

Voluntary testing for COVID-19: perceptions and utilization among the inhabitants of Saudi Arabia

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ABSTRACT

Objectives: Voluntary testing (VT) plays a crucial role in the prevention and control of infectious diseases. The present study investigated the perceptions and utilization of VT services for coronavirus disease 2019 (COVID-19) among the inhabitants of Saudi Arabia.

Methods: In total, 3,510 adult participants from all provinces of Saudi Arabia were recruited via a national online survey.

Results: Of the 3,510 participants, 88.9% were aware of the testing services available to them and of those, more than half (59.5%) had used the VT services and 96.1% were satisfied with the services. Contact with a positive COVID-19 case was the top reason for accessing VT, while a lack of awareness about the availability of VT services was the top perceived limiting factor. A history of chronic health conditions, anxiety and/or depression, and previous symptoms suggestive of COVID-19 were found to be predictors of the utilization of VT services (odds ratio [OR] 1.55, 95% confidence interval [CI] 1.22–1.96; OR 1.48, 95% CI 1.16–1.88; and OR 3.31, 95% CI 2.77–3.95), respectively.

Conclusion: The awareness of voluntary COVID-19 testing services was satisfactory among the Saudi Arabian population, but can be improved. Sociodemographic and health history predictors of the utilization of VT services were identified.

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Introduction

The prevalence of coronavirus disease 2019 (COVID-19) has exceeded 250 million confirmed cases with more than 5 million deaths worldwide. By the end of March 2022, there were

>750,000 confirmed COVID-19 cases in the Kingdom of Saudi Arabia, 9,043 reported deaths, and >62 million vaccine doses administered [1].

Voluntary testing (VT) plays a pivotal role in the early detection and treatment of infectious diseases, especially those associated with stigma such as human immunodeficiency virus (HIV). Several VT models have been developed to reach individuals and family members through their providers or clinical health settings. In addition, VT has been made easy and accessible for individuals in their communities and homes by bringing VT information to people on their smartphones and by providing home-based testing [2,3]. To detect and contain COVID-19 cases within countries and regions, mass screening strategies have been developed and executed, with the details determined according to each area's risk assessment. Studies have found wide variation in the application of these strategies in several countries. Some mass testing programs were conducted to screen large percentages of the population daily, as in the United Kingdom (UK) and Iceland. In some countries, the extensive labor and material costs involved limited mass testing, whereas nations with small populations such as Estonia and Luxembourg had higher capacities for mass screening. Despite these challenges, efficient strategies were adopted in countries with large populations, such as Republic of Korea (ROK) and Singapore. For example, ROK implemented drive-through testing, walk-through testing, and mobile examinations. Aggressive testing campaigns with multiple available testing times were implemented in Singapore and Saudi Arabia [4].

The strategic healthcare objectives of the Kingdom of Saudi Arabia for the years 2018 to 2020, in line with the Vision 2030 National Transformation Program, were defined as facilitating and promoting the prevention of health risks, increasing access to care, and enhancing quality. Therefore, the National Health Information Centre created cohesive multi-sectoral electronic health (eHealth) services to enable the healthcare transformation. In response to the COVID-19 pandemic, community-wide preventive and clinical measures were implemented by the government of Saudi Arabia. Multiple online platforms and hotlines were launched to provide COVID-19 counseling services, including pre-existing and new digital health solutions such as *Sehhaty* ("My Health") and *Tetamman* ("Rest Assured"). Moreover, a GPS-enabled application named *Tawakkalna* was launched to reveal possible infections, in association with another application called *Tabaud* ("Distancing"), which alerts individuals to confirmed case contacts. The Ministry of Health call service "937" and free-of-charge COVID-19 testing have been made available to all [5]. Individuals can

easily access any of the services, including the 937 hotline, for information on COVID-19 or to book an appointment through the *Mawid* ("Appointment") service [6].

A study by Alanzi [7] reviewed the utilization of free mobile applications related to the COVID-19 outbreak in several countries, including Saudi Arabia, Italy, Singapore, the UK, the United States (US), and India and revealed that the purposes of these applications varied. Some were used to combat the spread of the virus rather than to provide health care services information to the population. Raising awareness, booking appointments, online consultations, and contact tracing were functions that were also facilitated by these applications, highlighting their importance in combating the outbreak [7].

Studies have shown that certain characteristics and predictors contributed to the utilization of COVID-19 testing services among the population. The main factors were age, sex, occupation (healthcare workers in particular), immunocompromised status, a history of chronic disease (i.e., pulmonary diseases, diabetes, congestive heart failure, liver or renal failure), a recent trip to a major metropolitan area, or contact with a laboratory-confirmed case of COVID-19 [8]. Considering the existence of various limiting factors, VT is likely to be the most effective strategy [9].

VT for COVID-19 was encouraged by the health authorities in Saudi Arabia through widely available health education channels. An accurate assessment of the population's perception and utilization of VT enables health policy decision-makers to take the actions needed to improve the outcomes of services provided in the battle against the COVID-19 pandemic. The present study investigated the perceptions and utilization of voluntary COVID-19 testing services among the adult population of Saudi Arabia and also identified the factors that hindered or favored the utilization of these services.

Materials and Methods

Study Design and Setting

A cross-sectional analysis was conducted using data collected from June 15, 2021 to July 31, 2021 on all inhabitants of Saudi Arabia. The total population of Saudi Arabia is approximately 34.8 million people.

Study Population and Sampling Method

All adult inhabitants of Saudi Arabia over age 18 years who agreed to participate were eligible for inclusion in the study. The convenience sampling method was adopted to recruit the study sample. Invitations, including the study questionnaire, were distributed on social media platforms and groups (WhatsApp, Facebook, and Twitter). The sample

size was calculated based on a total population of 34.8 million with an expected frequency of 50%, a 0.05 level of precision, and a confidence level of 99%. Although the required sample size was 666, the sample was expanded to 3,510 to minimize the potential bias attributed to the convenience sampling method.

Study Tool and Data Collection

The data were collected using a structured, pre-designed, and self-administered online questionnaire that was developed by the researchers. The questionnaire was bilingual (Arabic and English) in the languages most commonly used by the inhabitants of Saudi Arabia. The questionnaire was composed of 4 main sections: (1) Sociodemographic and health characteristics of the participants (e.g., age, sex, nationality, education level, marital status, daily activity pattern, history of chronic conditions, and COVID-19 vaccination status). (2) The participants' perceptions of VT services in Saudi Arabia as assessed by answers to questions covering his/her knowledge of these services, whether he/she had used these services, and whether he/she would recommend these services to others. (3) Reasons for using the VT services (more than one choice was allowed). (4) Reasons for not using the VT services (more than one choice was allowed).

A pilot study was conducted to test the questionnaire on 35 participants to determine the time needed to administer it and the clarity of the questions. The pilot study participants were excluded from the final study.

The questionnaire was then formulated into an electronic version in Google Forms and distributed via social media platforms (WhatsApp, Facebook, and Twitter). All subjects meeting the inclusion criteria were invited to participate.

Ethical Considerations

Ethical approval was obtained from the Scientific and Ethical Committee of Batterjee Medical College (RES-2021-0043, June 10, 2021). The respondents were informed about the nature and aim of the study. The provision of informed consent via the user interface was a mandatory prerequisite for completion of the questionnaire. Participants were able to withdraw from the study at any stage. Data were collected anonymously and confidentiality was assured.

Variables and Data Analysis

The collected data were transferred to an Excel sheet, checked for completeness, coded, and analyzed using IBM SPSS ver. 23.0 (IBM Corp., Armonk, NY, USA). Numeric variables were presented as mean \pm standard deviation, and categorical variables were presented as numbers and percentages. The participants' perceptions of the VT services in Saudi Arabia

were presented as "yes" or "no" answers. Reasons for using the VT services for COVID-19, as well as reasons that might limit the use of these services, were presented and ranked according to frequency. The binary logistic regression model was fit to the dependent (outcome) variable, namely using or not using the VT services for COVID-19, and to the other independent variables (predictors). The model was evaluated for the prediction and estimation of the outcome. For the predictors, if the *p*-value was <0.05 , and the 95% confidence interval (CI) did not include 1 for odds ratios (ORs), then this variable was statistically significant in the model and was deemed likely to predict the outcome.

Results

The present study included 3,510 participants from all provinces of Saudi Arabia with a mean age of 37.2 ± 9.4 years. Women represented 53.1% of the study sample, and 47.6% of the participants were married. Most study participants resided in a major city and 73.4% perceived their social level as moderate. Those with chronic health conditions represented 18.0% of the study group. More than three-fourths (76.1%) reported they had received a COVID-19 vaccination (Table 1).

Regarding the perception and utilization of COVID-19 VT services, it was shown that 88.9% of participants were aware of these services and 59.5% of the aware participants had used the VT services. The overwhelming majority of the participants (96.1%) were satisfied with the service and reported that they would recommend VT to others (Table 2).

Analysis of the reasons given for visiting a COVID-19 VT site showed that contact with a positive COVID-19 case, having symptoms suggestive of COVID-19, and fear of infecting intimate persons were the top 3 reasons, reported by 49.2%, 42.0%, and 37.4% of the participants, respectively.

The top reasons limiting the utilization of VT services were ranked in a descending pattern as follows: lack of awareness of the services, fear of pain during the test procedure, and fear of the health consequences if the test is positive. These reasons were reported by 49.6%, 40.4%, and 38.3% of the participants, respectively (Table 3).

Logistic regression analysis of the predictors of VT service utilization showed that women and residents of villages were less likely to utilize the VT services than men and residents of major cities (odds ratio [OR] 0.82, 95% confidence interval [CI] 0.69–0.97; and OR 0.73, 95% CI 0.60–0.91; respectively). In addition, participants with higher education levels and those with high daily social activity levels were more likely to use VT services than participants with lower education levels and low social activity levels

Table 1. Sociodemographic and health characteristics of study participants ($n = 3,510$)

Characteristic	Value
Age (y)	37.2 ± 9.4
Sex	
Male	1,645 (46.9)
Female	1,865 (53.1)
Residence	
Major city	2,945 (83.9)
Village	565 (16.1)
Nationality	
Saudi	2,817 (80.3)
Non-Saudi	693 (19.7)
Marital status	
Married	1,672 (47.6)
Unmarried	1,838 (52.4)
Perceived social level	
High	273 (7.8)
Moderate	2,576 (73.4)
Low	661 (18.8)
Accommodation	
With family or housemates	3,266 (93.0)
Alone	244 (7.0)
Education level	
High school and lower	1,168 (33.3)
College degree and higher	2,342 (66.7)
Usual daily activity	
High social engagement	1,870 (53.3)
Low social engagement	1,640 (46.7)
Chronic health condition	
Yes	632 (18.0)
No	2,878 (82.0)
History of anxiety and/or depression	
Yes	485 (13.8)
No	3,025 (86.2)
Previous symptoms suggestive of COVID-19	
Yes	1,125 (32.1)
No	2,385 (67.9)
Received COVID-19 vaccine	
Yes	2,670 (76.1)
No	840 (23.9)

Data are presented as mean ± standard deviation or n (%).
COVID-19, coronavirus disease 2019.

Table 2. Perception and utilization of VT services for COVID-19 among inhabitants of Saudi Arabia during the COVID-19 pandemic ($n = 3,510$)

Variable	Yes	No
Awareness of the VT services ($n = 3,510$)	3,120 (88.9)	390 (11.1)
Used the VT service ($n = 3,120$)	1,855 (59.5)	1,265 (40.5)
Will recommend these services to others ($n = 1,855$)	1,783 (96.1)	72 (3.9)

Data are presented as n (%).

VT, voluntary testing; COVID-19, coronavirus disease 2019.

(OR 1.22, 95% CI 1.03–1.45; and OR 1.36, 95% CI 1.16–1.59; respectively). A history of chronic disease, anxiety and/or depression, previous symptoms suggestive of COVID-19, and receiving the COVID-19 vaccine were found to be predictors of the utilization of VT services (OR 1.55, 95% CI 1.22–1.96; OR 1.48, 95% CI 1.16–1.88; OR 3.31, 95% CI 2.77–3.95; and OR 1.62, 95% CI 1.34–1.96; respectively) (Table 4).

Discussion

VT plays a crucial role in the prevention and control of infectious diseases. Therefore, it is essential to understand the numerous limiting and motivating factors for the utilization of VT. This study assessed the perception and utilization of COVID-19 VT services among the inhabitants of Saudi Arabia.

The current study showed that most participants were aware of the availability of COVID-19 VT services. This awareness was attributed to the rapid implementation of mass health education campaigns and the availability of free VT in Saudi Arabia from the start of the pandemic [5]. This high level of awareness was compatible with a study in the US which reported a high level of engagement in various testing modalities for COVID-19 [10].

More than half of the study participants who were aware of VT services stated that they used them. These results agree with a study conducted in Saudi Arabia on mass screening that found most of the study sample had used the testing services that were made available in Saudi Arabia, whether as part of mass screening or because of contact with a COVID-19 positive case [4]. Reasons for not using VT services were attributed to the absence of suggestive symptoms, symptoms similar to other infections, and the stigma of testing positive for COVID-19 [11].

Our study showed a significantly high satisfaction rate with the VT services, which reflects the quality of the service provided. Another study conducted in Saudi Arabia to assess the satisfaction level of the population with virtual clinics found an overall satisfaction rate of 68.1%. A minority of the study sample reported interest in utilizing VT and virtual clinics

Table 3. Reasons that hinder or favor visits to the COVID-19 VT service sites during the COVID-19 pandemic among inhabitants of Saudi Arabia

Rank	Participants' perception	n (%)
Reasons for visiting COVID-19 VT service sites (n = 1,855) ^{a)}		
1	I had contact with a positive COVID-19 case	912 (49.2)
2	I had symptoms that made me concerned about my COVID-19 status	780 (42.0)
3	Fear of infecting intimate persons	694 (37.4)
4	For self-assurance before travel	377 (20.3)
5	I was advised by a friend or a family member	346 (18.7)
6	Others	95 (5.1)
Reasons that may limit use of COVID-19 VT services (n = 3,120) ^{a)}		
1	Lack of awareness	1,547 (49.6)
2	Fear of pain during the test procedure	1,260 (40.4)
3	Fear of the health consequences if I test positive	1,195 (38.3)
4	Probability of getting the infection	1,024 (32.8)
5	Expected long waiting time	906 (29.0)
6	Difficult accessibility	661 (21.2)
7	Social restrictions if positive	653 (20.9)
8	Social stigma of being positive	593 (19.0)
9	Cultural beliefs	530 (17.0)
10	Cost	332 (10.6)
11	Others	50 (1.6)

COVID-19, coronavirus disease 2019; VT, voluntary testing.

^{a)}More than 1 choice was allowed.

for travel purposes [12]. This finding is consistent with the international risk classification of the in-flight transmission of severe acute respiratory syndrome coronavirus 2 [13].

The top motivating reasons for utilization of VT services were: contact with a positive COVID-19 case, presence of symptoms suggestive of COVID-19, and fear of infecting intimate people. As a motivating reason, fear of infecting intimate people is consistent with a recent study conducted in the Western Region of Saudi Arabia that revealed higher levels of fear of COVID-19 among those living with families and flat-mates compared to those who lived alone [14].

The present study showed that lack of awareness was the most common limiting reason for not using COVID-19 VT services, similar to another study in Nigeria that revealed that many students did not utilize VT for HIV, despite fear of infection, because they were unaware of the services [15]. Our study also showed fear of pain during the test procedure was a major concern that prevented participants from using the VT services. This was supported by another study in the US that showed that the nasal swab method was too painful for some participants, who described it as invasive and refused it. Responses included “I don’t want a stick rammed up my nose,” and “I would drive further to get tested another way that was not the nose swab.” Overall, participants suggested that a more comfortable or gentle testing method would convince more people to get tested [16].

In the current study, expected long waiting times for test results were one reason that hindered people from taking the test. This result agrees with a study in the US that found that the time frame for results was important to participants [16]. In addition, our study showed that fear of the health consequences if the test is positive was a barrier to utilizing VT services. The consequences of testing positive have been classified into 3 major categories: physiological, cognitive, and behavioral [17].

The current study also revealed that the probability of getting infected while being tested was a concern for some participants. This could be explained by the prevalent fear and feelings of being unsafe at the start of the pandemic. These fears could be overcome by the implementation of standard environmental hygiene and using personal protective equipment for infection prevention and control at testing sites [18].

The present study showed that age was not a predicting factor for the utilization of VT services, unlike a study in the US that revealed significant differences in the utilization of COVID-19 testing based on age. Furthermore, our study demonstrated that men used VT services more than women. This could be explained by the fact that men are more involved in society outside the home, bringing them in contact with people and making them more likely to worry about the probability of infection. This was similar to a study

Table 4. Logistic regression analysis of the predictors of VT service utilization among inhabitants of Saudi Arabia during the COVID-19 pandemic

Variable	COR	95% CI	p-value	AOR	95% CI	p-value
Age (y)	1.01	0.99–1.01	0.82	0.99	0.98–1.00	0.06
Sex						
Male (ref.)	1			1		
Female	0.7	0.60–0.81	<0.001*	0.82	0.69–0.97	0.019*
Residence						
Major city (ref.)	1			1		
Village	0.8	0.66–0.97	0.021*	0.73	0.60–0.91	0.004*
Nationality						
Saudi Arabia (ref.)	1			1		
Non-Saudi Arabia	1.27	0.99–1.62	0.06	1.11	0.86–1.44	0.432
Marital status						
Married (ref.)	1			1		
Unmarried	0.98	0.85–1.13	0.728	1.11	0.86–1.44	0.432
Perceived social level						
High	0.89	0.65–1.21	0.449	0.95	0.67–1.34	0.762
Moderate	0.84	0.64–1.11	0.225	1.02	0.75–1.39	0.886
Low (ref.)	1			1		
Living accommodation						
With family or housemates	0.71	0.53–0.96	0.028*	0.89	0.64–1.24	0.490
Alone (ref.)	1			1		
Education level						
High school and lower (ref.)	1			1		
College degree and higher	1.25	1.07–1.45	0.004*	1.22	1.03–1.45	0.019*
Usual daily activity						
High social engagement	1.57	1.36–1.82	<0.001*	1.36	1.16–1.59	<0.001*
Low social engagement (ref.)	1			1		
Chronic health condition						
Yes	1.77	1.45–2.16	<0.001*	1.55	1.22–1.96	<0.001*
No (ref.)	1			1		
History of anxiety and/or depression						
Yes	1.88	1.50–2.35	<0.001*	1.48	1.16–1.88	0.001*
No (ref.)	1			1		
Previous symptoms suggestive of COVID-19						
Yes	3.45	2.91–4.09	<0.001*	3.31	2.77–3.95	<0.001*
No (ref.)	1			1		
Received COVID-19 vaccine						
Yes	1.59	1.33–1.88	<0.001*	1.62	1.34–1.96	<0.001*
No (ref.)	1			1		

VT, voluntary testing; COVID-19, coronavirus disease 2019; COR, crude odds ratio; CI, confidence interval; AOR, adjusted odds ratio; ref., reference category. * $p < 0.05$.

in the US that showed a predominance of male participants in testing for COVID-19 over females [9].

Study participants who lived in a major city used the VT services more than those who lived in a village. This could be explained by the availability of multiple VT centers in major cities compared to villages. Nationality was not a predictive factor of VT for COVID-19, as the service was available and free of charge for all inhabitants of Saudi

Arabia. Marital status, living accommodations, and perceived social levels were not found to be predictors of VT service utilization in Saudi Arabia, whereas a study conducted in Ethiopia on voluntary counseling and testing for HIV showed that women who were ever married were significantly more likely to be tested for HIV than those who were never married [19]. No differences were found between social levels in the utilization of VT services, as it was free and

available for all inhabitants.

The present study demonstrated that the rate of utilizing VT services for COVID-19 was higher among participants with higher education levels compared to participants with lower education levels. This finding agreed with another study conducted in England on mass testing of asymptomatic students for COVID-19 [20]. In participants with lower levels of education, this lower utilization of testing can be attributed to a lack of knowledge about the importance of testing and a perceived low risk of COVID-19 infection. In addition, some individuals were reluctant to acknowledge that they were even at risk and demonstrated behaviors at odds with professional perspectives, such as doubting the existence of the COVID-19 pandemic and denying its dangers. As a result, these individuals failed to adopt protective behaviors including testing. The same finding was also reported in a study conducted in Ethiopia about the utilization of voluntary HIV counseling and testing services [21].

In the current study, participants with high levels of daily social engagement were more likely to use VT services. Thunstrom et al. [9] also reported high rates of testing in people who had a higher chance of spreading the infection unintentionally (super-spreaders) such as people with jobs that require social interactions or extroverts with higher social activity levels. This was likely due to concerns that they could infect their family members or others at higher risk for developing serious illness from COVID-19.

Furthermore, people with chronic health conditions were more likely to use COVID-19 VT services. This is explained by the fact that people with chronic diseases such as chronic respiratory conditions, heart disease, diabetes, and obesity have a higher risk for developing severe health consequences if infected with COVID-19 [9]; therefore, concerns about their health lead to higher utilization of VT services.

This study found that having experienced symptoms suggestive of COVID-19 was a strong predictor of the utilization of VT services. A similar study in the US, using web and mobile applications to collect survey responses on health, found that respondents who reported common symptoms suggestive of COVID-19 (per the Centers for Disease Control: fever, cough, and loss of taste/smell) were more likely to be tested than asymptomatic respondents or those with less-common symptoms such as tightness in the chest [22]. This suggests that only symptomatic individuals in the US met screening criteria for determining who received a test, potentially missing asymptomatic and mildly symptomatic individuals at high risk for infection but not eligible for testing. This could lead to unfavorable consequences. This is supported by a study conducted in

the 4 regions of Northern Italy, in which 3 regions tested only symptomatic patients who needed hospitalization. A significant increase in the mortality rate was noted in contrast to the fourth region, which applied an extensive VT strategy, resulting in a lower mortality rate and reduction in unfavorable consequences [23].

People with a history of stress and depression in our study were more likely to use the COVID-19 VT services. This might be explained by high levels of health preoccupation in this group. This result is supported by a study from Haderlein et al. [24] on the association of post-traumatic stress disorder (PTSD) with COVID-19 testing and infection in US veterans seen in Veterans Health Administration services. The study reported that veterans with PTSD were more likely to test for COVID-19, indicating increased COVID-19 health concerns and hypervigilance.

The current study found that people who received COVID-19 vaccines were more likely to use VT services. This could be because people who perceived COVID-19 as a threatening disease were more likely to accept vaccines and protective measures such as handwashing, social distancing, frequent testing, and medical counseling [25]. This is supported by a study conducted in the UK stating that the possible reasons people refused the vaccine were mistrust, misinformation, and wrong beliefs about government institutions and health services, including testing and counseling. Additionally, some may question the existence of the COVID-19 pandemic, deny its dangers, and fail to adopt protective behaviors such as COVID-19 testing and counseling [26].

Strength and Limitation

To our knowledge, the current study is one of the few research projects assessing the VT services for COVID-19 in Saudi Arabia. Investigation of the predictors of VT service utilization is a strong point in this study. However, other aspects of this study may limit generalization of the results; for instance, only people with access to the internet could participate, and the results were based on a self-response survey from participants recruited through the convenience sampling technique. These limitations were minimized by including participants from all provinces of Saudi Arabia and by enlarging the sample size.

Conclusion

Awareness of the services available for voluntary COVID-19 testing was satisfactory among the population of Saudi Arabia, but improvement is still needed. Satisfaction with the services provided was notably high. The main motivating

factor for VT was contact with a confirmed case of COVID-19. The main limiting factors for VT were lack of awareness about service availability and fear of pain during the testing procedure. The main predictors of VT service utilization among the inhabitants of Saudi Arabia were: male sex, residence in a major city, higher education level, high daily levels of social engagement, chronic health conditions, a positive history of anxiety/depression, symptoms suggestive of COVID-19, and having received the COVID-19 vaccine. Further health education campaigns are recommended to improve the utilization of VT services, especially among hesitant users, and to enhance early case detection and proper containment of infection.

Notes

Ethics Approval

This study was approved by the Institutional Review Board of Batterjee Medical College (No. RES-2021-0043) and performed in accordance with the principles of the Declaration of Helsinki. Written informed consent was obtained for publication of this study.

Conflicts of Interest

The authors have no conflicts of interest to declare.

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Availability of Data

The datasets are not publicly available but are available from the corresponding author upon reasonable request.

Authors' Contributions

Conceptualization: EAAA; Data curation: EAAA, AM, SA; Formal analysis: EAAA; Investigation: all authors; Methodology: EAAA, RH, SM; Project administration: EAAA; Software: EAAA, MO; Supervision: EAAA; Validation: EAAA, AA; Visualization: EAAA; Writing-original draft: all authors; Writing-review & editing: all authors.

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