitarian organizations, development partners and donors, academics from Lebanon, Netherlands, Qatar, United Kingdom and United States of America, as well as senior WHO staff from the Regional Office for the Eastern Mediterranean, Cairo, Egypt, WHO headquarters, Geneva, Switzerland, and country offices in the Region.

## *Summary of discussions*

WHO global and regional polio laboratory coordinators gave presentations on the current state of the Global Polio Eradication Initiative (GPEI) and an overview of the performance, activities and challenges faced by the WHO Global Polio Laboratory Network (GPLN) and planned endgame strategies. They congratulated laboratory personnel on achieving the landmark certification of wild poliovirus type 3 (WPV3) eradication (2) and expressed appreciation for their commitment to eradicating wild poliovirus type 1. They noted that the increasing number of circulating vaccine-derived poliovirus type 2 (cVDPV2) outbreaks, since the switch from trivalent oral polio vaccine (tOPV) to bivalent oral polio vaccine (bOPV) in 2016, had led to a corresponding increase in GPLN workload.

They highlighted that the ongoing cVDPV2 outbreaks must be controlled by implementing the new strategies that are being developed. The achievements of polio laboratories in the Region, including the efficient and high quality work of laboratories for both acute flaccid paralysis (AFP) and environmental surveillance, and the establishment of new laboratories able to conduct intra-typic differentiation of polioviruses by real time polymerase chain reaction (RT-PCR) in Jordan and Morocco, were commended.

Key aspects of the regional network's laboratory quality assurance programme were discussed, with a focus on biosafety related to the handling of poliovirus. All 16 elements of the biorisk management system described in Annex 6 of the WHO global action plan (GAPIII) (3) will be assessed for all laboratories in the Region. Performance in the Region continues to be excellent, with laboratories providing high quality information on poliovirus isolation and characterization in a timely manner, which is essential for guiding GPEI activities. Laboratories in the Region are also actively engaged in supporting endgame activities such as pilot testing of improved laboratory methods.

## *Recommendations*

***To WHO***

- The Regional Coordinator, in collaboration with WHO headquarters, should work towards establishment of a laboratory surge hub to support laboratories in:
  - identifying and overcoming limitations affecting optimal performance, such as in logistics, resources and training;

[1] This report is based on the Summary Report on the Twenty-first intercountry meeting for directors of poliovirus laboratories in the WHO Eastern Mediterranean Region, 22–24 January 2020, Muscat, Oman (https://applications.emro.who.int/docs/WHOEMPOL441E-eng.pdf?ua=1&ua=1).

  - facilitating quick responses to increasing/changing testing demands; and
  - facilitating additional training for implementation of new methods and for refreshing purposes.
- collaborating with CDC on training of laboratories' staff on implementation of new direct detection assays; and
- ensuring that laboratories' staff are aware of use of novel OPV2 (nOPV2) strains.

***To Member States***

- The heads of laboratories, in collaboration with ministries of health and national authorities/stakeholders, should work with WHO to ensure the use of national resources to maintain the highest level of polio surveillance and respond to the increasing testing demands required for the completion of global polio eradication, including:
  - identifying alternative resources for sustaining laboratory functions at certification standards to address the potential reduction in GPEI resources; and
  - working with national vaccine preventable disease surveillance and health emergency teams to prioritize integration of existing polio assets in other relevant public health priority areas.
- ensuring that each laboratory completes a comprehensive contingency plan to address the challenges in outbreak or emergency settings placed on testing demand and submit the plan to the Regional Coordinator for review.
- ensuring that laboratory staff contribute to regular monitoring/review of all environmental surveillance sites for sensitivity, functionality and country relevance, using recommended WHO environmental surveillance laboratory performance indicators.

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