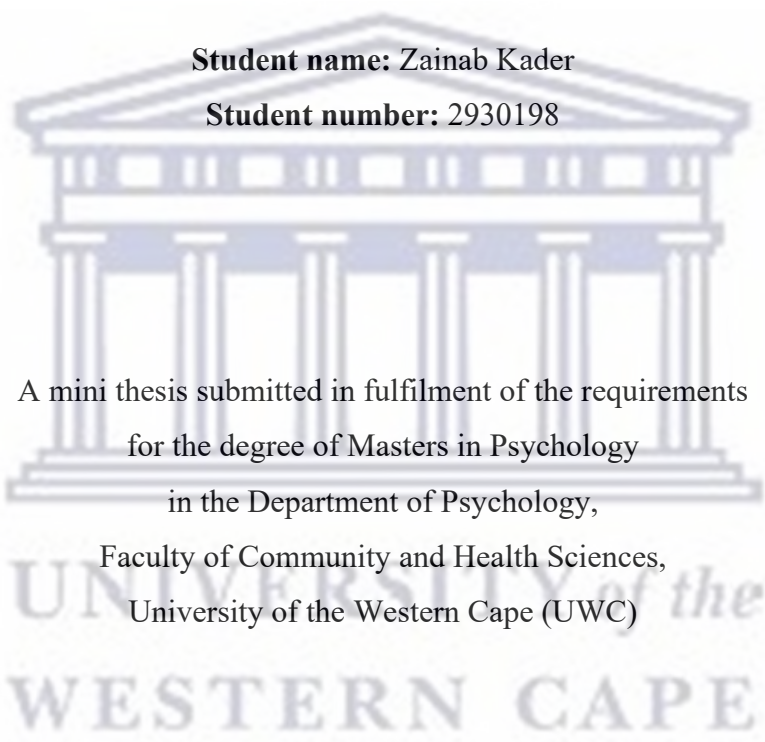


**A SYSTEMATIC REVIEW OF  
DIGITAL MENTAL HEALTH INTERVENTIONS  
FOR STUDENTS DURING THE COVID-19  
PANDEMIC**

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A mini thesis submitted in fulfilment of the requirements  
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## ABSTRACT

Students are vulnerable to mental health conditions, due to the pressures associated with tertiary learning. Disruptions in the academic processes caused by the COVID-19 pandemic added to the pressure, which raised concern for students' mental health, and the development of digital interventions to address their needs. Several digital interventions have come into existence, since the onset of the pandemic in 2019. Therefore, this current study was aimed at systematically reviewing existing digital mental health interventions for students during the COVID-19 pandemic, using a RE-AIM Framework, to evaluate their properties, and determine their efficacy. Consequently, the researcher employed a systematic review methodology to identify English, peer reviewed studies, published between January 2020 and April 2023, and focused on digital mental health interventions for students during the COVID 19 pandemic. Seven databases were accessed, namely, (1) Academic Search Complete, (2) Health Source: Nursing/Academic Edition, (3) Medline, (4) APA PsycArticles, (5) SosIndex with full text, (6) Sabinet and (7) PubMed. The following three levels of review were utilised to determine relevance and inclusion: (1) title screening; (2) abstract screening; and (3) full texts screening. Full text articles were critically appraised, using the RE-AIM appraisal tool. Eleven studies were deemed eligible for this current study. For each study, data were extracted, using the RE-AIM framework, and analysed using narrative synthesis. All the studies reached tertiary students, and their recruitment strategies were described. This review underscored the efficacy of diverse interventions in tackling mental health challenges among students amid the COVID-19 pandemic. The digital mental health interventions were effective in enhancing resilience, improving stress management, proving mindfulness techniques, encouraging nature exposure, and offering psychoeducational interventions. Consultations with experts were identified prior to the development of the intervention. In terms of implementation, the interventions were focused on improving the mental health of students, during the COVID-19 pandemic. Reports on the maintenance of results was limited, with only two studies commenting on the sustained impact of the intervention. Overall, the studies in this current review provided important lessons and recommendations on which future interventions could be built. Ultimately, this current study was valuable, as it consolidated and evaluated the important properties of diverse interventions, to provide recommendations for the improvement of future digital mental health interventions for students. The research is non-reactive and uses secondary data; however, all ethical principles were adhered to throughout the study.

## **LIST OF KEYWORDS**

COVID-19 Pandemic

Digital Mental Health

Digital Technologies

Effectiveness

Interventions

Mental Health

Mobile Application

RE-AIM

Students

Systematic Review

## DEFINITIONS OF TERMS

**Digital mental health:** Digital mental health refers to mental health services and information that is delivered, or enhanced through the internet and related technologies (Denecke et al., 2022).

**Interventions:** An intervention refers to a specific strategy to meet, or address an intended goal, problem, or behaviour (Fernandez et al., 2019).

**Mental health:** Mental health refers to a state of wellbeing that allows people to cope with the normal life stressors, and function well in various domains on their life. Mental health exists on a continuum, from optimal state of wellbeing, to having a mental disorder (Fusar-Poli et al., 2020).

**Digital technologies:** Digital technologies are electronic systems, tools, devices, and resources that generate, store, or process data. They are used to communicate with large audiences. They include, but are not limited to, smart phones, mobile or web applications, smart watches, websites, social media, online games, and online videos (Boschen & Casey, 2008).

**Systematic review:** A systematic review summarises literature in an explicit, rigorous, and reproducible manner, in order to present a critical synthesis of existing research (Munn et al., 2018).

**Students:** Students are people, who attend university, or other tertiary institutions (Chen & Lucock, 2022).

**COVID-19 pandemic:** The COVID-19 pandemic is an ongoing global pandemic, caused by a severe acute respiratory syndrome coronavirus. The first identified outbreak was in 2019. The pandemic has caused significant physical health, mental health, economic, and other challenges, globally (Wirkner et al., 2022).

## LIST OF ABBREVIATIONS

<b>3SBS</b>	–	Three Step Breathing Space
<b>AI</b>	–	Artificial Intelligence
<b>CBT</b>	–	Cognitive Behaviour Therapy
<b>COVID-19</b>	–	Coronavirus disease of 2019
<b>DBT</b>	–	Dialectical Behaviour Therapy
<b>eHealth</b>	–	Electronic Health
<b>FDA</b>	–	Food and Drug Administration
<b>GPS</b>	–	Global Positioning System
<b>HSSREC</b>	–	Humanities and Social Sciences Research Ethics Committee
<b>IAPT</b>	–	Improving Access to Psychological Therapies Program
<b>iCBT</b>	–	internet Cognitive Behavioural Therapy
<b>IT</b>	–	Information Technology
<b>ITC</b>	–	Information and Communication Technologies
<b>LMICs</b>	–	Lower-income and Middle-Income Countries
<b>MbChB</b>	–	Bachelor of Medicine and Surgery
<b>MH</b>	–	Mental Health
<b>mHealth</b>	–	Mobile Health
<b>MBC</b>	–	Mindfulness-Based College Program
<b>MBI</b>	–	Mindfulness-Based Intervention
<b>MPA</b>	–	Moderate Physical Activity

<b>MPsych</b>	–	Masters in Psychology
<b>NA</b>	–	Negative Affect
<b>NSFAS</b>	–	National Student Financial Aid Scheme
<b>NHS</b>	–	The National Health Service
<b>PANAS</b>	–	Positive and Negative Affect Schedule
<b>PRISMA</b>	–	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
<b>PTSD</b>	–	Post Traumatic Stress Disorder
<b>PA</b>	–	Physical Activity
<b>PPI</b>	–	Positive Psychology Intervention
<b>RCT</b>	–	Randomised Control Trial
<b>RE-AIM</b>	–	Reach, Efficacy, Adoption, Implementation and Maintenance
<b>RISE</b>	–	Resilience Skill Enhancement Program
<b>SC</b>	–	Supportive Counselling
<b>WHO</b>	–	World Health Organisation


## DECLARATION

I, **Zainab Kader**, declare that the thesis entitled, “**A systematic review of digital mental health interventions for students during the COVID-19 pandemic**”, submitted for the MPsych degree at the University of the Western Cape, is my own work. All the sources that I have used, or cited, have been indicated and acknowledged by means of complete references. This research project has never been submitted, previously, for any degree to any other institution.

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**Date:** February 2024

**Student Signature:**   
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**Zainab Kader**

## DEDICATION

This thesis is dedicated to my peanut, who showed me how to love fiercely, show strength in times of the greatest adversity, and be resilient, when I thought that I could no longer be. You have been in my heart from the start of this journey, and you will remain with me, until the end of time. This journey has felt worthwhile, knowing that you were a part of it. ♥♥♥

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# CHAPTER ONE

## INTRODUCTION

### 1.1. Introduction

The landscape of mental healthcare is undergoing significant transformation, owing to rapid advancements in digital technology (Lehtimaki et al., 2021). Traditional therapeutic approaches, while effective, often face challenges, such as limited accessibility, high costs, and social stigma (Lehtimaki et al., 2021). Digital mental health interventions have emerged as a compelling solution to these challenges, increasing access to mental health support (Naslund et al., 2017). To gain greater insights into digital mental health intervention and its effectiveness, this chapter is aimed at providing an understanding of digital mental health interventions, with a specific focus of its use for students, during the COVID-19 pandemic. A background about, and rationale for the phenomenon are highlighted, to provide insight into digital mental health interventions and its need, as well as applicability to students during the COVID-19 pandemic. This is followed by a description of the research problem, and the significance of this current study. In addition, the aim and objectives are detailed, followed by the thesis layout.

### 1.2. Background and rationale

The rapid spread of the COVID-19 pandemic, as well as the associated mitigation strategies, such as isolation, quarantine, physical distancing, and lock down restrictions, affected millions of people's lives (Cao et al., 2020). University students were a population group that was distinctively impacted by the pandemic, owing to the disruptions to the higher education sector, globally. They had to prepare for the rapid closure of universities, and transition to emergency remote online learning (Copeland et al., 2021). In addition, Copeland et al. (2021) highlight that students, living in dormitories, had to leave campus without delay to find alternate accommodation, as well as other resources. Due to disruptions in the academic processes, caused by the pandemic, students struggled to manage academic activities, experienced lowered levels of self-efficacy and motivation, as well as uncertainty regarding the completion their studies, confusion about study expectations, and a decreased sense of belonging at their institution of higher learning (Stathopoulou et al., 2020). Students, therefore, had to adapt to online learning without warning.

In addition to navigating this new way of learning, many students from disadvantaged backgrounds, struggled with the financial implications of this transition, as they would require adequate IT equipment to attend online classes, as well as reliable internet connectivity (Plakhotnik et al., 2021). Many students relied on part time jobs to assist with study and living costs; however, due to lockdown and the economic crisis, many students were unemployed, resulting in the need to move back to the family home, without sufficient preparation (Capone et al., 2020). Unemployment extends far beyond financial loss only, as it also includes the loss of self-esteem, social withdrawal, apathy, concern about the future, and increased mental health challenges (Flinchbaugh et al., 2012).

A culmination of these stressors caused diminished mental health and wellbeing for students, resulting in loneliness, anxiety, depression, eating disorders, alcohol and drug consumption, as well as increased levels of stress (Cao et al., 2020). This was particularly concerning for students who lacked social support (Kohls et al., 2020). Regrettably, many students have low mental health literacy, and consequently, may not recognise a need for treatment (Lattie et al., 2019). However, during the pandemic, discussions about mental health became more apparent, leading to the creation of innovative ways to address mental health challenges. The COVID-19 pandemic precipitated the adoption of digital tools, not only for academic processes, but also for individuals to deliver, and access services (Stein et al., 2021). The use of digital technologies to access mental health resources and support, particularly for students, emerged as a significant trend, actively supported, and often initiated by universities (Kola et al., 2021).

The World Mental Health Report acknowledges that digital technologies could offer promising tools to improve mental health, as they could strengthen mental health systems, by providing training and support to healthcare workers, informing and educating the public, enabling self-help, and delivering remote care (World Health Organization [WHO], 2022a). Ultimately, digital mental health interventions allow for greater mental health coverage, as they reduce time, expense, and travel. Additionally, it could suppress experiences of stigma, and allows the flexibility to suit students' schedules (Lehtimaki et al., 2021). Until recently, digital mental health interventions were used mainly in high-income countries; however, these interventions are becoming more available and affordable in many more countries and settings (Ibragimov et al., 2021).

Typically, people are more likely to have access to a mobile phone, than mental healthcare (Lehtimaki et al., 2021). Digital interventions represent tools to advance the support and treatment of students with mental health conditions (Naslund et al., 2017). To evaluate the effectiveness of these interventions for student populations, as well as identify the inconsistencies, this study is aimed at systematically reviewing digital mental health interventions for students, during the COVID-19 pandemic.

### **1.3. Problem statement and significance of the study**

The mental health of students at tertiary institutions is a growing concern (Montagni et al., 2020). A multitude of social and academic stressors, namely, the transition to adulthood, competition with peers, and the pressure to succeed, may trigger mental health challenges in students (Montagni et al., 2020). Due to stigmatising attitudes towards mental health, young people may tend to avoid face-to-face consultations, and attempt to manage their condition in isolation (Montagni et al., 2020). The COVID-19 pandemic initiated added challenges and stressors for students, which negatively affected their mental health further (Visser & Law-van Wyk, 2021). Consequently, a need for mental health intervention exists; however, several barriers, namely, lack of awareness, stigma, lack of available services, and finances, restrict students from accessing the mental health intervention they require (Nguse & Wassenaar, 2021).

According to Lehtimaki et al. (2021), digital mental health interventions provide students with the opportunity to access the support they require, without shame or stigma. During the COVID-19 pandemic, a number of digital interventions emerged, to address students' mental health (Dambi et al., 2022; Gabrielli et al., 2021; Riboldi et al., 2022; Theurel et al., 2022). Consequently, several studies were conducted to assess the effectiveness of digital mental health interventions for students during COVID-19 (Catuara-Solarz et al., 2022; Oliveira et al., 2021). Additionally, several reliable studies have focussed on the properties of the digital mental health interventions for students during the COVID-19 pandemic (Al Mamun et al., 2021; Duden et al., 2022; Li & Hasson, 2020; Ye et al., 2022), from a RE-AIM [Reach, Efficacy, Adoption, Implementation and Maintenance] perspective (Glasgow, 2006). This is imperative, as understanding the properties of the reach, efficacy, adoption, implementation, and maintenance of interventions, allows researchers, as well as practitioners, to evaluate the intervention (Glasgow, 2006; Glasgow et al., 1999).

During the COVID-19 pandemic, digital mental health interventions were instrumental in providing support to university students (Duden, 2022). Therefore, the researcher is of the opinion that, although the pandemic has abated mostly, it would be valuable to ascertain the properties of the digital mental interventions that were available to students, during the pandemic.

To address this vacuum, the researcher aims to systematically review the digital mental health interventions that were available for students during the COVID-19 pandemic, using a RE-AIM framework. Conducting this current study is significant, as it would allow for the scaling of these interventions, would determine its effectiveness, and could provide recommendations for future digital mental health interventions for students, with the aim of building on the existing interventions. The reviewing of interventions is essential, as it would allow for the strengths and weaknesses of various interventions to be consolidated. In addition, it could help researchers, practitioners, software developers, and policy makers, to identify what works, as well as what needs more work, in order to produce quality interventions that are appropriate, relevant, and effective.

#### **1.4. Research aim**

The aim of this current study was to systematically review digital mental health interventions for students, during the COVID-19 pandemic.

#### **1.5. Research objectives**

- To identify digital mental health interventions for students during the COVID-19 pandemic by means of a systematic review;
- To describe the characteristics of these digital mental health interventions for students during the COVID-19 pandemic, in terms of reach, efficacy, adoption, implementation and maintenance;
- To describe the effectiveness of digital mental health interventions for students during the COVID-19 pandemic; and
- To provide recommendations for the implementation of digital mental health interventions in the context of societal crisis.

## 1.6. Thesis layout

**Chapter One** comprises an introduction to the study of digital mental health interventions for students during the COVID-19 pandemic. The introduction, background and rationale, problem statement, significance of the study, research aim, and research objectives, are discussed.

**Chapter Two** contains a literary overview of existing research, focusing on digital mental health interventions for students during the COVID-19 pandemic. The researcher focuses on the impact of the COVID-19 pandemic on global mental health, on tertiary students' mental health, as well as mental health services. In addition, the history and current status of digital mental health interventions, such as telemedicine, mobile application, and artificial intelligence, are explored, as well as the role of digital mental health interventions in mental healthcare service provision, the advantages and disadvantages of digital mental health interventions, and the ethical considerations, when implementing digital mental health interventions.

**Chapter Three** is focused on the methodology of the research. The systematic steps undertaken to review digital mental health interventions for students during the COVID-19 pandemic are presented. The methodology is divided into sub-sections, namely, aim, objectives, research methodology, review questions, inclusion and exclusion criteria, search strategy, levels of review, critical appraisal, data extraction, data analysis, and ethical considerations.

**Chapter Four** includes the results of this current study. The characteristics of the included studies are described, as well as the reach, efficacy, adoption, implementation, and maintenance of the interventions that have been included in this current study.

**Chapter Five** encompasses a discussion of the findings, in relation to existing literature. The aims and objectives of the study are addressed. Additionally, the strengths and weaknesses of the study are described. The limitations of this current study are addressed, and recommendations offered to practitioners, researchers, and policy makers. In this final chapter, the researcher sums up the study in the form of a conclusion.

## CHAPTER TWO

### LITERATURE REVIEW

#### 2.1. Introduction

This chapter is focussed on the impact of the COVID-19 pandemic on global mental health, tertiary students' mental health, as well as mental health services. In addition, an overview of the history and current status of digital mental health interventions is provided, as well as the role of digital mental health interventions in mental healthcare service provision. Lastly, the advantages and disadvantages of digital mental health interventions, such as ethical dilemmas and the digital divide, are discussed.

#### 2.2. The impact of the COVID-19 pandemic on global mental health

The World Health Organisation (WHO, 2022b) reports that one in every eight people, or 970 million people around the world, live with a mental health condition. In 2020, the number of people living with depression, anxiety disorders, impulsivity, emotional disturbance, stress, somatization disorder, sleep disorders, panic attacks, irrational anger, post-traumatic stress symptoms, and suicidal behaviour, grew significantly because of the COVID-19 pandemic (Hossain et al., 2020). The responses and psychological reactions of individuals play a critical role in the way they respond to a crisis, such as a pandemic. Psychological reactions to pandemics include, emotional distress, maladaptive behaviours, and defensive responses. These reactions contribute toward the emotional distress of individuals, and affect their mental health during and after the outbreak (Cullen et al., 2020; Usher et al., 2020).

Typically, people feel unsafe and anxious when their environment changes, which creates feelings of panic, fear, and loss of control (Usher et al., 2020). Hypervigilance may develop because of the fear and anxiety, which, in severe cases, may lead to mental health conditions, such as acute stress disorder, post-traumatic stress disorder (PTSD), or depression (Usher et al., 2020). The fear of the unknown was a significant factor for many people, globally, as they had no control over the spread of the virus, nor prior knowledge about how the virus would affect them, or their loved ones, which caused them to experience despair, grief, loss of purpose, sadness, hopelessness and frustration (Cullen et al., 2020). Due to mixed messages

from social media, the government, and other sources, people were in a constant state of confusion and uncertainty, which culminated in emotional distress (Hossain et al., 2020).

However, while the pandemic was challenging for most people, the mental health impact of the pandemic was particularly challenging for certain population groups, namely, women, the elderly, students, children and adolescents, as well as frontline workers (Crocker et al., 2023; De Oliveira et al., 2022; Ghahramani et al., 2023). The findings of a global systematic review by Sun et al. (2023) revealed that the participants experienced a difference in mental health symptoms, *before* and *after* the pandemic. Additionally, the review findings revealed that university students, the elderly, as well as individuals, who self-identified as belonging to a gender or sexual minority group, displayed deteriorating depression symptoms, during the pandemic, compared to before. Females, in particular, appeared to have experienced deteriorating general mental health, anxiety symptoms, as well as depression symptoms (Sun et al., 2023).

Lee (2020) highlights the impact of the pandemic on children and adolescents. In addition to the health risks, as well as the essential activities that were restricted, educational institutions, such as day-care centres and schools, were also disrupted. These disruptions affected routines, socialising, and learning, which are essential for mental health (Lee, 2020).

The findings of a systematic review, conducted by De Oliveira et al. (2022), emphasised the mental health impact of the pandemic on children, as well as adolescents, and revealed that children in America, aged between 2 and 7 years, presented with uncooperative behaviour and sadness, or worry. Among the Chinese cohorts of the review, behavioural, emotional, hyperactivity-inattention, and peer problems were apparent. PTSD and suicidal ideation were also present among Chinese children and adolescents. The findings of the review in Spain and India, revealed that children and adolescents presented with fear, helplessness, and worry, related to the COVID-19 pandemic. The review also established that a large population of children and adolescents, across the world, in rural and urban contexts, reported anxiety and depressive symptoms (De Oliviera, 2022). Rauschenberg et al. (2021) report that, within a representative German youth population (aged 16 to 25 years), the COVID-19 pandemic had a negative impact on youth mental health, as social isolation, the lack of company, as well as COVID-19-related cognitive preoccupation worries and anxiety, were all associated with psychological distress. In essence, the findings of the systematic review by De Oliveira et al.

(2022) revealed an overall trend of declining mental health for children and adolescents, which, most likely, could be attributed to the COVID-19 pandemic.

It is also important to consider the impact of the pandemic on frontline workers, namely, the healthcare workers and mental healthcare workers. A global systematic review, conducted by Ghahramani et al. (2023), observed that healthcare workers were at a higher risk of experiencing psychological challenges, such as anxiety, depression, insomnia, burnout, stress, and PTSD, due to the high levels of psychological stress encountered, while treating COVID-19 patients. Among healthcare workers, insomnia was the most prevalent, while stress was the least. In addition, the study findings revealed that the prevalence of psychological challenges was higher among physicians, nurses, and older staff members. Healthcare workers expressed concern about their safety, as well as the safety of their loved ones, the loss of colleagues, working too many hours, worrying about their home supplies, and the ethical implications about rationing ventilators for the sick.

Apparently, higher rates of depression, anxiety, insomnia, and PTSD, emanated from the Chinese samples, when compared with other countries (Ghahramani et al., 2023). However, for many mental health workers, the pandemic took a toll on their mental health. According to Crocker et al. (2023), mental health workers have faced an increased workload, changed roles, burnout, decreased job satisfaction, telehealth challenges, such as difficulties in interpreting non-verbal cues and maintaining confidentiality, difficulties with work-life balance, and altered job performance. Additionally, they have experienced decreased wellbeing, increased psychological distress, anxiety, depression, isolation and reduced social interactions outside of work, as well as psychosocial challenges. Crocker et al. (2023) adds that the pandemic has altered the delivery of mental healthcare, while mental healthcare workers have faced the challenges of adapting to the increased demand, changes in service delivery, staff shortages, as well as navigating the personal impacts of the pandemic itself. This global review, conducted by Crocker et al. (2023), particularly observed that mental health workers experienced feelings of guilt and incompetence, as well as concerns about the effectiveness of online therapy. However, they also reported benefits, such as, acquiring new therapeutic skills, and improved patient engagement, during online therapy.

Evidently, the pandemic had a profound and diverse impact on mental health across various demographic groups and professional sectors; however, limited information about tertiary

student populations is communicated. Rudenstine et al. (2021) highlight that the COVID-19 pandemic was challenging for the student population, as they had to contend with challenges related to their academics, as well as the pandemic. Therefore, it could be concluded that this pandemic took a toll on the mental health of students pursuing tertiary education.

### **2.3. The impact of the COVID-19 pandemic on tertiary students' mental health**

The COVID-19 pandemic caused significant disruption in teaching, learning, as well as student engagement with staff and peers (Laher et al., 2021). Chen and Lucock (2022) report that university students in the United Kingdom experienced increased levels of psychological distress during the COVID-19 pandemic, particularly related to, anxiety, depression, and declined academic performance. Their most striking finding was that more than half of the university students in their study had high levels (with scores above the clinical cut off) of depression and anxiety, meaning that these students were experiencing clinically significant levels of depression and/or anxiety at the time of the survey in June 2020. Similar findings were reported in a review, which focused on students' mental health during the COVID-19 pandemic, and included international studies from Poland, Bangladesh, South Africa, China, Pakistan, as well as the United States of America (Aqeel et al., 2022; Cao et al., 2020; Debowska et al., 2020; Islam et al., 2020; Laher et al., 2021; Rudenstine et al., 2021; Wang et al., 2020).

A systematic review, conducted by Al Mamun et al. (2021), only focused on the mental health impact of the pandemic on tertiary students in Bangladesh. These students displayed a prevalence of depression, anxiety, and stress. The higher levels of depression, anxiety, and stress in students, were associated with socio-demographics, such as gender, younger age, lower family monthly income, urban residence, lower grade education status, living with family/parents, family size, and having children in the family. Additionally, behaviour and health-related mental health risk factors included, smoking, reporting more internet use time, lack of physical exercise, and dissatisfaction with sleeping status (Al Mamun et al., 2021). In contrast, a global review by Li et al. (2021) observed that depression was prevalent in tertiary students; male and female, undergraduate and graduate students, as well as for medical and non-medical majors. Essentially, it affected all types of students, and one sub-group was not observed to be more at risk than the other, suggesting that the mental health impact of the COVID-19 pandemic was universal for students (Li et al., 2021).

However, the findings of a South African study by Laher et al. (2021) revealed that the COVID-19 pandemic exacerbated the tertiary institution experience for first generation students, who were already confronted with numerous challenges, related to identity, lack of confidence, difficulty with asking for help, finance, academic and social disadvantages, as well as family dynamics. Katrevich and Aruguete (2017) highlight that, when faced with challenges, first generation students may have less social support, as their family members may lack an understanding of the university environment, as well as the pressures of studying at tertiary level. This often causes experiences of loneliness for students, who may be more prone to mental health challenges, as opposed to other students. Additionally, they may find it difficult to navigate the academic and social pressures, resultantly, feeling overwhelmed, frustrated, or inadequate.

Evidently, the impact of COVID-19 simply increases the levels of stress, because of the social restriction, the need to quarantine or isolate, threat to health, death of loved ones, interruption of courses, as well as the need to adapt to a new online learning environment (Visser et al., 2021). These views were affirmed in a rapid review by Sonn et al. (2021), which focused on South African literature. Sonn et al. (2021) add that students faced the daunting task of transitioning to online teaching and e-learning, with the management of the increased workload emerging as a primary concern. The absence of peer learning, a crucial element of the educational experience, led to heightened stress and anxiety among students, as they were unable to collaborate with peers, and seek support during the learning process. Financial concerns added another layer of stress, particularly for recipients of bursaries from National Student Financial Aid Scheme [NSFAS] (Republic of South Africa [RSA], Act 56 of 1999), who questioned the continuity of financial support. The plight of the *missing middle* students was also underscored (Garrod & Wildschut, 2021), with 30% of a disadvantaged university's student body, lacking the necessary technology for online learning (Sonn et al., 2021). These authors add that the pandemic highlighted the social disparities, as students grappled with issues, ranging from a lack of electricity and internet connectivity, to inadequate living spaces. Forced evacuations from university residences further compounded the challenges, leaving many, including international students, without alternative accommodation, and fearing the spread of the COVID-19 virus, when returning home. The pandemic's impact extended to postgraduate research endeavours, such as data collection, and disrupting projects across various disciplines.

However, Sonn et al. (2021) also observed that students adopted a positive approach as well. Students reported that some of the experiences taught them to be resilient, and made them more reflective about adapting, as well as creating new ways to work. They also recognised their need to embrace roles of leadership, by changing their mindset, attitude, and way of thinking. Students considered ways to foster a more positive perspective and support each other. They realised that this could be achieved by creating awareness in their communities about the pandemic, as well as the stigma associated with it.

Kedra and Kaltsidisi (2020) sought to understand the experiences of students at a university in Greece, during the pandemic. Students reported feeling anxious, insecure, fearful, concerned for the future of their studies, sadness, concern, curiosity about what exactly would follow, as well as disappointment that the new environment was not conducive to learning. Students also missed the social element of university life. Similarly, Visser and Law-van Wyk (2021) observed that students in South Africa experienced serious discomfort during the pandemic; they felt socially isolated, and had difficulty adjusting academically, which led to emotional challenges. According to these authors, the emotional impact of the COVID-19 pandemic on students was concerning and required intervention, as prolonged exposure to these feelings and experiences could result in serious mental health conditions. Support has proven to improve coping skills, resilience, and provide strategies, to mitigate the impact of the pandemic on academic and future success (Kola et al., 2021). In an attempt to address the mental health needs of students, but relieve the pressure on mental health services, Xiao and Wang (2023) recommended the use of digital mental health interventions, as it could assist with social support, information sharing, supportive strategies, as well as other mental health benefits for students.

#### **2.4. The impact of the COVID-19 pandemic on mental health services**

The COVID-19 pandemic disrupted mental health service provision globally, particularly in many lower-income and middle-income countries [LMICs], where substantial demands were placed on mental health, because of the pandemic (Kola, 2020). The global impact of the COVID-19 pandemic on mental health services, therefore, has been significant. The surge in mental health issues, including anxiety and depression, due to factors such as fear of infection, social isolation, and economic uncertainties, led to an unprecedented demand for mental health support (Cao et al., 2020). The findings of a global systematic review, representing 63

countries, focused on the impact of the COVID-19 pandemic on mental health services, revealed that the pandemic severely impacted service provision, created a shortage of staff and equipment (causing a challenge to meet the escalating needs of individuals seeking assistance), increased the workload and stress of staff, and decreased access for patients (Duden et al., 2022). It further highlighted that the global transition to telepsychiatry was a major change and challenge in mental healthcare services, raising concerns about regulation, training, and access to medication (Duden et al., 2022). To adapt to social distancing measures, many mental health services transitioned to telehealth platforms, not only enabling remote access, but also posing challenges, in terms of technology access and virtual interactions. Notably, numerous mental health facilities either closed, or substantially scaled down their operations, while telepsychiatric services were expanded (Duden et al., 2022). The lack of preparedness of mental health services and the shift towards telepsychiatric, impacted access, referrals, and admission to mental health services (Duden et al., 2022). Consequently, the digitalization of services allowed better access for some, but the restrictive measures hindered access for most. Additionally, staff experienced heightened effects on their mental health, increased burdens on patients, as well as the pausing of professional training (Duden et al., 2022).

While these challenges occurred, to various extents, across the global, low- and middle-income countries (LMICs) experienced additional, or distinctive challenges, when dealing with the impact of the COVID-19 pandemic on mental health services (Ibragimov et al., 2021). The surge in mental health challenges was exacerbated in these countries, due to a combination of factors. LMICs, typically, would have had weaker healthcare infrastructures, as well as fewer resources allocated to mental health services, prior to the pandemic (Cao et al., 2020). The sudden increase in demand overwhelmed these limited resources, creating a greater shortage of staff and equipment (Duden et al., 2022). The transition to telepsychiatry, which was a global response to social distancing measures, posed unique challenges for LMICs (Al Mamun et al., 2021). While telehealth platforms enabled remote access, issues of technology access and virtual interactions, were more pronounced in regions with limited digital infrastructure (Al Mamun et al., 2021). The closure, or significant scaling down of mental health facilities in many LMICs, further hindered in-person services (Duden et al., 2022).

In addition, the COVID-19 pandemic aggravated poverty and resulted in an increase in mental illnesses (Kumar & Kumar, 2020). Isolating people without adequate provisioning for their everyday life needs, could exacerbate people's stress and helplessness (Kumar & Kumar,

2020). Many people, living in LMICs, experienced overcrowded living conditions, adverse life events associated with socioeconomic vulnerabilities and extreme poverty, food scarcity impacting treatment adherence and provision for their family, creating experiences of anxiety and depression (Kumar, 2019). Vulnerable low wage-earning individuals, who also suffered from underlying chronic conditions were the most affected. This was aggravated, when they belonged to vulnerable groups, such as migrant workers, elderly, marginalised racial or ethnic groups, women, and individuals with mental illnesses (Kumar & Kumar, 2020). In such cases, access to services and available support was compromised.

Davies et al. (2023) highlight that outpatient substance abuse and opioid detoxification centres were closed to reduce face-to face contact and increase the provision of COVID-19 beds. The closure, or reduction of therapeutic services in some hospitals, contributed to relapses and heightened distress. The pandemic-induced restrictions also disrupted the provision of mental health services, causing setbacks in inpatient admissions, outpatient visits, and therapeutic interventions across various care levels. Hospitals redirected their staff to COVID-19 care, leading to a decrease in both the availability and quality of mental health services. Additionally, the closure of therapeutic wards and the reduction of psychosocial rehabilitation programmes further intensified the challenges faced in mental healthcare (Davies et al., 2023).

Nguse and Wassenaar (2021) report that one-in-six South Africans have a substance use, anxiety, or depressive disorder, and approximately 60% of South Africans may experience post-traumatic stress because of crime, motor vehicle accidents, or other traumatic incidents. However, only 27% of South Africans with severe mental disorders (such as psychosis, bipolar etc) have received treatment (Nguse & Wassenaar, 2021). Added to the existing mental health crisis, the COVID-19 pandemic exacerbated the negative experience of those suffering with mental health conditions (Cao et al., 2020). It has also intensified the pressures on children, adolescents, and young adults, which could result in a whole generation's mental health and wellbeing being jeopardised, consequently, increasing the need for mental health services (Tomlinson et al., 2022). This reality, therefore, highlights the need for more mental health interventions.

Unfortunately, health systems have not been able to respond adequately to the needs of the majority of the people requiring mental health intervention, because they are significantly under-resourced (Moitra et al., 2022). WHO (2022b) states that while effective prevention and

treatment options exist, many people with mental health conditions do not have access to effective care. A global study by Moitra et al. (2022) observed that wide disparities in treatment rates exist. For example, only one-third of people with depression received formal mental healthcare, while the mental health service use ranged from 33% in high-income countries to 8% in low- and lower middle-income countries. In South Africa, legislation and policies, such as the Mental Healthcare Act of 2002 (Republic of South Africa [RSA], Act No. 17 of 2002), the White paper on the rights of persons with disabilities (Republic of South Africa [RSA], 2016), National Health Act of 2003 (Republic of South Africa [RSA], Act 61 of 2003), and the National Mental Health Policy Framework and Strategic Plan 2013–2020 (Republic of South Africa [RSA], National Department of Health [DoH], 2013), have been implemented to direct and prioritise mental healthcare; however, a huge inconsistency exists between the policies and their implementation (Nguse & Wassenaar, 2021).

The lack of adequate mental health service provision could be the result of several reasons, namely: the lack of funding; the pressures placed on under-resourced large public sectors; unbalanced ratio of mental health professionals to patients; poor mental health literacy and awareness about mental health conditions, as well as access to services; the lack of training for nurses to identify mental health conditions; high patient loads that result in the failure to detect mental health conditions; the lack of referral agencies when nurses identify mental health conditions; space constraints, which limits confidentiality; high default rates in group interventions; and poor tracing of individuals (Docrat et al., 2019; Nguse & Wassenaar., 2021; Petersen et al., 2016).

As an attempt to service larger populations, and introduce scalable interventions, alternative types of interventions might have to be considered, to meet the mental health needs. According to Torous et al. (2020), this could be achieved by using digital interventions as screening, treatment, or therapeutic tools. Subsequently, during the COVID-19 pandemic, a transition to telehealth and digital services did occur in many countries, due to the disruption in healthcare provision. These interventions proved to be effective in helping individuals with their mental health challenges, indicating promise for the future of digital mental health interventions (Riboldi et al., 2022; Torous et al., 2020; Weis et al., 2021). Therefore, digital interventions could alleviate the burden, increase access, and improve resource capacity (Graham et al., 2020). In addition, it could be helpful to students, who are reluctant to access mental health services, due to barriers, such as lack of information, or stigma (Riboldi et al., 2022).

## 2.5. The history and current status of digital mental health interventions

Initially emerging in the late 20th century with simple computer-assisted therapies, digital mental health interventions have since evolved, harnessing the internet, mobile technologies, and artificial intelligence, to provide innovative mental health solutions (Neary & Schueller, 2018). These digital tools were primarily informational and educational; however, they quickly expanded to include interactive elements, such as online cognitive-behavioural therapies, virtual support groups, and self-help tools (Araújo, 2020). In recent years, the proliferation of smartphones and wearable technology has further revolutionised this field (Araújo, 2020).

The need for digital solutions became apparent during the COVID-19 pandemic. As a result, digital mental health interventions gained momentum and became more popular than ever before (Araújo, 2020). During the pandemic, digital mental health interventions were viewed as a complementary, or alternative way of assisting people, who could not access face to face mental health interventions, due to the restrictions, isolation, lack of resources, and other reasons (Balcombe & De Leo, 2020). It offered a solution to manage the demand for mental health services.

However, since digital mental health interventions have become more common, it has gained more attention. Weir (2021) highlights that experts do not fully agree with what is regarded as a digital mental health intervention; however, there is consensus that it is software of digital application that goes beyond *wellness*, which assists with losing weight, or meditation, for example. Digital mental health interventions are designed to treat, or manage a mental health condition, such as anxiety or depression (Balcombe & De Leo, 2020). Additionally, it has been agreed upon that typically, the digital mental health industry has three sub-sectors: telemedicine (eHealth), the smart device sector (mobile applications or mHealth), and artificial intelligence (AI).

### 2.5.1. Telemedicine (eHealth)

Telemedicine refers to the use of technologies to communicate with clients. This is one of the oldest methods of digital mental health interventions. Telemedicine allows for client and practitioner engagement, to complete assessments, monitor progress, or deliver an intervention (Balcombe & De Leo, 2020). Zur (2012) highlights that telemedicine has been used for more than half a century, and has been especially useful with suicide crisis

lines, where telephonic consultation has been employed effectively for suicide prevention. Additionally, it is helpful in the treatment of PTSD, depression, anxiety, and agoraphobia (McCall et al., 2019). Telemedicine also makes use of computers and the internet, for example, videoconferencing to perform therapeutic or psychiatric consultations, and emails (Zur, 2012). Mental health related social networking sites, such as Facebook, could also fall under the helm of e-mental health. These technologies are used to support and improve mental health conditions, as well as mental healthcare (Cheung et al., 2017).

### 2.5.2. Mobile Applications (mHealth)

In the last decade, smart phone interventions in mental health have become increasingly popular, especially with the youth, who are regarded as *digital natives*, as they are the first generation to have grown up in the digital age, and are accustomed to socialising, communicating, playing, connecting, shopping, and even having sex online (Tullett-Prado et al., 2023). This implies that online communication is common, within the comfort zone, and speaks the language of the target audience (Zur, 2012). Mobile applications offer a unique way of accessing information, monitoring, assessing progress, receiving personalised prompts, or notifications and support, collecting data, and using self-management interventions (Henson et al., 2019).

Mobile interventions can be interactive with their users, by providing a platform for users to input specific information about their experiences, emotions, and contexts, which could be followed by immediate responses, or meeting the specific needs of the user (Araújo, 2020). The assistance offered by the mobile interventions could also be a result of the technological capacities of smartphones, for example their voice recorders, cameras, GPS systems, and Bluetooth. These functionalities could provide clues about the condition of individuals, as well as their contexts, for example, some applications may use these functionalities to find cues and send notifications for stress management techniques, or safety tips (Jameel et al, 2022).

Neary and Schueller (2018) highlight three types of mobile applications within the mental health sphere: (a) self-help that provides self-management of mental health symptoms; (b) in conjunction with a professional coach or therapist online; and (c) blended care, which is a blend between traditional treatment and the mobile application. However,

Neary and Scheler (2018) raise the concern that an abundance of mobile applications is available; however, selecting a useful or suitable one may be a challenge, as it may not be supported by empirical evidence. This is alarming, as it provides consumers with a range of untested applications that may, or may not, be effective. These authors recommend using mobile applications with higher ratings and reviews, as a way of determining the *quality* of the application (Neary & Scheler, 2018).

However, Henson et al. (2019) assert that mobile interventions are effective in the management of depression, bipolar, and suicide ideation. In addition, considerable evidence indicates that these mobile applications have merit, and are effective in the management of mental health conditions (Ben-Zeev et al., 2018; Firth et al., 2017; Jameel et al., 2022).

### 2.5.3. Artificial Intelligence (AI)

Another predicted advancement in telehealth is the augmentation of user health apps with AI that can respond to the natural language conversations of its users (Jiang et al., 2017). AI can use sophisticated algorithms to *learn* features from a large volume of data, and subsequently use the obtained insights, to assist in clinical practice (Jiang et al., 2017). In addition, AI can respond audibly, in a way that a therapist might. Users could also type statements or questions to the programme, and the technology would be able to respond, as AI uses *chatbots*, and *virtual human* therapists (Hollis et al., 2018). However, it is not as prominent, or common, as telemedicine and mobile applications yet.

AI techniques are still in the process of being refined, improved, and marketed (Jiang et al., 2017). Graham et al. (2019) assert that AI might be able to help mental health practitioners to re-define mental health challenges, more objectively than currently done in the DSM-5. They argue that it could be achieved by identifying these disorders at an earlier, or prodromal stage, when interventions may be more effective. Additionally, AI might offer more personalised treatments, based on an individual's unique characteristics (Graham et al., 2019). However, Graham et al. (2019) posit that, while AI is being leveraged in certain settings, globally, we are still far from the sole use of AI, as the potential risks of error, as well as lack of evidence, are too high. It is also unlikely that AI will replace clinicians; instead, it is aimed at supporting clinical decision making and intervention. Additionally, the discipline of mental health has been slower to adopt AI

because of the human approach (forming a relationship, expressing empathy, watching non-verbal cues and others) that clinicians have in managing mental health challenges (Jiang et al., 2017).

Digital mental health interventions have been developed constantly throughout the past few decades, and continues to develop (Jameel et al., 2022). The modalities described, certainly indicate that digital mental health interventions could offer promise, guidance, and assistance in the mental health sphere, as well as fulfil a significant role in mental healthcare service provision.

## **2.6. The role of digital mental health interventions in mental healthcare service provision**

Digital mental health interventions have the potential to increase access to evidence-based mental healthcare online (Graham et al., 2020). Additionally, they have the potential to bridge the divide between the need for mental health services and access to services (Balcombe & De Leo, 2020). Digital technologies could provide people with information that was previously only available to a select few. In addition, it can deliver a range of services, namely, psychoeducation, prevention and promotional programmes, access to specialists or bi-lingual professionals, training, supervision, principles and techniques as treatment or support, follow ups, as well as support to family members, who have loved ones living with mental health difficulties (Graham et al., 2020; Kola, 2020).

Aguilera (2015) assert that digital mental health interventions proved to address problems, such as depression, substance use, and anxiety. The reach of digital technologies offers hope of more efficiently intervention, as well as the management of health problems, by leveraging limited human resources. Additionally, it offers opportunities to improve clinical interventions (Aguilera, 2015). According to Naslund et al. (2017), digital technologies have the potential to enhance users' outcomes, by increasing the reach of existing interventions, as well as by utilising new technologies to measure mental health behaviours.

Gan et al. (2021), however, assert that digital interventions are promising, as they offer researchers, or practitioners, the opportunity to assess and influence behaviour, as well as behaviour change. Additionally, they would be able to consult, offer treatment, as well as provide integrated care, using dynamic and individualised tools. Digital mental health

interventions could also empower people to manage, take ownership, or control of their mental health challenges. Weis et al. (2021) explain that using digital mental health interventions are particularly helpful for youth, as they foster a sense of empowerment and autonomy. Additionally, they allow young people to play a more active role in their healing process, and actively seek support or control in challenging situations.

## **2.7. Advantages and disadvantage of digital mental health interventions**

While digital mental health interventions offer a promising way to meet mental health needs, as well as address inadequacies in mental health service provision, many advantages and disadvantages of these types of interventions should be considered (Aboujaoude et al., 2020). Since the COVID-19 pandemic, society has become more reliant on technology; however, it remains vital to consider that digital mental health interventions are more beneficial than harmful to its users (Gan et al., 2021). Therefore, it is essential that the advantages, as well as disadvantages of digital mental health interventions are thoroughly comprehended.

### **2.7.1. Advantages of digital mental health interventions**

One of the key advantages of digital mental health interventions is its ability to be scalable, to assist in bridging the divide between the need for mental health services, and service provision (Gan et al., 2021). Weir (2021) posits that digital mental health interventions have the potential to reach more people, thereby alleviating the supply and demand challenge in mental health. Typically, many patients with mental health challenges wait an inordinate length of time for an appointment to receive initial counselling, or they have to travel far distances to access care, which is especially true in low socio-economic communities and rural areas (Seifert et al., 2019). Marcu et al. (2022) argue that scaling these interventions to broader populations may produce a small change in individual behaviour; however, it is important, as it allows for the shifting of population behaviour. In addition, these authors posit that this is possible because digital interventions are more immediate, and accessible, to provide tangible assistance, especially when individuals are unable to leave their home during a crisis, such as a global pandemic.

Digital technologies allow psychological interventions to be delivered directly to people, while maintaining high fidelity, and limited human resources (Gan et al., 2021). This is

achieved by controlling various factors, namely, the structure of the intervention, the manner in which the recipients receive the interventions, the ability to collect data as recipients engage with the content, as well as the monitoring of the intervention (Marcu et al., 2022). Essentially, it allows for the interventions to be on schedule, standardised and consistent. Additionally, they are convenient as they are set up in advance, and typically, run automatically, without much staff involvement and oversight (Marcu et al., 2022). Consequently, the interventions are allowed to be replicable across a number of contexts and populations (Fu et al., 2020).

According to Alkhalidi et al. (2016), digital mental health interventions allow for convenience and flexibility, as they can be delivered anywhere, and at any time. Additionally, users of these technologies could choose how they would like to interact with the content, in their own comfort zones, while still remaining within the allotted timeline of the intervention. These factors may render access to mental health interventions as more appealing, and allow for increased engagement (Marcu et al., 2022).

The advantages of anonymity, privacy, flexibility, and timeliness of access, afforded by digital mental health interventions, circumvents many of the commonly identified attitudinal and structural barriers to accessing care, such as time, cost, or stigma (Gan et al., 2021). Apparently, stigma is one of the key reasons for people's reluctance to access mental health services. Digital interventions provide the opportunity to avoid the threat of stigma, address delicate topics, and reach populations who are reluctant to access mental health services (Fu et al., 2020). The anonymity may encourage the recipients to feel more comfortable sharing and engaging with sensitive content. Ultimately, greater self-disclosure of undesirable behaviours and sensitive issues is fostered, without judgement, which could result in more successful outcomes. (Marcu et al., 2022)

According to Alkhalidi et al. (2016), reminders, coaching, and tailored feedback, offered by digital mental health interventions, allow for improved mental health outcomes, compared to the absence of interventions. Wu et al. (2021) observed a similar finding, when assessing the efficacy of using smartphone apps for depression and anxiety. This implies that digital mental health interventions have merit for the improvement of psychological outcomes for users of the intervention. However, while digital mental

health interventions show a lot of promise, there are disadvantages that should be considered, as negative aspects of technology do exist (Graham et al., 2020).

### 2.7.2. Disadvantages of digital mental health interventions

Digital mental health interventions are becoming more popular and relevant; however, the risk exists that some people, for example the elderly, will be excluded. Seifert et al. (2019) posit that when people are uncomfortable with new technologies, it could become a barrier to accessing interventions. This could stem from the lack of knowledge about the use of the internet, infrequent use of the internet, lack of experience, lack of skills, lack of motivation to learn about digital platforms, lack of social support, or the lack of access to digital tools. A sense of digital inferiority may emerge in older adults, who perceive the digital environment as exclusionary, rather than stimulating (Seifert et al., 2019). A similar trend is obvious because of the digital divide, which refers to the gap between people who are skilled in using and accessing technology, and those who are not. This digital divide is influenced by computer or smart phone ownership, reliable internet access, digital literacy, and opportunities to access information technology. Often people from rural areas or low socio-economic communities experience the impact of the digital divide (Sanders & Scanlon, 2021). Additionally, the development and implementation of digital mental health interventions require considerable planning, expertise, and financial resources (Hill et al., 2017). This would impact the quality and roll-out of digital mental health interventions in under resourced communities or countries (Fu et al., 2020; Hill et al., 2017).

Another disadvantage about digital interventions is, there is no guarantee that the correct person will receive the digital content, or the person will engage with the content in the intended manner (Balcombe & De Leo, 2020). Although technical logs record the amount of time the user spends within interfaces, or specific pages, it cannot guarantee that the content was read, understood, or whether insight was gained (Marcu et al., 2022). Additionally, technical difficulties could impact the delivery of the intervention content negatively; therefore, routine and robust monitoring should occur at the back-end systems, as waiting for intervention users to report challenges may lead to missed data and poor intervention fidelity. Regrettably, all digital mental health intervention developers may not be cognisant of this fact; therefore, they should be offered the relevant training (Shingleton & Palfai, 2016).

Digital mental health interventions may also cause several other concerns, namely, people might lose faith in mental health interventions after using an application that did not yield a desired outcome, which may result in them avoiding access to help or delaying treatment (Shingleton & Palfai, 2016). Weir (2021) argues that, in some cases, it seems overly practical for applications to treat mental health conditions, which are generally more personal and dynamic. Marcu et al (2022) concur and highlight that there are more nuanced components to therapeutic engagements, such as empathy, warmth, and understanding, which cannot be conveyed easily through digital interventions.

Aboujaoude et al. (2020) raise the concern of cyberbullying and online impulsivity, especially when the intervention has a group support component. Balcombe and De Leo (2020) highlight that quality assurance and control of the manner in which the intervention is implemented, is challenging; however, strict ethical considerations must be clarified and adhered to. Ultimately, one of the greatest challenges is the regulation of digital mental health interventions.

## **2.8. Regulation of digital mental health interventions**

A matter of concern is the fact that many available digital mental health interventions are not empirically validated (Hill et al., 2017). The lack of an accreditation pathway for digital mental health interventions may be a barrier to the uptake of the intervention among clinicians, as well as consumers (Batterham et al., 2019). The absence of empirical validation or approval for digital mental health interventions raises significant concerns about their efficacy, safety, and ethical implications (Balcombe & De Leo, 2020). Empirical validation involves rigorous scientific scrutiny, to ascertain the effectiveness and potential risks of a mental health intervention (Carl et al., 2022). Without such validation, there is a heightened risk that these interventions may not deliver the intended therapeutic benefits, and in some cases, they might even pose unforeseen adverse effects (Skorburg & Yam, 2021). This lack of empirical support not only compromises the wellbeing of the user, but also erodes public trust in the reliability and credibility of digital mental health tools (Balcombe & De Leo, 2020).

Consequently, ethical considerations are paramount, as individuals may be relying on interventions that lack a clear evidence base, potentially delaying access to more proven and evidence-based forms of treatment (Skorburg & Yam, 2021). Adhering to ethical guidelines is

important, as it allows for good conduct and motives from the start of the intervention, or research phase, until the end. It determines what is valuable and good for all people, especially the participants (Rani & Sharma, 2012). It reflects a commitment to standards beyond personal preferences, and is a commitment that is shared, as well as understood by various professions, societies, and individuals (Naik et al., 2022). When intervening in mental health, ethical considerations are especially important, as intervention transpires with vulnerable populations. Ethical practice is needed to facilitate the adoption and implementations of digital mental health interventions (Skorburg & Yam, 2021); however, it is also important for digital mental interventions to be regulated. Currently, regulatory compliance is still a concern among experts, stakeholders, and users, as these interventions may not meet the standards required by healthcare systems and regulatory bodies (Weir et al., 2021).

Constant efforts, however, are implemented in various parts of the world, to address these challenges. In Australia, Batterham et al. (2019) hosted a workshop with researchers in digital mental health, clinicians, a representative of people with lived experience of mental health conditions, government representatives from the Australian Department of Health, a consumer representative, and a note-taker, to discuss various mental health interventions offered to Australian citizens. Members of the workshop identified existing techniques for the assessment of digital mental health interventions, and reported on current approaches that may provide more efficient pathways to the development of a rigorous evaluation, or accreditation, of the digital mental health interventions. Some of these methods include gathering empirical evidence, while others account for user experience, security of data systems, and/or alignment with clinical treatment guidelines (Batterham et al., 2019). In addition, the workshop highlighted several challenges in the evaluation of digital mental health interventions, and their integration into accreditation processes. The challenges included the variability and suitability of randomised controlled trials (RCTs), as well as the management of low-quality studies (Batterham et al., 2019). The dynamic nature of interventions, their adaptation into apps, and evolving usage patterns, raised uncertainties about ongoing evidence validity. Emphasis was placed on the need to consider adherence, engagement, and safety, alongside empirical evidence. Additionally, concerns were voiced about the accessibility and frequency of updates to accreditation details on intervention websites, as well as the updating of databases with accredited and non-accredited digital mental health interventions (Batterham et al., 2019); however, strategies to resolve these challenges were not reported.

In the United Kingdom, the National Health Service (NHS) has embraced digital mental health interventions increasingly, which is evident through initiatives, such as the Digital Apps Library, as well as the integration of online psychological therapies into various programmes, for example, Improving Access to Psychological Therapies [IAPT] (Wakefield et al., 2021). The NHS has also forged partnerships with technology providers to develop and implement digital mental health solutions, particularly recognising the importance of these tools during the COVID-19 pandemic (Marcu et al., 2022). Despite the progress, challenges persist. Concerns over data security and privacy, equitable access, evidence-based practices, user engagement, and integration with traditional services, highlight the complexity of incorporating digital interventions into mental healthcare (Smith et al., 2023). Addressing these challenges are crucial to ensure the effective and widespread use of digital mental health tools, while maintaining the highest standards of care and accessibility for all (Marcu et al., 2022).

Weir (2021), therefore, highlights the need to receive clearance from the United States Food and Drug Administration (FDA); however, only a few digital therapeutic interventions have been submitted for FDA clearance. Receiving FDA clearance implies that the intervention is safe and effective. Consequently, in 2020, the FDA launched a Digital Health Centre of Excellence to coordinate research, support developers, and help reframe its regulatory approach to digital health technology; however, a large number of developers are producing digital mental health interventions without seeking clearance (Carl et al., 2022). This could be because of the FDA's failure to implement stringent measures for compliance. The agency indicated that it would exercise *enforcement discretion* for certain software functions, namely mobile applications (Weir, 2021). Software that falls into this category include applications that offer psychoeducation, motivational guidance, or coping skills to help people with diagnosed psychiatric conditions (Weir, 2021). However, since no one is regulating these interventions, it is difficult to assess its effectiveness, or determine the potential harms to users, who may be using unproven applications that are not evidence-based (Carl et al., 2022).

## **2.9. Conclusion**

In this chapter, the researcher provided an understanding of the impact of COVID-19 on mental health and mental health services. In addition, the value of digital mental health interventions was described, while the advantages, disadvantages, and regulatory needs were considered. Consequently, it is evident that the digital mental health interventions fulfil a valuable role in

managing the mental health difficulties of students. In the following chapter, the researcher describes the methodology of this study, to satisfy the aim of reviewing digital mental health interventions for students during the COVID-19 pandemic.

## CHAPTER THREE

### METHODOLOGY

#### 3.1. Introduction

In this chapter, the researcher presents the systematic steps followed to review studies on digital mental health interventions for students during the COVID-19 pandemic. A detailed account of the methodological procedures employed during the execution of this current study is provided, and reported in a descriptive manner.

#### 3.2. Research methodology

In this current study, a systematic review research methodology was employed. Systematic reviews follow robust, structured, replicable, and pre-defined processes that require meticulous methods, such as creating a well-formulated question, identifying appropriate and relevant studies, appraising the quality, and summarising evidence through an explicit and rigorous methodology (Khan et al., 2016). This allows for a critical synthesis of existing research. The rigour in a systematic review process differentiates systematic reviews from other types of reviews (Khan et al., 2016; Munn et al., 2018), and ensures that the results are meaningful and reliable to end users. Additionally, the results of systematic reviews provide the most valid evidence to inform the development of trustworthy guidelines and decision-making, which informs policy, future primary research, and intervention programmes effectively (Munn et al., 2018).

#### 3.3. Review questions

The review questions were:

- What digital interventions have been evaluated for their effectiveness in addressing mental health challenges among student populations during the COVID-19 pandemic?
- What are the characteristics of these digital mental health interventions, in terms of reach, efficacy, adoption, implementation, and maintenance?
- How effective were these digital mental health interventions for students during the COVID-19 pandemic?

- What are the recommendations for the implementation of digital mental health interventions in the context of societal crisis?

### **3.4. Criteria for inclusion of studies in the review**

The following inclusion criteria were applied in this current study:

- Studies had to be in the English language;
- Studies had to be full text and peer-reviewed studies, published in academic journals;
- All types of study methodologies and designs were included in this current study;
- Studies had to focus on digital mental health interventions for students during the COVID-19 pandemic;
- Studies had to be published between January 2020 and April 2023. The first outbreak of COVID-19 occurred in 2019; and
- As the location of the included studies was global, local and international studies were included.

### **3.5. Criteria for exclusion of studies in the review**

The following exclusion criteria were applied in this current study:

- Studies that were not published within the designated time period, and not in the English language;
- Full text journal articles that were not peer-reviewed, not available, and could not be sourced;
- Studies that were not focused on the students during the COVID-19 pandemic, and digital mental health interventions; and
- Reviews such as systematic reviews, scoping reviews, narrative reviews, rapid reviews, literature reviews et cetera.

### **3.6. Search strategy**

Seven databases were searched, namely: (1) Academic Search Complete (EbscoHost Web); (2) Health Source: Nursing/Academic Edition (EbscoHost Web); (3) Medline (EbscoHost Web);

(4) APA PsycArticles (EbscoHost Web); (5) SosIndex with full text (EbscoHost Web); (6) Sabinet; and (7) PubMed. These databases were selected as they were the dominant databases in the social sciences field. Most published research that focus on digital mental health interventions are in specific types of journals, which are located in these databases (Chapman, 2021; Papaioannou et al., 2009); therefore, it was anticipated that these databases would yield the necessary information to meet the aim and objectives of this current study. Examples of keywords that were used included: (1) digital; (2) interventions; (3) students; (4) mental health; and (5) COVID-19. The keywords were expanded, using the search terms outlined in Appendix A. The same search strategy was applied in all seven databases.

### **3.7. Method of review**

The retrieval strategy was adapted from the Preferred Reporting Items for Systematic Reviews and Meta-Analyses [PRISMA] (Moher et al., 2009), which depicts the levels of review, as well as the accompanying operational steps, namely, identification, screening, eligibility and inclusion. In this current study, three phases were used to identify appropriate studies to include. The three phases were: (a) screening the titles of the records identified from the search strategy; (b) screening abstracts for eligibility; and (c) a review of the full texts for inclusion in the study. At each point, studies that did not meet the inclusion criteria were eliminated, while duplicates were manually sought and removed. This process was tracked, using a tracking sheet (Appendix B).

To establish the reliability of eligible studies at the full text stage, a random selection of 10% of the full texts was screened by the primary researcher (ZK) and a Master's graduate (LP). The results pertaining to inclusion and exclusion were discussed by the researcher and the graduate. Any disputes and disagreements about the eligibility and inclusion of the studies were discussed until consensus was reached, regarding whether articles should be included or not. When consensus was not reached, the research supervisor was consulted to reach a decision.

In total, 292 154 titles were identified. After the removal of the duplicates (n=89), 292 065 title records were screened, and the titles that did not meet the inclusion criteria were excluded. This screening process resulted in 128 abstracts being eligible for phase 2 (abstract review). A total of 60 full-text articles were deemed eligible; however, only 11 of these studies met the inclusion criteria. The 49 studies were excluded because, (a) they did not meet the methodological rigour

required for this study, (b) they were intervention protocols, not intervention studies, and (c) the article was published during the pandemic, but the intervention was implemented before the pandemic; therefore, the focus was on interventions for students during the COVID-19 pandemic. The flow diagram of the review process described, is depicted in Figure 3.1.

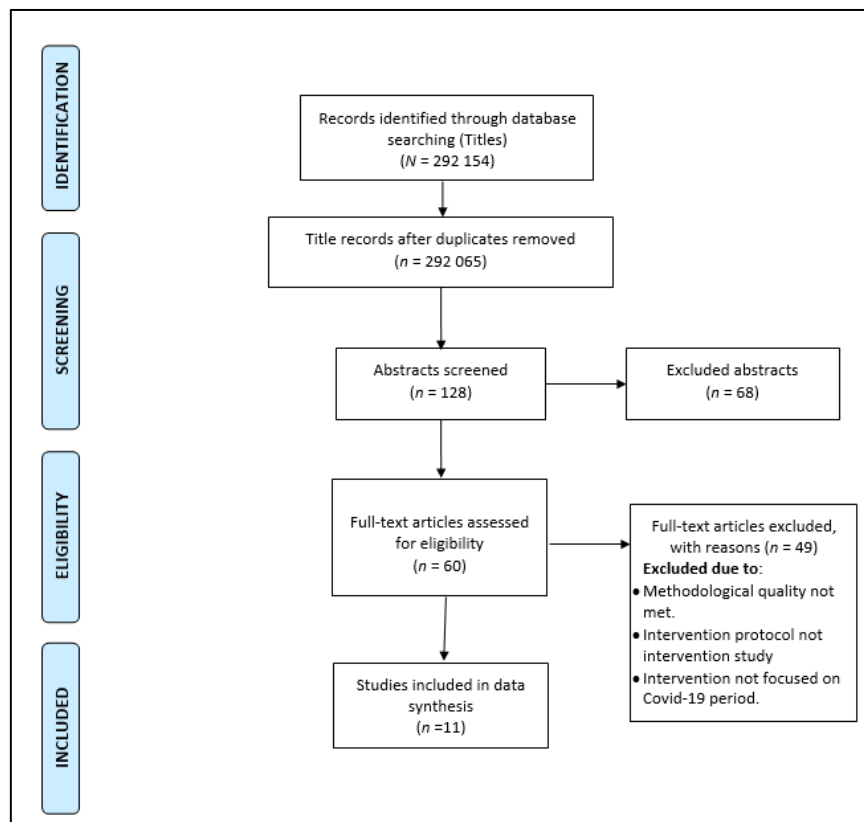


Figure 3.1: PRISMA flow diagram illustrating the review process

### 3.8. Quality assessment

All studies, meeting the inclusion criteria, underwent a quality assessment, using the adapted RE-AIM framework appraisal tool (Appendix C). The RE-AIM critical appraisal tool was used because the intention was to extract and synthesise the RE-AIM (reach, efficacy, adoption, implementation, and maintenance) properties from the included full text studies. The *reach* of the intervention referred to the intended target population. More specifically, it focused on the number of participants, who they were, and the representativeness of individuals who participated in the intervention. *Effectiveness* focused on assessing whether, or not, the intervention achieved its desired outcomes. *Adoption* was the extent to which the target staff, venues, or organisations adopted the intervention. *Implementation* focused on how the intervention was delivered, the cost factors, consistency, and adaption of the protocol in practice. Lastly, the *maintenance* of the intervention focused on the intervention effects on

individuals, or settings over time, for example, six months, or a year (Matthews et al., 2014). RE-AIM is a method to assess the sustainability and efficacy of interventions (Glasgow et al., 1999). Using the content of the manuscripts, the quality of the studies was rated by means of a percentage score on the five dimensions of the RE-AIM framework.

Meline (2006, p. 25) asserts that using a “threshold approach” guarantees a minimum level of quality. Each component of the study was assessed according to the guidelines of the quality assessment tool (Glasgow, 2006; Glasgow et al., 1999), and awarded a composite percentage, indicating its methodological rigor, and overall quality. The studies were classified into categories, based on their score: strong (67 - 100%); moderate (34 - 66%); and weak (0 - 33%) (Glasgow, 2006). Within this current study, ten (10) studies had a moderate score, and eleven (11) had a strong score. Studies with a strong score were included in this study, to ensure that the best available evidence, from which informed decisions could be made, are included (Glanville & McCool, 2009). The methodological quality of the included studies is described in Table 3.1.

### **3.9. Data extraction**

Data extraction allows for the procurement of pertinent information about the included studies, in terms of the characteristics of each study, in a concise and consistent manner. Data extraction helps to make the process efficient, while reducing the risk of errors and bias (Taylor et al., 2021). As advised by Armstrong et al. (2011), a Microsoft Excel spreadsheet was used during the extraction of the data. Data from the included studies were extracted and placed into a data extraction tool (Appendix D1 and Appendix D2) that was developed prior to the search, as well as piloted on a 30% random sample (moderate quality articles) of the final total sample, before the data extraction process. No adaptations were required.

The following data were extracted: author; year; country; study design; objective of the study; digital platform; reach (sample details and recruitment); effectiveness (reported efficacy of the study); adoption (setting, consultations, stakeholders); implementation (details about the intervention and its implementation); and maintenance (follow up as well as short term and long-term maintenance of the results, namely, >6 months). The extracted data on the self-constructed data sheet, as well as an in-depth account of the data is presented and discussed in Chapter four.

**Table 3.1: Methodological Quality of Studies**

No	Author and Year	REACH					EFFICACY					ADOPTION					IMPLEMENTATION					MAINTENANCE					Score out of 25	% Score	Score Category
		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24	Q25			
1	Ang et al., 2022	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	1	0	0	0	0	0	17	68	Strong	
2	Boyd & Alexander, 2022	1	1	1	1	0	1	1	1	1	1	1	1	1	0	1	1	1	0	1	0	1	0	0	1	19	76	Strong	
3	Chu et al., 2022	1	1	1	1	0	1	1	1	0	1	1	0	1	1	0	1	1	1	0	0	1	1	0	1	17	68	Strong	
4	Elgzar et al., 2020	1	0	0	0	0	1	1	1	0	1	1	1	0	0	1	1	1	0	1	0	0	1	0	0	13	52	Moderate	
5	Friedman et al., 2022	1	1	1	1	0	1	1	1	0	0	1	1	1	1	0	1	1	1	1	0	0	1	1	1	1	19	76	Strong
6	Hanani et al., 2022	1	1	1	1	0	1	1	0	0	0	1	1	0	1	0	1	1	1	1	0	0	1	0	0	1	15	60	Moderate
7	Karampas et al., 2022	1	0	1	0	0	1	1	0	1	1	1	1	0	1	0	1	0	1	0	0	0	1	0	0	1	13	52	Moderate
8	King et al., 2022	1	0	1	1	0	0	1	1	1	1	1	1	1	0	1	1	0	1	0	1	1	1	1	0	1	18	72	Strong
9	Lau et al., 2023	1	1	1	1	0	1	1	1	1	1	1	1	0	0	1	0	1	0	0	0	1	1	1	1	1	18	72	Strong
10	Ierardi et al., 2022	1	0	1	0	0	1	1	0	0	0	1	1	0	1	0	1	1	0	1	0	0	0	0	0	0	10	40	Moderate
11	Liu et al., 2021	1	0	1	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1	0	0	1	1	0	0	1	18	72	Strong
12	Nardi et al., 2022	1	1	1	1	0	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	1	1	0	1	20	80	Strong
13	Pagnini et al., 2021	1	0	1	1	0	1	1	1	0	0	1	1	1	1	0	1	1	1	0	1	0	0	0	0	0	14	56	Moderate
14	Philippot et al., 2022	1	1	1	1	0	0	1	1	1	1	1	0	0	0	0	1	1	1	1	0	0	0	0	0	0	12	48	Moderate
15	Rackoff et al., 2022	1	0	1	1	0	1	1	1	0	0	1	1	1	1	0	1	1	1	1	0	0	1	0	0	1	16	64	Moderate
16	Rizvi et al., 2022	1	1	1	1	0	1	1	1	1	1	1	1	1	0	1	0	1	1	1	0	0	0	0	0	0	16	64	Moderate
17	Shabahang et al., 2021	1	1	1	1	0	1	1	1	0	0	1	1	1	0	0	1	1	1	1	1	0	0	0	0	0	15	60	Moderate
18	Simonsson et al., 2021	1	0	1	1	0	1	1	1	0	0	1	1	1	1	0	1	1	1	1	0	0	1	1	0	1	17	68	Strong
19	Strehli et al., 2022	1	0	1	1	0	1	1	1	0	1	1	1	1	1	0	1	1	1	1	1	0	0	0	0	0	16	64	Moderate
20	Sun et al., 2022	1	1	1	1	0	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	1	1	1	1	22	.88	Strong
21	Tay et al., 2022	1	1	1	1	0	1	1	1	1	1	1	1	1	0	1	1	1	1	1	0	0	1	1	1	1	21	.84	Strong

Key

**1 - Yes 2-No**

0-33: Weak

34-66: Moderate

67-100: Strong

- Q1 Does the article indicate who the intervention is intended for (inclusion criteria)?
- Q2 Does the article report on exclusion criteria?
- Q3 Does the article report on the representativeness of the target population? (gender)?
- Q4 Does the article report on participation rate?
- Q5 Are there reports on indirect beneficiaries?
- Q6 Did the intervention achieve the intended objectives?
- Q7 Does the article report on the limitations of the intervention?
- Q8 Are there reports of attrition (no. of people who completed the programme)?
- Q9 Does the article include recommendations to improve the intervention?
- Q10 Does the article include recommendations for practice?
- Q11 Is the setting described in terms of country and place of intervention (e.g. Play Store, IStore etc)?
- Q12 Is the context described (web based, mobile phone etc.)?
- Q13 Is reference made to how accessible the place of intervention was to the participants (for example, their school, local clinic etc.)?
- Q14 Are there reports on the adoption of the intervention by the participants (for example, were they open to the intervention, resistant etc.)?
- Q15 Are there reports on consultation or partnering with community/school/family/other stakeholders prior to the intervention?
- Q16 Are there reports of resources required to conduct the intervention?
- Q17 Are there reports of who did the intervention (social worker, teacher etc.)?
- Q18 Is the duration and frequency of the intervention described?
- Q19 Is training or experience required to implement the intervention?
- Q20 Did participants evaluate the intervention?
- Q21 Does the article report on long term effects of the intervention (after 6 months)
- Q22 Does the article report on indicators used for intervention follow-up?
- Q23 Are there reports on the attrition rates (number of those completed the intervention vs. number that participated in the follow up)?
- Q24 Are there reports on relapse?
- Q25 Is the method of follow up indicated (telephone calls, interviews, questionnaire etc.)?

### **3.10. Data analysis**

The data were analysed, using narrative synthesis within the RE-AIM framework. The data were described in terms of the reach, efficacy, adoption, implementation and maintenance aspects. Narrative synthesis allows for the combination of findings from numerous studies. This form of analysis relies mainly on the use of words and texts, to summarise findings (Popay et al., 2006). Once all the results were presented and analysed, the researcher identified and compared the different elements of each study, in accordance with the RE-AIM framework, in order to address the review questions.

### **3.11. Ethical considerations**

Permission to conduct this systematic review was obtained from the Humanities and Social Sciences Research Ethics Committee (HSSREC) of the University of the Western Cape (Appendix E), reference number HS23/4/16. The researcher ensured that the integrity of the study was maintained, by following all the steps of a systematic review, and appropriately referencing all the articles. The primary researcher is a registered MPsych student at the institution, who had full access to the databases identified in the search strategy; therefore, all the studies were available to be downloaded legally, as they were within the library's resources (Suri, 2020). All the steps to maintain the integrity of this current study were followed by the researcher, through the avoidance of misconduct and plagiarism (Wager & Wiffen, 2011). Systematic reviews are available in the public domain, thereby, ensuring transparency (Suri, 2020; Wager & Wiffen, 2011). All research related materials will be kept for a minimum of five years, and all the data have been stored in a file on a password protected computer.

### **3.12. Conclusion**

In this chapter, the researcher discussed the methodology employed in this current study. The researcher provided insight into the overall process of collecting the data, and ensured that ethical procedures were considered. An overview of the aim, objectives, and review questions was provided, and the process of how the aim, objectives, and review questions will be met was outlined, through the identification, inclusion, and analysis of eligible peer reviewed studies. In the following chapter, the researcher provides the results of the study.

## CHAPTER FOUR

### RESULTS AND DISCUSSION

#### 4.1. Introduction

In this chapter, the researcher provides a descriptive account of the findings, while comparing and contrasting them with the existing literature. The results are presented, using the RE-AIM framework, to understand the properties of the included studies in this current systematic review. Additionally, the researcher describes the characteristics of the study, and discusses the themes, focused on the reach, efficacy, adoption, implementation, and maintenance of the interventions described in the included studies.

The themes will also be discussed in relation to the research objectives, which are to: (1) identify digital mental health interventions for students during the COVID-19 pandemic; (2) describe the REAIM characteristics of these digital mental health interventions for students during the COVID-19 pandemic; (3) describe the effectiveness of digital mental health interventions for students during the COVID-19 pandemic; and (4) provide recommendations for the implementation of digital mental health interventions, in the context of societal crisis.

#### 4.2. Characteristics of the studies

The characteristics of the eleven (11) included studies focuses on the year of publication, aim of the study, study design, digital platform, and the name of the intervention. The interventions were predominantly published in the years, 2021 (18%), and 2022 (72%). Most of the studies emanated from the United States of America (36%), followed by China (18%), and Singapore (18%). The remainder of the studies were from South Africa (9%), Hong Kong (9%), and the United Kingdom (9%).

Ten (10) studies were dedicated to assessing the effectiveness of the intervention, while one study delved into the lived experiences of the participants involved in the intervention, considering their suggestions for its enhancement. The following study designs were employed: qualitative (18%); randomised control trails (64%); pre-test post-test (9%); and a quasi-experiential design (9%). A significant portion of mental health interventions for students

were conducted through digital platforms. Most of these studies, approximately 36%, predominantly utilised Zoom, a video conferencing platform, for their virtual sessions. Zoom's features, such as video conferencing and screen sharing, facilitated interactive and engaging sessions, making it a preferred choice for many interventions (Hidayat et al., 2022).

In addition to Zoom, a variety of other digital platforms were employed, for example, LumiNus, an online learning platform at the National University of Singapore (NUS, 2019), was notable for its integration in educational environments, which possibly made it a familiar and accessible option for student-focused interventions. The Headspace mobile phone application (Chu et al., 2022), renowned for its mindfulness and meditation resources, was also utilised, offering guided practices to enhance mental wellbeing. YouTube (Lau et al., 2023) served as a versatile platform, providing a wide array of content ranging from instructional videos to relaxation techniques, making it a useful resource in diverse mental health interventions. WeChat's messaging and social features (Sun et al., 2022) allowed for continuous support and communication, making it a suitable choice for interventions requiring regular interaction and community building. Each intervention had a distinctive name that was specific to its focus, for instance, the Resilience Skill Enhancement programme [RISE] (Ang et al., 2022) was aimed at bolstering resilience, while WeActive and WeMindful (Friedman et al., 2022) were centred on promoting exercise and mindfulness, respectively. Similarly, Brief Repeated Virtual Nature Contact (Lau et al., 2023) was designed to provide exposure to nature, as a form of intervention.

The interventions focused on building resilience (Ang et al., 2022), mindful based interventions (Boyd & Alexander, 2022; Chu et al., 2022; Liu et al., 2021; Sun et al., 2022), improving exercise (Friedman et al., 2022), accessing mental health support (King et al., 2022), exposure to nature as a form of meditation (Lau et al., 2023), and psychoeducation on depression and anxiety (Tay et al., 2022). Included in most of the interventions was the desire to improve self-care and emotional regulation, as well as provide stress reduction techniques (Boyd & Alexander, 2022; Chu et al., 2022; Friedman et al., 2022; King et al., 2022; Lau et al., 2023; Nardi et al., 2022; Simonsson et al., 2021; Sun et al., 2022; Tay et al., 2022). Since the pandemic was rife during the time of the interventions, emphasis was placed on including messages that would educate students on how to keep safe and healthy during the pandemic (Friedman et al., 2022; Nardi et al., 2022; Sun et al., 2022; Tay et al., 2022).

The value of these type of interventions were highlighted by many scholars, thereby, affirming that building resilience, providing psychoeducation, teaching mindfulness practices, using nature and physical activity, as well as developing emotional regulation strategies, were important interventions during the pandemic, to assist students to navigate this difficult period (Lackey et al., 2021; Philippe et al., 2021; Zapata-Ospina et al., 2021). Efforts to build resilience helped the participants to gain more confidence, develop pandemic self-efficacy, address interpersonal problems better, develop coping strategies, find ways to adjust to the new situation, take responsibility, and focus more on factualism and spirituality (Soklaridis et al., 2020). Since mindfulness promotes awareness and metacognition, rumination decreases because of the disengagement from persistent negative cognitive activities. This helps to reduce stress and improve psychological wellbeing (Philippe et al., 2021).

The interventions in the current review were delivered, using an array of activities, via the various platforms, namely, Zoom, LumiNus, WeChat, YouTube, among others. The activities included videos, reading material, quizzes, relaxation activities, guided meditation, counselling, referrals to mental health professionals, monitoring vitals (heart rate, blood pressure), yoga, journaling, discussions, and reflections (Ang et al., 2022, Boyd & Alexander, 2022, Chu et al., 2022 , Friedman et al., 2022, King et al., 2022, Lau et al., 2023, Liu et al., 2021, Nardi et al., 2022, Simonsson et al., 2021, Sun et al., 2022, Tay et al., 2022). Having a diverse range of activities could cater to the multifaceted nature of mental wellbeing, and accommodate different preferences and needs among users. It offers a holistic and personalized approach to mental health support (Liverpool et al., 2020). Providing a variety of activity options encourages engagement and accessibility for a broader audience, making digital mental health interventions more inclusive and effective (Garrido et al., 2019).

The characteristics of each included study are presented in Table 4.1, followed by Table 4.2, which describes the RE-AIM properties of the included studies.

**Table 4.1: Characteristics of included studies**

No	Author & Year	Country	Aim of study	Study Design	Digital Platform	Name of Intervention
1	Ang et al., 2022	Singapore	Examine the effectiveness of the RISE programme by exploring students' experience of synchronous and asynchronous versions of a digital resilience training programme.	Qualitative study that formed part of a larger randomised control trial (RCT)	University's online learning platform LumiNUS and synchronous communication software Zoom	Resilience Skill Enhancement (RISE) Programme
2	Boyd & Alexander, 2022	South Africa	Explore whether medical students, attending an online mindfulness-based intervention (MBI), would show improved resilience and stress management, compared with attendance at an online supportive counselling (SC) programme. Secondary to this was the viability of the intervention according to participants' experiences.	Mixed-method randomised controlled design	Zoom	Online mindfulness-based intervention (MBI)
3	Chu et al., 2022	United States	Evaluate the effectiveness of daily use of a mindfulness mobile application, in improving student pharmacists' perceived stress, burnout, and mindfulness.	Randomised, longitudinal, waitlist-controlled trial	Mobile Application - Downloadable from an app store	Headspace
4	Friedman et al., 2022	United States	Examine the immediate and short-term effects of aerobic and resistance training (WeActive), and mindful exercise (WeMindful) virtual interventions, in improving physical activity (PA) and resilience among college students.	A quasi-experimental design was used to assign the participants to one of the two intervention groups: WeActive or WeMindful	Zoom	WeActive (aerobic and resistance training) and WeMindful (mindfulness training)
5	King et al., 2022	United States	Examining the efficacy of Electronic Bridge to Mental Health for College Students (eBridge) for increasing at-risk students' linkage to mental health services.	Randomised control	Secure online portal	eBridge
6	Lau et al., 2023	Hong Kong	Examining the effectiveness of a 3-week virtual nature contact. in improving nature connectedness and reducing psychophysiological stress.	Virtual experience-based pre-test-post-test intervention with a control group	15-min YouTube video to deliver the virtual experience	Brief Repeated Virtual Nature Contact
7	Liu et al., 2021	China	Examined the effectiveness of a web-based positive psychology intervention (PPI).	Randomised control trial	Web-based platform	Positive Psychology Intervention (PPI)
8	Nardi et al., 2022	Rhode Island, United States	Explore the lived experiences of undergraduates in a mindfulness-based programme at a "college of opportunity" that has high proportions of first-generation college students. Specifically, the aim was to: (1) explore the application of mindfulness practices in students' daily lives; (2) explore how participants believe mindfulness training affected their health and wellbeing; (3) learn participants' recommendations and suggested changes for mindfulness-based interventions in future iterations.	Qualitative Study	Zoom	Mindfulness-based College (MBC) programme
9	Simonsson et al., 2021	United Kingdom	Investigated whether an eight-week, online mindfulness programme impacted symptoms of anxiety and depression among students at the University of Oxford.	Randomised waitlist control design	Zoom	Mindfulness intervention
10	Sun et al., 2022	China	<u>Aims of this randomised controlled trial were threefold.</u> <ul style="list-style-type: none"> <li>• Firstly, the primary aim was to examine the effectiveness of a mindfulness-based mHealth intervention, in reducing symptoms of anxiety and depression for young adults in quarantine, compared to a rigorous active control (social support mHealth).</li> <li>• Secondly, to examine emotional suppression, a culturally-relevant emotion regulation strategy, as a potential intervention mediator.</li> <li>• The thirdly, to evaluate the feasibility and acceptability of the mindfulness mHealth in comparison to social support mHealth.</li> </ul>	Randomised control trial	First, videoconferencing via Zoom was used to provide weekly one-hour meetings for experiential and group learning of mindfulness. Second, a WeChat-based mini-programme was developed for (a) didactic learning regarding mindfulness, and (b) audio-based daily practice. As a ubiquitous communication tool, WeChat offers the potential for scalability, multiple interactive features, and capacity for rapid, affordable development of mini-programmes embedded within the app.	A mindfulness-based mobile health (mHealth) intervention- Mindfulness for Growth and Resilience
11	Tay et al., 2022	Singapore	Evaluate the effectiveness of the newly developed HOPE intervention in improving depression literacy, anxiety literacy, psychological wellbeing, and reducing personal stigma, as well as stress levels among young adults at a university in Singapore.	Two-armed, parallel, randomised controlled trial	Information and Communication Technologies (ICT) for Mental Health Prevention and Social Media	HOPE

**Table 4.2: RE-AIM properties of the included studies**

<b>REACH</b> Target Population, inclusion, exclusion, recruitment, participation rate	<b>EFFICACY</b> Meeting intended objectives, attrition, limitations, recommendations	<b>ADOPTION</b> Setting, consultation, participant feedback and adoption by participants	<b>IMPLEMENTATION</b> Nature of intervention, interventionalist and training of interventionalist	<b>MAINTENANCE (6 MONTHS)</b> Follow up and reports of relapse
<b>1. Ang et al., 2022</b>				
<b>Reach</b>	<p><b>Target population</b></p> <ul style="list-style-type: none"> <li>Undergraduate and postgraduate university students</li> </ul> <p><b>Participant details</b></p> <ul style="list-style-type: none"> <li>Female (58.2%)</li> <li>Ethnic Chinese (88.23%)</li> <li>Age range: 19-38; Mean age 22.53</li> </ul> <p><b>Inclusion criteria</b></p> <ul style="list-style-type: none"> <li>18 years and older</li> <li>Full time undergraduate studies</li> <li>Able to comprehend English</li> <li>No self-reported mental disorders</li> <li>Complete the Rise programme</li> </ul> <p><b>Participant rate</b></p> <ul style="list-style-type: none"> <li>58 (Group A) 56 (Group B)</li> <li>9 (Group A) 8 (Group B) – interview post intervention</li> </ul>			
<b>Efficacy</b>	<p><b>Efficacy</b></p> <ul style="list-style-type: none"> <li>Completion rate: 85%</li> <li>The thematic analysis unveiled four themes (embarking on a journey toward resilience, discovering strategies to develop resilience, finding a balance to benefit from resilience skill enhancement, and instilling resilience in the everyday) that highlighted how the implementation of RISE, its casual mechanisms, and contextual factors positively influenced students' resilience.</li> </ul> <p><b>Limitations</b></p> <ul style="list-style-type: none"> <li>Limited to one university in Singapore</li> <li>Limited participation; therefore, findings may not be representative of all participants.</li> <li>Students' insights are limited to one resilience training programme, so the findings may not be transferable to other resilience programmes.</li> </ul> <p><b>Recommendations</b></p> <ul style="list-style-type: none"> <li>Interventions should be interactive or increase engagement through videos by embedding gamification.</li> <li>Educators need to review the number of materials that students are required to review.</li> <li>Offer mental wellness programmes as electives with credits for students to fully immerse themselves in the programme.</li> <li>Make tasks optional to reduce burden on students.</li> </ul>			
<b>Adoption</b>	<p><b>Setting</b></p> <ul style="list-style-type: none"> <li>Online platform - Zoom and LumiNUS</li> </ul> <p><b>Consultation</b></p> <ul style="list-style-type: none"> <li>No stakeholder consultation, but the authors consulted resilience theory and the transactional model of stress and coping. This contributed to the content development. Systematic reviews were done to generate evidence, in order to develop the design of the programme and the development of resilience-enhancing strategies. A qualitative study, using a user-centred approach was conducted to provide the contextual information (included students' suggestions for resilience-enhancing strategies and preference for receiving resilience training) for the programme RISE.</li> </ul> <p><b>Participant feedback</b></p> <ul style="list-style-type: none"> <li>Students appreciated the contextually relevant content and the availability of various learning engagement tools.</li> <li>Students also credited the RISE programme for the provision of clear and practical techniques that allow them to enhance their resilience.</li> <li>However, some students experienced inertia and competing priorities that limited their participation.</li> </ul> <p><b>Adoption by participants</b></p> <ul style="list-style-type: none"> <li>Given that the intervention was delivered solely via a digital platform, students verbalised poorer engagement with the RISE programme.</li> </ul>			
<b>Implementation</b>	<p><b>Interventionalist and training</b></p> <ul style="list-style-type: none"> <li>Not specified</li> </ul>			

	<p><b>Intervention</b></p> <ul style="list-style-type: none"> <li>• <b>Experimental Group A:</b> Six-week training on any device that could be connected to the Internet.</li> <li>• Each week featured a different topic relating to building students' resilience.</li> <li>• Each week, participants had access to educational materials in the form of videos and reading materials. A programme guide, including the schedule, helplines, and take-home tasks, ranging from reflective practices to practical exercises and quizzes, relating to that week's topic, was provided to reinforce students' learning.</li> <li>• Three virtual face-to-face discussions were conducted over Zoom, and a forum was made available to facilitate discussions.</li> <li>• <b>Experimental Group B</b> only had access to the videos. The contents of the materials were the same in both groups.</li> </ul>
Maintenance	<ul style="list-style-type: none"> <li>• Not Specified</li> </ul>
<b>2. Boyd &amp; Alexander, 2022</b>	
Reach	<p><b>Target population</b></p> <ul style="list-style-type: none"> <li>• Year 2-6 MbChB Students</li> </ul> <p><b>Inclusion criteria</b></p> <ul style="list-style-type: none"> <li>• 18 years and older</li> <li>• Willingness to attend 5 of 6 weekly online sessions</li> <li>• Willingness to complete 10-15 min of daily home practice</li> <li>• Access to internet and laptop</li> </ul> <p><b>Exclusion criteria</b></p> <ul style="list-style-type: none"> <li>• Mental Health Condition</li> </ul> <p><b>Recruitment</b></p> <ul style="list-style-type: none"> <li>• Flyer via email</li> <li>• Class group Whatsapp</li> <li>• 3X online Zoom information sessions. Interested students contacted the researcher for more information.</li> <li>• Pre-assessment to determine eligibility.</li> </ul> <p><b>Participant rate</b></p> <ul style="list-style-type: none"> <li>• 45 students were recruited to allow for attrition.</li> </ul>
Efficacy	<p><b>Efficacy</b></p> <ul style="list-style-type: none"> <li>• The results revealed significant improvement in both groups' wellbeing (<math>p &lt; 0.001</math>), as well as how they perceived and managed stress (<math>p &lt; 0.001</math>). A statistically significant difference between participants in mindfulness (<math>p = 0.045</math>) reflected this changed stress management post-course.</li> <li>• Qualitative data indicated that the participants had begun to learn to adopt a metacognitive awareness, in response to stress.</li> </ul> <p><b>Attrition</b></p> <ul style="list-style-type: none"> <li>• 45 students consented to participate in the study. Five participants self-withdrew because of ill health and internet connectivity constraints. Thirty-eight participants (age range 19–30 years) completed the programmes and all measures.</li> </ul> <p><b>Limitations</b></p> <ul style="list-style-type: none"> <li>• Exclusion of participants, due to lack of data or connectivity challenges</li> <li>• Under-representation of Year 3 participants</li> <li>• Over-representation of women participants</li> <li>• Small sample size; therefore, limits to generalisability of results</li> <li>• First author had a dual role (researcher and the facilitator). This may have unintentionally affected the programme results.</li> </ul> <p><b>Recommendations</b></p> <ul style="list-style-type: none"> <li>• A programme of wellbeing enhancement for all medical students is recommended. It could be provided within the curriculum, or as an extramural, or through Campus Health services, to increase access to psychological support.</li> <li>• Include booster sessions, post-programme, to maintain benefits.</li> <li>• Have a suitably qualified mindfulness teacher with appropriate experience.</li> </ul>
	<p><b>Setting</b></p> <ul style="list-style-type: none"> <li>• Zoom</li> </ul>
Implementation	<p><b>Interventionist and trainer</b></p> <ul style="list-style-type: none"> <li>• A registered counsellor who is trained in mindfulness interventions</li> </ul>

	<p><b>Intervention</b></p> <ul style="list-style-type: none"> <li>• 60-min, online programmes</li> <li>• Emailed daily home practice for MBI participants and an offer to provide extra support.</li> <li>• Virtual classroom remained open for 5–10 min post-session, for participants who wished to ask questions, or to seek individual assistance.</li> </ul> <p><b>Mindfulness-based intervention content</b></p> <ul style="list-style-type: none"> <li>• 6-week MBI was adapted from Williams and Penman's 8-week self-help programme.</li> <li>• Theme-based sessions consisted of practices, activities and enquiries.</li> <li>• Early sessions focused on attention to internal and external experiences without judgement.</li> <li>• Shortened practices included body and breath, mindful movement and the body scan.</li> <li>• Practices provided opportunities to recognise mind habits, such as autopilot, mind wandering and dreaming.</li> <li>• Mini meditations introduced the Three Step Breathing Space (3SBS) separately, before including it in its entirety in week 3.</li> <li>• The remaining sessions focused on learning to view thoughts as mental events, with practices like sounds and thoughts and exploring difficulty.</li> <li>• Attitudes of kindness and curiosity for the self (personal experiences) and other people, were encouraged throughout the programme, but were encapsulated within a Loving Kindness meditation in session.</li> </ul> <p><b>Supportive counselling content</b></p> <ul style="list-style-type: none"> <li>• The 6-week SC psychoeducational programme consisted of evidence-based stress reduction techniques used in psychotherapy.</li> <li>• An introduction to stress included the use of a stress wheel and awareness triangle exercises. Thereafter, sessions focused on the role of emotions in heightening stressful experiences in conjunction with the awareness triangle, to explore such experiences</li> <li>• Progressive muscle relaxation, journaling, a communication genogram, and identification of goals and values, are examples of skills.</li> <li>• This took place within an encouraging, supportive environment, where participants reflected on the previous, present and future challenges, in conjunction with psychoeducation and skills' practice.</li> </ul>
<p><b>Maintenance</b></p>	<ul style="list-style-type: none"> <li>• Only had 8-week follow-up, which revealed that an online MBI and a SC programme are both feasible, and show potential for reducing stress, increasing stress management, and increasing resilience. The maintenance of results at 6 months or later was not assessed.</li> </ul>
<p><b>3. Chu et al., 2022</b></p>	
<p><b>Reach</b></p>	<p><b>Target population</b></p> <ul style="list-style-type: none"> <li>• 1<sup>st</sup> and 2<sup>nd</sup> year student pharmacists enrolled in a 3-year accelerated</li> </ul> <p><b>Participant details</b></p> <ul style="list-style-type: none"> <li>• Female and younger than 40</li> </ul> <p><b>Inclusion criteria</b></p> <ul style="list-style-type: none"> <li>• 18 years and older</li> <li>• Current, full time, PharmD students</li> <li>• Ownership of a smartphone</li> <li>• Willingness to download the app</li> <li>• Willingness to be randomised</li> <li>• Fluent in English</li> </ul> <p><b>Exclusion criteria</b></p> <ul style="list-style-type: none"> <li>• Current or recent (within the last 3 months) mindfulness practice for at least 10 minutes per day</li> <li>• Current or recent (within the last 3 months) use of Headspace, or a similar mindfulness mobile application</li> </ul> <p><b>Recruitment</b></p> <ul style="list-style-type: none"> <li>• Via email through class listservs</li> </ul>
<p><b>Efficacy</b></p>	<p><b>Efficacy</b></p> <ul style="list-style-type: none"> <li>• At the end of the intervention period (week 6), the intervention group experienced a decrease in perceived stress, indicated by a significantly lower score on the Perceived Stress Scale, and an increase in mindfulness, indicated by a significantly higher score on the Mindfulness Attention Awareness Scale, compared to the control group. Mindfulness increased steadily over the 10-week period, even though use after the 6-week period was optional, as the study intervention had ended. However, post intervention compliance dropped to 62%.</li> <li>• The use of a mindfulness application is an effective tool to reduce stress in student pharmacists, and this effect persisted, even after use of the application was no longer required.</li> </ul>

	<p><b>Attrition</b></p> <ul style="list-style-type: none"> <li>87 students met the inclusion criteria and were randomised to either the intervention or control group. Of these, a total of 56 participants completed the study. The remainder were lost to follow-up over the 10-week study. This was due to lack of data or non-completion of the baseline survey. Once use of the intervention had begun, attrition rates between the 2 groups were similar, with 6 and 7 participants not completing the study in the intervention and control groups, respectively</li> </ul> <p><b>Limitations</b></p> <ul style="list-style-type: none"> <li>Small sample size and higher proportion of female participants, in relation to national pharmacy graduate demographic</li> <li>Study conducted on several campuses and across different universities; therefore, the institutions' wellbeing efforts may vary at each campus. This may be a confounding bias.</li> <li>Participants may be more aware or interested in meditation practices than the average student, which could have led to potential selection bias.</li> <li>A per-protocol analysis was utilised in this current study, and data were not analysed for participants who did not complete all aspects of the protocol. Therefore, the applicability to scenarios, where students may not be able to set time aside consistently, may be diminished.</li> <li>The study was conducted in 3-year accelerated pharmacy programmes with first- and second-year students, and the results may not be reflective for 4-year pharmacy programmes or for students completing their advanced pharmacy practice experiences.</li> </ul> <p><b>Recommendations</b></p> <ul style="list-style-type: none"> <li>Evaluate the lasting effects of mindfulness practices on stress, burnout, and mindfulness beyond a 10-week period.</li> </ul>
<b>Adoption</b>	<p><b>Setting</b></p> <ul style="list-style-type: none"> <li>Headspace</li> </ul> <p><b>Mitigating dropout</b></p> <ul style="list-style-type: none"> <li>All study participants were incentivised with a free 1-year subscription to Headspace and a \$10 Amazon gift card, for timely completion of all surveys.</li> </ul>
<b>Implementation</b>	<ul style="list-style-type: none"> <li>A 10-week study period was selected to maximise the time between when IRB approval was received and the last day of the semester.</li> </ul> <p><b>Intervention group:</b></p> <ul style="list-style-type: none"> <li>Daily use of Headspace - an audio-guided mindfulness meditation mobile application, on student pharmacists' stress, burnout, and mindfulness.</li> <li>Meditate, using the application for at least 10 minutes a day, throughout the intervention period of 6 weeks.</li> <li>During the follow-up period, from 7 to 10 weeks, continued application use was optional.</li> <li>Emailed a daily survey to assess compliance and to remind them to use the application.</li> </ul> <p><b>Waitlist control group:</b> Asked to abstain from downloading and using the application for the entire 10-week period, but were granted mobile application access ,after the study period was complete.</p>
<b>Maintenance</b>	<ul style="list-style-type: none"> <li>Post assessment occurred after the intervention (6 weeks) and at follow-up (10 weeks). The differences identified at the end of the intervention persisted through to the end of the follow-up period (week 10). This included decreased stress and increased mindfulness. However, during the follow-up period, from week 6 to week 10, when application use was optional, compliance dropped to 62%. This may explain why, statistically, significant lasting effects were not seen at week 10 in the MBI-A and MBI-B. Despite lower application compliance in the follow-up period, significant differences in stress, mindfulness, and the personal achievement aspect of burnout, were maintained between the intervention and control groups. Maintenance of results were not assessed at 6 months or later.</li> </ul>
<b>4. Friedman et al., 2022</b>	
<b>Reach</b>	<p><b>Target population</b></p> <ul style="list-style-type: none"> <li>University Students</li> </ul> <p><b>Participant information</b></p> <ul style="list-style-type: none"> <li>58% were undergraduate students</li> <li>46 of the participants were cisgender female, 5 cisgender male, as well as 4 transgender and gender non-conforming</li> </ul> <p><b>Inclusion criteria</b></p> <ul style="list-style-type: none"> <li>Enrolled at the University of Michigan</li> <li>Written consent prior to participation</li> <li>Physical and mental abilities to engage in the intervention</li> <li>Have device with internet access</li> </ul> <p><b>Exclusion criteria</b></p> <ul style="list-style-type: none"> <li>Under the age of 18,</li> <li>Not able to exercise due to injury or illness</li> </ul> <p><b>Recruitment</b></p> <ul style="list-style-type: none"> <li>Posts on lab Instagram account</li> <li>The bulletin from the School of Kinesiology</li> <li>Canvas dashboard (the learning management system),</li> <li>A targeted email system.</li> </ul> <p><b>Participant rate</b></p> <ul style="list-style-type: none"> <li>77 participants</li> </ul>

<p><b>Efficacy</b></p>	<p><b>Efficacy</b></p> <ul style="list-style-type: none"> <li>There was a significant main effect of time for resilience (<math>F = 3.4.15, p = 0.024</math>), where both the WeActive group, and the WeMindful group, significantly increased the resilience scores from pre-test to follow up (<math>t = -2.74, p = 0.02</math>; <math>t = -2.54, p = 0.04</math>), respectively. For moderate physical activity (MPA), there was a significant interaction effect of time with group (<math>F = 4.81, p = 0.01, \eta^2 = 0.038</math>), where the WeActive group significantly increased moderate physical activity (MPA) over time, from pre-test to follow-up test, as compared to the WeMindful group (<math>t = -2.6, p = 0.033</math>). Only the WeActive intervention was effective in increasing MPA. Both interventions were effective in increasing resilience, from pre-test to 6-week follow up. The WeActive group showed an increase in total physical activity (TPA) at each time point, although not reaching a significant level; however, the WeMindful group saw an initial increase, and then a decrease in TPA. In relation to intensity, the WeActive group increased vigorous physical activity (VPA) significantly from pre-test to post-test, and Moderate Physical Activity (MPA) from pre-test to follow up. The WeMindful group did not show any significant changes in VPA and MPA at any time point. However, the WeMindful group saw an initial non-significant increase in walking physical activity (PA), from pre-test to post-test, followed by a significant decrease, from post-test to follow up. The WeActive group did not show any significant changes in walking PA at any time point.</li> </ul> <p><b>Attrition</b></p> <ul style="list-style-type: none"> <li>A total of 77 participants completed the intervention. Of the 77 participants, 57 participants completed the follow up questionnaire. Two participants were excluded due to missing outcome variable data.</li> </ul> <p><b>Limitations</b></p> <ul style="list-style-type: none"> <li>Virtual setting: Participants muted their sound and camera throughout the WeActive and WeMindful sessions; therefore, the instructors were unable to answer questions, or check the physical form. It was also difficult to assess engagement accuracy. Participants were allowed to complete the second session, asynchronously, each week and self-report completion. This implies the engagement rate could be subject to self-report bias. Along with the engagement rate, PA and resilience were both measured through a self-report questionnaire, which could be affected by self-report bias. COVID-19 stressors may have affected their perceived resilience. While the intervention, being held during a pandemic, allows for a snapshot in time, it could be less generalisable to a post-pandemic situation. Lack of diversity in participants (84% cisgender and 65% white).</li> </ul> <p><b>Recommendations</b></p> <ul style="list-style-type: none"> <li>Inform university authorities to increase access to mindfulness resources, as well as aerobic and resistance exercises, to increase the resilience of their student population. Further research should be conducted on the ways in which the student's race influences exercise intervention effects.</li> </ul>
<p><b>Adoption</b></p>	<p><b>Setting</b></p> <ul style="list-style-type: none"> <li>Zoom and Canvas Dashboard</li> </ul>
<p><b>Implementation</b></p>	<p><b>Interventionist and trainer</b></p> <ul style="list-style-type: none"> <li>Fitness instructor</li> </ul> <p><b>Intervention conditions</b></p> <ul style="list-style-type: none"> <li>Both WeMindful and WeActive groups attended two live and two pre-recorded, 30-minute exercise sessions per week, over the course of eight weeks. Additionally, lesson plans were posted on Canvas for participants who would rather follow along than watch a recorded video. It was recommended to do it with peers safely. Each week, an announcement was sent through Canvas, reminding participants of the exercise session times, and providing positive reinforcement, such as "Keep up the good work" and "Don't forget why you started".</li> </ul> <p><b>WeActive</b></p> <ul style="list-style-type: none"> <li>Lessons focused on aerobic and strength training exercises.</li> <li>Structured five-twenty-five-minute teaching format. Five minutes at the beginning and end were dedicated to warm up and cooldown, respectively.</li> <li>During the warmup, participants engaged in various walking patterns, in the first four weeks, and then high-impact aerobics movements in the last four weeks, and dynamic stretches. The cool down focused on static stretches, and ended with a summary review of the lesson. During the main twenty minutes of the session, the participants engaged in strength exercises, through a circuit format. The strength training was focused on a mix of both muscular strength and endurance. The instructor had two circuits for each lesson. The instructor started with easier exercises earlier in the intervention, and slightly progressed as intervention continued. The student-instructor first explained verbally and physically demonstrated the exercise, including modifications. Subsequently, participants were led to perform the exercise or accommodated movement. The instructor provided cues on proper forms of the exercise and motivation throughout the lesson.</li> </ul> <p><b>WeMindful:</b></p> <ul style="list-style-type: none"> <li>Lessons were mixed types of mindfulness-based yoga exercises. Physical exertion, intentional attention, and proprioception were emphasised.</li> <li>Structured lesson format for teaching each lesson; for example, each lesson started with a five-minute mindful warm up (e.g. body scan), with short-term goal setting. When the warmup movements ended, the participants were instructed to take deep breaths and set a goal for the session to come.</li> <li>The main session of the lesson consisted of 4–6 new beginner yoga poses and a review of the past week's poses.</li> <li>When teaching most poses, the instructors provided recommended accommodations to increase accessibility.</li> <li>After learning each pose, the facilitator taught the participants to put the poses together into a flow. Throughout the flow, the instructor cued participants through cadenced breath, namely, breathing in during the pose and out during the transition.</li> <li>Additionally, cues included engaging in the moment, being aware of the body, and breath.</li> <li>At the conclusion of the session, a five-minute mindfulness script was presented. The script often focused on breath, winding down, and positive reinforcement.</li> <li>During weeks 1–3 and 5–7, the participants learned new poses and flows. These poses and flows were then reviewed at the midterm session (week 4) and final session (week 8).</li> </ul>

	<p><b>Peer coaching for both groups</b></p> <ul style="list-style-type: none"> <li>• The session volume included one session every two weeks for 30 min.</li> <li>• The objective of peer coaching was to aid the participants in goal setting, facilitate virtual social interactions, and encourage reflection of progress.</li> <li>• In Zoom sessions, participants spoke out loud and discussed obstacles and coping mechanisms, perspectives of the exercise sessions and suggestions for future lessons. In addition to the Zoom sessions, the participants engaged with journal prompts to reflect independently on their progress, goals, and general feelings throughout the intervention.</li> <li>• All materials were posted on the intervention study website.</li> </ul>
<p><b>Maintenance</b></p>	<ul style="list-style-type: none"> <li>• Follow up was 6 weeks after the intervention.</li> <li>• 6 weeks after the intervention (follow up) resilience scores increased from pre-test to follow up.</li> <li>• For moderate physical activity (MPA), the WeActive group significantly increased MPA over time, from pre-test to follow-up test, as compared to the WeMindful group.</li> <li>• Only the WeActive intervention was effective in increasing MPA.</li> <li>• Both interventions were effective in increasing resilience from pre-test to 6-week follow up. Maintenance of results were not assessed at 6 months or later.</li> </ul>
<p><b>5. King et al., 2022</b></p>	
<p><b>Reach</b></p>	<p><b>Target population</b></p> <ul style="list-style-type: none"> <li>• University students</li> </ul> <p><b>Inclusion criteria</b></p> <ul style="list-style-type: none"> <li>• 18 years or older</li> <li>• Enrolment in a degree-seeking programme</li> <li>• Domestic resident (not from abroad)</li> <li>• More than one semester from graduation.</li> </ul> <p><b>Participant data</b></p> <ul style="list-style-type: none"> <li>• 3,363 people were eligible for inclusion in the intervention trial (positive suicide risk, completed baseline survey, and not currently receiving mental health services).</li> <li>• Female (n = 2,088; 62.3%), male (n = 1,171; 34.9%), transgender or genderqueer (n = 95; 2.8%, combined due to low frequency), and missing (n = 9; 0.3%).</li> <li>• White (n = 2,462, 73.2%)</li> <li>• The age range was 18-31+.</li> <li>• Undergraduate students (n = 2,562, 76.2%)</li> </ul>
<p><b>Efficacy</b></p>	<p><b>Efficacy</b></p> <ul style="list-style-type: none"> <li>• There were no significant main effects for eBridge at 6 months for the primary outcome of MH services utilisation (obtaining psychotherapy and/or psychotropic medications).</li> <li>• A total of 807 students (31.6%), including 392 students (31.1%) in the eBridge condition and 415 students (31.9%) in the Control condition, obtained mental health services prior to the 6-month follow-up.</li> <li>• There were no significant eBridge main effects for the secondary outcomes: students' readiness for MH services, MH stigma, depression, alcohol use, suicidal ideation, or suicide attempt.</li> <li>• There was no evidence of significant moderators for the intervention effects; none of the interactions between intervention assignment and moderator variables (2 vs. &gt; 2 positive suicide risk screens, readiness for treatment, gender, and history of multiple suicide attempts) were significant at <math>p &lt; .05</math>.</li> <li>• Since a majority of students in eBridge did not engage with online counselling meaningfully, the outcomes for the subgroup of students assigned to eBridge was examined, based on whether they posted zero, one, two, or more messages to the online counsellor.</li> <li>• Those who posted one message to the online counsellor had 47% greater odds of receiving any MH treatment (psychotherapy and/or psychotropic medications) compared to those in the Control group. Those posting two or more messages had 57% greater odds of receiving any MH treatment, and 72% greater odds of receiving psychotherapy, relative to the Control group. There was no evidence of significant moderators of these intervention effects.</li> </ul> <p>Although a programme that is effective at screening students and linking those at risk to MH services has the potential to help large numbers of vulnerable young adults during a developmental phase, marked by important life transitions, the study findings suggest that it is extremely challenging to engage students in such a programme.</p> <ul style="list-style-type: none"> <li>• eBridge had no effects on the primary outcome (linkage to MH services) or secondary outcomes (improved MH functioning).</li> <li>• However, eBridge was associated with greater linkage to MH services in the subgroup analyses that included only students in the eBridge condition, who engaged in the optional online counselling. Among this subgroup, which may have been inclined toward help-seeking, eBridge seems to have facilitated their decision to seek mental health treatment.</li> </ul> <p><b>Limitations</b></p> <ul style="list-style-type: none"> <li>• Sample was not nationally representative.</li> <li>• Regarding study design, it is possible that the Control condition, which included screening with personal feedback and the presentation of MH resource information on all screening and PF website pages, was beneficial to students, and obscured the differences between intervention groups.</li> <li>• Viewing PF was an option for students in the eBridge condition; however, this necessitated an additional step to view the feedback, which may have created an artificial hurdle and negatively impacted engagement and intervention effects.</li> </ul> <p><b>Recommendations</b></p> <ul style="list-style-type: none"> <li>• Provide PF automatically to students in both conditions, rather than requiring those in the eBridge condition, to actively choose to view this PF.</li> <li>• Identify strategies to facilitate the engagement of students in online interventions and MH services.</li> </ul>

<b>Adoption</b>	<b>Setting</b> <ul style="list-style-type: none"> <li>Online Secure Portal</li> </ul>
<b>Implementation</b>	<b>Interventionalist and training</b> <ul style="list-style-type: none"> <li>Mental Health Professional, who was knowledgeable about local Mental Health resources.</li> <li>eBridge counsellors were at master's or doctoral level mental health professionals and clinicians from counselling centres, clinics, clinical psychologists with faculty appointments, and clinicians in advanced training programmes (postgraduate social work fellows, postdoctoral fellows).</li> <li>eBridge counsellors completed Motivational Interviewing training.</li> </ul> <b>Intervention</b> <b>eBridge intervention</b> <ul style="list-style-type: none"> <li>Two online, Motivational Interviewing (MI)-adherent intervention components: the choice to access their personalised feedback (PF) and the option of confidential counselling, via a secure and confidential online portal, with an MH professional.</li> <li>After the screening survey, they could select to view their PF and/or click on one of three topics ("more about my concerns or my survey feedback," "more about available resources," "other") to begin a confidential exchange with a counsellor. eBridge counsellors focused on facilitating linkage to professional mental health services; they did not provide therapy, specifically targeting students' presenting problems.</li> <li>All communications were online. When one posted a message at the secure online site, the other received an email indicating a message had been posted.</li> <li>eBridge counsellors used MI-consistent messages that were affirming, and supported the students' autonomy.</li> <li>Counsellors also initiated communication with students, who did not click on any of the communication topics listed above, or who became inactive after initiating communications.</li> <li>Counsellors discontinued outreach when two consecutive messages were unanswered by students.</li> </ul> <b>Control condition</b> <ul style="list-style-type: none"> <li>Students were automatically taken to a webpage with their PF information displayed, after completing the online screen (this was not presented as an option), and were not offered the option of online counselling.</li> </ul>
<b>Maintenance</b>	<ul style="list-style-type: none"> <li>Six-month follow-up data were obtained from 79.0% (2,659 of 3,363) of study participants. Follow-up retention did not differ as a function of intervention assignment, <math>\chi^2(1) = 1.17, p = .28</math>. Retention was found to differ; however, by study site <math>\chi^2(3) = 56.11, p &lt; .001</math>, with rates ranging from 72.3% to 87.3%. Men (72.6%) were less likely to participate in the follow-up than women (82.4%) and gender minorities (84.9%), <math>\chi^2(2) = 46.41, p &lt; .001</math>. Similarly, students with higher depression scores at baseline, <math>M(SD) 13.33(5.7)</math> versus <math>12.77(5.6)</math>, <math>t(3,361) = 2.37, p = .018</math>, and students, who reported suicidal ideation in the past month, <math>\chi^2(1) = 4.37, p = .037</math>, were less likely to participate in the follow-up (76.3% vs. 79.8%). There were no differences in retention based on participants' age, race, ethnicity, use of alcohol, past-year suicidal ideation, or history of suicide attempt. Students, who posted messages, did not differ from students in the Control group at 6 months, with respect to other secondary outcomes.</li> </ul>
<b>6. Lau et al., 2023</b>	
<b>Reach</b>	<b>Inclusion criteria</b> <ul style="list-style-type: none"> <li>Full-time students</li> <li>18 years or older</li> <li>Ability to comprehend English</li> </ul> <b>Exclusion criteria</b> <ul style="list-style-type: none"> <li>Self-reported mental illness/disease/taking medicine,</li> <li>Consuming caffeinated drinks or food</li> <li>Consuming alcohol during the weeks of the study.</li> </ul> <b>Recruitment</b> <ul style="list-style-type: none"> <li>Convenience sampling</li> <li>Print advertisements and social media, including the school email network, Facebook, and Instagram, from December 2020 to November 2021.</li> </ul> <b>Participant rate</b> <ul style="list-style-type: none"> <li>56 participants were recruited, 3 dropped out after registration due to other commitments, leaving an eligible sample of 53. The retention rate of the participants by the last week of the intervention was 84.5%.</li> <li>To encourage retention, an incentive of HK\$100 was offered to each participant who completed the study.</li> </ul> <b>Participant data</b> <ul style="list-style-type: none"> <li>73.6% female</li> <li>Mean age: 20.3 years</li> </ul>
<b>Efficacy</b>	<b>Efficacy</b> <ul style="list-style-type: none"> <li>The findings revealed significant changes in psychological stress levels after nature interventions, compared with the baseline, including increased happiness and stronger emotions of comfort and relaxation. When compared with the control group, the results revealed that the nature intervention group had significantly higher levels of nature connectedness, happiness, and positive affect, but no significant effects on other psychological and physiological variables (cardiovascular responses).</li> </ul>

	<p><b>Limitations</b></p> <ul style="list-style-type: none"> <li>• Selection bias in the sampling, as students, who were either more stressed or more interested in nature experiences than others, were more likely to participate. Unequal sample size amongst the groups. This may have resulted in different probability of resulting in type one or two errors</li> <li>• Sample size was small for a conclusive interpretation of the interventions' effects. It is unclear whether the repetition of content might have caused the participants to become bored with, or tired of the intervention.</li> <li>• Participants' preferences for natural environments were not measured in the study.</li> <li>• This study focused on the results of pre-post-intervention comparison of a 3-week virtual nature experience only, but without investigating the continuous changes of the physiological factors (such as cardiovascular variables), which were rather fluctuated as expected. The fuller picture of the benefits of the virtual nature contact could be further explored in future studies, when the continuous changes of these variables are investigated.</li> <li>• Since the intervention was self-administered in the participants' homes due to the COVID-19 pandemic and university campus closures, the above-referenced fluctuations are likely to have been influenced by other confounding factors that are unaccounted for, warranting future research.</li> </ul> <p><b>Recommendations</b></p> <ul style="list-style-type: none"> <li>• Measure participants' personal inclination to connect with nature, for example, how often they visit nature. Replicate the study with a larger sample size, and with equally sized control and experimental groups, to capture the effectiveness of the virtual nature experience, with a higher degree of confidence. Future studies could randomise the control group and experimental group with participants of balanced gender, according to the levels of the participants' personal inclination to connect with nature, in order to reduce the potential bias.</li> <li>• Consider using virtual reality instead of YouTube videos. Further research is needed to explore whether videos of various natural environments, or videos of various scenes of the same natural environments, could be used to maximize the participants' perception of biodiversity.</li> </ul>
<b>Adoption</b>	<p><b>Setting</b></p> <ul style="list-style-type: none"> <li>• YouTube videos labelled non-commercial reuse (to avoid copyright limitations)</li> </ul>
<b>Implementation</b>	<p><b>Interventionist and training</b></p> <ul style="list-style-type: none"> <li>• Not specified</li> </ul> <p><b>Intervention</b></p> <ul style="list-style-type: none"> <li>• 3-week period of virtual nature experience on the psycho-physiological health. The participants were randomly assigned to different groups. There was one-way blinding – the participants were not informed about the group to which they would be assigned before the study.</li> <li>• The experimental groups were exposed to videos about urban nature, marine nature, and forest nature.</li> <li>• The control groups were exposed to videos about a shopping mall and a city.</li> <li>• Intervention was delivered via a 15-minute video of the aforementioned experiences. Each exposure condition included sounds, but lacked a narrative about the conditions depicted.</li> <li>• The interventions were administered three times per week for 3 weeks (9 interventions in total).</li> <li>• Before watching the videos, the participants were instructed to take 3 minutes of active rest, to minimise the impact of commuting, or other disturbances. After the active rest, an HRV monitor, oximeter, and blood pressure monitor were placed onto the participants, and remained in place throughout the intervention.</li> </ul>
<b>Maintenance</b>	<ul style="list-style-type: none"> <li>• A follow-up assessment was performed 2 weeks after the intervention period.</li> <li>• Compared to the baseline, using paired t-tests, significant differences were found in happiness, <math>t(18) = -3.31</math>, <math>p = 0.004</math>, and total mood disturbance, <math>t(18) = 2.19</math>, <math>p = 0.042</math>. The increased degree of positive emotions, including comfortable, relaxed, and natural feelings at the end of the intervention, were not sustained 2 weeks after the intervention, <math>p &gt; 0.05</math>. The participants' nature connectedness, perceived restorativeness, and psychological wellbeing reported at the 2-week follow-up, did not significantly differ from the baseline, <math>p &gt; 0.05</math>.</li> <li>• A comparison of the groups at follow-up was made, using independent t-tests. While Levene's test for equality of variance confirmed that the variables' variance did not differ significantly between the groups at the follow-up, <math>p &gt; 0.05</math>, our assumptions were validated. When compared to those in the urban group, our results demonstrated that the heightened nature connectedness of the virtual nature group, over the urban group, remained during the follow-up, <math>t(33) = -3.31</math>, <math>p = 0.002</math>, along with the increased emotions of feeling natural, <math>t(33) = -2.45</math>, <math>p = 0.02</math>. The boost in degree of comfortable and relaxed emotions, seen at the end of the 3-week intervention, however, was not sustained after 2 weeks, <math>p &gt; 0.05</math>. Despite the absence of significant differences in perceived restorativeness at Week 3, the participants in the virtual nature group reported significantly higher levels of perceived restorativeness at the follow-up, than at the baseline, <math>t(33) = -2.20</math>, <math>p = 0.04</math>. Total mood disturbance, happiness, and psychological wellbeing at the follow-up did not significantly differ from the baseline.</li> <li>• Follow up did not occur at 6 months or later to determine maintenance or shifts in results.</li> </ul>
<b>7. Liu et al., 2021</b>	
<b>Reach</b>	<p><b>Inclusion criteria</b></p> <ul style="list-style-type: none"> <li>• Enrolled in the health psychology program - University in China</li> </ul> <p><b>Recruitment</b></p> <ul style="list-style-type: none"> <li>• Recruited from either the School of Computer Science and Technology or the School of Foreign Languages, with an age range of between 19 and 22 years</li> </ul> <p><b>Participant rate</b></p> <ul style="list-style-type: none"> <li>• 420 students in the PPI group and 448 in the control group</li> <li>• Participation in psychological activities contributes to academic credits of students' coursework.</li> </ul>

<p><b>Efficacy</b></p>	<p><b>Efficacy</b></p> <ul style="list-style-type: none"> <li>Results reveal that the PPI sessions (vs. regular health reminders) significantly improved positive mood, and mitigated negative emotions among the students. The positive effect of the intervention also remained consistent at both 3- and 6-month follow-up.</li> </ul> <p><b>Positive Affect</b></p> <ul style="list-style-type: none"> <li>The main effect of treatment type reveals that the participants who received the web-based PPI, scored higher on PA (<math>M = 31.73</math>, <math>SE = 0.17</math>), than the participants who received only regular health notifications and reminders (<math>M = 28.54</math>, <math>SE = 0.17</math>). The main effect of time point demonstrates that students' PA score was still significantly different at certain phases, regardless of their randomised condition.</li> <li>Regarding the interaction effect, among participants at the posttreatment phase, 3-month follow-up, and 6-month follow-up time points, those undertaking the PPI sessions scored significantly higher (<math>p &lt; .01</math>) on PA (<math>M = 33.28</math>, <math>SE = 0.36</math>; <math>M = 31.05</math>, <math>SE = 0.35</math>; <math>M = 22.96</math>, <math>SE = 0.30</math>) than those who received only health reminders (<math>M = 28.37</math>, <math>SE = 0.35</math>; <math>M = 26.76</math>, <math>SE = 0.34</math>; <math>M = 30.50</math>, <math>SE = 0.29</math>).</li> <li>Additionally, participants assigned to the PPI group gained 4.66, 2.44, and 5.34 more PA points at the posttreatment phase, 3-month follow-up, and 6-month follow-up, respectively, compared to the baseline PA score (<math>p &lt; .001</math>).</li> <li>In addition, the PA score for the PPI group was 2.90 points higher at the 6-month follow-up than that measured at the 3-month follow-up (<math>p &lt; .001</math>). However, the PA scores at the 6-month and 3-month follow-ups were non-significantly different from those at the posttreatment assessment, <math>p = .14</math>.</li> <li>Among all the students in the control group, the PA score was non-significantly different at posttreatment, compared to the baseline assessment (<math>p = .76</math>).</li> <li>The PA score at the 3-month follow-up was also 1.77 points lower than that at baseline, and 1.61 points lower than that at posttreatment (<math>p &lt; .001</math>). In contrast, the PA score obtained at the 6-month follow-up was significantly improved by 1.97 points compared with baseline, 2.13 points compared with posttreatment, and 3.74 points compared with the 3-month follow-up phase (<math>p &lt; .001</math>).</li> </ul> <p><b>Negative Affect (NA)</b></p> <ul style="list-style-type: none"> <li>There was a significant main effect of type of treatment, <math>F(1, 866) = 817.18</math>, <math>p &lt; .001</math>, <math>\eta^2 = .485</math>, a significant main effect of the length of time before follow-up, <math>F(3, 2598) = 326.81</math>, <math>p &lt; .001</math>, <math>\eta^2 = .274</math>, and a significant interaction between type of treatment and follow-up time point, <math>F(3, 2598) = 122.15</math>, <math>p &lt; .001</math>, partial <math>\eta^2 = .124</math>, on the outcome of NA. The main effect of treatment type reveals that the participants who received the web-based PPI, scored lower on NA (<math>M = 19.79</math>, <math>SE = 0.14</math>), than the participants who received only regular psychological wellbeing reminders, or notifications (<math>M = 25.31</math>, <math>SE = 0.13</math>).</li> <li>The main effect of the follow-up time demonstrates that, if the factors of condition difference were ruled out, the participants scored fewer NA points at the 6-month follow-up (<math>M = 18.42</math>, <math>SE = 0.20</math>), than they did at baseline, posttreatment, and the 3-month follow-up (<math>M = 27.02</math>, <math>SE = 0.21</math>; <math>M = 21.79</math>, <math>SE = 0.19</math>; <math>M = 22.97</math>, <math>SE = 0.18</math>), respectively. The NA score was significantly (<math>p &lt; .001</math>) higher at the 3-month follow-up time point compared to the other three time points.</li> <li>With respect to the interaction effect, the NA scores of the PPI group were 10.38 points lower at post treatment, 6.98 points lower at 3-month follow-up, and 4.69 points lower at 6-month follow-up, compared to the scores of those in the control group (<math>ps &lt; .001</math>). In addition, among those assigned to the PPI condition, the NA score significantly declined at posttreatment, 3-month follow-up, and 6-month follow up time points, compared to their scores at baseline by 10.41, 7.54, and 10.95 points, respectively.</li> <li>The difference in NA scores between posttreatment and 3-month follow-up, however, was not significant (<math>p = .19</math>). In addition, the NA score showed more negative affect by 2.87 at the 3-month time point compared to that at posttreatment (<math>p &lt; .001</math>).</li> <li>For the control group, the only significant decrease of NA score was observed at the 6-month time point. The score at that time was 6.38 lower than at baseline, 6.22 points lower than at posttreatment, and 5.70 points lower than at the 3-month assessment (<math>p &lt; .001</math>). In contrast, the NA score at posttreatment had not changed significantly, with reference to baseline assessment (<math>p = .89</math>).</li> <li>The NA score at the 3-month follow-up had not altered significantly, compared to both baseline assessment (<math>p = .14</math>) and posttreatment (<math>p = .14</math>).</li> </ul> <p><b>Limitations</b></p> <ul style="list-style-type: none"> <li>Lacked certain demographic information in the baseline characteristics (socioeconomic status, student's family annual income or parents' occupation)</li> <li>The measure was not designed for medical conditions, such as clinically diagnosed depression or anxiety disorder; therefore, whether there was a significant effect of the web-based PPI on the relief of symptoms of mental illness remains unknown.</li> </ul> <p>Even though efforts were made to manipulate an identical timeline in both conditions, there was still approximately a 5- to 7-day difference between the PPI group and the control group, in terms of allocating treatment and receiving feedback at each treatment or assessment stage, over the course of the 6-month duration of the experiment. This time difference may have resulted in risks of exacerbating psychological stress in either group, because of the delay in being treated with the designated intervention.</p> <p><b>Recommendations</b></p> <ul style="list-style-type: none"> <li>Further research, such as randomised controlled trials, should be implemented soon.</li> </ul>
<p><b>Adoption</b></p>	<p><b>Setting</b></p> <ul style="list-style-type: none"> <li>Intervention website affiliated to the university</li> </ul> <p><b>Consultation</b></p> <ul style="list-style-type: none"> <li>The Positive and Negative Affect Schedule (PANAS) was used to assess affective state. To ensure that every item was understood by the participants, professors at the School of Foreign Languages at the university, were asked to interpret and define each word, using an accurate Chinese equivalent.</li> </ul>
<p><b>Implementation</b></p>	<p><b>Interventionist and training</b></p> <ul style="list-style-type: none"> <li>Not specified</li> </ul> <p><b>Intervention</b></p> <p><b>Web-based PPI condition</b></p> <ul style="list-style-type: none"> <li>Two psychotherapeutic techniques: positive future imagination and gratitude-inducing thinking.</li> <li>Spend 1-minute thinking about the most exciting expectation for your upcoming campus life, after our nation defeats coronavirus, and then writing down your thoughts. This was prompted by cues to facilitate the thought process.</li> </ul>

	<ul style="list-style-type: none"> <li>• After reading the instructions, the participants were asked to spend 15 minutes writing about their expected outcomes from their prospective university life.</li> <li>• When they completed that task, the following instructions were given for the imagination part: "Now that the 15-minute time for writing is over, bring to life as vividly as possible the things you have written by utilising your imagination. It is cued by: Take 5 minutes to contemplate your life, as your best possible self. Imagine your ideal future life at our university, in as much detail as you can. Please make a mental note of the present feelings, induced by your imagination, regarding your future life expectation at our campus.</li> <li>• The participants, who finished this step, were able to proceed to the next PPI session by clicking the "Done" button.</li> <li>• Another email, with the website link for the second session, would automatically be generated. However, the participants were required to complete the second session within 3 days of receiving the email, in order to receive the postintervention assessment.</li> <li>• The instructions for the second session of the PPI focused on gratitude-inducing thinking. Cues were provided to facilitate the thinking process.</li> <li>• Upon completion, the participants had to complete a post treatment assessment.</li> </ul> <p><b>Control group</b></p> <ul style="list-style-type: none"> <li>• Mental health reminders were sent to the participants' university email accounts, four times during a two-week period. The reminders contained regular informative content about health, including daily tips, such as "wash your hands," "wear a mask when going out," and "stay optimistic about your life." The participants had to complete a post treatment assessment after the 2-week period</li> </ul>
<b>Maintenance</b>	<ul style="list-style-type: none"> <li>• Regarding the interaction effect, among participants at the posttreatment, 3-month follow-up, and 6-month follow-up time points, those undertaking the PPI sessions scored significantly higher on Positive Affect (PA), than did those who received only health reminders.</li> <li>• In addition, the PA score for the PPI group was 2.90 points higher at the 6-month follow-up, than that measured at the 3-month follow-up (<math>p &lt; .001</math>). However, the PA scores at the 6-month and 3-month follow-ups were non-significantly different from those at the posttreatment assessment, <math>p = .14</math>.</li> <li>• Among all the students in the control group, the PA score was non-significantly different at posttreatment, compared to the baseline assessment. The PA score at the 3-month follow-up was 1.77 points lower than that at baseline, and 1.61 points lower than that at posttreatment (<math>p &lt; .001</math>).</li> <li>• In contrast, the PA score obtained at the 6-month follow-up was significantly improved by 1.97 points compared with baseline, 2.13 points compared with posttreatment, and 3.74 points compared with the 3-month follow-up phase (<math>p &lt; .001</math>).</li> <li>• The main effect of the follow-up time demonstrates that, if the factors of condition difference were ruled out, the participants scored fewer Negative Affect (NA) points at the 6-month follow-up than they did at baseline, posttreatment, and the 3-month follow-up, respectively. However, the NA score was significantly (<math>p &lt; .001</math>) higher at the 3-month follow-up time point, in comparison with the other three time points.</li> <li>• With respect to the interaction effect, the NA scores of the PPI group were 10.38 points lower at posttreatment, 6.98 points lower at 3-month follow-up, and 4.69 points lower at 6-month follow-up compared to the scores of those in the control group (<math>ps &lt; .001</math>).</li> <li>• In addition, among those assigned to the PPI condition, the NA score significantly declined at posttreatment, 3-month follow-up, and 6-month follow-up time points, compared to their scores at baseline.</li> <li>• The difference in NA scores between posttreatment and 3-month follow-up, however, was not significant (<math>p = .19</math>). In addition, the NA score showed more negative affect by 2.87 at the 3-month time point, compared to that at posttreatment (<math>p &lt; .001</math>).</li> <li>• For the control group, the only significant decrease of NA score was observed at the 6-month time point. The score at that time was 6.38 lower than at baseline, 6.22 points lower than at posttreatment, and 5.70 points lower compared to what it was at the 3-month assessment (<math>p &lt; .001</math>).</li> <li>• In contrast, the NA score at posttreatment had not changed significantly with reference to baseline assessment. Also, the NA score at the 3-month follow-up had not altered significantly compared to both baseline assessment (<math>p = .14</math>) and posttreatment (<math>p = .14</math>).</li> </ul>
<b>8. Nardi et al., 2022</b>	
<b>Reach</b>	<p><b>Inclusion criteria</b></p> <ul style="list-style-type: none"> <li>• 18-32 years of age</li> <li>• Currently matriculated at the school</li> <li>• Able to read, write, and speak in English</li> </ul> <p><b>Exclusion criteria</b></p> <ul style="list-style-type: none"> <li>• Current regular meditation practice (practicing meditation more than once a week)</li> <li>• Serious medical illness precluding regular class attendance</li> <li>• Current substance abuse, suicidal ideation</li> <li>• History of bipolar or psychotic disorders or self-injurious behaviours</li> </ul> <p><b>Recruitment</b></p> <ul style="list-style-type: none"> <li>• Social media postings (Instagram, Facebook), flyers, email recruitment - resulted in a very sample (<math>n = 4</math>). Recruitment procedures were modified - study staff met with classes to present the intervention to students.</li> </ul> <p><b>Participant rate</b></p> <ul style="list-style-type: none"> <li>• 16 students – 12 were female</li> </ul>

<p><b>Efficacy</b></p>	<p><b>Efficacy</b></p> <ul style="list-style-type: none"> <li>• There were no notable differences by FGCS vs non-FGCS.</li> <li>• Overall, students found mindfulness useful and believed that mindfulness training enhanced stress management. They found it contributed to their wellbeing, even while having busy schedules, reduced the stress from commuting, as well as the heavy responsibilities of balancing work/academic life, and the uncertainty of the ongoing global pandemic.</li> <li>• Concerning intervention delivery, the students stated that, due to multiple responsibilities (pressures of commuting to class or balancing job/academic time schedules), they preferred in-person delivery, and the intervention should be offered in split, shorter sessions, in the morning or early afternoon.</li> <li>• Regarding the application and initiation of mindfulness, the students reported that, over the 4-month period, from the beginning the intervention to the completion of the interview, they used mindfulness practices that could easily be incorporated into their daily routine (mindfully walking, eating mindfully), as opposed to those practices, which required more accommodations and planning (longer sitting practice, body scans). It was revealed that these shorter, impromptu practices often enhanced the quality and attention paid to existing behaviours, such as eating, engaging in physical activity, or studying. For some students, mindfulness also enhanced the enjoyment of activities and increased students' motivation to engage in self-care.</li> <li>• The most common application of mindfulness practices was, managing the wide array of stressors, such as working, COVID-19, academic stress, and specific life situations (difficulties in living situations, ongoing mental health conditions).</li> <li>• While engaging in mindfulness for stress management, students seemed to report that they had become more resilient and able to recover faster from challenging situations, which was especially important for students, managing ongoing mental health diagnoses (anxiety, depression).</li> <li>• Students reported on being more present, and able to notice stressors, as well as mentally ground themselves.</li> <li>• Improved ability to self-regulate, let go of difficulties beyond their control, as well as act with mindfulness and self-care in situations, in which they observed that they held higher levels of agency.</li> </ul> <p><b>Limitations</b></p> <ul style="list-style-type: none"> <li>• Small sample of participants (n = 16) from one academic institution, which lowers transferability and diversity. During analysis, the participants were not asked to review the findings or transcripts for inconsistencies, and did not provide feedback on the findings presented. This may have elicited additional information, or allowed the participants to correct any responses that they would deem necessary to revise.</li> </ul> <p><b>Recommendations</b></p> <ul style="list-style-type: none"> <li>• A targeted recruitment strategy, with specific inclusion criteria, to yield a greater sample size. Specific interview questions, regarding the FGCS status, may have elicited more direct feedback regarding mindfulness. Future research should build on the qualitative findings that investigate efficacy and effectiveness, utilising mixed method study designs (exploratory sequential study designs), among larger sample sizes, and include multi-site research strategies, across multiple academic institutions.</li> </ul>
<p><b>Adoption</b></p>	<p><b>Setting</b></p> <ul style="list-style-type: none"> <li>• Zoom</li> </ul> <p><b>Participant feedback</b></p> <ul style="list-style-type: none"> <li>• Conducted through online live verbal interviews, using questions such as: "What was most helpful for you about this course?", "After going through this mindfulness intervention, what is your understanding of how it may improve your wellbeing?", "We want to make this intervention better. You have been through it once. How do you think we can make it better?". "One question we have is whether it would be easier for students to attend two shorter (approximately 1.5 hours) courses over the week, as opposed to 1 longer course. What are your thoughts on this?", "What are your thoughts on digital delivery of this intervention?".</li> </ul> <p><b>Responses</b></p> <ul style="list-style-type: none"> <li>• Students found mindfulness useful and believed that mindfulness training enhanced stress management and contributed to their wellbeing.</li> <li>• In terms of intervention delivery, students would have preferred in person sessions, and split, shorter sessions in the morning or early afternoon.</li> <li>• Students preferred some of the mindfulness practices that could be easily incorporated into their daily routine (mindfully walking, eating mindfully), as opposed to those practices that required more accommodations and planning (longer sitting practice, body scans).</li> <li>• Shorter, impromptu practices often enhanced the quality and attention paid to existing behaviours, such as eating, engaging in physical activity, or studying. For some students, mindfulness also enhanced the enjoyment of activities and increased students' motivation to engage in self-care.</li> <li>• Mostly applied to stressors, such as working, COVID-19, academic stress, and specific life situations (difficulties in living situation, ongoing mental health conditions).</li> <li>• While engaging in mindfulness for stress management, students seemed to report that they had become more resilient and able to recover faster from challenging situations, which was especially important for students, managing ongoing mental health diagnoses.</li> <li>• Students described a temporal process by which mindfulness increased present-moment awareness, allowing them to notice stressors and mentally ground themselves. After exercising this self-regulation, they were able to decide on a more effective, less reactive course of action.</li> <li>• In many cases, those actions involved letting go of difficulties beyond their control, as well as acting with mindfulness and self-care in situations, in which they observed that they held higher levels of agency.</li> </ul>
<p><b>Implementation</b></p>	<p><b>Interventionist and training</b></p> <ul style="list-style-type: none"> <li>• Recruitment procedure was facilitated by faculty support for the study.</li> <li>• Independent Instructor, who had experience in offering MBPs among college students, as well as to diverse populations, and was fluent in both Spanish and English. The instructor was certified in both through MBSR and MBC instructor trainings.</li> </ul>

	<p><b>Intervention</b></p> <ul style="list-style-type: none"> <li>MBC builds on a foundation of mindfulness skills (meditation, yoga, self-awareness, attention control, emotional regulation, etc.) through the use of a standardised curriculum. However, customisations are made, for example, the inclusion of education on the determinants of young adult wellbeing and mindfulness education and practices were designed to be implemented by students, in the context of specific health behaviours: diet, mindfully engaging in physical activity and dietary change, awareness of alcohol use, stress, enhancing sleep, mindful social engagement, deep relaxation, and academic performance. The participants were then encouraged to engage in 45 minutes of formal mindfulness practice recordings, at least 6 days a week, MBC is amended to allow participants to choose their home practice lengths, through 10-, 20-, 30- and 45-minute recordings.</li> <li>This intervention also strives to increase self-regulation, specifically self-awareness, emotional regulation, and attention control.</li> </ul>
<b>Maintenance</b>	<ul style="list-style-type: none"> <li>Not specified</li> </ul>
<b>9. Simonsen et al., 2021</b>	
<b>Reach</b>	<p><b>Inclusion criteria</b></p> <ul style="list-style-type: none"> <li>18 years or older</li> <li>Students at the University of Oxford</li> </ul> <p><b>Participant rate</b></p> <ul style="list-style-type: none"> <li>One-hundred and seventy-seven participants (71.8% age 18-24 years; 64.4% female; 68.9% White; 55.9% Undergraduate) completed baseline measures (T1). Of these, 165 (93%) completed measures at post-test (T2) and 162 (92%) completed measures at follow-up (T3).</li> </ul>
<b>Efficacy</b>	<p><b>Efficacy</b></p> <ul style="list-style-type: none"> <li>There were no significant differences across conditions on clinical or demographic measures at baseline (<math>p &gt; .050</math>).</li> <li>Groups did not differ in likelihood of completing post-test or follow-up assessments (<math>p &gt; .050</math>).</li> <li>Anxiety and depression scores showed acceptable skewness and kurtosis.</li> <li>On average, anxiety symptoms were moderately elevated (mean=11.19, SD=3.63, T&gt;60) and depression symptoms were mildly elevated (mean=9.95, SD=3.87, T-score&gt;55).</li> <li>A significant time X group interaction was detected for changes in anxiety over time (<math>B=-0.36</math>, <math>t=-2.25</math>, <math>p=.025</math>) with the treatment group showing larger reductions relative to the control group.</li> <li>Between-group Cohen's d effect sizes (within-group change in treatment minus within-group change in control) showed a small magnitude difference at post-test (<math>d=-0.39</math>) and follow-up (<math>d=-0.20</math>).</li> <li>The time X group interaction was not significant for depression (<math>B=-0.06</math>, <math>t=-0.94</math>, <math>p=.347</math>). Correspondingly, the between-group Cohen's ds were also smaller at post-test (<math>d=-0.26</math>) and follow-up (<math>d=-0.06</math>).</li> </ul> <p><b>Limitations</b></p> <ul style="list-style-type: none"> <li>Limited sample size impacting generalisability of the findings.</li> <li>The participants were not asked to report on the amount of home practice.</li> <li>Anxiety and depression scores were assessed, using self-reported measures, and may, therefore, have been influenced by social desirability bias.</li> </ul> <p><b>Recommendations</b></p> <ul style="list-style-type: none"> <li>Not specified</li> </ul>
<b>Adoption</b>	<p><b>Setting</b></p> <ul style="list-style-type: none"> <li>Zoom</li> </ul>
<b>Implementation</b>	<p><b>Interventionist and training</b></p> <ul style="list-style-type: none"> <li>Mindfulness teacher</li> <li>The mindfulness teacher met Good Practice Guidelines for Teachers of Mindfulness-Based Interventions, as defined by the British Association of Mindfulness Based Approaches.</li> </ul> <p><b>Intervention</b></p> <ul style="list-style-type: none"> <li>The eight-week mindfulness programme was adapted from the book, Mindfulness: A practical guide to finding peace in a frantic world. 8 weekly Zoom classes</li> <li>Classes lasted 90 minutes (to allow participants to familiarize themselves with the online format). Sessions 1 and 2 were 105 minutes and involved mindfulness meditation practices, periods of inquiry and reflection, and interactive exercises, based on cognitive behavioural therapy.</li> <li>Participants were encouraged to engage with home practice 20-30 minutes per day.</li> <li>Four courses (15-29 participants in each course) were delivered in parallel by the same mindfulness teacher.</li> <li>If the participants were absent from a session, they were invited to attend one of the parallel sessions that week.</li> </ul>
<b>Maintenance</b>	<ul style="list-style-type: none"> <li>The post-test assessment was taken after the end of the first mindfulness course, and the follow-up assessment was taken one month after the post-test.</li> <li>Participants, randomised to the mindfulness condition, showed a significantly greater reduction in anxiety, but not depression over time, relative to the participants, randomised to the waitlist control condition.</li> <li>Maintenance of results were not assessed at 6 months or later.</li> </ul>

## 10. Sun et al., 2022

<p><b>Reach</b></p>	<p><b>Inclusion criteria</b></p> <ul style="list-style-type: none"> <li>• Chinese</li> <li>• Currently enrolled as an undergraduate or graduate level university student</li> <li>• Age 18 or older</li> <li>• Can read, speak, and write Mandarin Chinese</li> <li>• Self-report, as currently in quarantine, due to the pandemic, without physically attending school</li> <li>• Have daily personal internet access</li> <li>• Access to Zoom video conferencing and WeChat</li> <li>• Experiencing elevated psychological distress, such that their depression or anxiety symptoms at or above the mild cut-off on the Patient Health Questionnaire-9, and the 7-item Generalized Anxiety Disorder Scale (GAD-7; Chinese version)</li> </ul> <p><b>Exclusion criteria</b></p> <ul style="list-style-type: none"> <li>• Taking psychotropic medication</li> <li>• Receiving or planning to receive other professional psychological treatment</li> <li>• Unable to attend weekly meetings, due to scheduling conflict</li> <li>• Indicated imminent risk of self-harm</li> </ul> <p><b>Recruitment</b></p> <ul style="list-style-type: none"> <li>• Recruited 114 Chinese university students</li> <li>• WeChat-based flyers</li> <li>• Websites targeting college students</li> <li>• Participant data</li> <li>• Mean age: 22.21 years old</li> <li>• Female: 73.7%</li> <li>• Participants resided in 27 various provinces out of the total 34 provinces in China</li> <li>• Undergraduate (67.5%). Most participants (59.6%)</li> </ul>
<p><b>Efficacy</b></p>	<p><b>Efficacy</b></p> <ul style="list-style-type: none"> <li>• Both groups showed overall reductions in anxiety and depression, as well as increased mindfulness and social support. Participants, randomised to the mindfulness mHealth condition, showed significantly greater reduction in anxiety.</li> <li>• Using intent-to-treat (ITT) analysis, linear mixed effects models showed that, compared to social support mHealth, mindfulness mHealth had superior effect on anxiety (<math>p = .024</math>, between-group <math>d = 0.72</math>).</li> <li>• Both conditions improved on depression (baseline-to-FU <math>d_s &gt; 1.10</math>, between-group difference not significant, <math>d = 0.36</math> favouring mindfulness).</li> <li>• There was an interaction of emotional suppression reduction X condition in improvement of anxiety and depression.</li> <li>• Mindfulness mHealth was demonstrated to be more feasible and acceptable in programme engagement, evaluation, skills improvement, and perceived benefit. Retention was high in both conditions (<math>&gt; 80\%</math>).</li> <li>• Difference in self-reported adverse effect was non-significant (3.9% in mindfulness and 8.7% in social support).</li> <li>• Results of this pilot trial suggest that both mindfulness and social support, delivered via mHealth, show promise in reducing distress among young adults in quarantine, with mindfulness being particularly effective in addressing anxiety.</li> </ul> <p><b>Limitations</b></p> <ul style="list-style-type: none"> <li>• Potential self-report bias.</li> <li>• Assessments were limited to the brief and non-diagnostic nature of the mental health scales.</li> <li>• Another methodological limitation is that although a mixed model approach is the standard practice for intent-to-treat analysis in clinical trials, we cannot be certain that data are missing at random. Therefore, estimates of effect sizes could be biased by data, missing not at random.</li> <li>• The lack of passive control hinders our knowledge on the efficacy of both interventions, in comparison to passage of time alone. A control condition, using another evidence-based treatment, such as cognitive behavioural therapy, would also have provided information on the relative efficacy of the mindfulness programme, compared to another frontline treatment.</li> <li>• Unmodeled nesting with smaller groups may have downwardly biased standard errors.</li> <li>• The rapid intervention development, and use of everyday platforms was a strength, given its cost-effectiveness and responsiveness to the public health emergency. It also limited the collection of complex user engagement data, such as user log-in and practice time.</li> <li>• Findings of the current study indicate potential benefits of an mHealth-based, tailored intervention approach to engage vulnerable populations and reduce the burden on mental health providers during a public health crisis in the LMIC context. However, this does not guarantee the uptake and effectiveness of both interventions in the real world.</li> </ul>

	<p><b>Recommendations</b></p> <ul style="list-style-type: none"> <li>• Use more comprehensive mental health assessments, ideally including diagnostic assessment by a clinician.</li> <li>• Aim for a larger sample size and include longer follow-up periods (6 months or longer).</li> <li>• Collect comprehensive data to further uncover what type of mHealth engagement may be most crucial for symptoms improvement.</li> </ul>
<b>Adoption</b>	<p><b>Consultation</b></p> <ul style="list-style-type: none"> <li>• Referred to local therapists, if suicide risk was present</li> <li>• Experts in mindfulness and university students' mental health provided input into the course outline.</li> </ul>
<b>Implementation</b>	<p><b>Development of intervention content</b></p> <ul style="list-style-type: none"> <li>• A licensed counsellor, a licensed psychologist, and a Mindfulness-Based Stress Reduction teacher.</li> <li>• The first author, a PhD-level psychologist, who has experience working with psychiatric populations and teaching mindfulness, delivered the intervention, including didactic videos, audio recordings, and weekly videoconferencing.</li> <li>• Four study research assistants with experiences in mindfulness received further training from the first author and provide individually tailored responses to participants, who submitted questions or difficulties related to their daily practice journaling.</li> <li>• An RA, who is a licensed counsellor in China and has extensive experience leading psychotherapy groups, delivered the social support mHealth intervention.</li> </ul> <p><b>Intervention</b></p> <ul style="list-style-type: none"> <li>• Participants were randomised to either a mindfulness-based mHealth condition or a social support-based mHealth condition. Both conditions were matched in duration and session length.</li> </ul> <p><b>Mindfulness for growth and resilience</b></p> <ul style="list-style-type: none"> <li>• 4 weeks. Adapted from Mindfulness-based Stress Reduction and Mindfulness-based Cognitive Therapy, tailored as an app-based intervention for university students during COVID-19.</li> <li>• Asked students in a focus group about challenges related to mental health in the pandemic context, and asked them to try three brief mindfulness exercises (5–10 minutes), including focused attention, body scan, and loving-kindness meditation. Students were then asked about their experiences with these exercises and how such exercises might assist in coping with their distress. Additionally, a brief video example was provided to gather participants' feedback. It included a total of 20 videos (~ 3 minutes each, ~ 5 videos per week), which participants could review in a designated order, namely, reviewing the first video unlocks the next video, followed by session-specific questions, to which the participants could provide a text response. The programme also included audio recordings for mindfulness practice (~ 2 per week, which varied from 5 to 40 minutes each), followed by the option of journaling about one's experience of the practice.</li> <li>• WeChat, which allowed for text, picture, and audio-based messages, was used for asynchronous group communication and discussion (sharing of practice experiences, group-based practice feedback).</li> <li>• Week 1: Orientation to the programme, including an understanding of what mindfulness is, the potential benefits of mindfulness in addressing common psychological symptoms in the COVID-19 pandemic context, and brief mindfulness exercises, namely, focused attention and mindful walking (audio recordings of these two practices were also provided).</li> <li>• Week 2: Awareness on bodily experience, including noticing physical sensations throughout the day and its connection with emotional states, encouraging awareness of various mental states, practicing the body scan, and mindful eating. Informal homework of "pleasant event calendar" was provided: the participants were asked to notice their bodily sensations, thoughts, emotions, and impulses during a pleasant event in their day.</li> <li>• Week 3: Focused on habitual patterns of the mind, reviewed the concept of experiential avoidance, with practices focused on awareness of thoughts and working with difficult emotions, through recognition and acceptance (audio recordings of these two exercises were also provided). An informal homework of "unpleasant event calendar" was provided and the participants were encouraged to notice and record their bodily sensations, thoughts, emotions, and impulses during an unpleasant event in their day.</li> <li>• Week 4: Focused on understanding self-care, reviewed skills that the participants developed during the programme, and encouraged ongoing application to future challenges in the emerging infectious disease context and various difficulties in the participants' lives.</li> </ul> <p><b>Social support-based mHealth:</b></p> <ul style="list-style-type: none"> <li>• Session 1 was focused on establishing ground rules; introductions; understanding how to best seek, provide, and receive interpersonal support; and sharing one's current experiences, related to the pandemic.</li> <li>• Session 2–4 discussed topics and experiences, identified by the participants as a useful focus of each session, such as family relations, isolation, school-related stress, and coping strategies.</li> </ul>
<b>Maintenance</b>	<ul style="list-style-type: none"> <li>• Only 1- and 2-month follow up, no 6-month follow up - highlighted in efficacy.</li> </ul>
<b>11. Tay et al., 2022</b>	
<b>Reach</b>	<p><b>Target population</b></p> <ul style="list-style-type: none"> <li>• Year 2-6 MbChB Students</li> </ul> <p><b>Inclusion criteria</b></p> <ul style="list-style-type: none"> <li>• Aged 18 to 24 years old with internet access</li> <li>• English literacy</li> </ul> <p><b>Exclusion criteria</b></p> <ul style="list-style-type: none"> <li>• Participants with reading or hearing problems</li> </ul> <p><b>Recruitment</b></p> <ul style="list-style-type: none"> <li>• Convenience sampling</li> <li>• University's social media channels, including Twitter, Telegram, Facebook, Instagram, and SnapChat. Interested people had to contact the researchers</li> </ul>

	<p><b>Participant rate</b></p> <ul style="list-style-type: none"> <li>179 participants were recruited via various social media platforms. One participant dropped out.</li> </ul>
<b>Efficacy</b>	<p><b>Efficacy</b></p> <ul style="list-style-type: none"> <li>There were no statistically significant changes in stress and psychological wellbeing levels between and within groups.  <b>Depression literacy:</b> The intervention group had higher depression literacy scores at post-intervention and two-month follow-up.  <b>Factors affecting depression literacy:</b> Females did not differ in depression literacy scores, compared with males  <b>Anxiety literacy:</b> The intervention group had higher anxiety literacy scores at post-intervention and two-month follow-up.</li> <li><b>Factors affecting anxiety literacy:</b> Females have higher anxiety literacy scores, compared with males. In terms of discipline, healthcare undergraduates in nursing, psychology, and pharmacy were associated with higher depression and anxiety literacy scores. Conversely, students from non-healthcare undergraduate fields (such as business and engineering) had lower depression and anxiety literacy scores.  <b>Personal stigma (Depression):</b> Intervention group had a lower personal stigma about depression post-intervention than the control group; however, this result was not sustained at the two-month follow-up.</li> <li><b>Stress and psychological wellbeing:</b> The HOPE intervention reduced stress at post-intervention and two-month follow-up, but this did not reach statistical significance. Also, the HOPE intervention did not improve psychological wellbeing.</li> </ul> <p><b>Limitations</b></p> <ul style="list-style-type: none"> <li>Recruitment only from a university setting, which limits the generalisability to other groups.  Self-reported questionnaires that could have resulted in social desirability bias.  The follow-up assessment was performed up to two months later; therefore, changes in literacy levels beyond this period might not be captured.  The study did not capture the participants' adherence to positive psychology and relaxation exercises.</li> </ul> <p><b>Recommendations</b></p> <ul style="list-style-type: none"> <li>The findings of this study could be replicated in studies involving young adults in various settings.  Longitudinal studies could be conducted to examine the effects of MHL changes on psychological wellbeing, depression, and anxiety levels, to ascertain actual clinical benefits over different periods.  Longitudinal studies could also examine the impact and sustainability of such MHL interventions.  Qualitative research could help elicit findings to complement the quantitative results, when evaluating the participants' perspectives on the interventions.  Future research could also examine the students' psychological wellbeing and stress levels after the COVID-19 pandemic.</li> </ul>
<b>Adoption</b>	<p><b>Setting</b></p> <ul style="list-style-type: none"> <li>Information and Communication Technologies (ICT) for Mental Health Prevention  Social Media</li> </ul> <p><b>Consultation</b></p> <ul style="list-style-type: none"> <li>The intervention protocol was reviewed by three clinicians</li> </ul> <p><b>Participant feedback</b></p> <ul style="list-style-type: none"> <li>Feedback was implemented after a pilot study. The following changes were required: (1) shortened questionnaires, (2) weekly WhatsApp and email reminders, (3) incentives for participants who accessed the intervention, and (4) shortened duration of the intervention (from four to two weeks).</li> </ul>
<b>Implementation</b>	<p><b>Interventionist and training</b></p> <ul style="list-style-type: none"> <li>Not specified</li> </ul> <p><b>Intervention</b></p> <p><b>Control group</b></p> <ul style="list-style-type: none"> <li>Access to website containing inspirational quotes, such as, "Today is full of possible" and "You can do anything". The participants were required to review the website at least once during the study.</li> </ul> <p><b>Intervention group</b></p> <ul style="list-style-type: none"> <li>Website with inspirational quotes (Same as control group)</li> <li>The HOPE intervention consisted of four sessions.</li> <li>Participants had to attend two sessions per week for two weeks.</li> <li>Each session lasted approximately ten minutes and contained pre-post quizzes, video(s), and illustrations about mental health.</li> <li>Session 1: Information on myths, symptoms, causes of depression, self-help strategies, and treatments for depression.</li> <li>Session 2: Included practical examples of positive psychology, such as expressions of gratitude, affect, and strength-based exercises.</li> <li>Session 3: information regarding myths, causes, symptoms, self-help strategies, and treatments of anxiety disorders.</li> <li>Session 4: Relaxation exercises and self-management strategies for unhealthy thoughts that utilised techniques from cognitive behaviour therapy. Weekly reminders through emails and WhatsApp were disseminated to participants to complete their sessions.</li> </ul>
<b>Maintenance</b>	<ul style="list-style-type: none"> <li>Follow up at 2 months - reported in efficacy</li> </ul>

### 4.3. Reach

All the included studies focused on university students (Ang et al., 2022; Boyd & Alexander, 2022; Chu et al., 2022; Friedman et al., 2022; King et al., 2022; Lau et al., 2023; Liu et al., 2021; Nardi et al., 2022; Simonsson et al., 2021; Sun et al., 2022; Tay et al., 2022). Some of the studies only recruited undergraduate students (Boyd & Alexander, 2022; Chu et al., 2022; Friedman et al., 2022; King et al., 2022; Tay et al., 2022), whereas other studies were not specific, or stipulated inclusion for undergraduate and postgraduate students (Ang et al., 2022, Lau et al., 2023; Nardi et al., 2022; Simonsson et al., 2021; Sun et al., 2022). Some studies specifically targeted students from the health discipline, for example, the studies had a specific focus on undergraduate MBChB students (Boyd & Alexander, 2022; Tay et al., 2022), pharmacy students (Chu et al., 2022), or students in the health psychology programme (Liu et al., 2021).

Similarities regarding inclusion criteria existed across the studies. For example, all the studies required the participants to be eighteen-years-old or older, have a fair command of the English language, be full time students, have no self-reported medical conditions, and be willing to participate in the intervention (Ang et al., 2022; Boyd & Alexander, 2022; Chu et al., 2022; Friedman et al., 2022; King et al., 2022; Lau et al., 2023; Liu et al., 2021; Nardi et al., 2022; Simonsson et al., 2021; Sun et al., 2022; Tay et al., 2022). However, some studies had additional inclusion criteria, such as access to the internet (Boyd & Alexander, 2022; Chu et al., 2022; Friedman et al., 2022; Sun et al., 2022), willingness to be randomised (Chu et al., 2022), physical and mental ability to engage in the intervention (Friedman et al., 2022), be a domestic resident, as well as be more than one semester away from graduation (King et al., 2022), experiencing elevated psychological distress, and currently in quarantine due the pandemic (Sun et al., 2022).

In terms of exclusion criteria, the studies reported that the participants should not be suffering from a pre-existing physical or mental health condition (Boyd & Alexander, 2022; Lau et al., 2023; Nardi et al., 2022), be substance dependent (Nardi et al., 2022), have suicide ideation (Nardi et al., 2022; Sun et al., 2022), have an exercise injury (Friedman et al., 2022), have participated in a similar intervention prior to this current study (Chu et al., 2022; Nardi et al., 2022; Sun et al., 2022), have consumed alcohol or caffeinated products (Lau et al., 2023), be

taking psychotropic medication (Lau et al., 2023; Sun et al., 2022), unable to commit to the programme (Sun et al., 2022), or have reading or hearing problems (Tay et al., 2022).

Recruitment strategies differed across studies. The strategies included sending flyers via email, sending messages in class WhatsApp groups, Zoom information sessions, emails via class listservs, posts on lab Instagram accounts, bulletin boards, Canva dashboard, convenience sampling, and the study staff met with classes to inform them about the study (Ang et al., 2022; Boyd & Alexander, 2022; Chu et al., 2022; Friedman et al., 2022; King et al., 2022; Lau et al., 2023; Liu et al., 2021; Nardi et al., 2022; Simonsson et al., 2021; Sun et al., 2022; Tay et al., 2022). In some cases, a pre-assessment or meeting was held prior to the intervention, to determine suitability for the intervention (Nardi et al., 2022; Sun et al., 2022).

A total of 4,140 university students were reached across the eleven intervention studies (Ang et al., 2022; Boyd & Alexander, 2022; Chu et al., 2022; Friedman et al., 2022; King et al., 2022; Lau et al., 2023; Liu et al., 2021; Nardi et al., 2022; Simonsson et al., 2021; Sun et al., 2022; Tay et al., 2022). While, all the studies allowed all genders to participate, most studies reported to have more female participation, compared to other genders (Friedman et al., 2022; King et al., 2022; Lau et al., 2023; Nardi et al., 2022; Simonsson et al., 2021; Sun et al., 2022). The findings of this study revealed that these recruitment strategies were effective in reaching the intended population. However, despite efforts to include all genders, female participation was more pronounced. This finding could be explained by Lobato et al. (2014) and Morante et al. (2017), who claim that women may be more committed to improving interpersonal relationships, potentially more confident online than in face-to-face environments, more willing to learn from others, open to seek support, and may be more self-directed. They also argued that it could be more of a social norm in communities for women to access mental health and other health promotion services (Lobato et al., 2014). Either way, these views suggest that, while female participation should be encouraged, recruitment strategies should also focus on ways to include participation from other genders, as mental health challenges affects all genders, which in turn suggests a need of intervention for all genders (Singh, 2021).

As providing mental health support to university students was a key component of the studies included in this review, it was important for the participants to engage in the intervention, when experiencing elevated psychological distress during the COVID-19 pandemic (Cullen et al., 2020). Besides, a scoping review by Li (2023) highlighted the importance of reliable internet

access for the participants to engage in technology, or online platforms, as intended. Having a good understanding of the language, in which an intervention is delivered, is also important, as it allows for more engagement and benefit. This is particularly relevant when the intervention involves written or verbal communication (Alderwick & Gottlieb, 2019). Excluding individuals with self-reported medical or mental health conditions, is usually common practice in research, to ensure the safety and wellbeing of the participants, as non-maleficence is an ethical consideration (Morrow et al., 2019).

When considering digital mental health interventions, reflecting on its value and reach with other populations is important, as significant insights could be gained. Healthcare workers, for example, were at the coalface of medical service delivery during the pandemic. Blake et al (2020) developed and evaluated a digital learning package for health care workers in the United Kingdom, which provided guidance on reducing social stigma, psychological first aid, self-care strategies, social support, strategies to manage emotions, and signposting relating to psychological wellbeing. Experts in mental health, and those with direct pandemic experiences from the frontline, were consulted when the intervention was developed (Blake et al., 2020). The intervention techniques and modules were similar to those in the current review, which focused on students; however, the content and delivery targeted health care workers.

In addition, considering different time periods and contexts are also important when reflecting on the reach of interventions. Digital mental health interventions only emerged in the late 20th century, gained momentum in the 21st century, and increase rapidly during the pandemic to meet mental health service delivery needs (Neary & Schueller, 2018). However, in terms of context, the pandemic widened the disparity in mental health service delivery in Low- and Middle-income Countries (LMIC). The ratio of LMIC mental health therapists was estimated at only 0.5% of what was available in high-income countries. The pandemic stretched these resources even further, because, when humanitarian or societal crises (resulting from of armed conflict, natural disasters, or disease outbreaks) are superimposed onto the underlying adversity, mental health needs become even more acute, but access to care usually remains limited (Ibragimov et al., 2021). In terms of reaching these populations, activity managers from Médecins Sans Frontières (MSF), a medical humanitarian organisation, reported challenges that they experienced, when implementing digital mental health interventions in these settings. They reported: being unable to reach clients; poor network coverage; a lack of communication devices; a lack of a private space at home; language barriers; varying staff digital literacy levels

to implement digital interventions with clients (for example, completing assessments telephonically and capturing electronically); as well as the exclusion of children, the elderly, and people with severe mental health conditions. In terms of advantages, they reflected on the greater accessibility for some clients, time efficiency, and less travelling costs (Ibragimov et al., 2021). This suggests that, when digital mental health interventions are designed, these challenges should be considered, to ensure greater reach and equal opportunity.

#### **4.4. Efficacy**

All the studies referred to how effective their respective interventions were. A synopsis of each intervention is provided in Table 4.3. Most of the studies developed interventions for an experimental and a control group. Both groups received intervention, but the control group either received less interaction, or a support-based intervention. Intervention periods ranged from a two-week period to an eight-week period (Ang et al., 2022; Boyd & Alexander, 2022; Chu et al., 2022; Friedman et al., 2022; King et al., 2022; Lau et al., 2023; Liu et al., 2021; Sun et al., 2022; Tay et al., 2022).

Each study, however, reported their intervention effects differently, based on their methodology. Qualitative reports indicated that the RISE intervention by Ang et al. (2022) had positively improved university students' resilience. The online mindfulness-based intervention by Boyd and Alexander (2022) also had positive outcomes, in terms of the university students' wellbeing, and their ability to manage stress. Similarly, the mindfulness intervention by Chu et al. (2022), using Headspace, showed a decrease in perceived stress, and an increase in mindfulness, using mindfulness was an effective strategy to reduce stress in student pharmacists. Friedman et al. (2022) reported that their WeActive and WeMindful intervention was effective in increasing resilience among university students; however, only WeActive was effective in improving students' interest and engagement in physical activity. The participants in the study of Nardi et al. (2022) found mindfulness useful, believing that mindfulness training enhanced their ability to manage stress, and improved their wellbeing, despite their busy schedules, amid the uncertainty of the global pandemic. They reported that they used mindfulness practices in their daily routine. For some students, mindfulness also enhanced the enjoyment of activities, increased their motivation to engage in self-care, enhanced their resilience, and helped them recover faster from adversity.

**Table 4.3. Synopsis of interventions**

Author & Year	Intervention 1 (Experiment Intervention)			Intervention 2 (Control or Support Based intervention)		
	Time	Content	Activities	Time	Content	Activities
Ang et al., 2022	6 weeks 3 virtual discussion	Building resilience	Videos Reading materials Helplines  Take home tasks (reflective activities and quizzes)		Building resilience	Videos
Boyd & Alexander, 2022	60 min Virtual class stayed open 5-10 minutes post intervention 6 weeks	Mindfulness based Intervention  Attention to internal and external experiences without judgement  Mindfulness	Homework activities Enquiries Body and Breath, mindful movement and body scan Recognise mind habits, mind wandering and dreaming Mini meditation Exploring thoughts Attitudes of kindness	60 min Virtual class stayed open 5-10 minutes post intervention 6 weeks	Supportive intervention  Stress reduction Goals Values communication	Homework activities Psychoeducation on stress reduction techniques Stress when and awareness triangle Role of emotions in stressful experiences Progressive muscle relation, journaling and reflection
Chu et al., 2022	6 weeks Headspace for 10 min per day	Mindfulness	Audio guided meditation app Daily survey		Mindfulness	Access to app after 10 weeks (post intervention and follow up)
Friedman et al., 2022	8 weeks 4 x exercise sessions per week • 25-minute teaching format • 5-minute warm up • 5-minute cool down	Aerobic and strength sessions Goal setting Coping mechanisms	Posted lesson plans on Canvas Announcements with positive messaging	8 weeks 4 x exercise sessions per week • 5-minute mindful warm up followed by deep breathing and goal setting • Ended with 5-minute mindful script – breath, winding down and positive reinforcement 1 peer coaching every 2 weeks for 30 min	Mindfulness based yoga Goal setting Coping mechanisms	Yoga poses Deep breathing Body and breath awareness
King et al., 2022	6 months	Mental health support	Counselling Personalised feedback Referrals to mental health professionals Supportive messaging	6 months	Mental health support	Personal feedback
Lau et al., 2023	3 weeks 3 x per week 15-minute videos 3 min active rest before watching videos	Exposure to nature	Urban nature, marine nature and forest nature videos Monitoring using HRV monitor, oximeter and blood pressure machine	3 weeks 3 x per week 15-minute videos 3 min active rest before watching videos	Exposure to City life	Shopping mall and city videos Monitoring using HRV monitor, oximeter and blood pressure machine

Liu et al., 2021	1-minute thinking about future 15-minute writing about the future 5 min contemplation about being your best self	Positive future imagination Gratitude inducing thinking	Imaginative thinking Journaling Web based cues	Four times during two-week period	Mental health	Mental health reminders were emailed pertaining to informative content about mental health and tips to stay safe during the pandemic
Nardi et al., 2022	Participants could choose 10, 20-, 30- or 40-minute recordings	Mindfulness Increase self-regulation, self-awareness, emotional regulation and attention control	Meditation, yoga, self-awareness, attention control, emotional regulation Psychoeducation – health, wellbeing and mindfulness			
Simonsson et al., 2021	8 sessions weekly for 90- min Week 1 and 2 – 105 min - allow for orientation to platform Home practice 20-30 min daily	Mindfulness	Mindful programme adapted from the book: A practical guide to finding peace in a frantic world			
Sun et al., 2022	4-week 3 exercises 5-10 minutes 20 videos – 5 per week for review	Mindfulness based Cognitive Therapy Physiological symptoms of COVID-19 Understanding self-care	Focused attention, body scan, loving kindness meditation Discussions Videos Audio recordings for mindfulness Journaling We chat- text, picture and audio messages Body scan and recognising emotions	4 sessions	Accessing support	Sharing experiences related to the pandemic (family relations, isolation, school related stress and coping strategies)
Tay et al., 2022	2 sessions per week for 2 weeks 10-minute sessions Weekly reminders to complete sessions	Inspirational quotes Psychoeducation – depression and anxiety	Access to website containing inspirational quotes Quiz Videos Illustrations Relaxation and self-management strategies for unhealthy thought (CBT)		Inspirational quotes	Access to website containing inspirational quotes

When comparing the intervention and control groups, Simonsen et al., (2021) observed greater reductions in anxiety, but not depression symptoms, for participants in the mindfulness condition, relative to participants in the waitlist control condition. The university students, who participated in the mindfulness based cognitive therapy intervention (mindfulness mHealth) by Sun et al. (2022), reported a reduction in anxiety, compared to the participants in the social support mHealth group. Both conditions improved student experience of depression. Mindfulness mHealth was more feasible and acceptable in programme engagement, evaluation, skills improvement, and perceived benefit; however, the results of this pilot trial suggested that both mindfulness and social support, delivered via mHealth, showed promise in reducing distress among young adults in quarantine, with mindfulness being particularly effective in addressing anxiety.

Riboldi et al. (2022) systematically reviewed digital mental health interventions that were developed across the globe. They observed similar findings to the current study, for example, mindfulness-based interventions and positive psychology interventions (gratitude, kindness, engagement in meaningful action, as well as the reorientation of attention towards the positive and satisfying aspects of life) were effective for university students during the pandemic. Mindfulness interventions also proved to be more effective in improving students' anxiety symptoms, when they were offered for a longer period, such as eight weeks. However, they also observed additional interventions that proved to be effective, such as Cognitive Behaviour Therapy (CBT), Dialectical Behaviour Therapy (DBT), and mind-body interventions. These interventions were effective in improving anxiety symptoms and emotional regulation. In a scoping review by Oti and Pitt (2021), a gamified CBT application for depression and alcohol use disorders appeared effective. The games allowed students to become absorbed in the virtual world, while raising awareness, showing empathy to players, and gaining skills to manage mental health conditions.

In their systematic review, Ye et al. (2022) reviewed online psychosocial interventions and observed that psychoeducation was a valuable tool for mental health support during the COVID-19 pandemic, because it was a practical and effective intervention for students during a public health crisis. It provided tools, skills, and strategies for tracking and managing symptoms, as well as improving psychological wellbeing (Zapata-Ospina et al., 2021). Additionally, social support, delivered via mHealth, was instrumental in reducing distress among students (Sun et al., 2022). Social support lowers the adverse effects of stress, uplifts mood, and decreases the duration, as well as intensity of emotions that are negative for many people, because it provides a sense of understanding and belonging (Cheung et al., 2017). Amid the COVID-19 pandemic, digital social support, via social media, widened social circles, maintained ties, and enhanced connectedness (Pandey et al., 2021).

This suggests that various modalities could be effective in improving the mental health of students during a global crisis.

In this current systematic review, the researcher observed that digital mental health interventions proved to be instrumental in enhancing individual agency, promoting self-care, managing stress, and fostering overall wellbeing (Ang et al., 2022; Boyd & Alexander, 2022; Friedman et al., 2022; King et al., 2022; Liu et al., 2021; Lu et al., 2021; Nardi et al., 2021; Simonson et al., 2021; Sun et al., 2022; Tay et al., 2022). The accessibility and convenience, afforded by digital platforms, empowered individuals to take an active role in their mental health journey, thereby contributing to an improvement in agency (Riboldi et al., 2022). The user-centric nature of these interventions allows individuals to tailor their experiences, fostering a sense of control and autonomy over their wellbeing (Weis et al., 2021). Additionally, digital interventions facilitate the widespread dissemination of evidence-based self-care practices. In times of societal crisis, digital mental health interventions prove effective through their accessibility, scalability, and timely support (Riboldi et al., 2022). These platforms transcend physical barriers, offering remote access to mental health resources. The real-time nature of digital interventions enables swift dissemination of coping strategies and information, providing immediate assistance to individuals in need (Catuara-Solarz et al., 2022). The anonymity afforded by online platforms fosters a more inclusive and stigma-free environment, encouraging individuals to seek help without fear (Garrido et al., 2019). Additionally, the adaptability of digital tools allows for quick adjustments to address evolving mental health needs during crises (Weis et al., 2021). The convenience and flexibility of these interventions make them crucial in reaching diverse populations, especially when traditional mental health services face constraints (Weis et al., 2021).

Interestingly, in their scoping review, Peng et al. (2024) observed that digital mental health interventions were increasingly adopted by older adults, and found to be efficacious. Despite inherent challenges of using a technological platform, such as low digital literacy and device inaccessibility, older adults could conveniently undergo screening and treatment in their homes, or any location with internet access, they could overcome transportation barriers and shortages of healthcare providers, it was more cost effective, it fostered self-empowerment, while virtual communities broadened social support networks and contributed to the reduction of loneliness. Once again, this reflects the value and effectiveness of digital mental health interventions, not only with student populations, but also with the greater population.

However, it is also important to acknowledge studies that did not yield the anticipated results. The eBridge had no significant main effects for mental health utilisation, such as accessing psychotherapy

or psychotropic medication. There were also no significant differences in the secondary outcomes, such as, readiness for treatment, or engagement with an online counsellor. However, eBridge was associated with greater linkage to mental health services in subgroup analyses that included only students in the eBridge condition, who engaged in the optional online counselling. Among this subgroup, which may have been inclined toward help-seeking, eBridge seems to have facilitated their decision to seek mental health treatment (King et al., 2022). Hom et al. (2015) identify the importance of connecting people with depression and suicidal ideation to appropriate mental health care services, as a key component of intervention efforts. Individuals may reject available, or online treatment and support, due to feelings of hopelessness, pessimism, impaired problem-solving skills, and maladaptive coping mechanisms that are often characteristic of people with mental health difficulties. Additionally, the lack of perceived needs, contributes to the reluctance, as some individuals may not recognise that they have a problem, or can benefit from interventions or professional services (Hom et al., 2015). Therefore, it is important for interventions to consider having either resources indicated on the website, applications for students who may need them, or referral pathways, as part of the intervention design. This would ensure that the participants, who were triggered by using the online application, or need further support, could access them.

Similarly, in their intervention, Tay et al. (2022) observed no statistically significant changes in stress and psychological wellbeing levels between, and within groups. Women did not differ in depression literacy scores, compared with males, however, women had higher anxiety literacy scores than men did. In terms of academic disciplines, healthcare undergraduates in nursing, psychology, and pharmacy, reported higher depression and anxiety, compared to students in other disciplines, such as business and engineering.

In terms of personal stigma, the intervention group had a lower personal stigma about depression post-intervention, than the control group; however, this result was not sustained at the two-month follow-up. The initial success of the intervention in reducing personal stigma related to depression post-intervention, underscores the dynamic nature of stigma, and the challenges in achieving long-term mitigation (Gorman & Brennan, 2023). Stigma, deeply rooted in societal perceptions and influenced by cultural, as well as structural factors, remains a significant barrier to student engagement with mental health services (Eisenberg & Lipson, 2019; Lipson et al., 2019). While the intervention temporarily influenced individual attitudes, achieving sustained reduction in personal stigma proved difficult, potentially due to societal norms, or a lack of ongoing support (Kanuri et al., 2020; Tay et al., 2022).

Stigmatisation of mental illness could lead to resistance in accessing mental health services, as well as victimisation, exacerbating mental health difficulties, or internalising the stigmatising messages (Gorman & Brennan, 2023; Lipson et al., 2019). Evidently, there is a need for comprehensive, enduring strategies that address, not only individual perspectives, but also societal dynamics and institutional biases, to foster lasting change in the perceptions surrounding depression and other mental health conditions (Kanuri et al., 2020).

Lau et al., (2023) reported that the post intervention assessment revealed that the participants, who were exposed to the nature interventions, proved to have an increased experience of happiness, as well as stronger emotions of comfort and relaxation, compared to the control group. While the nature intervention resulted in significantly higher levels of nature connectedness, happiness, and positive affect, it had no significant difference on other psychological or physiological factors. Nature has been acknowledged for its positive impact on affect, cognition, restoration, and wellbeing, reducing stress, anxiety, and depressive symptoms, as highlighted by Lackey et al. (2021). However, the immediate benefits of nature may not be sustained once individuals return to their usual circumstances and stressors (Ningtyas et al., 2023). Lockdown restrictions during the pandemic led to a reliance on virtual experiences of nature, potentially affecting the sustainability of intervention results (Lau et al., 2023). Despite this, a brief virtual nature intervention with adolescent's post-pandemic demonstrated positive effects, including reduced stress and improved relaxation, mood, attention, and nature connection (Owens & Bunce, 2023). These findings suggest that integrating nature into mental health interventions, rather than making it the sole focus, could be a valuable approach for future interventions.

The positive psychology intervention by Liu et al. (2021) was effective in improving positive mood and mitigating negative emotions among the university students. It was more effective than the control group intervention, who only received regular health notifications and reminders. For students in the control group, their positive and negative affect scores were not significantly different at post treatment, compared to baseline. While health reminders play a crucial role in prompting individuals to prioritise their mental health, effective interventions extend beyond regular prompts, actively involving individuals in their mental health journey (Xu et al., 2018). When users could engage with digital behaviour change interventions, they display increased focused attention, interest, and enjoyment. The interactive and participatory nature of engaging interventions enhances motivation, interest, attention, and commitment, particularly among children and young people (Liverpool et al., 2020; Yeager & Benight, 2018). Therefore, it can be inferred that engaging interventions may be

more effective than passive interventions for students, particularly in times of societal context, where there is already a sense of passivity and lack of control (Weis et al., 2021)

Lastly, while students may have found the pandemic particularly challenging, many students struggled pre-pandemic with their mental health, because of experiences of academic pressure, anxiety, depression, grief, stress, social and academic challenges, as well as a host of other challenges (Harrer et al., 2018). The interventions offered to these students were similar to those offered during the pandemic, but the focus appeared to be more academic, compared to interventions offered to students during the pandemic (Damiano et al., 2021). Perhaps, in the pre-pandemic landscape, the prevailing emphasis on academic achievement eclipsed the recognition of students' underlying mental health challenges, as the goal was to improve academic functioning (Zapata-Ospina et al., 2021). As a result, interventions were geared more towards academic support, potentially neglecting the essential balance between academic success and mental wellness. The advent of the pandemic, however, brought mental health to the forefront, as the entire educational landscape underwent a significant transformation (Bicar et al. 2021).

This was particularly true for nursing students. The findings of a systematic review by Li and Hasson (2020) that focused on stress levels and resilience of nursing students' pre-pandemic, revealed that stress was a key feature of a nursing student's life, which affects their psychological wellbeing. Nursing students reported stress levels that ranged from moderate to high. As a coping strategy, resilience was reported to be variable, which demonstrated that more attention was needed to help student nurses to develop their resilience. Prior to the pandemic, limited digital interventions were available for nursing students; however, during the pandemic, attention was turned towards nursing students. While they may have had similar stressors to other students, namely, overwhelming academic pressure, concerns about the pandemic, social distancing, insufficient physical activity, and excessive use of social media, they also had specific challenges, such as assisting patients in hospitals, as well as having easier/earlier access to information about the pandemic, which they could not disclose, until it became public knowledge. This may have contributed to mental health difficulties, such as depression, stress, and anxiety, due to the fear of the uncontrollability of the pandemic (Dai et al., 2022). Consequently, digital interventions to support nursing students were created, which included mindfulness-based interventions (Dai et al., 2022), as well as digital storytelling, to improve resilience, and help students to cope with their mental health challenges. Digital story telling is visual arts-based intervention that empowers the students to share their lived experiences. Opportunities for insight, reducing stigma, and recovery, were created. In essence, this suggests that students may have grappled with mental health challenges, prior to the pandemic, and many may have mental health

difficulties post-pandemic. However, because of the COVID-19 pandemic, several learnings have been generated, in terms of understanding students' mental health and digital mental health interventions. It is important to consider which interventions have been effective in providing evidence-based services, capable of meeting the mental health needs of students, globally, particularly, during societal crises.

When considering the efficacy of this current study, it is also valuable to consider the limitations of the included studies, as they encourage further inquiry and refinement in future studies. The following limitations were expressed across the studies: (1) limited sample size affecting generalisability and representativeness; (2) exclusion of participants due to internet or data challenges affects the number of participants and may be stigmatising; (3) under-representation or over representation resulting in lack of diversity, or not being nationally representative; (4) study conducted over several campuses, resulting in students having varying exposure to wellbeing programmes, thereby creating a confounding bias; (5) some students may be more interested in meditation, resulting in selection bias; (6) within the virtual interaction, sound and video were switched off; therefore, non-verbal communication could not be interpreted; (7) self-report bias; (8) results obtained in the pandemic may not be transferable to a post-pandemic situation; (9) artificial hurdles that stem from too many steps in the online interventions; (10) measures and interventions were not designed for people with severe mental health challenges, resulting in exclusion; (11) delays in delivering treatment to experiment and control groups; and (12) participants did not view transcripts; therefore, accuracy and additional information may have been lost in the process (Ang et al., 2022; Boyd & Alexander, 2022; Chu et al., 2022; Friedman et al., 2022; King et al., 2022; Lau et al., 2023; Liu et al., 2021; Nardi et al., 2022; Simonsson et al., 2021; Sun et al., 2022; Tay et al., 2022).

#### **4.5. Adoption**

Consultation with stakeholders is valuable in intervention design and implementation. Four studies referred to stakeholder consultations; however, each one had a specific focus. Tay et al. (2022) consulted with clinicians to review the intervention. Sun et al. (2022) formed partnerships with the local therapists to refer participants, who presented with suicide risk. They also consulted experts in mindfulness and university mental health, to provide input in the interventions course outline. Liu et al. (2021) used the Positive and Negative Affect Schedule (PANAS) to assess affective state; however, it was important to ensure that the items were understood by the participants. Therefore, they consulted with professors at the School of Foreign Languages at the university, to define each word, using an accurate Chinese equivalent. Ang et al. (2022) did not consult with stakeholders, but

consulted literature, such as the resilience theory, the transactional model of stress and coping, as well as systematic reviews, to assist with the design and development of the intervention. In addition, a qualitative study, using a user-centred approach, was conducted to provide the contextual information for the programme.

Research and stakeholder consultation were important components in the development and implementation of the interventions documented in the studies in this current review. These findings were echoed in a scoping review by Oti and Pitt (2021), in which the stakeholders were involved in all stages of the intervention, including the contextual inquiry, prototype building, the pilot study, and the clinical trial. Consultations with experts and stakeholders play a pivotal role in the development of effective mental health interventions (Byrne, 2019). Engaging with professionals, researchers, and clinicians, ensures that interventions are informed by the latest evidence-based practices, and aligned with the current understanding of mental health issues (Balfour et al., 2021). Experts bring specialised knowledge, which helps to refine intervention strategies, while ensuring that they are theoretically sound and tailored to the specific needs of the target population (Byrne, 2019). Additionally, involving stakeholders, such as individuals with lived experience, community leaders, and advocacy groups, helps to incorporate diverse perspectives, cultural nuances, and real-world insights into the intervention design (Petkovic et al., 2020).

This collaborative approach, not only enhances the intervention's relevance and cultural sensitivity, but also fosters a sense of ownership, as well as acceptance within the community or population group, for example, among students (Marcu et al., 2022). By fostering a multidisciplinary and inclusive dialogue, consultations with experts and stakeholders contribute to the development of more comprehensive, contextually appropriate, and ethical mental health interventions (Haldane et al., 2019).

Additionally, obtaining participant feedback was also valuable when considering the adoption of the interventions. Students, therefore, were consulted throughout the design process, to participate in idea generation and provide feedback on existing design concepts. This was important to ensure that students found the interventions relevant, unharmed, meaningful and engaging (Oti & Pitt, 2021). Three studies assessed participants' feedback regarding the intervention (Ang et al., 2022; Nardi et al., 2022; Tay et al., 2022). University students appreciated contextually relevant content, as well as clear and practical techniques that allowed them to enhance their resilience (Ang et al., 2022). In addition, Ang et al. (2022) reported that the participants ascribed the poorer engagement and adoption of the RISE programme intervention, to it being delivered solely via a digital platform, as well as due

to the students' competing priorities. The participants in a study by Tay et al. (2022) reported that shortened questionnaires, weekly reminders, incentives for participation, and a shortened programme, would have resulted in greater adoption of the intervention. Students in a study by Nardi et al. (2022) observed that the intervention was useful in improving agency, engaging in self-care, managing stress, and improving wellbeing, while the techniques could be used in an array of situations and contexts. Similar to the participants in the study of Ang et al. (2022), the students would have preferred in-person sessions, and agreed with the participants in the study of Tay et al. (2022) regarding an intervention with a shorter duration.

The participants in the current systematic review reported that they appreciated the clear and practical skills, as they could be empowering, in terms of accessibility, comprehensibility, and manageability. They could also provide the confidence to believe that creating change is possible in an individual's experience or situation (Steinbrenner et al., 2020). The clarity could enhance commitment, trust, collaboration, and engagement of the user (Steinbrenner et al., 2020). Practical skills, rooted in evidence-based practices, enable mental health professionals to implement targeted and goal-oriented interventions, addressing specific needs and challenges faced by individuals (Bevan Jones et al., 2020). The practicality of these skills is particularly crucial in equipping individuals with tangible tools for self-management and coping, as well as facilitating the integration of therapeutic strategies into daily life (Dineen-Griffin et al., 2019). The value of having clear, practical interventions and goals across populations, who access health services, have been recognised long before the pandemic (Jané-Llopis & Barry, 2005), as well as post pandemic (Macaulay et al., 2023). For example, children, youth, and young adults, who were on the Autism spectrum, benefit from clear, practical tools, as they enhance understanding, commitment, trust, collaboration, and engagement (Steinbrenner et al., 2020). Clear, practical skills and tools were also valuable for adults accessing primary health care services during the pandemic, since they could not readily or routinely access these services (Dineen-Griffin et al., 2019).

Lastly, to improve interventions, the participants expressed a desire for face-to-face contact, in addition to the digital intervention, as well as shorter interventions, reminders, and incentives, to make the intervention more appealing and effective (Ang et al., 2022; Liu et al., 2021; Nardi et al., 2021; Tay et al., 2022). The incorporation of face-to-face contact, alongside digital interventions, represents a comprehensive and adaptive approach (Van Emmenis et al., 2022). Face-to-face contact brings a human element to the intervention, fostering a deeper connection between mental health professionals and individuals seeking support. This personal interaction could enhance rapport, trust, and the

overall therapeutic alliance, which is crucial for the success of interventions (Van Emmenis et al., 2022).

Shorter intervention durations respond to the evolving preferences and attention spans of individuals in the digital age (Bradbury, 2016). They make mental health support more accessible, reducing potential barriers, such as time constraints, resource constraints, and the loss of motivation over time. This adaptability aligns with the diverse needs of individuals, who seek assistance (Marcu et al., 2022). Reminders play a pivotal role in maintaining engagement and adherence to interventions (Alkhalidi et al., 2016). In the fast-paced university environment, where distractions are abundant, periodic reminders help individuals to stay connected to the intervention, reinforcing the learned skills and strategies over time (Gan et al., 2021). The introduction of incentives provides an additional motivational element. Rewards or acknowledgments could serve as positive reinforcements, encouraging individuals to actively participate in and complete the intervention (Boucher et al., 2021). Incentives contribute to a sense of accomplishment and could potentially enhance the overall effectiveness of the intervention (Boucher et al., 2021).

#### **4.6. Implementation**

Five studies reported on the professional background of the individual implementing the intervention, while four of those studies also reported on the training of the interventionalist. Interventions were implemented by the following professionals: a registered counsellor, trained in mindfulness (Boyd & Alexander, 2022); a fitness instructor (Friedman et al., 2022); a mental health professional, who was knowledgeable about local mental health resources; eBridge counsellors, who were master's or doctoral level mental health professionals; clinicians from counselling centres, clinics; clinical psychologists with faculty appointments; and clinicians in advanced training programmes (postgraduate social work fellows, postdoctoral fellows).

The eBridge counsellors completed Motivational Interviewing training (King et al., 2022). Nardi et al. (2022) reported that recruitment was facilitated by the faculty support for the study, but the intervention was implemented by an independent instructor, who had experience in offering mindfulness-based practices to college students and to diverse populations. The instructor was certified in both the Mindfulness-based Stress Reduction, and Mindfulness-based College programmes. The instructor was also fluent in Spanish and English. Simmons et al. (2021) reported that their mindfulness intervention was facilitated by a mindfulness teacher, who met Good practice

guidelines for teachers of mindfulness-based interventions, as defined by the British Association of Mindfulness-based Approaches.

A review by Lehtimäki (2021) highlights the importance of seeking assistance from a professional, who has a recognised and legitimate role in providing support. It was further reported that, despite the lack of preference for formal mental health, or government websites, several studies found that young people valued online services administered by mental health professionals. This increases the usability, trust, and fidelity of the programme. As students grapple with the challenges of the pandemic, mental health professionals play a pivotal role in developing and implementing interventions that cater to diverse needs, requiring a nuanced understanding of evolving mental health issues (Neary & Schueller, 2018). In addition, mental health professionals are equipped to recognise the significance of relationships and connection for both individual and social wellbeing; therefore, they can encourage the need to foster supportive communities (Slade, 2010). This was crucial for students facing the isolating effects of remote learning and social distancing (Balcombe & De Leo, 2020).

The studies did not offer extensive information about how well the intervention was executed in practice, the fidelity to the original plan, and adaptations during implementation. However, Tay et al. (2022) reported conducting two pilot trials, to evaluate the initial outcomes of the HOPE intervention, prior to the implementation of the main intervention. The results of the first pilot study revealed high dropouts and poor adherence to the intervention. Consequently, a second pilot study was conducted, with the following changes, based on feedback from the first pilot study: (1) shortened questionnaires; (2) weekly WhatsApp and email reminders; (3) incentives for participants, who accessed the intervention; and (4) shortened duration of the intervention (from four to two weeks). The results from the second pilot study revealed that the research design and revised procedures were more acceptable to the participants (Tay et al., 2022). According to Pearson et al. (2020), pilot studies test the feasibility of methods and procedures to be used in larger-scale studies. They play an important role in improving the conduct and quality of an intervention; therefore, this is an important and necessary step, especially when creating interventions for vulnerable groups, namely mental health users, during volatile periods, such as a pandemic.

In terms of implementation, several studies adapted their interventions from evidence-based practices, to cater to the specific aims of their target population. For example, Nardi et al. (2022) utilised the Mindfulness-Based College (MBC) programme as an evidence-informed adaptation of the Mindfulness-Based Stress Reduction (MBSR) programme, to accommodate undergraduate

students. Similarly, Liu et al. (2021) adapted a web-based positive psychology intervention to accommodate the Chinese context. Simmonson et al. (2021) adapted an intervention from the book, *Mindfulness: A Practical Guide to Finding Peace in a Frantic World*, for students, and Sun et al. (2022) created a 4-week intervention by gathering insights from “Mindfulness for Growth and Resilience”, an established evidence-based mindfulness-based intervention. Tomkins and Bristow (2023) assert that interventions should be based on evidence-based practices, as they offer ideas of *what works*, as well as *how to problem-solve*, and allows for confidence in clinical decisions. These are important factors to consider, when offering a mental health intervention to students.

In hindsight, in terms of improving their programme, Boyd and Alexander (2022) state that their intervention may have been more helpful, if they had added booster sessions post-programme to maintain benefits. They highlight the value of facilitation by a suitably qualified mindfulness teacher, with appropriate experience, to improve the execution of the intervention. Similarly, King et al. (2022) recognised a need to place more emphasis on encouraging students to engage in online counselling. Ang et al. (2022) discovered that synchronous communication through *live* discussion sessions would have been more amenable to students, as it would have allowed for greater engagement and social learning. The authors proposed that these suggestions may have improved the delivery, implementation, and the outcomes of the interventions.

Lastly, while explicit costs of the interventions were not stated, King et al. (2022) and Lau et al. (2023) highlighted that they offered students an incentive to keep them motivated to participate in the programme. Additionally, King et al. (2022) reported that the incentive prize drawings totalled \$1,000 per university (being 10 x \$100 gift certificates). On the other hand, Lau et al. (2023) offered each participant, who completed the study, an incentive of HK\$100. The goal of both studies was to increase participation and encourage retention.

Studies, such as Chu et al, (2022), Friedman et al. (2022), Lau et al. (2023), and Sun et al. (2022), highlighted that using mobile application and virtual platforms lowered the costs for the implementors and participants, while increasing responsiveness, flexibility, convenience, and accessibility. A systematic review by Jankovic et al. (2021) highlights that investment in digital interventions for mental health conditions is growing rapidly, offering the potential to elevate systems that are currently overstretched. They can be advantageous from a cost perspective, due to the reduced need for physical infrastructure, transportation, and human resources. However, it is important to note that the cost-effectiveness could vary, depending on the specific type of intervention, the technology used, and the context in which it is implemented. Regrettably, at this point, it is impossible to say conclusively that

digital mental health interventions are more cost effective, compared to in-person interventions, due to varying results by the studies in their review.

#### **4.7. Maintenance**

While nine studies reported on follow-up effects (Boyd & Alexander, 2022; Chu et al., 2022; Friedman et al., 2022; King et al., 2022; Lau et al., 2023; Liu et al., 2021; Simonsson et al., 2021; Sun et al., 2022; Tay et al., 2022), only two studies considered the intervention effects at 6 months or later (King et al., 2022; Liu et al., 2022). The remainder of the studies assessed follow-up at various points, ranging from 2 weeks post intervention to 10 weeks post intervention.

Regarding the two studies that reported maintenance at 6 months, King et al. (2022) reported that 79% of the participants engaged in the follow-up assessment. The eBridge intervention had no significant effect on the primary outcomes (linkage to MH services) or secondary outcomes (improved MH functioning). As a result, the authors highlight the urgent need for more effective strategies to engage young adults in online mental health interventions. On the other hand, Liu et al. (2021) found that the participants in the experiment group scored significantly higher on positive affect, than did those who received only health reminders. In addition, the scores improved at 6-month follow-up, compared to the 3-month follow-up; however, they were non-significant, compared to the post-treatment scores. The positive affect score, obtained at the 6-month follow-up, was also significantly improved, compared with the baseline assessment. The participants scored fewer negative affect points at the 6-month follow-up, than they did at baseline, post treatment, and the 3-month follow-up, respectively. Additionally, negative affect scores were lower for the experimental group, compared to the control group. However, the control group also demonstrated a significant decrease at 6 months, compared to their baseline assessment. This means that the interventions used in the experimental and control group had an impact on enhancing mood.

Kwan et al. (2019) assert that follow-up studies, as well as reporting the maintenance of results are important, because they provide insights and evidence on the sustaining benefits, or an intervention, as well as the motivation to continue with the intervention. Matthews et al. (2014) assert that maintenance of results should be assessed at least 6 months post intervention, to gain an idea of the intervention effects over time. Understanding the maintenance of mental health interventions is paramount in ensuring the long-term wellbeing of individuals (Byrne, 2019). Investigating the sustained effectiveness of interventions over time provides valuable insights into preventing relapses, tailoring treatments to evolving needs, and optimising resource allocation. This knowledge aids

mental health professionals to develop evidence-based practices, inform policies, and enhance treatment planning (Kwan et al., 2019).

#### **4.8. Recommendations for the implementation of digital mental health interventions in the context of societal crisis**

The findings of this current study revealed several recommendations for the implementation of digital mental health interventions, particularly, during periods of societal crises. The recommendations were based on inadequacies in the included studies, as well as recommendations to improve future interventions. Considering the findings of Ang et al. (2022), it is recommended that offering credit-bearing modules for mental health activities should be considered. This would improve engagement, motivation, and commitment, especially when there are competing demands, such as academic demands, or demands related to the crisis. Similarly, Boyd & Alexander (2022) suggest that the integration of wellbeing enhancement initiatives for medical students, within the curriculum or through extramural programmes, such as Campus Health services, could enhance self-compassion and avoid burnout. Lau et al. (2023), on the other hand, propose university-level incentives or mandates for mental health screening participation. This would ensure that students receive the mental health support that they need, without fear or reservations about accessing it. It is noteworthy to acknowledge a need to bridge the divide between individuals requiring treatment and those participating in it; therefore, behavioural economics principles have been employed in healthcare (Boucher et al., 2021). This involves applying incentives, especially within digital mental health interventions, to motivate student behaviour change, and enhance engagement with mental health services (Boucher et al., 2021). Incentives may be financial or non-financial, such as motivational messaging, gamification, points, fitness and nutrition support, and the loss aversion techniques (Cotton & Patel, 2019).

Chang et al. (2023) undertook a study to understand how financial incentives could encourage student engagement with a digital mental health app, as well as the mental health outcomes relating to the intervention. They found that financial incentives alone do not significantly increase user engagement, or impact users' anxiety symptoms, depressive symptoms, wellbeing, and emotion regulation difficulties. However, Saleem et al. (2021) observed that personalised support during the intervention, access to social support, and personalised feedback, seem to promote engagement with digital interventions for mental health promotion. Perhaps, an incorporation of incentives and personalised support during the intervention, access to social support, and personalised feedback could be valuable in improving user engagement in digital mental health interventions.

Sun et al. (2022) also proposes that comprehensive mental health assessments would be valuable in digital mental health interventions, to determine the students' needs and allow for prevention, or early intervention. The idea of incorporating assessment is corroborated by Taher et al. (2023), who argue that a safety assessment should also occur, to manage risk within digital mental health interventions. Taher et al. (2023) emphasise that risk and safety should be assessed systematically and proactively, in every digital mental health intervention. The methods, instruments and outcomes should also be documented comprehensively. However, Hassem and Laher (2022) highlight that, currently, there are limited psychometrically validated, online screening instruments for mental health. Therefore, using psychological assessment in the online space, introduces a myriad of ethical concerns from issues around confidentiality, through to risk and data security necessitating (Hassem & Laher, 2020). Consequently, it is recommended that ethical guidelines on the online screening of mental health should always be consulted and considered prior to including assessment in digital mental health interventions. According to Hassem and Laher (2022), ethical guidelines have not yet been established fully; therefore, this is an emerging set of guidelines.

Ang et al. (2022) highlight that students desire more attractive visuals, as well as the flexibility to review materials at their own pace. Chu et al. (2022) and Nardi et al. (2022) concur, and add that, when interventions are flexible, it could promote agency, as students could determine when they would need support, and for how long. In efforts to increase user engagement, Bevan-Jones et al. (2020) propose that digital mental health interventions for children and young people should involve co-design. This requires a shift from the traditional practice of experts designing interventions for users, to a process where interventions are created with stakeholders, as well as children and young people. This would humanise the intervention and prevent the intervention from being overly structured, rigid, and unresponsive (Bevan-Jones et al., 2020).

Similarly, Lattie et al. (2022) highlight that many online programmes rely heavily on psychoeducation, text-based lessons, problem-solving therapy, and attention bias modification training. They argue that it is unlikely that these types of interventions are engaging to children, adolescents and students. Therefore, digital mental health interventions need to keep their market in mind, when developing interventions, to ensure that they attract the user. This view is supported by an example of Woebot, an app that uses a CBT-based conversational agent. This app is intended for children 12 years and older; however, the app only demonstrated efficacy in decreasing depressive and anxiety symptoms in college students, and some evidence for efficacy in improving substance misuse behaviours and cravings in adults (Fitzpatrick et al., 2017; Prochaska et al., 2021).

Design needs, therefore, should allow for flexibility, clear confidentiality, and data sharing practices, to increase feelings of safety about disclosing information in online spaces, use of language, an age-appropriate cognitive load and frameworks specific to youth (Fedele et al., 2019). In addition, it is essential to ensure a user-friendly design, by considering the lower technical readiness of users, incorporating intuitive interfaces, and providing simple navigation (Peng et al., 2024). This may be particularly helpful to older adults, who may not be as comfortable with technology, because some older adults view digital innovations as exclusionary, rather than stimulating (Seifert et al., 2019).

There is a need to consider strategies that could support students, post intervention, to maintain the effects of the intervention, as internet therapies appeal to students, particularly those, who would not otherwise seek mental health support (Dunbar et al., 2018). To maintain the benefits of interventions, Boyd & Alexander (2022) propose including booster sessions, post-programme. Sun et al. (2022), as well as Tay et al. (2022), assert the need for longer follow-up periods, to determine the continued impact of the intervention. Sustaining the benefits of an intervention is a proactive strategy, to reinforce and solidify the positive outcomes achieved during the intervention (Sun et al., 2022; Tay et al., 2022). Becker & Torous (2019) recommend support post intervention, such as check-in's with therapists, or automated reminders. Additionally, for students who prefer human interaction, referrals to access face-to-face support, when needed, may also be an effective strategy to maintain the effects, or bolster the support, post intervention (Becker & Torous, 2019).

On the other hand, King et al. (2022) highlight the importance of cultural tailoring, and suggest that, in order to boost student engagement in online mental health interventions, efforts need to be made to incorporate cultural aspects, to make the intervention, or websites, more user friendly and relatable. Bevan-Jones et al. (2020) argue that interventions cannot simply be adapted from other interventions. For example, child and adolescent mental health requires specific considerations; therefore, they cannot merely be adaptations from adult programmes. A developmental, or age-appropriate approach is needed, regarding the content and design of a programme, as well as accounting for the range of interests of children and adolescents. Similarly, specific considerations have to be made, when tailoring intervention for different religious or cultural groups (King et al., 2022).

It is also important that interventions follow evidence-based practices, to ensure the effectiveness, safety, and efficiency of interventions (Sun et al., 2022). Lattie et al. (2022) studied recommendations for more accessible digital mental health services, and specifically explored traditional face-to-face therapeutic modalities. According to Lattie et al. (2022), digital mental health interventions are typically designed, based on psychological treatments that have demonstrated efficacy in traditional,

face-to-face mental health care. In addition, Lattie et al. (2022) highlight that cognitive behavioural therapy (CBT), acceptance and commitment therapy, and psychodynamic therapy, are therapeutic models that are commonly used in face-to-face therapy, which have been used frequently in the development of digital mental health interventions. They also observed that digital mental health services are typically designed, based on psychological treatments that have demonstrated efficacy in traditional, face-to-face mental health care. Internet-based cognitive behavioural therapy (CBT) programmes have produced clinically meaningful effects (Lattie et al., 2022). Guided interventions, with human support, have shown efficacy for common mental health problems. For example, guiding users through cognitive restructuring and using interactive tools to prompt users to modify maladaptive behaviour patterns and engage in more adaptive behaviours. Encouraging caregiver involvement in digital mental health interventions could be important for youth, who face barriers to seeking care (Lattie et al., 2022).

Acceptance Commitment Therapy, also considered an evidence-based practice, helps users with acceptance strategies, along with commitment and behaviour change strategies. It was especially useful in conditions, such as depression, anxiety, psychosis, eating disorders, irritable bowel syndrome and grief (Lattie et al., 2022). Interpersonal therapy is effective in mitigating the effects of depression, as the interventions focus on improving the quality of a client's interpersonal relationships and social functioning, to help reduce their distress.

On the other hand, psychodynamic therapy, which is a central face-to-face therapeutic modality, is not considered as effective within the digital sphere, which is evidenced by a smaller and weaker evidence base (Lattie et al., 2022). This could be due to the key components of the therapy, which is a less structured modality that focuses on affect and expression of emotion, unconscious defence mechanisms, identification of recurring themes in the patient's life, and discussions of past experiences (focusing on early life experiences, interpersonal relationships, as well as the therapeutic relationship between patient and therapist). In addition, this modality focuses on an exploration of the patient's fantasy life (patients are encouraged to speak freely about whatever comes to mind during sessions), transference, and countertransference. However, psychodynamic practices were considered more effective, when offered telephonically, where there was constant engagement with the therapist (Lattie et al., 2022).

Based on the research by Sun et al. (2022) and Lattie et al. (2022), it is crucial to prioritise evidence-based practices in the development and implementation of digital mental health interventions. Given the success of internet-based cognitive behavioural therapy (CBT) programmes, it is recommended

that guided interventions with human support be incorporated, utilising interactive tools to prompt users to modify maladaptive behaviour patterns. Acceptance and Commitment Therapy (ACT) has demonstrated efficacy in various conditions, making it a valuable addition to digital mental health interventions. However, caution should be exercised with psychodynamic therapy in the digital sphere, due to a weaker evidence base, possibly emanating from its less structured nature, as well as emphasis on various interpersonal and emotional components. However, psychodynamic practices may prove more effective when delivered telephonically, with consistent therapist engagement. Additionally, promoting caregiver involvement in digital mental health interventions could be vital, especially for youth facing barriers to seeking care. In general, practitioners and developers should prioritise interventions that are grounded in empirical evidence, while considering the specific strengths and limitations of therapeutic modalities in the digital realm.

Liu et al. (2021) advocate for innovative approaches, such as Positive Psychology Interventions (PPI), to address mental health problems. They recommend that individuals be taught methods of initiating positive emotions that lead to a eudemonic life. This does not imply simply changing negative experiences to pleasant moments, but providing skills to engage in meaningful activities that are beneficial, empowering, positive, and purposeful. According to Lattie et al. (2022), positive psychology-based interventions have also been effective at reducing depressive symptoms. Positive psychology interventions aim to increase wellbeing, by cultivating positive feelings, such as gratitude, positive cognitions, and positive behaviours. Digital mental health intervention programmes, based within a positive psychology framework that focuses on supporting patients to understand and recognise areas of growth, as well as work towards resilience and a greater sense of wellbeing, are effective at reducing depressive symptoms (Job & Williams, 2020).

Lastly, despite, benefiting from digital mental health interventions, the incorporation of face-to-face elements may enhance student motivation, as there would be a human element of connection and support (Ang et al., 2022; Nardi et al., 2022). This view is supported by Lattie et al. (2022), who recognised the value of including computer, as well as web-based programmes with psychoeducation and skill-building components, often including some form of human support. Therapist-guided internet Cognitive Behavioral Therapy (iCBT) has shown efficacy and cost-effectiveness in treating depression and anxiety, particularly, among older adults (Tomasino, 2017). Blended interventions, combining web-based and face-to-face sessions, have also demonstrated benefits, with higher client satisfaction and wellbeing (Van Emmenis et al., 2022). Exploring hybrid approaches that combine digital and face-to-face elements are crucial, to acknowledge the value of personal interactions, while leveraging technology benefits (Tomasino, 2017).

In the context of societal crisis, such as the COVID-19 pandemic, these recommendations provide valuable insights into the effective strategies and considerations, for the implementation of digital mental health interventions, particularly targeting university students. The pandemic significantly impacted the mental health of students, elevating psychological distress, and necessitating innovative approaches to support their wellbeing. Addressing issues of access, inclusion, ethical considerations, gender disparities, and long-term impact, is essential for designing effective interventions that could support individuals, particularly university students, during times of crises. The role of mental health professionals, the diversity of engagement strategies, and the need for ongoing research and adaptation, further contribute to the development of resilient mental health support systems in the face of societal challenges.

#### **4.9. Conclusion**

In this chapter, the researcher presented the intervention properties of digital mental health interventions for students during the COVID-19 pandemic. Insight into recruitment strategies, efficacy, and limitations of interventions were provided. In addition, the researcher highlighted the role of stakeholders, as well as the various interventionalists required to execute the interventions, and outlines the interventions implemented, to achieve the aim of improving the mental health of university students during the COVID-19 pandemic. The intervention effects over time are described by considering the longer-term impact on the mental health of university students.

In this review, the researcher systematically identified digital mental health interventions, tailored for university students, amid the challenges posed by the COVID-19 pandemic. The interventions comprised a spectrum of strategies, including resilience-building, mindfulness practices, stress reduction techniques, psychoeducation, exposure to nature, physical activity, and emotional regulation. Recruitment methods primarily leveraged internet-based platforms, such as emails, social media, Zoom meetings, and university portals. Notably, the participants actively acknowledged their need for intervention, fostering an increased interest in mental health services. The effectiveness of these digital interventions was underscored by their positive impact on individual agency, self-care, stress management, and overall wellbeing. Additionally, social support, through mobile health platforms, particularly mindfulness, demonstrated promise in alleviating distress among students during societal crises.

The researcher also acknowledged the multifaceted nature of effective mental health interventions, emphasising the importance of combining digital tools with human elements, and addressing

individual preferences. To enhance these interventions, the participants expressed a preference for face-to-face contact, alongside digital approaches, shorter durations, reminders, and incentives. Ultimately, the findings contributed valuable insights and recommendations for the implementation of digital mental health interventions, especially in the context of societal crises, such as the COVID-19 pandemic. In addition, the findings provided an evaluation of digital mental health interventions for students. The interventions were described in terms of the REAIM properties, allowing for a detailed understanding of each intervention, which determined the effectiveness of the interventions, and concluded with the provision of recommendations that could improve the development of future digital mental health interventions.

## CHAPTER FIVE

### LIMITATIONS, RECOMMENDATIONS, AND CONCLUSION

#### 5.1. Introduction

Amid the challenges imposed by the COVID-19 pandemic, digital mental health interventions have emerged as vital resources to support the mental health and wellbeing of students (Kola et al., 2021). The abrupt shift to remote online learning, as well as the isolation brought on by social distancing measures, significantly impacted the mental health of students worldwide (Cao et al., 2020). In response, digital mental health tools, ranging from mobile apps, to online counselling platforms, became instrumental in providing accessible and immediate support (Stein et al., 2022). These interventions offered a variety of mental health services, including stress management, anxiety reduction, and coping strategies, tailored to the unique needs of students, navigating the uncertainties of the pandemic (Flinchbaugh et al., 2012).

This current study was aimed at systematically reviewing digital mental health interventions for students during the COVID-19 pandemic, and focused on addressing specific research questions related to the aim, namely: (1) identifying interventions that were evaluated for their effectiveness in addressing mental health challenges among student populations during the COVID-19 pandemic; (2) the characteristics of these interventions, in terms of the RE-AIM framework; (3) the effectiveness of these interventions; and (4) recommendations for the implementation of digital mental health interventions, in the context of societal crisis. However, to further contribute to the body of knowledge related to digital mental health interventions for student populations, it is important to acknowledge this current study's limitations, and provide relevant, as well as evidence-driven recommendations. Therefore, in this chapter, the researcher describes the limitations of the study, and provides recommendations for future research, practice, and policy, with particular focus on how it could be applied in the context of societal crisis, as well as the South African context.

#### 5.2. Limitations of the study

The following limitations were identified in this current study:

- Systematic reviews tend to consider published studies mainly, implying that unpublished studies, or grey literature that could have provided valuable contributions, were excluded.

- Although the current review utilised a broad search category and seven dominant databases in the social sciences field, only interventions published in journals within the included databases were located, resulting in only eleven appropriate studies.
- To allow for methodological rigour, several moderate quality studies were excluded. These studies may have provided different insights about digital mental health interventions for students during the COVID-19 pandemic. However, it was important to maintain the rigour in this current study, which influenced the decision to only include studies that proved to have strong methodological rigour.
- Since only studies in the English language were considered, language bias was present. This implied that relevant studies presented in other languages were omitted, thereby limiting the sampling frame.
- Owing to the variability in the study design, the participants, interventions, and outcomes of the identified studies, comparing them, in terms of strengths and weaknesses for the RE-AIM dimensions, was challenging, as the studies were heterogenous. In addition, not all the studies provided sufficient information about each dimension.
- While the RE-AIM framework is a model that could be used to assess the properties of various interventions, as well as their effectiveness, several other models exist that could have provided different, or additional insights, namely, the financial or resource implications, scalability, feasibility, sustainability, and replicability of the interventions.
- Systematic reviews are time-consuming to conduct; therefore, a time lag could exist between the last included study and the generation of this current thesis, implying that new evidence could have emerged after the data collection was completed. However, all measures were taken to complete the report within the shortest possible time, post data collection.

Despite these limitations, the findings of this current study provided valuable insights and direction, while summarising and synthesising evidenced-based digital mental health interventions for students during the COVID-19 pandemic.

### **5.3. Recommendations for research**

The need for extended follow-up beyond six months prompts inquiries into the lasting impact of interventions on mental health (Dunbar et al., 2018). Consequently, there is a call for research to delve into the specific consequences of the digital divide among student populations, aiming to inform the

development of targeted interventions and policies (Sanders & Scanlon, 2021). In addition, an investigation into the effectiveness of multilingual digital mental health interventions, compared to single-language options, is recommended, with a focus on assessing reach, engagement, and outcomes, across diverse linguistic groups (Fedele et al., 2019). Another avenue for research involves exploring user experiences with digital mental health interventions, across various cultural contexts, aiming to comprehend the impact of cultural nuances on engagement and effectiveness (Bevan Jones et al., 2020). It would also be important to assess the impact of the COVID-19 pandemic on students' mental health, with the potential of informing the development of targeted interventions and support programmes. Exploring barriers and facilitators to the implementation of digital mental health interventions in educational settings is also proposed, aiming to identify strategies for enhancing uptake and integration into existing support structures (Kedra & Kaltsidis, 2020). Lastly, investigating the correlation between mental health and academic performance among tertiary students during and after the COVID-19 pandemic is recommended, with a specific interest in understanding how digital mental health interventions could positively influence academic outcomes (Sonn et al., 2021).

#### **5.4. Recommendations for practice**

In addition to the aforementioned recommendations, a comprehensive approach to fortify the implementation and impact of digital mental health interventions, should include the introduction of digital literacy programmes. These programmes should aim to enhance technological skills, particularly in communities with limited access, empowering individuals to navigate, and effectively engage with digital mental health interventions during times of crises, or when in need of support (Haldane et al., 2019). Simultaneously, substantial investment in digital infrastructure is imperative to address potential disparities. Regular assessments should be conducted to identify technology access limitations, with ensuing strategies, developed to provide the necessary resources, such as devices and internet connectivity, particularly in regions with a shortage of mental health professionals, or where access to services is challenging, due to distance or resource constraints (Sanders & Scanlon, 2021). Establishing partnerships with digital service providers is advocated, to explore possibilities for the provision of subsidised, or free, access to digital mental health platforms during crises, a measure particularly advantageous for financially constrained student populations (Al Mamun et al., 2021).

In addition, the design of multilingual interventions is crucial to foster inclusivity. Initiatives should be explored to create interventions in multiple languages, ensuring a broader reach among diverse

populations affected by crises (Alderwick & Gottlieb, 2019). A balanced approach to inclusion and safety is recommended in future interventions, exploring ways to include the participants with existing conditions, while ensuring adequate support and minimising potential harm during crises (Balcombe & De Leo, 2020). Tailoring interventions specifically to the needs of tertiary students, is paramount, while necessitating the development and implementation of evidence-based digital mental health interventions geared towards this demographic. Similarly, targeted support programmes for first-generation students should be instituted, addressing issues related to identity, lack of confidence, financial constraints, and difficulties in navigating academic and social pressures (Katreovich & Aruguete, 2017).

Diversifying recruitment approaches is integral, while acknowledging and addressing cultural, as well as societal norms, to encourage participation, and influence equal involvement from all genders during crises (Job & Williams, 2020). Community involvement in the development of interventions is highlighted as essential, to enhance the relevance and acceptance of digital mental health interventions, especially in diverse settings. Collaborative efforts between educational institutions, mental health professionals, and technology experts are underscored, to create holistic and effective digital mental health solutions (Balfour et al., 2021). Leveraging professional expertise from mental health professionals, technology experts, and other relevant professionals, is crucial for the development and implementation of evidence-based interventions during crises (Kumar, 2019).

Addressing stigma remains a pivotal aspect of the overall strategy, requiring innovative approaches, particularly among student populations, to ensure sustained engagement with mental health interventions. Prioritising interactive interventions is advocated to maintain user interest, motivation, and positive outcomes, incorporating diverse activities and personalised approaches, for a comprehensive and empowering user experience (Gorman & Brennan, 2023). Multifaceted intervention strategies, encompassing exposure to nature, physical activity, stress management, and mindfulness practices, should be considered for their effectiveness in supporting students during crises (Chu et al., 2022).

Additionally, targeted outreach programmes within communities or universities are essential, to raise awareness about available digital mental health resources, accompanied by education on how to access and utilise these interventions (Kwan, 2019). Lastly, the training of health workers and university personnel about digital mental health interventions is recommended, to promote their use during times of distress and crises (Crocker et al., 2023).

## 5.5. Recommendations for policy

To advance digital inclusion in marginalised regions, it is recommended that policies be implemented to incentivise companies to provide reduced-cost, or free internet access. In the realm of mental health, to foster innovation in digital interventions, research and development needs to be incentivised (Chang et al., 2023). Encouraging collaborative partnerships between academia, industry, and government, could enhance intervention effectiveness. Integrating digital mental health interventions into broader public health programmes and policies is essential (Kumar, 2019). Policymakers should emphasise the significance of mental health, allocating resources to support technology-driven mental health initiatives. To address linguistic diversity, policies should promote the creation of multilingual digital mental health resources, ensuring that interventions are available in languages spoken by diverse populations (Friedman et al., 2022). Accessibility standards for digital mental health platforms should be established and enforced, to cater to users with varying technological proficiencies and abilities. Clear regulations and ethical guidelines, including compliance with data protection laws, are crucial for digital mental health interventions, necessitating regulatory clearance (Hassem & Laher, 2022). Aligning national mental health policies with digital interventions could bridge the gap between policy intentions and practical implementation. Finally, advocating for increased funding and resources for mental health services, encompassing both traditional and digital approaches, is paramount (Nguse & Wassenaar, 2021).

When considering and implementing these recommendations at the levels of practice, policy, and research, stakeholders could contribute to creating a more inclusive and effective digital mental health landscape, during times of crises, as well as within resource constraint contexts. Addressing technology and language disparities ensures that the benefits of mental health interventions are accessible to all, fostering a more resilient and supportive response to societal challenges. Understanding users' needs and experiences allows for the delivery of interventions that are appropriate, relevant and appealing. In addition, implementing digital mental health interventions in South Africa, holds immense potential for the addressing of mental health challenges in a diverse and expansive context. These interventions offer increased accessibility, overcoming geographical barriers, and providing a private avenue to seek help; consequently, tackling potential stigma. In times of societal crises, the flexibility of digital platforms allows for rapid response and tailored support. Given South Africa's significant youth population, leveraging technology, aligns with their preferences and habits. Additionally, the diverse linguistic and cultural landscape could be accommodated through digital platforms. Cost-effectiveness, data-driven decision-making, and the capacity for preventive measures, could contribute to the appeal of digital solutions. This approach

not only supports individuals directly, but also serves as a means for capacity building within the mental health sector. Ultimately, integrating digital mental health interventions into South Africa's healthcare strategy, represents a forward-thinking and inclusive approach to meeting the mental health needs of its population.

## **5.6. Conclusion**

In response to the unprecedented challenges posed by the COVID-19 pandemic, in this current study, the researcher embarked on a systematic review, with a specific focus on digital mental health interventions, tailored for tertiary students. The study was guided by distinct research inquiries. In Chapter One, the researcher introduced the study and highlighted what the researcher strived to achieve. In Chapter Two, the researcher provided an in-depth understanding of the diverse landscape of digital mental health interventions, particularly for students during the COVID-19 pandemic. This laid the foundation for a more comprehensive understanding of the evolving landscape of mental health support mechanisms. Chapter Three contained a detailed methodology of how the research process would unfold. In Chapter Four, the researcher critically assessed the characteristics of the interventions, through the lens of the RE-AIM framework, examining aspects related to their 5 key outcomes, namely, Reach, Effectiveness, Adoption, Implementation, and Maintenance. Chapter Five comprised an account of how the findings could be understood, from a South African and international perspective. It also contained actionable recommendations for the implementation of digital mental health interventions, acknowledging its potential role within the broader societal context of crises.

In conclusion, this current systematic review encompassed a comprehensive examination of digital mental health interventions, tailored for students during the COVID-19 pandemic. By scrutinising the diverse landscape of available interventions, and evaluating their characteristics through the RE-AIM framework, the findings of this research has contributed to a nuanced understanding of the evolving role of technology, in supporting student mental health. The assessment of effectiveness not only illuminated the current situation, but also highlighted areas for improvement and innovation in digital mental health strategies. In addition, the actionable recommendations, presented in this current study, offer a forward-looking perspective on the implementation of digital interventions, not only within the immediate context, but also as part of a broader approach to mental health support during societal crises. As the discourse on mental health support mechanisms for students continues to evolve, the researcher anticipates that this research will serve as a valuable resource, providing insights that resonate beyond the confines of the COVID-19 pandemic.

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## APPENDICES

### Appendix A: Search terms

1. "Digital" OR "Technology" AND "Mental Health" OR "Psychological" AND "Students" AND "COVID-19" AND "School" OR "University" OR "College" AND "Intervention"
2. "Digital" AND "Mental Health" OR "Psychological" AND "Students" AND "COVID-19"
3. "Mobile" OR "Internet" OR "Phone" AND "Mental Health" OR "Psychological" AND "Students" AND "COVID-19"
4. "Online" OR "On-line" OR "Remote" OR "Web-based" AND "Mental Health" OR "Psychological" AND "Students" AND "COVID-19"
5. "Internet" OR "Application" OR "APP" OR "Video" AND "Treatment" AND "Students" AND "COVID-19" AND "Intervention"
6. "Digital" AND "Stress" OR "Depression" OR "Trauma" OR "Suicide" OR "Substance" AND "Students" AND "COVID-19" AND "Intervention"
7. "Computer" OR "Phone" OR "Internet" AND "Intervention" OR "Program" OR "Treatment" AND "Students" AND "COVID-19"
8. "COVID-19" AND "Virtual" AND "Intervention" AND "Students" AND "Undergraduate" OR "Postgraduate"
9. "Phone" OR "Internet" AND "Intervention" OR "Program" OR "Treatment" AND "Wellbeing" AND "Students" AND "COVID-19"
10. "Telephone" or "Smart Phone" or "Cell Phone" OR "Text Message" OR "SMS" OR "E-Mail" AND "Psychiatry" OR "Psychology" AND "Students" AND "COVID-19" AND "Intervention"
11. "Internet" AND "Treatment" OR "Diagnosis" OR "Screening" OR "Prevention" AND "Therapy" OR "Counselling" AND "Students" AND "COVID-19"

## Appendix B: Tracking sheet

No.	Search Terms	Authors Title Screening Titles retrieved based on suitability	Hits (Title)	Retrieved (Abstract) Abstracts retrieved based on suitability	Comments	Duplicates	Final Retrieval (Full text) Suitable Full text retrieved that will be RE-AIM appraised
<b>1. Academic Search Complete (EbscoHost Web)</b>							
1	"Digital" OR "Technology" AND "Mental Health" OR "Psychological" AND "Students" AND "COVID-19" AND "School" OR "University" OR "College" AND "Intervention"	Han, Yun, 2022 Nardi et al 2022 Liu et al., 2022 Jormand et al., 2022 Vereenoghe et al., 2021 Chia-chen, 2023 Monarque, et al., 2023 Rey-Ronquillo,2022 Song et al., 2022 Paiva et al., 2022 Liu et al., 2021	27 842	Han, Yun, 2022 Nardi et al 2022 Liu et al., 2022 Jormand et al., 2022  Song et al., 2022 Paiva et al., 2022 Liu et al., 2021	Majority of the articles used the word digital in various contexts and disciplines. In terms of health, there was a focus on health-related challenges and dentistry. There was little focus on mental health, less on digital mental health and even less focusing on students.	0	Nardi et al 2022
2	"Digital" AND "Mental Health" OR "Psychological" AND "Students" AND "COVID-19"	Han et al., 2023 Song et al., 2022 (Duplicate) Han, Yun, 2022 (Duplicate) van Doorn et al., 2021 Banerjee et al.,2021 Halldorsson et al.,2021 Merry et al, 2020	88	   van Doorn et al., 2021 Banerjee et al.,2021	Duplicates are from Academic Search Complete String 1	2	Liu et al., 2021
3	"Mobile" OR "Internet" OR "Phone" AND "Mental Health" OR "Psychological" AND "Students" AND "COVID-19"	Smart et al. 2023 Rachamim et al., 2022 Orosa-Duarte et al., 2021 Moffitt-Carney et al., 2021 Fenger et al., 2020	5,375	  Orosa-Duarte et al., 2021 Moffitt-Carney et al., 2021 Fenger et al., 2020	Limited focus on mental health interventions. Most focused on things such as mobile interventions for cancer, smoking, weight loss etc.	0	
4	"mHealth" OR "Remote" OR "Web-based" AND "Mental Health" OR "Psychological" AND "Students" AND "COVID-19"	Zulkipliy et al., 2023  Viskovich & Pakenham, 2020	4,577	Zulkipliy et al., 2023	Limited focus on students using digital intervention platforms, more focus on teaching and learning online during COVID.	0	
5	"Internet" OR "Application" OR "APP" OR "Video" AND "Treatment" AND "Students" AND "COVID-19" AND "Intervention"	Smart et al. 2023 (duplicate) Moffitt-Carney et al., 2021 Levin et al., 2022	738	  Levin et al., 2022	Duplicate from academic search complete string 3  Majority of the app focus is on what children use it for (not interventions)- use it for learning (improving language	4	

No.	Search Terms	Authors Title Screening Titles retrieved based on suitability	Hits (Title)	Retrieved (Abstract) Abstracts retrieved based on suitability	Comments	Duplicates	Final Retrieval (Full text) Suitable Full text retrieved that will be RE-AIM appraised
		Flett et al., 2020		Flett et al., 2020	skills, fitness apps. Articles also focus on the effects of internet over use but not about interventions or how it affects mental health		
6	"Digital" AND "Stress" OR "Depression" OR "Trauma" OR "Suicide" OR "Substance" AND "Students" AND "COVID-19" AND "Intervention"	Rachamim et al., 2022 (duplicate) Fenger et al., 2020 (duplicate) Görge et al., 2020  Kola et al., 2022  Amsalem & Martin, 2022 Görge et al., 2020 (duplicate) Arndt et al., 2020	1,247		Majority of the articles speak to students experiences of depression/trauma, and those focusing on interventions are not digital (eg. In person program run at school).	1	
7	"Computer" OR "Phone" OR "Internet" AND "Intervention" OR "Program" OR "Treatment" AND "Students" AND "COVID-19"	Rachamim et al., 2022 (duplicate) Smart et al. 2023 (duplicate) Görge et al., 2020 (duplicate) Arndt et al., 2020 (duplicate)  Fang et al., 2021 Gutierrez, et al., 2020 Joosten-Hagye et al., 2020  Viskovich & Pakenham, 2020 (duplicate)	908	Fang et al., 2021	<p>Duplicate from academic search complete string 3</p> <p>Duplicate from academic search complete string 5</p> <p>Duplicate from academic search complete string 6</p> <p>Studies focusing on intervention for mental health were not online/digital. Limited focus on COVID-19</p> <p>Duplicate from Academic search complete string 4</p>	5	
8	"COVID-19" AND "Virtual" AND "Intervention" AND "Students" AND "Undergraduate" OR "Postgraduate"	Not applicable	30		Studies focused on students experiences during postgrade/undergrad. And also focused on the relationship between supervisors and students; why students study postgrad etc.	0	

No.	Search Terms	Authors Title Screening Titles retrieved based on suitability	Hits (Title)	Retrieved (Abstract) Abstracts retrieved based on suitability	Comments	Duplicates	Final Retrieval (Full text) Suitable Full text retrieved that will be RE-AIM appraised
9	"Phone" OR "Internet" AND "Intervention" OR "Program" OR "Treatment" AND "Wellbeing" AND "Students" AND "COVID-19"	Rachamim et al., 2022 (duplicate) Görges et al., 2020 (duplicate) Arndt et al., 2020 (duplicate)  Fang et al., 2021 (duplicate)  Long et al., 2021 Young et al., 2021 Joosten-Hagye et al., 2020 (duplicate)	823	Long et al., 2021	Duplicate from academic search complete string 3 Duplicate from academic search complete string 5 Duplicate from academic search complete string 6 Duplicate from academic search complete string 7  Duplicate from academic search complete string 7	5	
10	"Telephone" or "Smart Phone" or "Cell Phone" OR "Text Message" OR "SMS" OR "E-Mail" AND "Psychiatry" OR "Psychology" AND "Students" AND "COVID-19" AND "Intervention"	Andersson et al., 2021	86	Andersson et al., 2021	Focus on self-help for children with behavioural problems, smartphone use and how it links to poor sleep. Not focusing on interventions and mental health during COVID	0	
11	"Internet" AND "Treatment" OR "Diagnosis" OR "Screening" OR "Prevention" AND "Therapy" OR "Counselling" AND "Students" AND "COVID-19"	Smart et al. 2023 (duplicate)	834		Duplicate from academic search complete string 5 Focus on screening for things such as cancer, HIV and anxiety, but does not speak to digital interventions for mental health, particularly for students, and limited connection to COVID	1	

**TOTAL 2**

No.	Search Terms	Authors Title Screening Titles retrieved based on suitability	Hits (Title)	Retrieved (Abstract) Abstracts retrieved based on suitability	Comments	Duplicates	Final Retrieval (Full text) Suitable Full text retrieved that will be RE-AIM appraised
<b>2. Health Source: Nursing/Academic Edition</b>							
1	"Digital" OR "Technology" AND "Mental Health" OR "Psychological" AND "Students" AND "COVID-19" AND "School" OR "University" OR "College" AND "Intervention"	Flett et al., 2020 (duplicate)  Banerjee et al., 2021 (duplicate) Rodriguez et al., 2020 Saber et al., 2020 Song et al., 2022 Yange et al., 2020	307	Rodriguez et al., 2020  Yange et al., 2020	Duplicate from Academic search complete string 5  Duplicate from Academic search complete string 2 A number of Articles based on digital intervention were systematic reviews- excluded. Limited focus on digital interventions, health related articles focused mainly on Autism and food insecurity etc	2	
2	"Digital" AND "Mental Health" OR "Psychological" AND "Students" AND "COVID-19"	Banerjee et al., 2021 (duplicate)	2		One article is duplicate and the other focused of distance learning and health Duplicate from Academic search complete string 2	1	
3	"Mobile" OR "Internet" OR "Phone" AND "Mental Health" OR "Psychological" AND "Students" AND "COVID-19"	De Luca et al., 2020 Lu & Ma, 2022  Moffitt-Carney et al., 2021 (duplicate) Orosa-Duarte et al., 2021 (Duplicate) Pang, 2022  Rachamim et al., 2022 (duplicate) Smart et al., 2023 (duplicate) Zhang, 2022	138	De Luca et al., 2020	Health focus on HIV, the eyes, a lot of focus on intervention in tinnitus (ringing in ear and nose)- limited focus on COVID-19  Duplicates from Academic Search complete string 3	0	
4	"mHealth" OR "Remote" OR "Web-based" AND "Mental Health" OR "Psychological" AND "Students" AND "COVID-19"	<b>Not applicable</b>	65		Health interventions focused on hearing, autism. Limited focus on COVID-19 linked to mental health and students	0	
5	"Internet" OR "Application" OR "APP" OR "Video" AND "Treatment" AND "Students" AND "COVID-19" AND "Intervention"	Lu & Ma, 2022 (duplicate) Zhang, 2022 (Duplicate) Pang, 2022 (duplicate)  Levin et al., 2022 (duplicate)	340		Interventions apps mostly focus on auditory treatments, physical health of people, service women, and sexual health Duplicate from Health Source string 3 Duplicates from Academic Search complete string 5	10	

No.	Search Terms	Authors Title Screening Titles retrieved based on suitability	Hits (Title)	Retrieved (Abstract) Abstracts retrieved based on suitability	Comments	Duplicates	Final Retrieval (Full text) Suitable Full text retrieved that will be RE-AIM appraised
6	"Digital" AND "Stress" OR "Depression" OR "Trauma" OR "Suicide" OR "Substance" AND "Students" AND "COVID-19" AND "Intervention"	Rachamim et al., 2022 (duplicate) Chu et al., 2022 Orosa-Duarte et al., 2021 (duplicate) Smart et al. 2023 (duplicate) Flett et al., 2020 (duplicate) Moffitt-Carney et al., 2021 (duplicate) De Luca et al., 2020 (duplicate) Not Applicable/ not appropriate to the study	668	Chu et al., 2022	Duplicates from Academic Search complete string 3  Duplicate from Health Source string 3 Duplicate from Academic Search complete string 3 Duplicate from Health source string 1 Duplicate from Academic Search complete string 3 Duplicate from Health Source string 3 Limited focus on mental health problems (i.e. depression), in relation to students and digital interventions. Focus is on treatments or investigating the effects of mental health problems, but not in the digital space. COVID related articles speak to trauma, depression, stress and interventions, but not in relation to students and digital MH interventions	0	Chu et al., 2022
7	"Computer" OR "Phone" OR "Internet" AND "Intervention" OR "Program" OR "Treatment" AND "Students" AND "COVID-19"	Rachamim et al., 2022 (duplicate) Smart et al. 2023 (duplicate) Schjøberg Marques & Braidwood, 2021	759		Duplicate from Health Source string 3 Duplicate from Academic Search complete string 3 Majority of the articles are focused on programmes or treatments for family care, education programmes for students etc., but no focus on online mental health interventions mostly targeted at families, mothers, autistic children- not really students. Limited focus on COVID and digital mental health interventions	2	

No.	Search Terms	Authors Title Screening Titles retrieved based on suitability	Hits (Title)	Retrieved (Abstract) Abstracts retrieved based on suitability	Comments	Duplicates	Final Retrieval (Full text) Suitable Full text retrieved that will be RE-AIM appraised
		Joosten-Hagye et al., 2020 (duplicate)			Duplicate from academic search complete string 7.		
8	"COVID-19" AND "Virtual" AND "Intervention" AND "Students" AND "Undergraduate" OR "Postgraduate"	Not applicable	20		Focus is on under-/post- graduate training particularly for medical and pharmacy students. No focus on mental health or digital mental health interventions.	0	
9	"Phone" OR "Internet" AND "Intervention" OR "Program" OR "Treatment" AND "Wellbeing" AND "Students" AND "COVID-19"	Rachamim et al., 2022 (duplicate)	719		Speaks to experiences of programs (often education programs, rehab programs)- not online or aimed at students' mental health. Numerus studies on HIV	1	
10	"Telephone" or "Smart Phone" or "Cell Phone" OR "Text Message" OR "SMS" OR "E-Mail" AND "Psychiatry" OR "Psychology" AND "Students" AND "COVID-19" AND "Intervention"	Ribeiro et al., 2021	37		Duplicate from Academic Search complete string 3 Smart phone and text messaging not focused on mental health interventions. Focus' on contraceptives, pregnant women, behavioural health interventions. Majority of target is parents	0	
11	"Internet" AND "Treatment" OR "Diagnosis" OR "Screening" OR "Prevention" AND "Therapy" OR "Counselling" AND "Students" AND "COVID-19"	Smart et al. 2023 (duplicate)	802		Duplicate from Academic Search complete string 3 Majority of the diagnosis focus is on ASD, autoimmune diseases, HIV, screening of diseases etc but not linked to mental health interventions. Screening of students during COVID- not linked to MH interventions	1	

**TOTAL 1**

No.	Search Terms	Authors Title Screening Titles retrieved based on suitability	Hits (Title)	Retrieved (Abstract) Abstracts retrieved based on suitability	Comments	Duplicates	Final Retrieval (Full text) Suitable Full text retrieved that will be RE-AIM appraised
<b>3. Medline (EbscoHost Web)</b>							
1	"Digital" OR "Technology" AND "Mental Health" OR "Psychological" AND "Students" AND "COVID-19" AND "School" OR "University" OR "College" AND "Intervention"	<p>Han et al., 2023 (duplicate)</p> <p>Kardefelt-Winther, et al., 2020</p> <p>Finch et al., 2023</p> <p>Tong et al., 2023</p> <p>Szigethy et al., 2023</p> <p>Mathews et al., 2022</p> <p>Lim et al., 2021</p> <p>Kruger, et al., 2020</p> <p>Kirschner, et al., 2020</p> <p>Kanuri et al., 2020</p> <p>Mindu et al., 2023</p> <p>Dallinger et al., 2022</p> <p>Parker et al., 2022</p> <p>King et al., 2022</p> <p>Frings et al., 2022</p> <p>Zulkipli et al., 2023 (duplicate)</p> <p>Keyan et al., 2022</p> <p>Kemp et al., 2021</p> <p>Yang et al., 2020</p> <p>Tay et al., 2022</p>	3,696	<p>[Redacted]</p> <p>Lim et al., 2021</p> <p>Kruger, et al., 2020</p> <p>Kirschner, et al., 2020</p> <p>Kanuri et al., 2020</p> <p>[Redacted]</p> <p>King et al., 2022</p> <p>[Redacted]</p> <p>Keyan et al., 2022</p> <p>[Redacted]</p> <p>Yang et al., 2020</p> <p>Tay et al., 2022</p> <p>Sun et al., 2022</p>	<p>Duplicate from Academic health search string 2</p> <p>Focus is on dietary interventions, adult hypertension, limited focus on students. A lot of focus on patients not students</p> <p>Duplicate from Academic search complete string 4</p>	1	<p>King et al., 2022</p> <p>Tay et al., 2022</p> <p>Sun et al., 2022</p>

		Sun et al., 2022				
		Conceição et al., 2022				
		Di Giacomo et al., 2021		Conceição et al., 2022		
2	"Digital" AND "Mental Health" OR "Psychological" AND "Students" AND "COVID-19"	Song et al., 2022 (Duplicate) 497			Overall majority of the studies Speaks to effects of COVID on mental health but limited to interventions (and not digital). Also speaks to physical health interventions,	5
		Min et al., 2022			Duplicate from academic search complete string 1	
		van Doorn et al., 2021 (Duplicate)			Duplicate from academic search complete string 2	
		Banerjee et al., 2021				
		Shi et al., 2021				
		Alvarez-Jimenez et al., 2020				
		Finch et al., 2023 (duplicate)			Duplicate from medline string 1	
		Keyan et al., 2022 (duplicate)				
		Philippot et al., 2022		Philippot et al., 2022		Philippot et al., 2022
		Pagnini et al., 2021		Pagnini et al., 2021		Pagnini et al., 2021
		Craig et al., 2021				
		Shi et al., 2021		Shi et al., 2021		
3	"Mobile" OR "Internet" OR "Phone" AND "Mental Health" OR "Psychological" AND "Students" AND "COVID-19"	No inclusions/ not applicable 8730			Mobile apps focused on things such as cancer, gastoral diseases, limited focus on students (focused on pregnant women and	
4	"mHealth" OR "Remote" OR "Web-based" AND "Mental Health" OR "Psychological" AND "Students" AND "COVID-19"	Sun et al., 2022 (duplicate) 5042			Duplicate from medline string 1	1
					Limited focus on students. Majority of the articles were focused on mhealth for cancer patients	
5	"Internet" OR "Application" OR "APP" OR "Video" AND "Treatment" AND "Students" AND "COVID-19" AND "Intervention"	MacLean et al., 2020 55 520			Majority of the apps are focused on mhealth for diabetes, testing for COVID, physical activity during COVID, COVID tracing,	0
		Akin-Sar et al. 2022				
		Bertuzzi et al., 2022		Ismail et al., 2021		
6		Ismail et al., 2021			Limited focus on digital mental health interventions for	0
		Capriola-Hal et al., 2021				
		Fawaz & Samaha, 2020				

	"Digital" AND "Stress" OR "Depression" OR "Trauma" OR "Suicide" OR "Substance" AND "Students" AND "COVID-19" AND "Intervention"	Santander-Hernández et al., 2022	21,318		students. Focus is mostly on psychological disorders during COVID and its effects, but no focus on digital mental health interventions.	
7	"Computer" OR "Phone" OR "Internet" AND "Intervention" OR "Program" OR "Treatment" AND "Students" AND "COVID-19"	Bertuzzi et al., 2022 (duplicate) Rachamim et al., 2022 (duplicate) Wang et al., 2022 Casella et al., 2022 Dibao-Dina et al. 2022 Brog et al., 2021 Zhou et al., 2022	15,715	Wang et al., 2022	Duplicate from medline string 5  Duplicates from Academic Search complete string 3	2
8	"COVID-19" AND "Virtual" AND "Intervention" AND "Students" AND "Undergraduate" OR "Postgraduate"	Not applicable	790		Focus on the needs of students during COVID. Limited focus on mental health. Numerous studies are scoping and systematic reviews (excluded). Limited focus on digital interventions	0
9	"Phone" OR "Internet" AND "Intervention" OR "Program" OR "Treatment" AND "Wellbeing" AND "Students" AND "COVID-19"	Castillo et al., 2020 Haug et al., 2023 Pietsch et al., 2023 Rachyla et al., 2021 Simonsson et al., 2021 Edge et al., 2021 Martínez et al., 2021 Karampas et al., 2022 Schulte et al., 2022 Viskovich & Pakenham, 2020 (duplicate) Arndt et al., 2020 (duplicate) Casella et al., 2022 Wang et al., 2022 (duplicate)	30,077	Rachyla et al., 2021 Simonsson et al., 2021 Edge et al., 2021 Karampas et al., 2022	Digital interventions mostly focused on cancer, diabetes, pain management, dementia etc. very little focus on digital mental health interventions for students .	3
10	"Telephone" or "Smart Phone" or "Cell Phone" OR "Text Message" OR "SMS" OR "E-Mail" AND "Psychiatry" OR "Psychology" AND "Students" AND "COVID-19" AND "Intervention"	WONG et al., 2021 Kageyama et al., 2020	4,048	Kageyama et al., 2020	Duplicate from Academic search complete string 4 Duplicate from Academic search complete string 6 Duplicate from medline string 7 Duplicate from medline string 7	0
11		Ierardi et al., 2022 Hamlett et al. 2022		Le rardi et al., 2022	Screening focus on diseases such as cancer, HIV, and COVID,	1

“Internet” AND “Treatment” OR “Diagnosis” OR  
 “Screening” OR “Prevention” AND “Therapy” OR  
 “Counselling” AND “Students” AND “COVID-19”

Midgley et al., 2021  
 Parker et al., 2020  
 Smart et al., 2023 (Duplicate)

49,749

and treatment thereof.  
 Treatment also focused on  
 primary care, adults,  
 Duplicate from Academic search  
 complete string 3

**TOTAL 8**

No.	Search Terms	Authors Title Screening Titles retrieved based on suitability	Hits (Title)	Retrieved (Abstract) Abstracts retrieved based on suitability	Comments	Duplicates	Final Retrieval (Full text) Suitable Full text retrieved that will be RE-AIM appraised
<b>4. APA PsycArticles (EbscoHost Web)</b>							
1	“Digital” OR “Technology” AND “Mental Health” OR “Psychological” AND “Students” AND “COVID-19” AND “School” OR “University” OR “College” AND “Intervention”	Farahani et al., 2023  Tavakoli et al., 2022	1065		Articles tend to focus on mental health and interventions of health care workers and adults in general. Many studies also focused on people’s attitudes and behaviours during the pandemic. Numerous studies focused on suicide, loneliness and social isolation during the pandemic as well as race, racism and discrimination, but not in focusing on students. Big focus on sports, athletes, etc	0	
2	“Digital” AND “Mental Health” OR “Psychological” AND “Students” AND “COVID-19”	Farahani et al., 2023 (duplicate) Tavakoli et al., 2022 (Duplicate)	201		Much focus on suicide and suicidal ideation. Very little focus on digital interventions. With regard to digital, most articles speak about learning online, not necessarily linked to mental health or interventions. Very little focus on students. Numerous articles were systematic reviews	2 (duplicates from string 1)	
3	“Mobile” OR “Internet” OR “Phone” AND “Mental Health” OR “Psychological” AND “Students” AND “COVID-19”	Farahani et al., 2023 (duplicate) Tavakoli et al., 2022 (Duplicate)	592		Focus on healthcare workers, and effects of COVID-19 on healthcare line and health careline callers.	2 (duplicates from string 1)	

No.	Search Terms	Authors Title Screening Titles retrieved based on suitability	Hits (Title)	Retrieved (Abstract) Abstracts retrieved based on suitability	Comments	Duplicates	Final Retrieval (Full text) Suitable Full text retrieved that will be RE-AIM appraised
4	"mHealth" OR "Remote" OR "Web-based" AND "Mental Health" OR "Psychological" AND "Students" AND "COVID-19"	Not applicable	3890			0	
5	"Internet" OR "Application" OR "APP" OR "Video" AND "Treatment" AND "Students" AND "COVID-19" AND "Intervention"	Not applicable	92		Very little focus on COVID-19 and students mental health. Some focus on employees. No reference to students, online interventions and mental health	0	
6	"Digital" AND "Stress" OR "Depression" OR "Trauma" OR "Suicide" OR "Substance" AND "Students" AND "COVID-19" AND "Intervention"	Not applicable	62		No focus on digital/online interventions. Majority of the articles focused on trauma speaks to racial trauma, and factors leading to trauma but no focus on digital mental health interventions. Very little focus on students	0	
7	"Computer" OR "Phone" OR "Internet" AND "Intervention" OR "Program" OR "Treatment" AND "Students" AND "COVID-19"	Not applicable	16		Focus on employee mental health, designing school based programs for suicide prevention	0	
8	"COVID-19" AND "Virtual" AND "Intervention" AND "Students" AND "Undergraduate" OR "Postgraduate"	No hits	0		No hits	0	
9	"Phone" OR "Internet" AND "Intervention" OR "Program" OR "Treatment" AND "Wellbeing" AND "Students" AND "COVID-19"	Not applicable	12		Focus on employee mental health, designing school-based programs for suicide prevention	0	
10	"Telephone" or "Smart Phone" or "Cell Phone" OR "Text Message" OR "SMS" OR "E-Mail" AND "Psychiatry" OR "Psychology" AND "Students" AND "COVID-19" AND "Intervention"	Not applicable	22		Articles speak to prevention and treatment of psychiatric disorders- not digital/online interventions for students	0	
11	"Internet" AND "Treatment" OR "Diagnosis" OR "Screening" OR "Prevention" AND "Therapy" OR "Counselling" AND "Students" AND "COVID-19"	Not applicable	3		Focus is on veterans, screening workload (systematic review), and screening dark personalities. No focus on students and digital mental health interventions and COVID.	0	

**TOTAL 0**

No.	Search Terms	Authors Title Screening Titles retrieved based on suitability	Hits (Title)	Retrieved (Abstract) Abstracts retrieved based on suitability	Comments	Duplicates	Final Retrieval (Full text) Suitable Full text retrieved that will be RE-AIM appraised
<b>5. SosIndex with full text (EbscoHost Web)</b>							
1	"Digital" OR "Technology" AND "Mental Health" OR "Psychological" AND "Students" AND "COVID-19" AND "School" OR "University" OR "College" AND "Intervention"	<p>Song et al., 2022 (duplicate) Chun et al., 2022</p> <p>Rodriguez et al., 2020 (duplicate) Flett et al., 2020 (duplicate) Musyoka et al., 2020</p>	3,274	<p>Chun et al., 2022</p> <p>Musyoka et al., 2020</p>	<p>Duplicate from health source string 1</p> <p>Duplicate from health source string 1</p> <p>Duplicate from Academic search complete string 5</p>	2	

No.	Search Terms	Authors Title Screening Titles retrieved based on suitability	Hits (Title)	Retrieved (Abstract) Abstracts retrieved based on suitability	Comments	Duplicates	Final Retrieval (Full text) Suitable Full text retrieved that will be RE-AIM appraised
2	"Digital" AND "Mental Health" OR "Psychological" AND "Students" AND "COVID-19"	Halldorsson et al., 2021(duplicate) Davies & Bergin, 2020 Mehmet et al., 2020 Granic et al., 2020	35		Duplicate from academic search complete string 2	1	
3	"Mobile" OR "Internet" OR "Phone" AND "Mental Health" OR "Psychological" AND "Students" AND "COVID-19"	Pang, 2022 (duplicate) Reyes et al., 2022  Berg & Perich, 2022	1,154	Reyes et al., 2022	Duplicate from health source string 3 Focus on searching the internet for health concerns; nurses concerns, childbirth. Internet based interventions aimed at hearing loss, behaviour in children, pregnancy etc.	1	
4	"mHealth" OR "Remote" OR "Web-based" AND "Mental Health" OR "Psychological" AND "Students" AND "COVID-19"	Musyoka et al., 2020 (duplicate) Sun et al., 2022 (duplicate) Andersen et al., 2022	592		Duplicate from sosindex string 1 Duplicate from medline string 1 Mhealth studies focus mostly on hearing loss, chronic disease management. Remote studies focused on working from home	2	
5	"Internet" OR "Application" OR "APP" OR "Video" AND "Treatment" AND "Students" AND "COVID-19" AND "Intervention"	Reyes et al., 2022 (duplicate) Flett et al., 2020 (duplicate)  Berg & Perich, 2022 (duplicate) Lu & Ma, 2022 (duplicate)  Pang, 2022 (duplicate)	5,386		Duplicate from sosindex string 3 Duplicate from Academic search complete string 5  Duplicate from sosindex string 3		
6	"Digital" AND "Stress" OR "Depression" OR "Trauma" OR "Suicide" OR "Substance" AND "Students" AND "COVID-19" AND "Intervention"	Litwin et al., 2023 Zou, 2022	2,951	Zou, 2022	Majority of the studies did not focus on interventions for students. It spoke to pregnant women etc.		

No.	Search Terms	Authors Title Screening Titles retrieved based on suitability	Hits (Title)	Retrieved (Abstract) Abstracts retrieved based on suitability	Comments	Duplicates	Final Retrieval (Full text) Suitable Full text retrieved that will be RE-AIM appraised
7	"Computer" OR "Phone" OR "Internet" AND "Intervention" OR "Program" OR "Treatment" AND "Students" AND "COVID-19"	Rodriguez et al., 2020 (duplicate)	10,367		Duplicate from health source string 1  All other articles focused on pregnant women, the relationship students had with mental health (during COVID) but not linking to digital interventions	1	
8	"COVID-19" AND "Virtual" AND "Intervention" AND "Students" AND "Undergraduate" OR "Postgraduate"	Not applicable	69		Majority focused on students' research, students in the medical field, peer feedback and mentoring... limited focus on online mental health interventions	0	
9	"Phone" OR "Internet" AND "Intervention" OR "Program" OR "Treatment" AND "Wellbeing" AND "Students" AND "COVID-19"	Rachamim et al., 2022 (duplicate) Smart et al. 2023 (duplicate) Görges et al., 2020 (duplicate)	2,998		Duplicate from academic search complete string 3 Duplicate from Academic Search complete string 3 Duplicate from academic search complete string 5	3	
10	"Telephone" or "Smart Phone" or "Cell Phone" OR "Text Message" OR "SMS" OR "E-Mail" AND "Psychiatry" OR "Psychology" AND "Students" AND "COVID-19" AND "Intervention"	Hides et al., 2021 Sindahl et al., 2020	354		Text message intervention focused on patients, sleep etc. also focused on cellphone use and how it affects students/patients etc (but not linked to interventions)		
11	"Internet" AND "Treatment" OR "Diagnosis" OR "Screening" OR "Prevention" AND "Therapy" OR "Counselling" AND "Students" AND "COVID-19"	Smart et al. 2023 (duplicate)	2,053		Duplicate from Academic Search complete string 3  A lot of focus on cancer screening, autism, downsyndrome. Therapy focused on hearing, cancer, physical therapy. Limited focus on digital interventions/treatment and limited focus on students..	1	
<b>TOTAL</b>						<b>0</b>	

No.	Search Terms	Authors Title Screening Titles retrieved based on suitability	Hits (Title)	Retrieved (Abstract) Abstracts retrieved based on suitability	Comments re. title screening	Duplicates	Final Retrieval (Full text) Suitable Full text retrieved that will be RE-AIM appraised
<b>6. Sabinet (28 April)- Not enough fields to add all the key terms; hence all key terms in string placed in search bar.</b>							
1	"Digital" OR "Technology" AND "Mental Health" OR "Psychological" AND "Students" AND "COVID-19" AND "School" OR "University" OR "College" AND "Intervention"	No hits	0		No hits	0	
2	"Digital" AND "Mental Health" OR "Psychological" AND "Students" AND "COVID-19"	Not applicable	36		Articles not speaking to digital mental health of students. Titles focused on COVID-19 and advertising, and social media, COVID-19 experiences, COVID-19 public sector performance etc.	0	
3	"Mobile" OR "Internet" OR "Phone" AND "Mental Health" OR "Psychological" AND "Students" AND "COVID-19"	Boyd & Alexander, 2022 Elgzar et al., 2020	205	Boyd & Alexander, 2022 Elgzar et al., 2020	no focus on students, their psychological needs and digital intervention. Focus on things such as entrepreneurs, training programmes for creative problem solving, COVID-19 and impact on personal work perspective; education rights, Focus on entrepreneurship, COVID-19 effect on work perspectives; healthcare workers perspectives of COVID-19 vaccination; youth unemployment; experiences of online learning. Limited focus on digital mental health interventions	0	Boyd & Alexander, 2022 Elgzar et al., 2020
4	"mHealth" OR "Remote" OR "Web-based" AND "Mental Health" OR "Psychological" AND "Students" AND "COVID-19"	Boyd & Alexander, 2022 (duplicate)	205			1	
5	"Internet" OR "Application" OR "APP" OR "Video" AND "Treatment" AND "Students" AND "COVID-19" AND "Intervention"	Not applicable	21		Duplicate from sabinet string 3 Focus on telemedicine in sexual and reproductive health, health care workers, the impact of COVID on education system, legislative response to COVID-19- not focus on digital interventions	0	
6	"Digital" AND "Stress" OR "Depression" OR "Trauma" OR "Suicide" OR "Substance" AND "Students" AND "COVID-19" AND "Intervention"	Not Applicable	7		Focus on education	0	

No.	Search Terms	Authors Title Screening Titles retrieved based on suitability	Hits (Title)	Retrieved (Abstract) Abstracts retrieved based on suitability	Comments re. title screening	Duplicates	Final Retrieval (Full text) Suitable Full text retrieved that will be RE-AIM appraised
7	"Computer" OR "Phone" OR "Internet" AND "Intervention" OR "Program" OR "Treatment" AND "Students" AND "COVID-19"	Not Applicable	84		Focus on education and healthcare workers	0	
8	"COVID-19" AND "Virtual" AND "Intervention" AND "Students" AND "Undergraduate" OR "Postgraduate"	Not Applicable	55		Focus on education, learning online etc. but not mental health interventions	0	
9	"Phone" OR "Internet" AND "Intervention" OR "Program" OR "Treatment" AND "Wellbeing" AND "Students" AND "COVID-19"	Not Applicable	75		Measures taken by universities during COVID; prevention and treatments of COVID	0	
10	"Telephone" or "Smart Phone" or "Cell Phone" OR "Text Message" OR "SMS" OR "E-Mail" AND "Psychiatry" OR "Psychology" AND "Students" AND "COVID-19" AND "Intervention"	No Hits	0		N/A	0	
11	"Internet" AND "Treatment" OR "Diagnosis" OR "Screening" OR "Prevention" AND "Therapy" OR "Counselling" AND "Students" AND "COVID-19"	Not Applicable	29		Preventing violence,	0	
<b>TOTAL</b>						<b>2</b>	

No.	Search Terms	Authors Title Screening Titles retrieved based on suitability	Hits (Title)	Retrieved (Abstract) Abstracts retrieved based on suitability	Comments	Duplicates	Final Retrieval (Full text) Suitable Full text retrieved that will be RE-AIM appraised
<b>7. PubMed</b>							
1	"Digital" OR "Technology" AND "Mental Health" OR "Psychological" AND "Students" AND "COVID-19" AND "School" OR "University" OR "College" AND "Intervention"	Ang et al., 2022  Friedman et al., 2022 Liu et al., 2022 (duplicate) Lau et al., 2023 Strehli et al., 2022 Sun et al., 2022 (duplicate)	14 166	Ang et al., 2022  Friedman et al., 2022  Lau et al., 2023 Strehli et al., 2022	Student's experiences with stress and depression, not focusing on interventions (digital). Mhealth interventions focusing on physical health	2	Ang et al., 2022  Friedman et al., 2022  Lau et al., 2023 Strehli et al., 2022
					Duplicate from academic search complete string 1		
					Duplicate from Medline string 1		

No.	Search Terms	Authors Title Screening Titles retrieved based on suitability	Hits (Title)	Retrieved (Abstract) Abstracts retrieved based on suitability	Comments	Duplicates	Final Retrieval (Full text) Suitable Full text retrieved that will be RE-AIM appraised
		McCloud et al., 2020 Van Lith et al., 2021 Shabahang et al., 2021 Küchler et al., 2023		McCloud et al., 2020 Van Lith et al., 2021 Shabahang et al., 2021 Küchler et al., 2023			Shabahang et al., 2021
2	"Digital" AND "Mental Health" OR "Psychological" AND "Students" AND "COVID-19"	Friedman et al., 2022 (duplicate) Sun et al., 2022 (duplicate) Lau et al., 2023 (duplicate)	28		Limited focus on students mental health interventions, less on digital interventions Duplicates from medline string 1 (Sun et al) and Pubmed string 1	3	
3	"Mobile" OR "Internet" OR "Phone" AND "Mental Health" OR "Psychological" AND "Students" AND "COVID-19"	Friedman et al., 2022 (duplicate) Sun et al., 2022 (duplicate) Lau et al., 2023 (duplicate)	29		Limited focus on students mental health interventions, less on digital interventions Duplicates from medline string 1 (Sun et al) and Pubmed string 1	3	
4	"mHealth" OR "Remote" OR "Web-based" AND "Mental Health" OR "Psychological" AND "Students" AND "COVID-19"	Hanani et al., 2022 Sun et al., 2022 (duplicate)  Friedman et al., 2022 (duplicate) Lau et al., 2023 (duplicate)  Hanani et al., 2022 (duplicate)	28	Hanani et al., 2022	Limited focus on students mental health interventions, less on digital interventions Duplicates from medline string 1 (Sun et al) duplicates from Pubmed string 1  Duplicate from Pubmed string 3	4	Hanani et al., 2022
5	"Internet" OR "Application" OR "APP" OR "Video" AND "Treatment" AND "Students" AND "COVID-19" AND "Intervention"	Rizvi et al., 2022	2	Rizvi et al., 2022		0	Rizvi et al., 2022
6	"Digital" AND "Stress" OR "Depression" OR "Trauma" OR "Suicide" OR "Substance" AND "Students" AND "COVID-19" AND "Intervention"	Sun et al., 2022 (duplicate)	8		Duplicate from medline string 1	1	
7	"Computer" OR "Phone" OR "Internet" AND "Intervention" OR "Program" OR "Treatment" AND "Students" AND "COVID-19"	Simonsson et al., 2021 (duplicate) Zheng et al., 2021 Shabahang et al., 2021 (duplicate) Rackoff et al., 2022 Rizvi et al., 2022 (duplicate) Sun et al., 2022 (duplicate)	33		Duplicate from medline string 9  Duplicate from Pubmed string 3  Rackoff et al., 2022  Duplicate from Pubmed string 5  Duplicate from Pubmed string 3	5	Rackoff et al., 2022

No.	Search Terms	Authors Title Screening Titles retrieved based on suitability	Hits (Title)	Retrieved (Abstract) Abstracts retrieved based on suitability	Comments	Duplicates	Final Retrieval (Full text) Suitable Full text retrieved that will be RE-AIM appraised
		Hanani et al., 2022 (duplicate)			Duplicate from Pubmed string 3		
8	"COVID-19" AND "Virtual" AND "Intervention" AND "Students" AND "Undergraduate" OR "Postgraduate"	Not applicable	339		Limited focus on mental health interventions. More focus on medications that is not mental health related (i.e. diet, COVID treatment)	0	
9	"Phone" OR "Internet" AND "Intervention" OR "Program" OR "Treatment" AND "Wellbeing" AND "Students" AND "COVID-19"	Not applicable	2		Articles not linked to student/digital mental health interventions	0	
10	"Telephone" or "Smart Phone" or "Cell Phone" OR "Text Message" OR "SMS" OR "E-Mail" AND "Psychiatry" OR "Psychology" AND "Students" AND "COVID-19" AND "Intervention"	Shabahang et al., 2021 (duplicate) Friedman et al., 2022 (duplicate) Sun et al., 2022 (duplicate) Hanani et al., 2022 (duplicate)	17		Duplicates from Pubmed string 3.  Duplicate from medline string 1	5	
11	"Internet" AND "Treatment" OR "Diagnosis" OR "Screening" OR "Prevention" AND "Therapy" OR "Counselling" AND "Students" AND "COVID-19"	Zheng et al., 2021 (duplicate) Rizvi et al., 2022 Zheng et al., 2021 (duplicate) Rackoff et al., 2022 (duplicate) Sun et al., 2022 (duplicate)	10		duplicate from Pumed string 5 Duplicate #1 from Pubmed string 7  Duplicate from medline string 1	2	

**TOTAL 8**

### Summary

Title Screening		Abstract Screening		Full Text Screening	
Academic Search Complete	42 548	Academic Search Complete	18	Academic Search Complete	2

Health Source	3857	Health Source	4	Health Source	1
Medline	195 182	Medline	21	Medline	8
APA PsycArticles	5955	APA PsycArticles	0	APA PsycArticles	0
SosIndex	29 233	SosIndex	4	SosIndex	0
Sabinet	717	Sabinet	2	Sabinet	2
Pubmed	14 662	Pubmed	11	Pubmed	8
<b>Total</b>	<b>292 154</b>	<b>Total</b>	<b>60</b>	<b>Total</b>	<b>21 – For appraisal</b>
<b>Duplicates: 89</b>					
<b>Titles after Duplicates: 292 065</b>					
<b>Eligible Abstracts Screened: 128</b>					

## Appendix C: Critical appraisal tools for the screening of articles – Interventions

REACH		
QUESTION	SCORING	
Does the article indicate who the intervention is intended for (inclusion criteria)?	Yes = 1	No = 0
Does the article report on exclusion criteria?	Yes = 1	No = 0
Does the article report on the representativeness of the target population? (gender)?	Yes = 1	No = 0
Does the article report on participation rate?	Yes = 1	No = 0
Are there reports on indirect beneficiaries?	Yes = 1	No = 0
EFFECTIVENESS		
Did the intervention achieve the intended objectives?	Yes = 1	No = 0
Does the article report on the limitations of the intervention?	Yes = 1	No = 0
Are there reports of attrition (no. of people who completed the programme)?	Yes = 1	No = 0
Does the article include recommendations to improve the intervention?	Yes = 1	No = 0
Does the article include recommendations for practice?	Yes = 1	No = 0
ADOPTION		
Is the setting described in terms of country and place of intervention (e.g. Play Store, IStore etc)?	Yes = 1	No = 0
Is the context described (web based, mobile phone etc.)?	Yes = 1	No = 0
Is reference made to how accessible the place of intervention was to the participants (for example, their school, local clinic etc.)?	Yes = 1	No = 0
Are there reports on the adoption of the intervention by the participants (for example, were they open to the intervention, resistant etc.)?	Yes = 1	No = 0
Are there reports on consultation or partnering with community/school/family/other stakeholders prior to the intervention?	Yes = 1	No = 0
IMPLEMENTATION		
Are there reports of resources required to conduct the intervention?	Yes = 1	No = 0
Are there reports of who did the intervention (social worker, teacher etc.)?	Yes = 1	No = 0
Is the duration and frequency of the intervention described?	Yes = 1	No = 0
Is training or experience required to implement the intervention?	Yes = 1	No = 0
Did participants evaluate the intervention?	Yes = 1	No = 0
MAINTENANCE		
Does the article report on long term effects of the intervention (after 6 months)	Yes = 1	No = 0
Does the article report on indicators used for intervention follow-up?	Yes = 1	No = 0
Are there reports on the attrition rates (number of those completed the intervention vs. number that participated in the follow up)?	Yes = 1	No = 0
Are there reports on relapse?	Yes = 1	No = 0
Is the method of follow up indicated (telephone calls, interviews, questionnaire etc.)?	Yes = 1	No = 0
<b>TOTAL</b>		<b>25</b>

*Adapted from Glasgow et al (1999)*

## Appendix D1: Data extraction tool (Demographics)

No	Author and Year	Country	Aim of study	Study Design	Digital Platform	Name of Intervention
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						

## Appendix D2: Data extraction tool (REAIM Properties)

<b>REACH</b> Target Population, inclusion, exclusion, recruitment, participation rate	<b>EFFICACY</b> Meeting intended objectives, attrition, limitations, recommendations	<b>ADOPTION</b> Setting, consultation, participant feedback and adoption by participants	<b>IMPLEMENTATION</b> Nature of intervention, interventionalist and training of interventionalist	<b>MAINTENANCE (6 MONTHS)</b> Follow up and reports of relapse
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Ang et al., 2022

Reach

Efficacy

Adoption

Implementation

Maintenance

Boyd & Alexander, 2022

Reach

Efficacy

Adoption

Implementation

Maintenance

Chu et al., 2022

Reach

Efficacy

Adoption

**Implementation**

**Maintenance**

**Friedman et al., 2022**

**Reach**

**Efficacy**

**Adoption**

**Implementation**

**Maintenance**

**King et al., 2022**

**Reach**

**Efficacy**

**Adoption**

**Implementation**

**Maintenance**

**Lau et al., 2022**

**Reach**

**Efficacy**

**Adoption**

**Implementation**

**Maintenance**

**Liu et al., 2021**

**Reach**

**Efficacy**

**Adoption**

**Implementation**

**Maintenance**

**Nardi et al., 2022**

**Reach**

**Efficacy**

**Adoption**

**Implementation**

**Maintenance**

**Simmons et al., 2021**

**Reach**

**Efficacy**

**Adoption**

**Implementation**

**Maintenance**

**Sun et al., 2022**

**Reach**

**Efficacy**

**Adoption**

**Implementation**

**Maintenance**

**Tay et al., 2022**

**Reach**

**Efficacy**

**Adoption**

**Implementation**

**Maintenance**

## Appendix E: Ethics approval from the Human and Social Sciences Research Ethics Committee



UNIVERSITY of the  
WESTERN CAPE

Directorate: DVC: Research and Innovation  
Research Development & Postgraduate Support  
Tel: +27 21 959 4111  
Email: [research-ethics@uwc.ac.za](mailto:research-ethics@uwc.ac.za)

12 June 2023

Dr Z Kader  
Psychology  
Faculty of Community and Health Sciences

**HSSREC Reference Number:** HS23/4/16

**Project Title:** A systematic review of digital mental health interventions for students during the COVID-19 Pandemic

**Approval Period:** 09 June 2023 – 08 June 2024

I hereby certify that the Humanities and Social Science Research Ethics Committee of the University of the Western Cape approved the methodology and ethics of the above-mentioned research project.

Any amendments, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.

*Please remember to submit an annual progress report at least two months before expiry date. Failure to submit your annual progress report on time will result in the immediate lapse of your ethics approval and you will have to resubmit an entirely new ethics application.*

For permission to conduct research using student and/or staff data or to distribute research surveys/questionnaires please apply via: <https://sites.google.com/uwc.ac.za/permissionresearch/home>

*The permission letter must then be submitted to HSSREC for record keeping purposes.*

The Committee must be informed of any serious adverse events and/or termination of the study.

A handwritten signature in black ink, appearing to read 'Josias'.

Ms Patricia Josias  
Coordinator: Research Ethics  
University of the Western Cape

NHREC Registration Number: HSSREC-130416-049

University of the Western Cape, Robert Sobukwe Road, Bellville 7535, Republic of South Africa

## Appendix F: Editorial Certificate

29 February 2024

To whom it may concern

Dear Sir/Madam

**RE: Editorial certificate**

This letter serves to prove that the thesis listed below was language edited for proper English, grammar, punctuation, spelling, as well as overall layout and style by myself, publisher/proprietor of Aquarian Publications, a native English speaking editor.

**Thesis title**

A SYSTEMATIC REVIEW OF DIGITAL MENTAL HEALTH INTERVENTIONS FOR STUDENTS DURING THE COVID-19 PANDEMIC

**Author**

Zainab Kader

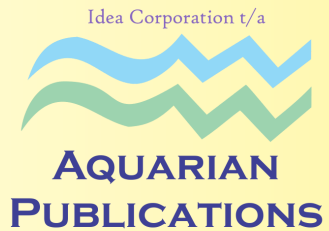
The research content, or the author's intentions, were not altered in any way during the editing process, and the author has the authority to accept, or reject my suggestions and changes.

Should you have any questions or concerns about this edited document, I can be contacted at the listed telephone and fax numbers or e-mail addresses.

Yours truly



E H Londt  
Publisher/Proprietor



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