The health belief model's ability to predict COVID-19 preventive behavior: A systematic review

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Abstract

Objective: The health belief model specifies that individuals' perceptions about particular behavior can predict the performance of respective behavior. So far, the model has been used to explain why people did not follow COVID-19 preventive behavior. Although we are using it, to our best knowledge, its predictive ability in COVID-19 preventive behavior is unexplored. So, this review aimed to assess the model's predictive ability and identify the most frequently related construct.
Method: A systematic review was conducted to examine the predictive ability of health belief model in COVID-19 preventive behavior using research done all over the world. Preferred reporting items for systematic review and meta-analysis guidelines were used. Comprehensive literature was searched using databases such as PubMed, Google scholar, and African Online Journal to retrieve related articles. Descriptive analyses such as the proportion of studies that better explained COVID-19 prevention behavior and the significance ratio of each construct of the model were made.
Result: Overall, 1552 articles were retrieved using a search strategy and finally 32 articles fulfilling the inclusion criteria undergo the review. We found that in the majority (87.5%) of the studies health belief model has a good predictive ability of COVID-19-related behavior. Overall the explained variance for health belief model ranged from 6.5% to 90.1%. The perceived benefit was the most frequently significant predictor; highest significance ratio (96.7%) followed by self-efficacy, cues to action perceived barrier, susceptibility, and severity in decreasing order.
Conclusion: Health belief model has a good predictive ability of COVID-19-related behavior in the majority of reviewed studies. The perceived benefit was the most frequently significant predictor of COVID-19-related behavior. Professionals who are in need can effectively use health belief model in planning and designing interventions to prevent and control the pandemic.

Keywords

Health belief model, predictive ability, COVID-19 preventive behavior, systematic review

Introduction

The 2019 novel coronavirus disease is caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and spread to several countries. On 30 January 2020, the World Health Organization's (WHO)[1] Emergency Committee considered it a global health emergency and declared it to be a pandemic in March 2020.[2] It was first identified as clusters of pneumonia cases that have been reported for unknown reasons in Wuhan, Hubei Province, China.[3] The COVID-19 pandemic has negatively affected economic growth, sense of security, healthcare system, trade relations, tourism, employment, education, and global interactions of many countries across the globe.[4]

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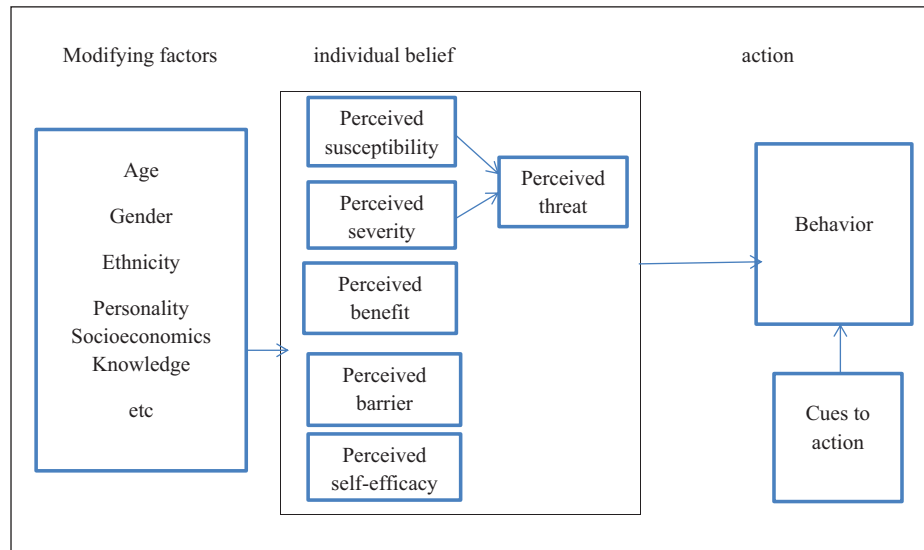Email: amarezewdie23@gmail.com

Figure 1. Conceptual framework of the health belief model.

WHO has recommended several health-promotive behaviors for the prevention of the COVID-19 pandemic. Facemask wearing, social distancing, hand washing with soap and water, use of alcohol-based hand sanitizer, self-isolation, avoiding spending time in crowded places, and taking the vaccine was the most highly advocated behavior to prevent and control the pandemic. These preventive behavior are investigated and framed as interventions by different theoretical molds in different parts of the world.[5–7]

Different scholars such as sociologists, psychologists, and behavioral and public health experts have proposed a variety of theories and models to explain the factors affecting people's health behavior, among these the prominent was the health belief model (HBM). HBM was introduced by Rosenstock and is a general conceptual framework and theoretical guideline for health behaviors in public health research. It consists of constructs, namely the perceived susceptibility, perceived severity, perceived benefits, perceived barriers, self-efficacy, cues to action, and preventive health behaviors. Despite the subsequent development of alternate models, the HBM is still widely used in health campaigns and taught in academic settings.[8,9]

Systematic review and meta-analysis are combined and summarized sources of evidence for actual practice. They settle controversies arising from apparently conflicting individual studies and can answer questions not addressed by the individual studies. Systematic review and meta-analyses adopt "a replicable, scientific, transparent and detailed process that aims to minimize bias through exhaustive literature searches by providing an audit trail of the reviewers' decisions, procedures, and conclusions.[10,11] Those qualities of systematic review and meta-analyses put them at the top of the evidence hierarchy and increase their importance for policy formulation and decision-making.[12]

Review of the model

The HBM specifies that individuals' perceptions of six variables can predict their behavior.[8] First, the model argues people will be more motivated to act in healthy ways if they believe they are susceptible to a particular negative health outcome. Second, the model predicts that the stronger people's perception of the severity of the negative health outcome, the more they will be motivated to act to avoid that outcome. Susceptibility and severity concern the individual's perception of the threat to a negative health outcome. Third, the individual must perceive that the target behavior will provide strong positive benefits. Fourth, the model argues that if people perceive there are strong barriers that prevent them from adopting the preventive behavior, they will be unlikely to do so. Fifth, the model also assumes individuals should perceive as they are capable of performing that particular behavior. Finally, HBM includes a cue to action whereby the individual is spurred to adopt the preventive behavior by some additional elements[13–15] (Figure 1). HBM has been used to explain a variety of health problems; from preventive behavior to complex sick role behaviors.[16] The model's ability to explain and predict a variety of behaviors associated with positive health outcomes has been successfully investigated several times.[17] The model has also been used to develop many successful health communication interventions by framing messages to the HBM variables to change health behaviors.[18] The ability of each component of the HBM in predicting a variety of health behaviors is quite different. Additionally, the model's ability in explaining people's behavior to newly emerging health problems is unstudied.[19]

As COVID-19 pandemic emerged and propagated across the world scholars from different departments investigated the reason why people did not follow COVID-19 preventive

behavior using the important framework, the HBM. Several interventions are also being implemented to prevent this pandemic, which is framed using the HBM. Despite we use the HBM for explaining COVID-19 behavior and designing of COVID prevention program; to our best knowledge, issue related to its predictive ability and most frequently associated construct to COVID-19 behavior is unexplored. So this systematic review aims to assess predictive ability and identify the most frequently related construct of the model to COVID-19 preventive behavior.

Significance of the study

The result of the review would be beneficial in planning and implementing an intervention to improve COVID-19 preventive behavior. Since it evaluates the effectiveness of the HBM in explaining COVID-19 preventive behavior, it can help program designers confidently use the model in COVID-19 prevention programs. Since the review identifies the most frequently associated construct of the model to COVID-19 preventive behavior, therefore it contributes evidence inputs for preparing messages and materials for outreach and media campaigns by considering the identified important construct to prevent and control COVID-19. In addition, it may ignite a new insight for further studies that might be conducted on a related topic.

Method

Study design and setting

A systematic review was conducted to examine the predictive ability of HBM in COVID-19 preventive behavior and identify the most frequently associated construct of the model to COVID-19 preventive behavior using research done all over the world on COVID-19 preventive behavior incorporating HBM as a framework. Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guidelines were used for this review (supplementary table 1). PRISMA is a protocol consisting of checklists that guide the conduct and reporting of systematic reviews and meta-analyses, which increase the transparency and accuracy of reviews in medicine and other fields.[20]

Search strategies and sources of information

We have checked the PROSPERO database (http://www.library.ucsf.edu/) and the resources on COVID-END (COVID-END) whether published or ongoing projects exist related to the topic to avoid any further duplication. Thus, the findings revealed that there were no ongoing or published articles in the area of this topic. Then this systematic review was registered in the PROSPERO database with Id no of CRD42022311171. Comprehensive literature was searched in databases such as PubMed, Google scholar, and African Online Journal to

retrieve related articles from 28 December 2021 to 7 January 2022. Gray literature was searched using Google. Search terms were formulated using PICO guidelines through the online databases. Medical Subject Headings (MeSH) and key terms had been developed using different Boolean operators "AND" and "OR." The following search term was used: "COVID-19" OR "SARS-CoV-2" OR "coronavirus" OR "coronavirus disease" AND "health belief model."

Eligibility criteria

In this systematic review, we included studies that meet the following criteria. First, a study must be done on COVID-19 preventive behavior using HBM. Second, no restriction was made regarding country, population group, race, gender, and publication date. Study which employ a qualitative method and not report explaining ability such as variance explained, study with data extracted, duplicate, abstract-only papers, articles without available full text, conference, editorial, author response theses, case reports, case series, and systematic review studies are excluded at each respective stage of screening.

Outcome measurements

This review has two main outcomes. The primary outcome was the proportion of variance of COVID-19 prevention behavior explained by the HBM. It is defined as the variance of COVID-19 prevention behavior which is explained by the HBM framework that they are employed in their research article starting from the drafting of the conceptual framework up to the fitting of the analysis model. Therefore, all included studies were reporting the proportion of variance explained by the model they are fitted as analysis output. Thus, a higher percentage of explained variance indicates a great explaining ability of the model in COVID-19 preventive behavior. It also means that you make better predictions.[21] The secondary outcome was factors associated with coronavirus disease 2019 (COVID-19) preventive behavior (constructs of HBM). Construct that are frequently associated with the behavior are considered as an important factor that needs focus while we design interventions to improve COVID-19 prevention behavior.

Data extraction

All studies obtained from all databases were exported to Endnote version X8 software to remove duplicate studies. Then after, all studies were exported to a Microsoft Excel spreadsheet. Four authors (A.Z., A.M., T.S., and M.G.) independently extracted all the important data using a standardized data extraction form which was adapted from the Joanna Briggs Institute (JBI) data extraction format for the first outcome.[22] For the first outcome (proportion of variance) the data extraction format included (primary author, year of publication, country, sample size, analysis model fitted, and

Table 1. Study characteristics, proportion variance, and type of COVID-19 related behavior explained in included studies in the systematic review 2022.

Authors	Year	Country	Sample size	Analysis model fitted	The proportion of variance explained	Type of COVID-19 preventive behavior
Le An et al.[24]	2021	Vietnam	462	HLoR	30% (Cox and Snell)	Vaccine acceptance
Shmueli L.[25]	2021	Israeli	398	HLoR	74% (Cox and Snell)	Vaccination intention
Karimy et al.[26]	2021	Iran	1090	MLR	27%	Prevention practice
Zampetakis and Melas[27]	2021	Greece	1006	MLMA	59%	Vaccination intention
Tong KKit et al[28]	2020	China	616	MLR	6.5%	Face masking
Patwary et al[29]	2021	Bangladeshi	639	HLoR	21%(Cox and Snell)	Vaccine acceptance
Almazyad et al.[30]	2021	Saud Arabiya	135	MLR	65%	Prevention practice
Barakat and Kasemy[31]	2020	Egypt	182	MLR	58.4%	Prevention practice
Cervera-Torres et al.[32]	2021	Spain	325	MLR	28%	intention to self-isolate
González-Castro et al[33]	2021	Spain	757	Path analysis	35%	Prevention practice
Hossain et al.[34]	2021	Bangladesh	1,497	MLR	31%	vaccine hesitancy
Mirakzadeh et al.[35]	2021	Iran	80	SEM	56%	Prevention practice
Moghadam et al.[36]	2022	Iran	304	SEM	59%	Prevention practice
Kim and Kim[37]	2020	Korea	1525	MLR	27.7%	Prevention practice
Wang, Zhao, and Fan[38]	2021	China	337	HLR	25.6%	willingness to wear masks
Yan et al.[39]	2021	China	1255	HLR	38.2%	Adherence to prevention measure
Noghabi, Ali Delshad, et al.[40]	2021	Iran	1,020	MLR	51.1%	Prevention practice
Mirzaei et al.[41]	2021	Iran	558	MLR	29.3%	Prevention practice
Al-Metwali et al.[42]	2021	Iraq	1680	MLR	67.8%	Vaccine acceptance
Badr et al.[43]	2021	USA	2222	MLR	15%	Adherence to prevention measure
Fathian-Dastgerdi, Tavakoli, and Jaleh[44]	2021	Iran	797	HLR	46%	Prevention practice
Suess et al.[45]	2022	USA	1478	SEM	46.6%	Willingness to vaccinate
Mahindarathne, Prasad[46]	2021	Sri Lanka	307	MLR	48.7%	Prevention practice
Mercadante and Law[47]	2021	USA	525	Path analysis	13%	Decision-making determinant to vaccinate
Ellithorpe et al.[48]	2022	USA	682	MLR	62%	Intention to vaccinate
Tsai et al.[49]	2021	Taiwan	361	HLR	58.1%	Behavioral intention to practice
Handebo et al.[50]	2021	Ethiopia	301	MLR	54%	Intention to vaccinate
Zuo et al.[51]	2021	China	342	HLR	90.1%	Prevention practice
Hansen et al.[52]	2021	USA	425	MLR	41%	Social distancing
Mehanna, Elhadi, Lucero-Prisno[53]	2021	Sudan	680	MLR	43.4%	Adherence to prevention measure
Kamran et al.[54]	2021	Iran	1861	MLR	54.7%	Adherence to prevention measure
Rosental and Shmueli[55]	2021	Israel	628	HLoR	66%	Vaccine acceptance

HLoR: hierarchical logistic regression; MLR: multiple linear regression; HLR: hierarchical linear regression; MLMA: multilevel modeling analyses; SEM: structural equation modeling.

proportion of variance explained. Another three authors (J.B., N.K., and A.Y.) extracted data for the second outcome (associated factors of COVID-19 preventive behavior (constructs of HBM)) using table format which shows the effect size of each construct on COVID-19 prevention behavior with the level of significance. In case of disagreement, all the authors were met and discussed the issue and resolve it.

Quality assessment

To assess the quality of each study included in this systematic review, the modified Newcastle Ottawa Quality Assessment Scale for cross-sectional studies was used (Supplementary Table 2).[23] Three authors (A.Z., A.M., and T.S.) have assessed the quality of each study (i.e. methodological quality, sample selection, sample size, comparability and the outcome, and statistical analysis of the study). In the case of disagreement between authors; another four authors (M.G., J.B., N.K., and A.Y.) were involved and discussed and resolved the disagreement.

Statistical analysis

Selected articles were entered into Microsoft Excel spreadsheet format for analysis. For the primary objective (outcome) descriptive analyses such as the proportion of studies that better explained COVID-19 prevention behavior were made. For the second objective (outcome) frequency of each construct of the HBM for which it significantly predicts (significance ratio) COVID-19 prevention behavior were made considering all included studies. Then, verification of the most frequently associated (predictor) was given for possible use in the practical setting.

Patient and public involvement

In this review, neither patient nor the public was involved in the study design, conduct, reporting, or dissemination plans of our research.

Result

Overall, 1552 articles were retrieved using a search strategy about COVID-19 prevention behavior and HBM worldwide. Duplicates (257) were removed and 1295 articles remained. After reviewing ($n = 683$) articles were excluded by title, and ($n = 394$) articles were excluded by reading abstracts. Therefore, 218 full-text articles were accessed and assessed for inclusion criteria, resulting in the further exclusion of 186 articles primarily due to listed reasons (Figure 2). As a result, 32 studies fulfilled the inclusion criteria to undergo the final systematic review. Concerning the country in which the studies were done, the included studies relatively cover all segments of the globe despite Iran, the United States, and China having 7, 4, and 4 articles included countries, respectively. Of the total included studies 11(34%) of them utilized HBM for explaining COVID-19 vaccine acceptance and intention. The remaining 21 studies use HBM for explaining adherence and intention to practice COVID-19 prevention measures separately as well as in groups as prevention precaution (Table 1).

Predicting ability of HBM in COVID-related behavior

Regarding the predictive ability of the HBM, in the majority 28 (87.5%) of the studies, HBM has a good predictive ability ($R^2 > 25\%$) of COVID-19-related behavior.[24–27,30–42,44–46,48–55] From this nearly half (43.7%) of the studies, HBM had explained 50% and above variance of COVID-19-related behavior and intention. Overall, the explained variance for HBM ranged from 6.5% to 90.1% (Table 1).

Frequency of statistically significant association of HBM constructs with COVID-19 preventive behavior

Knowing how frequently a certain factor predicts certain behavior is important to consider that factor when we plan to change the respective behavior. Included studies in this review incorporate those six key constructs of HBM in their analysis model as a predictor of respective behavior. Considering this, perceived susceptibility was significantly associated with COVID-19-related behavior in 19(59.4%) studies and it was the only construct that is not missed in all studies. From these, in three studies it was considered in combination with perceived severity as a perceived threat. Similarly, perceived severity significantly predicted COVID-19-related behavior in 12 (40%) of studies. In two studies it was not considered as a predictor.

Regarding perceived benefit, it was significantly associated with COVID-19-related behavior in 29(96.7%) of studies even if it was not included in two studies as a model construct. It is the most frequently significant predictor of COVID-19-related behavior and intention in this review since it was not significant only in a single study (higher significance ratio). Likewise perceived barrier significantly predicted COVID-19-related behavior in 16 (64%) of the studies and it was not considered as a model construct in 7 studies.

Concerning self-efficacy, it was a significant predictor of COVID-19-related behavior in 14(87.5%) studies. Although it was missed in half of[16] included studies as a model construct, it is the second most frequently associated construct of HBM with COVID-19-related behavior. Similarly, cues to action were significantly associated with COVID-19-related behavior in 13 (72.2%) studies and it

Table 2. Significance ratio of HBM constructs with COVID-19-related behavior of each included studies in the systematic review 2022.

Authors	Statistically significant at ($p < 0.05$) effect size of constructs of HBM on respective COVID-19 prevention behavior					
	Perceived susceptibility	Perceived severity	Perceived benefit	Perceived barrier	Self-efficacy	Cues to action
An PL, et al.[24]	OR 2.3	With Ps	1.8	–	NI	8.5
Shmueli L.[25]	–	OR=2.36	4.49	–	1.82	1.99
Karimy M, et al.[26]	–	β=0.079	0.105	–0.182	NI	0.252
Zampetakis LA and Melas C[27]	b=–0.16	0.29	0.37	–0.31	NI	NI
Tong KK, et al[28]	–	–	β 0.08	–	NI	–
Patwary MM, et al[29]	OR=1.78	–	2.00	0.49	NI	2.05
Almazyad, EM, et al.[30]	β=0.378	–	0.156	–	–	–
Barakat AM and Kasemy ZA.[31]	β=0.162	–	0.239	–0.131	0.158	–
Cervera-Torres S, et al.[32]	–	–	β –0.138	–	–0.190	–
González-Castro JL, et al[33]	b=0.14	0.65	NI	NI	–	NI
Hossain MB, et al.[34]	β=–0.06	–0.11	–0.33	0.30	NI	NI
Mirakzadeh AA, et al.[35]	β=0.34	0.16	0.33	–	0.19	0.09
Moghadam MT, et al.[36]	–	β=0.18	0.14	–	0.14	0.35
Kim S and Kim S.[37]	β=–0.06	0.12	0.04	–	0.23	0.08
Wang M, Zhao C and Fan J.[38]	β=0.12	NI	0.10	–0.14	NI	NI
Yan E, et al.[39]	–	NI	0.10	–0.05	0.07	0.17
Noghabi A, et al.[40]	β=0.10	0.14	0.33	–0.20	0.23	0.09
Mirzaei A, et al.[41]	–	–	β=0.19	–0.25	0.30	NI
Al-Metwali BZ, et al.[42]	–	–	β=0.37	0.17	NI	0.15
Badr H, et al.[43]	b=0.23	With Ps	NI	NI	NI	NI
Fathian-Dastgerdi Z, Tavakoli B and Jaleh M[44]	β=– 0.05	–	0.07	–0.10	0.59	NI
Suess C, et al.[45]	β=.40	.79	0.91	NI	NI	NI
Mahindarathne PP[46]	–	–	b=0.40	–0.1	0.405	NI
Mercadante AR and Law AV[47]	–	–	β=–0.11	0.31	NI	–0.21
Ellithorpe ME, et al.[48]	–	b=0.08	0.66	NI	NI	NI
Tsai FJ, et al.[49]	β=0.09	–	0.27	–0.15	.48	–
Handebo S, et al.[50]	β=0.16	–	0.38	–0.16	NI	0.34
Zuo Y, et al.[51]	b=0.05	With Ps	0.37	NI	0.32	NI
Hansen AC, et al.[52]	b=0.43	–	0.82	NI	0.48	NI
Mehanna A, Elhadi YA, Lucero-Prisno DE[53]	–	b=0.11	0.35	–	NI	–
Kamran Aziz, et al.[54]	–	–	–	NI	NI	NI
Rosental H and Shmueli L.[55]	β=0.06	–	0.26	–0.15	NI	0.07
Significance ratio	59.4%	40%	96.7%	64%	87.5%	72.2%

b: unstandardized coefficient; β: standardized coefficient; NI: not included; Ps; Perceived susceptibility; –means nonsignificant.
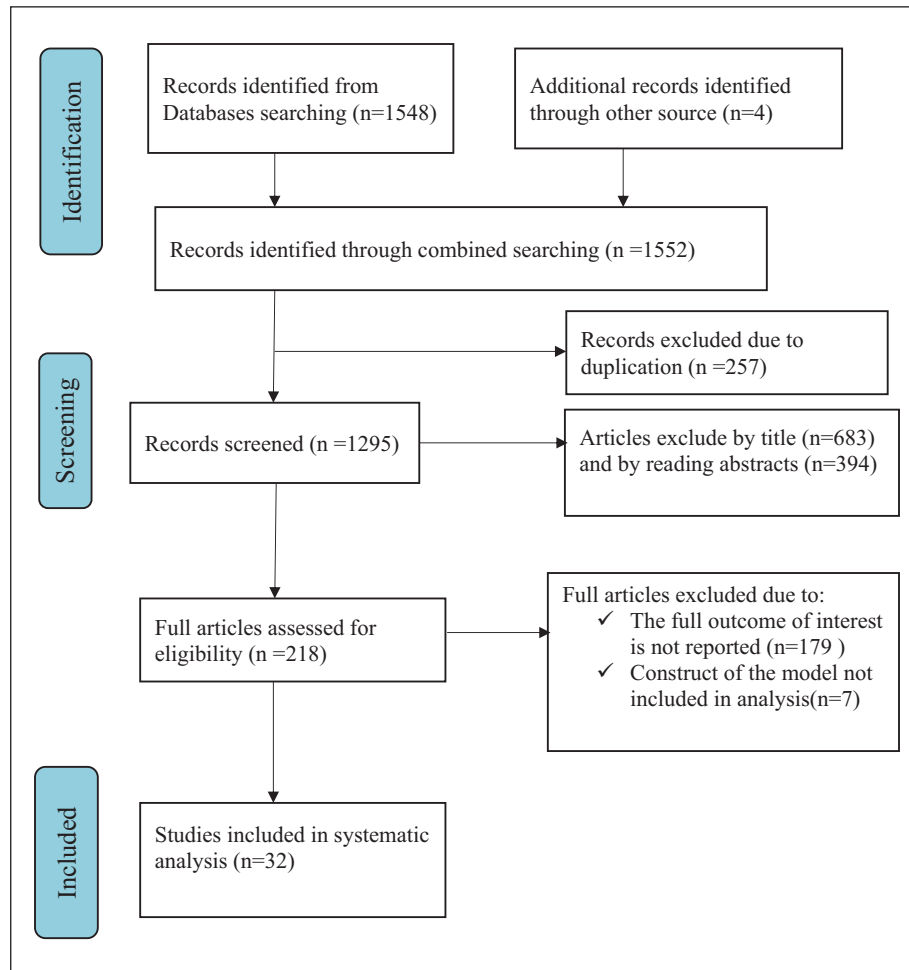
Figure 2. Flow chart of study selection for systematic review on predicting ability of the health belief model in COVID-19 preventive behavior.

was not considered as a model construct in nearly half[14] studies (Table 2).

Discussion

Psychological theories significantly contribute to the planning and design of effective public health and health promotion interventions.[16] This is particularly true in the current environment where public health officials need insights into effective COVID-19 responses, which has severely impacted many aspects of individuals' lives across the globe.[56] There is also increasing evidence that protective behaviors are culturally molded, requiring a focused examination of perceptions and behaviors using verified and practically supported frameworks.[57] One of the important frameworks was HBM which we have been using for many health-related behaviors including COVID-19-related behavior and intention. In this review, we have focused on this important framework (HBM) to assess its predictive ability and how frequently its construct predicts

the current COVID pandemic-related behavior in studies done all over the world.

We found that in the majority (87.5%) of the studies HBM has a good predictive ability of COVID-19-related behavior. From this, in half of the studies, HBM had explained 50% and above variance of COVID-19-related behavior and intention. The finding is consistent with a systematic review done on evaluating the effectiveness of the HBM in improving adherence by reviewing interventional studies. In that review, the majority (83%) of the HBM-based intervention studies achieved statistically significant improvements in adherence.[58] Overall, the explained variance for HBM ranged from 6.5% to 90.1%, which was comparable to a systematic review and meta-analysis on the effectiveness of HBM for mammography screening; the explained variance for HBM ranged from 25% to 89%.[59] This finding implies HBM had a significant predictive ability of COVID-19 preventive behavior and indicates the use of the model in designing an intervention to prevent and control the pandemic.

In this review, we have also examined the significant ratio of each six constructs of HBM with COVID-19 preventive behavior. The reason why we focus on the significance ratio of each construct is that knowing how frequently a certain variable or construct predicts certain behavior is important to consider the variable while we plan to change the respective behavior. Communication messages, as well as educational appeals, should target the factor that is frequently linked to the behavior. Concerning this perceived benefit was significantly associated with COVID-19 related behavior in almost all (96.7%) of studies. It was the most frequently significant predictor (highest significance ratio) of COVID-19-related behavior and intention. This finding was compliment with a systematic review and meta-analysis done on the effectiveness of HBM and the theory of planned behavior for mammography screening, in which the components of cues to action and perceived benefits were the variables most strongly associated with participation in mammography screening.[59] However, the significance ratio in the current review is slightly lower than a critical review on HBM-related investigations published during the period 1974–1984; in which the significance ratio of perceived benefit was 78%.[17] The possible discrepancy may be due to; the critical review was done for many different health behaviors which may lower the significance level of perceived benefit. In another way in the current review, perceived benefits (perceived importance of those COVID-19 prevention precautions) have great ability of predicting COVID-19 preventive behavior. This finding implies COVID-19 prevention behavior change intervention should address benefits of the prevention measures.

Self-efficacy, cues to action, perceived barrier, perceived susceptibility, and severity have 87.5%, 72.2%, 64%, 59.4%, and 40% significance ratios in this systematic review, respectively. This indicates self-efficacy was the second most frequent significant predictor of COVID-19-related behavior whereas perceived severity was the last significant predictor. This finding is compliment with a critical review of HBM-related investigations published during the period 1974–1984.[17] The finding implies COVID-19 behavior change intervention should target self-efficacy, important cues to action, individual perception of barriers, disease vulnerability, and severity in order of significance.

Restriction of our search strategy to the English language may limit our sample studies included in our review. Furthermore, variations in effect size that are reported by included primary studies restrict us from doing a meta-analysis to estimate pooled effect size rather we have focused on evaluating predicting ability of the HBM and identifying the most frequently associated construct of the model to COVID-19 preventive behavior.

Conclusion

HBM has a good predictive ability of COVID-19-related behavior in the majority of reviewed studies. This implies that HBM can explain COVID-19 preventive behavior by using its important components or constructs which increase its use in planning and designing an intervention to prevent and control the COVID-19 pandemic. To target our focus to the most frequently significant construct, we have evaluated the significance ratio of all constructs of HBM in the reviewed articles. Concerning this, perceived benefit was the most frequently significant predictor (highest significance ratio) of COVID-19-related behavior and intention. Self-efficacy, cues to action, perceived barrier, perceived susceptibility, and severity were the remaining significant predictor of COVID-19-related behavior in decreasing order of significance ratio. Public health professionals and health promotion experts should consider those constructs of HBM in order of significance while they plan and design behavior change interventions.

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Supplemental material

Supplemental material for this article is available online.

References

1. COVID W. *Guidance on maintaining essential health services and systems*. Geneva: World Health Organization, 2020.
2. Sohrabi C, Alsafi Z, O'Neill N, et al. World Health Organization declares global emergency: a review of the 2019 novel coronavirus (COVID-19). *Int J Surg* 2020; 76: 71–76.
3. Chan JF-W, Yuan S, Kok K-H, To KK-W Chu H, et al. A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster. *Lancet* 2020; 395(10223): 514–523.
4. Nicola M, Alsafi Z, Sohrabi C, et al. The socio-economic implications of the coronavirus and COVID-19 pandemic: a review. *Int J Surg* 2020; 78: 122.
5. World Health Organization. *Infection prevention and control guidance for long-term care facilities in the context of COVID-19: interim guidance, 21 March 2020*. Geneva: World Health Organization, 2020.
6. Control CfD Prevention. Centers for disease control and prevention coronavirus disease, 2019, https://www.cdc.gov/
7. Abdullahi Z, Aliyu M, Umar B, et al. Sanitizer and cleaning for COVID-19: principles, guidelines, and prospective, https://www.researchgate.net/publication/343473456_sanitizer_and_cleaning_for_covid-19_principles_guidelines_and_prospective
8. Rosenstock IM. Historical origins of the health belief model. *Health Educ Monograph* 1974; 2(4): 328–335.
9. Rosenstock IM, Strecher VJ and Becker MH. Social learning theory and the health belief model. *Health Educ Quart* 1988; 15(2): 175–183.
10. Tranfield D, Denyer D and Smart P. Towards a methodology for developing evidence-informed management knowledge by means of a systematic review. *Brit J Manag* 2003; 14(3): 207–222.
11. Briner RB and Walshe ND. From passively received wisdom to actively constructed knowledge: teaching systematic review skills as a foundation of evidence-based management. *Acad Manag Learn Educ* 2014; 13(3): 415–432.
12. Ahn E and Kang H. Introduction to systematic review and meta-analysis. *Korean J Anesthesiol* 2018; 71(2): 103.
13. Glanz K, Rimer BK and Viswanath K. *Health behavior: theory, research, and practice*. Hoboken, NJ: John Wiley & Sons, 2015.
14. Glanz K, Rimer BK and Viswanath K. *Health behavior, and health education: theory, research, and practice*. Hoboken, NJ: John Wiley & Sons, 2008.
15. Abraham C and Sheeran P. The health belief model. *Predict Health Behav* 2015; 2: 30–55.
16. Murphy S and Bennett P. Health psychology and public health: theoretical possibilities. *J Health Psychol* 2004; 9(1): 13–27.
17. Janz NK and Becker MH. The health belief model: a decade later. *Health Educ Q* 1984; 11(1): 1–47.
18. Sohl SJ and Moyer A. Tailored interventions to promote mammography screening: a meta-analytic review. *Prev Med* 2007; 45(4): 252–261.
19. Harrison JA, Mullen PD and Green LW. A meta-analysis of studies of the health belief model with adults. *Health Educ Res* 1992; 7(1): 107–116.
20. Moher D, Liberati A, Tetzlaff J, et al. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Ann Intern Med* 2009; 151(4): 264–269.
21. Rosenthal G and Rosenthal JA. *Statistics and data interpretation for social work*. New York: Springer, 2011.
22. Munn Z, Tufanaru C and Aromataris E. JBI's systematic reviews: data extraction and synthesis. *Am J Nurs* 2014; 114(7): 49–54.
23. McPheeters ML, Kripalani S, Peterson NB, et al. Closing the quality gap: revisiting the state of the science (vol. 3: quality improvement interventions to address health disparities). *Evid Report Technol Assess* 2012; 208(3): 1–475.
24. An PL, Nguyen HTN, Dang HTB, et al. Integrating health behavior theories to predict intention to get a COVID-19 vaccine. *Health Serv Insights* 2021; 14: 11786329211060130.
25. Shmueli L. Predicting intention to receive COVID-19 vaccine among the general population using the health belief model and the theory of planned behavior model. *BMC Public Health* 2021; 21(1): 1–13.
26. Karimy M, Bastami F, Sharifat R, et al. Factors related to preventive COVID-19 behaviors using health belief model among general population: a cross-sectional study in Iran. *BMC Public Health* 2021; 21(1): 1–8.
27. Zampetakis LA and Melas C. The health belief model predicts vaccination intentions against COVID-19: a survey experiment approach. *Appl Psychol Health Well Being* 2021; 13(2): 469–484.
28. Tong KK, Chen JH and Yu EWy Wu AM. Adherence to COVID-19 precautionary measures: applying the health belief model and generalized social beliefs to a probability community sample. *Appl Psychol* 2020; 12(4): 1205–1223.
29. Patwary MM, Bardhan M, Disha AS, et al. Determinants of COVID-19 vaccine acceptance among the adult population of Bangladesh using the health belief model and the theory of planned behavior model. *Vaccines* 2021; 9(12): 1393.
30. Almazyad EM, Ahmad A, Jomar DE, et al. Perception of ophthalmologists of COVID-19 using the health belief model. *Cureus* 2021; 13(1): e12681.
31. Barakat AM and Kasemy ZA. Preventive health behaviors during coronavirus disease 2019 pandemic based on health belief model among Egyptians. *Middle East Current Psychiat* 2020; 27(1): 1–9.
32. Cervera-Torres S, Ruiz-Fernández S, Godbersen H, et al. Influence of resilience and optimism on distress and intention to self-isolate: contrasting lower and higher COVID-19 illness risk samples from an extended health belief model. *Front Psychol* 2021; 12: 662395.
33. González-Castro JL, Ubillos-Landa S, Puente-Martãnez A, et al. Perceived vulnerability and severity predict adherence to COVID-19 protection measures: the mediating role of instrumental coping. *Front Psychol* 2021; 12: 674032.
34. Hossain MB, Alam M, Islam M, et al. Health belief model, theory of planned behavior, or psychological antecedents: what predicts COVID-19 vaccine hesitancy better among the Bangladeshi adults? *Front Public Health* 2021: 1172.
35. Mirakzadeh AA, Karamian F, Khosravi E, et al. Analysis of preventive behaviors of rural tourism hosts in the face of COVID-19 pandemic: application of health belief model. *Front Public Health* 2021; 9: 793173.

36. Tajeri Moghadam M, Zobeidi T, Sieber S, et al. Investigating the adoption of precautionary behaviors among young rural adults in South Iran during COVID-19. *Front Public Health* 2022; 10: 787929.

37. Kim S and Kim S. Analysis of the impact of health beliefs and resource factors on preventive behaviors against the COVID-19 pandemic. *Int J Environ Res Public Health* 2020; 17(22): 8666.

38. Wang M, Zhao C and Fan J. To wear or not to wear: analysis of individuals' tendency to wear masks during the COVID-19 pandemic in China. *Int J Environ Res Public Health* 2021; 18(21): 11298.

39. Yan E, Lai DW, Lee VW, et al. Predicting public adherence to COVID-19 preventive measures: a cross-sectional study in Hong Kong. *Int J Environ Res Public Health* 2021; 18(23): 12403.

40. Delshad Noghabi A, Mohammadzadeh F, Yoshany N, et al. The prevalence of preventive behaviors and associated factors during the early phase of the COVID-19 pandemic among Iranian people: application of a health belief model. *J Prev Med Hyg* 2021; 62(1): E60–E66.

41. Mirzaei A, Kazembeigi F, Kakaei H, et al. Application of health belief model to predict COVID-19-preventive behaviors among a sample of Iranian adult population. *J Educ Health Promot* 2021; 10: 69.

42. Al-Metwali BZ, Al-Jumaili AA, Al-Alag ZA, et al. Exploring the acceptance of COVID-19 vaccine among healthcare workers and general population using health belief model. *J Eval Clin Pract* 2021; 27(5): 1112–1122.

43. Badr H, Oluyomi A, Woodard L, et al. Sociodemographic and health belief model factors associated with nonadherence to COVID-19 mitigation strategies in the United States. *Ann Behav Med* 2021; 55(7): 677–685.

44. Fathian-Dastgerdi Z, Khoshgoftar M, Tavakoli B, et al. Factors associated with preventive behaviors of COVID-19 among adolescents: applying the health belief model. *Res Social Adm Pharm* 2021; 17(10): 1786–1790.

45. Suess C, Maddock J, Dogru T, et al. Using the health belief model to examine travelers' willingness to vaccinate and support for vaccination requirements prior to travel. *Tour Manag* 2022; 88: 104405.

46. Mahindarathne PP. Assessing COVID-19 preventive behaviors using the health belief model: a Sri Lankan study. *J Taibah Univ Med Sci* 2021; 16(6): 914–919.

47. Mercadante AR and Law AV. Will they, or Won't they? Examining patients' vaccine intention for flu and COVID-19 using the health belief model. *Res Soc Admin Pharm* 2021; 17(9): 1596–1605.

48. Ellithorpe ME, Aladé F, Adams RB, et al. Looking ahead: caregivers' COVID-19 vaccination intention for children 5 years old and younger using the health belief model. *Vaccine* 2022; 40: 1404–1412.

49. Tsai F-J, Hu Y-J, Chen C-Y, et al. Using the health belief model to explore nursing students' relationships between COVID-19 knowledge, health beliefs, cues to action, self-efficacy, and behavioral intention: a cross-sectional survey study. *Medicine* 2021; 100(11): e25201.

50. Handebo S, Wolde M, Shitu K, et al. Determinant of intention to receive COVID-19 vaccine among school teachers in Gondar City, Northwest Ethiopia. *PLoS ONE* 2021; 16(6): e0253499.

51. Zuo Y, Zhang M, Si Y, et al. Prediction of health risk preventative behavior of amateur marathon runners: a cross-sectional study. *Risk Manag Healthc Policy* 2021; 14: 2929–2944.

52. Hansen AC, Farewell CV, Jewell JS, et al. Exploring predictors of social distancing compliance in the United States during the COVID-19 pandemic. *Disaster Med Public Health* 2021; 9: 1–7.

53. Mehanna A, Elhadi YAM and Lucero-Prisno Iii DE. Public willingness to adhere to COVID-19 precautionary measures in Sudan: an application of the health belief model. *Pan Afr Med J* 2021; 39: 135.

54. Kamran A, Isazadehfar K, Heydari H, et al. Risk perception and adherence to preventive behaviors related to the COVID-19 pandemic: a community-based study applying the health belief model. *Bjpsych Open* 2021; 7(4): e113.

55. Rosental H and Shmueli L. Integrating health behavior theories to predict COVID-19 vaccine acceptance: differences between medical students and nursing students. *Vaccines* 2021; 9(7): 783.

56. Bavel JJV, Baicker K, Boggio PS, et al. Using social and behavioral science to support COVID-19 pandemic response. *Nature Human Behavior* 2020; 4(5): 460–471.

57. Karl J and Fischer R. Affect and state mindfulness, 2021, https://www.researchgate.net/publication/350019417_Affect_and_State_Mindfulness

58. Jones CJ, Smith H and Llewellyn C. Evaluating the effectiveness of health belief model interventions in improving adherence: a systematic review. *Health Psychol Rev* 2014; 8(3): 253–269.

59. Ritchie D, Van den Broucke S and Van Hal G. The health belief model and theory of planned behavior applied to mammography screening: a systematic review and meta-analysis. *Public Health Nurs* 2021; 38(3): 482–492.