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Short Communication

Integrated Management of Biological Risks During the COVID-19 Pandemic in Morocco

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Abstract

The present study assesses adherence to COVID-19 prevention measures during the lockdown in Morocco and analyzes the country's multisectoral response to the pandemic within a biological risk assessment framework. A cross-sectional online questionnaire was administered to assess demographic characteristics, knowledge about COVID-19, perceptions of transmission modes, and adherence to precautionary behaviors. The results highlight that, in the absence of specific treatment at the beginning of the epidemic, strict adherence to preventative measures remained the most effective way to protect individuals and communities. Beyond individual behaviors, the article examines Morocco's national response framework, structured around three interdependent pillars: health, economy, and social order. Overall, Morocco's experience highlights the crucial role of proactive planning, digital innovation, and intersectoral coordination in strengthening health resilience and preparedness for future biological threats.

Keywords: COVID-19, Prevention measures, Health resilience

Introduction

The emergence of COVID-19 represents a major threat to global public health and has profoundly challenged health systems worldwide [1,2]. Like many countries, Morocco implemented a series of restrictive measures to enforce the state of public health emergency and limit the spread of COVID-19. These measures included restrictions on freedom of movement, suspension of educational activities, and border closures, aiming to protect vulnerable groups such as older adults and individuals with chronic diseases [3]. The first confirmed COVID-19 case in Morocco was reported on 2 March 2020. Ten days later, land, air, and maritime borders were closed, and on 16 March 2020, in-person teaching was suspended in all educational institutions. The state of public health emergency was officially declared on 20 March 2020. From a public health perspective, the most effective preventive strategy consists of reducing exposure to the virus [4,5]. Key measures include wearing face masks, practicing respiratory hygiene, frequent handwashing or hand disinfection, avoiding contact with infected individuals, maintaining physical distancing, and avoiding touching the eyes, nose, and mouth with unclean hands [6,7] The effectiveness of these measures largely depends on public adherence, making individual responsibility and risk perception central determinants of epidemic control [8,9]. This study contributes to the assessment of biological risks by evaluating the degree of population adherence to preventive behaviors and examining the preventive measures implemented by Moroccan authorities during the lockdown period. The objective is to draw lessons that can inform future prepared-

ness strategies and strengthen societal resilience in anticipation of potential emerging epidemics.

Material and Methods

To achieve our objective, an online questionnaire was developed, including questions on several topics: demographic data (sex, age, region, level of education, etc.), knowledge about COVID-19, modes of transmission, preventive measures such as avoiding sharing utensils and meals, covering the mouth with a tissue when coughing or sneezing, handwashing with liquid soap, washing hands immediately after coughing, sneezing, or blowing the nose, and washing hands after touching potentially contaminated objects (door handles, elevator buttons, or ticket counters). The use of masks was also addressed. The average estimated completion time for the questionnaire was 3 minutes.

The questionnaire was distributed via social media. Data collection began three weeks after the start of the lockdown and lasted for two weeks, from April 10 to April 24. The study objective was explained at the beginning of the questionnaire, and all responses were anonymous. Responses from participants under 20 years of age were excluded from the analysis.

Results

Evaluation of Compliance with Preventive Measures against COVID-19

This study is based on a rapidly disseminated online survey de-signed to assess adherence of the Moroccan adult population to preventive measures against Covid-19. This methodological approach is particularly suitable for real-time monitoring of citizens' knowledge and behaviors in the context of rapidly evolving infectious outbreaks [10,11]. A total of 350 participants were included in the analysis. The study population consisted predominantly of men (70%), corresponding to a male-to-female ratio of 2. The 20–30 age group accounted for 50% of the sample, and 38% of respondents were students. The Rabat-Salé-Kénitra region recorded the highest participation, with 60% of responses. Regarding preventive measures against SARS-CoV-2, 44% of participants identified mask-wearing, isolation, lockdown, hand hygiene using hydro alcoholic solutions, and handwashing with soap as the most effective measures. Sex-stratified distributions of Responses to questions are presented in (Table 1).

Table 1: Responses to questions by gender of participants.

Nbr		Female		Male		Total	
		%	Nbr	%	Nbr	%	
a. **Did you cover your mouth with your bare hands when you sneezed or coughed?**	Most of the time	19	17.8	38	15.8	57	16.4
	Not at all	35	32.7	63	26.1	98	28.2
	Sometimes	39	36.4	81	33.6	120	34.5
	Always	14	13.1	59	24.5	73	21
	Nbr Total	107	100	241	100	348	100
	Total %	30.7		69.3		100	
b.Have you used soap or liquid	Most of the time	5	4.7	21	8.7	26	7.5
	Not at all	2	1.9	5	2.1	7	2
	Sometimes	100	93.5	215	89.2	315	90.5
	Nbr Total	107	100	241	100	348	100
	Total %	30.7		69.3		100	
c. Did you wear a face mask in the last three days?	Most of the time	10	9.5	41	17	51	14.7
	Not at all	33	31.4	31	12.9	64	18.5
	Sometimes	7	6.7	23	9.5	30	8.7
	Always	55	52.4	146	60.6	201	58.1
	Nbr Total	105	100	241	100	346	100
	Total %	30.3		69.7		100	
d. **Have you used service utensils (baguettes or spoons) to share food when you have joined others in the last three days**	Most of the time	6	5.7	30	12.6	36	10.5
	Not at all	56	53.3	142	59.7	198	57.7
	Sometimes	24	22.9	37	15.5	61	17.8
	Always	19	18.1	29	12.2	48	14
	Nbr Total	105	100	238	100	343	100
	Total %	30.6		68.8		100	

e. **In the last three days, when you have touched objects that may be wearing coronavirus, have you taken any preventive measures using silk**	Most of the time	16	15.2	40	16.7	56	16.3
	Not at all	10	9.5	15	6.3	25	7.3
	Sometimes	11	10.5	32	13.4	43	12.5
	Always	68	64.8	152	63.6	220	64
	Nbr Total	105	100	239	100	344	100
	Total %	30.5		69.5		100	
f. **In the last three days, after touching objects that could carry the Covid-19, have you washed your hands as**	Most of the time	8	9.6	20	11.2	28	10.7
	Not at all	8	9.6	19	10.6	27	10.3
	Sometimes	1	1.2	7	3.9	8	3.1
	Always	66	79.5	133	74.3	199	76
	Nbr Total	83	100	179	100	262	100
	Total %	31.7		68.3		100	
g. **Are you satisfied with the preventiv e measures taken by the health authoritie**	Unsatisfied	0	0	8	3.3	8	2.3
	Moderately satisfied	35	32.7	81	33.8	116	33.4
	Satisfied	72	67.3	151	62.9	223	64.3
	Nbr Total	107	100	240	100	347	100
	Total %	30.8		69.2	28.8	100	

With respect to respiratory etiquette, 13% of women versus 25% of men reported covering their mouth with their hands when coughing, whereas 33% of women and 26% of men responded "not at all." Hygiene practices were generally satisfactory: 93% of women and 90% of men reported recent handwashing with soap or liquid cleanser. Mask-wearing was relatively well adopted, with more than half of the participants reporting systematic use. However, the sharing of eating utensils persisted among 18% of women and 12% of men. Additionally, more than two-thirds of participants continued to use tissue paper after exposure to potentially contaminated objects, and three-quarters reported washing their hands rapidly afterwards.

More than 60% of respondents of both sexes reported being satisfied with the preventive measures implemented by health authorities. Current knowledge on SARS-CoV-2 transmission partly builds on data accumulated during the 2003 SARS-CoV outbreak [12]. The primary modes of transmission include respiratory droplets, direct contact, and potential orofecal transmission which justify recommendations for physical distancing (≥1 m) and mask use. On 7 April 2020, Morocco made mask-wearing mandatory for any exceptional travel, while ensuring the availability of subsidized masks, with national production reaching 100 million units [13]. Three days after this measure, 31% of women and 13% of men reported not wearing a mask, highlighting the need to strengthen communication and awareness-raising actions.

Overall, more than 90% of participants reported regularly washing their hands with soap. Two-thirds used tissue paper after exposure to potentially contaminated surfaces, and three-quarters then washed their hands promptly. In total, 64% expressed satisfaction with the sanitary measures, while 2.5% re-ported dissatisfaction. The epidemiological situation in Morocco remained relatively controlled due to the implementation of the National Covid-19 Surveillance and Response Plan, aimed at early case identification, transmission limitation, and the organization of an adapted health response (WHO, 2020). Since the WHO declaration of a pandemic [14] human-to-human transmission of SARS-CoV-2 has been confirmed. As of 10 April 2020, more than 85,054 cases had been reported worldwide (case-fatality rate 8.55%), including 1,448 in Morocco (case-fatality rate 7.38%) [15]. To reduce viral spread, Moroccan authorities deployed a series of strict sanitary measures. Barrier gestures remain essential for reducing infection risk, as emphasized by the French Society of Emergency Medicine.

Public Order Maintenance and Crisis Governance

Morocco's response to the COVID-19 crisis was based on a robust legal framework that legitimized travel restrictions and strengthened public confidence. The coordinated action of local authorities, health services, and security forces enabled effective public order management, combining health measures, travel controls, and the implementation of emergency measures. The Royal Armed Forces played a key role in logistics and crisis management. The country's decentralized administrative structure facilitated the rapid implementation of health measures, effective communication, and support for the population. Early border closures, nationwide disinfection campaigns, the distribution of masks, and targeted assistance to vulnerable groups contributed to epidemiological control, supported by international cooperation and strategic partnerships for the supply of essential medical equipment.

Health Response

Faced with limited hospital capacity and uneven territorial coverage, Moroccan authorities adopted a preventive strategy centered around command centers, school closures, a ban on gather-

ings, expanded testing, and a dedicated special fund. The response included deploying military field hospitals, acquiring strategic medical equipment, and producing ventilators and masks locally. Testing capacity was increased through new laboratory platforms, while care pathways were reorganized and provided free of charge, including hotel isolation. Extensive mobilization of civil society bolstered logistical and technological support. National coordination was ensured by an inter-ministerial committee, with the Ministry of Health maintaining continuous public communication through daily updates, multilingual campaigns, digital tools, and training aligned with scientific recommendations [16-22].

Economic Response

The economic analysis by the High Commission for Planning predicted a sharp decline in external demand, exports, and domestic consumption, leading to a contraction in GDP in the second quarter of 2020. International organizations warned of the risks of recession and the strains on macroeconomic stability. In response, Morocco mobilized a Solidarity Fund to strengthen health infra-structure, preserve employment, support vulnerable households, and stabilize the economy. Complementary fiscal, monetary, and social measures, including loan repayment deferrals, liquidity support, cash transfers, and targeted sectoral aid, were implemented to mitigate internal and external shocks and avert a deep recession.

Conclusion

The effectiveness of public health policies depends on their outcomes and the priority given to the well-being of the population. In the absence of a specific treatment for COVID-19, containment measures and strict adherence to preventative measures remain the most effective means of protection. Morocco's response to the pandemic demonstrated the value of a coordinated and centralized approach to health resilience, while also revealing structural weaknesses such as limited hospital capacity, territorial disparities in access to care, and inadequate health data systems. Strengthening health resilience therefore requires sustained investment in surveillance, crisis preparedness, digital innovation, social protection, and enhanced coordination at the local, national, and international levels.

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Conflict of Interest

None.

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