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EXPLORING INFLUENCING FACTORS ON THE ADOPTION OF NON-PHARMACEUTICAL INTERVENTIONS DURING PANDEMICS: COVID-19 AS AN EXAMPLE

By

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B.Sc., King Saud University, 2015
M.S., Thomas Jefferson University, 2019

A Dissertation
Submitted to the Faculty of the
School of Public Health and Information Sciences of the University of Louisville
in Partial Fulfillment of the Requirements
for the Degree of

Doctor of Philosophy in Public Health Sciences

Department of Health Promotion and Behavioral Sciences
University of Louisville
Louisville, Kentucky

May 2024

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A Dissertation Approved on
April 4, 2024

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DEDICATION

To

My beloved mother

Whose unwavering love, support, belief, and encouragement have been the cornerstone of my journey.

To

My late father

Today, I fulfill my promise to you that I will, one day, become a doctor.

ACKNOWLEDGMENTS

"يا عظيمَ اللطف، ويا جميلَ العَطف، يا مَن خزائنُه ملأى ويمينُه سخَّى، مسألتي وفَّقتني إليها، وأعنتني عليها، وأجبتني فيها، وتقدَّم إحسانُك، وتواتر امتنانُك، ولا زِلت يا وهَّابُ في رِعاية أمري ووِلايته، وتدبير حالي وكِفايته. وكم من مسألة اوصدت ابوابها فكان القصد الى بابك، وكم من حاجة قضيت في عز جنابك، والاحسان قديم والعهد تالد والفضل خالد يا عظيم العطا.

فلك الحمد قبل المسألة وحينها وبعدها، ولك الشكر على التوفيق للشكر."

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- AAA

ABSTRACT

EXPLORING INFLUENCING FACTORS ON THE ADOPTION OF NON-PHARMACEUTICAL INTERVENTIONS DURING PANDEMICS

Ahmed Abdulmohsen I Alobaydullah

April 4, 2024

Background: Pandemics are associated with loss of life, hospitalizations, and disruption to people's social and economic lives. As the 2019 pandemic illustrates, COVID-19 can be prevented by pharmaceutical and non-pharmaceutical interventions (NPIs). Recommended measures such as wearing a mask, washing hands, social distancing, and self-quarantine have been proven to curb the spread of the coronavirus. Identifying the factors associated with adherence to NPIs is the first step in understanding which levers of change to pull when designing health promotion interventions such as health communication campaigns. This dissertation explores these factors and proposes a health communication framework during pandemics.

Research Questions: This dissertation has three research questions: 1) What demographic, personal-cognitive, and socio-environmental factors influenced the adoption of non-pharmaceutical interventions during pandemics among health care university students? 2) Which psychological, cognitive, or socio-environmental factors are more predictive of adherence to COVID-19 NPIs among the Saudi population? 3) What risk communication framework best suits public health messaging and communication to promote adopting non-pharmaceutical interventions during

a pandemic?

Methods: In the first manuscript, a systematic review was conducted to identify demographic, personal-cognitive, and socio-environmental factors influencing the adoption of non-pharmaceutical interventions during a pandemic among health care university students. In the second manuscript, a quantitative non-experimental survey research design study was conducted, where a Social Cognitive Theory-guided survey was used to measure adherence to non-pharmaceutical interventions and explore the personal cognitive and socio-environmental influencing factors. The third manuscript uses a grounded theory technique to explore the relevant literature on NPIs communication and develops a conceptual framework to assist the health communicator during pandemics.

Results: In manuscript 1, the systematic review identified 18 articles for full-text review. The results yielded 18 demographic factors associated with NPIs practice factors, of which being older, female, observing others practice NPIs, and having higher risk perception levels were influencing factors. Additionally, cues to action, source of information, anger, confusion, and positive attitude, perceived stress, susceptibility, benefits, barriers, and severity influenced NPIs adherence. In manuscript 2, NPIs were strongly correlated with normative beliefs and negatively correlated with self-efficacy. The hierarchical multiple regression model revealed that socio-environmental factors explained a significant proportion of variance in NPIs (52%). In manuscript 3, the *Pandemic Behavioral Prevention Framework* was developed based on components adopted from the CDC's Crisis and Emergency Risk Communication Model, The Social Amplification of Risk Perception Framework, and The Social Cognitive Theory.

Conclusion: The dissertation's manuscripts found that demographic factors such as age and gender, personal cognitive factors such as risk perception, and socioenvironmental factors like social norms are influential when deciding to practice NPIs. These factors can be the basis of any health promotion intervention to promote NPIs in future pandemics. Also, we developed the *Pandemic Behavioral Prevention Framework* to utilize the currently used models of communication, risk, and behavior in shaping effective NPIs communication during pandemics.

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CHAPTER I. INTRODUCTION

OVERVIEW OF CHAPTER

This chapter introduces the subject of this dissertation, details COVID-19, introduces pandemic prevention measures and delineates the contributions of the three studies in the dissertation to the pandemic prevention literature. The chapter includes the statement of the problem, the purpose of the studies, the theoretical framework of the dissertation, a brief description of the three studies methodologies, and the research questions to be answered by their results.

1.1 BACKGROUND

The novel coronavirus is similar to past coronaviruses in that it can cause serious symptoms such as difficulty breathing, fever, and lung infections (Li et al., 2021). All these viruses are usually common among animals; however, few were reported to be affecting humans (Li et al., 2021). Among the six coronavirus species that were detected in humans, the Middle East Respiratory Syndrome Coronavirus (MERS) and severe acute respiratory syndrome coronavirus (SARS-CoV) were the only ones that were reported to cause serious illness that may lead to death (Cui et al., 2019). The spread of these viruses was expected to occur in the future due to rapid spreading and increased human-animal interactions, which happened in December 2019 (Wong et al., 2015).

On December 29, 2019, the first case of Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) was reported in Wuhan, China (Backer et al., 2020). The novel coronavirus would spread to almost every country in the following months and

cause millions of hospitalizations and deaths worldwide (Wu & McGoogan, 2020). SARS-CoV-2, or COVID-19, is characterized by its ability to transmit to individuals of all ages. However, older people are associated with more severe symptoms and higher fatality rates, whereas younger people are more likely to be asymptomatic or show mild symptoms (Wu & McGoogan, 2020). Additionally, existing comorbidities such as obesity, hypertension, diabetes, and immunodeficiency are linked with higher rates of severe illness and death (Li et al., 2021). Among those infected with COVID-19, fever and new persistent cough are the most reported symptoms (Grant et al., 2020; Hu et al., 2021). Other symptoms include new loss of taste and smell, headache, sputum production, a sore throat, diarrhea, chills, nausea and vomiting, and chest pain (Grant et al., 2020). COVID-19 symptoms follow an incubation period of 1-14 days, where the most commonly reported incubation period is five days (Wu & McGoogan, 2020). The prevalence of the infection outbreak is characterized by its widespread in many countries and regions around the world. The global prevalence of COVID-19 is estimated to be 774 million cases and over 7 million deaths (World Health Organization, 2023).

The large spread of COVID-19, coupled with the serious symptoms of the disease, has caused many health, psychological, and economic consequences of the novel coronavirus. The most reported long-term health effects of COVID-19 are fatigue, headache, attention disorder, hair loss, and dyspnea (Lopez-Leon et al., 2021). Other mental health effects on COVID-19 survivors have been reported, such as depression, anxiety, post-traumatic stress disorder symptoms, and stigma, though the causal relationship has yet to be established (Duan et al., 2020; Yuan et al., 2021; Zhao et al., 2021). Beyond morbidity and mortality, COVID-19 has accrued a huge economic and

social burden on populations worldwide. Interruptions in the production and supply chain of goods, travel restrictions between countries, and market anomalies caused by panic contributed to the economic instability of populations (McKibbin & Fernando, 2020). COVID-19's effects on the economy differ from past infectious disease outbreaks due to the fast spread of the virus in high- and middle-income countries and highly integrated world economies, causing the individual to suffer the economic burden on top of the health consequences (Pak et al., 2020).

The most common mode of transmission of COVID-19 is through large air droplets expelled while sneezing, coughing, or talking from one person to another (Wiersinga et al., 2020). Epidemiologic data suggest that being within 6 feet of an infected individual for 15 minutes will increase the likelihood of getting infected with COVID-19 (Chu et al., 2020). Small air droplets expelled while normal breathing was also a mode of transmission of COVID-19 (Edwards et al., 2021). Another COVID-19 transmission mode is the spread through surface contact, where infection can happen when in contact with a surface with the virus and then touching one's nose, eyes, or mouth (Wiersinga et al., 2020). All the mentioned transmission modes of COVID-19 yield the urgency of adopting preventive interventions that prevent illness or infection from occurring to reduce the rising incidence of the disease.

1.11 *COVID-19 Prevention Interventions*

Every nation had to prevent COVID-19 from infecting its population and burdening its healthcare system. Without therapeutic health interventions, health systems used preventive and policy interventions to stop the spread of the virus, Namely, stay-at-

home orders, non-pharmaceutical Interventions (NPIs), and vaccination. In the following subsections, these interventions and their relative success or failure will be discussed.

1.111 Stay-at-home orders and curfews

When COVID-19 started spreading, and the transmission dynamics were unclear, the first public health intervention was to establish stay-at-home orders and curfews in some countries. These policy interventions acted as more restrictive NPIs to protect healthcare systems from overload. They were characterized by mandating that individuals stay at their homes or shelter in place, and businesses and educational institutions were mandated to close and provide their services remotely (Ding et al., 2020). In more extreme cases, such as in China and Saudi Arabia, curfews were implemented, which are characterized by imposing monetary fines on curfew violators (Yezli & Khan, 2020). These measures were not meant to be permanent, as they could cause fatigue and other undesirable outcomes when extended.

Although some policymakers expected unfavorable outcomes from the lockdown and curfews, these measures yielded positive outcomes that were crucial in stopping the spread of COVID-19. In China, where the virus was first discovered and the first curfew was implemented, public health agencies observed immediate benefits after the curfew. The curfew significantly decreased the COVID-19 growth rate (Lau et al., 2020). Curfews demonstrated the same positive effects in other parts of the world with different implementation approaches. For example, a partial lockdown was implemented in Saudi Arabia in preparation for a full lockdown and curfew (Alanezi et al., 2020). The partial lockdown did not hinder new case reporting, but a noticeable decrease in new cases was observed once the full lockdown was implemented (Alanezi et al., 2020). Despite the

lockdowns success in slowing the spread of COVID-19, it has caused harm in other areas. Those struggling financially before the lockdowns experienced hunger at greater rates (Reynolds, 2020). Additionally, the overdose rates of opioids increased drastically during lockdowns, and reports of domestic violence -especially against women- increased (American Medical Association, 2021; Wenham et al., 2020). Finally, due to the overload of the healthcare systems with COVID-19-related cases, patients were reported to miss other vaccinations and health services (Kaufman et al., 2020; O'Leary et al., 2021).

Even though lockdowns were effective in some contexts, when taken to a global scale, they struggle to show the same positive effect in slowing down the spread of COVID-19. When the effects of lockdowns are combined with the effects of NPIs, they show a significant decline in the spread of COVID-19. However, when the effect of lockdowns was isolated from the effects of NPIs by comparing eight countries (England, France, and the United States) with two control arms that only implemented NPIs (Sweden and South Korea), lockdowns did not show significant benefits in reducing COVID-19 cases (Bendavid et al., 2021). Hence, further investigation into the utility of NPIs is warranted as the next prevention intervention.

1.112 Non-pharmaceutical Interventions (NPIs)

The next intervention was to recommend non-pharmaceutical interventions (NPIs) to the populations. NPIs are actions recommended to a community -other than medicinal- that will help slow the spread of infection. Sometimes called Community Mitigation Strategies, NPIs are often recommended when a respiratory illness spreads, such as SARS in 2003 and the Pandemic influenza (Liao et al., 2011). NPIs are not cost-free; however, they relieve society of the socioeconomic consequences of major lockdowns

and travel restrictions, making them more feasible to apply in the long run. In the case of COVID-19, various health organizations such as the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO) have recommended the use of NPIs to combat COVID-19 (Van Bavel et al., 2020). The COVID-19 NPIs included washing hands with soap and water, wearing a mask or a face-covering in public, keeping a physical distance of at least 1.5 meters in public, and self-quarantining when directed (Van Bavel et al., 2020). Promoting NPIs among the public was *in place of* a well-organized and prepared governmental disaster response to such a viral infection. Health authorities around the globe found themselves resorting to controlling the pandemic through social and health behavior change (West et al., 2020).

When taken separately, each NPIs is effective in slowing down the spread of COVID-19. Mask-wearing was consistently associated with fewer infections and lower mortality rates from COVID-19, especially in the initial waves of the pandemic (An et al., 2021). Social distancing had a similar positive effect in curbing the spread of the virus, especially when implemented more stringently, such as business closures and fines (Imai et al., 2020). It is challenging to quantify or empirically assess the effectiveness of handwashing and self-quarantine since they are actions performed mostly at home and, therefore, hard to monitor. Nevertheless, when taken as a supporting policy with the other NPIs, they successfully fought COVID-19 (Chu et al., 2020). Despite their usefulness in combating COVID-19, the public health response needed to provide more protection against getting infected with COVID-19. That is when COVID-19 vaccinations were rolled out.

1.113 Vaccination

COVID-19 vaccines were developed to give communities the immunity they needed to combat the virus despite huge logistical and operational challenges. The newly developed vaccines proved to be effective in preventing severe illness in 74-95% of the cases, with excellent efficacy in mitigating the COVID-19 burden (Katella, 2021). Under normal circumstances, COVID-19 vaccines would be adopted by most people, giving affected communities herd immunity; however, that did not happen. While the public health community was optimistic about the potential of such effective and safe vaccines, the public's acceptance of the vaccine was spotty. Regardless of how many vaccines were administered in a certain community, the cases were guaranteed to decrease and vaccine hesitancy rates to increase (Sallam, 2021). The resurgence of new variants (Delta and Omicron) puts the efficacy of the COVID-19 vaccines in question and yields the need to look beyond pharmaceutical solutions.

1.13 What Influences Adherence to NPIs?

Due to the recency of the COVID-19 pandemic, we will establish a clear understanding of the determinants of adherence with NPIs in past pandemics and then explore the literature on COVID-19 to identify current gaps in the literature. Only NPIs consistent with COVID-19 NPIs will be included in this literature review, including wearing a mask, washing hands, social distancing, and self-quarantine.

1.131 Demographic Influences on the Adoption of NPIs During Past Infectious Disease Outbreaks

The first demographic characteristic that influenced the adoption of NPIs is age. Older age was consistently associated with an increased likelihood of adopting the

recommended behaviors (Lau et al., 2003; Leung et al., 2005). Interestingly, the relationship of age with NPIs was consistent among different populations, and when a logistical regression model was applied to NPIs with different predictive factors, age often had an inverted U-shaped or dose-response gradient positive relationship with NPIs (Leung et al., 2005; Leung et al., 2003). Additionally, age had no significant relationship with NPIs adherence during the MERS (Lee et al., 2020). The association between age and NPIs could be explained by older individuals being more likely to report higher levels of perceived susceptibility to being infected during a pandemic (Barr et al., 2008).

When it comes to gender, the association is slightly more conclusive. During SARS and MERS, women were consistently more likely than men to practice NPIs among different populations (Lau et al., 2003; Lee et al., 2020; Quah & Hin-Peng, 2004; Tang & Wong, 2004). The association between gender and NPIs can be attributed to the higher rates of perceived risk and perceived susceptibility reported among women (Brug et al., 2009).

The relationship between educational level and NPIs is inconclusive; though evidence suggests being more educated predicted engagement with NPIs, there was no significant relationship between educational level and practicing NPIs among samples from the Netherlands or Hong Kong during the MERS and SARS outbreaks (Lau et al., 2004; Lee et al., 2020; Tang & Wong, 2003).

Lastly, it is well-documented that racial and ethnic minorities are the most vulnerable during any disaster (Hutchins et al., 2009). However, the relationship between race/ethnicity and NPIs has not been well investigated because most studies were conducted in Asia and among ethnically homogenous groups. One study in the United

Kingdom found non-Whites to be practicing mask-wearing and social distancing three to four times more than Whites. However, the non-White sample was too small to draw meaningful conclusions (Rubin et al., 2009).

1.132 Psychological Influences on the Adoption of NPIs During Past Infectious Diseases Outbreaks

In many studies, perceived outcome expectancy was associated with an increased likelihood of practicing NPIs (Lau et al., 2003; Lau, Yang, Tsui, & Pang, 2004; Tang & Wong, 2003). Perceived outcome expectancy is defined here by the respondent's perception of the recommended behavior's positive outcomes. During the H1N1 flu pandemic in 2009, handwashing increased in those who perceived handwashing to provide effective protection from infection (OR: 1.8, CI = 1.5, 2.2; Rubin et al., 2009). Additionally, perceived susceptibility is a construct that has been defined differently in various studies, albeit yielding the same positive association with practicing NPIs. Perceived susceptibility is most often measured as being concerned about becoming ill and perceived risk level. Perceiving oneself as susceptible to SARS was linked to greater commitment to social distancing in Canada and the United States, and it mediated the relationship between health messages and mask-wearing and handwashing during MERS (Blendon et al., 2004; Jang & Park, 2018).

The perceived severity of diseases and the perceived cost of performing NPIs influenced the adoption of NPIs. Those who believed SARS to be fatal were more likely to wear a mask in public (Lau, Yang, Tsui, Pang, et al., 2004), and those who considered SARS to be well-controlled reported lower mask-wearing rates (Lau et al., 2003). Most studies have not examined barriers thoroughly based on the assumption that NPIs are

cost-free. However, in a focus group study conducted in the UK, participants identified barriers to carrying out NPIs, such as the lack of space to practice social distancing and forgetting to wash hands (Morrison & Yardley, 2009).

1.133 The Adoption of NPIs During COVID-19: What Has Changed?

Consistent with past pandemics, the demographic characteristics that predicted adherence to NPIs were replicated during COVID-19. Unsurprisingly, in cross-sectional and longitudinal studies, women consistently showed higher rates of mask-wearing, handwashing, social distancing, and quarantining than men (Barber & Kim, 2021; Coroiu et al., 2020; Cvetković et al., 2020; Galasso et al., 2020; Lüdecke & von dem Knesebeck, 2020; Muto et al., 2020; Raude et al., 2020). As for age, the relationship persists, with few studies showing that being older is associated with more NPIs adherence, and being younger is associated with less adherence. In a Spanish sample, the youngest age group reported the lowest adherence rates to mask-wearing, and those over 65 reported the highest rate (OR: 2.26, CI: 1.05, 4.83; (Barceló & Sheen, 2020). The same relationship was found among a study of more than 4,600 participants that investigated the relationship between age and adhering to health precautions, although the correlation was barely significant (Clark et al., 2020). According to the literature reviewed, we can conclude that there is a moderate to strong relationship between age, gender, and NPIs.

In a study comparing adherence with NPIs during the 2015 MERS outbreak and COVID-19, researchers found that those who reported higher risk perception during both periods were more likely to practice NPIs (Jang et al., 2020). In US and Chinese samples, linear regression models revealed that those who perceived a higher risk of being personally affected by COVID-19 were more adherent to handwashing and social

distancing (Wise et al., 2020; Xu et al., 2020). Once again, risk perception appears to be a significant indicator of NPIs adherence. Additionally, knowledge about the recommended COVID-19 NPIs has been found to be a predictor of NPIs adherence (Xu et al., 2020), and in samples with high NPIs knowledge, practicing NPIs was also high (Alhazmi et al., 2020; Tripathi et al., 2020).

1.1331 Social Norms as an Influencing Factor

Unsurprisingly, social norms are predictive of NPIs adherence. Most studies defined social norms as what the respondents perceive as the normative behavior among the people most important to them, mostly family and friends. Social norms were associated with a higher likelihood of adherence with various NPIs behaviors. Beginning with complying with national lockdowns, when asked to estimate the percentage of people the same age as them following lockdown measures, respondents from the UK reported social norms as a significant predictor of their adherence with lockdowns (Smith et al., 2020). Additionally, when asked about the most influencing barrier to their adherence with social distancing, 31% of an international sample of 2,013 individuals said that it was the large number of people walking on the streets without practicing social distancing (Coroiu et al., 2020). Additionally, when the frequency and approval of practicing handwashing and social distancing among family and friends were hypothesized to represent perceived social norms, each unit increase predicted doubling the odds of performing these behaviors (Goldberg et al., 2020).

1.2 STATEMENT OF THE PROBLEM

When non-pharmaceutical interventions (NPIs) were introduced as a preventive measure against the spread of COVID-19, health officials were concerned about the

degree of adoption and adherence to these measures. Despite the demonstrated effectiveness of NPIs, researchers were unclear why some people accept practicing NPIs and some do not (Van Bavel et al., 2020). The previous section outlines what we knew about past pandemics about NPIs adherence. However, the adherence of specific groups has yet to be reviewed, a theory-based approach to measuring NPIs adherence is lacking, and a framework to guide health communications about NPIs during the pandemic needs to be developed. In this dissertation, we systematically review the related literature on the adoption of NPIs among health care university students, investigate the influencing factors in the adoption of NPIs among the Saudi population using a health behavior theory to guide the investigation of adherence to NPIs among the Saudi population and find group differences that will help shape future health communication campaigns directed to them.

1.3 THE IMPORTANCE OF THE PROBLEM

1.31 Behavioral Sciences as A Key Factor in Combating COVID-19

As past pandemics have illustrated and COVID-19 has emphasized, the response to a viral outbreak must be collaborative between governments, healthcare organizations, businesses, media outlets, and community members. The collective responses of these actors form a complex and interacting system, which holds the individual members of the society and their behaviors at the absolute center of the system (Bradley et al., 2020). Therefore, using behavioral sciences to understand the psychological, social, and environmental factors is essential to developing health promotion interventions, drafting health-oriented policies, and shaping effective health communication campaigns (West et al., 2020). In the case of COVID-19, governments and communities have relied on

behavioral sciences to promote the adoption of NPIs, which were used to curb the spread of the infection, mitigate its harm and the side effects of the measures taken to control it, and build resilience and increase preparedness for future variants and pandemics (West et al., 2020). One of the most striking examples of the importance of using behavioral sciences in response to a pandemic was after the vaccine rollout began and cases were expected to decrease. The lack of understanding of how people perceived the COVID-19 vaccine and their lack of commitment to continuing practicing NPIs taught public health leaders the importance of behavioral sciences even when pharmaceutical solutions are available. The former director of the National Institutes of Health, Dr Francis Collins (2021), states his greatest regret after retiring from the NIH: “maybe we underinvested in research on human behavior. I never imagined a year ago, when those vaccines were just proving to be fantastically safe and effective, that we would still have 60 million [American] people who had not taken advantage of them” (Collins, 2021, para. 8).

Even though epidemiologists modeled the COVID-19 mode of transmission in the first period of the pandemic, few epidemiologists suspected behavior and behavior change strategies would be the true obstacle to ending the pandemic. After identifying transmission modes, public health must seek behavioral sciences to be visited to end the pandemic. In this situation, empirical evaluations of the community's response to the pandemic will guide the development of future health interventions. However, research investigating the drivers of such behavior change is lacking (West et al., 2020).

1.4 THE THEORETICAL FOUNDATION SUPPORTING THE PROBLEM OR THE ISSUE

Given the complex nature of the pandemic and the response to it, we are using a multi-level theory to explore the dissertation problem. The Social Cognitive Theory guided the search in the systematic review manuscript of this dissertation, as well as the development of the survey in the second manuscript. In the third manuscript, even though multiple risk communication frameworks are explored alongside the Social Cognitive Theory, we see SCT as the basis of that investigation. Other frameworks are added to understand how communication during pandemics happens, and each are explored in the third manuscript.

1.41 Social Cognitive Theory and The Social-Ecological Model

In his seminal paper "Social Foundations of Thought and Action: A Social Cognitive Theory," Albert Bandura challenged the common understanding of how humans behave, which had been commonly described as reactive in nature (Bandura, 1986). The description of human behavior was either a response to influential forces in the environment or the inner impulses concealed within humans and created over their life courses (Bandura, 2001). Bandura advanced the viewing of human behavior as the result of proactive, self-reflecting, and self-regulating processes taking place between three categories of influences: behavioral, personal, and environmental (Bandura, 2004; DiClemente et al., 2019). In this triad of influences, a reciprocal relationship between the three influences determines the complex decision to engage in a behavior (Bandura, 1989).

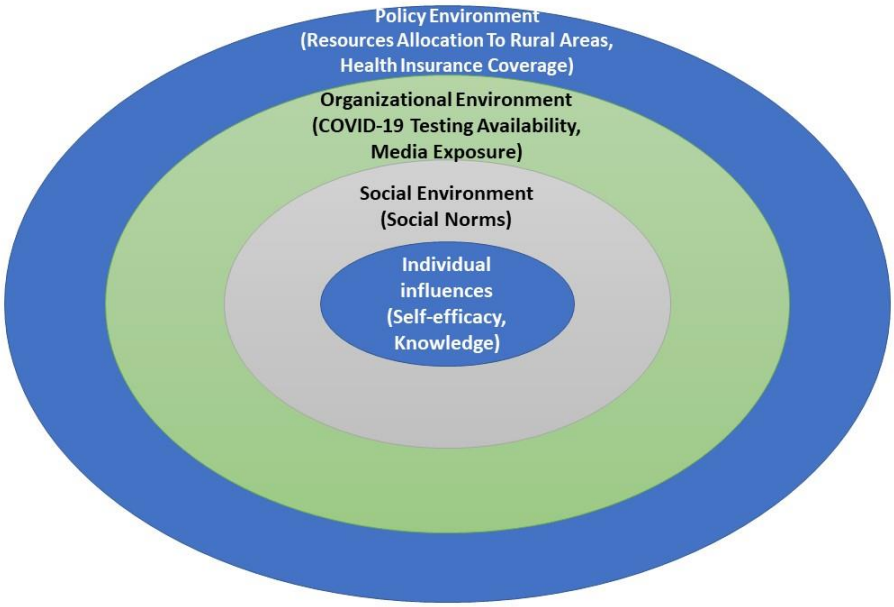
Even though the Social Learning Theory – which preceded SCT – postulates the same sources of influence on human behavior, the Social Cognitive Theory came to add a crucial concept that the influences are intertwined (Bandura, 2001). The SCT suggests individuals are affected by their environment and in a dynamic relationship with their social and environmental contexts (Kelder et al., 2015). Once Bandura introduced the dynamic relationship called *reciprocal determinism*, he addressed the persistent tension between the social structures and human agency, suggesting that they influence each other and interact to produce social and individual changes (Bandura, 2004).

The choice of SCT to predict non-pharmaceutical interventions (NPIs) adherence stems from its ability to operate on different levels of the socio-ecological model while centralizing individual behavior as the unit of measurement (Golden & Earp, 2012). Moreover, as the goal of the dissertation is to inform health communication, we refrained from using grand theories as they do not usually include the types of operationalized constructs that SCT provides (Braun et al., 2012). Considered mainly as an interpersonal level theory, the reciprocal determinism concept of SCT extends the interpersonal influence on the larger policy and organizational environment, as they affect the interpersonal circle of influence.

Following an extensive review of the literature on what factors generally influenced NPIs adherence in past pandemics and during COVID-19, we selected the following constructs from SCT: socio-environmental (social norms or normative beliefs, media exposure, and barriers) and personal cognitive (self-efficacy, knowledge, risk perception, and outcome expectations). When applied to the socio-ecological model, the SCT operates on the individual level by determining how self-efficacy, outcome

expectations, risk perception, and knowledge influence behavior. On the social or interpersonal level, the social support and norms formed by the behavior of the proximal social network determine engagement with a behavior. As for the organizational environment, the theory posits that barriers or reinforcements created by the organizational environment influence individual behavior. The messages circulating in the media, or the testing abilities of health organizations in a community, affect the behavior of wearing a mask or getting tested for COVID-19. Lastly, the policy environment is the overarching level where SCT suggests the environment can influence behavior. For example, the working conditions governed by national or local policies influence the individual ability to practice social distancing. We present the following graph demonstrating how SCT fits into the socio-ecological model using examples from the COVID-19 NPIs behaviors. Figure 1.1. gives an example of the influence on pandemic behavior based on their application of the ecological model.

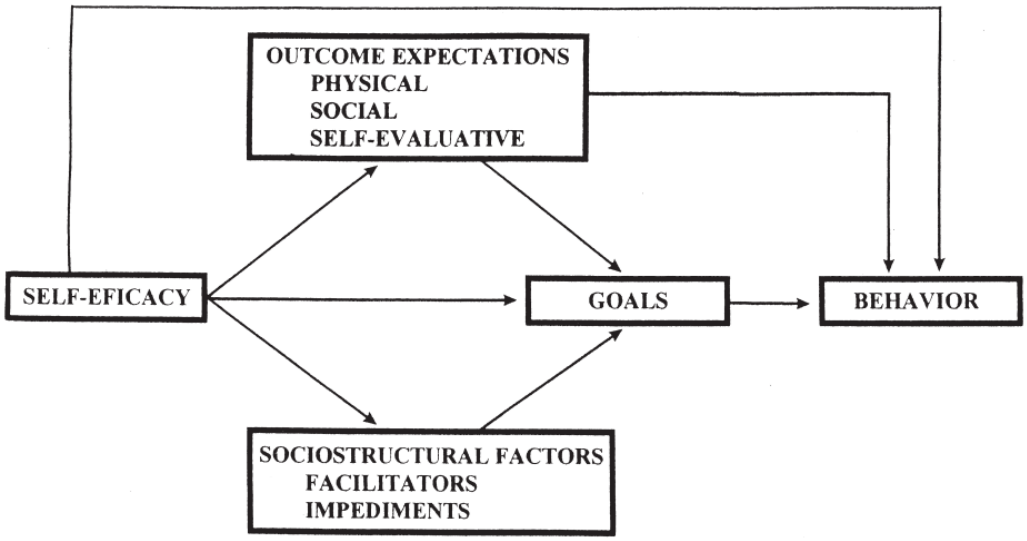
Figure 1.1. *Pandemic influences on the ecological model*



1.42 Core Tenets of The Social Cognitive Theory

The popularity of SCT has yielded the need for Bandura and others to redirect and revise it to fit health promotion applications. In this re-introduction of SCT, Bandura centralized self-efficacy as a core belief affecting the basic personal change processes. As shown in Figure 1.2 (Bandura, 2004), these basic processes include the goals, outcome expectations, perceived barriers and facilitators in the environment, and, ultimately, the behavior (Bandura, 2004). We recognize that the Social Cognitive Theory is broad in scope and cannot be summarized into five constructs. However, following Bandura's 2004 article, we selected the five core constructs as particularly relevant to the context of health promotion.

Figure 1.2. *Bandura's Structural paths of influence*



1.421 Knowledge

Knowledge is a precursor to behavior change. Behavior change is preconditioned by the presence of the body of knowledge necessary to make a decision (Bandura, 2004). Although insufficient, having the knowledge required to change a behavior rings true for anyone working to change health behavior. For example, knowledge about certain food

additives that cause cancer, such as foods rich in saturated fats or artificial sweeteners, is crucial in an individual's decision to refrain from consuming them (DiClemente et al., 2019). Although not necessarily sufficient in behavioral change, knowledge was the subject of many public health efforts, such as doctor's office pamphlets, billboards, and mass media campaigns (Noar, 2006).

There are two types of knowledge in health promotion: content knowledge and procedural knowledge (Bandura, 1986). Content knowledge includes the basic understanding of the advantages and disadvantages of health behavior, whereas procedural knowledge involves understanding the procedures required to engage in health behavior. After content knowledge about the food options and additives is acquired, procedural knowledge comes as knowing how to purchase food or prepare food without the cancer-causing additives. Having both types of knowledge does not mean engaging in the behavior. Moving to behavior change requires more sophisticated mental processes that support knowledge.

1.422 Perceived Self-Efficacy

Perceived self-efficacy is perhaps the most popular theoretical construct in health promotion and health behavior (Maddux & Gosselin, 2012). Perceived self-efficacy is the individual's perception of their ability to adopt the required health behavior (Bandura et al., 1999). Within the SCT, self-efficacy is associated with initiating a behavioral goal, developing and mastering new behavioral skills, and sustaining the behavior despite obstacles, barriers, and impediments (Glanz et al., 2015). For complex behaviors such as testicular cancer self-examination, prior procedural knowledge about the self-examination assists self-efficacy among the target population (Moore & Topping, 1999).

SCT views the self-efficacy construct as a perception, where the person's actual level of self-efficacy is unknown, as they decide to engage with behavior on what they perceive as their level of self-efficacy (Bandura et al., 1999).

Four sources formulate an individual's self-efficacy: prior experience of mastery, vicarious experience, social persuasion, and emotional arousal (Bandura et al., 1999). First, the person's previous experience of success or failure in engaging in the behavior is used when developing behavior skills, predicting behavioral outcomes, and mentally visualizing their self-efficacy level for that behavior. Secondly, self-efficacy is formed through vicarious experience, observing others succeed or fail in performing a task (Bandura et al., 1999). Sometimes called observational learning, using a role model or an influential leader to perform the task increases the vicarious experience.

The third source from which self-efficacy can be formed is the presence of persuasion, reinforcements, and support in the social environment, where the persuasion takes the form of a family member or a socially admirable person directly encouraging or discouraging those around them (Bandura et al., 1999). This source of self-efficacy is applied most to interventions implemented among younger populations, where the public health practitioner employs socially popular youth to influence the perceptions of certain health behaviors (Green et al., 2008). The final source of self-efficacy is the emotional response to a task, where the emotional arousal acts as a cue to the pessimistic and optimistic viewpoints of the behavior (Bandura et al., 1999). Bandura suggests that the previous four sources vary in importance and strength based on the behavior or task (Bandura et al., 1999). Understanding the sources of self-efficacy is pivotal in

conceptualizing one's motivation to engage in a behavior and serves as a potential change point for health promotion interventions.

1.423 Outcome Expectations

Conceptualizing the drive to engage in health behavior is partially concerned with perceptions about what precedes a behavior – self-efficacy; the other side of the story is what the individual expects to be the physical or social outcomes after engaging in the behavior. Outcome expectations are the anticipated positive outcomes resulting from engaging in a behavior (Bandura, 2004). For example, an outcome expectation of wearing an N95 respirator is avoiding contracting COVID. Both are based on perceptions; there is a link between strong self-efficacy and a better outcome expectation, where the perceived anticipated outcome is a product of how the individual perceives their ability to perform the health behavior (DiClemente et al., 2019). Using the respirator example, a strong belief that the person can correctly wear and breathe easily through the respirator is paramount to anticipate outcomes successfully.

Like self-efficacy, vicarious learning plays a role in forming positive outcome expectations. The observation of someone else bearing the fruit of a healthy diet regarding their weight control and better mental health results in better outcome expectations where they are learned vicariously, even though the observation can be difficult to support change if the benefits are long-term such as vaccination (Watson et al., 2017). Vicarious learning is also true for negative outcomes when the tobacco smoker observes the well-documented anticipated weight gain after their peers quit smoking, forming negative outcome expectations that hinder smoking cessation (Pisinger & Jorgensen, 2007).

1.424 Goal Formation

Bandura argues that goal setting is how motivation can manifest to build and initiate intentions to engage in a behavior (Bandura, 1986). SCT asserts that behavioral goals are best achieved when broken down into a progressive series of subgoals (Bandura, 1986). Thus, according to SCT, selecting small, measurable, and achievable subgoals is the optimal method for health promotion to achieve a major behavioral change (DiClemente et al., 2019). Therefore, the actualization of behavioral intentions is done by forming behavioral goals, leading to behavior change. Goal-forming is necessary but insufficient for behavior change, and it is challenging to achieve these goals. As a major theory of motivation, SCT emphasizes the role of the interplay between internal processes and social influences in supporting motivation, which will lead to better behavioral outcomes (Schunk & DiBenedetto, 2020). Hence, the manifestation of these sources of influence is best characterized by the individual's positive outcome expectations and high level of self-efficacy, which is what Bandura suggests will enhance achieving behavioral goals after their formation (Bandura, 2004).

1.425 Socio-Structural Factors

Attaining behavioral goals with appropriately perceived self-efficacy and positive outcome expectations is conditioned by the impeding and supporting factors. People's physical and social environment limits or enables them to engage in a behavior successfully (Bandura et al., 1999). According to SCT, impediments can be classified into cognitive or environmental impediments (Bandura, 2004). SCT adds the environmental barriers to the perceived barriers mentioned in other health behavior theories, such as the Health Belief Model, and suggests that they are linked together to

discourage or encourage an individual from engaging in a behavior. For example, cognitive barriers to physical activity can be low perceived self-efficacy or negative outcome expectations. On the other hand, environmental barriers can include bad infrastructure status in the community where parks are scarce and sometimes unkempt, lacking walking trails, or increased violence rates (Glanz et al., 2015).

If an individual overcomes the cognitive barriers, it is important to notice that it might not be sufficient as they will be impeded from starting the behavior by environmental barriers, even though they are cognitively prepared. Thus, perceiving the environmental impact on cognitive preparedness is a product of balancing these two influences and can be influenced by personality traits. A highly efficacious person or group is more likely to overcome environmental barriers; however, this is not guaranteed (Bandura, 2009). Finally, when an individual perceives them as sufficient and supportive, social norms and media exposure act as opportunities for the behavior to be adopted by the individual.

1.43 Using the Social Cognitive Theory to Predict Change in Adherence with NPIs

Concerning health behavior in times of emerging infectious diseases, the expectancy-value theories such as the health belief model, protection motivation theory, and the theory of planned behavior are undeniably the most used models for prediction, as observed during SARS or the H1N1 influenza pandemic (Bish & Michie, 2010; Leppin & Aro, 2009; Smith, 2006; Taylor, 2019). Nevertheless, these models identify the individual cognitive and affective factors supporting the adherence to recommended behaviors. They are limited in using socio-environmental factors to predict adherence. They usually fail to answer questions such as why subgroups of a population vary in

adherence to behavioral health recommendations (Raude et al., 2020). The adherence to health recommendations can vary based on cognitive, psychosocial, and sociocultural factors.

Ultimately, this dissertation aims to inform future pandemic health communication campaigns regarding which relevant determinants best predict adherence to NPIs. We use the SCT to formulate our research question, and the hierarchical linear regression model results to indicate the factors that predict the most NPI adherence. Due to the scarcity of utilizing a health behavior theoretical framework for NPIs adherence prediction, we believe there is a need for a theoretically driven prediction model based on a theory encapsulating the socio-environmental and personal cognitive processes when preventing infection from COVID-19. Choosing the SCT to predict NPIs helps determine the sources that create social norms surrounding COVID-19 NPIs. Additionally, it presents collective efficacy to remedy the policy failure in creating a health-protecting environment during COVID-19, and it describes the duality of influence between the individual and their environment in forming a collective risk perception. All the following reasons to choose SCT to guide the dissertation stem from its relevance to how people perceive health information and interact with media and their social environment during disasters and pandemics (Ekström & Kverndokk, 2015; Tierney et al., 2006).

1.431 Social Norms Predict NPIs Through Social Cognitive Means

Successfully changing the social norms around a health behavior motivates adopting the behavior (Reid et al., 2010). The social norms of protective behaviors during pandemics are established through institutional engagement in issuing the relevant health-protecting policies, the media messages supporting or undermining the behaviors, and the

behaviors of family and friends (Prati et al., 2011). During COVID-19, engagement from institutions in issuing orders to protect against the infection was widely observed and followed by communities around the world; however, media influences in shaping the social norms of COVID-19 NPIs is an area that SCT can uncover.

Bandura, (2009) posits that media can directly influence behavior through education, motivation, and guidance or through a socially mediated indirect influence pathway connecting participants to social networks and communities. These social milieus represent the area where the largest share of behavior change is occurring. Recent investigations during COVID-19 revealed that social norms predicted social distancing, handwashing, and mask-wearing (Goldberg et al., 2020). The socially mediated relationship is where SCT can provide value in determining where to intervene to increase adherence to COVID-19 NPIs. Using SCT, we can influence the social norms of NPIs in our health communication campaign through the socially mediated relationship between the media and NPIs.

1.432 Collective Agency to Combat Policy Failure

As observed in many COVID-19 behaviors, policy failures supported the increased rates of nonadherence. Harmful labor regulations prevented infected individuals from self-quarantine. Overcrowding in housing arrangements among groups such as immigrants in the Middle East made it impossible to practice social distancing (Butler, 2020; Sherlock, 2020). The burden of these structural impediments is evident, and the self-efficacy to overcome them is questioned. SCT finds a framework to work with the controversial debate between individualistic and structuralist approaches to health, where health is viewed either to be completely controlled by the individual or the

product of socioenvironmental, economic, and political situations. The SCT advocates for following a social orientation of health, where the collective agency of a group of people forms collective efficacy (Bandura, 2000, 2001). Collective efficacy supports the community's effort to increase public awareness of COVID-19, advocate and communicate with policymakers, and build community capacity to change health-harming policies. The collective efficacy within SCT is a leverage point to lift policy-level impediments in the way of practicing NPIs.

1.433 The Social Construction of COVID-19 Risk Perception

Risk perception has been identified as an influencing factor in predicting preparedness for natural disasters and infectious disease outbreaks (Bish & Michie, 2010; Wise et al., 2020). Although geographical proximity is a determining factor in shaping individual risk perception in natural disasters, that does not apply to the COVID-19 pandemic and its protective behaviors. Risk perception levels were the same in Hubie province – where Wuhan is the capital -- and in the geographically distal Guangdong province, which suggests an explanation beyond proximity (Zhou, 2022). Scherer & Cho (2003) suggest the existence of relational social groups of individuals who formulate their risk perception, which is most true during COVID-19, when a person's social network has expanded to communities on social media (Cinelli et al., 2020). SCT provides a theoretical explanation of how risk perception is formed during infectious disease outbreaks by linking the individual with their social environment. The reciprocal determinism characteristic of the SCT postulates that individual risk perception is formed

by interacting with the environment (worry among family and friends and media) and, consequently, predicting engagement with NPIs behaviors.

1.44 The Limitations of The Social Cognitive Theory

Social Cognitive Theory has received much praise for its practicality when applied to interventions, guidance in determining relevant change points for health interventions, and support for policy change advocacy. However, SCT does not come without limitations when applied to pandemic protective behaviors. The following limitations challenge the utility of SCT as a theoretical framework for predicting NPIs adherence.

1.441 Self-Efficacy Beliefs: Disturbed Relationships with Outcome Expectations

Two key mediators in SCT linking self-efficacy and behavior are goal setting and outcome expectations (Bandura, 2004). However, high-quality evidence challenges the directionality of this mediation, bringing the relationships between these key tents into question. Bandura contends that self-efficacy temporally precedes outcome expectations in that individuals can foresee positive outcomes because of their behavior only if they feel confident in their ability to perform the behavior in the first place. However, the literature points to positive future outcomes as a precedent for the change in self-efficacy beliefs. For instance, when people are given incentives to engage in physical activity or asked to think about the negative outcomes of smoking, their self-efficacy beliefs improve (Williams & Rhodes, 2016). This manipulation of outcome expectations contradicts the original causal pathway between self-efficacy and outcome expectations, a construct not considered a source of self-efficacy beliefs in SCT (Bandura et al., 1999).

A reconsideration of outcome expectations as a source and a consequence of self-efficacy beliefs is warranted.

1.442 Wide-Ranging Focus and Operationalizing Issues

The triadic relationship between behavior, cognitive, and environmental influences presents opportunities to explain and predict health behaviors and dissect health issues for well-supported health interventions. However, it presents a huge challenge to implementing public health interventions. The complex relationship has caused many health interventions to choose only a few constructs – usually including self-efficacy to intervene and evaluate (Munro et al., 2007). SCT-guided public health interventions often inadequately operationalize the theory's constructs and report insufficient results. In some cases, they focus on a few constructs, which will invalidate the claimed conclusions about the SCT-based intervention (Avery et al., 2013; Hutchison et al., 2009; Painter et al., 2008).

1.443 Within-Person Effects on Self-Efficacy and Behavior

Even though the between-person differences in constructs such as self-efficacy and the association with behavior are well-established and empirically tested, the within-person differences are not addressed by the SCT. Daily and within-person fluctuations are expected when attempting to sustain health-protective behaviors, where the fluctuation can be attributed to emotional responses to social interactions and environmental barriers (Dunton, 2018). It is important to Include the time-invariant SCT explanatory factors in the health intervention, such as beliefs, attitudes, and perception in explaining and predicting differences between people. However, the lack of inclusion of

time-varying explanatory factors makes conclusions about within-person effects on behavior unfeasible.

1.444 Cross-Cultural Issues

For a theory that values the relationship between the individual and their social context, the SCT literature does not properly explore how cultures influence behavior. Differences in the social context are not considered when applying SCT to explain differences in behavior. Upon its development, SCT was mostly applied to Western individuals, who have a different relationship with their society than people from different cultures. For example, Asian and Middle Eastern cultures value the social influences on individual behavioral intentions and attitudes more than Western culture (Schunk & Pajares, 2009). Social norms, a construct considered in some of the applications of SCT on behavior, do not include the cultural influences on these norms and whether they influence other constructs in the theory.

1.5 RESEARCH AIMS AND QUESTIONS

The dissertation manuscripts focus mainly on understanding adherence to NPIs and how to use this understanding to improve health communication during pandemics. The three manuscripts aim to 1) determine the influencing factors on the adoption of NPIs among health care university students, 2) is to explore the influence of social and cognitive factors on the adoption of COVID-19 non-pharmaceutical interventions among a Saudi sample, 3) build a conceptual model which explains the pathways that lead to decision making when considering practicing NPIs during a pandemic. Based on the aims of the dissertation, the following research questions were developed:

- What demographic, personal-cognitive, and socio-environmental factors influenced the adoption of non-pharmaceutical interventions during pandemics among health care university students?
- Which psychological, cognitive, or socio-environmental factors are more predictive of adherence to COVID-19 NPIs among the Saudi population?
- What risk communication framework best suits public health messaging and communication to promote adopting non-pharmaceutical interventions during a pandemic?

1.6 THE METHODOLOGY USED TO ANSWER THE QUESTIONS

In the first manuscript, a systematic review was conducted to identify demographic, personal-cognitive, and socio-environmental factors influencing the adoption of non-pharmaceutical interventions during a pandemic among health care university students. In the second manuscript, a quantitative non-experimental survey research design study was conducted, where a Social Cognitive Theory-guided survey was used to measure adherence to non-pharmaceutical interventions and explore the personal cognitive and socio-environmental influencing factors. In the third manuscript, the grounded theory technique "conceptual framework analysis method" developed by Jabareen (2009) was used to explore the relevant literature on NPIs communication and consequently develop a conceptual framework to assist the health communicator during pandemics.

1.7 THE CONTRIBUTION OF EACH ARTICLE TO THE RESEARCH TOPIC

This dissertation aims to fill the gap in communicating to the public about the use of NPIs during pandemics – especially the early part of them. We begin by identifying

determinants and drivers of NPIs adherence in the literature, which will establish the most important construct to include in NPIs research and practice. Next, the second manuscript applies a multi-level theory to understanding NPIs adherence among an under-researched population. The results add to our understanding of NPIs adherence by using the lens of the Social Cognitive Theory. The third manuscript is where the aims of the dissertation are solidified. The conceptual model is the product that should emerge from conducting the first two studies and the tool the health communicator needs to capitalize on to communicate effectively during a pandemic. Overall, the dissertation represents the progression from reviewing and empirically researching to creating a tool for advancing health communication during pandemics.

1.8 POSITIONALITY STATEMENT:

As the writer of this dissertation, I have a unique position on research topic, population, and methodologies. Philosophically, I follow a post-positivist view of research. My research endeavors are a step toward uncovering the truth of the research project. I operate through the lenses of theoretical influences on practice. My work can influence public health practice, as evidenced by my development of the Pandemic Behavioral Prevention Framework. My work will be complete once the findings of the three manuscripts are applied to real-life situations. As a Saudi Arabian national who received a Western education, I hold the position of an insider as well as an outsider. My upbringing at the study site, AlAhsa, enabled me to understand the perspective of my research population and the context of pandemic prevention. I witnessed firsthand the transformation caused by the Middle Eastern Respiratory Syndrome on the population's attitude toward pandemic preparedness in general. My education in the United States

provided me with the experiences of accomplished researchers who questioned my approach to the dissertation topic when needed. More importantly, I was able to have a helicopter view of my community, allowing me to reflect on the long-held beliefs surrounding the dissertation topic.

CHAPTER II: DEMOGRAPHIC, PERSONAL-COGNITIVE, AND SOCIO-ENVIRONMENTAL INFLUENCING FACTORS ON THE ADOPTION OF NON-PHARMACEUTICAL INTERVENTIONS AMONG HEALTH CARE UNIVERSITY STUDENTS DURING PANDEMICS: A SYSTEMATIC REVIEW

2.1 INTRODUCTION

Pandemics are one of the most damaging disasters to human life and community health. The traditional definition captures some aspects of a pandemic, but not all. According to Ready.gov, a pandemic is "a disease outbreak that spans several countries and affects a large number of people." However, much of the damage done by pandemics can be attributed to their description rather than definition. A pandemic happens when a disease transfers to wide geographical areas, leading to severe medical consequences caused by high transmissibility, weak population immunity, and high disease severity (Morens et al., 2009). Novelty is an important trait of a pandemic; the term pandemic is usually associated with new diseases for which humans have limited immunity (Qiu et al., 2017). The impact of pandemics is massive in magnitude and seriousness, resulting in deteriorated health, a damaged economy, low population mobility, and an existential crisis for countries with poor healthcare infrastructure (Maurice, 2016; Qiu et al., 2017).

Every nation must prevent the pandemic from affecting its population and burdening its healthcare system. Without therapeutic health interventions, health systems resort to preventive and policy interventions before attempting to stop the spread of the

virus through pharmaceutical solutions. In the case of the recent pandemic, COVID-19, stay-at-home orders, non-pharmaceutical interventions (NPIs), and vaccination were the primary prevention strategies. Health organizations ordered Stay-at-home orders as the first line of defense against COVID-19 and implemented curfews in more extreme cases, such as in China and Saudi Arabia, where monetary fines were imposed on curfew violators (Yezli & Khan, 2020). Nine months after the World Health Organization declared COVID-19 a pandemic, the first vaccine was developed (Centers for Disease Control and Prevention, 2022). Under optimal circumstances, COVID-19 vaccines would be adopted by most people, giving the affected communities *herd immunity*; however, that did not happen. Although the public health community was planning to end the pandemic with effective and safe vaccines, the public did not have sufficient vaccine acceptance rates to end the virus's spread (Sallam, 2021).

A characteristic of a virus that makes it difficult to contain is its ability to mutate. New variants, which in the case of COVID-19 occurred roughly every 2-3 months, challenge the effectiveness of the vaccines. Consequently, there is a significant need to look beyond pharmaceutical solutions.

2.11 Non-Pharmaceutical Interventions (NPIs)

In this article, the intervention of interest involves the use of NPIs. Non-Pharmaceutical Interventions are non-medicinal actions recommended to a community to help slow the spread of infection. Sometimes called community mitigation strategies, NPIs are often recommended when a respiratory illness spreads, such as Severe Acute Respiratory Syndrome (SARS) in 2003 and the H1N1 pandemic in 2009 (Liao et al., 2011). Instead of a thoroughly planned and structured governmental response to a viral

outbreak, the public is encouraged to adopt non-pharmaceutical interventions (NPIs). Health authorities worldwide have used social and behavioral sciences to manage the pandemic (West et al., 2020).

The psychological, social, and environmental factors influencing behavior must be studied to initiate a proper health promotion intervention, policies that generate better outcomes, and well-designed health communications (West et al., 2020). In every infectious disease outbreak, the role of government officials and the public health professionals is to use behavioral science to promote the use of NPIs, consequently slowing the spread of the virus, reducing the loss of life and damage to people's lives, and making the public more resilient to future pandemic risks (West et al., 2020). An example of the significance of integrating behavioral sciences in pandemic response emerged post-vaccine rollout when a decline in cases was anticipated but not fully realized. Public health leaders were challenged by the public's perception of the COVID-19 vaccine's safety and their reluctance to continue practicing NPIs.

For NPIs to protect the community, all groups within the community need to have sufficient knowledge, resources, and adequate levels of practice. Community protection is achieved when all stakeholders participate in the response, including receivers of medical care and health care providers and students (Le An et al., 2021). Like health care providers, health care students are at risk of infection and spreading infection to patients if their adherence to NPIs is poor (Hamza, Badary, Elmazar, 2021). Considered by many healthcare systems around the world to be the first line of defense, health care students are prone to be overwhelmed by the overflow of new information and the need to be constantly prepared (Goni-Fuste et al., 2021). Students’ knowledge, attitudes, and

practice of NPIs have been inadequate during COVID-19 (Mohsin et al., 2021, Noreen et al., 2020, Olaimat et al., 2020). In addition to being at risk during pandemics, health care students are facing rising levels of anxiety and stress while committing to their studies and having to participate in patient care in multiple capacities (Son et al., 2020, Wang et al., 2020, Hedima et al., 2021). It is essential to consider the factors affecting health care students as they represent a key part of the pandemic response and are the future health care professionals who will lead the response to new infectious disease outbreaks (Alrasheedy et al., 2021).

Using behavioral sciences to slow the spread of a pandemic begins with a solid understanding of the baseline personal-cognitive, socio-environmental, and demographic factors influencing the adoption of non-pharmaceutical interventions during a pandemic. This paper aims to determine those factors among health care university students and synthesize the available evidence about their impact on the individual decision-making process in a pandemic. Choosing health care university students is based on their role in pandemics: being on the front lines in treating patients and community outreach efforts. This systematic review adopts a Social Cognitive perspective to examine the factors influencing NPIs adherence. The literature reviewed for the systematic review will be categorized based on how the Social Cognitive Theory explains the behavior. Three categories of factors will be the focus of this systematic review: demographic, personal cognitive, and socio-environmental factors.

2.2 METHODS

2.21 Research question

This study was motivated by the question: what demographic, personal-cognitive, and socio-environmental factors influenced the adoption of non-pharmaceutical interventions during pandemics among health care university students? This systematic review was conducted to answer the research question. A systematic review summarizes the body of literature in which the included studies are systematically searched, critically appraised, and synthesized (Gopalakrishnan & Ganeshkumar, 2013). A systematic review is the appropriate method to answer this research question because it delivers a comprehensive overview of the factors influencing NPIs practice among health care students.

2.22 Searches – Electronic databases

The following databases were searched: PubMed, Embase, WHO database on COVID-19, ProQuest Dissertations and Theses, and Google Scholar. An initial search was developed and conducted in PubMed and was modified as needed for the other databases. Gray literature was located by searching for dissertations on ProQuest and Google Scholar for conference proceedings. In addition, the references of the included articles were checked, and the journals Frontiers in Public Health, PloS One, and International Journal of Environmental Research and Public Health were hand-searched to locate additional records. Due to resource challenges regarding costs, time, and expertise in non-English literature, only articles written in English were included. We recognize this constraint as a limitation of this review. The search covered literature

published from 2004, when the first pandemic of interest occurred, until August 2023, the month during which the search was conducted.

2.23 Inclusion/exclusion criteria

Health care students above the age of 18 were included. The Sample, Phenomenon of Interest, Design, Evaluation, Research framework (SPIDER) guided the writing of the research question and the development of inclusion and exclusion criteria, such as which phenomena of interest and type of studies to be included. Table 2.1 shows our application of the SPIDER framework. The SPIDER framework is recommended when the systematic review is conducted to explore a phenomenon and not evaluate an intervention, which is aligned with this systematic review on NPIs practice (Ford et al., 2021).

Table 2.1. *SPIDER framework*

S	**Sample**	Health care university students
PI	**Phenomenon of Interest**	Adopting NPIs
D	**Design**	Survey
E	**Evaluation**	Odds ratio/correlation, means, etc.
R	**Research Type**	Quantitative

2.24 Keywords

A comprehensive list of search terms was created following the SPIDER framework. When the systematic review includes mixed methods or prevalence studies, the SPIDER framework has been used as an alternative to the widely used Population, Intervention, Comparison, Outcomes and Study design (PICOS) framework (Amir-

Behghadami, 2021). The SPIDER framework strategy enables the researcher to generate more comprehensive keywords and to better manage the articles located after the database search (Cooke et al., 2012). After consultation with a research librarian, free text terms and MeSH terms were included. The following table includes the list created for PubMed. Similar searches were conducted on the other databases, with adjustments as needed.

Table 2.2. *PubMed keyword search*

COVID-19	(((“hand washing” OR “Washing hands” OR “face mask” OR “social distancing” OR “self-quarantine”) AND (“determinants” OR “compliance” OR “noncompliance” OR “non-compliance” OR “adherence” OR “non-adherence” OR “nonadherence” OR “predictors”)) AND (“COVID-19” NOT (“effectiveness” OR “efficacy”))) AND (“University students” OR “students” OR “college”)
MERS	(((“non pharmaceutical interventions” OR “non-pharmaceutical interventions” OR “npi” OR “npis” OR “preparedness” OR “protective behavior” OR “protective behaviors” OR “hand washing” OR “Hand Disinfection” OR “Hand Sanitization” OR “Handwashing” OR “Washing hands” OR “face masks” OR “face mask” OR “masking” OR “mask wearing” OR “social distancing” OR “social distance” OR “physical distancing” OR “physical distance” OR “self quarantine” OR “self-quarantine” OR “Stay at Home”) AND (“determinant” OR “determinants” OR “determine” OR “determines” OR “determining” OR “Compliance” OR “complies” OR “comply” OR “complying” OR “noncompliance” OR “non-compliance” OR “non compliance” OR “adherence” OR “non-adherence” OR “non adherence” OR “nonadherence” OR “adhere” OR “adheres” OR “adhering” OR “predictors” OR “predictor” OR “predict” OR “predicts” OR “predicted” OR “factor” OR “factors”)) AND (“MERS” OR “Middle East Respiratory Syndrome” OR “Middle Eastern Respiratory Syndrome”)) AND (“University students” OR “students” OR “college”)
H1N1	(((“non pharmaceutical interventions” OR “non-pharmaceutical interventions” OR “npi” OR “npis” OR “preparedness” OR “protective behavior” OR “protective behaviors” OR “hand washing” OR “Hand Disinfection” OR “Hand Sanitization” OR “Handwashing” OR “Washing hands” OR “face masks” OR “face mask” OR “masking” OR “mask wearing” OR “social distancing” OR “social distance” OR “physical distancing” OR “physical distance” OR “self quarantine” OR “self-quarantine” OR “Stay at Home”) AND (“determinant” OR “determinants” OR “determine” OR “determines” OR “determining” OR “Compliance” OR “complies” OR “comply” OR “complying” OR “noncompliance” OR “non-compliance” OR “non compliance” OR “adherence” OR “non-adherence” OR “non adherence” OR “nonadherence” OR “adhere” OR “adheres” OR “adhering” OR “predictors” OR “predictor” OR “predict” OR “predicts” OR “predicted” OR “factor” OR “factors”)) AND (“H1N1” OR “swine flu” OR “swine influenza”)) AND (“University students” OR “students” OR “college”)
SARS	((“non pharmaceutical interventions” OR “non-pharmaceutical interventions” OR “npi” OR “npis” OR “preparedness” OR “protective behavior” OR “protective

	behaviors" OR "hand washing" OR "Hand Disinfection" OR "Hand Sanitization" OR "Handwashing" OR "Washing hands" OR "face masks" OR "face mask" OR "masking" OR "mask wearing" OR "social distancing" OR "social distance" OR "physical distancing" OR "physical distance" OR "self quarantine" OR "self-quarantine" OR "Stay at Home") AND ("Severe Acute Respiratory Syndrome" OR "SARS" OR "SARS-CoV" NOT "COVID-19" NOT "SARS-CoV-2")) AND ("University students" OR "students" OR "college")

2.25 Types of studies to be included

All types of observational studies, including cross-sectional, case-control, and cohort studies, were included in the analysis.

2.26 Conditions or domains being studied

Pandemics with a zoonotic etiology were the focus of this study. The zoonotic diseases included Severe Acute Respiratory Syndrome-Coronavirus 2 (SARS-CoV-2; commonly called COVID-19), Severe Acute Respiratory Syndrome (SARS), the Middle East Respiratory Syndrome Coronavirus (MERS-CoV), and H1N1 influenza.

2.27 Interventions

The intervention of interest was the adoption of NPIs. In the case of COVID-19, various health organizations, such as the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO), recommended the use of NPIs to combat COVID-19 (Van Bavel et al., 2020). During COVID-19, and previously during SARS and H1N1, NPIs included washing hands with soap and water, wearing a mask or a face-covering in public, keeping a physical distance of at least 1.5 meters while in public, and self-quarantining/isolation when directed (Van Bavel et al., 2020). Other NPIs, such as disinfecting groceries, school closures, and banning public gatherings, were variously implemented and discontinued as the nature of the disease transmission was understood. Therefore, they were not included in this study. Non-pharmaceutical

interventions are not cost-free; however, they relieve society of the socioeconomic consequences of major lockdowns and travel restrictions, making them more feasible to apply in the long run.

2.28 Predictors of NPIs

1- Demographic factors influencing the adoption of NPIs among health care students during pandemics.

2- Personal cognitive factors influencing the adoption of NPIs among health care students during pandemics.

3- Socio-environmental factors influencing the adoption of NPIs among health care students during pandemics.

2.29 Measures of effect

Continuous quantitative outcome measures were extracted with as much information as possible from the studies. In the case of categorical quantitative outcome measures, risk ratios or odds ratio was reported.

2.210 Data extraction (article selection and data coding)

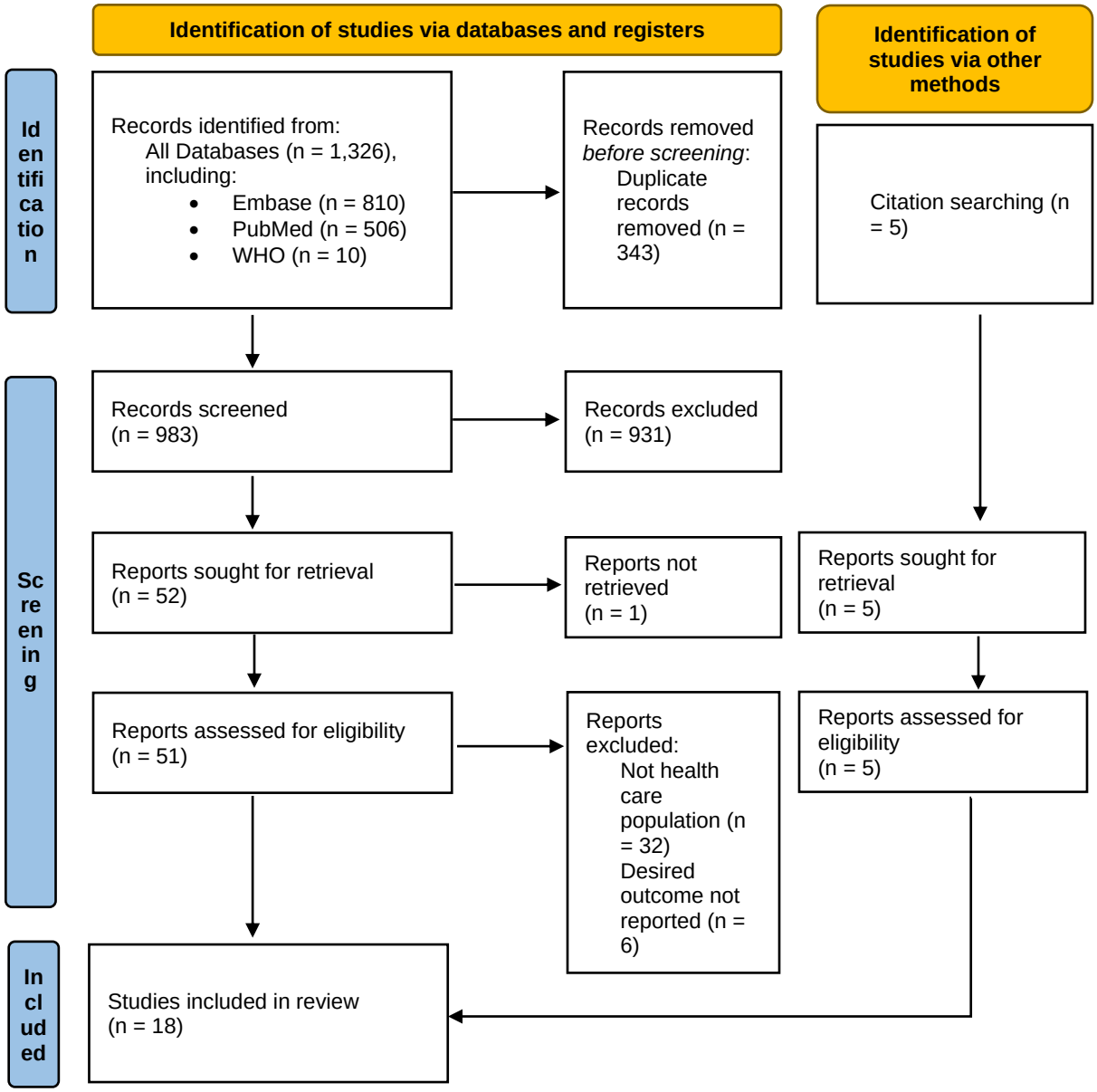
The first author and a co-author screened titles and abstracts to assess if the articles met the eligibility criteria. In the case of a discrepancy, a resolution was reached by consulting the study's senior author. Agreement between the two reviewers needed to be met for the title and the abstract to qualify for full-text screening. No disagreement occurred in this stage. Then, the two reviewers began the process of screening the full-text articles. If a full-text article could not be located, the first author was contacted and asked to provide their article; the article was excluded if a reply was not received. All full-text articles were located and obtained from the databases available to the authors.

The reviewers independently performed a full-text screening based on the eligibility criteria. In the case of a discrepancy, a resolution was reached by consulting the study's senior author. All articles that passed full text screening were included in data extraction. Using structured forms, data were independently extracted by the two reviewers. When a disagreement happened during data extraction, a discussion was initiated to achieve a consensus. The senior author was contacted to give a final decision if the discussion did not result in an agreement. If data was missing from an article, the corresponding author was contacted, and a response requested within 14 days.

2.211 Selection of studies

The articles identified from the database search and other sources were managed through EndNote Reference Manager. The two reviewers performed screenings of titles, abstracts, and full-text PDFs using the online screening tool *Rayyan* (Ouzzani et al., 2016). The screening results are reported using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram to describe the study selection process visually. The two main reasons for studies exclusion were: not including health care students or not reporting NPIs adherence.

Figure 2.1. *PRISMA flowchart*



From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71.

2.212 Quality assessment

This study used a *descriptive quality assessment approach*, in which we assess the credibility of included studies in relation to the topics covered in this study. Other more commonly used critical appraisal tools were considered problematic for this study since

they typically include the use of subjectively determined and unnecessary weighing scales (Crowe & Sheppard, 2011). According to Crowe & Sheppard (2011) and others (Li et al., 2021; Valentine, 2019), assessments which rely on the scores produced by the weighing scales can falsely represent the quality of the study. Quality assessment scores can be misleading when two studies have the same score but are scored differently in specific scale items (Li, 2023). Lastly, the weights of the items of quality assessment scales are highly subjective and mostly reflect the authors' beliefs on which dimensions of the scale are important (Valentine, 2019).

The articles selected for inclusion were critically appraised by the two reviewers using a tool specifically designed by the primary researcher. The input of an expert in systematic reviews was incorporated in refining the tool items and clearly describing each item. The critical appraisal tool (see Table 2.3) helps the reviewer to report on three main areas: the quality of the sampling process, the quality of measurements and reporting of these measurements, and the quality of their choice of statistical analyses. The two reviewers evaluated each study on each item and reported the combined study quality assessment. See Table 2.4 and Appendix (A) for how each study was scored.

Table 2.3. *Quality Assessment Tool - Ideal Study Approach*

Entry	Description
Are NPIs measured using a frequency scale such as the Likert scale?	Preventing pandemics through practicing and adhering to NPIs is influenced by how frequently these behaviors are practiced. Even though a binary scoring system has valid information about practicing, a scale measuring frequency produces more accurate results. Therefore, choosing to use binary measure or frequency measures is expected to affect the quality of reporting and the overall quality of the study.
Are the statistical tests appropriate for study variables measurements and distribution?	To accurately analyze the relationship between variables, the appropriate test needs to be conducted. For example, odds ratio or chi-square test are appropriate for binary items. For continuous items, Peason's correlation or linear regression is appropriate. Also, when the normal distribution cannot be assumed, are non-

	parametric tests used?
Is adherence to NPIs measured using a validated tool? If not, are there successful attempts to establish any type of validity (content, construct, or face)?	For studies using surveys, did the authors establish the validity of the tool by reporting the psychometric properties of the tool? If not, do the authors justify the inclusion of the survey in their study?
What measures are taken by the researchers to ensure reliable study results	Describe what the researchers did to establish reliability. That includes pilot testing and back translation.
Was the target/reference population clearly defined? For a healthcare university student sample, does the sample contain non-healthcare students or faculty?	When measuring influencing factors, it is important to cover all aspects of the construct for the association to be valid if present. For example, when measuring knowledge, did the researchers measure knowledge about the pandemic risk, prevention, or how to practice NPIs?
Did the authors calculate influencing factors (demographic, cognitive, and social) using an appropriate scoring method?	In a study of association, confounding factors can compromise the relationship between two variables. It is important that the researchers identify the confounding factors relevant to their population and properly account for them in the statistical analysis.

Table 2.4. *Included studies' performance on validity, reliability, and measurement*.

	Reviewers' comments on		
Study	**Validity**	**Reliability**	**Measurement**
Salim et al., 2021	No validated tool Pilot testing	Cronbach alpha test = 0.73	Binary
Baniyas et al., 2021	No validated tool Pilot testing Build on published survey	No efforts were done towards establishing reliability.	Binary and 3-point Likert type scale
Khalil et al., 2020	No validated tool Pilot testing Back translation	Cronbach alpha test = 0.76	5-point Likert type scale
Alrasheedy et al., 2022	No validated tool Pilot testing Expert consultation	Cronbach alpha test = 0.73	Binary
Le An et al., 2021	No validated tool	No efforts were done towards establishing reliability.	Binary
Ahmed at al., 2022	No validated tool Pilot testing Build on published survey	Cronbach alpha test = 0.73	Binary and 3-point Likert type scale
Ahmad et al., 2022	No validated tool	Cronbach alpha test =	Not mentioned

	Expert consultation Build on published survey	0.72	
Zemni et al., 2023	No validated tool	Cronbach alpha test = 0.83	5-point Likert type scale
Tang et al., 2021	No validated tool Build on published survey	Cronbach alpha test = 0.88	5-point Likert type scale
Zhang et al., 2022	No validated tool	No efforts were done towards establishing reliability.	Binary
Maheshwari et al., 2020	No validated tool Pilot testing Expert consultation	Cronbach alpha test = 0.71	Binary
Noreen et al., 2020	No validated tool Pilot testing Expert consultation Build on published survey	Cronbach alpha test = 0.79	3-point Likert type scale
Soltan et al., 2020	No validated tool Pilot testing Expert consultation Build on published survey	Cronbach alpha test = 0.70	Binary
Kim et al., 2016	No validated tool Expert consultation Build on published survey Content validity index	Cronbach alpha test = 0.77	Binary
Hassan et al., 2023	No validated tool Expert consultation	No efforts were done towards establishing reliability.	Binary
Singh et al., 2011	No validated tool Pilot testing	Cronbach alpha test = 0.76	Binary
Taghrir et al., 2020	No validated tool Expert consultation Build on published survey	Cronbach alpha test = 0.81	Binary
Siramaneerat et al., 2022	No validated tool Pilot testing Expert consultation	Cronbach alpha test = 0.90	3-point Likert type scale

2.213 Strategy for data synthesis

This systematic review followed a *narrative synthesis,* in which the synthesis of findings from the included studies relies primarily on summarizing and explaining using narrative and text (Campbell et al., 2016). Narrative synthesis starts by grouping and clustering the included articles into smaller groups to manage the narrative synthesis process better. The grouping was done according to the pandemic type and type of influencing factors. Afterward, tabulation was used to develop an initial description of the included articles and identify patterns within and across studies. Finally, the narrative synthesis was concluded by describing the findings of the studies. The results were analyzed using text and tabulated data to draw conclusions when possible.

We used narrative synthesis in the analysis to describe the data as a compelling story that summarizes the data. For example, whether a study reported significant results, the direction and magnitude of the relationships between studied variables, and data were not excluded if they were statistically insignificant. The findings were described in terms of consensus and divergence from the story told by the data. A narrative synthesis can be informative to the reader in a systematic review that is not intended to draw conclusions on treatment effectiveness (Xiao & Watson, 2019). Narrative synthesis is recommended for a review exploring the factors associated with a recent or unstudied phenomenon as they provide explanatory and exploratory information (Popay et al., 2006).

2.3 RESULTS

The database search identified 1,326 articles. After excluding 343 duplicate records, the title and abstract screening excluded 931 more records. Full-text screening resulted in the inclusion of 13 studies and the identification of five additional studies

through citation searching. The 18 included studies were observational studies; all were cross-sectional studies with online recruitment strategies. The total number of participants was 17,579, from programs of study including allied health sciences, medicine, pharmacy, dental, and nursing. Studies were conducted in 12 countries, including Saudi Arabia, India, Egypt, China, and Thailand. Only two of the included studies were conducted on NPIs in a disease outbreak different from COVID-19. These studies are summarized in Table 2.5.

The results section is comprised of two main sections: the characteristics and trends of the included studies and the results obtained from the full-text data extraction. The choice to report the prominent trends of the studies stems from the many gaps in research design and measurement, as seen in Table 2.3. Reporting these trends will support future research on this topic. Additionally, the results are classified into three groups: demographic factors, personal-cognitive factors, and socio-environmental factors.

Table 2.5. ***Study characteristics***

Author (year)	Study location	Pandemic reported	NPI	Factors reported	Subject of study	Study design	Sample size	Reviewers' comments
Ahmad et al., 2022	Pakistan	COVID-19	(M, D, H, Q)	0	Medical students	Cross-sectional	1342	
Ahmed et al., 2022	Egypt	COVID-19	(M, D, H, Q)	0	Medical students	Cross-sectional	537	Only male sample
Alrasheedy et al., 2022	Saudi Arabia	COVID-19	(M, D, H, Q)	0	Pharmacy Students	Cross-sectional	232	Non-compliance reported
Baniyas et al., 2021	UAE	COVID-19	(M, D, H)	0	medical and health sciences students	Cross-sectional	677	
Hassan et al., 2023	Iraq	COVID-19	(M, D, H)	0	Medical students	Cross-sectional	214	
Khalil et al., 2020	Iraq	COVID-19	(D, H)	0	Medical students	Cross-sectional	1380	surface disinfection + avoiding touching face measured
Kim et al., 2016	S. Korea	MERS	(D, H)	0,1,2	Nursing students	Cross-sectional	249	
Le An et al., 2021	Vietnam	COVID-19	(M, D, H, Q)	0,1,2	All majors	Cross-sectional	2351	
Maheshwari et al., 2020	India	COVID-19	(M, D, H, Q)	0	Medical students	Cross-sectional	354	
Noreen et al., 2020	Pakistan	COVID-19	(D, H,)	0	Medical students	Cross-sectional	1474	
Salim et al., 2021	Egypt	COVID-19	(M, D, H, Q)	0	Medical students	Cross-sectional	3263	

Singh et al., 2011	India	H1N1	(M, D, H, Q)	0	Dental students	Cross-sectional	448	
Siramaneerat et al., 2022	Thailand	COVID-19	(M, D, H, Q)	1	Nursing students	Cross-sectional	620	
Soltan et al., 2020	Egypt	COVID-19	(M, D, H)	1,2,3	Medical students	Cross-sectional	283	
Taghrir et al., 2020	Iran	COVID-19	(M, D, H, Q)	0,1,2	Medical students	Cross-sectional	240	
Tang et al., 2021	China	COVID-19	(M, D, H)	0,1	health sciences students	Cross-sectional	2706	M and H measured together- D measured alone
Zemni et al., 2023	Tunisia	COVID-19	(M, D, H)	0,1	Medical students	Cross-sectional	678	
Zhang et al., 2022	China	COVID-19	(M, H, Q)	0	Medical students	Cross-sectional	531	

for factors reported, 0 = demographic. 1 = personal cognitive, 2 = socio-environmental
For NPI: M = mask wearing, D = social distancing, H = hand washing, Q =self-quarantine

2.31 Study Characteristics

Data extraction and quality assessment revealed a few notable trends. Most notable is the overrepresentation of developing countries in the review. In addition, Other important trends are described below.

2.311 The Lack of a Theoretical Framework

The lack of a theoretical framework is apparent in the methodology, the design of the study tool, and the objectives of the reviewed studies. The exception in this review is the Siramaneerat et al., (2022) article conducted during COVID-19. Siramaneerat et al. (2022) used the Health Belief Model (HBM) core elements to draw conclusions on the relationship between the HBM constructs and NPIs adherence. Even though theirs is not the only study measuring constructs such as self-efficacy and perceived risk, the Simamaneerat et al. paper adds structure to NPIs investigation, allowing for more accurate conclusions and standardization when studying future infectious disease outbreaks.

In NPIs studies conducted among the general population, a theoretical framework is rarely used to inform the study's design and methods (Bish & Michie, 2010). However, when theories are used, it is usually the expectancy-value theories such as the health belief model, protection motivation theory, and the theory of planned behavior which are used as models for prediction (Bish & Michie, 2010; Leppin & Aro, 2009; Smith, 2006; Taylor, 2019). These models, among others, identify the individual cognitive and affective factors supporting adherence to recommended behaviors. Additionally, they can identify socio-environmental factors that predict adherence (or non-adherence). Using theory in investigating NPIs influencing factors helps answer questions such as why

subgroups of a population vary in adherence to behavioral health recommendations. The variation can be attributed to demographic, cognitive, and psychosocial factors (Raude et al., 2020). In our review, 1 of 18 studies reported using a theoretical framework to inform their work.

2.312 Overrepresentation of developing countries

The 12 countries in this review are considered developing countries, with many considered low and middle-income countries, such as Iraq and Pakistan (The World Bank, 2023). The importance of this representation lies in how rare it is in the NPIs compliance literature. A gap in the NPIs literature is the overrepresentation of European, North American, and Chinese populations (Yang et al., 2014).

2.313 The absence of validated survey tools and established reliability

The efforts to ensure the validity and reliability of the studies' results were found to be insufficient. None of the included studies used a validated survey tool. Instead, eight studies resorted to building their survey tool on published literature to standardize their investigation and align with other studies studying NPIs (Ahmad et al., 2022; Ahmed, 2022; Baniyas et al., 2021; Kim & Choi, 2016; Noreen et al., 2020; Soltan et al., 2020; Taghrir et al., 2020; Tang et al., 2021). In addition, most efforts were made toward establishing face and content validity such as expert consultation (Ahmad et al., 2022; Alrasheedy et al., 2021; Hassan et al., 2023; Kim & Choi, 2016; Maheshwari et al., 2020; Noreen et al., 2020; Siramaneerat et al., 2022; Soltan et al., 2020; Taghrir et al., 2020), pilot testing (Ahmed, 2022; Alrasheedy et al., 2021; Baniyas et al., 2021; Khalil et al., 2020; Maheshwari et al., 2020; Noreen et al., 2020; Salem et al., 2021; Singh et al., 2012; Siramaneerat et al., 2022; Soltan et al., 2020), and back translation (Khalil et al., 2020).

One study did not report any efforts done toward validity (Le An et al., 2021). Lastly, four studies did not mention how reliability was assessed (Baniyas et al., 2021; Hassan et al., 2023; Le An et al., 2021; Zhang & Ba-Thein, 2022). The remaining studies used Cronbach's alpha test to assess reliability, all of which reported a satisfactory score of 0.7 to 0.9.

Table 2.6. *Summary of demographic factors associated with NPIs practice.*

Factors	Study population	Analytical strategy	Main conclusion	Cited by
Age	1380 medical students	Independent samples T-test*	Over 20 yrs. old associated with more NPIs practice	Khalil et al., 2020
	354 medical students	One-way ANOVA	Over 24 yrs. old associated with more NPIs practice	Maheshwari et al., 2020
	249 nursing students	Pearson correlation*	Being older is associated with more NPIs practice	Kim et al., 2016
	214 medical students	Independent samples T-test	Over 22 yrs. old associated with more NPIs practice	Hassan et al., 2023
Gender	3263 medical students	Mann–Whitney U test	Males and females have similar practice rates	Salim et al., 2021
	1380 medical students	Independent samples T-test*	Females practice NPIs more than males	Khalil et al., 2020
	232 pharmacy students	Chi-square test of independence*	Females practice NPIs more than males	Alrasheedy et al., 2022
	2351 health care students	Multiple logistic regression*	Females practice NPIs more than males	Le An et al., 2021
	678 medical students	Multiple logistic regression*	Females practice NPIs more than males	Zemni et al., 2023
	2706 health care students	Independent samples T-test*	Females practice social distancing and hand washing more than males	Tang et al., 2021
	354 medical students	Independent samples T-test*	Females practice NPIs more than	Maheshwari et al., 2020

			males	
	1474 medical students	Multiple logistic regression*	Males practice NPIs more than females	Noreen et al., 2020
	283 medical students	Mann–Whitney U test*	Females practice NPIs more than males	Soltan et al., 2020
	249 nursing students	Independent samples T-test*	Females practice NPIs more than males	Kim et al., 2016
	214 medical students	Independent samples T-test*	Females practice NPIs more than males	Hassan et al., 2023
	448 dental students	Independent samples T-test*	Males practice NPIs more than females	Singh et al., 2011
	240 medical students	Mann–Whitney U test	Females practice NPIs more than males	Taghrir et al., 2020
Program of Study	677 health care students	Mann–Whitney U test	No difference in NPIs practice rates across programs of study	Baniyas et al., 2021
	1380 medical students	One-way ANOVA*	Medical students had higher NPIs rates than dentistry and pharmacy students	Khalil et al., 2020
Educational level	677 health care students	Mann–Whitney U test	Graduate students had higher NPIs rates than undergraduates	Baniyas et al., 2021
	1342 medical students	Independent samples T-test*	Students in clinical years had higher NPIs rates than preclinical	Ahmad et al., 2022
	2706 health care students	One-way ANOVA*	Students in preclinical years had higher NPIs rates than clinical	Tang et al., 2021
	283 medical students	Mann–Whitney U test*	Students in clinical years had higher NPIs rates than preclinical	Soltan et al., 2020
	448 dental students	Independent samples T-test*	Students in clinical years had higher NPIs rates than preclinical	Singh et al., 2011

	3263 medical students	Mann–Whitney U test*	Students living in urban areas practice NPIs more than those living in rural areas	Salim et al., 2021
Residence	537 male medical students	Chi-square test of independence	Students living in rural areas practice NPIs more than those living in urban areas	Ahmed et al., 2022
	214 medical students	Independent samples T-test*	Students living in urban areas practice NPIs more than those living in rural areas	Hassan et al., 2023

* p-value <0.05

2.32 The influencing demographic factors on the adherence to non-pharmaceutical interventions

The included studies mostly reported on demographic factors and lacked information about personal-cognitive and socio-environmental factors. The included studies analyzed adherence to NPIs using parametric and non-parametric tests, which included the t-test, the Mann–Whitney test, One-way ANOVA, Logistic regression, the Chi-square test, and Pearson's correlation.

2.321 Age

Four studies reported age differences in health care students' (HCS) adherence to NPIs (Hassan et al., 2023; Khalil et al., 2020; Kim & Choi, 2016; Maheshwari et al., 2020). According to Khalil et al. (2020), those above the age of 20 years reported higher (M = 4.17, SD = 0.82) NPIs adherence rates than those younger than 20 years (M = 4.04, SD = 0.98; $t(1379) = 2.82$, p = <0.005). Kim and Choi, (2016) found that HCS adherence to NPIs increases with age ($r[249]=0.14$, $p<0.05$). The remaining two studies found the

same relationship between being older and higher NPIs adherence, albeit non-significant, likely due to being under-powered. Maheshwari et al. (2020) found that those over the age of 24 to have the highest NPIs practice rate (M = 7.33, SD = 0.89, F= 0.33, p= 0.72), and Hassan et al. (2023) found that those over the age of 22 to have the highest NPIs practice rate (M = 0.99, SD = 0.84, t= 0.58, p= 0.57)

2.322 Gender

Gender was the most commonly reported demographic factor. Two studies found that HCS males were more adherent to NPIs practices than females (Noreen et al., 2020; Singh et al., 2012). However, 11 of 13 studies found more adherence among females than males. For example, Khalil et al. (2020) found that female HSC adhered to NPIs more (M = 4.17, SD = 0.90; t(1379) = 3.99, p = <0.001) than their male counterparts (M = 3.97, SD = 0.90; t(1379) = 3.99, p = <0.001). Le An et al. (2021) also concluded that females are approximately twice as likely to adhere to NPIs than males (OR 1.9 95% CI: 1.35– 2.67). Finally, when looking at NPIs behaviors separately, females continued to show the same high levels of adherence across different behaviors. According to Tang et al. (2021), female HCS practiced NPIs at a significantly higher rate (M = 43.5, SD = 8.11; t(2754) = -3.55, p = <0.001) than males (M = 41.6, SD = 8.72; t(2754) = -3.55, p = <0.001). The same relationship persisted when looking at females' hand-washing practices (M = 23.1, SD = 2.76; t(2754) = -3.75, p = <0.004) in comparison to their male counterparts (M = 22.4, SD = 3.64; t(2754) = -3.75, p = <0.004).

2.323 Other factors

Khalil et al. (2020) found that HCS in medicine (M = 4.28, SD = 0.63) were practicing NPIs (F[2,1380] = 42.57, p < 0.001) at higher rates than those in dentistry (M = 3.94, SD = 1.10), and pharmacy (M = 3.74, SD = 1.24). Three studies investigated the association between students' residence and NPIs adherence, where living in an urban area was associated with significantly higher levels of NPIs compliance. For example, Hassan et al. (2023) reported that the HSC who lived in urban areas (M = 0.99, SD = 0.05; t(213) = 2.40, p = 0.01) were practicing NPIs at higher rates than their peers who are living in rural areas (M = 0.96, SD = 0.10). Lastly, when looking at the effect of being a student during clinical years compared to non-clinical years, only one study reported higher NPIs adherence rates among the non-clinical HCS (Tang et al. 2021). Meanwhile, students in clinical years (M = 5.25, SD = 1.48; t(447) = 12.13, p = 0.001) were found to be practicing NPIs at significantly higher rates than their pre-clinical peers (M = 3.48, SD = 0.95).

In summary, all studies that reported on age found that being older was associated with more NPIs adherence. Of the studies that reported on gender, most reported that females adhere to NPIs more than males. These consistent findings suggest that the results are more conclusive on their influence on NPIs adherence. On the other hand, the studies that reported on the program of study, educational level, and residence had conflicting conclusions, suggesting these factors are not as clear cut.

Table 2.7. *Summary of personal cognitive factors associated with NPIs practice.*

Factors	Study	Analytical	Main conclusion	Cited by

	population	strategy		
Anger	531 medical students	Multiple logistic regression*	Anger is associated with more NPIs practice	Zhang et al., 2022
Confusion	531 medical students	Multiple logistic regression*	Confusion is associated with more NPIs practice	Zhang et al., 2022
Attitude	2351 health care students	Multiple logistic regression*	Positive attitude toward NPIs is associated with higher NPIs practice than negative attitude	Le An et al., 2021
Perceived risk	283 medical students	Mann–Whitney U test*	Higher levels of perceived risk are associated with higher NPIs practice	Soltan et al., 2020
	249 nursing students	Pearson correlation*	Higher levels of perceived risk are associated with higher NPIs practice	Kim et al., 2016
	620 nursing students	Pearson correlation*	Higher levels of perceived risk are associated with higher NPIs practice	Siramaneerat et al., 2022
Knowledge	2351 health care students	Multiple logistic regression*	Students with sufficient knowledge about NPIs are 4 times more likely to practice NPIs than those with insufficient knowledge	Le An et al., 2021
	249 nursing students	Pearson correlation*	Sufficient knowledge about NPIs is positively correlated with more NPIs practice	Kim et al., 2016
	620 nursing students	Pearson correlation*	Sufficient knowledge about NPIs is positively correlated with more NPIs practice	Siramaneerat et al., 2022
	240 medical students	Spearman correlation	Sufficient knowledge about NPIs is negatively correlated with more NPIs practice	Taghrir et al., 2020
Perceived stress	678 medical students	Multiple logistic regression*	Higher levels of perceived stress are negatively associated with NPIs practice	Zemni et al., 2023
Perceived	620 nursing	Pearson	Higher levels of	Siramaneerat

susceptibility	students	correlation*	perceived susceptibility are positively correlated with more NPIs practice	et al., 2022
Perceived benefits	620 nursing students	Pearson correlation*	Higher levels of perceived benefits are positively correlated with more NPIs practice	Siramaneerat et al., 2022
Perceived barriers	620 nursing students	Pearson correlation*	Higher levels of perceived barriers are positively correlated with more NPIs practice	Siramaneerat et al., 2022
Perceived severity	620 nursing students	Pearson correlation*	Higher levels of perceived severity are positively correlated with more NPIs practice	Siramaneerat et al., 2022

* p-value <0.05

2.33 Influencing personal-cognitive factors on adherence to non-pharmaceutical interventions

The personal-cognitive factors reported in the included studies were not as comprehensive as the reporting on demographic factors. For example, affective factors such as anger, confusion, and attitude, were reported by two studies. Feelings of anger and confusion were reported by Zhang et al. (2022) to be associated with less adherence with self-quarantine (OR= .32 CI=[.12-.76], OR= .30 CI=[.12-.76]), as well as less adherence with masking (OR= .12 CI=[.03-.50]) and handwashing (OR= .27 CI=[.08-.88]). Additionally, Le An et al. (2021) found that students with positive attitudes toward NPIs were four times more likely to practice NPIs (OR = 4.0 CI= [3.09–6.35], p=<.00) than those with negative attitudes. On the other hand, four studies showed that sufficient knowledge about the infectious disease and the application of NPIs affected the student's adherence to NPIs (Kim & Choi, 2016; Le An et al., 2021; Siramaneerat et al., 2022; Taghrir et al., 2020). Three concluded that having sufficient knowledge was associated

with higher adherence to NPIs, with one study reporting an odds ratio of 4.4 (CI= 2.82–5.68) (Le An et al., 2021).

Perceived risk of infection was reported by three studies as influential in students' levels of NPIs practice. Soltan et al. (2020) and Kim & Choi (2016) concluded that having higher levels of infection risk perception is associated with higher levels of adherence to NPIs (r[248]=0.29, p<0.01). However, Taghrir et al. (2020) reported a negative relationship between risk perception and NPIs (rs = -0.128; P < 0.05). Also, perceived stress was found to be negatively associated with NPIs practice (β= -.13, SE= .04, CI= [-.22, -.04], p=.004). Finally, constructs from the Health Belief Model were examined by Siramaneerat et al. (2022) and found to be positively correlated with students' adherence to NPIs. Those constructs are perceived susceptibility (r[619]=0.21, p<0.01), perceived benefits (r[619]=0.33, p<0.01), perceived barriers (r[619]=0.23, p<0.01), and perceived severity (r[619]=0.19, p<0.01).

In summary, higher levels of affective factors, including anger, confusion, and positive attitude, influenced NPIs adherence. Also, higher levels of perceived risk, stress, susceptibility, benefits, barriers, and severity influence NPIs adherence. On the other hand, the studies that reported on knowledge were not as conclusive on its relationship with NPIs.

Table 2.8. *Summary of social environmental factors associated with NPIs practice.*

Factors	Study population	Analytical strategy	Main conclusion	Cited by
Cues to action	620 nursing students	Pearson correlation*	More cues to action in the environment are associated with higher NPIs practice	Siramaneerat et al., 2022
Source of information	2351 health care students	Multiple logistic regression*	Students who reported Websites of hospital, Ministry of Health,	Le An et al., 2021

			World Health Organization as their main source of information were more likely to adhere to NPIs than those who relied on other sources	
Observational learning	283 medical students	Mann–Whitney U test*	Higher levels of observational learning are associated with higher NPIs practice	Soltan et al., 2020
	249 nursing students	Pearson correlation*	Higher levels of observational learning are associated with higher NPIs practice	Kim et al., 2016
	240 medical students	Mann–Whitney U test	Higher levels of observational learning are associated with higher NPIs practice	Taghrir et al., 2020

* p-value <0.05

2.34 The influencing socio-environmental factors on the adherence to non-pharmaceutical interventions

Like personal-cognitive factors, the socio-environmental factors examined by the included studies did not include all the possible influencing factors, and most studies lacked theory and structure. Bandura's (2004) construct of observational learning, or vicarious learning, was found by Soltan et al. (2020) to be influential in HCS' reported level of NPIs adherence. Specifically, those who reported learning from others (mean ranks= 148) had higher levels of NPIs adherence than those who did not (mean ranks= 129) (U= 7620, P= 0.04). Two other studies found a similar relationship, although they were not statistically significant (Kim & Choi, 2016; Taghrir et al., 2020). Another influencing factor was the external cues to action, which was found by Siramaneerat et al. (2022) to be positively correlated with students' adherence to NPIs (r[619]=0.29,

p<0.01). Finally, Le An et al. 2021 found that when it comes to the source of information, those who reported websites of a hospital, the Ministry of Health, and the World Health Organization as their main source of information were more likely to adhere to NPIs than those who relied on other sources (OR = 2.3 CI= [1.57–3.28], *p*=<.00). In summary, cues to action, source of information, and observational learning influenced NPIs adherence.

2.4 DISCUSSION

This study explored the factors that influence NPIs adherence among health care students. In a group usually at the forefront of any infectious disease response, health care students are at a higher risk of being infected or spreading the infection (Khubrani et al., 2018). Our findings highlight the need to make NPIs studies population- and context-specific. Our analyzes demonstrate the relative importance or unimportance of particular demographic, personal-cognitive, and socio-environmental factors; the narrative analysis format is ideally suited for use by public health practitioners and policymakers. Demographic factors dominate health care students' reported factors associated with NPIs, which aligns with the literature on NPIs from other populations (Bish & Michie, 2010; Regmi & Lwin, 2021).

This study is one of the first to synthesize findings relating primarily to non-Western populations. In the NPIs literature, North American and European samples are prevalent, and other populations are under-researched. When studying a behavior highly influenced by governmental policy and required to be followed by societies, neglecting the non-Western and developing world perspective can be problematic as they have a different perspective on health behaviors (Singer et al., 2016). Additionally, the trends identified in the studies such as lack of theoretical frameworks or use of validated

measures, reflect the emergent nature of pandemic research. The ability to establish psychometric characteristics of a survey tool is hindered by the sense of urgency to publish findings. Further, as each pandemic differs, tools previously used may not be applicable in the present. Lastly, journal editors may be less hesitant to accept flawed, but relevant and timely research papers during an international crisis.

Age and gender influenced NPIs practice among health care students. This finding can be attributed to the higher risk perception found in older people and females (Yildirim et al., 2021). Hence, health promotion interventions can use this information to guide and tailor interventions directed at health care students. The tailoring can be directed toward the groups needing education, such as younger males with low-risk perceptions. It is important to note that these differences in NPIs adherence based on age and gender were found in health care workers (Ferdous et al., 2021). Even though some of our population, health care students, are not in clinical years and not treating patients, being female and older was consistently associated with higher NPIs practice. In contrast, we could not conclude that being in a different program of study or educational level directly influences NPIs adherence. However, Hasan et al. (2021) have found that health care students had more knowledge and NPIs practice than their non-health student counterparts. Even if we cannot conclude a difference between the different programs of study, it is important to know that health care students are more adherent to NPIs when compared to college students.

Higher levels of affective factors, including anger, confusion, and positive attitude, influenced NPIs adherence. This finding is consistent with the commonly seen reaction to disasters and pandemics in other populations (Wang et al., 2020). Generally,

anger and confusion follow feelings of panic, stress, and fright, which is potentially the justification for following NPIs guidelines. Of course, negative feelings can have the adverse effect of shutting down and not engaging with NPIs (Zhang & Ba-Thein, 2022). Also, higher levels of perceived risk, stress, susceptibility, benefits, barriers, and severity influence NPIs adherence. When a person is aware of the pandemic severity, NPIs benefits, and has an adequate level of risk perception, the likelihood of engaging in preventive behaviors significantly increases (Li et al., 2020)

The socio-environmental factors: cues to action, source of information, and observational learning influenced NPIs adherence. The effect of environmental cues to actions, such as communications from social circles, media, or community leaders, lies in their ability to support the individual's ability to cognitive processes and intentions to engage in NPIs (Siramaneerat et al., 2022). Additionally, when health care students follow guidelines from official organizations, it implies their willingness to accept future guidelines and potentially future health communication campaigns (Le An et al., 2021). Finally, observing others perform NPIs and being willing to learn is a crucial finding as this implies their willingness to participate in education not only as receivers but also as contributors (Soltan et al., 2020).

2.5 STRENGTHS AND LIMITATIONS

We add to the literature a systematic review of health care students' adherence to NPIs since SARS in 2004. A strength of our review is that developing countries are the focus, which fills a gap in the NPIs literature on adherence among non-Western populations. Also, by developing the quality assessment tool specifically for our review, we were able to adequately describe the studies' performance in different quality areas

(Appendix A). Our study is not without limitations, though. The included studies performed inadequately in quality areas, such as using validated tools and frequency measures instead of binary measures of NPIs. We could not include non-English studies, which might limit our access to a bigger pool of related studies. Finally, even though our review had a social cognitive view on NPIs adherence, this cannot be said about the included studies, of which many did not use any health behavior theory to investigate NPIs.

2.6 CONCLUSION

This is the first systematic review to identify and theoretically categorize the determinants of NPIs adherence among health care students. We found consensus and disagreement across the literature, providing insights on opportunities for public health practitioners to improve adherence with NPIs in our population. Our systematic review showed the importance of investigating the drivers of NPIs adherence among health care students. As a complex health intervention, identifying NPIs adherence influencing factors such as age, gender, risk perception, and observational learning is crucial to future studies and health communication campaigns. Also, we found that the current understanding of NPIs adherence among our population is unacceptable, with more needed to be done in terms of the methods of investigation. When possible, future NPIs adherence research should use theoretical frameworks, validated tools, and the cognitive and social factors that influence pandemic preventive behaviors.

CHAPTER III: UNDERSTANDING THE SOCIAL AND COGNITIVE INFLUENCES ON THE ADOPTION OF COVID-19 NON-PHARMACEUTICAL INTERVENTIONS BEHAVIORS: A SURVEY OF A SAUDI ARABIAN SAMPLE

3.1 INTRODUCTION

Since December 2019, SARS-CoV-2 has spread throughout the world, posing health, social, and economic threats that are comparable to previous pandemics such as the Spanish Influenza of 1918. The current global prevalence of COVID-19 is estimated to be 774 million cases and over 7 million deaths (World Health Organization, 2023). Many authors, such as Stock et al. (2020) and Lachmann (2020), consider this a significant undercount of cases and fatalities. The social context of the current pandemic creates unique obstacles to controlling and arresting its spread, as world travel and international trade are much greater than in the past. Further, while anti-vaccine and anti-science attitudes have existed previously, the advent of social media has amplified the impact of false or misleading information.

Initially, the lack of effective vaccines and medications forced health organizations such as the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO) to rely on the use of Non-Pharmaceutical Interventions (NPIs) to combat COVID-19 (Van Bavel et al., 2020; West et al., 2020). Recommended NPIs include frequently washing hands with soap and warm water, wearing a mask or a face covering in public, keeping a physical distance of at least 1.5 meters in public, and self-quarantine when directed (Lai et al., 2020; Van Bavel et al., 2020). Without adequate

medical technologies, health authorities resorted to controlling the pandemic through social and health behavior change (West et al., 2020). In some countries, such as Saudi Arabia, NPIs recommendations were supplemented with government-imposed lockdowns and curfews (Neve, 2020).

Residents of Saudi Arabia have bitter experiences with infectious disease outbreaks; the Middle Eastern Respiratory Syndrome (MERS), which had a whopping fatality rate of 34% (Memish et al., 2020), resulted in 780 deaths in 7 years. The lessons learned from MERS prepared the Saudi healthcare system to respond to the current pandemic. For example, hospitals in Saudi Arabia have already established triage units for respiratory diseases equipped with negative-pressure ventilation systems to limit infection (Neve, 2020). The kingdom was also prepared to implement strict containment measures that ensured limited social movement, while other countries hesitated to take such measures. The measures included partial and full curfews that lasted for three months, large fines on those who violated curfews, prohibiting large gatherings, and monitoring the movement of individuals through the Tawakkalna app (Neve, 2020). The Saudi public largely adhered to these measures; however, the toll of this restriction impacted most people's financial and psychological well-being (Alkhamees et al., 2020). When later COVID-19 waves occurred, the government implemented less restrictive NPIs guidelines; adherence became voluntary and consequently less well-accepted. This study aims to understand better why residents of Saudi Arabia adhered or not to voluntary NPI recommendations.

As past pandemics have illustrated and COVID-19 emphasized the response to a viral outbreak must be collaborative between governments, healthcare organizations,

businesses, media outlets, and community members (Anderson et al., 2020). The collective response forms a complex and interacting system that places individuals and their behaviors at the absolute center of the system (Bradley et al., 2020). According to the CDC's Science Agenda for COVID-19, priority area VI, objective 2: "social, economic, and behavioral factors also play a key role in adoption of recommended personal protective behaviors and community mitigation measures and require study" (CDC, 2021). Therefore, using behavioral sciences to understand the psychological, social, and environmental factors is essential to developing health promotion interventions, drafting health-oriented policies, and shaping effective health communication campaigns (West et al., 2020).

During the partial curfew period, researchers found that most people in Saudi Arabia had optimistic attitudes about the threat of COVID-19 and overall good adherence to avoiding social gatherings and washing hands (Al-Hanawi et al., 2020). This study adds to the Al-Hanawi et al. study by studying the adoption of NPIs recommendations within the theoretical lens of the Social Cognitive Theory.

3.11 Application of Theory and A Present Gap

Studies of behavioral responses to emerging infectious diseases have found success in applying expectancy-value theories such as the Health Belief Model and the Theory of Planned Behavior (Ajzen et al., 2018; Brewer et al., 2007) to understanding individual risk behaviors (Bish & Michie, 2010; Leppin & Aro, 2009; Smith, 2006; Taylor, 2019). However, these theories downplay the importance of social and structural influences on adherence to prescribed guidelines. For example, the Health Belief model

offers little explanation of why subgroups of a population vary in their adherence to health behavioral recommendations (Raude et al., 2020).

Individual behavior is influenced by cognitive and affective factors and by sociocultural factors such as normative beliefs. Other factors, such as resource availability and effective health messaging, play an important role (Wong & Jensen, 2020). Studies show that risk perceptions and preparedness behaviors vary across countries, even after controlling for educational status, age, and employment status (Finucane et al., 2000; Kahan et al., 2007; Raude et al., 2005). A recent meta-analysis found females are about 50% more likely than men to practice NPIs (Moran & Del Valle, 2016), though this difference varied when considering where the sample was drawn (Clark et al., 2020). This result suggests that social-cultural influences on behavior play a large role in behavior. Prati and colleagues (2011) used a social-cognitive framework to study adherence during the H1N1 pandemic in 2009. Cognitive factors included perceived coping efficacy, perceived likelihood of infection, perceived seriousness, personal impact, and severity of illness; social factors included perceived preparedness of institutions, family members and friends' levels of worry, and exposure to media campaigns (Prati et al., 2011). Social factors such as exposure to media campaigns were predictive of pandemic protective behaviors without the mediation of the respondent's affective response, whereas the cognitive factors were mediated by affect. More recently, Wong and Jensen (2020) studied adherence to COVID-19 guidelines and concluded social and cultural factors should be considered when understanding personal actions to mitigate individual health risks. This study explores the influence of social and cognitive factors on adopting COVID-19 non-pharmaceutical interventions and answers the

research question: which psychological, cognitive, or socio-environmental factors are more predictive of adherence to COVID-19 NPIs among the Saudi population?

3.2 METHODS

3.21 Participants and Procedures

Prior studies in Saudi Arabia have shown potential participants to be receptive to internet-based studies (Al-Hanawi et al., 2020). In this study, we recruited participants and distributed an online survey to King Saud bin Abdulaziz University for Health Sciences (KSAU-HS) staff and students via electronic bulletin boards, emailed fliers, and select social media groups. We recruited participants over 18 years of age who lived in Al-Ahsa region. Participants were encouraged to invite others on their social networks.

Al-Ahsa is a city in eastern Saudi Arabia; the total area of Al-Ahsa is 379 sq km, with a total population of 1.3 million (UNISCO). The King Saud bin Abdulaziz University for Health Sciences – Al-Ahsa campus (KSAU-HS) has approximately 1,500 students and 144 faculty and staff (KSAU-HS, 2020). According to the most recent census, residents of Al-Ahsa are a quarter of the population of the Eastern Province, Saudi Arabia's third largest administrative region (2010 census).

3.22 Measurement

We developed a 59-item survey based on Social Cognitive Theory to measure adherence to COVID-19 non-pharmaceutical behavioral recommendations. The survey was initially developed in English and then translated into Arabic. To test the translation, an Arabic-speaking PhD student not associated with the study translated the survey back into English. Changes were implemented as needed, and the final survey was retested for

linguistic accuracy. The survey was open from March 02, 2021, to April 4, 2021. We used SurveyMonkey as the platform to disseminate our survey to the study participants.

In addition to the information described below, the survey elicited sociodemographic information, including age, gender, marital status, education, occupation, nationality, place of residence, number of household members, average monthly income, vaccination status, and the presence of COVID-19 health risk factors.

3.221 Personal Cognitive Factors

Self-efficacy beliefs of adopting COVID-19 NPIs, outcome expectancies of adherence to NPIs, and knowledge of COVID-19 were assessed. We used seven Likert-type scale items to measure the perceived ability to adopt COVID-19 NPIs; for example, one question is: “I can maintain my social distance (1.5m) outside my residence”. Options were presented as "1=strongly disagree to 5=strongly agree". An aggregate variable was created by summing the seven items, with scores ranging from 7 to 35, with higher scores indicating higher perceived self-efficacy levels. The aggregate variable showed good internal reliability (Cronbach's Alpha = 0.83; Mohajan, 2017).

To assess outcome expectancies, we used five Likert-type questions asking participants about the perceived outcomes of adopting COVID-19 NPIs. A sample item is “I believe that following COVID-19 safety measures will be beneficial to my health”. Scale items ranged from "1=strongly disagree to 5=strongly agree". Aggregate scores ranged from five to 25, with higher scores indicating higher perceived positive outcomes of adherence to COVID-19 NPIs behaviors. The aggregate variable had a Cronbach’s Alpha of 0.76, indicating satisfactory internal reliability.

Knowledge was assessed about COVID-19 symptoms, transmission routes, and understanding of the effectiveness of NPIs behaviors in preventing infection. Knowledge items were developed from the available information from the CDC, the WHO, and the Saudi Arabian Ministry of Health; final validation of the knowledge items was done by comparing them to the Understanding America Study website (Bennett et al., 2020). Knowledge items were presented as true or false. Incorrect or "don't know" answers were coded as zero, and correct answers were coded as one. Total scores ranged from zero to 13, with higher scores indicating higher COVID-19 knowledge.

3.222 Socioenvironmental Factors

We used three constructs to evaluate socio-environmental factors: participants' perceptions of the social norms of adopting COVID-19 NPIs, media exposure, and participants' perception of what observational learning had occurred. Normative beliefs (e.g., social norms) were measured with four questions relating to how frequently they perceived important others as performing COVID-19 NPIs. A sample item is "Please indicate how much do you think the people close to you accept adopting social distancing". The five-point Likert scale ranged from "1=never to 5=always". Total scores ranged from four to 20, with higher scores indicating COVID-19 NPIs to be more socially acceptable. The resulting Cronbach's alpha coefficient was 0.88, indicating satisfactory internal reliability.

Media exposure was a single item factor asking the participant how they perceived their media exposure to COVID-19-related information: "Do you think you are receiving the necessary COVID-19 related information you need to make a decision about your health?" Choice options were "yes", "no", or "I don't know".

Observational learning was a single item factor asking the participant: “I had to learn new skills to properly perform the recommended precautionary measures (e.g. face covering, hand washing).” Choice options were "yes", "no", or "I don't know".

3.223 Adherence to NPIs Behaviors

The main dependent variable was the self-reported frequency of the performance of NPIs behaviors mask wearing, hand washing, social distancing, and quarantining/isolating. A sample item was “Please indicate how frequently you wear a face mask when you leave your residence.” The five-point Likert scale ranged from "1=never to 5=always". Total scores ranged from four to 20, with higher scores indicating more adherence to COVID-19 NPIs. The aggregate variable had a Cronbach’s alpha coefficient of 0.80, indicating satisfactory internal reliability.

3.23 Analytical Analysis

Parametric and non-parametric analyses were used where appropriate. Cross-tabulations and other descriptive reports were generated. Correlation, t-tests, and analysis of variance (ANOVA) were used to determine group differences in the dependent variable. A hierarchical multiple regression model was built to explore the influence of the social-cognitive and demographic factors on the adoption of NPIs. Model building was ordered as: demographics, personal cognitive factors, and socioenvironmental factors. Analyses were done using SPSS software (IBM SPSS Statistics for Windows, Version 27), and type 1 errors were limited to alpha = 0.05.

3.24 Ethics Approval Statement

This study and all its related procedures involving human participants followed national and international research committee ethical standards. The design and execution

of this study were evaluated, approved, and exempted from obtaining signed consent by the institutional review board of the University of Louisville (Ref# 713658). The research committee at King Saud Bin Abdulaziz University for Health Sciences reviewed the ethical approval by the University of Louisville and deemed it to be sufficient for their approval.

3.3 RESULTS

Table 3.1. Summary data of the social and demographic characteristics of study participants.

Variable	Mean	SD	CI	Min-Max	N	%
NPIs level	**16.61**	**3.78**	**(16.2-17)**	**4-20**		
Knowledge	**10.00**	**3.21**	**(9.7-10.3)**	**0-13**		
Self-Efficacy	**30.73**	**3.91**	**(30.3-31)**	**15-35**		
Social norms	**15.46**	**4.34**	**(15-15.9)**	**4-20**		
Outcome Expectancies	**21.28**	**3.36**	**(20.9-21.6)**	**5-25**		
Age	**32.14**	**11.70**	**(31-33.3)**	**18-69**		
Sex						
Female					**119**	**37.3**
Male					**200**	**62.3**
Residence						
Urban Al-Ahsa					**269**	**85.3**
Rural Al-Ahsa					**51**	**14.7**
Marital Status						

Single	**160**	**50.2**
Married	**150**	**47.0**
Occupation		
Health	**38**	**11.9**
Education	**71**	**22.3**
Student	**78**	**24.5**
Unemployed	**35**	**11**
Other	**97**	**30.4**
Education		
Middle School	**5**	**1.6**
High School	**86**	**27.0**
2 Year Diploma	**39**	**12.2**
Bachelor's Degree	**180**	**56.4**
Graduate Degree	**9**	**2.8**
Nationality		
Saudi	**311**	**97.5**
Non-Saudi	**8**	**2.5**
Household members		
Less than 6	**139**	**43.8**
Six and more	**178**	**56.2**
Presence of chronic diseases		
Yes	**21**	**6.6**
No	**295**	**93.4**
Monthly income		
Less than 3000 SAR	**66**	**20.7**

3,000 to 8,999 SAR	**71**	**22.3**
9,000 to 14,999 SAR	**81**	**25.4**
15,000 to 29,999 SAR	**34**	**10.7**
30,000 SAR and above	**10**	**3.1**
COVID-19 testing		
Never tested	**116**	**31.5**
Tested, negative result	**180**	**48.9**
Tested, positive result	**61**	**16.6**
Vaccinated against COVID-19		
Yes	**160**	**44.2**
No	**202**	**55.8**
COVID-19 information		
Ministry of Health	**249**	**67.7**
Official social media accounts	**69**	**18.8**
Unofficial social media accounts	**19**	**5.2**
Doctor	**9**	**2.4**
Media exposure		
Sufficient	**219**	**77.9**
Insufficient	**62**	**22.1**
Learned New skills to protect against COVID-19?		
Yes	**172**	**64.9**
No	**93**	**35.1**

After excluding 38 participants who lived outside the study catchment area, the sample included 368 participants. The sample was mostly male (62%); 80% lived in urban Al-Ahsa, 25% were students, and around 68% reported the Ministry of Health as their main source for COVID-19 information. Additionally, 44% of study sample was vaccinated with at least one dose. In Tables 3.1, 3.3, and 3.44, study participants' social and demographic characteristics are presented, along with the mean scores of the main variables.

The overall mean frequency of NPIs behaviors was 16.61 (*SD*=3.78, CI= 16.2-17). Females (*M* = 17.04, *SD* = 3.86, CI=[16.3-17.7]) reported higher level of NPIs practice than males (*M* = 16.29, *SD* = 4.12), CI= [15.7-16.9], *t*(258) = 2.19, *p* = 0.03); those living in rural Al-Ahsa (*M* = 17.69, *SD* = 1.85, CI= [17.2-18.2]) were more adherent to NPIs behaviors than those in urban Al-Ahsa (*M* = 16.27, *SD* = 4.25), CI=[15.8-16.8], *t*(260) = 2.19, *p* = 0.03. Those who reported receiving enough information about COVID-19 from the media (*M* = 16.90, *SD* = 3.68, CI= [16.4-17.4]) reported practicing NPIs behaviors more than those who thought they did not receive enough information (*M* = 14.98, *SD* = 4.82, CI=[13.8-16.2], *t*(203) = 2.77, *p* = 0.02). Those who reported the need to learn new skills to perform NPIs behaviors (*M* = 16.02, *SD* = 4.54, CI= [15.3-16.7]) engaged in fewer NPIs behaviors than those who already knew how to perform the behaviors (*M* = 17.30, *SD* = 2.70, CI= [16.8-17.8], *t*(263) = -2.03, *p* = 0.04).

The mean social norms score was 15.46 (*SD*=4.34, CI= [15-15.9]); significant difference in perceived social norms was found between participants who received enough COVID-19 information from the media (*M* = 15.85, *SD* = 4.06, CI= [15.3-16.4])

and those who did not (M = 14.09, SD = 4.82, CI= [12.9-15.3], t(203) = 2.06, p = 0.04); no other group-level differences in social norms were observed. Non-pharmaceutical interventions were strongly correlated with social norms (r[265]=0.73, p<0.001).

Table 3.2. Pearson Correlation Matrix for behavioral, cognitive, and socioenvironmental factors.

Variable	1	2	3	4	5
1. NPIs	–				
2. Social norms	.73**	–			
3. Outcome expectancies	.06	.06	–		
4. Self-efficacy	.25**	.21**	.49**	–	
5. Knowledge	.08	.08	.04	.1	–

Note: NPIs = Non-Pharmaceutical Interventions; **p < .001.

Overall mean knowledge was 10.00 out of 13 (SD = 3.21, CI= [9.7-10.3]). Independent samples t-test revealed knowledge scores differed between those who did not have to learn new NPIs skills (M = 11.21, SD = 1.59, CI= [10.9-11.5]) and those who did (M = 10.73, SD = 1.81, CI= [10.5-11], t(263) = 2.17, p = 0.03).

Overall mean self-efficacy was 30.73 (SD = 3.91, CI= [30.3-31]). Self-efficacy differed as a function of media exposure. The highest self-efficacy scores were found among those who considered the Saudi Ministry of Health as their main source of information (M = 31.13, SD = 3.76, CI= [30.6-31.6]; F(2,260) = 4.16, p = 0.02) and those who believed they were receiving the adequate amount of information (M = 31.63, SD =

3.30, CI= [31.2-32.1]; $t(218) = 4.14$, $p = <0.001$). As Table 3.2 shows, self-efficacy, and outcome expectancies were moderately correlated.

The mean outcome expectancies level among the study sample was 21.28 out of 25 (*SD* = 3.36, CI= [20.9-21.6]); those who received the COVID-19 vaccine had significantly higher outcome expectancies levels (*M* = 21.83, *SD* = 2.88, CI= [21.4-22.3]) than those who answered "No" to the vaccination question (*M* = 20.84, *SD* = 3.77, CI= [20.3-21.4]; $t(257) = 2.77$, $p = 0.01$). No other group differences were observed.

Table 3.3. Mean scores of NPIs adherence level and social norms among social and demographic groups.

Variable			NPIs Score			Social Norms Score		
	N	%	M (CI)	SD	*p*	M (CI)	SD	*p*
Sex								
Female	119	37.3	17.04 (16.3-17.7)	3.86	.03	15.56	4.09	
Male	200	62.3	16.29 (15.7-16.9)	4.12		15.40	4.40	
Residence								
Urban Al-Ahsa	269	85.3	16.27 (15.8-16.8)	4.25	.03	15.44	4.45	
Rural Al-Ahsa	51	14.7	17.69 (17.2-18.2)	1.85		15.54	3.19	
Education								
High School	86	27.0	16.04	4.17		15.31	4.36	
2 Year Diploma	39	12.2	17.25	3.63		16.33	4.24	
Bachelor's Degree	180	56.4	16.34	4.15		15.33	4.41	
Household members								

Less than 6	139	43.8	16.13	4.30	15.40	4.24
Six and more	178	56.2	16.74	3.80	15.50	4.36
Monthly income						
Less than 3000 SAR	66	20.7	16.49	3.56	15.82	4.06
3,000 to 8,999 SAR	71	22.3	15.31	5.05	14.33	5.42
9,000 to 14,999 SAR	81	25.4	16.58	3.67	15.75	3.66
15,000 to 29,999 SAR	34	10.7	16.43	3.93	15.00	3.72
30,000 SAR and above	10	3.1	16.75	3.56	14.88	3.56
COVID-19 testing						
Never tested	116	31.5	15.94	4.67	15.13	4.83

Tested, negative result	180	48.9	16.52	3.52	15.62	3.99
Tested, positive result	61	16.6	16.37	4.73	15.60	4.61
Vaccinated against COVID-19						
Yes	160	44.2	16.34	4.20	15.40	4.58
No	202	55.8	16.58	3.89	15.51	3.99
COVID-19 information						
Ministry of Health	249	67.7	16.82	3.95	15.76	4.15
Official social media	69	18.8	15.68	3.91	15.24	4.28
Unofficial social media	19	5.2	16.88	2.30	13.75	5.92
Media						

exposure									
Sufficient	219	77.9	16.90 (16.4-17.4)	3.68		15.85 (15.3-16.4)	4.06		
					.02				.04
Insufficient	62	22.1	14.98 (13.8-16.2)	4.82		14.09 (12.9-15.3)	4.82		
Learned New skills									
Yes	172	64.9	16.02 (15.3-16.7)	4.54		15.09	4.62		
					.02				
No	93	35.1	17.30 (16.8-17.8)	2.70		16.15	3.53		

Table 3.4. Mean scores of cognitive predictor variables among social and demographic groups.

Variable			**Knowledge**			**Self-efficacy**			**Outcome expectancies**		
	N	**%**	**M (CI)**	**SD**	***p***	**M (CI)**	**SD**	***p***	**M**	**SD**	***p***
Sex											
Female	119	37.3	10.94	1.73		31.21	3.62		21.53	3.52	
Male	200	62.3	10.88	1.77		30.44	4.03		21.14	3.52	
Residence											
Urban Al-	26	85.3	10.83	1.82		30.79	3.97		21.45	3.45	

Ahsa	9							
Rural Al-Ahsa	51	14.7	11.35	1.13	29.98	3.63	20.50	2.96
Education								
High School	86	27.0	10.63	2.11	30.47	4.16	20.83	3.46
2 Year Diploma	39	12.2	10.96	1.40	32.00	3.55	21.13	2.88
Bachelor's Degree	180	56.4	11.00	1.63	30.55	3.79	21.50	3.56
Household members								
Less than 6	139	43.8	11.05	1.73	30.47	4.19	21.27	3.52
Six and more	178	56.2	10.77	1.76	30.90	3.70	21.36	3.31
Monthly income								

Less than 3000 SAR	66	20.7	10.44	2.00	31.26	3.70	20.85	4.22
3,000 to 8,999 SAR	71	22.3	11.10	1.45	30.96	3.64	21.76	2.96
9,000 to 14,999 SAR	81	25.4	10.98	1.59	30.78	3.69	21.35	2.81
15,000 to 29,999 SAR	34	10.7	10.95	1.43	29.82	4.52	21.43	3.41
30,000 SAR and above	10	3.1	11.75	1.04	29.75	3.77	21.63	2.26
COVID-19 testing								
Never tested	116	31.5	10.94	2.00	30.84	3.98	20.38	4.02
Tested negative	180	48.9	11.01	1.45	31.01	3.73	21.70	3.09
Tested positive	61	16.6	10.57	2.08	30.06	4.02	21.77	2.87

Vaccinated against COVID-19									
Yes	160	44.2	10.84	1.69	30.94	3.97	21.83 (21.4-22.3)	2.88	.01
No	202	55.8	10.95	1.81	30.50	3.83	20.84 (20.3-21.4)	3.77	
COVID-19 information									
Ministry of Health	249	67.7	11.09	1.60	31.13 (30.6-31.6)	3.76	21.64 (21.3-22)	2.98	
Official social media	69	18.8	10.73	1.76	29.90 (29-30.8)	3.90	20.68 (19.6-21.7)	4.43	.05
Unofficial social media	19	5.2	9.63	2.50	28.75 (27.1-30.4)	3.67	20.62 (19.3-22)	2.97	

Media											
exposure											
Sufficient	219	77.9	10.90	1.79		31.63 (31.2-32.1)	3.30	<.01	21.56	3.21	
Insufficient	62	22.1	10.89	1.63		29.20 (28.1-30.3)	4.55		20.50	3.92	
Learned											
New skills											
Yes	172	64.9	10.73 (10.5-11)	1.81	.03	30.70	4.03		21.68 (21.2-22.2)	3.31	.05
No	93	35.1	11.21 (10.9-11.5)	1.59		30.72	3.68		20.64 (19.9-21.3)	3.48	

Table 3.5. Hierarchical Regression Analysis Summary for NPIs Increase on Demographics, Cognitive Factors, and Socioenvironmental Factors.

Model and Predictor Variable	*β*	*t*	*Sig.*	R^2	ΔR^2	*F*	*df*
Model 1 – Demographics			.442	.014	–	.901	(3, 187)

Age	.009	1.344					
Sex	.065	.442					
Vaccine	-.111	-.780					
Model 2 – Add Cognitive Factors			.116	.045	.031	1.46	(3, 184)
Self-efficacy	.317	2.252					
Outcome Expectancies	-.164	-1.484					
Knowledge	.027	.694					
Model 3- Add Socioenvironmental Factors			<.001**	.586	.541	28.44	(3, 181)
Social Norms	.663	14.884					
Media	-.103	-1.060					
Observational Learning	.109	.969					

Note: NPIs = Non-Pharmaceutical Interventions; ΔR^2 = change in R^2; F = F-statistic. **$p < .001$.

A hierarchical linear regression model was built to assess the factors that influenced NPI adherence. Demographic factors were first entered into the model. These factors, which included sex, age, and vaccination status, only accounted for one percent of the variability in NPIs behaviors (R^2 = .01, F (3, 187) = .90, p = .44.)

The next block, cognitive factors, included self-efficacy, outcome expectancies, and knowledge. This block accounted for 4.5% of the variation in NPIs adherence R^2 = .03, F(3, 184) = 1.46 p = .11.. Among the cognitive factors, self-efficacy was most influential (b = .31, t (184) = 2.25, p < 0.01).

The third block, socio-environmental factors, which included social norm, media exposure, and observational learning, explained an additional 58.6% of the variation in NPIs adherence, and the change in R^2 was significant, F (3,181) = 28.44, p < 0.001. Among the socio-environmental factors, social norms were the most influential (b = .66, t(181) = 14.88, p < .001).

3.4 DISCUSSION

The present study is the first to apply a fully integrated social, cognitive, and environmental model to understanding NPIs within the Saudi population. Previous studies have considered social-cognitive factors to understand single behaviors (Hagger et al., 2020), separately evaluated social and socioenvironmental constructs (Savadori & Lauriola, 2021), measured psychological factors (Bailey et al., 2021), or tested multiple behavioral models and concluded the usefulness of a social cognitive model (Raude et al., 2020). The current study adds to the literature by exploring social cognitive factors in a sample of suburban and rural Saudi Arabians. The timing of this study is important. Data was collected in the early stages of vaccine rollout and when the Saudi government's

most stringent restrictions were loosened (Smithe et al., 2021). Accordingly, and due to the similarity in vaccine hesitancy/refusal and NPIs non-adherence, we controlled for vaccine status in our hierarchical regression model (Hengartner et al., 2022). Studying people living in Saudi Arabia is important because this country has recent and deadly experience with another coronavirus pandemic; cases and fatalities from MERS were highest in Saudi Arabia (Memish et al., 2020). Additionally, the political orientation of the Saudi Arabian government permits rigorous restrictive measures such as curfews to be implemented.

The regression model showed that social norms are an important indicator of NPIs adherence and the most influential among all social factors. Social norms have consistently shown their strong relationship with NPIs at different time points of the COVID-19 pandemic, even when the definition of NPIs was different. In early studies of the COVID pandemic, researchers found social norms were highly predictive of behaviors such as avoiding gatherings in public places, forgoing handshaking, and disinfecting surfaces around the house (Goldberg et al., 2020). Other researchers had found that decreased levels of perceived social norms of staying at home predicted low adherence levels to staying at home (Smith et al., 2020). Moreover, similar associations between social norms and NPIs have been found in other countries (Gouin et al., 2020; Raude et al., 2020). These previous results, coupled with ours, suggest the importance of social norms in influencing NPIs behaviors even in countries where the health security of the population is prioritized over individual freedoms (Alobaydullah et al., 2022).

Social norms can only influence behavior change to the extent to which these norms are observable (Reid, Cialdini, and Aiken, 2010). Establishing the relationship

between social norms and NPIs in Saudi society is the first step in building more rigorous and effective public health interventions. We are hopeful our findings will help public health agencies to create campaigns that normalize the use of NPIs. We anticipate that social norms differ between subgroups of the Saudi community, and that understanding these differences is crucial to building effective health campaigns to create a more equitable pandemic response.

Consistent with past literature, we found female gender to be a significant predictor of adherence with NPIs (Bish & Michie, 2010; Clark et al., 2020; Raude et al., 2020; Sánchez-Arenas et al., 2021). Equally important, our study sample showed a low level of risk perception while displaying a high level of NPIs adherence. In a study of medical students in Saudi Arabia, participants showed moderate levels of risk perception (Alsoghair et al., 2021). The low and moderate levels of risk perception among the Saudi samples raise the question of the quality of risk communication in the Kingdom. This finding supports the need to develop a framework for communicating risk during pandemics to increase NPIs compliance.

In our sample, 68% of participants reported that the Ministry of Health was their main media source. The trust the participants showed in the Ministry of Health demonstrates the outsized influence a single source of information can have on risk perceptions. In other countries, where decentralized media outlets and social media are prominent, the influence of governmental health agencies likely differs. Thus, it is important to consider the type of governmental structure when examining the contributions of different information sources.

Exploring cognitive and social factors is valuable to understanding why people practice NPIs differently. Measuring self-efficacy levels was important in two aspects. First, it allowed us to add the levels of self-efficacy among a Saudi sample to the broader global self-efficacy literature, where we found a similarly strong positive correlation between self-efficacy and NPIs (Chong et al., 2020; Fathian-Dastgerdi et al., 2021; Pollak et al., 2020). Second, we assessed self-efficacy levels based on two important indicators: the source and sufficiency of COVID-19 information. Sufficient exposure to information from the leading health entity in the country led to significantly higher levels of self-efficacy. This finding is a significant testimony to the Ministry of Health's concentrated efforts to educate the Saudi public about COVID-19 prevention (Siddiqui et al., 2020). Perhaps because the Saudi Ministry of Health had recent and effective experience with the MERS pandemic, they were evaluated by the population to be trustworthy.

Lessons learned from the COVID-19 pandemic should be captured and communicated to the public. Importantly, the public should be told of the successes and failures and what steps are being taken to strengthen future responses.

Vaccinated and unvaccinated individuals differed in outcome expectancies or perceived benefits levels. This finding is expected as the vaccinated had already adopted one recommended behavior – vaccination. It is safe to consider their positive outcome expectancies from getting vaccinated to be similar to adopting NPIs (Hengartner et al., 2022). The relationship between outcome expectancies and vaccine uptake has been well established; our study shed light on the relationship between NPIs' outcome expectancies and vaccine uptake (Mahmud et al., 2021; Mercadante & Law, 2021).

3.5 STRENGTHS AND LIMITATIONS

To the best of our knowledge, this study is the first to investigate NPIs in Saudi Arabia using a multi-level health behavior theory. Through the Social Cognitive Theory lens, we explored multiple levels of the Social Ecological Model in an under-researched population. Additionally, the study was conducted when the COVID-19 vaccines were just beginning to be distributed to the public, enabling us to control for vaccine status. This study is not without its limitations. Even though the most important constructs of SCT were included, the study survey tool does not include all constructs of the SCT. For example, we intentionally did not include collective efficacy from the SCT model. We did this because when the survey was distributed, social distancing guidelines and limited social interactions prevented the population from forming an adequate perception collective efficacy. Another limitation is the retrospective nature of study results; participants might experience recall bias or over-report the socially desirable NPIs behavior. The study's use of cross-sectional design and convenience sampling limits its generalizability.

3.7 CONCLUSION

The study investigated NPIs among a Saudi sample through the lens of the Social Cognitive Model. An online survey was distributed in February 2021 to measure the samples' overall NPIs adherence and which factors, personal-cognitive or socioenvironmental, are the most influential in the participants' adherence to NPIs. The findings highlight the usefulness of a social cognitive model in predicting NPIs. The study shows that social factors, especially social norms, significantly influence the

adoption of NPIs. Hence, social factors should be considered when developing public health campaigns against COVID-19 and future infectious diseases.

CHAPTER IV: HEALTH COMMUNICATION IN TIMES OF PANDEMICS: A FRAMEWORK FOR INCREASED COMMUNITY PARTICIPATION IN INFECTION PREVENTION

4.1 INTRODUCTION

Communicating about risk during disasters is daunting for the public health researcher, policymaker, and practitioner. For the researcher, understanding people's perception of risk depends on fully understanding the critical variables that dynamically shape their perception of risk. These critical variables include social resistance to pharmaceutical products (e.g., vaccines), circulating rumors on risk and prevention, cultural characteristics, health literacy levels, and alternative worldviews (Barrelet et al., 2013; Jackson et al., 2021). Organizations and policymakers are charged with a similarly demanding mission. Their duty begins by finding pathways to reach their constituents, deciding on the most reliable and current recommendations, keeping the people’s trust and faith in their organization, understanding and mastering navigation through new popular media outlets, and lastly, crafting well-constructed risk and crisis messages (Berg et al., 2021). Finally, practitioners must communicate many details quickly and effectively about an evolving issue to an audience who first hears about the risk they should avoid (Chess & Clarke, 2007). The challenges above illustrate the difficulty of establishing community resilience in times of pandemic and motivating the public to wash their hands or wear face masks as prevention measures.

Public health organizations and practitioners do not mandate the public to wear a mask or practice social distancing, rather, they recommend these behaviors. So, they must motivate their audience through theory and critically evaluating the situation during a pandemic (Utych, 2021). Theory provides structure when thinking about the determinants of behavior change, provides the logical model of behavioral change, and guides the selection of channels and the content of the message about prevention efforts (Bartholomew & Mullen, 2011). As for the situational analysis, every pandemic provides novel obstacles for the health communicator and public health organizations to overcome. During the 2004 Severe Acute Respiratory Syndrome (SARS) pandemic, the information dissemination process could not match the sea of information and the demand by the community to receive the latest guidelines (Arguin et al., 2004). During the H1N1 pandemic in 2009, the propagation of rumors in unprecedented numbers and extent contributed to an unprecedented lack of trust in health authorities (Barrelet et al., 2013). The lack of trust resulted from an environment that encouraged the public to develop their own narrative when the alleged experts took exclusive possession of the situation (Barrelet et al., 2013). Finally, the evolution of social media as the main source of official and unofficial news and information made health and risk communication during COVID-19 more complex and added to the challenges in pandemic risk communication (Malecki et al., 2021).

COVID-19 presented health communicators with many challenges, especially during the first half of 2020. The lack of perceived governmental control over the pandemic prompted a subset of the public to panic and act against its interest (Cheung & Parent, 2021). Many protests have taken place in countries such as the United Kingdom

and Canada, the anti-vaccine movement has reemerged, and disparities have arisen due to variations in adherence levels to COVID-19 prevention measures (Martin & Vanderslott, 2022; Weiss & Paasche-Orlow, 2020). While the public needed reliable and consistent guidelines, lockdowns and mask mandates were imposed, leaving room for growing skepticism and discontent (Martin & Vanderslott, 2022).

The natural life cycle of a pandemic begins with a phase where the confusion is high, prevention interventions' efficacy and effectiveness are not well-established, and a vaccine or medication is not yet ready for distribution (Carvalho et al., 2021). The health communicator is left with the task of relying on insufficient data to communicate NPIs use to the public to stop the spread of the virus. Therefore, the need to communicate effectively to the public is apparent, and a conceptual model is the starting point for public health professionals to use in the early phases of a pandemic.

4.11 Aim

This paper aims to build a conceptual model explaining the pathways that lead to decision-making when recommending practicing NPIs during a pandemic. The conceptual model is built on the critical evaluation of popular risk communication theories in light of lessons learned during COVID-19.

4.2 METHODS

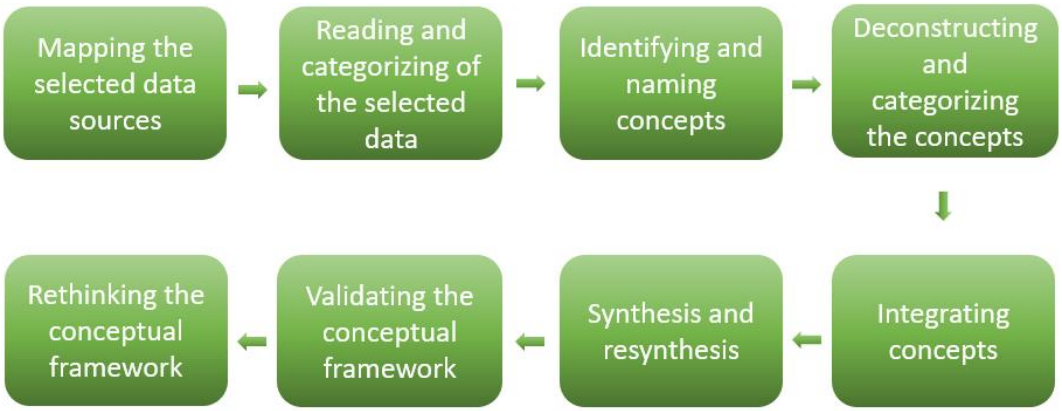
This study uses the conceptual framework analysis method developed by Jabareen (2009) to theorize risk communication. Jabareen's method, referred to as *conceptual framework analysis,* is a grounded theory technique used to create, identify, and discover a phenomenon's major concepts. The major concepts constitute the phenomena's theoretical framework when taken together. According to this method, a conceptual

framework is “a network, or a plane, of interlinked concepts that together provide a comprehensive understanding of a phenomenon or phenomena” (Jabareen, 2009). Therefore, this study does not aim to present a collection of concepts related to our topic; rather, to develop a network of concepts that consistently intertwine to compose a comprehensive understanding of pandemic risk communication. The conceptual framework analysis method fits the aim of this article due to its flexibility and capacity for modification. When communicating about an evolutionary phenomenon such as a pandemic, Jabareen’s method enables the researcher and practitioner to retrospectively conceptualize and modify the response based on the newly available data and the evolution of the pandemic.

According to the conceptual framework analysis methodology, the development of a conceptual framework involves eight phases: (1) mapping diverse data sources from various disciplines; (2) literature review and data categorization; (3) identifying and labeling the relevant concepts; (4) breaking down and categorizing the identified concepts; (5) integrating the identified concepts; (6) synthesizing, re-synthesizing, and ensuring coherence; (7) validating the conceptual framework; and (8) rethinking the conceptual framework (Jabareen, 2012). We condensed some phases to describe the results of our study better. The conceptual framework analysis method theorizes each concept to have its unique characteristics, assumptions, shortcomings, and purpose within the developed conceptual framework. Developing the conceptual framework entails thoroughly examining and categorizing the relevant literature on risk communication's psychological, environmental, and social dimensions. The literature for this study is

drawn from the domains of public health, health communication, psychology, crisis communication, and risk communication.

Figure 4.1. *Jabareen's conceptual framework analysis methodology*



4.3 RESULTS

4.31 Phase 1 and 2: Mapping and categorizing the selected data sources - Theoretical background.

In these two initial steps, we explore and categorize the multi-disciplinary literature that is the basis of the conceptual framework (Jabareen, 2009). This paper is based on three theoretical approaches to NPIs risk communication. The first theoretical approach is the CDC's Crisis and Emergency Risk Communication (CERC) Model, which provides strategic communication in all pandemic phases. Second, we regard risk communication during a pandemic from the Social Amplification of Risk Perception Framework (SARF) point of view, where adequate risk perception is shaped by targeted media strategy. Third, we consider the Social Cognitive Theory (SCT) to guide the exploration of the reciprocal relationship between the individual and their environment, where community participation is the core element of motivation for individual pandemic

prevention. The next section explains why these frameworks were selected and how each relates to pandemic risk communication.

4.311 The phases of crisis and emergency risk communication

Promoting time-sensitive behaviors such as NPIs is highly dependent on strategic communication, which is disseminated in all pandemic phases (Seeger et al., 2020). The Crisis and Emergency Risk Communication Model (CERC) provides the health communicator with a comprehensive and highly specialized phases of a pandemic that other models failed to do (Seeger et al., 2020). Models such as the three-stage model of crisis communication and Turner's Six-Stage Man-made Disasters Model are overly simplistic, too general, or non-comprehensive (Bills et al., 2023; Coombs, 2021; Pedersen et al., 2020). The Crisis and Emergency Risk Communication Model provides what the models above lacked in terms of specificity and the possibility for communication to occur in all pandemic dimensions, including physical, health, social, and mental (Sellnow & Seeger, 2021). A common pitfall when preparing for a future risk is the delusion that we can fairly anticipate future events based on our knowledge of past events, a mistake often exposed by inadequate responses to unprecedented devastating disasters (Aven, 2016; Taleb, 2014). Therefore, preparing a community to achieve adequate preparedness to engage with NPIs must happen at all pandemic phases to prevent a future pandemic (Marcassoli et al., 2023).

There are two assumptions when choosing CERC to divide the pandemic into phases. First, considered as having a developmental view of pandemics, the CERC model assumes the complexity of a pandemic with many seemingly isolated causal factors (Matthew et al., 2012). The simple cause-effect relationship is not what CERC phases

assume in a pandemic; rather, there is a dynamic relationship between the involved factors and stakeholders throughout the pandemic phases (Sellnow & Seeger, 2021). The second assumption is that a pandemic is time-order and time-sensitive and is related to how participants experience and describe the events of a pandemic (Seeger et al., 2003). Those affected by the COVID-19 pandemic recall their negative experiences. They described it as: “It felt like time stood still for many months while life was ‘on hold’ and every day was similar, with no punctuation by landmark events.” (Velasco et al., 2023, p. 1137).

4.312 Socially amplified pandemic risk perception

The social amplification of risk framework (SARF) was developed to explain the underlying processes of risk perception, including social and individual processes (Kasperson et al., 2013). Ever since the Kasperson et al., (1988) paper conceptualized SARF, researchers have investigated the public and individual response to a risky situation and whether various amplification stations (social organizations, media, social media, and interpersonal interactions) intensify or attenuate risk perception. According to classical communication theory, amplification is the intensification or attenuation of a transmitted signal, consequently guaranteeing the addition or loss of information from the original (Kasperson et al., 1988). The main assumption of SARF is that risk messages interact with psychological, social, and cultural processes and consequently shape risk behavior through a socially shaped risk perception (Kasperson et al., 2013). Therefore, experiencing risk is not merely an experience of the physical threat of getting infected during a pandemic but is the product of new meanings of risk ascribed by individuals and communities and the accompanying subjective interpretations of risk (Hopfer et al.,

2021). In the case of NPIs communication, pandemic risk to the receiver is processed cognitively according to social, cultural, and historical influences.

To the health communicator, the layperson's perception of risk is not inferior to the expert's objective construction of risk. SARF provides the communicator with windows to intervene and gaps to fill (Kasperson et al., 2022). Therefore, according to SARF, risk communication intensification or attenuation occurs in two phases: the early transmission of information by any official or unofficial agencies, then the societal response represented by individuals creating behavioral change, economic and social impacts through forming their own risk perception and communicating within each other (Pidgeon et al., 2003). In the initial phase of information transferring, four factors can intensify or attenuate risk perception: (1) the volume of risk information; (2) the clarity, ambiguity, or controversy of information; (3) how the information is exaggerated, and (4) the accompanying connotations of risk information (Hopfer et al., 2021). As a result, individuals and groups gather NPIs information, respond to the communicated messages, and become amplification stations by changing their behaviors and interpersonal communication (Renn et al., 1992). An amplification station is an individual, group, or institution that ascribes meaning to risk and impacts other individuals, shaping the collective social risk perception (Renn et al., 1992).

The receiver’s response to risk messages is what SARF focuses on and considers the explanatory factor in the different meanings of risk individuals assign (Kasperson et al., 2022). Social amplification tends to thrive in situations characterized by significant risks and high levels of uncertainty, where the public reaction is heavily influenced by what they are exposed to rather than what they already know (Kasperson, 2012). In the

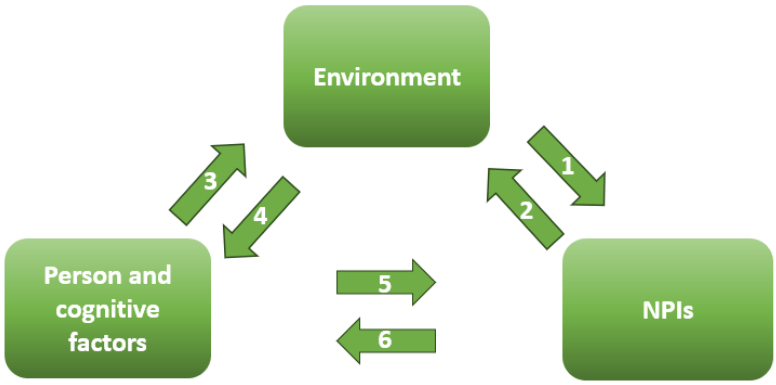
case of communicating NPIs messages during pandemics, SARF provides our framework with how the receiver is processing the NPIs message and what steps the message receiver takes to reach solidified beliefs about practicing NPIs. We adopted how SARF views the development of risk perception from an individual aspect, which is the basis of a shared social perception of risk (Renn et al., 1992). The social processes are discussed from a social cognitive perspective in the next section.

Finally, marginalized and at-risk groups are an integral part of the success of NPIs communication, and their experience of risk is accounted for in our framework using message targeting. Message targeting is building the message on shared characteristics of the population, such as race and socioeconomic status (Schiavo, 2013). Before message targeting, audience segmentation must occur, where the public is divided into distinctive segments for easy identification (Thompson et al., 2022). In pandemics, the most vulnerable segments should be identified and properly targeted by the health communicator, and targeting should be based on the segments' needs and concerns (Schiavo, 2013). For example, African Americans experienced significantly higher fatality rates than Whites during COVID-19 (Yancy, 2020). This significant disparity cannot only be explained by race and access to care, but there should be an examination of more complex issues such as the higher prevalence of comorbidities such as hypertension, diabetes, obesity, and cardiovascular diseases (Braveman & Gottlieb, 2014; Yancy, 2020). The health communicator should target this audience segment to address their unique risk, and they should receive all the information needed to make an informed decision about their NPIs behavior.

4.313 Social cognitive influences on NPIs behavior

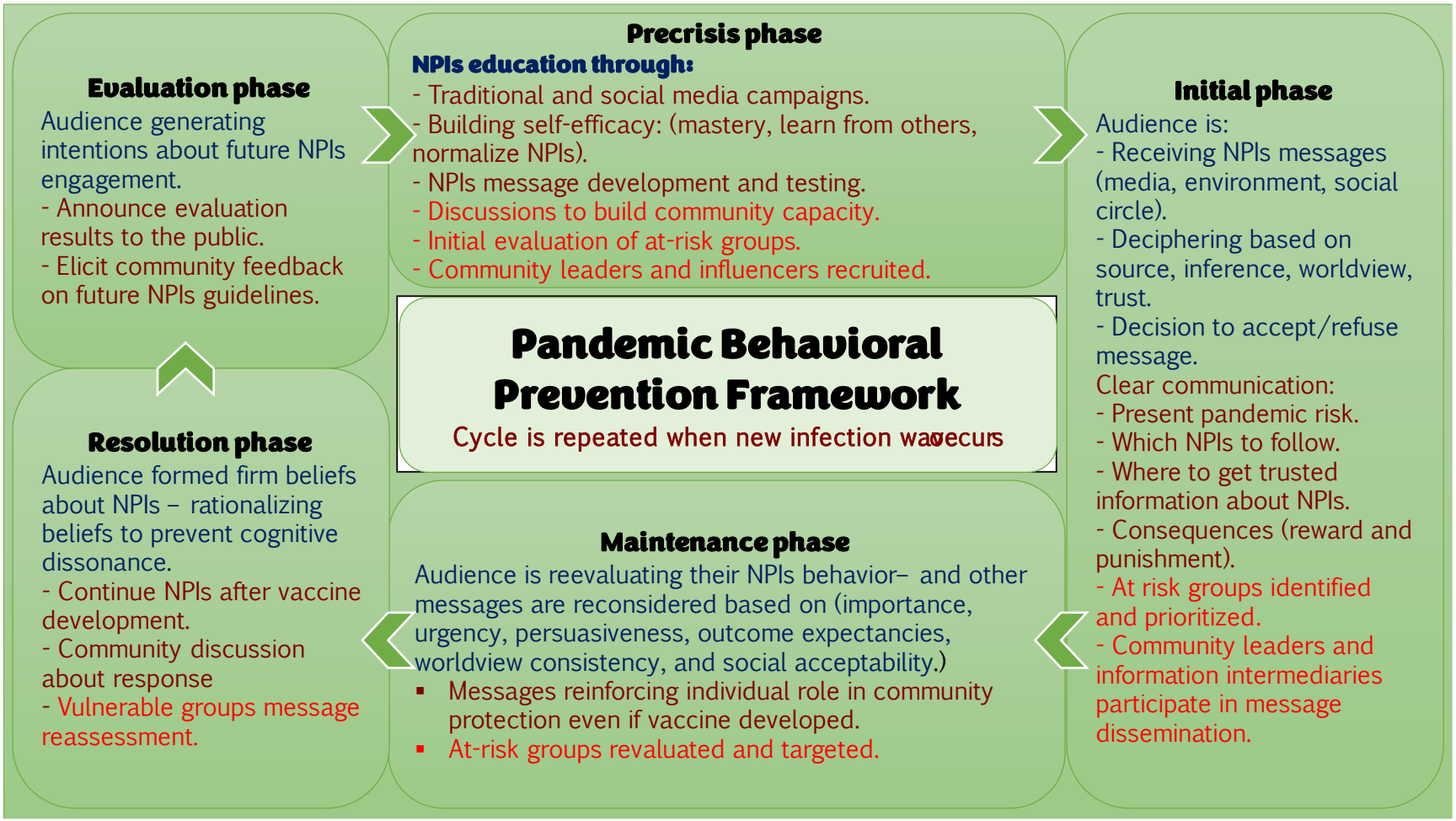
The main role of social cognitive theory (SCT) in our framework is to unfold the triadic reciprocal determinism occurring among practicing NPIs, which includes behavior, interaction with the environment, and individual psychological processes (Bandura, 2004). While CERC and SARF describe when a message needs to be communicated and what is happening internally at the individual level in response to the message, SCT depicts how the internal process and the environment directly influence and shape NPIs behavior. Reciprocal triadic causation in a risk communication context such as NPIs promotion takes the shape of six relationships among the components in Figure 4.2. They are as follows: (1) social, economic, and political environment causing a personal behavioral change to practice NPIs; (2) individuals influencing their environment through choosing a behavior such as leaning toward a political affiliation; (3) individuals influencing their sociocultural environment through their collective cognitions; (4) the environment changing the cognitive attributes of a person such as self-efficacy level; (5) people cognition dictate their engagement with NPIs behavior, and (6) adherence to NPIs behavior is posited to influence a person's cognition (DiClemente et al., 2019). Most risk communication interventions target the personal and cognitive aspects of the triad to influence the other two components, and this is the approach of our proposed framework (Luszczynska & Schwarzer, 2015).

Figure 4.2. *Bandura's triad of reciprocal determinism*



The target of NPIs messages in our framework is the person in the triad. Since this framework targets individual behavior change, we rely on personal cognitive factors to influence the other two components of the triad. It is important to note that Bandura's triadic model views the person as the sum of all their cognitive attributes, including knowledge, self-efficacy, and outcome expectancies (Bandura, 2004). Through pre-pandemic education and messages throughout the pandemic phases, the audience's knowledge about NPIs risk is expected to be improved, their self-efficacy to be sufficient, and their outcome expectancies to be positive. The main assumption of self-efficacy is that people can learn and increase their confidence in their abilities by observing (Schunk, 2012). The health communicator can target two primary sources of self-efficacy: vicarious learning and verbal persuasion (Schunk, 2012). Using vicarious learning and verbal persuasion in the context of NPIs communication takes the shape of (1) observation of people in similar situations (2) believing that the individual can adopt the behavior they observed, and (3) using role models, those with authority, and who the public considers credible to persuade the message audience (Hagger & Hamilton, 2022; Luszczynska & Schwarzer, 2015).

Figure 4.3. *Pandemic Behavioral Prevention Framework*



4.32 Phase 3: Identifying and naming concepts

In this step, the previously mentioned theories and models are further inspected through an extensive reading of the relevant literature. After establishing the relevancy of the CERC, SARF, and SCT models to pandemic prevention, we moved to find the relevant concepts affecting health communication efforts during a pandemic. Crisis and Emergency Risk Communication (CERC) describes response to a pandemic as a phases process; adapted from the original authors, we describe NPIs promotion based on these phases and what they entail (Reynolds & Seeger, 2005).

Table 4.1. *NPIs pandemic communication according to CERC phases*

Phases	**Description**
Precrisis (Risk Messages; Warnings; Preparations)	NPIs Communication and education campaigns motivating the public and the response community to: • Understanding Pandemic risk and how prevention works. • Building capacity to enable behavior change. • Testing strategies and message content.
Initial Event (Uncertainty Reduction; Self-efficacy; Reassurance)	Rapid communication to the general public to: • Provide factual information about the pandemic risk to prevent emotional turmoil. • Specific instructions on what NPIs to follow. • Continuous communication on where to get more information.
Maintenance (Ongoing Uncertainty Reduction; Self-efficacy; Reassurance)	Communication to the general public and to affected groups seeking to facilitate: • In depth understanding of the pandemic risk and effectiveness of NPIs reassessed. • Reinforcing the individual role in preventing a pandemic, continue to build self-efficacy.
Resolution (Updates Regarding Resolution; Discussions about Cause and New Risks/New Understandings of Risk)	Public communication and campaigns directed toward the general public and affected groups seeking to: • Persuading to continue NPIs after vaccine/treatment is disseminated. • Community-wide discussions on the overall response. • Communicate how NPIs work with new risks.
Evaluation (Discussions of Adequacy of Response; Consensus about Lessons and New	Communication directed toward the community to: • Evaluate community response. • Discuss lessons learned. • Improve future responses by evaluating current community

Understandings of Risks)	actions – link to phase I.

To promote NPIs, the health communicator must understand how individuals process information and how they become individual stations of amplification. The social amplification of risk framework acts as a conceptual framework of a social phenomenon, where the health communicator can select, order, and classify its concepts (Renn et al., 1992). In this paper, we adopt Renn et al., (1992) steps in individual perception of information and tailor it to NPIs communication to specific subgroups:

Table 4.2. *NPIs pandemic communication according to SARF individual steps to risk perception*

Steps	Description
Passing through attention filters	NPIs messages from the environment, other individuals, and the media are selected and processed.
Decoding of signals	Attention is given to what the messages mean. Message deciphering is dependent on sources of information, explicit or implicit inferences, what factual statements mean to the receiver, and beliefs on the credibility and trust level of the source. In this step, the political environment is considered by the receiver.
Drawing inferences	Conclusions are made about the message and the source; the receiver uses intuitive heuristics to generalize NPIs messages and learned symbolism to judge the significance of the content.
Comparing the decoded messages with other messages	NPIs message is compared with what peers believe about the message, the misinformation in different media outlets, and previous experiences.
Evaluating messages	The messages are weighted based on importance, urgency, persuasiveness, outcome expectancies, perceived consistency with one's worldview, and social acceptability.
Forming specific beliefs	Firm beliefs about NPIs practice are formed; this is where previously held beliefs are changed or asserted.
Rationalizing belief system	Sorting and reinterpreting NPIs beliefs in order to minimize cognitive dissonance.
Forming a propensity to take corresponding actions	Intentions about future NPIs practices aligned with the belief system are generated.

4.33 Phase 4 and 5: Deconstructing, categorizing, and integrating the concepts

In this step, the main concepts identified above were integrated into one table summarizing their definitions and their role in the conceptual framework ontologically, epistemologically, or methodologically (Jabareen, 2009). Concepts such as self-efficacy appeared in all three models; Table 4.3 determines the definition and role used in the conceptual framework.

Table 4.3. *Conceptual model integrated concepts*

Concept name	Definition	Ontology, epistemology, or methodology role	Reference
Pandemic response phases	Response to a pandemic occurs in five phases that cover pre-, during, and post-pandemic efforts.	The phases play a regulatory role in the pandemic efforts, dissecting the response into recognizable chunks.	(M. W. Seeger et al., 2020)
Amplified risk	Risk messages interact with psychological, social, and cultural processes, consequently shaping risk behavior through a socially shaped risk perception	Inputs from the environment continuously shape risk perception; the nature of risk perceived by the individual is subjective and socially constructed.	(Kasperson et al., 2022)
Self-efficacy	The psychological state concerning one's perspective on their capacity to execute their plans or successfully accomplish a task.	The belief in one's ability is found to be a primary motivator for behavior change.	(Bandura, 2004)
Vicarious learning	Observing people in similar situations and believing that the individual can adopt the behavior they observed	For a behavior to be socially adopted, a vicarious experience must happen, building a sense of self-efficacy and learned mastery.	(Schunk, 2012)
Outcome expectations	The beliefs associated with a specific behavior that result in particular outcomes.	The outcome expected from an action shapes the decision to engage in behavior change. Social influences also shape one's outcome expectations.	(Zlatanović, 2016)

4.34 Phase 6: synthesizing, re-synthesizing, and ensuring coherence

In this important step, the identified concepts are synthesized and re-synthesized, and we made sure the pandemic behavioral prevention framework makes sense. The concepts are put together and properly synthesized in the framework based on their methodological properties. As shown in Figure 4.3, the *Pandemic Behavioral Prevention Framework* divides NPIs communications during pandemics into five phases. Each phase has its actions and how the audience is expected to behave. The framework places the at-risk groups at the heart of NPIs communication, making them the central part of a successful pandemic response.

4.35 Phase 7 and 8: Validating the conceptual framework and rethinking the conceptual framework

In this step, practitioners other than the framework author evaluate the framework for coherence and comprehensiveness. Continuous improvement and evaluation efforts characterize this step. Therefore, we see our work here as an initial evaluation work, and we plan to take this framework to larger audiences for evaluation purposes. We will ask them open-ended questions about the feasibility and utility and solicit their suggested changes to the framework. We will ask them open-ended questions about the feasibility, utility, and suggested changes to the framework. Their answers will be summarized and used to make refinements.

4.4 DISCUSSION

The *Pandemic Behavioral Prevention Framework* uses widely applied models and theoretical frameworks to pandemic communications to increase the adoption and adherence to NPIs. We expect the framework to be successful due to its consideration of

what the audience is processing while they receive education and messages. For example, when the audience evaluates their NPIs decision during the maintenance phase, the health communication is directed to provide the message that further supports the continuation of NPIs practice. Additionally, the framework emphasizes the role of identifying and targeting vulnerable groups in a successful NPIs communication campaign. More importantly, developing the *Pandemic Behavioral Prevention Framework* is an attempt to fill several gaps in NPIs communication during pandemics.

4.41 Integrating risk and emergency communication with health communication

Health organizations around the globe rely on two main frameworks to shape their communications to the public during any infectious disease outbreak: the US Centers for Disease Control and Prevention Crisis and Emergency Risk Communication guidelines and training module and the World Health Organization's Outbreak Communications guidelines (M. W. Seeger et al., 2020; World Health Organization, 2005). These frameworks provide guidelines focused on the unique challenges associated with times of emergency and disease outbreak, such as the sense of urgency, volatility, uncertainty, and communicating under tight time constraints (Seeger et al., 2020). This focus is justified when looking at the crises occurring when the CERC was developed, namely, the 2001 World Trade Center and the anthrax terrorist attacks (Gostin & Nuzzo, 2021). Unlike a bio-terrorism event, a pandemic is more than just an outbreak of a pathogen. It is a continuously evolving threat moving throughout communities around the globe (Gostin & Nuzzo, 2021).

The current risk and emergency communication frameworks cannot wholly capture communication during a disease outbreak. These frameworks can be useful in the

first stages of the outbreak, where the disease outbreak is causing harm at the community level. However, these models fall short of effectively slowing the spread of the disease when it spreads globally over an extended period, which is a characteristic of pandemics (Khanna et al., 2020). The COVID-19 pandemic showed that the level of the disease is constantly changing, and the virus is mutilating and creating different disease severity patterns depending on the location and time (Rahman et al., 2021). The education efforts in the pre-crisis phase of the Pandemic Behavioral Prevention Framework can fill this gap and support the pandemic response with a resilient community. Pre-crisis communications and education can establish proper cough etiquette, a culture of hand hygiene, and a general acceptance of NPIs (Khanna et al., 2020).

4.42 Encourage utilizing effective communication channels

Pandemics develop and spread rapidly, and information needs to be communicated through channels with the same abilities to spread. The first pandemic in the Internet age was the H1N1 Flu of 2009, where the tools to communicate online were deemed promising for the outbreak's rapidly evolving situation (Cloes et al., 2015). However, health communicators could not deal with the internet's ability to erase the distinction between the sender and the audience. The rise of personal and professional blogs and other platforms was the beginning of the end of the usual method of communication, where the information is sent through one entity, the experts (Briggs & Nichter, 2009). COVID-19 occurred in a similarly challenging environment where social media is how people receive, send, and discuss all aspects of the pandemic (Vosoughi et al., 2018). Health communication during disasters should utilize the most used medium of communication to succeed (Vosoughi et al., 2018). The unprecedented connectivity

produced what experts have described as an infodemic, where misinformation travels twice as fast as credible information (Vosoughi et al., 2018). Additionally, the line that most health care professionals have to draw between their professional and personal identity has produced a disconnect between the public and the expert opinion (Topf & Williams, 2021). The *Pandemic Behavioral Prevention Framework* encourages fully utilizing the most widely used communication channels during a pandemic.

4.43 Build trust before it is compromised

Trustworthiness is a goal all risk communicators aspire to when they eventually need to communicate risk to their audience. The CDC and WHO emergency and outbreak communication guidelines regard trust as a fundamental component of risk communications. They center trust as the basis for building stakeholder relationships (Seeger et al., 2020; World Health Organization, 2005). Often regarded as the most important asset during a crisis, trust should not be compromised, or the efforts to persuade the public to follow guidelines and change behavior will be severely compromised (Betsch et al., 2020). Trust-building efforts during crises do not happen in a vacuum; they are often the result of how society trusts official institutions and those in power (Bouder, 2015). In the 21st century, health communicators must function in what has been described as post-trust societies, where the general trust in policymakers and government officials is declining to dangerous lows (Bouder, 2015; Lofstedt, 2012). Losing public trust implies that many components of trust are not well established with the public, such as objectivity, openness, honesty, competence, fairness, and consistency (Uslaner, 2018). The observed lack of trust in crises, especially COVID-19, indicates the difficulty of abruptly trying to establish trust when the belief in the authorities'

competence, knowledge, fairness, and integrity has been jeopardized (Jennings et al., 2021). The *Pandemic Behavioral Prevention Framework* supports trust building through pre-crisis educational efforts and demands clear communication by the health communicator throughout the pandemic.

The political turmoil experienced by many societies during pandemics adds a layer to the complexity of trust building and maintenance (Greer et al., 2020). Societies have experienced different political environments and challenges based on the country's regime type and social policy (Albrecht, 2022). In a democratic society such as the United States, a division in political affiliation contributed to less-than-expected NPIs adherence and vaccine uptake. Meanwhile, more authoritarian societies, such as China, experienced high engagement with NPIs but were observed to have low information flow and compromised public trust (Kavanagh & Singh, 2020). The discrepancy in responses and policies raised many questions about what approach is best in the short and long term. Even though the questions cannot be answered with certainty without a long examination of both approaches, raising them during a pandemic is imperative to reorganize the current assumptions and begin setting future research agendas (Kavanagh & Singh, 2020). Since the outcome of this study is directed at individuals, seeking policy change and addressing the volatile political environment during pandemics is beyond the scope of this research. However, we acknowledge its effect on individuals' NPI behaviors.

4.44 Limiting the deadly consequences of a bad response on the most vulnerable populations

Similar to other pandemics, COVID-19 spread throughout the world and caused death and disruption to people's social, economic, and mental health. However, wherever it went, COVID-19 consistently affected the most vulnerable populations (da Silva Nunes et al., 2023). The consequences of the spread of a novel virus are the same as those of other diseases, conditions, and inequities, where the impoverished, excluded, and oppressed are in greater danger (da Silva Nunes et al., 2023). Also, these consequences are consistent in different countries with different social, economic, educational, and racial construction (Ismail et al., 2021). During pandemics, developed countries are not significantly different from the developing countries that might be partially dependent on their support. Both societies struggle to lift the burden off their most at-risk groups (Ataguba & Ataguba, 2020). In other non-urgent health concerns, public health organizations and researchers examine the social determinants of health (SDOH) associated with the issue at hand; similarly, in an infectious disease outbreak, the SDOH must be identified and examined (Goulbourne & Yanovitzky, 2021). Preventing a pandemic does not require the at-risk individual to access good health care, buy expensive medical tools, live in affluent areas with proper infrastructure, or invest their time and income; rather, a behavioral change with very few tangible barriers must happen.

When examining social determinants of health during a pandemic, it is evident that effective communication is essential to support those at risk (Goulbourne & Yanovitzky, 2021). Effective risk communication as a core SDOH during a pandemic

supports the efforts to test, screen, and clinically support the public and will, consequently, slow the spread of the disease. Health systems focus on delivering care and addressing the SDOH in their communities. Effective communication can be overlooked as a crucial component of motivating and sustaining behavior change among the most vulnerable (Goulbourne & Yanovitzky, 2021). The focus on other SDOHs leaves the physical and mental health of the marginalized and vulnerable groups exposed and in their most vulnerable state during a pandemic (Yoo et al., 2023). The current efforts in risk and emergency communication need to be directed to those in underserved areas, those with low educational levels, and racial and ethnic minorities most likely to have higher fatality rates than the majority (Ataguba & Ataguba, 2020). Ultimately, a gap needs to be addressed by effectively developing targeted risk messages and communication to those suffering from inequities and scoring poorly in the socioeconomic gradient.

4.5 STRENGTHS AND LIMITATIONS

This paper utilizes a flexible and easily revised grounded theory method to build a conceptual framework for NPIs communication during volatile pandemics. The *Pandemic Behavioral Prevention Framework* heavily emphasizes targeting vulnerable populations with appropriate messages. However, this study is not without its limitations. The developed framework has not yet been tested for effectiveness or applied to communication efforts by public health practitioners. Also, the validation phase of the study needs to be conducted with large audiences, such as conferences and scientific meetings.

4.7 CONCLUSION

This conceptual paper represents the integration of different disciplines on how to motivate individuals to practice and maintain NPIs during a pandemic. It emphasizes considering the individual processes of the message receivers and how they interact and affect their environment and behavior in all pandemic phases. The health communicator will be equipped with a flexible and applicable tool to tackle the volatility of pandemics. The *Pandemic Behavioral Prevention Framework* needs to be used in real-life applications and tested using experimental studies. It is important to examine the framework's impact on the general public or study participants.

CHAPTER V: DISCUSSION AND IMPLICATIONS FOR POLICY & PRACTICE

This dissertation used three research methods to explore the factors influencing adherence to NPIs. The goal of using these methods is to tackle the dissertation problem using different approaches. By systemically searching the literature, surveying an underserved population, and developing a conceptual framework, we offer the NPIs literature with valuable information that can be used in future responses to pandemics.

Exploring the influencing factors on NPIs adherence greatly enhances the pandemic response and enables community members to play their role in protecting the community (Thompson et al., 2022). In the initial phase of a pandemic, health organizations rely solely on the public's understanding of pandemic risk and their commitment to mitigating that risk (Borah et al., 2023). Using social cognitive lenses in the three manuscripts enabled us to contribute to the pandemic response with highly specific constructs to target by the public health practitioner and health communicator. The dissertation results speak to the implications of using a behavioral theory on NPIs research (Borah et al., 2023). The previously held beliefs about health campaigns should be shifted toward the socialization of human behavior, the transformation of pandemic policy towards the most vulnerable, and the preparation of those charged with preparing others.

Message design in health communication is a crucial area of intervention design that is often receiving inadequate consideration (Schiavo, 2013). The variation of NPIs adherence reported by the three manuscripts indicates the need to reevaluate current

approaches to message design. The results can potentially transform the content and focus of a pandemic risk message (Thompson et al., 2022). For example, the Saudi Ministry of Health could design its pandemic messages to be focused on making NPIs socially acceptable and the social norm. The content could be about how the public has been consistently using NPIs in previous pandemics and how they are expected to continue to do so.

5.1 PUBLIC HEALTH PRACTICE IMPLICATIONS

Using Manuscript 1, the health communicator can find change points among the healthcare student population when promoting NPIs. We suggest focusing on influencing the appropriate risk perceptions and using role models. By finding group differences in adherence to NPIs, we also lay the ground for message tailoring in all COVID-19 health communication. The health communicator can target the most hesitant groups among health care students to practice NPIs, such as males with low-risk perception levels. In Manuscript 2, we provide the Saudi Ministry of Health, the major health organization responsible for public health in Saudi Arabia, with the cognitive and social predictors of NPIs adherence in the Saudi population. Access to these results will allow the Ministry of Health (MOH) to be prepared with highly effective constructs specific to the Saudi population. For example, MOH can construct its messages to target the viewer's perceived self-efficacy and normalize NPIs. Our results can be used during the segmentation process of health communication campaigns. When segmenting the Saudi population into demographic, psychological, geographic, and behavioral segments, the least adherent groups, such as males and those with low self-efficacy levels, can be targeted by the COVID-19 health communication campaign. Lastly, in Manuscript 3, the

Pandemic Behavioral Prevention Framework provides the health communicator with a flexible and applicable tool to tackle the volatility of pandemics.

5.2 PUBLIC HEALTH POLICY IMPLICATIONS

The findings from Manuscripts 1 and 2 suggest that policymakers can improve the public's health through two channels: assigning resources to promote NPIs among groups with lower adherence rates and reevaluating their organization's pandemic preparedness communication strategies. By identifying the groups with the lowest adherence rates with NPIs, we provide policymakers in Saudi Arabia with solid evidence for which groups need NPIs supplies when a shortage is experienced (N95 masks, for example). Policymakers should utilize the findings to address the barriers and ensure that the decision to engage with NPIs is more equitable. Secondly, our findings present a chance for the pandemic preparedness policies and plans to improve key cognitive and social factors, such as self-efficacy and social norms. Our findings support the development of new disaster preparedness policies focused on building resilience in groups less adherent to NPIs. Resilience can be built through drafting pandemic preparedness policies focused on using the influencing factors identified by our studies as potential change points. The *Pandemic Behavioral Prevention Framework* in Manuscript 3 provides policymakers with a framework for organizing responses to COVID-19 and future pandemics. Including the framework in pandemic preparedness policies ensures the health communicator is equipped with what they need in all pandemic phases.

5.3 PUBLIC HEALTH RESEARCH IMPLICATIONS

When examining the first manuscript, we recommend that future research should be focused on the cognitive and socio-environmental factors when studying NPIs

practice among health care students. We recommend using theoretical frameworks when investigating NPIs among health care students because of the lack of theoretical framework observed in the previous studies included in the systematic review. Future researchers must develop and test validated tools in their investigation of NPIs. Additionally, in quantitative research on NPIs among health care students, we recommend the inclusion and accounting for confounding factors. The second manuscript's results indicate a need to investigate NPIs further using experimental research studies guided by the Social Cognitive Theory. Lastly, future research may focus on testing the *Pandemic Behavioral Prevention Framework* using Structural Equation Modeling to establish reliability of the model.

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APPENDIX (A) QUALITY ASSESSMENT

Are NPIs measured using a frequency scale such as Likert scale?

Article	Reviewers' comment	Support for judgement
Ahmad et al., 2022	Not mentioned	Not mentioned
Ahmed et al., 2022	The authors measured NPIs using both Likert scale questions and binary questions. Thirteen out of the fifteen questions were 3-point Likert scale questions.	"The first thirteen questions used a three-point Likert scale (yes=2, sometimes= 1, no=0) while the last two questions were categorized as "yes" or "no" with reversal scoring (yes=0, no=2)." p. 3
Alrasheedy et al., 2022	The researchers used a binary item to measure NPIs practice.	Table 4. p. 734
Baniyas et al., 2021	NPIs were mostly measured using a binary yes/no scale. Likert scale was used to measure adherence as well.	"Using multiple-choice questions, yes/no questions, and a Likert scale" p.4
Hassan et al., 2023	The researchers used a binary scoring system scale to measure NPIs practice. The 3-item score is not converted to a categorical measure.	"Only two choices (yes/no) were given for the questions about COVID-19 that are practice-related." p. 435
Khalil et al., 2020	NPIs were measured using a 5-point Likert scale (strongly disagree-strongly agree). The questions were in the form of statements, where the participants respond with their level of agreement with the statement.	Table 4. p. 4183
Kim et al., 2016	The researchers used a binary scoring system scale to measure NPIs practice. The 9-item score is not converted to a categorical measure.	"The participant was assigned one point if he or she practised the behaviour and 0 points if he or she did not practise or care about the behaviour." p. 2544
Le An et al., 2021	No, the researchers used a binary item to measure NPIs practice. An arbitrary cutoff point of 7 was considered good practice.	"For assessing practices, each item had a choice of yes/ no, having 1 point per good practice, with a good practice resulting from an overall score of 7 points or higher, and under 7 points was categorized as poor practices." p. 3407
Maheshwari et al., 2020	No, the researchers used a binary item to measure NPIs practice.	"Only two options namely 'Yes' and 'No' were assigned for the questions related to practice towards COVID- 19." p. 101

Noreen et al., 2020	The researchers used a 3-point item Likert scale to measure NPIs practice. An arbitrary cutoff point of 6 was considered adequate practice.	"For practice questions, 2 points were awarded for yes, one for sometimes and zero for no, and the scores = >6were taken as adequate and < 6, were taken as inadequate." p. 4
Salim et al., 2021	No, the researchers used a binary item to measure NPIs practice.	"1 point for constructive and 0 for passive options in the practice section." p.1429
Singh et al., 2011	The researchers used a binary scoring system scale to measure NPIs practice. The 7-item score is not converted to a categorical measure.	"One question for behavioural response (consisted of 7 items)" / "The participants were asked to respond 'yes/no' for the questions regarding knowledge, attitude, and behavioural response." p. 340
Siramaneerat et al., 2022	The researchers used a 3-point item Likert scale to measure NPIs practice.	"Each item was scored as 3 (regularly), 2 (often), 1 (sometimes), and 0 (not at all)." p. 936
Soltan et al., 2020	The researchers used a binary scoring system scale to measure NPIs practice.	"Choices are "yes" or "no." One point was assigned for each appropriate behavior and 0 points for inappropriate behaviors" p. 2570
Taghrir et al., 2020	The researchers used a binary scoring system scale to measure NPIs practice. The 9-item score is not converted to a categorical measure.	"Choices were 'yes' or 'no' and the participant was assigned one point for each appropriate behavior and 0 point for inappropriate behaviors. The total score ranged from 0 to 9." p. 250
Tang et al., 2021	NPIs were measured using a 5-point Likert scale. The questions were in the form of statements, where the participants respond with their level of agreement with the statement.	"SoD was measured using ten items while PHM was measured by five items. .. 5-point Likert scale, where 1 was "very unlikely," and 5 was "very likely."" p. 3762
Zemni et al., 2023	NPIs were measured using a 5-point Likert scale. The questions were in the form of statements, where the participants respond with their level of agreement with the statement. Bloom's cut-off point was used to turn the score into a categorical variable.	"The overall precautionary measures score was obtained from the sum of the 11 items already described and ranged from 0 to 44; a higher score indicated better preventive behavior toward COVID-19. Practice score was then converted to a score of 0–100. Compliance with precautionary measures related to COVID-19 was categorized, using Bloom's cut-off point." p. 4
Zhang et al., 2022	It can be inferred by the use of chi-squared test and logistic regression that all variables were binary. Although this can't be confirmed,	Not mentioned

For the purposes of this review, are the statistical tests appropriate for study variables measurements and distribution?

Article	Reviewers' comment	Support for judgement
Ahmad et al., 2022	The authors used an independent sample t-test to compare NPIs score.	"To compare the mean scores of practices among the clinical and preclinical groups, an independent sample t-test was used." p,2
Ahmed et al., 2022	The authors arbitrarily converted The NPIs continuous variable to a binary (adherent/non-adherent) score. Then compared the two groups using chi-square test.	"The differences between the studied variables were analyzed using chi-square tests for qualitative variables." "Participants with a total score of 21 points (70% of the total score) or more were considered adherent to COVID-19 preventive measures while those with a score of 20 or less were considered non-adherent to COVID-19 preventive measures." p. 3
Alrasheedy et al., 2022	The authors conducting parametric and non-parametric tests to analyze NPIs (Chi-square test and Fisher's exact test). No mention of the normality of data.	"Chi-square test for independence (χ2 test) and its alternative Fisher's exact test were used to examine the association for categorical variables." p. 731
Baniyas et al., 2021	The authors conducting the appropriate non-parametric tests to analyze NPIs (Fisher's Exact and Mann-Whitney U tests)	"Continuous data (Age and scores) did not have a normal distribution; hence nonparametric statistical methods were used to compare different groups as such methods analyze the ranks" p.4
Hassan et al., 2023	Groups within study sample analyzed if they have adequate NPIs practice by conducting t-test.	Table 5. p. 437-438
Khalil et al., 2020	The authors calculated the mean NPIs practice and then used t-tests and ANOVA for group comparison between study groups.	"Unpaired t-test and One Way ANOVA test were used for the computed average Likert scale scores related to students' general knowledge, attitudes and practice." p. 4181
Kim et al., 2016	Groups within study sample analyzed if they have adequate NPIs practice by conducting t-test and Pearson's correlation.	"Differences in the major variables according to general characteristics were analysed using independent t-test, and the correlations among the variables were computed using the independent Pearson's correlations test." p. 2545
Le An et al., 2021	After calculating the NPIs practice score, a regression analysis was performed to determine the factors associated with good practice.	"A multivariable regression analysis was done to determine the factors associated with preventive practices." p. 3407

Maheshwari et al., 2020	After establishing the normality of the data by Kolmogorov Smirnov test, parametric tests were conducted including t-test and ANOVA.	"Practice scores were tested for normality of distribution using a one-sample Kolmogorov Smirnov test." / "Comparisons of KAP scores among the students with respect to gender, religion, and age-category are done using independent samples t-test and one-way analysis of variance (ANOVA), as appropriate." p. 101
Noreen et al., 2020	Groups within study sample analyzed if they have adequate NPIs practice by establishing a binary logistic regression model.	"Binary logistic regression analysis was used to explore the association of knowledge, attitudes, and practices score with gender and academic years." p. 4
Salim et al., 2021	The researchers chose to compare group differences using the Mann–Whitney test, even though the distribution of the sample was not discussed.	"The Mann–Whitney and Kruskal–Wallis tests of significance were used for comparison when applicable." p.1429
Singh et al., 2011	Groups within study sample analyzed if they have adequate NPIs practice by conducting t-test.	"The Student t-test was used to test for statistical significance of means at $p < 0.05$." p. 341
Siramaneerat et al., 2022	Factors influencing NPIs practice were analyzed using Pearson's correlation.	Table 3. p. 937
Soltan et al., 2020	After establishing the absence of the normality of the data by Shapiro-Wilk test, non-parametric tests were conducted including Mann- Whitney U test and Spearman's correlation.	"The normal distribution of the continuous data was checked using the Shapiro-Wilk test." / "Inferential statistics data were analyzed using the Mann- Whitney U test and Spearman's correlation" p. 2570
Taghrir et al., 2020	After establishing the absence of the normality of the data by Kolmogorov-Smirnov test, non-parametric tests were conducted including Mann- Whitney U test and Spearman's correlation.	"We used Kolmogorov-Smirnov to assess normality of distribution of continuous variables; None of the major outcomes followed a normal distribution and were analyzed using the Mann-Whitney test and Spearman's rank correlation test." p. 251
Tang et al., 2021	The authors used an independent sample t-test and ANOVA to compare NPIs score.	"Subgroup analyses were conducted to investigate the differences of outcomes in demographic variables using independent t-test or one-way ANOVA with Tukey post-hoc test." p. 3762
Zemni et al., 2023	The NPIs unconverted score was used a dependent variable in a multiple linear regression model examining the relationship	"Multiple linear regression analysis was used to determine the relationship between the total score and students' features." p. 4

	between NPIs and other variables.	
Zhang et al., 2022	Chi-squared test and logistic regression were conducted for all categorical variables. No mention of continuous variables and their analysis.	"Differences between categorical variables, including gender, residence, family structure, academic background, emotions, knowledge, attitude, and compliance, were analyzed by the Chi-squared test; the relationships between the variables were analyzed by multiple logistic regression." p.42

Is adherence to NPIs measured using a validated tool? If not, are there successful attempts to establish any type of validity (content, construct, or face)?

Article	Reviewers' comment	Support for judgement
Ahmad et al., 2022	No validated tool has been used. And no efforts were done towards establishing validity except following WHO guidelines and consulting an epidemiologist.	"The questionnaire was designed according to the guidelines provided by WHO and by an epidemiologist's expert opinion." p.2
Ahmed et al., 2022	No validated tool has been used. Instead, the researchers had attempted to establish face and content validity of the survey using pilot testing to students and constructing the survey question from previously published studies.	"Data were collected using a structured self-reported Arabic questionnaire that was constructed based on reviewing the previously published literature. The questionnaire was formulated first in English and then translated to Arabic." p. 2
Alrasheedy et al., 2022	No validated tool has been used. Instead, the researchers had attempted to establish face and content validity of the survey using pilot testing to students and consulting with a group of expert academics.	"To establish face and content validity, the draft questionnaire was given to four academicians for their review and comments. In addition, it was sent to ten pharmacy students for their review, comments and suggestions including its clarity, simplicity, and understanding." p.731
Baniyas et al., 2021	No validated tool has been used. Instead, the researchers had attempted to establish face and content validity of the survey using pilot testing and using survey questions which had been previously used in similar situations.	"The questionnaire was designed and developed in May 2020 based on two similar published studies." p.3 "The questionnaire was then piloted among 10 participants for face and content validity. The questions were then modified, refined, rephrased, and restructured to be simpler and clearer" p.3
Hassan et al., 2023	No validated tool has been used. And no efforts were done towards establishing validity except building the survey based on previous literature.	"Malaysian research on COVID-19's knowledge, beliefs, and activities was used as the basis for the assessment." p.435

Khalil et al., 2020	No validated tool has been used. Instead, the researchers had attempted to establish face validity of the survey using pilot testing in the students' mother tongue. Additionally, back translation was used to ensure accuracy and comprehension.	"Questionnaire form was developed by authors based on published research. However, it was revised, modified, and judged by five Experts in relevant fields of Epidemiology, Virology and Immunology and rather piloted on 65 students who were not included in the final study." / "The developed English questionnaire version was translated to Arabic language then re-translated to English language to ensure items accuracy and meaningfulness." p. 4181
Kim et al., 2016	No validated tool has been used. And no efforts were done towards establishing validity except building the survey based on previous literature, consulting experts, and conducting content validity index.	"The content validity of the scale was tested by two infection control professors, two infection control nurse practitioners and one infectious disease specialist. The CVI of this scale was 0.90." p. 2544
Le An et al., 2021	No validated tool has been used. Instead, the researchers had attempted to establish face and content validity of the survey using pilot testing to students and consulting with a group of expert academics.	"After the preparation of the questionnaire, it was sent to some experts to consult their opinions regarding the validity of the questionnaire followed by a small pilot study." p. 101
Maheshwari et al., 2020	No validated tool has been used. Instead, the researchers had attempted to establish face and content validity of the survey using pilot testing to students and consulting with a group of expert academics.	"After the preparation of the questionnaire, it was sent to some experts to consult their opinions regarding the validity of the questionnaire followed by a small pilot study." p. 101
Noreen et al., 2020	No validated tool has been used. And no efforts were done towards establishing validity except building the survey based on previous literature, consulting experts, and pilot testing.	"The self-reported questionnaire was originally developed by an extensive literature review of already published literature and WHO myth-buster document." / "Two senior faculty members were requested to review the tool for its construct and content validity." p. 3
Salim et al., 2021	No validated tool has been used. Instead, the researchers had attempted to establish face validity of the survey using pilot testing in the students' mother tongue.	"The questionnaire developed in Arabic using a simple local language and was previously tested in a pilot study with 300 participants of the four affiliations (beyond those studied). The questionnaire reliability was confirmed by applying a reliability test using Cronbach alpha (0.73)" p.1428
Singh et al., 2011	No validated tool has been used. And no efforts were done towards establishing validity except pilot testing.	"Prior to data collection, the questions were pre-tested among a group of 20 dental students in order to ensure the level of validity." p. 340

Siramaneerat et al., 2022	Factors influencing NPIs practice were analyzed using Pearson's correlation.	Table 3. p. 937
Soltan et al., 2020	No validated tool has been used. And no efforts were done towards establishing validity except building the survey based on previous literature, consulting experts, and pilot testing.	"The questionnaire was face validated by three expert opinions with no major modifications. A pilot study was carried out on 20 students before the study." p. 2570
Taghrir et al., 2020	No validated tool has been used. And no efforts were done towards establishing validity except building the survey based on previous literature and expert consultation.	"Validation of items was established by three experts including one infectious disease specialist and two epidemiologists." p. 250
Tang et al., 2021	No validated tool has been used. And no efforts were done towards establishing validity except building the survey based on previous literature.	"All scales and demographic information were translated into Chinese for collecting the data in Putian by forward-backward translation. The Chinese scales were then validated by five experts ... The content validity of all scales ranged from very good to satisfactory (CVI =0.7–1)" p. 3763
Zemni et al., 2023	No validated tool has been used. And no efforts were done towards establishing validity except building the survey based on previous literature.	"The second part was developed based on previous literature review and contained 11 items about practices related to the protective measures adopted for COVID-19." p.3
Zhang et al., 2022	No validated tool has been used. And no efforts were done towards establishing validity.	"Due to the time constraint, pilot testing and validation of the questionnaire were not done" p.42

What are the measures taken by the researchers to ensure study results are reliable?

Article	**Reviewers' comment**	**Support for judgement**
Ahmad et al., 2022	The researchers used only the Cronbach alpha test to establish reliability, the test had a satisfactory score of 0.72.	"For this study, alpha has a cumulative value of 0.715," p. 2
Ahmed et al., 2022	The researchers used only the Cronbach alpha test to establish reliability, the test had a satisfactory score of 0.73.	"The questionnaire was tested for internal consistency and reliability using Cronbach's α test and it was 0.88." p. 2

Alrasheedy et al., 2022	The researchers used only the Cronbach alpha test to establish reliability, the test had a satisfactory score of 0.73.	"The Cronbach's alpha coefficient for the KAP questionnaire from our study was 0.728, which was seen as acceptable and shows consistency." p. 731
Baniyas et al., 2021	No efforts were done towards establishing reliability.	"Since the COVID-19 pandemic is evolving quickly and hence influencing related knowledge and attitudes we decided to depend on face and content validity, as reliability testing was not feasible." p.3
Hassan et al., 2023	No efforts were done towards establishing reliability.	Not mentioned
Khalil et al., 2020	The researchers used pilot testing and back translation to establish reliability. Additionally, the Cronbach alpha test was conducted and yielded a satisfactory score of 0.76	"The reliability of the questionnaire items was evaluated using internal consistency (Cronbach's alpha) test, and it was found to be (0.76)." p. 4180
Kim et al., 2016	The researchers used only the Cronbach alpha test to establish reliability, the test had a satisfactory score of 0.77.	"The reliability (Cronbach's a) of the scale was 0.73 in the pilot study with 20 nursing students and 0.77 in this survey about preventive behaviour for MERS." p. 2544
Le An et al., 2021	No efforts were done towards establishing reliability.	Not mentioned
Maheshwari et al., 2020	The researchers used only the Cronbach alpha test to establish reliability, the test had a satisfactory score of 0.71.	"Cronbach's alpha coefficient of the knowledge statements was 0.71." p. 101
Noreen et al., 2020	The researchers used only the Cronbach alpha test to establish reliability, the test had a satisfactory score of 0.79.	"Cronbach's alpha was 0.79." p. 3
Salim et al., 2021	The researchers used pilot testing and using the local dialect in the Arabic language to establish reliability. Additionally, the Cronbach alpha test was conducted and yielded a satisfactory score of 0.73.	"The questionnaire developed in Arabic using a simple local language and was previously tested in a pilot study with 300 participants of the four affiliations (beyond those studied). The questionnaire reliability was confirmed by applying a reliability test using Cronbach alpha (0.73)" p.1428
Singh et al., 2011	The researchers used only the Cronbach alpha test to establish reliability, the test had a satisfactory score of 0.76.	"Degree of repeatability (Cronbach alpha = 0.76)." p. 340

Siramaneerat et al., 2022	The researchers used only the Cronbach alpha test to establish reliability, the test had a satisfactory score of 0.90.	"Cronbach's alpha was 0.895, indicating that the questionnaire was reliable." p. 936
Soltan et al., 2020	The researchers used only the Cronbach alpha test to establish reliability, the test had a satisfactory score of 0.7.	"With acceptable Cronbach's α of 0.7" p. 2570
Taghrir et al., 2020	The researchers used only the Cronbach alpha test to establish reliability, the test had a satisfactory score of 0.81.	"Reliability was tested in a pilot study with 30 participants and in the original study using Cronbach's alpha. The results were alpha = 0.72 and 0.81, respectively." p. 250
Tang et al., 2021	The researchers used only the Cronbach alpha test to establish reliability, the test had a satisfactory score of 0.88.	Table 1. p. 3762
Zemni et al., 2023	The researchers used only the Cronbach alpha test to establish reliability, the test had a satisfactory score of 0.83.	"The reliability of the preventive practices of the COVID-19 scale was assessed using Cronbach's Alpha Coefficient, which was 0.83, indicating the sufficient level of reliability." p. 3
Zhang et al., 2022	No efforts were done towards establishing reliability.	"Due to the time constraint, pilot testing and validation of the questionnaire were not done" p.42

Was the target/reference population clearly defined? For a healthcare university student sample, does it contain non-healthcare students or faculty?

Article	Reviewers' comment	Support for judgement
Ahmad et al., 2022	Non-probability convenience sampling technique was used in this study. The authors only included responses from their target population.	"non-probability consecutive sampling. The study's inclusion criteria were all medical students (≥18 years) who participated in the Micro-fest++ event and currently studying in any medical college across Pakistan." p. 2
Ahmed et al., 2022	Non-probability convenience sampling technique was used in this study. The authors only included responses from their target population, which is male medical students.	"Any male student at the Cairo branch of Al-Azhar Faculty of Medicine who had internet access, WhatsApp/Facebook application, and was willing to participate in the study was included." p. 2

Alrasheedy et al., 2022	The researchers used a convenience sampling strategy, where only pharmacy university students were targeted. Additionally, they drew their sample from a predetermined sampling frame, no randomization.	"All doctor of pharmacy (PharmD) students (2nd - 6th year) of Unaizah College of Pharmacy, Qassim University, were invited to participate in the study." p. 731
Baniyas et al., 2021	The researchers used a non-probability sampling strategy, where only medical and healthcare university students were targeted.	"We developed a sampling frame including the list of all medical and health sciences colleges and universities in the UAE" p.3
Hassan et al., 2023	The researchers administered their survey in a medical college, where only medical university students were targeted.	"A selection of students was subjected to a cross-sectional study in the College of Medicine, Kirkuk University, Iraq." p. 435
Khalil et al., 2020	The researchers used a convenience sampling strategy, where only medical university students were targeted. Additionally, they drew their sample from a predetermined sampling frame, no randomization.	"Convenience sample of 1380 Iraqi medical undergraduate students of three main medical branches from five Governmental Universities with a total number of around 13,000 medical undergraduate students within Baghdad city." p. 4180
Kim et al., 2016	The researchers administered their survey in a nursing college, where only nursing university students were targeted.	"Nursing students from two- to four-year nursing college programmes in two cities were sampled using convenient sampling." p. 2543-2544
Le An et al., 2021	The researchers used a convenience sampling strategy, where only the health care university students were targeted.	"An online-based cross-sectional survey was conducted using convenience sampling with all students at the University of Medicine and Pharmacy in Ho Chi Minh City (UMP), between June and August 2020 via a structured questionnaire." p. 3406
Maheshwari et al., 2020	The researchers administered their survey in a medical college, where only medical university students were targeted.	"This cross-sectional survey was conducted among the medical students from a government medical college, in Uttarakhand." p, 101
Noreen et al., 2020	The researchers administered their survey in many medical colleges, where only medical university students were targeted.	"This survey was conducted among medical students from different Pakistani universities." p. 3
Salim et al., 2021	The researchers used a purposive sampling strategy, where only healthcare university students were targeted.	"Among the 6000 Student Union volunteers (total population), a convenient sample of 3263 participants (54.3%) responded to the online survey. … social networks and social media groups that link the Student Union together" p.1428

Singh et al., 2011	The researchers administered their survey in a dental college and hospital, where only dental university students were targeted.	"A cross-sectional survey was conducted in the Pacific Dental College and Hospital …. A total of 448 dental students participated in the survey." p. 340
Siramaneerat et al., 2022	The researchers administered their survey in a nursing college, where only nursing university students were targeted.	"A cross sectional survey was conducted among nursing students at Boromarajonani College of Nursing, Thailand." p. 935
Soltan et al., 2020	The researchers administered their survey in a medical college, where only medical university students were targeted.	"Medical students in the faculty of medicine of both sexes, who agreed to participate in the study, were included." p. 2569
Taghrir et al., 2020	The researchers administered their survey in many medical colleges, where only medical university students were targeted.	"This cross-sectional study was conducted on Iranian medical students to investigate their COVID-19 related knowledge, self-reported preventive behaviors and risk perception." p. 250
Tang et al., 2021	Non-probability convenience sampling technique was used in this study. The authors only included health care university students.	"Eligibility criteria included fulltime students aged 18 years or older … participating universities or tertiary education institutions for this study." p. 3761
Zemni et al., 2023	Non-probability convenience sampling technique was used in this study. The authors only included medical university students.	"All undergraduate medical students of the faculty of medicine of Monastir from the first year to the fifth year were included in the study. Participants were recruited through convenience sampling." p. 3
Zhang et al., 2022	The researchers administered their survey in a medical college, where only healthcare university students were targeted.	"This is a cross-sectional, self-administered, anonymous, online survey with medical, dental, and nursing students at Shantou University Medical College in Guangdong province, China" p.42

Did the authors calculated influencing factors (demographic, cognitive, and social) using an appropriate scoring method?

Article	Reviewers' comment	Support for judgement
Ahmad et al., 2022	From supplementary table 4, it can be inferred that the relevant demographic factor (clinical/pre-clinical) was scored using a binary system	Supplementary table 4.
Ahmed et al., 2022	From table 4, it can be inferred that the relevant demographic factor (residence) was scored using a categorical and binary system.	Table 4. p. 6

Alrasheedy et al., 2022	From the supplemental table, it can be inferred that the relevant demographic factors (major, gender, comorbidities, and age) were scored using a categorical and binary system.	Supplemental table S2
Baniyas et al., 2021	From the results section, it can be inferred that the relevant demographic factors (major and level of education) were scored using a categorical and binary system.	Not mentioned
Hassan et al., 2023	From table 5, it can be inferred that the relevant factors were scored using a binary system.	Table 5. p. 437-438
Khalil et al., 2020	From the results section, it can be inferred that the relevant demographic factors (major, gender, and age) were scored using a categorical and binary system.	Table 5. p. 4183
Kim et al., 2016	From table 1, it can be inferred that the relevant factors were scored using a binary system.	Table 1. p. 2545
Le An et al., 2021	From table 1, it can be inferred that the relevant factors were scored using a binary system.	Table 1. p. 2545
Maheshwari et al., 2020	From table 5, it can be inferred that the relevant demographic factors (age and gender) were scored using a categorical and binary system.	Table 5. p. 103
Noreen et al., 2020	From table 4, it can be inferred that the relevant demographic factor (gender) was scored using a binary system.	Table 4. p. 8
Salim et al., 2021	Main study variables were gender and residence, they were appropriately coded as binary. The knowledge score was comprehensive of all aspects of pandemic knowledge.	“The calculated total score for KAP included five variables in the Knowledge section of COVID-19 (mode of …, preventive measures, and actions in case of illness.” p.1429
Singh et al., 2011	From table 3, it can be inferred that the relevant factor was scored using a binary system.	Table 3. p. 342
Siramaneerat et al., 2022	The relevant factors were scored using a continuous scoring system.	Table 3. p. 937
Soltan et al., 2020	From table 5, it can be inferred that the relevant demographic factors were scored using a binary system.	Table 5. p. 2573

Taghrir et al., 2020	The relevant factors (knowledge and risk perception) were scored using a continuous scoring system.	"A correct answer was assigned 1 point and an incorrect answer or 'I don't know' were assigned 0 points. . … Total cumulative score ranged from 2 to 8." p. 250-251
Tang et al., 2021	From table 3, it can be inferred that the relevant demographic factors (major and gender) were scored using a categorical and binary system.	Table 3. p. 3765
Zemni et al., 2023	From table 4, it can be inferred that the relevant factors (gender and perceived stress) were scored using a binary system and continuous scale, respectively.	Table 4. p. 10
Zhang et al., 2022	It can be inferred by the use of Chi-squared test and logistic regression that all variables were binary. Although this can't be confirmed,	Not mentioned

APPENDIX (B) STUDY SURVEY

Demographics:

1- Age
- 18-24
- 25-34
- 35-44
- 45-54
- 55-64
- 65 and above

2- Gender
- Male.
- Female.

3- Marital status
- Single.
- Married.
- Divorced.
- Widow/widower.

4- Education
- Middle school.
- High school.
- 2 Year diploma.
- Bachelor's degree.
- Graduate degree.

5- Occupation
- Health.
- Education.
- Security/military.
- Administrative.
- Student.
- Self-employed.
- Unemployed.
- Other.

6- I am:
- Saudi.
- Non-Saudi.

7- Place of residence:
- Urban Al-Ahsa.
- Rural Al-Ahsa.

8- Your average monthly income:
- Less than 3000 SAR.

- 3,000 to 8,999 SAR.
- 9,000 to 14,999 SAR.
- 15,000 to 29,999 SAR.
- 30,000 SAR and above.
- Prefer not to say.

9- Do you have any of the following chronic health condition (COPD, Asthma, HIV, cancer, heart disease)?
   - Yes.
   - No.
   - Unsure.
   - Prefer not to say.

10- Which of the following categories best describe you (if you've been tested multiple times report the last test)?
   - I was never tested for COVID-19.
   - I was tested for COVID-19 and the result was negative.
   - I was tested for COVID-19 and the result was positive, and I did not receive any treatment.
   - I was tested for COVID-19 and the result was positive, and I received treatment.

COVID-19 source of information.

11- What is your main source for receiving COVID-19 related information?
   - Ministry of Health.
   - My doctor/nurse.
   - Social media (experts).
   - Social media (influencers).
   - Friends and family.
   - Scientific journals.
   - Newspapers.
   - TV.
   - Radio.
   - Other.

12- Do you think you are receiving the necessary COVID-19 related information you need to make a decision about your health?
   - Yes.
   - No.
   - Not sure.

13- I have trust in my COVID-19 information source:
   - Strongly Agree.
   - Agree.
   - Neutral.
   - Disagree.
   - Strongly Disagree.

COVID-19 Response

PLEASE INDICATE HOW MUCH YOU AGREE WITH THE FOLLOWING STATEMENTS:

14- BEFORE COVID-19 WAS DECLARED AS A PANDEMIC, I KNEW THE RESOURCES THAT I NEED TO PREPARE FOR COVID-19:
- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

15- Before COVID-19 was declared as a pandemic, I was able to obtain the resources I needed to prepare for COVID-19:
- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

16- If COVID-19 continues to be a pandemic, I will have the resources I need to be prepared:
- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

17- I will be more prepared if another wave of COVID-19 hits my community:
- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

18- For me, the impact of the COVID-19 pandemic had:
- No effect
- Minor effect
- Neutral
- Moderate effect
- Major effect

19- I am at risk of being infected with COVID-19:
- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

20- I believe there is going to be another wave of COVID-19:
- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

21- I am satisfied with the way I adjusted to the changes caused by COVID-19:
- Strongly Agree

- Agree
- Neutral
- Disagree
- Strongly Disagree

22- Rate your satisfaction with the measures taken against COVID-19 by the health officials in your community:
- Completely dissatisfied
- Mostly dissatisfied
- Neither satisfied nor dissatisfied
- Mostly satisfied
- Completely satisfied

23- Rate your satisfaction with the measures taken against COVID-19 by the people in your community:
- Completely dissatisfied.
- Mostly dissatisfied.
- Neither satisfied nor dissatisfied.
- Mostly satisfied.
- Completely satisfied.

COVID-19 Knowledge

24- Please indicate which of the following is a COVID-19 symptom:

	Yes	No	Not sure
New loss of taste or smell			
Fever			
Cough			
Vision loss			
Shortness of breath			
Weight gain			

25- COVID-19 CAN BE TRANSMITTED THROUGH TALKING TOO CLOSELY:
- TRUE.
- FALSE.
- I DON'T KNOW.

26- COVID-19 CAN BE TRANSMITTED THROUGH THE SKIN:
- TRUE.
- FALSE.
- I DON'T KNOW.

27- COVID-19 CAN BE TRANSMITTED WHEN SOMEONE SNEEZES/COUGHS ON YOU:
- TRUE.
- FALSE.
- I DON'T KNOW.

28- PLEASE INDICATE WHICH OF THE FOLLOWING MEASURES CAN PREVENTS THE SPREAD OF COVID-19:

	Yes	No	Not sure
Face covering/mask			
Social distancing			
Gloves			
Washing hands with soap and water			

Self-Efficacy:

PLEASE INDICATE HOW MUCH YOU AGREE WITH THE FOLLOWING STATEMENTS:

29- I can wear a face mask outside my residence:
- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

30- I can properly wash my hands with soap and water after contact with surfaces outside my residence:
- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

31- I can maintain my social distance (1.5m) outside my residence:
- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

32- I can stay home when authorities direct me to:
- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

33- I can self-quarantine when I'm directed to do so by my healthcare provider:
- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

34- I feel confident about my ability to adopt to new COVID-19 precautionary measures:
- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

35- I have the resources I need to adhere to COVID-19 precautionary measures:
- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

36- I feel confident about my ability to follow the official COVID-19 guidelines in the future:
- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

Outcome expectancies

PLEASE INDICATE HOW MUCH YOU AGREE WITH THE FOLLOWING STATEMENTS:

37- I BELIEVE THE PROTECTIVE ACTIONS TAKEN AGAINST COVID-19 IS BENEFICIAL TO MY HEALTH:
- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

38- I BELIEVE THE PROTECTIVE ACTIONS TAKEN AGAINST COVID-19 IS BENEFICIAL TO MY FAMILY'S HEALTH:
- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

39- I BELIEVE THE PROTECTIVE ACTIONS TAKEN AGAINST COVID-19 IS BENEFICIAL TO MY COMMUNITY'S HEALTH:
- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

40- I BELIEVE THE PROTECTIVE ACTIONS TAKEN AGAINST COVID-19 IS BENEFICIAL TO MY MENTAL HEALTH:
- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

41- I BELIEVE THE PROTECTIVE ACTIONS TAKEN AGAINST COVID-19 IS BENEFICIAL TO MY FINANCIAL STATUS:

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

NORMATIVE BELIEFS

42- Please indicate how frequent you do the following measures when you leave your residence:

	Never	**Rarely**	**Sometimes**	**Frequently**	**Always**
A. Face mask					
B. Wash hands/Hand sanitizer					
C. Social distancing (1.5 m)					
D. Quarantine – when directed					

43- PLEASE INDICATE HOW DO YOU THINK THE PEOPLE THAT ARE IMPORTANT TO YOU ARE ADOPTING TO THE FOLLOWING MEASURES WHEN THEY LEAVE THEIR RESIDENCE:

	Never	**Rarely**	**Sometimes**	**Frequently**	**Always**
A. Face mask					
B. Wash hands/Hand sanitizer					
C. Social distancing (1.5 m)					
D. Quarantine – when directed					

Observational Learning

44- I had to learn new skills to properly perform the recommended precautionary measures (e.g. face covering, hand washing):

- Yes
- No

45- If you answered yes, how did you learn the new skills (check all that apply):

- Watching family member or a friend
- Watching a community member
- Watching an instructional video on TV
- Watching an instructional video online
- Watching a healthcare provider
- Reading a pamphlet/flyer
- Other (Specify)

APPENDIX (C) IRB APPROVAL LETTER

UNIVERSITY OF LOUISVILLE

Human Subjects Protection Program Office
MedCenter One – Suite 200
501 E. Broadway
Louisville, KY 40202-1798

DATE:	October 20, 2020
TO:	Andrew S LaJoie, Ph.D.
FROM:	The University of Louisville Institutional Review Board
IRB#:	20.0738
STUDY TITLE:	Understanding COVID-19 Preparedness Among Residents of Al-Ahsa, Saudi Arabia Using the Social Cognitive Theory
REFERENCE #:	713658
DATE OF REVIEW:	10/17/2020
IRB STAFF CONTACT:	Sherry Block 852-2163 slbloc04@louisville.edu

This study was reviewed on 10/17/2020 and determined by the Chair/Vice-Chair of the Institutional Review Board that the study is exempt according to 45 CFR 46.101(b) under Category 2: Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior unless, the information is obtained in an identifiable manner and any disclosure of the subjects responses outside of research could reasonably place the subject at risk.

This study was also approved through 45 CFR 46.117(c), which means that an IRB may waive the requirement for the investigator to obtain a signed informed consent form for some or all subjects.

Documents/Attachments reviewed and approved:

Submission Components			
Title	Version #	Version Date	Outcome
Arabic Preamble Certification of Accuracy for Translation	Version 1.0	10/06/2020	Approved
(Arabic Preamble) Consent COVID-19 SA	Version 1.0	10/06/2020	Approved
Certification of Accuracy for Translation	Version 2.0	09/21/2020	Approved
Social media advertisement (Arabic)	Version 2.0	09/21/2020	Approved
Social media advertisements (English)	Version 2.0	09/21/2020	Approved
Study Survey (Arabic)	Version 2.0	09/21/2020	Approved
Study Survey (English)	Version 2.0	09/21/2020	Approved
(clean) SA COVID-19 study protocol	Version 2.0	09/21/2020	Approved
Preamble consent COVID-19 SA	Version 1.0	09/21/2020	Approved

CURRICULUM VITAE

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RESEARCH INTERESTS

Pandemic Preparedness Behavior, Disaster Preparedness, First Responders Mental Health

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Doctor of Philosophy (Ph.D.) in Public Health Sciences, Health Promotion and Behavioral Sciences Specialization

University of Louisville, Louisville, KY Enrolled since August 2019

Master of Sciences (M.S.) in Disaster Medicine and Management

Jefferson University, Philadelphia, PA Degree awarded May 2019

Bachelor of Sciences (B.S.) in Emergency Medical Services

King Saud University, Riyadh, Saudi Arabia Degree awarded June 2014

EMPLOYMENT

***Graduate Research Assistant*:** University of Louisville, Office of research and innovation

Louisville, United States August 2023 to December 2023

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Al Ahsa, Saudi Arabia October 2016 to July 2019

Advanced Paramedic: King Faisal General Hospital

Al Ahsa, Saudi Arabia May 2016 to September 2016

PUBLICATIONS

In Press

Logsdon, M.L., Schubert, M.L., Sears, C., Miller, E., **Alobaydullah, A.A.,** Lain, K. (2024). Outcomes of Integrating Community-Based Doulas into Healthcare System. *The American Journal of Maternal Child Nursing.*

In Preparation

Alobaydullah, A., LaJoie, A.S., Thomas, S.D., Fumey. R.A, and Chaney, C. "Understanding the Social and Cognitive Influences on the Adoption Of COVID-19 Non-Pharmaceutical Interventions Behaviors."

REPORTS

Karimi SM, Salunkhe SS, White K, Chen YT, McKinney WP, Little BB, DuPre NC, Mitra R, Adkins ER, **Ahmed A. Alobaydullah**, Barclay JA, Ezekekwu E, Dylan M. Hursta , Aravind R. Kothagadia , Martha M. Popescua, Devin N Swinneya, Moyer S. "Results of the Third Observational Surveys of Mask Use in Indoor Public Areas in Jefferson County, KY, during January 25−31, 2021." February 2021.

CONFERENCES AND RESEARCH PRESENTATIONS

Alobaydullah, A.A., Thomas, S.D., Simpson. A., Fumey, R., Doss, N., & LaJoie, A.S. (2022). "International and Cross-Cultural Examination of Vaccine Acceptance and Non-Pharmaceutical Intervention Behaviors Compliance". Research!Louisville Annual Conference, Louisville, KY.

Alobaydullah, A.A., Thomas, S.D., Fumey, R., Simpson, A., Chaney, C., & LaJoie, A.S. (2021). Understanding the social and cognitive influences on the adoption of COVID-19 non pharmaceutical interventions behaviors. American Public Health Association Annual Meeting. October 21, 2021 (Virtual/Poster).

Alobaydullah, A., Thomas, S.D., Fumey, R., Chaney, C., Simpson, A, and LaJoie, A.S., (2021). Non-Pharmaceutical Interventions Compliance in Saudi Arabia. University of Louisville School of Public Health and Information Sciences SGA Presents: Public Health Seminar Series. Louisville, KY.

Simpson, A., LaJoie, A.S., D., Antimisiaris, D., Thomas, S.D., & **Alobaydullah, A. A.,** (2021). Asian-American and Pacific Islander Experience and Behaviors During the COVID-19 Pandemic. University of Louisville Undergraduate Research Symposium. Louisville, Kentucky.

Thomas, S.D., **Alobaydullah, A.A**., Fumey, R., Chaney, C., Simpson, A., & LaJoie, A.S. (2021). Influencers of the decision to vaccinate and engage in other COVID-19 protective behaviors. 43rd Annual Meeting of the Society for Medical Decision Making. October 18-20, 2021 (Virtual/Poster).

Thomas, S.D., **Alobaydullah, A.,** Fumey, R., Chaney, C., Simpson, A, and LaJoie, A.S., (2021). Acceptance of COVID-19 Vaccine & Non-Pharmaceutical Interventions.

UL-School of Public Health and Information Sciences SGA Presents: Public Health Seminar Series. Louisville, Kentucky.

"Observing Mask Use in the Jefferson County, KY: Results from Stratified Random Sampling Studies." Kentucky Public Health Association Educational Conference, April 2021. Seyed M. Karimi, PhD; Sonali S. Salunkhe, MD, MPH; Kelsey B. White, MDiv, MSc; Bert B. Little, PhD; W. Paul McKinney, MD; Natalie C. DuPré, ScD; Riten Mitra, PhD; Shaminul H. Shakib, MPH; YuTing Chen, MPH, MS; Emily R. Adkins; **Ahmed A. Alobaydullah**, …

TEACHING EXPERIENCE

- ***University of Louisville***
  - *Instructor*
    - PHPB 401 - Public Health Communication Theory and Practice Spring 2022
    - PHPB 401 - Public Health Communication Theory and Practice Spring 2023
  - *Co-teaching*
    - PHPB 401 - Public Health Communication Theory and Practice Fall 2021

- ***King Saud Bin Abdulaziz University for Health Sciences***
  - *Teaching:*
    - EMMS 201 - Introduction to Emergency Medical Services Spring 2017
  - *Co-teaching:*
    - EMMS 311 - Paramedic Practice I and Communication for EMT Fall 2016
    - EMMS 314 - Pathophysiology of the Cardiovascular System Fall 2016
    - EMMS 315 - Pathophysiology of the Respiratory System Fall 2016
    - EMMS 411 - Pathophysiology of the Nervous System Fall 2016
    - EMMS 412 - Mental Health & Mental Illness Spring 2017
    - EMMS 416 - Professional Studies System Spring 2017
    - EMMS 413 - Pathophysiology of the Body Systems Spring 2017
    - EMMS 417 - Applied Paramedic Practice Spring 2017

PROFESSIONAL EXPERIENCE

- President at The Saudi Student Association at University of Louisville *October 2020- October 2021*
- Health film reviewer – Public Health Film Festival program of APHA 2021 Annual Meeting and Expo (Oct. 23 - 27)
- Certified Mental Health First Aid Provider.
- Mass gathering at the Hajj, Mecca, Saudi Red Crescent Authority - Volunteer paramedic for more than 250 hours.

LANGUAGES

- English: Full Professional
- Arabic: Native

PROFESSIONAL SKILLS

- Microsoft Office
- Teaching
- R Language
- SPSS