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Predictors of Preventive Behaviors of COVID-19 among the Public in Egypt: Applying the Health Belief Model

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ABSTRACT

Background: SARS-CoV-2 coronavirus causes a severe acute respiratory syndrome called COVID-19. WHO declared COVID-19 outbreak as a global pandemic. Predictive factors for participating in preventative behavior could be extremely helpful in improving people's health. The health belief model (HBM) is a tool used for predicting and explaining COVID-19-related behavior. **Objective:** To evaluate the population's perception regarding COVID-19 and the practice of preventive behavior using HBM and identify the predictors of adopting preventive behavior among a sample of the public in Egypt. **Method:** A survey was carried out among 805 adult participants (18 years or more). The online questionnaire was conducted from August 1, 2020 to December 31, 2020. **Results:** A total of 805 participants (mean age of 30.63±10.06 years, 53.8% females) completed the questionnaire. Approximately 77.3% scored a high level of practicing preventive behavior. Preventive behavior practice was positively correlated with perceived severity (r=0.21), perceived susceptibility (r=0.28), perceived benefits (r=0.41), cues to actions (r=0.41), self-efficacy (r=0.51), and a significant negative correlation (r=-0.32) with perceived barriers. Male gender (β = 0.79), perceived susceptibility (β= 0.36), perceived benefits (β= 0.33), perceived barriers (β= 0.14), self-efficacy (β = 1.85), and cues to action (β = 0.61) were identified as predictors for COVID-19 Preventive behavior practice. **Conclusions:** Results showed a high degree of COVID-19 perception (based on HBM) and preventive behavior practice among the studied population. Designing a health educational intervention based on HBM constructs is recommended to enhance adherence to preventive behavior.

INTRODUCTION

Several acute atypical respiratory illnesses including pneumonia with unknown causes emerged in Wuhan, China, in December 2019. A new coronavirus was to blame. the novel coronavirus was called SARS-CoV-2, 2019.[1] As of January 1, 2023, there had been over 656 million confirmed cases of COVID-19 worldwide, with over 6.6 million deaths reported to WHO. At that time, Egypt had 515,670 confirmed cases of COVID-19, with more than twenty-four thousand deaths reported to WHO.[2]

Egypt has adopted WHO containment and mitigation strategies to control COVID-19 transmission.[3] Containment strategies are including contact tracing, rapid case identification and isolation, and quarantine of contacts. Mitigation strategies include social distancing, partial 'lock-down', and improved personal and environmental hygiene. [4]

In Egypt, Previous research has indicated that, despite national and international organizations' recommendations, the level of preventative behavior to avoid the spread of covid-19 is still unsatisfactory.[5] As a result, identifying factors affecting adherence to the recommended guidelines for covid-19 prevention is critical. The health belief model is one of the behavioral models

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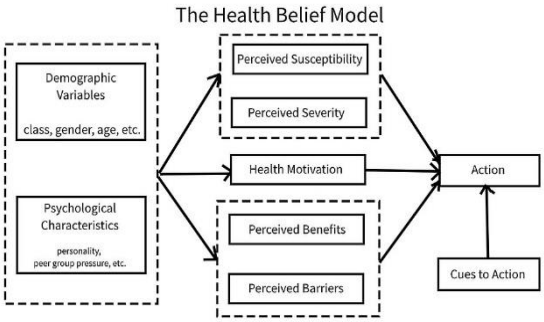

Figure 1: The theoretical framework of the study.

used to identify factors that cause behavioral modifications for disease control. Prior studies have established the HBM as an effective model for explaining, understanding, and predicting preventative behaviors against infectious diseases. [6]

The health belief model (HBM) is a tool designed to explain patients' behavior and comprehend why people didn't engage in disease strategies and behaviors during health campaigns. HBM constructions include perceived susceptibility, perceived severity, cues to action, self-efficacy, perceived benefits, and perceived barriers. [7] Regarding this model, in order to adopt COVID-19 preventive practices, individuals must first feel the risk (perceived susceptibility to COVID-19), then recognize the seriousness of the complications (perceived severity of the disease), through receiving information from the media and health care providers To participate in health-related behaviors (cues of action), to have confidence in the importance and relevance of preventive behaviors (perceived benefits from preventive measures), and to feel that preventive actions for these behaviors are less costly than their benefits (perceived barriers). Finally, individuals assume they can perform preventive behaviors (self-efficacy), allowing them to implement COVID-19 prevention.[8]

The implementation of public health interventions should be founded on a knowledge of the perceptions and determinants responsible for people's resistance to COVID-19 prevention measures. This study aims to evaluate the perception toward COVID 19 based on constructs of the health belief model (HBM), and to identify the predictors of preventive behavior among sample of public in Egypt during COVID-19 pandemic.

Table 1: Socio-demographic and medical characteristics of the participants

	Participants	
	N	%
Age in years (Mean ± SD)	30.63±10.061	
Gender		
Male	372	46.2
Female	433	53.8
Marital status		
Single	362	45
Married	415	51.5
Divorced / Widow	28	3.5
Educational level		
Less than university	60	7.4
University	617	76.6
Master and higher	128	15.9
Residence		
Urban	678	84.2
Rural	127	15.8
Nationality		
Egyptian	797	99
Others*	8	1
History of Hypertension		
Yes	59	7.3
No	746	92.7
History of DM		
Yes	46	5.7
No	759	94.3
History of Chronic chest diseases		
Yes	91	11.3
No	714	88.7
Previous COVID Infection		
Yes	111	13.8
No	694	86.2

*N= 805 *Other nationalities are 3 Syrians and 5 Saudians*

METHODS

A survey was conducted on Egyptian population from August 1 to December 30, 2020, following the Egyptian government's the implementation of lockdown. A structured questionnaire was created for the Google survey tool (Google Forms), and the generated link was distributed to the public via social media (Facebook and WhatsApp). The inclusion criteria to participate in the study were living in Egypt, can read and write, having internet access, and aged ≥18 years. Data was collected using a convenience sampling method. The sample size was calculated by using the Epi info program, with a confidence level of 95% and a margin of error of 5%. A previous study showed that 42.9% of the studied groups have good practice of preventive behaviors toward COVID-19. [5] Based on this finding and with a design effect of 2, a sample size of at least 770 participants was estimated. The collected sample had 805 participants by the completion of the data collecting time schedule.

Validity of the data collection tool: The questionnaire was developed by the authors after reviewing previously relevant studies, [5, 6, 9, 10] and following the WHO frequently asked questions.[11] The theoretical framework for our study is illustrated in Figure 1.

The questionnaire was checked and validated for content and relevance by authors, and by three experts from public health department, Ain Shams University. Then the researcher conducted a pilot study.

Pilot study: The designed online questionnaire was pilot tested on about 10% of the sample size (we collected 112 responses) before data collection. Results based on pilot clarity of the statements in the questionnaire were assessed. Data obtained from the pilot study was excluded from the analysis.

Data collection tools: The questionnaire contained three sections. Section 1: Socio-demographic characteristics and Pre-existing condition (e.g., Age, gender, chronic diseases, and previous COVID-19 infection). Section 2: The Health Belief Model consisted of 22 items asking about the perception about COVID-19. [12, 13] The HBM consists of 6 subscales measuring participants' perceived susceptibility and severity of COVID-19, cues to action, self- efficacy, perceived benefits, and barriers, Responses to scale items were evaluated on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). HBM constructs' reliability was calculated using Cronbach's alpha; the results ranged from 0.7 to 0.9. Section 3: Preventive behaviors of the participants toward COVID-19: It consisted of 10 questions based on WHO-recommended preventative measures. [11] The answer for this section was 4 points Likert scale (always, often, sometimes, rarely), ranging from 1 (rarely) to 4 (always). The total score ranged from 10 to 40 and was transformed into a percentage. Scores of more than 75%, 50% to 75%, and less than 50% were assigned to high, moderate, and low levels of adherence to preventive behaviors, respectively. the reliability of practicing preventive behaviors was assessed by Cronbach's alpha, and the result was 0.86.

Statistical analysis: After revising, coding, and data entry into the computer, the data was analyzed using the SPSS version 25 (SPSS, Inc., Chicago, IL, USA). The quantitative data were described using mean, standard deviation, and range values. The qualitative data were presented using numbers and percentages. The significance level was determined at p less than 0.05. Total scores for COVID-19 prevention behavior and health belief model elements were computed. Mean and standard deviation, as well as score percentages, were used to measure study participants' levels of preventive behavior practice and perception regarding health belief model constructs. The Pearson correlation test was performed to investigate the correlations between scores. The Independent student t test and the ANOVA test were used to investigate the relationship between the participants' preventative behavior and other characteristics such as age, gender, educational level, and HBM. The scales of the health belief model were correlated with the participants' preventive practices. The researchers used the multiple linear regression to identify the impact of age, gender, residency, educational level, previous covid-19 infection, and health belief model score on the preventive behavior score among our sample.

RESULTS

Eight hundred and five participants participated in our study (mean age, 30.63 ± 10.06 years; 372 [46.2%] were males. Most of them were married (51.6%), completed University education (76.6%). However, 7.3 % of the studied sample were hypertensive, 5.7% of them were having DM, and 11.3% were having Chronic chest diseases. 13.8% of the participants reported previous COVID-19 infection (Table 1).

The participants showed a high level of perceived susceptibility (mean% ± SD: 74.71% ± 16.1%) for COVID-19. 41.5% of the participants showed a strong agreement about their susceptibility of getting COVID-19, in terms of “Being afraid of getting COVID-19 has led to changes in my daily activities”. Perceived severity score was high (mean% ± SD: 73.65% ± 15.17%). 39.9% of participants strongly agreed regarding the severity of COVID-19 which expressed as if they caught coronavirus disease, they would get impaired to do their daily activities (Table 2). The highest perceived benefits by participants were reported in terms of “feeling safe from infection by applying social distancing” (56.3%), followed by “feeling safe from infection by washing hands frequently with water and soap” (54.7%). While the highest hindering

Table 2: Health Belief Model of COVID-19 among the studied sample (N and %)

	Strongly agree	Agree	Neutral	Disagree	Strongly Disagree
Perceived susceptibility					
1. based on my overall health, I perceive myself to be at risk of COVID-19 infection.	140 (17.4%)	201 (25%)	326 (40.5%)	124 (15.4%)	14 (1.7%)
2. Being afraid of getting COVID-19 has led to changes in my daily activities such as avoiding crowded places and washing hands more than usual.	334 (41.5%)	265 (32.9%)	138 (17.1%)	58 (7.2%)	10 (1.2%)
Perceived severity					
1. COVID-19 is a serious infection and has a high mortality rate.	311 (38.6%)	307 (38.1%)	127 (15.8%)	55 (6.8%)	5 (0.6%)
2. If I caught coronavirus disease, I would get too impaired to do my daily activities.	321 (39.9%)	278 (34.5%)	141 (17.5%)	53 (6.6%)	12 (1.5%)
3. If I get the disease, I won't be treated easily.	165 (20.5%)	182 (22.6%)	289 (35.9%)	144 (17.9%)	25 (3.1%)
4. If I got the disease, I would suffer severe symptoms.	187 (23.2%)	233 (28.9%)	287 (35.7%)	83 (10.3%)	15 (1.9%)
5. If I get infected, I may lose my life.	151 (18.8%)	162 (20.1%)	345 (42.9%)	118 (14.7%)	29 (3.6%)
Perceived benefits					
1. Feeling safe from infection when I wash my hands with soap and water regularly.	440 (54.7%)	280 (34.8%)	77 (9.6%)	8 (1%)	0 (0%)
2. Feeling safe from infection by wearing masks and disposable gloves.	412 (51.2%)	289 (35.9%)	88 (10.9%)	14 (1.7%)	2 (0.2%)
3. Feeling safe from infection by applying social distancing.	453 (56.3%)	275 (34.2%)	67 (8.3%)	9 (1.1%)	1 (0.1%)
4. Staying at home prevents me and my family from acquiring the disease.	413 (51.3%)	270 (33.5%)	99 (12.3%)	17 (2.1%)	6 (0.7%)
Perceived barriers					
1. It is challenging to adhere to the prevention guidelines for COVID-19.	84 (10.4%)	162 (20.1%)	205 (25.5%)	295 (36.6%)	59 (7.3%)
2. it's not possible to leave 1-meter distance from others in public places and transportation.	219 (27.2%)	225 (28%)	163 (20.2%)	163 (20.2%)	35 (4.3%)
3. I don't have the capacity to apply preventative instructions, as preventive measures take too much effort and time.	70 (8.7%)	112 (13.9%)	195 (24.2%)	326 (40.5%)	102 (12.7%)
4. It is challenging to wash hands with soap and water regularly.	44 (5.5%)	113 (14%)	136 (16.9%)	345 (42.9%)	167 (20.7%)
5. The gel and solutions for disinfection are costly and unavailable in the markets.	127 (15.8%)	159 (19.8%)	236 (29.3%)	215 (26.7%)	68 (8.4%)
6. The mask is scarce in the markets; thus, I do not wear a mask.	78 (9.7%)	92 (11.4%)	196 (24.3%)	330 (41%)	109 (13.5%)
7. It's challenging to stay at home to avoid infection.	180 (22.4%)	176 (21.9%)	229 (28.4%)	158 (19.6%)	62 (7.7%)
8 It's challenging to avoid touching my mouth, nose and eyes with my unwashed hands.	152 (18.9%)	207 (25.7%)	205 (25.5%)	185 (23%)	56 (7%)
Self-efficacy					
Ability to adhere to COVID-19 prevention guidelines	275 (34.2%)	376 (46.7%)	133 (16.5%)	18 (2.2%)	3 (0.4%)
Cues to Actions					
1. Mass media, and the ministry of health message on social media about the disease has been helpful.	275 (34.2%)	326 (40.5%)	162 (20.1%)	37 (4.6%)	5 (0.6%)
2. I don't want to transmit COVID-19 to people around me.	492 (61.1%)	248 (30.8%)	59 (7.3%)	5 (0.6%)	1 (0.1%)

N= 805, data were presented as number and percentage

barriers facing participants were "it's not possible to leave 1-meter distance from others in public places and transportation." (27.2%) followed by "to stay at home to prevent COVID-19 is difficult" reported by 22.4% of the participants (Table 2).

Participants had high self-efficacy score (mean% ± SD: 82.4% ± 15.8%), 34.2% of participants strongly believed in their ability to follow preventive measures against COVID-19. As regard Cues to

Table 2b: Health Belief Model of COVID-19 among the studied sample (scores)

	Mean ± SD (min-max)	Mean% ± SD
Perceived susceptibility score	7.47 ± 1.61 (2-10)	74.71 ± 16.1
Perceived severity score	18.49 ± 3.79 (8-25)	73.65 ± 15.17
Perceived benefits score	17.57 ± 2.51 (8-20)	87.85 ± 12.53
Perceived barriers score	23.78 ± 6.85 (8-40)	60.56 ± 17.13
Self-efficacy score	4.12 ± 0.79 (1-5)	82.4 ± 15.8
Cues to Actions score	8.55 ± 1.28 (4-10)	85.52 ± 12.8

Table 3: Participants' preventive practice toward COVID-19

	Statements about adoption of precautionary behavior / actions	Always	Often	Sometimes	Rarely
1.	I never leave the house unless essential.	235 (29.2%)	384 (47.7%)	146 (18.1%)	40 (5%)
2.	I maintain a social distance of at least one meter from other people	198 (24.6%)	387 (48.1%)	181 (22.5%)	39 (4.8%)
3.	When coughing or sneezing, I hold a tissue or my bent elbow in front of my mouth and nose.	544 (67.6%)	221 (27.5%)	34 (4.2%)	6 (0.7%)
4.	I don't kiss or shake hands with other people.	363 (45.1%)	329 (40.9%)	91 (11.3%)	22 (2.7%)
5.	After entering the house, I wash my hands with soap and water without touching anything.	578 (71.8%)	169 (21%)	50 (6.2%)	8 (1%)
6.	I frequently wash my hands for at least 20 seconds per hour with soap, water, or hand sanitizer.	429 (53.3%)	265 (32.9%)	94 (11.7%)	17 (2.1%)
7.	I avoid touching my mouth, nose, or eyes with unwashed hands.	298 (37%)	337 (41.9%)	140 (17.4%)	30 (3.7%)
8.	I wear a mask in crowded places.	466 (57.9%)	227 (28.2%)	83 (10.3%)	29 (3.6%)
9.	I clean my home by chlorine regularly.	299 (37.1%)	284 (35.3%)	173 (21.5%)	49 (6.1%)
10.	I don't go to my work if I have any symptoms like fever, cough	480 (59.6%)	239 (29.7%)	69 (8.6%)	17 (2.1%)
Total Practice Score					
	Mean ± SD (min-max)	32.88 ± 5.233 (11 - 40)			
	Mean% ± SD (min-max)	82.19% ± 13.08% (27.5%- 100%)			
Participants' Preventive practice level toward COVID-19:					
	High performance level (>75%)	622 (77.3%)			
	Average performance level (≥50 - ≤75%)	168 (20.9%)			
	Low performance level (<50%)	15 (1.9%)			

N= 805, data were presented as number and percentage unless mentioned otherwise

Actions, 61.1% of the participants reported strong agreement with "I avoid transferring COVID-19 to people around me" as a stimulus to undertake preventive practices against COVID-19 (Table 2). The practice of preventive behavior by the studied participants is demonstrated in Table 3. Most of the study participants (77.3%) had a high-performance level of Preventive practice. The lowest Preventive practice recorded was "I maintain at least one meter away from others." (24.6%), The highest Preventive practice recorded was "I frequently wash hands with water and soap." (71.8%), followed by "When I cough or sneeze, I put a tissue paper or my bending elbow in front of my mouth." (67.6%).

Table 4 showed that age, educational level, marital status, Previous COVID Infection, and participants with hypertension, DM, or Chronic chest diseases were significantly associated with the perceived susceptibility score with (P-value<0.05). As participants aged≥ 30 years, had Previous COVID Infection, hypertension, DM or Chronic chest diseases had higher Perceived susceptibility score. post hoc Test found that the participants with secondary educational level, and singles had lower Perceived susceptibility score than other groups

Table 4: Associations between demographic characteristics and mean scores for the HBM constructs, and preventive behaviors

	Perceived susceptibility	Perceived severity	Perceived benefits	Perceived barriers	Self-efficacy	Cues to Actions	Preventive practice
Age category							
<30 (n=424)	7.1 ± 1.6	18.2± 3.6	17.5±2.5	24.3± 6.6	4 ± 0.8	8.4±1.3	32.2±5.3
≥30 (n=381)	7.8 ± 1.56	18.85±3.9	17.7±2.5	23.2±7.1	4.3 ±0.7	8.7±1.2	33.68±5
P value (T test)	<0.01*	<0.01*	0.21	0.03*	<0.01*	<0.01*	<0.01*
Gender:							
Male (372)	7.57±1.7	18.87±3.96	17.46±2.6	24±7.3	4.1±0.8	8.6±1.3	32.6±5.5
Female (433)	7.39±1.5	18.15±3.61	17.67±2.4	23.60±6.5	4.1±0.8	8.5±1.2	33.13±5
P value (T test)	0.1	<0.01*	0.25	0.43	0.46	0.25	0.14
Marital status:							
Single (362)	7.16±1.6	18.44±3.75	17.56±2.5	24.46±6.8	4±0.8	8.5±1.3	32.3±5.3
Married (415)	7.74±1.6	18.44±3.84	17.6±2.56	23.14±6.8	4.2±0.7	8.6±1.2	33.5±5.2
Divorced/widow (28)	7.5±1.77	19.79±3.55	17.29±2.2	24.32±7.8	4.3±0.9	8.7±1.1	32.3±4.3
P value (ANOVA)	<0.01*	0.18	0.81	0.026*	<0.01*	0.26	<0.01*
Educational level:							
Read and write/ primary/ Preparatory (11)	7.55±1.8	21.18±2.52	17.45±2.8	31.64±4.4	4.9±0.3	8.7±1.2	33.6±4.4
Secondary/ Vocational/ Institute (49)	6.9±1.78	17.65±4.12	17.53±2.7	23.18±6.4	4.2±0.8	8.7±1.3	32.1±5.1
University (617)	7.45±1.6	18.59±3.78	17.54±2.5	23.78±6.9	4.1±0.8	8.5±1.3	32.8±5.3
Master and higher (128)	7.78±1.6	18.09±3.7	17.73±2.2	23.30±6.8	4.2±0.7	8.7±1.2	33.5±5
P value (ANOVA)	0.01*	0.021*	0.9	<0.01*	<0.01*	0.3	0.36
Residence							
Urban (678)	7.48±1.6	18.57±3.8	17.58±2.5	23.67±6.8	4.1±0.8	8.5±1.3	33 ±5.2
Rural (127)	7.42±1.7	18.05±3.67	17.53±2.5	24.36±7.1	4.1±0.9	8.7±1.3	32.4±5.2
P value (T test)	0.68	0.16	0.84	0.3	0.93	0.11	0.22
Previous COVID-19 Infection							
Yes (111)	8.23±1.5	19.77±4.3	18.02±2.5	23.63±8.5	4.2±0.8	8.9±1.2	33.5±5
No (694)	7.35±1.6	18.28±3.66	17.50±2.5	23.8±6.56	4.1±0.8	8.5±1.3	32.8±5.3
P value (T test)	<0.01*	<0.01*	0.04*	0.84	0.13	<0.01*	0.16
Hypertension							
yes (59)	8.07±1.3	19.51±4	17.4±2.45	22.07±6.6	4.3±0.6	8.75±1.2	33.9±4.8
No (746)	7.42±1.6	18.41±3.77	17.6±2.5	23.91±6.9	4.1±0.8	8.54±1.3	32.8±5.3
P value (T test)	<0.01*	0.03*	0.5	0.046*	0.13	0.22	0.11
Diabetes							
Yes (46)	8.46±1.3	20.22±3.8	17.4±2.6	23.52±7.1	4.4±0.8	8.78±1.2	33.8±4.8
No (759)	7.41±1.6	18.38±3.8	17.58±2.5	23.79±6.9	4.1±0.8	8.54±1.3	32.8±5.3
P value (T test)	<0.01*	<0.01*	0.62	0.8	<0.01*	0.21	0.24
Chronic chest diseases							
Yes (91)	8.2±1.6	19.23±4.1	18±2.2	24.40±7.7	4.1±0.9	8.5±1.4	33.4±5.3
No (714)	7.38±1.6	18.39±3.7	17.5±2.5	23.70±6.7	4.1±0.8	8.6±1.3	32.8±5.2
P value (T test)	<0.01*	0.047*	0.06	0.36	0.77	0.72	0.32

N=805. Data were presented as mean ± standard deviation. HBM: the health belief model, T test: the independent samples T-test, ANOVA: the Analysis of the variance formula.

(p<0.05) (Table 4). There was a statistically significant relationship between the perceived severity score with age, gender, educational level, Previous COVID Infection, and participant with hypertension, DM, or Chronic chest diseases (P-value<0.05). As participants aged ≥ 30 years, males, the Secondary educational level, participants who had Previous COVID Infection, and participants with hypertension, or DM or Chronic chest diseases had higher Perceived severity score (Table 4).

The participants who had Previous COVID Infection had higher perceived benefits score (P-value<0.05). There was a statistically significant relationship

Table 5: The correlation between health belief model constructs and the preventive practice of the participants among the studied sample

Constructs of HBM	Pearson Correlation	P-value
Perceived susceptibility score	0.283*	<0.01
Perceived severity score	0.207*	<0.01
Perceived benefits score	0.405*	<0.01
Perceived barriers score	-0.317*	<0.01
Self-efficacy score	0.508*	<0.01
Cues to Actions score	0.409*	<0.01

*N= 805 * Correlation is significant at the 0.01 level (2-tailed).*

between perceived barriers score with age, marital status, educational level, and participant with hypertension (P-value<0.05). As participants aged≥ 30 years, and participants with hypertension had lower Perceived barriers score. Post hoc Test found that Preparatory and less educational level, and single participants had higher Perceived barriers score(p<0.05) (Table 4). Regarding the self–efficacy score: age, marital status, educational level, and participant with DM were significantly associated (P-value<0.05). As 30s and more age group, Preparatory and less educational level group, married participants, and participants with DM, had higher Self-efficacy score (P-value<0.05) (Table 4).

Table 4 also shows that Cues to Actions score had a statistically significant relationship with age and Previous COVID Infection. The participants aged ≥ 30 years, and who had Previous COVID Infection had higher Cues to Actions score (p<0.05).

The practice of Preventive behavior significantly associated to age, and marital status (p < 0.05). as participants aged ≥ 30 years, married participants had higher Preventive behavior practice score(p<0.01) (Table 4). Preventive behavior practice had significant positive correlation with perceived susceptibility(r=0.28), perceived severity(r=0.21), perceived benefits(r=0.41), cues to actions(r=0.41), self-efficacy(r=0.51), and a significant negative correlation (r=-0.32) with perceived barriers (Table 5). The multiple linear regression illustrated that male gender (β = – 0.79), perceived susceptibility (β = 0.36), self-efficacy (β = 1.85), cues to action (β = 0.61), perceived benefits (β = 0.33), and perceived barriers (β = – 0.15) were the predictor variables that significantly associated with the practice of COVID-19 Preventive behavior (p < 0.01) (Table 6).

DISCUSSION

The Health Belief Model (HBM) supposes that changing people's attitudes and beliefs leads to change in the practice of preventive health behavior. Results from previous study showed that: Health belief model has a good predictive ability of COVID-19-related behavior in most reviewed studies (87.5%). They proved that the health belief model could be applied in the planning and designing of strategies for confronting the covid-19 epidemic. [14]

The results of present study showed a high degree of perceived susceptibility (mean% ± SD: 74.71% ± 16.1%) for COVID-19. Approximately 74.4% of our participants reported agreement about their susceptibility for getting COVID-19. Like these results, a study in Saudi Arabia in 2021 showed that most of respondents (89.67%) had perceived susceptibility of contracting COVID-19 if they had been into contact with an infectious patient. [15]

The results of perceived severity were also observed at high level (mean% ± SD: 73.65% ± 15.17%). 76.7% of participants reported agreement and strong agreement about the severity of COVID-19. It was expressed as COVID-19 is a serious disease and has a high mortality rate. This agrees with the study by (Syed, et al., 2021) 58.98% of respondents reported agreement/strong agreement with that COVID-19 is more severe than any other respiratory diseases. [15]

The perceived benefits score about complying with COVID-19 preventive behavior was reported at higher level (mean% ± SD: 87.85% ± 12.53%). The highest perceived benefits by participants were reported that 90.5% of participants agreed or strongly agreed with "I feel safe from infection by applying social distancing.". In the Saudi Arabia survey, a substantial number (71.7%) of Participants believed (agreed/strongly agreed) that if they followed the ministry of health guidelines, they

Table 6: Multiple linear regression for the variables associated with participants' practice of COVID-19 infection preventive behavior.

Predictors	B	95% confidence		T test	P-value
		Lower limit	Upper limit		
Age	.016	-.025	.057	.77	0.44
Male versus female gender	-.79	-1.39	-.198	-2.62	<0.01*
Married versus unmarried	.45	-.27	1.17	1.23	0.22
University and higher educational level versus primary/ preparatory/ vocational/ institutional education	.69	-.45	1.815	1.18	0.23
Urban versus rural residence	.48	-0.32	1.28	1.2	0.24
Previous COVID Infection	-0.43	-1.28	0.44	-0.96	0.33
Hypertension	0.12	-1.08	1.3	0.2	0.84
Diabetes	-.54	-1.988	.91	-.73	0.47
Chronic Chest diseases	.21	-.72	1.13	.44	0.66
Perceived susceptibility Score	.36	.16	.57	3.44	<0.01*
Perceived severity Score	.08	-.01	.17	1.8	0.073
Perceived benefits Score	.33	.19	.46	4.8	<0.01*
Perceived barriers Score	-.15	-.19	-.1	-6.26	<0.01*
Self-efficacy	1.85	1.39	2.3	7.99	<0.01*
Cues to Actions Score	.61	.335	.88	4.38	<0.01*

F test = 28.864, p<0.01. R-square =0.384

would not become infected with COVID-19. [15] The perceived barriers score was also high (mean% ± SD: 60.56% ± 17.13%). one of the hindering barriers facing participants was "It is difficult to stay at home to prevent COVID-19." reported (agreed/strongly agreed) by 44.3% of the participants. Our findings are consistent with those of Syed et al., 2021, [15] who discovered that 60.18% of participants showed agreement/strongly agreement that not leaving the house caused difficulties during home confinement.

The results have showed a high Cues to Actions score (mean% ± SD: 85.52% ± 12.8%). 74.7% of the participants reported agreement or strong agreement with "Mass media, and the ministry of health message on social media about the disease has been helpful." as a stimulus to undertake preventive practices against COVID-19. This is very close to the outcomes found by Syed, et al., 2021, [15] Majority of participants (92.66%) reported agreement/strongly agreement that the MOH's coronavirus awareness program assisted them in implementing community preventive measures. This demonstrates the potency of the message delivered by the various media platforms.

Most of the study participants (77.3%) had a high-practice level of COVID-19 preventive behavior. The highest Preventive practice reported was that 71.8% of participants wash hands with water and soap, followed by: they place a tissue paper or bending elbow in front of their mouth and nose when coughing or sneezing (67.6%). Similar to these results, Abd Elhameed et al., 2021 study revealed that 73.6% and 75.8%of the participants respectively covered their mouth and nose during sneezing and washed their hands regularly, 65.4% wore masks in public places.[16] In the same direction, Erfani et al., 2020 reported that most of the participants (79.4%) stated that keeping social distance/avoiding crowds and crowded locations can help to restrict the spread of COVID-19.[18] The findings could be due to the health education campaigns which conducted under the supervision of the Egyptian Ministry of Health and Population (MoHP) to improve public understanding of the disease and influence behavioral transformation.

Our study found that participants aged 30 years and older, had Previous COVID Infection, hypertension, diabetes or chronic chest diseases, had higher perceived susceptibility score. Along with our results, Karimy et al., 2021 mentioned that COVID-19 perceived susceptibility was higher in older adults (aged +70) than in younger ones (aged 15-29).[6] This can be explained by the fact that National clinical COVID-19 registries have revealed that the elderly have a higher mortality rate.[18]

The perceived susceptibility score was significantly different between secondary educational level and master and higher educational level (secondary educational level had lower score). Furthermore, the perceived susceptibility score was significantly different between single and married participants (singles had lower score). Similarly, Scarinci et al., 2021 reported that participants with a secondary school education or less were more probable to

ignore the risk of infection, when compared to those with a college degree or higher.[19] As educational level is positively corelated to both health literacy scores and engagement in healthy behaviors.

Current study findings reports that 30 years and older participants, males had higher perceived severity score. This result was similar to Karimy et al., 2021, but participants with secondary educational level had higher perceived severity score than preparatory or less educational level.[6] That result was in congruent with Karimy et al., 2021 who found that there is a statistically significant relationship between the perceived severity score with age, gender, and marital status ($p < 0.01$), as COVID-19 was perceived as more severe by elderly people (aged + 70 years) than by younger ones (aged 15-29 years), but the perceived severity score wasn't affected by educational level nor history of chronic diseases ($p > 0.05$).[6]

Moreover, Costa, 2020 demonstrated that there was a significant association between perceived severity and educational level, as those with secondary education presented higher severity scores than those with higher educational levels.[20] Participants with hypertension and immune system diseases also reported higher perceived severity scores ($p < 0.001$). [20] This suggests that Precautions made for the management of their chronic conditions are evaluated as protective factor against exposure. There was a statistically significant association between the perceived barriers score with age, marital status, educational level, and participant with hypertension (P-value<0.05). Participants with hypertension had lower perceived barriers score. Moreover, the less than 30s age groups, singles, participants with preparatory and less educational level had higher Perceived barriers score. Unlike Costa, 2020 who reported that the participants' age, and sex didn't affect the perceived barriers score.[20]

The self-efficacy score was significantly association with age, marital status, educational level, and participants with DM. Single participants and participants less than 30 years had lower Perceived Self-efficacy score compared to married and 30 years and more participants. Similarly, Jahangiry et al., 2020 founded that Participants who were older, female, single, well-educated, and lived in rural areas had significantly higher self-efficacy scores. [21] These participants believed in their ability to carry out the recommended COVID-19 preventive practices. That may be because younger adults usually take more risks and disregard health advice.

Our findings suggest that there was a statistically significant relationship between the cues to actions with age, and previous COVID infection. Cues to actions score was significantly higher among participants aged≥ 30 years. The participants who had previous COVID infection also had higher cues to actions score. In consistent with this, Abbaszadeh et al., 2007 reported that a cue to action has a direct relationship with age, so that as age increases. [22]

Practice study shows that preventive practice of the participants significantly associated to age, and marital status ($p < 0.05$) and there is no association between adherence to preventive practice, and gender, educational level, residence, previous COVID infection, nor chronic diseases of participants. Apart from this, the participants less than 30 years had lower preventive behavior practice score than 30 years and more participants. Singles had lower preventive practice score than married. In the same line, Salavati et al., 2021 demonstrated that that gender (female), and marital status (married), were the only predictors of protective behaviors.[23] Also, Karimy et al., 2021 reported that Women performed better in terms of preventive behavior than men. Also, individuals with a university education, married individuals, and individuals without any chronic condition showed better COVID-19 preventive practices. ($p < 0.05$).[6]

Furthermore, the current survey shows that participants with higher perceived susceptibility score, higher perceived severity score, higher perceived benefits score, higher self-efficacy score, higher cues to actions score and lower perceived barriers score are more likely to adhere to these preventive practices against COVID-19. As Preventive behavior practice had significant positive correlation with perceived susceptibility score ($r=0.28$), perceived severity score ($r=0.21$), perceived benefits score ($r=0.41$), cues to actions score ($r=0.41$), self-efficacy score ($r=0.51$), and a significant negative correlation ($r=-0.32$) of moderate degree with perceived barriers score.

Similarly, A study in Iran showed a positive correlation between the practice of COVID-19 preventive behaviors with perceived benefits, severity, and cues to action. Furthermore, A negative association was also discovered between perceived barriers and COVID-19 preventative behaviors.[6] Also, Tadesse et al., 2020 reported that participants with low cues to action and self-efficacy practiced

COVID prevention measures lower than those with high cues to action and a high level of cues to action, respectively [AOR = 0.05, 95% CI (0.026,0.10)] and [AOR = 0.08, 95% CI (0.04,0.14)].[24]

The present study showed that most of constructs of health believe model score (except perceived severity score) and gender were the predictor variables that had a statistically significant relationship with participant preventative behavior. the multiple linear regression model showed that male gender (β = – 0.79), perceived susceptibility (β = 0.36), perceived benefits (β = 0.33), perceived barriers (β = – 0.14), self-efficacy (β = 1.85), cues to action (β = 0.61) were significant predictors for the practice of COVID-19 preventative behavior ($p < 0.05$). Similarly, Karimy et al., 2021 reported that female gender (β= 0.11), perceived barriers (β= -0.18), perceived benefits (β= 0.1), internal cues to action (β =0.12), and external cues to action (β= 0.25), were predictors of COVID-19 preventive behaviors (p 0.05).[6]

CONCLUSIONS

A high level of preventive behavior practice against COVID-19 was revealed among the studied group (77.3%). The participants' practice of preventive behavior was significantly correlated with all constructs of HBM. So, we recommend designing a health education depending on HBM for improvement of public adherence to COVID-19 preventive behavior. Also, public awareness campaigns to prevent or minimize the effects of future potential waves of any infectious disease pandemic to encourage the public to adopt preventive behavior. We recommend emphasizing the benefits of preventive behaviors that protect against getting an infectious disease and its complications, presenting recommendations and guidance for overcoming barriers, and providing cues to action using social media, especially among men.

***Limitations of the study*:** The study was conducted with only volunteer participants who filled out the online questionnaire, As The survey was conducted from 1st August 2020 to end of December 2020 after the implementation of lockdown measures by the government of Egypt. Thus, the findings may not be generalized to the entire Egyptian population. The current study results might be subjected to recall bias as the participants were asked to complete preventive practice questions during the past month.

Ethical considerations: The research ethics committee at Ain Shams University's college of medicine approved this study (Approval number: FMASU M S 386/2020). The study followed international ethics rules as well as the Helsinki Declaration (2013). The anonymity of the questionnaire ensured data confidentiality. The study title, purpose, and inclusion criteria appeared on the first page of the online survey, and a question asking the participants: Would you like to participate in the study? It was considered as consent for participation.

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