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Precautionary health behavior in MENA: Risk perception, mental health, and neighborhood effects

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Abstract

With no immediate treatment, non-pharmaceutical interventions are critical to contain disease outbreaks. But the enactment of public health preventive measures does not necessarily imply compliance. This study examines what determines the uptake of precautionary health behavior in the Middle East and North Africa (MENA) in the context of COVID-19. Using a unique *panel* survey of four MENA countries for November 2020–June 2021, we estimate the effects of disease risk perception, mental health, and neighborhood compliance, among other factors, on the adoption of precautionary behaviors. Our estimates show that those very worried about being infected with COVID-19 were about 8 percentage points (ppts), 7 ppts, and 11 ppts more likely to maintain physical distance, wear a mask, and wash their hands with soap more often, respectively. Those who did not feel cheerful or in good spirits at any time were 2 ppts less likely to maintain physical distance and to wash their hands with soap. Neighborhood effects were significant but of smaller magnitude. The effect of risk perception is most significant in Tunisia and Jordan, and that of mental health is most significant in Morocco and Egypt. Our findings call upon MENA governments to tailor their public health policies and communication for a strong effect on behavior change and adherence during disease outbreaks, helping contain their spread.

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Keywords: Risk perception; mental health; neighborhood effect; precautionary health behavior, COVID-19; MENA.

1. Introduction and background

In the absence of immediate pandemic treatments, non-pharmaceutical interventions imposing social distancing are key mechanisms adopted by governments to contain disease outbreaks, epidemics, and pandemics (Anderson et al., 2020). Physical distancing, wearing a mask, and cleaning hands are the most cost-effective precautions. More than 120 countries worldwide mandated the wearing of face masks in public to contain the first wave of COVID-19. Among these countries in the Middle East and North Africa (MENA) region are Egypt, Jordan, Morocco, and Tunisia.

However, enactment of public policies does not necessarily imply compliance. This hypothesis is more evident if the public measures are health ones (Nivette et al., 2021). While governments are using various tactics, such as fines, to enforce favorable measures, individual rather than government action is what counts in the battle against pandemics. Hence, there is a persistent need to rigorously explain why, during a pandemic, individuals do not consistently engage in precautionary health practices (also referred to as "preventive health practices").

The aim of this study is to examine the determinants of precautionary health behavior in the MENA region, with a special focus on the role of disease risk perception, mental health status, and neighborhood compliance. We estimate the effects on the uptake of three preventive health measures across 17,657 households in four MENA countries (Egypt, Jordan, Morocco, and Tunisia) between November 2020 and July 2021. Our analysis is performed within a holistic framework that identifies which determinants increase the risk of non-compliance and how it has evolved during the course of the pandemic.

We explore three research questions. First, what is the estimated effect of individual perception of COVID-19 disease risk, mental health status, and public adherence on the individual uptake of different COVID-19 precautionary health behaviors in MENA? Second, which determinants significantly contributed to the prediction of non-compliance with preventive health measures toward COVID-19 in MENA? Third, how did COVID-19 risk perception and associated precautionary behavior among individuals in MENA evolve during the pandemic? And what determined the evolution?

One of the key determinants of the types of behavior individuals adopt is risk perception. *Risk perception* is a main component of theories of behavior change and is a core feature of the health belief model (Rosenstock, 1974), the protection motivation theory (Rogers, 1975), and the precaution adaption process model (Weinstein, 1987). These theoretical models are used to

explain precautionary health behaviors (for an overview, see Van der Plight (1996)). Empirical literature indicates that risk perception is a subjective psychological construct that varies by cognitive, emotional, social, cultural, and individual characteristics between populations (e.g., Leiserowitz, 2006; Joffe, 2003; Sjoberg, 2002; Loewenstein et al., 2001).

The association between risk perception and precautionary health behavior during pandemics is well attested for developed countries. Bish and Michie (2010) and Leppin and Aro (2009) provided a meta-analysis of the factors influencing precautionary behavior during pandemics and concluded that perceived susceptibility to and severity of a disease and believing in the effectiveness of precautionary measures increased their implementation. A low-to-moderate risk perception related to the 2009 H1N1 influenza pandemic together with a lack of concern were reported in various developed countries based on surveys conducted in these countries. Examples include Italy (Ferrante et al., 2011), The Netherlands (Bults et al., 2011), and the United States (SteelFisher et al., 2010). However, the population perception about the risk of catching H1N1 was associated with multiple precautionary behaviors in the United Kingdom (Rudisill, 2013). In the context of SARS, the population with high-risk perception in The Netherlands adopted the recommended precautionary behaviors in the face of the pandemic (Brug et al., 2004).

Risk perception has been studied in some disciplines, such as environmental risk, but far less is known about how the public perceives the risk associated with disease outbreaks (De Zwart et al., 2009). Moreover, the empirical evidence on this association in developing countries in the times of health crises is scant. To date, no evidence exists for the MENA region.

There is also no evidence for MENA on how individual mental health status and neighborhood compliance with preventive health measures affect engaging in precautionary health behavior either in the COVID-19 context or before the pandemic (for example, from the Avian Influenza (H5N1) or from the acute respiratory syndrome (SARS), both of which hit some countries in the region).

The *mental health* consequences of COVID-19 and social distancing have been widely studied. The pandemic is associated with substantial increases in anxiety and depression, substance use, loneliness, and domestic violence (Galea et al., 2020), but only mild psychological impact is reported for MENA (Al Dhaheri et al., 2021). The opposite direction of the relationship has rarely been examined and the evidence is mixed. Some studies show that anhedonic depression symptoms during COVID-19 had a negative indirect effect on precautionary behavior through

general health behaviors (e.g., Frías-Armenta et al., 2021). Some studies indicated the negative effect of anxiety in addition to depression (e.g., Stickley et al., 2020). On the contrary, there is evidence that individuals with clinically significant mental health problems might practice preventive measures to COVID-19 to a greater and longer extent than those without (Lee et al., 2021).

There is a growing body of literature on *peer/neighborhood effects* or, broadly, social norms and health behaviors (El-Shal & Moustafa, 2021). Evidence is limited, however, in the context of disease outbreaks and COVID-19. An unanswered question that warrants investigation is: does public compliance with preventive health measures affect individual compliance?

Specific socio-demographic and socio-economic characteristics, such as gender (i.e., female), and age (i.e., elderly), are associated with greater compliance with preventive health behaviors during COVID-19 (Nivette et al., 2021; Galasso et al., 2020; Brouard et al., 2020). Evidence on some characteristics, such as education is inconsistent. While some studies found that higher education is associated with greater compliance, other studies reported the opposite (e.g., Nivette et al., 2021) or reported no effect (e.g., Brouard et al., 2020). Individuals from some demographic backgrounds may lack the practical capacity to comply due to their occupation or economic concerns (e.g., Webster et al., 2020), but this finding applies to quarantine rather than maintaining a physical distance, wearing a face mask, or washing hands with soap more often.

The significance of our study is twofold. First, it is the first to report an empirical analysis of the adoption of precautionary health behaviors in the MENA region. Second, by identifying the effect of risk perception, mental health, and neighborhood compliance, and non-complying groups, our findings will enable MENA governments to adopt effective public health measures driving behavior change and, thus, disease containment. Informing public health policies is key in view of the successive waves of COVID-19 and the rising frequency of disease outbreaks in general. One straight policy implication, for example, is that public communication strategies should focus on risk communication (i.e., raising levels of perceived COVID-19 threat) and target certain demographic groups.

2. Data

We hypothesize that COVID-19 disease risk perception affected participation in precautionary health behavior against COVID-19 in MENA, and that its effect is more significant than that

of mental health status, neighborhood compliance, and socio-demographic and socio-economic factors. We also hypothesize that the effect of risk perception on precautionary behavior did *not* persist over the pandemic course.

Data source. To test our hypotheses, we exploit a unique panel dataset, recently released by the Economic Research Forum (ERF): the COVID-19 MENA Monitor Household (CMMHH) survey. We make use of the relevant *individual* data collected from four MENA countries on the perception of COVID-19 disease risk, social norms, socio-demographic factors, and socio-economic status over the period from November 2020 to June 2021. The four countries are Egypt (two waves), Jordan (two waves), Morocco (four waves), and Tunisia (four waves). The first wave was collected in November 2020, the second in January 2021, the third in March 2021, and the fourth in June 2021. All available survey waves are used. But because not all individuals were re-interviewed, our working sample mainly consists of 6,459 individuals who were interviewed at least in two waves in the four countries and reported on their precautionary health behaviors.

Precautionary health behavior. We include three *dependent* variables to measure compliance with COVID-19 public health preventive measures. Respondents are asked whether they adopt three precautionary behaviors that reflect national and international recommendations. Each respondent indicates if s/he tries to stay at least one meter away from other people when outside the house, wears a mask when outside the house, and washes his/her hands with soap more often than s/he did before COVID-19.

Determinants of precautionary behavior. We include four groups of *explanatory* variables that reflect individual perception of COVID-19 disease risk, mental health status, neighborhood effect, and socio-demographic and socio-economic factors.

Risk perception is captured by a self-reported measure of how worried the respondent is about being infected with COVID-19 using a Likert scale: not at all worried, a little worried, rather worried, very worried, or I had it already.

Mental health status is captured by a categorical variable, where respondents were asked for how long over the two weeks preceding the survey they felt cheerful and in good spirits: all of the time, most of the time, more than half the time, less than half the time, some of the time, or at no time.

We measure social compliance with preventive health measures by constructing three *district-level* variables of the adoption of the three discussed preventive health measures, reflecting the

neighborhood effect. The three measures are calculated as the percentage of individuals within a level-2 administrative division who reported maintaining a physical distance, wearing a mask, or washing hands with soap more often. Level-2 administrative division boundaries correspond to the district level (e.g., qesm or markaz for Egypt)

Finally, we include a set of other confounding socio-demographic and socio-economic factors. Five variables reflect the socio-demographic factors hypothesized as relevant for precautionary health behavior and (non-)compliance: age (in years), gender (male or female), marital status (never married, currently married, or widowed/divorced), location (urban, rural, or camp (for Jordan only)), and household size. Three *categorical* variables reflect socio-economic status: highest level of education completed (less than basic, basic, secondary, or higher education), employment status (employed/out of the labor force or unemployed), and change in household's total monthly income compared to February 2020 (increased/stayed the same or decreased).

As an explanatory variable in a model extension examining the evolution of risk perception and associated precautionary health behavior during COVID-19, we interact risk perception, here measured by reporting being "very worried" about being infected with COVID-19, with a variable capturing distance of a survey wave (in days) from the first time (observed survey wave) a respondent reported being "very worried".

We provide the summary statistics of the data used in the Appendix (see Table A.1).

3. Identification strategy

We base our empirical analyses on two panel data models: the probit model and the conditional (two-way fixed-effects) logit (logistic) model.

First, to examine the determinants of participation in COVID-19 precautionary health behavior, we estimate the probability that an individual i in country c adopts a precautionary behavior at month t. The following probit model is employed:

$$Pr(PHB_{it} = 1) = F\left(\theta_o + \theta_r R_{it} + \theta_m M_{it} + \theta_p P_{it} + \theta_z Z_{it}\right) \qquad (1)$$

$F(\cdot)$ is a binomial probit link function; PHB_{it} is a binary variable for individual i (in country c) reporting adoption of a precautionary behavior at wave t; R_{it} is a categorical variable for

individual perception of COVID-19 risk; M_{it} is a categorical variable for individual mental health status; P_{it} is a continuous *district-level* variable capturing broader social compliance with preventive health measures "neighborhood effect"; and Z_{it} is a vector of other confounding factors, including relevant socio-demographic and socio-economic variables, in addition to country and month dummies.

The model is estimated by the maximum likelihood (ML) method three times, each for one type of preventive measure. Robust standard errors are obtained.

Our probit model has two advantages. It is a random-effects model that allows us to estimate the effects of variables that are not expected to vary significantly or to vary at all across survey waves (e.g., gender). Obtaining marginal effects and predicted probabilities is as well feasible postestimation; we report them separately for the four countries plus the pooled estimates. The estimates are directly interpreted as the predictors of (non)adoption of precautionary health behaviors.

To control for *unobserved* individual and time fixed effects, we also use the conditional logit model below, where the probability of adopting a precautionary behavior, PHB_{ict}, is specified conditional on the current and past values of all time-varying regressors listed in equation (1), let us refer to them as X_i^t; unobserved individual-specific effects, α_i; and unobserved month-specific effects, λ_t.

$$\Pr(PHB_{it} = 1 \mid X_i^t, \alpha, \lambda, \beta) = G\left(\beta_r R_{it} + \beta_m M_{it} + \beta_p P_{it} + \beta_z Z_{it} + \alpha_i + \lambda_t\right) \qquad (2)$$

$G(\cdot)$ is a binomial logit link function. The vector Z_{it} here only includes time-varying factors: unemployment status and income change (decrease). The proposed conditional logit estimators are consistent and are computationally preferred in the context of this study as T is relatively small.

The key identifying assumption of our empirical strategy is that conditional on the inclusion of time-varying control variables, there are no time-varying unobservable characteristics that can affect the probability of adopting precautionary health behavior. By including individual fixed effects, we control for all time-invariant heterogeneity across individuals. We also include survey wave dummies to control for common trends. Moreover, we include two time-varying variables that may be pertinent to engaging in precautionary behavior during COVID-19. These are all the relevant time-varying variables that we could identify based on the design of the

CMMHH survey. We believe that the effect of other time-varying unobservable attributes is minimal, if any.

Since our dependent variable is binary, probit and conditional logit models, which interpret the regression function as a conditional probability function of the likelihood of participating in precautionary behavior, are well suited to answer our research questions: the obtained estimates are directly interpreted as the predictors of (non)adoption of precautionary health behaviors.

Second, in another set of estimations, to examine the evolution of individual COVID-19 risk perception and associated precautionary behavior over the course of COVID-19, specifically if the effect of risk perception fades over time, we interact risk perception with a variable that reflects a survey wave's distance (in days) from the first time (observed wave) a respondent reported being "very worried", denoted as D_{it}. All else remains the same.

$$\Pr(PHB_{it} = 1 \mid X_i^t, \dots) = H\big(\beta_r R_{it} + \delta D_{it} + \zeta(R_{it} * D_{it}) + \beta_m M_{it} + \beta_p P_{it} + \beta_z Z_{it} + \alpha_i + \lambda_t\big) \quad (3)$$

The coefficient on the survey wave's distance, δ, helps us analyze if COVID-19 precautionary behaviors are becoming deeply engrained habits over the course of the pandemic or, on the contrary, if individuals tend to forgo favorable health behaviors as time passes. The coefficient on the interaction term, ζ, helps us analyze how the effect of COVID-19 risk perception on precautionary health behaviors changes over time.

Standard errors are estimated using the bootstrap technique.

Robustness checks. We rely on Akaike's information criterion (AIC) and Bayesian information criterion (BIC) to assess the performance of the estimated models. Robust generalized linear models (GLM) are estimated to verify the robustness of the probit and conditional logit model estimates. Other measures of mental health status are used interchangeably to test the stability of the obtained coefficients: feeling calm and relaxed, feeling active and vigorous (which may partly reflect an individual's overall health status), feeling fresh and rested, and daily life being filled with interesting things. The results of our battery of robustness checks are reported in the Appendix.

4. Results and discussion

4.1 Baseline estimated effects on precautionary behavior

Table 1 presents the main results from equation (1) of the effects of risk perception, mental health, and neighborhood compliance, among other factors on the likelihood of adopting precautionary health behavior in the context of COVID-19 between November 2020 and June 2021 for the pooled sample. We separately estimate and report the effects on three types of preventive health measures.

Our estimates show that risk perception, specifically being rather or very worried about being infected with COVID-19, has the most significant effect on the likelihood of adopting precautionary behaviors, be it maintaining physical distance, wearing a mask, or washing hands with soap more often than before COVID-19. The magnitude of the effect is the highest for wearing a mask, followed by washing hands with soap and maintaining physical distance, respectively. The likelihood of compliance increases the higher the level of worry. We also find that being infected with COVID-19 already has a significant but lower effect on adherence (Table 1).

Consistent with the literature, our estimates show that women are significantly more likely than men to engage in all three types of precautionary health behaviors. Being married as well is associated with a higher likelihood of adopting all three precautionary behaviors. No effects are observed for being widowed or divorced. Being unemployed or residing in a rural setting significantly increase the likelihood of compliance. Educational level has no effect on both maintaining physical distance and wearing a mask, echoing the findings of Brouard et al. (2020), and a significant negative effect on washing hands with soap more often, echoing the findings of Nivette et al. (2021) (Table 1).

In parallel, Table 1 indicates that mental health affects the uptake of precautionary health behaviors, namely maintaining physical distance and washing hands with soap more often, but only when sadness is acute (possibly reflecting depression). Specifically, reporting *not* feeling cheerful or in good spirits at any time at all was associated with a significantly lower likelihood of engaging in precautionary behavior. When sadness is less severe, like feeling cheerful or in good spirits less than half the time or some of the time, we detect no effects on precautionary behavior.

TABLE 1
Estimated effects on precautionary health behavior (November 2020 – June 2021)
Dependent variables: Three preventive health measures

	Staying 1+ meter away from people	Wearing a mask	Washing hands with soap more often
Risk perception (Ref: Not at all worried)			
A little worried	0.660***	0.783***	0.556***
	(0.060)	(0.073)	(0.053)
Rather worried	0.704***	0.926***	0.803***
	(0.081)	(0.103)	(0.071)
Very worried	0.775***	1.128***	0.988***
	(0.072)	(0.095)	(0.072)
I had it already	0.352***	0.515***	0.326***
	(0.122)	(0.156)	(0.104)
Mental health (Ref: Felt cheerful and in good spirits all of the time)			
Most of the time	-0.010	0.098	-0.041
	(0.089)	(0.107)	(0.082)
More than half the time	-0.069	0.010	-0.043
	(0.109)	(0.123)	(0.097)
Less than half the time	-0.041	0.084	-0.003
	(0.097)	(0.114)	(0.087)
Some of the time	-0.010	0.162*	0.007
	(0.081)	(0.094)	(0.072)
At no time	-0.228***	-0.070	-0.182**
	(0.085)	(0.100)	(0.076)
Neighborhood effect	0.073***	0.085***	0.064***
	(0.003)	(0.004)	(0.002)
Confounding factors			
Age	0.018***	0.020***	0.007***
	(0.003)	(0.004)	(0.003)
Female	0.388***	0.585***	0.305***
	(0.061)	(0.081)	(0.053)
Marital status (Ref=Never married)			
Currently Married	0.322***	0.192**	0.167***
	(0.072)	(0.092)	(0.064)
Widowed/divorced	0.186	0.091	0.116
	(0.149)	(0.194)	(0.133)
Residence (Ref=Urban)			
Rural	0.147**	0.138*	0.124**
	(0.063)	(0.078)	(0.056)
Household size	-0.029**	-0.013	-0.004
	(0.012)	(0.014)	(0.010)
Education (Ref=Less than basic)			
Basic	-0.089	-0.097	-0.129*
	(0.085)	(0.109)	(0.077)
Secondary	-0.043	0.023	-0.228***
	(0.079)	(0.099)	(0.071)
Higher education	-0.052	0.166	-0.295***
	(0.084)	(0.110)	(0.076)
Unemployment	0.173***	0.210***	0.060
	(0.058)	(0.071)	(0.051)
Country (Ref=Jordan)			
Morocco	0.134	0.096	0.268***
	(0.083)	(0.108)	(0.073)
Tunisia	0.266***	0.073	0.268***
	(0.081)	(0.105)	(0.066)
Egypt	0.368***	0.236*	0.373***
	(0.104)	(0.137)	(0.094)
N	16,518	16,518	16,518

Each column represents a separate regression. Robust standard errors are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. Included but not reported confounding factors include household income decrease (insignificant) and month effects (mostly significant).

Broader (or neighborhood) compliance with precautionary health behavior increases the individual's likelihood of adherence significantly. We observe this relationship for all three preventive health measures, with the largest effect being observed on wearing a mask (Table 1).

In Table 2, we report the *marginal* effects of our three determinants of interest, namely risk perception, mental health, and neighborhood compliance, on the likelihood of adopting precautionary health behavior during COVID-19 between November 2020 and June 2021 for the pooled sample. The reported estimates can directly be interpreted as the predictors of (non)adoption of precautionary behavior. Similarly, we separately estimate and report the effects on three types of preventive health measures.

TABLE 2
Marginal effects of risk perception, mental health, and neighborhood on precautionary health behavior (November 2020 – June 2021)
Dependent variables: Three preventive health measures

	Staying 1+ meter away from people	Wearing a mask	Washing hands with soap more often
Risk perception (Ref: Not at all worried)			
A little worried	0.067***	0.059***	0.073***
	(0.006)	(0.005)	(0.007)
Rather worried	0.070***	0.066***	0.095***
	(0.007)	(0.006)	(0.007)
Very worried	0.075***	0.074***	0.108***
	(0.006)	(0.005)	(0.007)
I had it already	0.041***	0.043***	0.047***
	(0.012)	(0.011)	(0.013)
Mental health (Ref: Felt cheerful and in good spirits all of the time)			
Most of the time	-0.001	0.006	-0.004
	(0.008)	(0.007)	(0.009)
More than half the time	-0.006	0.001	-0.005
	(0.010)	(0.008)	(0.010)
Less than half the time	-0.004	0.005	0.000
	(0.009)	(0.007)	(0.009)
Some of the time	-0.001	0.010*	0.001
	(0.007)	(0.006)	(0.008)
At no time	-0.022***	-0.005	-0.021**
	(0.008)	(0.007)	(0.008)
Neighborhood effect	0.007***	0.005	0.007***
	(0.000)	(0.000)	(0.000)
N	16,518	16,518	16,518

Each column represents a separate regression. Standard errors are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Our estimates show that risk perception significantly increased the likelihood of engaging in all three types of preventive health measures. Mental health and neighborhood compliance significantly increased the likelihood of maintaining physical distance and washing hands with soap more often, but did not affect the likelihood of wearing a mask.

Specifically, Table 2 indicates that those who were very worried about being infected with COVID-19 were about 8 percentage points (ppts), 7 ppts, and 11 ppts more likely to try to stay at least one meter away from people, wear a mask, and wash their hands with soap more often, respectively. Those who were infected with COVID-19 already were about 4 ppts, 4 ppts, and 5 ppts, respectively, more likely to maintain physical distance, wear a mask, and wash their hands with soap more often.

With respect to mental health, our estimates show that those who did not feel cheerful or in good spirits at any time were 2 ppts less likely to maintain physical distance and to wash their hands with soap more often. Neighborhood effects were of smaller magnitude (Table 2).

Table 3 presents the *marginal* effects of risk perception, mental health, and neighborhood compliance, on the likelihood of adopting precautionary by country. Overall, the effect of risk perception appears to be most significant in Tunisia and Jordan, and that of mental health is most significant in Morocco and Egypt.

In terms of the effect of risk perception, Tunisians who were very worried about being infected with COVID-19 were about 10 ppts, 10 ppts, and 14 ppts, respectively, more likely to maintain physical distance, wear a mask, and wash their hands with soap more often. The respective figures stood at about 11 ppts, 5 ppts, and 15 ppts for Jordanians; 4 ppts, 4 ppts, and 5 ppts for Moroccans; and 5 ppts, 7 ppts, and 10 ppts for Egyptians. Note that risk perception seems to have no effect on wearing masks in Egypt, no matter the level of worry (Table 3).

As for mental health, Moroccans who did not feel cheerful or in good spirits at any time at all (possibly reflecting depression) were 5 ppts and 2 ppts less likely to maintain physical distance and to wash their hands with soap more often, respectively. However, we do not find any effect of acute sadness on adopting any of the three preventive measures in Egypt, Jordan, or Tunisia. In Egypt, we see a significant positive association between reporting feeling cheerful and in good spirits sometimes (more than half the time, less than half the time, and some of the time) and the likelihood of maintaining physical distance and washing hands with soap more often. A similar association is observed in Jordan with wearing masks.

TABLE 3

Marginal effects of risk perception, mental health, and neighborhood on precautionary health behavior by country (November 2020 – June 2021)

Dependent variables: Three preventive health measures

	Egypt			**Jordan**			**Morocco**			**Tunisia**		
	Staying 1+ meter away from people	Wearing a mask	Washing hands with soap more often	Staying 1+ meter away from people	Wearing a mask	Washing hands with soap more often	Staying 1+ meter away from people	Wearing a mask	Washing hands with soap more often	Staying 1+ meter away from people	Wearing a mask	Washing hands with soap more often
Risk perception (Ref: Not at all worried)												
A little worried	0.067***	0.064	0.075***	0.074***	0.016	0.063***	0.061***	0.051***	0.049***	0.069***	0.076***	0.089***
	(0.015)	(0.073)	(0.021)	(0.016)	(0.011)	(0.021)	(0.010)	(0.007)	(0.007)	(0.009)	(0.009)	(0.011)
Rather worried	0.061***	0.057	0.071***	0.089***	0.030***	0.124***	0.039**	0.048***	0.029**	0.079***	0.093***	0.130***
	(0.016)	(0.050)	(0.019)	(0.016)	(0.010)	(0.020)	(0.018)	(0.012)	(0.015)	(0.010)	(0.011)	(0.012)
Very worried	0.050***	0.071	0.095***	0.107***	0.049***	0.151***	0.044***	0.041***	0.050***	0.096***	0.103***	0.138***
	(0.016)	(0.122)	(0.017)	(0.015)	(0.008)	(0.019)	(0.012)	(0.009)	(0.009)	(0.009)	(0.009)	(0.011)
I had it already	0.071***	0.029	0.056	0.071***	0.019	0.052*	0.020	0.066***	0.037	0.027	0.038*	0.043*
	(0.026)	(0.050)	(0.043)	(0.021)	(0.015)	(0.030)	(0.032)	(0.010)	(0.023)	(0.021)	(0.021)	(0.025)
Mental health (Ref: Felt cheerful and in good spirits all of the time)												
Most of the time	0.083**	-0.003	0.038	0.023	0.029*	0.010	-0.022*	0.002	-0.020**	-0.004	0.001	0.003
	(0.034)	(0.033)	(0.034)	(0.022)	(0.016)	(0.029)	(0.013)	(0.010)	(0.009)	(0.011)	(0.013)	(0.016)
More than half the time	0.074**	-0.007	0.065**	0.005	0.029*	0.005	0.005	-0.007	-0.030*	-0.015	-0.002	0.001
	(0.036)	(0.072)	(0.032)	(0.025)	(0.017)	(0.031)	(0.020)	(0.016)	(0.018)	(0.014)	(0.014)	(0.017)
Less than half the time	0.060*	-0.009	0.058*	0.025	0.031*	-0.004	-0.040**	0.004	-0.011	0.003	0.008	0.007
	(0.035)	(0.083)	(0.032)	(0.022)	(0.016)	(0.029)	(0.020)	(0.013)	(0.014)	(0.011)	(0.012)	(0.015)
Some of the time	0.078**	-0.014	0.054*	0.014	0.025	0.003	-0.027**	0.003	-0.019**	0.002	0.019*	0.014
	(0.033)	(0.096)	(0.031)	(0.021)	(0.016)	(0.027)	(0.013)	(0.008)	(0.008)	(0.010)	(0.011)	(0.013)
At no time	0.023	-0.011	0.018	0.001	0.010	-0.024	-0.047***	-0.010	-0.024**	-0.016	-0.001	-0.016
	(0.035)	(0.083)	(0.034)	(0.021)	(0.017)	(0.026)	(0.015)	(0.010)	(0.010)	(0.011)	(0.012)	(0.014)
Neighborhood effect	0.005***	0.004	0.006***	0.007***	0.004***	0.010***	0.008***	0.006***	0.006***	0.006***	0.006***	0.007***
	(0.001)	(0.020)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
N	1,766	1,766	1,766	3,106	3,106	3,106	4,880	4,880	4,880	6,766	6,766	6,766

Each column represents a separate regression. Standard errors are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Finally, the country-level estimates in Table 3 provides evidence that neighborhood adherence with preventive health measures has a significant but limited effect on the likelihood that an individual adopts a precautionary health behavior. This result holds in all countries and for all preventive measures with the exception of wearing masks in Egypt. In fact, the likelihood of wearing a mask in Egypt is not affected by risk perception, mental health, nor neighborhood compliance, which warrants further investigation.

4.2 Conditional fixed effects on precautionary behavior

Table 4 reports the conditional fixed effects from equation (2) on precautionary health behavior against COVID-19 for the pooled sample, controlling for *unobserved* individual and time fixed effects.

Our estimates confirm the significance of disease risk perception on the likelihood of adopting precautionary health behavior. This result is observed for those reporting being "very worried", "rather worried", or even "a little worried" about being infected with COVID-19. The effect appears to be the greatest on the likelihood of wearing a mask, followed, respectively, by that of washing hands with soap more often and maintaining physical distance.

Diverging from our baseline estimates (Table 1), Table 4 shows that prior COVID-19 infection does not affect the uptake of precautionary behavior, regardless of the type of preventive health measure.

In parallel, Table 4 emphasizes the effect of mental health on adopting precautionary health behavior, especially maintaining physical distance and washing hands with soap more often. In fact, the conditional fixed effects estimates in Table 4 are more significant and larger in magnitude than the baseline estimates reported in Table 1.

Table 4 also emphasizes the effect of neighborhood compliance on engaging in precautionary health behavior, where significant effects are reported for all three preventive measures. Again, the conditional fixed effects estimates in Table 4 are larger in magnitude than the baseline estimates reported in Table 1.

Finally, we find that being unemployed significantly increases the likelihood of maintaining physical distance and washing hands with soap more often, but has no effect on wearing a mask (Table 4).

TABLE 4
Conditional fixed effects on precautionary health behavior (November 2020 – June 2021)
Dependent variables: Three preventive health measures

	Staying 1+ meter away from people	Wearing a mask	Washing hands with soap more often
Risk perception (Ref: Not at all worried)			
A little worried	0.681***	0.999***	0.325**
	(0.134)	(0.181)	(0.151)
Rather worried	0.316	0.599**	0.459***
	(0.199)	(0.293)	(0.165)
Very worried	0.480**	1.132***	0.779***
	(0.221)	(0.249)	(0.199)
I had it already	0.123	0.461	-0.137
	(0.295)	(0.427)	(0.313)
Mental health (Ref: Felt cheerful and in good spirits all of the time)			
Most of the time	-0.439**	0.330	-0.391*
	(0.211)	(0.274)	(0.206)
More than half the time	-0.576**	0.172	-0.394*
	(0.243)	(0.251)	(0.235)
Less than half the time	-0.455*	0.331	-0.205
	(0.233)	(0.295)	(0.199)
Some of the time	-0.537***	0.219	-0.343*
	(0.194)	(0.222)	(0.200)
At no time	-0.799***	0.033	-0.425**
	(0.210)	(0.245)	(0.183)
Neighborhood effect	0.141***	0.155***	0.124***
	(0.006)	(0.010)	(0.007)
Confounding factors			
Unemployment	0.291*	0.153	0.331**
	(0.153)	(0.205)	(0.162)
Income decrease	0.029	-0.086	0.155
	(0.103)	(0.149)	(0.118)
N	3,159	2,689	3,555

Each column represents a separate regression. Bootstrapped standard errors are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. Month effects are included in all estimations.

5. Conclusion and policy implications

Non-pharmaceutical interventions are critical to contain disease outbreaks, especially when no immediate treatment is available. The importance of such interventions was stressed amid the outbreak of COVID-19. Governments worldwide enacted unprecedented policy measures to mitigate and contain the pandemic. In the absence of disease treatment and prevention during the first wave of infections, the only means to save lives was to exploit non-pharmaceutical interventions. Populations in most countries were demanded to adopt social distancing among other precautionary behaviors.

As the enactment of public health preventive measures does not necessarily imply compliance, there is a persistent need to understand why, during a pandemic, individuals do not consistently engage in precautionary health practices.

In this study, we examine what determines the adoption of precautionary health behavior in the MENA region in the context of COVID-19. To do this, we make use of a unique panel survey of four MENA countries for November 2020–June 2021 to estimate the effects of disease risk perception, mental health, and neighborhood compliance, among other socio-demographic and socio-economic factors, on the uptake of precautionary behavior. The study is the first attempt to provide robust evidence on precautionary behavior in the region both during COVID-19 and in the context of disease outbreaks in general.

Our estimates show that those who were very worried about being infected with COVID-19 were about 8 ppts, 7 ppts, and 11 ppts more likely to try to stay at least one meter away from people, wear a mask, and wash their hands with soap more often, respectively. Those who did not feel cheerful or in good spirits at any time at all were 2 ppts less likely to maintain physical distance and to wash their hands with soap more often. Neighborhood effects were significant but of smaller magnitude. The effect of risk perception seems to be the most significant in Tunisia and Jordan, and that of mental health is the most significant in Morocco and Egypt.

The findings of this study call upon MENA governments to tailor their public health policies and communication strategies for a strong effect on behavior change and compliance during disease outbreaks, helping contain their spread at the early stages. While governments in the region are employing various tactics, such as fines, to enforce favorable measures; inducing behavior change at the individual level is what counts in the battle against disease outbreaks.

Straight policy implications, for example, include an increased focus of public communication strategies on risk communication (i.e., raising levels of perceived COVID-19 threat). Targeting certain demographic groups, such as males, young adults, urban populations, the employed, has also proven to be effective in other regions. In this regard, MENA governments may wish to consider tailoring their communication strategies to typically non-complying population segments. For instance, for young adults with low self-control, self-monitoring, environmental restructuring, or nudging may increase compliance. Moreover, addressing mental distress and anxiety during public health crises may help increase the likelihood of engagement in preventive health behaviors.

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Appendix A

TABLE A.1

Summary statistics

	Obs.	Mean	Standard deviation	Minimum	Maximum
Preventive health measure					
Staying 1+ meter away from people	16,524	0.878	0.327	0	1
Wearing a mask	16,524	0.897	0.305	0	1
Washing hands with soap more often	16,524	0.865	0.342	0	1
Risk perception	16,524	2.282	1.256	1	5
Mental health	16,524	4.169	1.669	1	6
Neighborhood effect					
Staying 1+ meter away from people	20,910	87.721	12.448	0	100
Wearing a mask	20,910	89.754	12.544	0	100
Washing hands with soap more often	20,910	87.042	12.831	0	100
Confounding factors					
Age	25,836	37.975	12.133	18	64
Female	25,836	0.401	0.490	0	1
Marital status	25,836	1.780	0.522	1	3
Residence	25,836	1.311	0.473	1	3
Household size	25,836	4.944	2.346	1	54
Education	25,836	2.496	1.116	1	4
Unemployment	16,524	0.221	0.415	0	1
Income change	16,518	0.549	0.498	0	1