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The Use of the Health Belief Model in the Context of Heatwaves Research: A Rapid Review

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Abstract

As heatwaves increase and intensify worldwide, so has the research aimed at outlining strategies to protect individuals from their impact. Interventions that promote adaptive measures to heatwaves are encouraged, but evidence on how to develop such interventions is still scarce. Although the Health Belief Model is one of the leading frameworks guiding behavioral change interventions, the evidence of its use in heatwave research is limited. This rapid review aims to identify and describe the main themes and key findings in the literature regarding the use of the Health Belief Model in heatwaves research. It also highlights important research gaps and future research priorities. Following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, 10 articles were included, with a geographic distribution as follows: United States (n = 1), Australia (n = 1), Pakistan (n = 1), and China (n = 1), as well as Malaysia (n = 2), Germany (n = 1), and Austria (n = 1). Results showed a lack of research using the Health Belief Model to study heatwaves induced by climate change. Half of the studies assessed heatwave risk perception, with the 2 most frequently used constructs being Perceived Susceptibility and Perceived Severity. The Self-efficacy construct was instead used less often. Most of the research was conducted in urban communities. This review underscores the need for further research using the Health Belief Model.

Background

The world is witnessing an extraordinary threat level posed by climate change, characterized by a rise in the frequency of extreme events such as heatwaves, wildfires, cold waves, droughts, floods, and hurricanes. The 2021 Global Climate Risk Index shows that from 2000 to 2019, over 475 000 people lost their lives due to more than 11 000 extreme weather events worldwide, resulting in economic losses totaling approximately US$2.56 trillion.[1] In particular, the increasing trend in the frequency and intensity of heatwaves is particularly concerning as emphasized in the IPCC 6th Assessment Report,[2] and in previous research.[3–6] Approximately 30% of the world's population experiences 20 days of extreme heat annually.[7] Without interventions to reduce greenhouse gas emissions, it is projected that this number will increase to 74% by 2100.[5,8] Heatwaves are often associated with increased mortality and morbidity.[9–12] As with other public health threats, interventions that encourage adaptive measures at the individual level are thus very needed. Health behaviors of individuals are influenced by various factors, such as interactions with healthcare providers, patients' perception of risk, and availability of health services, among others.[13,14]

Behavioral scientists have sought to understand individual changes in health behaviors through the lens of specific theoretical and conceptual frameworks.[15,16] Historically, the HBM has been widely used since the 1950s to understand individuals' health behavior and has been applied globally in different cultural contexts and fields to encourage preventive behaviors,[17,18] such as health promotion, health risks, and vaccination, as well as contraceptive use,[19–26] patients' adherence to medical treatments,[27,28] and physician visits.[29,30]

The HBM model states that an individual's health behavior is determined by 6 constructs: perceived susceptibility *(perception of the risk of contracting a condition)*, perceived severity (*perception of the seriousness of a personal vulnerability and its consequences e.g., death, disability, injury, and pain)*, perceived benefits *(perception that engaging in recommended behaviors would bring benefits and would be efficacious)*, and perceived barriers *(perception of the negative aspect of a particular recommended action, which acts as an impediment to undertaking such action)*, as well as cues to actions *(factors that prompted action)*; and self-efficacy *(confidence in one's ability to perform the recommended health behavior)*.[31]

The use of the HBM beyond health sciences is more recent and still limited. Recently, there has been a growing interest in the use of the HBM in the field of disaster science. For instance, Inal et al.,[32] used the HBM for developing a disaster preparedness belief scale; Ejeta et al.,[33] used it to predict a community's flood preparedness.

The increasing frequency and intensity of heatwaves pose serious risks to the population and could drastically reduce human activity. However, heatwaves are often overlooked in the examination of extreme weather events, particularly concerning their impacts on the economy and health.[34] Despite the substantial and overwhelming evidence regarding the consequences of heatwaves,[5,7,35–37] the inclination of individuals to believe that they can manage the threat presented by heatwaves in comparison to other hazards amplifies the concern surrounding heatwaves. This lack of understanding regarding heatwaves underscores the significance of investigating perception and adaptive behaviors concerning their risks. Therefore, more research is warranted, employing established frameworks like the HBM, to explore perceptions, motivations, and behaviors linked to extreme heat events.[34,38,39] This approach can facilitate the formulation of precise interventions aimed at safeguarding individuals from the adverse repercussions of heatwaves and, ultimately, contributing to enhanced public health outcomes amidst the backdrop of climate change. Hence, this rapid review aimed to evaluate how much the HBM (as a conceptual framework) has been used in the context of heatwaves globally, to emphasize research gaps and future research priorities.

Methods

Databases and Search Terms

In December 2022, a systematic literature search was conducted in PubMed, Scopus, and Web of Science to identify relevant peer-reviewed studies following the PRISMA guidelines.[40] The search terms used were "heatwave" OR "heat wave" AND "Health Belief Model" OR "HBM" whereas similar keywords for heatwaves such as "high temperature," "hot weather," "extreme temperature," "extreme heat" were used to identify relevant articles (see Appendix A for a full list of search terms and queries).

Inclusion and Exclusion Criteria

Peer-reviewed articles were included if they dealt with heatwaves and used the HBM in their methodology, either fully or partially. A variety of articles were included, such as systematic, scoping, and narrative reviews, as well as letters to the editor, and original studies, etc. The exclusion criteria comprised publications in the form of books/ chapters, guidelines, policy reports, and original studies that did not use the HBM as part of their methodology, fully or partially. The search was unrestricted in terms of time frame due to the limited availability of studies on the topic.

Data Extraction

The following information was extracted from the retrieved articles: author(s), year of publication, geographical location (country), and article title, as well as type of article, objectives of the study, HBM use, and type of study. Other information used include study population, sample size, data collection methodology, and questionnaire/ interview language, as well as type of scale used, demographic data, empirical methods used, and study limitation. Data extraction was performed using a standardized excel spreadsheet developed for this review. The selected articles were thoroughly analyzed to investigate HBM use. First, the HBM constructs were clustered into different subgroups based on the number of statements used to define each construct. Subsequently, all the HBM constructs were subdivided into different themes. Methodological implications, scope, and fidelity to theory were also explored. Data was also extracted from the retrieved articles to address the usage of the 6 elements of the HBM and the type of statements used. The statements used to express HBM constructs were quantitatively analyzed to reveal the most emphasized constructs in the context of heatwaves research.

Results

A total of 1971 potentially relevant articles were generated by the search string, and eligibility criteria were applied to narrow down the articles for full-text reading. The article selection process is outlined in the PRISMA Flow Diagram in Figure 1. The included articles were published in the last 10 years and represented the following geographical locations: Canada (n = 2),[41,42] United States (n = 1),[43] Australia (n = 1),[38] and Pakistan (n = 1),[44] as well as China (n = 1),[45] Malaysia (n = 1),[46,47] Germany (n = 1),[48] and Austria (n = 1).[49] Among them, 8 studies were conducted in urban settings, 1 in urban and peri-urban settings, and 1 in both urban and rural settings. All the retrieved articles adopted a cross-sectional study design (Table 1). We excluded articles from the final list of articles for different reasons such as articles not aligning with the study's objective or using the HBM in studying other phenomena such as floods etc.

Health Belief Model Use

The Health Belief Model's 6 constructs - Perceived Susceptibility, Perceived Severity, Perceived Benefits, and Perceived Barriers, as well as Cues to Action, and Self-Efficacy, were used differently in the studies and expressed through different statements. A total of 119 different statements were used across all the studies, as shown in Table 2.

Three studies used the HBM as a framework to measure knowledge, risk perception, attitude, and practices with regard to heatwaves.[45–47] Arsad et al. used the HBM as a guiding principle to develop and validate a questionnaire on knowledge, risk perception, attitudes, and practices regarding heatwaves in Malaysia. Wang et al. used 4 different constructs of the HBM (Perceived Susceptibility, Perceived Severity, Perceived Benefits, and Cues to Actions) to develop a questionnaire for assessing the health-related adaptive behaviors and perception towards climate change among students.[45] Furthermore, the study investigated specific climate change-related phenomena such as extreme heat exposure, extreme cold exposure, and rainstorm exposure. Wong et al. used the HBM as a framework aiming to measure people's knowledge, attitudes, prevention practices, and health impact of temperature rise associated with the Urban Heat Island.[47]

Three studies used the HBM to predict the adoption of healthy behaviors during heatwaves.[38,41,44] Akompab et al. used the HBM as a framework to study cognitive determinants that play a key role in an individual's perception and adaptive behaviors regarding heatwaves.[38] Rauf et al. used the HBM as a theoretical framework to assess heatwaves related perception of Faisalabad's residents in both urban and peri-urban settings,[44] while Richard et al. used the

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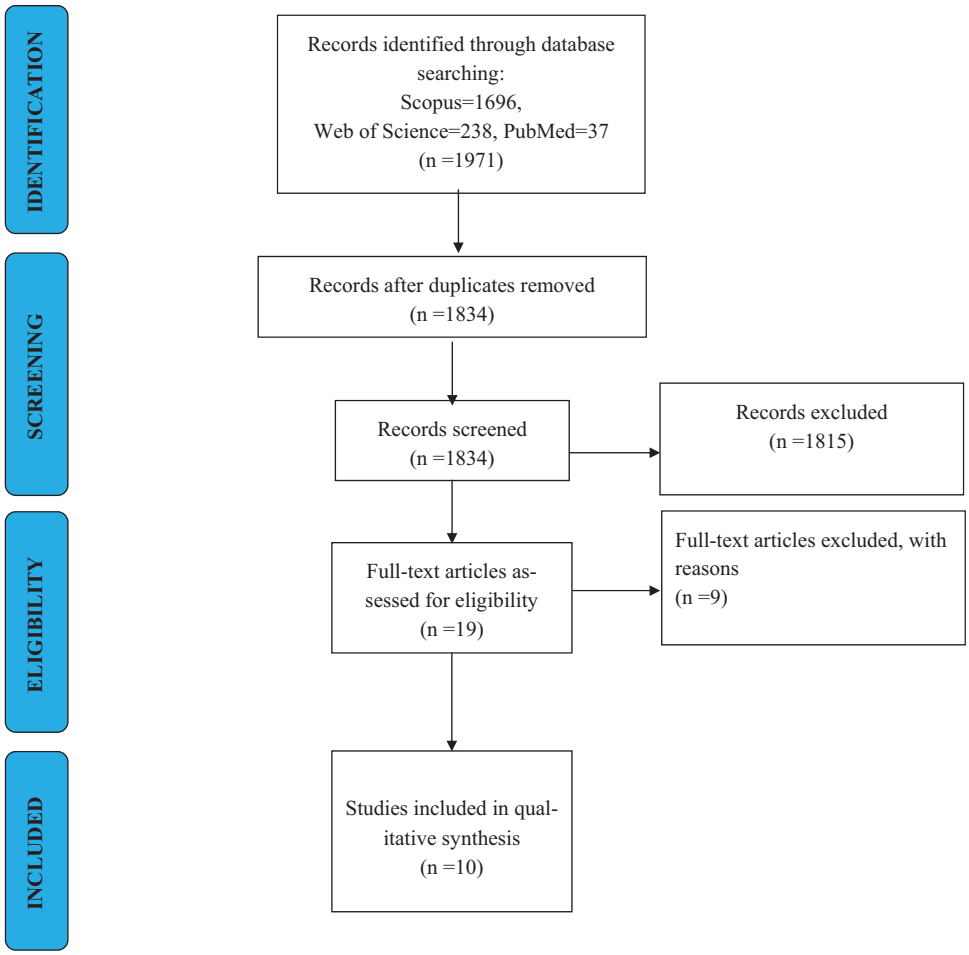

Figure 1. PRISMA flow diagram.

HBM to test the predictive performance in taking preventive action for older adults with chronic health conditions such as Chronic Heart Failure (CHF) and Chronic Obstructive Pulmonary Disease (COPD).[41]

Likewise, 4 studies used the HBM along with other models and theories in measuring adaptation behaviors toward heatwaves.[42,43,48,49] Beckman et al. used the HBM model to measure heatwave risk perception among private household owners. Grothmann et al. used the HBM constructs along with other theories such as Protection Motivation Theory (PMT) and Norm-Activation Theory (NAT), to develop targeted communication formats to change behaviors. The study emphasized the use of these theories for designing communication interventions that are relevant to the behavioral change.[49] Semenza et al. applied the HBM to measure respondents' motivation to involve in voluntary mitigation and adaptation actions based on their beliefs and attitudes.[43] Valois et al. used the HBM along with the Theory of Planned Behavior (TPB) to predict and explain elderly people's self-reported Heat Adaptation Behavior (HAB). They evaluated whether using two HBM constructs in addition to TPB variables increased the predictive performance of the model in predicting the adoption of HAB.

The analysis of the fidelity of original studies to the HBM revealed that all studies except 2 were either guided by or grounded in the principles of the HBM.[42,48] Two studies implemented the HBM in its complete and original form.[43,47] Six studies[38,41–44,47] integrated the HBM across all phases of their research, including problem formulation, objective establishment, and methodology, as well as data interpretation, and more. Lastly, apart from a single study,[48] the HBM model played a pivotal role in shaping the findings of the reviewed articles. Supplementary Table (Level of fidelity to the theory of the included articles) provides an overview of the level of fidelity to the theory of the articles included in this review.

HBM Constructs

The aim of this section is to show how the HBM's 6 constructs were utilized and what types of statements were selected. The subthemes identified within each construct are presented visually in Figure 2.

Perceived susceptibility

Two studies referred to perceived vulnerability as a synonym for perceived susceptibility.[32,44] In this context, 2 main thematic areas have been identified, namely "health and well-being," and "location and environment" (Figure 2). "Health and well-being" items were largely focused on health complications arising due to extreme heat such as dehydration, respiratory disease, and sunburn (e.g., "Due to my state of health, if I do not protect myself from the heat, I am more likely to suffer from respiratory difficulties during a heatwave").[41] "Location and environment"

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Table 1. Details of reviewed articles

S. No	Authors	Objectives/ Aims	Year	Country	Used components of HBM
1.	Arsad et al.	To develop and validate a Malay-language questionnaire for measuring Knowledge, Risk Perception, Attitude, and Practices (KRPAP) regarding Heatwaves in the Malaysian community.	2022	Malaysia	Perceived Susceptibility, Perceived Severity, Perceived Benefits, Perceived Barriers, and Cues to Actions
2.	Wang et al.	To investigate knowledge, attitude, risk perception, and health-related adaptive behaviors of primary school children towards climate change; to explore influencing factors; to validate the theoretical framework of adaptive behaviors concerning climate change.	2022	China	Perceived Severity, Perceived Susceptibility/ Vulnerability
3.	Beckmann et al.	To analyze factors related to heat adaptation measures in private households by applying Protective Action Decision Model (PADM).	2021	Germany	Perceived Severity, Perceived Susceptibility/ Vulnerability
4.	Valois et al.	To predict and explain elderly people's self-reported Heat Adaptation Behavior (HAB) using the Theory of Planned Behavior (TPB) and some constructs from the HBM, to identify the beliefs that are the most important for elderly people, and to examine the moderated effect of gender on HAB, beliefs, attitudes, intentions, perceived control over behaviors, and perceived social norms.	2020	Canada	Perceived Severity, Perceived Susceptibility/ Vulnerability
5.	Wong et al.	To assess the knowledge, attitudes, prevention practices, and health impact of temperature rise associated with Urban Heat Island 2018 Malaysia.	2018	Malaysia	Perceived Susceptibility, Perceived Severity, Perceived Benefits, Perceived Barriers and Cues to Actions, Self-efficacy
6.	Grothmann et al.	The aim was to develop communication formats targeting specific group using psychological knowledge and theories such as Protect Motivation Theory, Health Belief Model, Norm-Activation.	2017	Austria	Perceived Susceptibility, Perceived Severity, Perceived Benefits, Perceived Barriers
7.	Rauf et al.	To bridge the information gap in heatwaves literature in Pakistan by examining knowledge, perception, and adaptation to heatwaves along with delineating factors that influence these variables.	2017	Pakistan	Perceived Susceptibility, Perceived Severity, Perceived Benefits, Perceived Barriers, and Cues to Actions
8.	Akompab et al.	To examine the usefulness of the constructs of the HBM in predicting the adoption of healthy behaviors during heatwaves, to identify the factors that will predict risk perception to heatwaves, and to assess participants' knowledge related to heatwaves.	2013	Australia	Perceived Susceptibility, Perceived Severity, Perceived Benefits, Perceived Barriers, and Cues to Actions
9.	Richard et al.	To evaluate the association between selected components of the HBM for heat-related and protective behavior among noninstitutionalized middle-aged and older adults with serious chronic health conditions.	2011	Canada	Perceived Susceptibility, Perceived Severity, Perceived Benefits, Perceived Barriers, and Cues to Actions
10.	Semenza et al.	To assess the health context as a motivating factor for adaptation and mitigation behavior.	2011	USA	Perceived Susceptibility, Perceived Severity, Perceived Benefits, Perceived Barriers and Cues to Actions, Self-efficacy

items refer to the susceptibility of someone's living and/ or working environment and location (e.g., "Meteorologists speak of 'hot days,' these are days with temperatures of more than 30 degrees Celsius. To what extent do you think that climate change will lead to an increase in the number of hot days in the region in which you work?").[49]

Perceived severity

Based on the statements used, 3 main thematic areas were identified within the perceived severity construct, namely "physical health," "mental health," and "lifestyle disruption and health services utilization" (Figure 2). "Physical health" encompassed the risk of physical injuries, respiratory difficulties, dehydration, and skin cancer, as well as long-term health complications, and personal loss (e.g., "Dehydration due to heatwaves may lead me to long-term health damages")[44]. "Mental health" included the possible consequences of heatwaves on people's mental health (e.g., "Some people say that they feel negative impacts on their mental health during periods of high heat and high humidity. If this happens to you next summer, would you say that the negative consequences for your mental health will be very severe?").[42] "Lifestyle disruption and health services utilization" incorporated statements on disruption in life and lifestyle as a result of heatwaves (e.g., "Do you believe that climate change can endanger your life/ lifestyle?"). [43]

Perceived benefits

Statements on *Perceived benefits* were further sub-categorized into 3 key areas, namely "hygiene and sanitation measures," "lifestyle and behavioral measures," and "care for others" (Figure 2). "Hygiene and sanitation measures" highlighted benefits such as safe water, better sleep, stable health, and personal preparedness to reduce negative health consequences (e.g., "Staying at home allows me to keep my health stable during a heatwave").[41] "Lifestyle and behavioral measures" reported the benefits of adopting new habits, use of protective measures, and staying cool in an air-conditioning environment, etc. (e.g., "Staying in an air-conditioned environment will reduce the chance of me suffering from dehydration").[38] "Care for others" encompasses measures that benefit friends, family members, and loved ones (e.g., "Is there already something

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Table 2. Number of statements used by authors for all the Health Belief Model constructs

HBM Constructs	Arsad et al.	Wang et al.	Beckmann et al.	Valois et al.	Wong et al.	Grothmann et al.	Rauf et al.	Akompab et al.	Richard, et al.	Semenza, et al.	Total No. of Statements
Perceived Susceptibility	3	2	1	1	1	1	4	4	3	1	21
Perceived Severity	3	2	1	2	1	1	5	5	9	1	30
Perceived Benefits	3	1	0	0	1	1	6	6	5	1	24
Perceived Barriers	3	0	0	0	1	1	4	4	8	1	22
Cues to Actions	3	1	0	0	1	1	5	5	3	1	20
Self-efficacy	0	0	0	0	1	0	0	0	0	1	2
Total No. of Statements	15	6	2	3	6	5	24	24	28	6	119

Figure 2. Sub-categorization of Health Belief Model constructs based on the reviewed articles.

you currently do to prevent negative effects of heat on the people you care for? If so, what?").[49]

Perceived barriers

The different statements used in retrieved studies were categorized into 4 key domains, namely "economic barriers," "health barriers," "security barriers," and "general barriers" (Figure 2). "Economic barriers" included high costs associated with the use of available resources such as buying an air conditioner (AC) or paying electric bills (e.g., "During a heatwave, it is too expensive to buy or run an AC").[38] "Health barriers" included actions such as drinking less water due to personal health or a perception of ACs as bad for personal health (e.g., "My health condition will not allow me to drink more water").[44] "Security barriers" included household-related obstacles in implementing protective actions, and hesitance to leave doors open at night due to safety issues (e.g., "Due to security issues, I will not open my doors at night even during a heatwave").[38] "General barriers" included a lack of understanding by older populations of available resources such as AC, or the disturbance caused by the noise generated by AC (e.g., "During a heatwave, it is difficult to adjust the temperature/ air-conditioner").[41]

Cues to action

The different statements used to measure cues to action construct of the HBM were classified into 2 main domains: "internal cues" and "external cues" (Figure 2). "Internal cues" include the experience of heatwaves and personal motivations (e.g., "As a result of my personal experience of heatwaves, I would keep safe during such a heatwave").[38] "External cues" included warnings received from others, and the acquisition of early warning information to avoid the negative impacts of extreme heat (e.g., "I will adapt to heatwaves if I would have been warned by a family member/friend about their severity").[44]

Self-efficacy

Only 2 studies in the retrieved articles used self-efficacy in their analysis through the use of 2 different statements (e.g., Do you think that you have the ability and power to protect yourself from dangerous events from climate change?").[43] Both studies focused on how people can bring change in their lifestyles i.e., the "ability to change" (Figure 2).

Heatwaves Risk Perception

Six out of 10 studies used the constructs of "Perceived Vulnerability" and "Perceived Severity" to assess heatwave-related risk perception.[38,44–46,48,49] Some determinants of risk perception were then identified in the target populations. For instance, determinants of low-risk perception were being married, earning a gross annual household income greater than $60 000, not having a fan, and having a high level of knowledge,[38,44] while 1 determinant was found for high-risk perception, i.e., living with others.[38]

Some other studies investigated determinants of specific HBM constructs. In particular, fatalism, perceived work stress, and living in urban (vs. peri-urban) areas were identified as determinants of high perceived barriers,[44,49] while experiencing health impacts related to the Urban Heat Island (UHI) was associated with having high perceived susceptibility, high perceived severity, high perceived benefits, and barriers to preventing UHI.[47] Studies also

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used the HBM to identify determinants of adaptive measures, respectively identifying high perceived susceptibility,[42,43] high perceived severity,[42,43] high perceived benefits,[38,41,43,44] low perceived barriers,[41,44] and high cues to action.[38,41,44]

Discussion

This rapid review sheds light on the utilization of the HBM in the field of climate change research, specifically in the context of heatwaves. Despite the widespread use of the HBM in health behavior research, this rapid review highlights the limited use of the HBM in the context of heatwaves research globally. The review highlights the variations in the application of the HBM across the studies, with a diverse array of constructs and statements used by authors for various purposes. This may indicate a need for standardization of the HBM constructs in the context of heatwaves research. Moreover, the results demonstrate that the HBM constructs can effectively be implemented in various contexts and locations, something that was already suggested by previous research.

Besides the HBM, other theories have been used to address heatwaves such as the Theory of Planned Behavior (TPB).[50,51] However, this theory mostly focuses on attitudes, social norms, and perceived control over behavior with a broader focus that extends beyond health-specific contexts. The HBM is one of the most widely used models and explains why individuals engage in health behaviors such as seeking advice or undergoing assessment for health concerns. The HBM was therefore chosen because it addresses individual beliefs and perceptions related to health threats and to engage in protective actions.

Developing countries were under-represented in the review, even if they are the most exposed to a greater occurrence of heatwaves.[37] This confirms trends in climate change research globally,[52] and underlines an important gap that needs to be filled. It is also noteworthy that most of the studies were conducted in urban communities, indicating a lack of research in rural and peri-urban communities. This is relevant, as these may face different challenges and barriers in adapting to heatwaves. While evidence suggest that people living in urban areas are generally more vulnerable to the impact of heatwaves,[53] exploring heatwaves' perception in rural contexts could be informative for the development of targeted preventive interventions. In addition, few studies used HBM to predict the adoption of healthy behaviors during heatwaves, suggesting that more research in this area is warranted. Additionally, there is a gap in the research on the use of 'Self-efficacy' in the context of heatwaves and the potential importance of this construct in promoting adaptive behaviors. It has been observed that within social cognitive theories, self-efficacy beliefs are powerful predictors of behaviors,[54] as they represent the level of confidence in one 's ability to implement a preventive/ adaptive behavior.

Strengths and Limitations

The present review had some limitations which should be considered. The search was restricted to published scientific articles, thus excluding any relevant insights from grey literature. Additionally, the focus of the review was narrowed to the use of the HBM in the context of heatwaves, as expanding the search to encompass all 6 constructs of the HBM separately would have gone beyond the scope of this rapid review, potentially warranting a separate dedicated literature review. Likewise, the scarcity of articles using the HBM resulted in a small number of articles selected for a thorough analysis. Despite these limitations, the review offers a glimpse into the current use of HBM in this context that can be useful to guide future research. Additionally, the review highlights a growing trend in the use of the HBM in recent years, indicating a growing interest in the model.

Conclusions and Recommendations

This study is the first comprehensive literature review on the use of the HBM in the context of heatwaves. Our findings demonstrate that while the utilization of the HBM in the examination of heatwaves is currently in its infancy, there is potential for future growth and advancement in this field, including broadening representation across geographical regions, languages, and the inclusion of the self-efficacy construct in future studies. Moreover, there is a need for better standardization of the HBM constructs, more research in rural and peri-urban communities, and the use of HBM to predict the adoption of healthy behaviors during heatwaves.

With a clear mandate and objective, the model possesses the strength to be used in the context of climate extremes and can be extended to different types of hazards and risks. Given the increasing attention from governments and institutions to climate change adaptation, including at a community level, more research using the HBM in the context of heatwaves and other extreme weather events is warranted.

Supplementary material. To view supplementary material for this article, please visit https://doi.org/10.1017/dmp.2024.26

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