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EFFECT OF BREATHING EXERCISES ON PERCEIVED STRESS LEVEL AMONG THE FRENCH-SPEAKING COMMUNITY IN ABU DHABI, UAE: A COMPARATIVE STUDY BETWEEN ONLINE AND MOBILE APPLICATION DELIVERY METHODS

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EFFECT OF BREATHING EXERCISES ON PERCEIVED STRESS LEVEL AMONG THE FRENCH-SPEAKING COMMUNITY IN ABU DHABI, UAE: A COMPARATIVE STUDY BETWEEN ONLINE AND MOBILE APPLICATION DELIVERY METHODS

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This thesis is submitted in partial fulfilment of the requirements for the degree of Master of Science in Clinical Psychology

Under the Supervision of Dr. Fadwa Al Mughairbi

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Declaration of Original Work

I, Nathalie El Asmar, the undersigned, a graduate student at the United Arab Emirates University (UAEU), and the author of this thesis entitled "*Effect of Breathing Exercises on Perceived Stress Level Among the French-Speaking Community in Abu Dhabi, UAE: A Comparative Study Between Online and Mobile Application Delivery Methods*", hereby, solemnly declare that this thesis is my own original research work that has been done and prepared by me under the supervision of Dr. Fadwa Al Mughairbi, in the College of Medicine and Health Sciences at UAEU. This work has not previously formed the basis for the award of any academic degree, diploma or a similar title at this or any other university. Any materials borrowed from other sources (whether published or unpublished) and relied upon or included in my thesis have been properly cited and acknowledged in accordance with appropriate academic conventions. I further declare that there is no potential conflict of interest with respect to the research, data collection, authorship, presentation and/or publication of this thesis.

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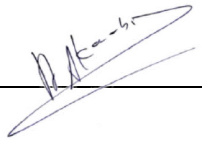
Signature  Date 28/12/2021

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Abstract

Breathing exercises have many health benefits, especially in terms of stress reduction. Several studies have examined the effect of breathing on stress levels; however, there is a lack of studies comparing delivery methods. This study aimed to compare the difference in perceived stress levels in people who performed breathing exercises face-to-face using an online video conferencing tool versus people who used a mobile breathing application. The sample consisted of sixty-two French-speaking individuals living in Abu Dhabi, United Arab Emirates. Before beginning the study, volunteers completed the Perceived Stress Scale-14 items. Those with results that showed a medium to a high level of stress were recruited. Participants were randomly divided into two groups, the internet meeting (IM) group, and the mobile application (MA) group. The participants of the IM group were subject to direct training breathing classes via an internet meeting program once per week for four weeks; each session lasted 20 minutes (including welcoming, explanations, questionnaire, breathing exercises, and discussion with the researcher); they were then instructed to apply the breathing exercises on their own two other times per week. The MA group used the "Breathe: Relax and Focus" mobile application three times per week for 5 minutes for four weeks. At midpoint and endpoint, all participants completed the PSS-14 to measure their perceived stress. Results showed that both delivery methods were equally successful in reducing perceived stress. This study paves the way to show that it is essential to consider the delivery methods used in stress management and that the future of clinical practice is moving towards the administration of blended treatment delivery.

Keywords: Breathing, Perceived Stress, Face-to-Face, Mobile Application, Stress Management, Mental Health.

Title and Abstract (in Arabic)

تأثير تمارين التنفس على مستوى التوتر المّدرَك وسط عينة من الناطقين باللغة الفرنسية في أبو ظبي: دراسة مقارنة بين طرق تقديم التمارين عبر الانترنت وتطبيقات الهاتف المتحرك

الملخص

لتمارين التنفس العديد من الفوائد الصحية، خاصة فيما يتعلق بتخفيف التوتر. بحثت العديد من الدراسات تأثير التنفس على مستويات التوتر. ومع ذلك، هناك نقص في الدراسات التي تقارن بين طرق تقديم هذه التمارين. هدفت هذه الدراسة إلى مقارنة الاختلاف في مستويات التوتر االمّدرَك لدى الأشخاص الذين أجروا تمارين التنفس عبر ارشاد مباشر عن طريق برنامج المقابلة بالإنترنت مقارنة بالأشخاص الذين استخدموا تمارين التنفس بواسطة تطبيقات الهواتف المتحركة. تكونت العينة من اثنين وستين فرداً من الناطقين باللغة الفرنسية القانطين في مدينة أبو ظبي بدولة الإمارات العربية المتحدة. قبل بدء الدراسة، أكمل المتطوعون مقياس التوتر المدرك – 14 سؤال. تم اختيار أولئك الذين أظهرت نتائجهم مستوى متوسط إلى مرتفع من التوتر. تم تقسيم المشاركين بشكل عشوائي إلى مجموعتين، مجموعة مقابلات الانترنت (IM) ومجموعة تطبيقات الهاتف المتحرك (MA). خضع المشاركون في مجموعة IM إلى إرشاد مباشر لتدريبات التنفس عبر برنامج مقابلات بواسطة الانترنت، مرة واحدة في الأسبوع لمدة أربعة أسابيع، استغرقت كل جلسة 20 دقيقة (بما في ذلك الترحيب، والشرح، والاستبيان، وتمارين التنفس، والمناقشة مع الباحث)؛ ثم تم توجيههم لتطبيق تمارين التنفس بأنفسهم مرتين أسبوعيا. أما مجموعةMA، فقد استخدمت تطبيق الهاتف المتحرك "Breathe: Relax and Focus" ثلاث مرات في الأسبوع لمدة 5 دقائق لمدة أربعة أسابيع. في نهاية كل أسبوع، أكمل جميع المشاركين مقياس PSS-14 لقياس التوتر المّدرَك. أظهرت النتائج أن كلتا طريقتي التوصيل كانتا ناجحتين بشكل متساوٍ في تقليل التوتر المّدرَك. تمهد هذه الدراسة الطريق لإظهار أنه من الضروري النظر في طرق التسليم المستخدمة في إدارة التوتر وأن مستقبل الممارسة السريرية يتجه نحو إدارة تقديم طرق علاج تجمع بين الطرق المختلفة.

مفاهيم البحث الرئيسية: التنفس، التوتر المدرك، وجها لوجه، تطبيقات الهاتف المتحرك، إدارة التوتر، الصحة العقلية.

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And of course, I will not forget my university colleagues and friends, thank you for your presence and encouraging words.

Dedication

To my beloved husband and children

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List of Abbreviations

APA	American Psychological Association
Apps	Mobile Applications
DRB	Deep Relaxation Breathing
ELS	Early Life Stress
GAS	General Adaptation Syndrome
IM	Internet Meeting
MA	Mobile App
MB	Mindfulness Breathwork
PSL	Perceived Stress Level
PSS	Perceived Stress Scale
SDB	Slow and Deep Breathing
UAE	United Arab Emirates
YB	Yogic Breathing

Chapter 1: Introduction

1.1 Overview

Stress is a significant concern in our fast-paced society. It is even more of a problem since the Coronavirus pandemic started in early 2020. In the past few years, self-reported stress has significantly risen. Gallup, a large polling company, reported that stress, among other negative emotions, was declared the highest in 2020 since the company started its global tracking in 2005. However, the report indicated that this presenting problem had started almost ten years ago and that 2020 was the worst and most stressful year, with an increase of five percentage points compared to 2019. The worldwide population's negative experience is rising, and this trend has been constant for the past 15 years. The record of 40% of the respondents reported experiencing stress on the day preceding the survey, with more than half the countries reporting an increase (Gallup, 2021).

When stress does arise, some of the ways to lessen the effect of distress may, at first glance, seem beneficial. In the long run, behaviors such as binge eating, oversleeping, alcohol consumption, or overspending will have adverse consequences. How is it possible to reverse this fight or flight response, more commonly called acute stress response? Countless techniques exist. One way is to put the body under a relaxation response (Benson et al., 1974), where the body approaches a state of physiological and psychological relaxation. Studies show that mind-body interventions, including the activation of the relaxation response, are an effective method to reduce the effects of stress (Benson et al., 1974; Cohen et al., 2007). Working with the body makes it possible to regulate emotions and, therefore, the mind

(Shanon, 2008). Research shows that relaxation techniques are a complementary and beneficial way to reduce stress (Goessl et al., 2017; Hopper et al., 2018; Toussaint et al., 2021; Woodyard, 2011).

Overcoming stress can be achieved in several ways. Stress management techniques are scientifically proven approaches to reducing stress. They encompass several methods and tools to help individuals improve their health and adapt to challenging situations. Stress relievers, such as taking a walk, listening to music, exercising, journaling, meditating, or practicing breathing, effectively calm the body and mind. Therefore, as a stress management technique, relaxation approaches are known to positively affect physiological and psychological states (Bastani et al., 2005; Ertekin Pinar et al., 2018; Goessl et al., 2017; Toussaint et al., 2021; Woodyard, 2011). These techniques should be practiced frequently and should become a habit to manage stress in the long run.

As a relaxation technique, breathing exercises induce a relaxing state that calms the body and helps in times of stress. Many types of exercises exist, among them deep breathing or also known as diaphragmatic breathing. It involves “the contraction of the diaphragm muscle to move air downward into the body, which increases diaphragm length and breathing efficiency and facilitates more efficient exhalation” (Chen et al., 2017, p. 329). It is used in multiple settings and for multiple patient populations (Toussaint et al., 2021). Research shows that this strategy effectively reduces stress (Brown & Gerbarg, 2005; Christakis et al., 2012; Maqbool Kermane, 2016). In their newly released guide providing techniques to help people cope with stress, the World Health Organization (WHO, 2020) suggests breathing as a grounding exercise to reduce stress levels and as a technique that helps to accept the disturbing thoughts and feelings that anyone can have.

Thousands of mental health mobile applications (Apps) exist in the mobile health scene. The growing consumer interest in this type of support allows clinicians to add a component to the treatment processes (Neary & Schueller, 2018). Apps have the advantages of being inexpensive, allowing immediate and easy access, and having a broad reach (Duraimani, 2019; Flett et al., 2019; Linardon et al., 2019). However, researchers question their efficacy for a range of mental health conditions (Huckvale et al., 2020; Linardon et al., 2019; Neary & Schueller, 2018) and challenge the fact that apps based on stress management programs help relieve stress symptoms (Flett et al., 2019; Hwang & Jo, 2019). As breathing is part of stress management programs, there is growing research on its efficacy in reducing stress levels. However, studies comparing breathing techniques and the way they are delivered and studies on breathing apps and their efficacy are lacking.

Culture plays an essential role in expatriation. When people relocate to a new country, adapting to new lifestyles, habits, and ways of life becomes challenging. Routines can be disrupted, and homesickness can be present, leaving family and friends behind makes adaptation and adjustment difficult. Language and cultural norms are factors that can induce stress due to disruptions in the lives of people moving to a new country (Shin et al., 2007); therefore, as an essential part of adapting to a new culture, communication and language become a barrier. In addition to being foreign to a country, the current health situation provoked by the pandemic made it, if not impossible, very difficult to travel for people needing to see their families. Thereby, another stressor was weighing on people's shoulders. Preventing stress is not always possible. Finding ways to decrease stress levels is the best solution; stress management training is one of the ways to manage stress.

1.2 Statement of the Problem

Stress has many negative consequences, and the damage it can cause can be detrimental to well-being. However, stress is unavoidable, and dealing with it can prevent severe physical and mental health problems. Diverse strategies exist to manage stress, and mind-body interventions are one way to tackle the difficulties experienced by individuals affected by the problem of stress. As a stress management tool, breathing has been shown to help reduce stress. Breathing can be practiced in different ways and through various means.

The purpose of this experiment is to differentiate the perceived stress levels of individuals practicing breathing with a trainer and those using a self-directed mobile application without the direct input of a trainer, and thus to know if human interaction has an importance on the results. The outcome can provide evidence for the overall importance of mind-body strategies in stress management. In addition, the study will pave the way for future research based on the different ways of practicing breathing.

1.3 Relevant Literature

1.3.1 Stress

"People are disturbed not by a thing, but by their perception of a thing" – Epictetus

A Brief History Leading to a Definition of Stress

Stress is both the most well-defined concept and the most widely used generic term. Stress has been the subject of many models, whether in physiology, psychology, sociology, or medicine. Nevertheless, it remains a fuzzy notion that characterizes a biological, psychological, and social phenomenon. In clinical psychology, stress finds its origin in the research of Hans Selye, who provided a physiological model of stress

(Hinkle, 1974). Working on this model, Selye described a general process called the general adaptation syndrome (GAS), corresponding to a physiological reaction of the organism subjected to aggression, it was called Selye's Syndrome (Tan & Yip, 2018), and later termed as stress response (Robinson, 2018). Building on Selye's work, Richard Lazarus took further the definition of stress. In defining this construct, he brought up the importance of personal meaning, appraisal, and emotions (Robinson, 2018), thus incorporating cognition as part of the stress responses. Cognitive factors and coping strategies were considered critical elements for Lazarus (Le Moal, 2007).

Defining stress seems a rather difficult task, Le Moal (2007) expressed the impossibility of defining stress, Del Giudice et al. (2018) indicated the challenge to define stress, Selye (1959) himself specified the complication of using the correct terms. He defined *stress* as "a state manifested by a specific syndrome which consists of all the non-specifically induced changes in a biologic system" (Selye, 1959, p.403). Koolhaas et al. (2011) attested how stress had been debated scientifically since Selye first introduced the term in biology. The authors (p.1292) proposed that stress "should be considered as a cognitive perception of uncontrollability and/or unpredictability that is expressed in a physiological and behavioral response." Furthermore, Del Giudice et al. (2018, p. 1019) stated that the scientific field refined the definition of stress by referring to "stressors," which are "actual or perceived threats to the homeostasis of the organism" and to "stress responses", which are reactions of the organism to return to homeostasis (Chrousos, 2009). Koolhaas et al. (2011, p. 1292) continued to point out that "virtually all activities of an organism directly or indirectly concern the defense of homeostasis", therefore the authors suggested reconsidering the construct of stress as a threat to homeostasis. Armario (2006) highlighted this point of view. He rejected the reference of homeostasis to explain stress. Nonetheless, homeostasis

continues to be a reference in the definition of stress. Authors such as Epel et al. (2018) defined *stress* as the occurrence of an unforeseen event or situation ("stressors" or "stressor exposures") that threaten the physical or mental integrity, therefore the homeostasis. They also referred to the "stress responses" as cognitive, emotional, and biological reactions to situations. Having been ruled out for defining stress, McEwen (2000, as cited in Armario, 2006) revised the term homeostasis and started to use the term allostasis in the scientific literature. Sterling and Eyer developed the term allostasis in 1988 (Schnall et al., 2017, p. 101) and worked on theories of stress to "include the physiological consequences of chronic exposure." *Allostasis* is defined as "the process of achieving stability through change in anticipation of physiological requirements" (Sterling & Eyer, 1988, as cited in Koolhaas et al., 2011, p. 1297). Armario (2006) and Le Moal (2007) suggested that to define stress, it would be best to use allostasis rather than homeostasis, allostasis being a "more accurate and flexible concept than homeostasis" (Le Moal, 2007, S3).

Stress is present in people's daily lives and is often talked about; its popular use is widespread. Several models of stress have followed one another and still coexist, some more in the medical sciences. In psychology, a significant number of theoretical models have tried to explain the etiology of stress. Lazarus' work was of great prominence; for him, the "stress response" is associated with multiple factors (Robinson, 2018). His theory considered the phenomenological approach and the importance of human variations towards stress (Lazarus & Folkman, 1984). For Lazarus & Folkman (1984, p. 22), the concept of cognitive appraisal is necessary to the study of stress. The authors emphasized the importance of individual and group differences.

Robinson (2018) underlined that since Selye's first works, stress and its impact on people's physiological and psychological health were of concern to epidemiologists and public health researchers. He continued to highlight how World Wars I and II influenced the different disciplines to ally and study how psychological stress impacts the body and the mind.

Impact of Stress

Stress exposures have various impacts depending on the different developmental periods of life; they are thus an essential factor to consider when studying the effects of stress. According to van Bodegom et al. (2017), early life stress exposures can alter brain maturation and have long-lasting effects. Research on maternal stress during pregnancy shows links to the risk of preterm birth (Lilliecreutz et al., 2016), shorter telomeres of newborns (Send et al., 2017), decreased cognitive functions of children (Polanska et al., 2017), and among many other outcomes, attention skills and spatial working memory during early childhood (Plamondon et al., 2015). Maternal stress (among other factors) has also shown repercussions on attachment security (Atkinson, 2000). Another critical period of life is adolescence; it is a period where the organism matures. Thus, stressor exposures are essential to take into consideration. Lo Iacono and Carola (2018) reported that stress exposures likely cause psychopathologies in adult life. A meta-analysis conducted by LeMoult et al. (2020) concluded that early life stress (ELS) (they defined ELS as "any event with characteristics that would be considered stressful during early life, including divorce, hospitalization, and death of family member" p. 844) was a predictor for depression in childhood and adolescence.

Not all individuals are equal when facing adverse and stressful situations. Epel et al. (2018) emphasized the idea of context to measure the impact on aging and health.

By context, the authors referred to “individual and environmental factors, personal histories of stressor exposure (stress in childhood in particular but also cumulative life stress), current chronic stressors, and existing protective factors” (p. 162). It is also important to distinguish acute stressful situations from chronic stressful situations as they have distinct effects on health. A state of acute stress corresponds to the body’s reactions when one faces a threat or a one-off issue (e.g., public speaking, unexpected situation); when the situation ends, the symptoms of stress stop soon after. The state of chronic stress is a body response to a stressful situation that sets in over time. It always has deleterious effects on health.

Intuitively, one might think that stress can have adverse effects on health, and research shows how stress can predict and exacerbate considerable mental health problems, such as depression (Herbison et al., 2017), schizophrenia (Gomes & Grace, 2017), and Alzheimer’s disease (Justice, 2018). Stress can also negatively affect memory (Hidalgo et al., 2019; Schwabe, 2017). However, a meta-analysis conducted by Shields et al. (2017) highlighted that stress impacts different phases of memory and depending on when stress occurred during a task (e.g., encoding or retrieval), it can impair or improve memory.

With psychological responses to stress come physiological responses. Elevation in respiratory rate, heart rate, and systolic blood pressure result from stress (Hopper et al., 2018). Stress also affects cardiovascular disease (Dar et al., 2019) and adults who already have a preexisting cardiovascular disease are at high risk of illness (Kivimäki & Steptoe, 2018).

More than physiological and psychological impacts on individuals, stress has a major impact on the economy. A systematic review by Hassard et al. (2018) summarized and compared studies evaluating the cost of work-related stress to society

(expressed in US dollars), "the total estimated cost of work-related stress was observed to range from $221.3 million to upward of $187 billion" (p. 12). However, the authors noted that analyzing research on the costs of work-related stress to society from an international perspective is, at this time, difficult (p. 14). The significant impacts of stress on individuals and the economy empowers researchers to establish stress-reduction interventions. Hopper et al. (2018) emphasized the importance of evidence-based, low cost, easy to use and self-administered stress reduction interventions to treat and manage this global health issue.

Today as we enter the end of the second year of living with the Coronavirus disease (COVID-19), numerous studies have analyzed the impact of the virus on mental health. Benham (2021) reported on studies conducted in China, Spain, Italy, and the United States, where respondents reported stress with varying degrees. The author pointed out that the "findings are limited by the lack of comparison groups and/or the nature of the stress measures employed" (p. 505). His findings did not suggest an increase in self-perceived stress, contrary to what other studies indicated. Benham's (2021) findings corroborated those of Ekama Ilesanmi et al. (2021), who reported low stress levels in their studied sample. Despite results found in certain studies, it is fair to say that the pandemic that began in early 2020 has had a significant mark on people, whether it is in their stress level or their quality of life.

Prevalence of Stress

Stress affects all strata of society, all gender and age groups. Worker or not, everyone will face stress one day. Evaluating stress levels is a difficult task for researchers as stress is a personal and subjective experience. However, self-report measures of life stressor exposure are common and easy to use in assessing stress. Slavich (2016) referred to some concerns about their reliability and validity that

researchers meet. To have more accurate answers from respondents, researchers have developed interview-based systems (Slavich, 2016). However, it is nearly impossible for investigators to measure stress this way when conducting surveys about stress. Taking into consideration the above information, it is challenging to assess stress levels for the general population. However, some countries, such as the United States, conduct surveys about stress. Each year since 2007, the American Psychological Association (APA) surveys Americans about stress. The 2020 report indicated that this year was different compared to other years due to the COVID-19 pandemic, with 78% of adults reporting that the coronavirus pandemic was a great source of stress for them, and 67% of them reporting experience of increased stress during the pandemic (APA, 2020). The pandemic has affected many persons, among them parents and their children. According to the APA's 2021 Stress in America survey (APA, 2021), about half of the parents have seen an increase in their stress level due to a shift from physical to remote schooling.

A systematic review and meta-analysis conducted by Salari et al. (2020) on the prevalence of stress, anxiety, and depression in the general population following the COVID-19 pandemic found that 29.6 % experienced stress. The analyzed studies found that women are more prone to stress. This finding is in line with other studies, one of which was conducted on the Italian population (Mazza et al., 2020). Salari et al. (2020) reported that the age group of 21 to 40 years were the most impacted group due to them being "key active working forces" (p. 5) and being more informed through social media. Mazza et al. (2020) found the same results, however, they did not specify the exact ages. Another systematic review and meta-analysis conducted by Nochaiwong et al. (2021) on the global prevalence of mental health among the general population during the coronavirus pandemic found similar results to previous reviews.

A study conducted by Cheikh Ismail et al. (2021) on the impact of the coronavirus pandemic lockdown on mental health and well-being in the United Arab Emirates (UAE) showed that increased stress was experienced by 43% of the participants when it came to work-related issues, 36.5% of them when it came to financial matters and 55.7% when it came to the subject of home during the lockdown.

1.3.2 Stress Management Techniques

Protecting oneself from the effects of stress can be either innate or learned. Some people are more prone to regulate their stress levels on their own, while others would find this task immeasurable. Controlling stress levels is not necessarily aimed at people having diseases or disorders but also at healthy people (Varvogli & Darviri, 2011). Below is a review of some of the most used and evidenced-based techniques.

Evidence-based Stress Management Techniques

In the introduction of their book, Lehrer et al. (2007) emphasize the importance of learning how to use stress management techniques and evaluating their clinical worth (p. 6). Many ways of reducing stress exist. Examples are social support, positive coping, optimism, prayer, exercise (McGrady, 2007). Stress management techniques are also numerous. Below is an explanation of a few of them.

Relaxation Techniques

A state of relaxation means that the body is free from tension and the mind free from anxiety. It is, therefore, a state that needs conscious effort at first and can become natural with time. Smith (2007) sorts the relaxation techniques into six families: yoga stretching, progressive muscle relaxation, breathing exercises, autogenic training, imagery/positive self-statements, and meditation/mindfulness. According to the author, each stress response corresponds to a relaxation technique. For example, if one

experiences stress in their muscles, the best-suited technique would be the progressive muscle relaxation technique; if there is emotional stress, imagery and positive self-talk would be an excellent technique to use. Some techniques combine several types of relaxation techniques. For example, mindfulness meditation is a blend of breathing, mindfulness, and yoga stretching.

Even though relaxation techniques are ancient, the scientific literature has seen an increase in research over the years. A plethora of studies has examined the effect of relaxation techniques on many areas such as work, students, parenting, physical health, coping strategies. There are also many reviews assessing different types of techniques. They show that this stress reduction technique is an alternative therapeutic approach and complementary to therapy (Sharma & Rush, 2014).

Smartphone Interventions

Stress management resources are multiplying, and mobile applications in the health sector are proliferating. There is much interest and an increase in the research associated with app-supported smartphone interventions in the field of mental health problems (Linardon et al., 2019). Today, smartphone owners are trumping people who do not use this type of phone. According to the *Digital 2021 Q2 Global Digital Statshot* report, 5.29 billion people own a mobile phone, representing 67% of the world's population (Kemp, 2021). Thus, the use of self-help stress management tools is more and more accessible, and people who cannot pay for human interaction have a wide choice from which to choose. Indeed, constant accessibility, flexibility, low cost, and sometimes free access are some of the benefits of these techniques.

A meta-analysis conducted by Linardon et al. (2019) suggested that there is evidence that app-supported smartphone interventions are effective for certain types of mental health problems, such as depression, anxiety, and stress. The authors pointed

out that the long-term efficacy of this kind of intervention is “an important goal” (p. 334). Similar findings were also found in studies reporting the decrease in stress level and the improvement of well-being after using a mobile application (Serino et al., 2015; Dillon et al., 2016; Coelhoso et al., 2019; Hwang & Jo, 2019).

1.3.3 Breathing Techniques

What is the first and last thing we do in life? We breathe! Breathing is natural, we never think about it, and yet we even forget about it. Breathing is free, automatic, accessible to everyone, and has no side effects. Breathing exercises engage individuals in an active process of taking conscious control of their respiration (Gholamrezaei et al., 2021).

In western culture, breathing techniques have been used recently and are not related to any religious or spiritual beliefs; instead, they are used for therapeutic purposes and are based on paced breathing (Zaccaro et al., 2018). Aideyan et al. (2020, p. 79) referred to breathing techniques as “innumerable (…) with much complexity in type, application, and outcome”, they, however, share commonalities. The same authors identified three broad categories of breathing techniques in the clinical field: deep relaxation breathing (DRB), mindfulness breathwork (MB), and yogic breathing (YB). The research focused on DRB mainly aims at studying the effects on acute anxiety and chronic stress (Aideyan et al., 2020). According to Aideyan et al. (2020, p. 83), “MB techniques are typically administered as a stand-alone intervention”; they are techniques that bring attention to breathing (Maqbool Kermane, 2016). YB finds its foundation in yoga practice and is named *pranayama* in Sanskrit. This type of technique enables the alteration of the breathing process. Examples are rapid

diaphragmatic breathing, slow/deep breathing, alternate nostril breathing, and breath holding/retention (Jayawardena et al., 2020).

Studies on breathing exercises, such as equal breathing, 4-7-8 breathing, alternate-nostril breathing, or box breathing (to name a few), are scarce and even not available. When it comes to studies on breathing, what researchers focus on is the type of breathing; paced versus fast. Some techniques are known to be beneficial for reducing certain inconveniences of life or can help relieve some of life's mishaps, such as difficulty in sleeping or lack of focus. Box breathing (or square breathing or four-square breathing), for example, is a type of paced breathing and is known to be one of these techniques that help people reduce their stress levels. The U.S. Navy SEALs much use it. Lauria et al. (2017) suggested that box breathing is an evidence-based performance-enhancing psychological skill to practice improving emergency care providers' performance under stress. The authors recommended this exercise to reduce stress levels and "help optimize psychological readiness and performance" (p. 888). A certain rhythm has to be followed to use the box breathing exercises, as its name comes from the symbol of a square that people have to visualize. Each step requires a count of four, and the person follows each side of the square by breathing through the diaphragm. The first step is to inhale through the nose, hold the breath, exhale through the nose or mouth, and finally hold the breath again. The same pattern is repeated until a state of relaxation is reached (Figure 1).

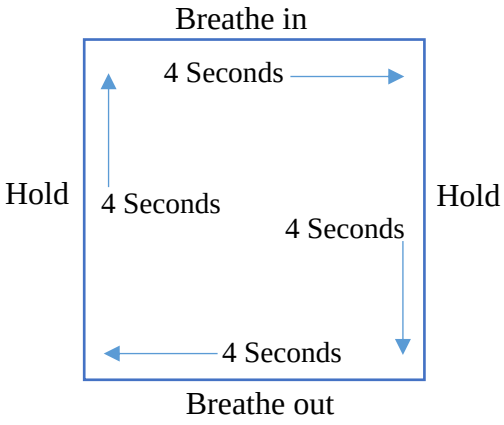

Figure 1: Method for Box Breathing.

Benefits of Breathing

Practicing slow and deep breathing (SDB) (or diaphragmatic breathing) brings many mental and physical health advantages. The practice is easy to learn, free, simple, does not need special tools or equipment and can be done anytime. In short, it is just right under your nose and easy to access! When considering the physiology aspect, evidence of some pain attenuation while practicing SDB has been shown (Jafari et al., 2020; Zautra et al., 2010). A study taking into account the physiological and psychological aspects showed improvements in the heart rate and salivary cortisol levels, mood, and perceived stress, with no improvements observed in the control group (study conducted on university students by Perciavalle et al., 2017). A meta-analysis by Yau and Loke (2021) examining the impact of diaphragmatic breathing on physiological and psychological measures in prehypertensive or hypertensive adults concluded a positive effect of the breathing practice resulting in “decreased of systolic and diastolic blood pressures, reduced heart rate, a relaxing effect, and reduced anxiety”. Other studies showed the effects of SDB on lowering blood pressure and

hypertension (Adler et al., 2019; Kalaivani et al., 2019; Kaushik et al., 2006; Ublosakka-Jones et al., 2018).

There are many studies on breathing and its impact on mental health. The research focused on the study of breathing and stress has demonstrated a decrease in stress levels and an increase in well-being (Peterson et al., 2017). Studies focusing on test anxiety and stress found large effect sizes (Cho et al., 2016; Khng, 2017; Paul et al., 2007). Studies examining the effect of SDB on anxiety found that SDB is a valuable technique to reduce anxiety (Chen et al., 2017; Kim et al., 2015).

Technology-assisted Breathing

Breathing exercises can be taught in individual or group sessions or practiced through technology-based programs. Brown et al. (2013, p. 131) emphasized the idea that "nowhere has the merger of Eastern and Western practices been more apparent than in the surge of technology-based programs and devices to facilitate therapeutic breathing practices." Today, more than 100,000 smart/mobile health applications are available in the online market of mobile phones (Faezipour & Faezipour, 2020); thousands of them are breathing apps. Among the advantages of using mobile apps are the opportunities for individuals who do not have access or cannot afford traditional guided practices. They also offer a visual aid for those who lack concentration and are not used to this type of practice. Chittaro & Sioni (2014) evaluated mobile apps using visual aids and concluded the effectiveness of this type of aid in breathing practices. Sound can also be added to the apps, which provides the practitioner support that can help in concentration. Aside from the apps that are only focused on breathing, many stress management apps exist. Christmann et al. (2017) found that breathing exercises were included in nearly half (44%) of the apps studied.

1.4 The Current Study

1.4.1 Aim

Very few studies have examined the link between breathing and stress. A thorough literature review comparing the practices of breathing exercises has not resulted in a significant number of studies in the clinical field. Thus, the importance of the present work will seek to compare the perceived stress levels of individuals who will receive guided breathing sessions through an online video conferencing tool and those who will use a mobile breathing app; a study that has never been conducted in the past. Today, and since the beginning of the year 2020, with the coronavirus pandemic, which began to spread, more and more people are using online video conferencing tools. Therefore, the importance of using such tools can demonstrate if this type of communication tool can effectively reduce stress levels.

1.4.2 Hypotheses

Human interaction plays a particular role in enhancing and increasing behavioral engagement. In a group setting, group dynamics, participation, and the implication of members can act as motivational factors for engaging in the desired behavior. Therefore, the guided breathing sessions delivered by the trainer through a video conferencing tool would motivate the participants of the IM group to engage in their breathing sessions on their own, resulting in lower perceived stress compared to the MA group. In addition, as more and more mobile applications in the field of self-care emerge, mobile applications can be useful for their accessibility and may have a good effect in decreasing stress.

Based on the previous assumptions, the following hypotheses were set:

1) The IM group will have a significant decrease in perceived stress.
2) The MA group will have a significant decrease in perceived stress.
3) The guided breathing sessions of the IM group will motivate the group to engage in their breathing sessions on their own, resulting in lower perceived stress compared to the MA group.

Chapter 2: Methods

2.1 Participants and Design

The study recruited francophone residents in Abu Dhabi (UAE). This was necessitated by French being the first language of the breathwork instructor (also author of this work). Living abroad is a pleasing experience but can be challenging for people who do not speak the same language as the host country. Adapting to new social and cultural environments demands many efforts. Today, with the Coronavirus pandemic, life has its uncertainties, and expatriates experience higher stress levels than before. Baburajan (2021) studied the psychological impact of the COVID-19 pandemic among expatriate residents in the UAE and found that intense stress and feeling of uncertainty were predominant.

The researcher employed two ways to recruit participants. Individuals who the researcher knew were contacted via telephone and informed about the possibility of participating in a study on breathing and stress. Participants were also recruited via Facebook advertisement on groups known to have francophone members. Therefore, purposive sampling was used, and to get more participants, the snowball sampling method was used. In all, 133 persons responded to the invitation to participate in the study. They were sent a link to an online screening form to determine eligibility in line with the researcher's inclusion and exclusion criteria. Individuals (both genders) of 18 years and above and francophones were included. The individuals who reported any of the following were excluded from the study: PSS-14 score below 18, non-francophone, regular practice of breathing exercises, meditation, regular practice of yoga, individuals with self-report of the following diseases: cardiovascular, respiratory, neurological, autoimmune, and neuropathy. A study by Jafari et al. (2020)

investigating the effects of SDB on the management of pain used similar exclusion criteria. Another research by Gholamrezaei et al. (2021) exploring the psychophysiological responses to SDB also used similar exclusion criteria.

In total, 65 participants passed the screening procedure and were sent written informed consent forms. Three participants dropped out after the second week of the experiment; therefore, they were excluded from the study. The participants ranged in age from 24 to 51 years (M = 41, SD = 5.6). Of the 62 participants, 75.8% (n = 47) were female, and 24.2% (n = 15) were male. Table 1 shows the gender differences in terms of the means and standard deviations of the perceived stress levels at baseline, midpoint and endpoint. Self-report of nationality indicated that more than half of the participants, that is to say, 61.3% (n = 38) were Lebanese, 19.4% (n = 12) were French, 4.8% (n = 3) were Argentinian, and the rest were from various nationalities. Table 2 shows the details of the different nationalities represented. In terms of employment, more than half of the participants reported being employed (69.8%, n = 44), the rest of the participants were not employed (19%, n = 12), not employed and looking for work (9.5%, n = 6) and not looking for work (1.6%, n = 1).

Table 1: Gender Differences in Means and Standard Deviations of PSL

	Baseline		Midpoint[1]		Endpoint[2]	
	Mean	SD	Mean	SD	Mean	SD
Female	27.21	4.97	25.43	4.97	23.38	6.56
Male	27.13	6.44	24.47	4.49	22.07	4.45

[1] Week 2
[2] Week 4

Table 2: Descriptive Statistics of Participant's Nationalities

Nationality	n	%
Lebanese	38	61.3
French	12	19.4
Argentinian	3	4.8
Cameroonian	2	3.2
Algerian	1	1.6
Belgian	1	1.6
Brazilian	1	1.6
Indonesian	1	1.6
Italian	1	1.6
Polish	1	1.6
Spanish	1	1.6
Total	62	100

Following eligibility, participants were allocated to the IM group and to the MA group based on a website called randomlists.com using the team generator. After randomization, all participants read and signed the consent form of the group they were allocated to (Appendices A and B).

The study received approval from the Social Sciences Ethics Committee Research of United Arab Emirates University (reference number: ERS_2021_7310).

2.2 Instrument

2.2.1 The Perceived Stress Scale

The primary outcome measure was the perceived stress level as measured by the Perceived Stress Scale-14 (PSS; Cohen et al., 1983) (Appendix C). The PSS is a measure of "the degree to which situations in one's life are appraised as stressful" (Cohen et al., 1983, p. 387). The scale is a self-report measure based on the psychological conceptualization of stress. It contains 14 items and measures perceived stress over the last month. Participants indicate how often they have found their lives unpredictable, uncontrollable, and overloaded in the previous month.

Response choices are answered on a 5-point Likert scale ranging from (0) “Never” to (4) to “Very often”. The scores are obtained by reversing responses to the seven positively stated items. The final score is the sum of all items, and possible scores range from 0 to 56, with higher scores indicating greater perceived stress. The scale is not a diagnostic instrument; therefore, no cut-offs exist for the scale.

Good psychometric properties of the PSS-14 have been reported in a study using breathing as a relaxation technique to reduce stress, with a Cronbach’s alpha of .93 before intervention and .89 after intervention (Gika et al., 2012). In a study using a mindfulness stress management program which included diaphragmatic breathing (Stefanaki et al., 2015) a Cronbach alpha of .77 was demonstrated as being satisfactory. In this study, Cronbach’s alpha was .75 (at baseline) and .86 (at endpoint).

2.3 Data Collection

Data were collected at four time points: baseline, week 2, week 4, and 3-month follow-up, involving an online form that included the PSS-14. Socio-demographic data were collected from the recruiting questionnaire. At week 2 and 4, all participants completed the form. At 3-month follow-up, 61 participants completed the form. Data collection began in May 2021 and was completed in October 2021. For the flow of participants, see Figure 2.

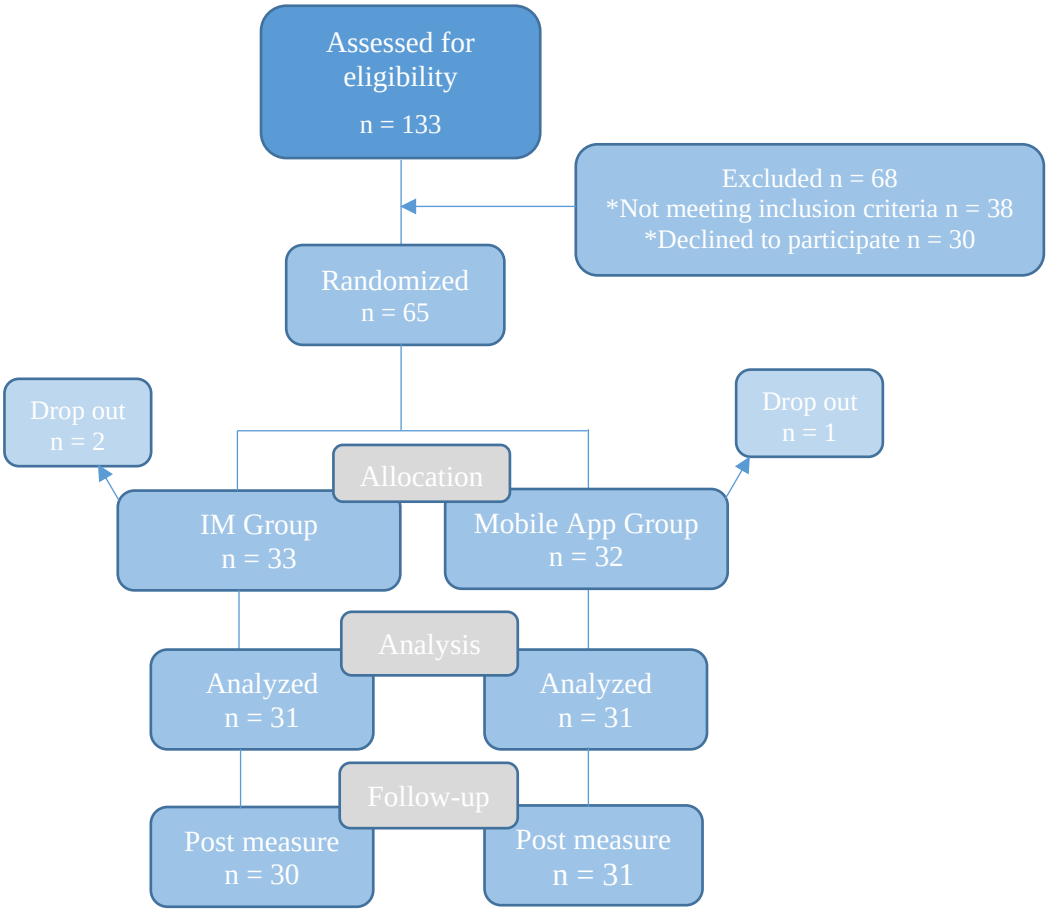

Figure 2: Flow of Participants

2.4 Procedure and Protocol

Via a Zoom meeting, a video conferencing tool, both groups learned about breathing and, more specifically, box breathing, the breathing exercise used for the study. This breathing exercise is a simple relaxation technique that can help reset breathing and return to its normal rhythm. They were informed that they could do it anywhere, anytime, and that box breathing can help reduce stress, improve mood and help control and manage emotions.

2.4.1 Internet Meeting Group

The IM group received in total four sessions of breathing. Each breathing session was conducted via a Zoom meeting on the first day of each week for four consecutive weeks during June 2021. All online sessions were conducted in French. During the first session, the participants received guidance about the technique from the breathwork instructor (also author of this work), who gave the following information:

"Imagine a box. Inhale as you visualize ascending to one side of the box, gradually filling your lungs with air for a count of 4. When you reach the top, hold your breath for 4 seconds as you imagine walking through the top of the box. Gradually exhale as you imagine traveling to the other side of the box. Pause again for 4 seconds as you move forward through the bottom of the box. Then repeat.

You have to do this for 5 minutes, focusing on your breathing. If you can do it sitting down with your feet on the ground, that will help you too, but it can be done anywhere. Remember to think about the box and to focus on your breathing. Breathing is done only through the nose; the mouth must remain closed.

It is usual for your thoughts to slip away; when you realize it, refocus on your breathing".

After the first learning phase, the participants were instructed to practice on their own two other times per week, using the technique learned during the breathing session (Figure 3).

Subsequent interventions consisted of a 20-minute session, including a welcome, questions and comments about the past week experience, a 5-minute breathing session, and feedback from the session. The researcher used verbal guidance

during the breathing exercise, prompting participants through each step of the breathing signal (inhale, hold, exhale, hold); relaxing music was set in the background.

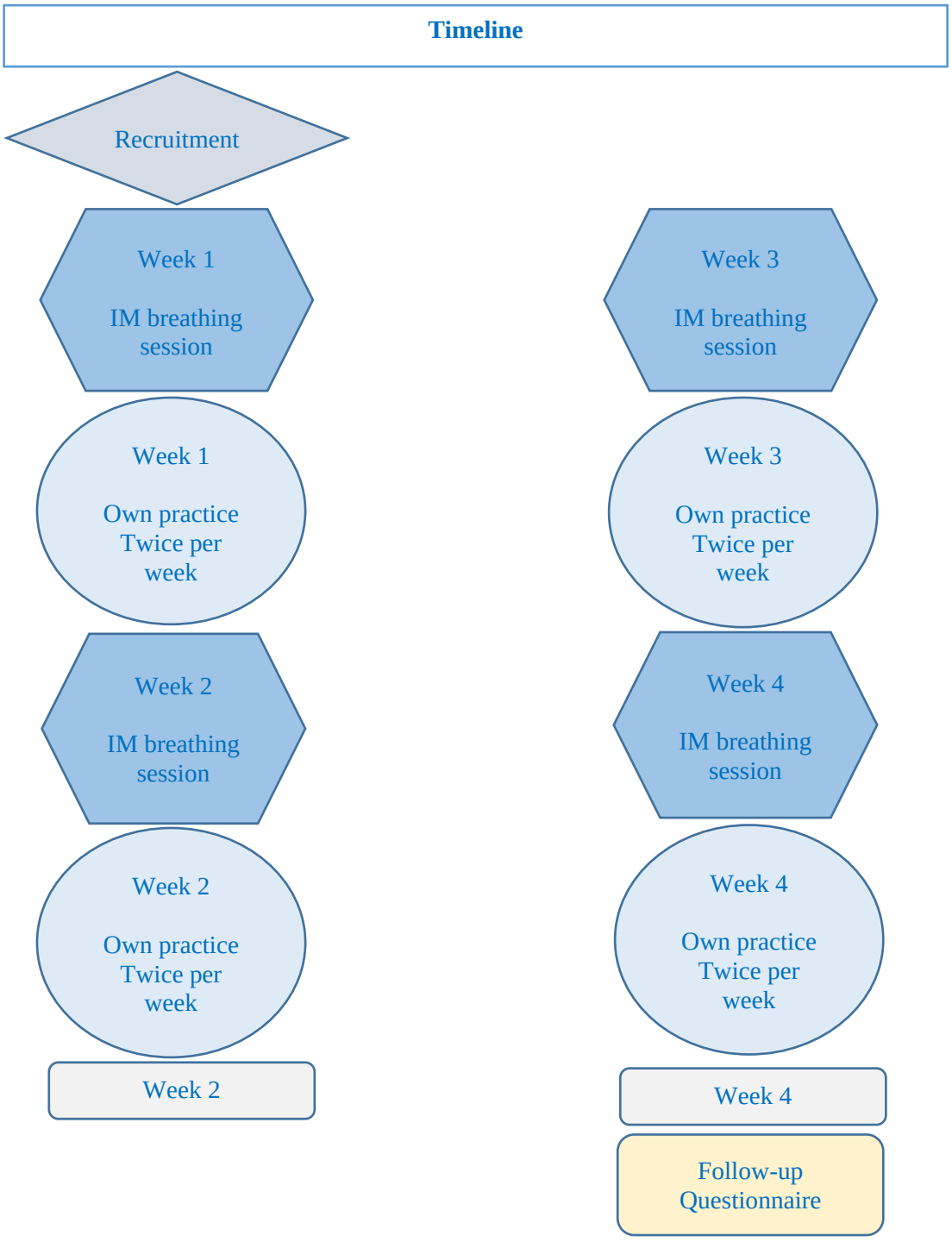

Figure 3: Protocol Diagram of the IM Group

2.4.2 Mobile App Group

At the beginning of the study, the researcher gathered all participants in a Zoom meeting to explain the breathing technique they would use over the four-week experiment. The researcher showed the app to be downloaded, called "*Breathe: Relax and Focus*" and what functionalities the app can have (Figure 4). The researcher then explained the steps to follow in terms of duration (number of minutes per session) and number of sessions to be done per week. Participants were instructed to practice the breathing exercise for 5 minutes three times per week.

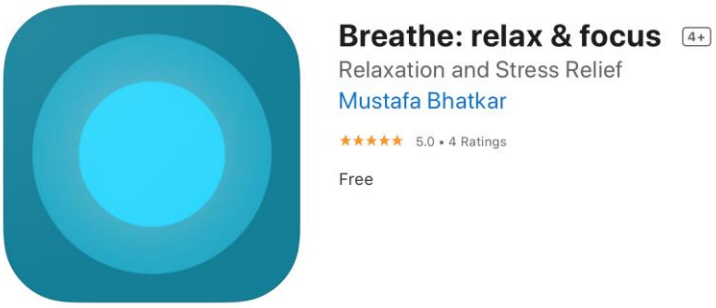

Figure 4: Layout of the "*Breathe: Relax and Focus*" Application

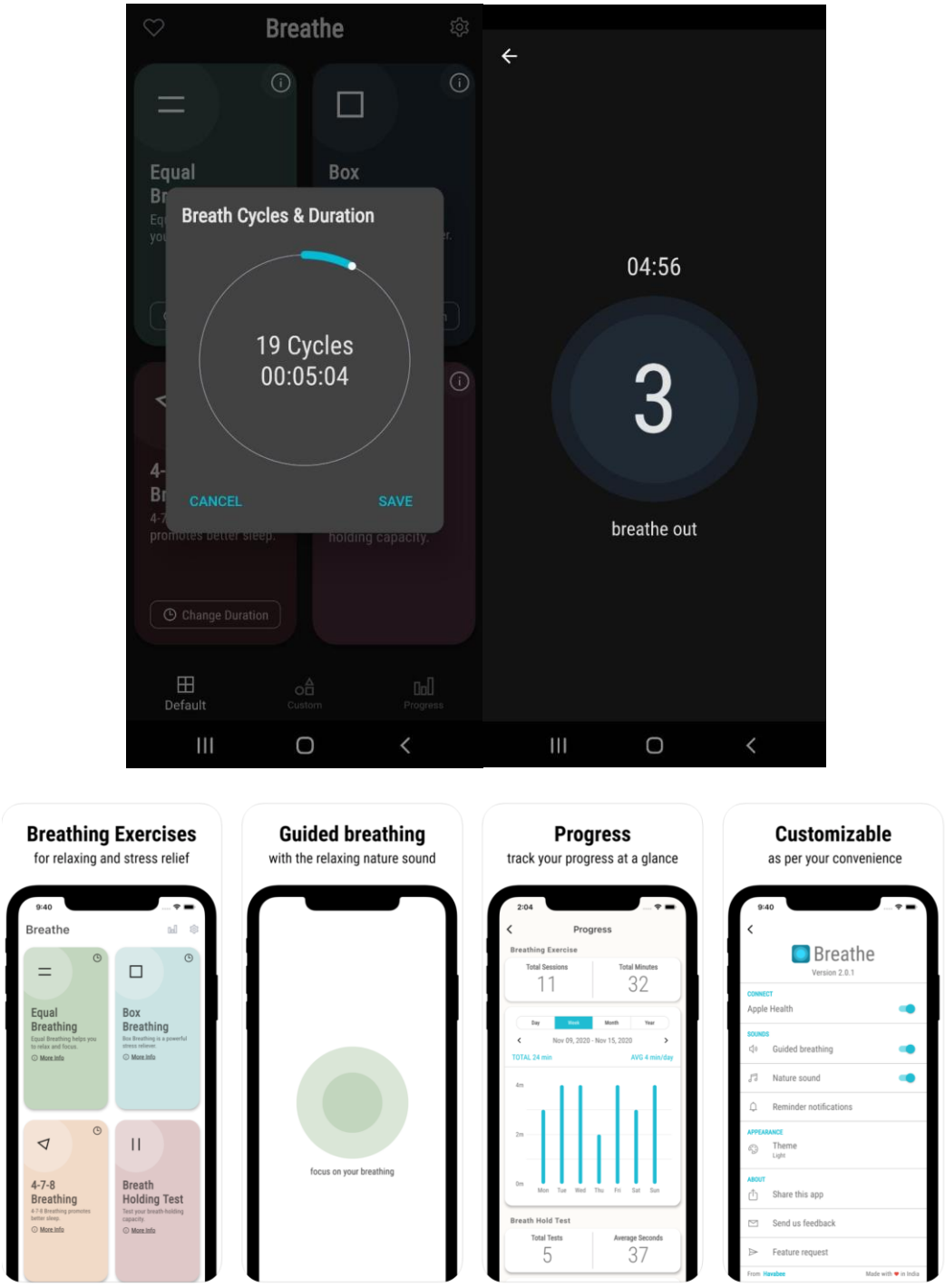

Figure 4: Layout of the "*Breathe: Relax and Focus*" Application (continued)

2.5 Data Analysis

Statistical analyses were performed using the statistical software package IBM SPSS v.26.0. Descriptive characteristics are represented as mean values, standard

deviation (*SD*), absolute (*n*), and proportional values (%). Statistical significance was set at $p < 0.05$. The normality of data was assessed with the Shapiro-Wilk test and by computing skewness and kurtosis values. Statistical analysis was performed using the one-way analysis of covariance (ANCOVA) to test the intervention impacts while controlling for baseline differences between the groups. To explore the impact of time on PSL in each group, the analysis was conducted with a one-way repeated measures analysis of variance (ANOVA) and paired *t*-tests.

Chapter 3: Results

3.1 Attrition Rate and Protocol Adherence

Of the 65 participants selected for the study, three did not complete the four-week experiment. Two of the participants in the IM group attended two breathing sessions but did not fill the questionnaires for weeks 2, 3, and 4. The third participant in the MA group became positive to the Coronavirus after the first week of the study; thus, she discontinued the experiment. The IM group attrition rate was 6%, leaving 31 in the analysis, and the MA group attrition rate was 3.12%, leaving 31 in the analysis.

By analyzing the weekly data, 43.1% of all participants were found to have followed the instructions about the required number of sessions per week (as a reminder, the required was 3 times per week). More specifically, 46% of the participants of the IM group and 40.3% of the participants of the MA group followed the required instructions. As far as the duration of each breathing practice is concerned, 75.4% of all participants followed the instructions (as a reminder, the required was 5 minutes per breathing practice). More specifically, 71.8% of the participants of the IM group and 79% of the participants of the MA group followed the required instructions. Details of the protocol adherence are shown in Tables 3 to 6.

Table 3: IM Group (n = 31) - How often have you done the breathing exercises?

	Week 1	Week 2	Week 3	Week 4	Total	Frequency
1	0	1	1	4	6	4.8%
2	7	11	13	9	40	32.3%
3	21	14	13	9	57	46.0%
4	3	5	4	5	17	13.7%
More than 5 times	0	0	0	4	4	3.2%

Table 4: MA Group (*n* = 31) - How often have you used the mobile app "Breathe: relax & focus" to do the breathing exercises?

	Week 1	Week 2	Week 3	Week 4	Total	Frequency
1	1	3	2	2	8	6.5%
2	3	9	7	5	24	19.4%
3	14	12	11	13	50	40.3%
4	8	2	6	6	22	17.7%
5	4	5	5	2	16	12.9%
More than 5 times	1	0	0	3	4	3.2%

Table 5: IM Group (*n* = 31) - How long did you breathe per breathing session?

	Week 1	Week 2	Week 3	Week 4	Total	Frequency
Less than 5 minutes	4	2	2	4	12	9.7%
5 minutes	23	23	23	20	89	71.8%
More than 5 minutes	4	6	6	7	23	18.5%

Table 6: MA Group (*n* = 31) - How long did you breathe per breathing session?

	Week 1	Week 2	Week 3	Week 4	Total	Frequency
Less than 5 minutes	3	3	0	3	9	7.3%
5 minutes	25	24	26	23	98	79%
More than 5 minutes	3	4	5	5	17	13.7%

3.2 Acceptability and Feelings of the Overall Experiment

Acceptability was assessed at post-intervention (week 4), participants answered an open-ended question related to the benefits of the overall experiment: "Do you think the breathing exercises have helped you? If yes, in what sense? If no, why?". The majority of participants in both groups found breathing exercises to be helpful, with exactly the same results between the two groups. 80% of the participants found the breathing exercises helpful, 10% of them didn't know if it was helpful, and 10% of them did not find breathing exercises helpful.

Feeling was assessed at post-intervention (week 4). Participants were able to choose several feelings at the question: "How did you feel after doing the breathing exercises?". Overall, 61% felt good, 31% very good and 8% felt that nothing had change. More specifically, 87% of the participants felt relaxed after doing the breathing exercises, 26% felt sleepy and 10% felt happy.

3.3 Data Normality

Skewness and kurtosis values for baseline, midpoint and end point for the stress level scores indicated that the data adhered to a normal distribution. Across both groups, for skewness, values ranged from - .45 to 1.12, and for kurtosis, values ranged from -.19 to 1.78. One of the skewness and one of the kurtosis values are beyond the -1 threshold; this is considered minimal (values that are approximately between -2 and +2 are considered within acceptable limits; George & Mallery, 2019, pp. 114–115). Table 6 displays skewness and kurtosis for both groups and all time points.

Table 7: Descriptive Statistics

	IM Group				MA Group			
Time Point	M[1]	SD[2]	Skewness	Kurtosis	M[1]	SD[2]	Skewness	Kurtosis
Baseline	27.39	4.77	0.65	1.78	27	5.86	1.12	0.46
Midpoint[3]	26.10	4.95	-0.45	0.65	24.29	4.63	0.38	0.72
Endpoint[4]	23.19	7.39	0.51	-0.08	22.94	4.60	-0.09	-0.19

[1] Mean, Lower score indicates better outcome
[2] Standard Deviation
[3] week 2
[4] week 4

3.4 ANOVA repeated measures

To verify the first and second hypotheses related to PSL, a one-way repeated measures ANOVA was conducted to compare the effect of time on PSL at baseline,

midpoint (week 2) and endpoint (week 4) for both groups. Figure 5 shows estimated marginal means for both groups at baseline, midpoint, and endpoint.

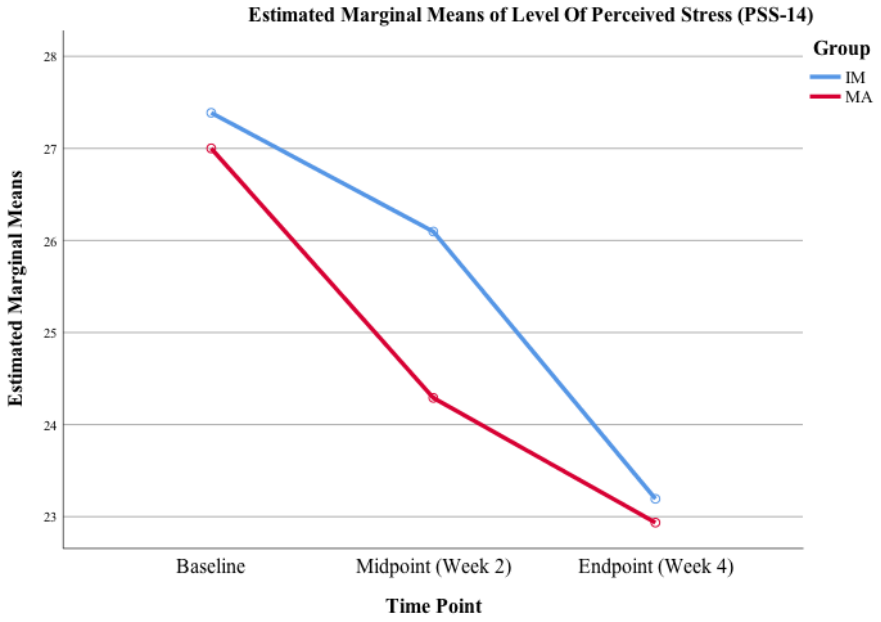

Figure 5: Estimated marginal means for the IM (blue line) and MA (red line) groups at baseline, midpoint, and endpoint

3.4.1 Within Group Analysis for the IM Group

There was a statistically significant effect of time on PSL, Wilk's Lambda = .72, F (2, 29) = 5.59, p = .009, ηp^2= .28. The results of the repeated measures ANOVA showed that there was a significant main effect of time on the level of perceived stress [F(1.7, 50.97)=8.07, ηp^2= .21, p < .001]. When comparing mean scores within the group across all the measurement time points, there was a statistically significant difference, except between baseline and midpoint (week 2), even though the results show a numerical decrease (Table 7). At baseline mean PSL was 27.39 ± .86 with a confidence interval of 95% [25.64, 29.14]. At midpoint mean PSL was 26.10 ± .89 with a confidence interval of 95% [24.28, 27.91]. At endpoint mean PSL was 23.19 ± 1.33 with a confidence interval of 95% [20.48, 25.91] (Table 7). Three paired sample

t-tests were conducted to make post hoc comparison between conditions. A first paired samples t-test indicated that there was no significant difference between the PSL score at baseline (*M*=27.39, *SD*=4.77) and at midpoint (*M*=26.1, *SD*=4.95); *t*(30)= 1.43, *p*= .164. A second paired samples t-test indicated that there was a significant difference between the PSL score at midpoint (*M*=26.1, *SD*=4.95) and at end point (*M*=23.19, *SD*=7.39); *t*(30)= 2.91, *p*= .007. A third paired samples t-test indicated that there was a significant difference between the PSL score at baseline (*M*=27.39, *SD*=4.77) and at end point (*M*=23.19, *SD*=7.39); *t*(30)= 3.30, *p*= .002 (Table 8). These results support the hypothesis that time affects levels of perceived stress.

Table 8: Estimates of the IM Group on Perceived Stress Level

			95% Confidence Interval	
Time Point	M[1]	SE[2]	Lower Bound	Upper Bound
Baseline	27.39	0.86	25.64	29.14
Midpoint[3]	26.10	0.89	24.28	27.91
Endpoint[4]	23.19	1.33	20.48	25.91

[1] Mean
[2] Standard Error
[3] Week 2
[4] Week 4

Table 9: Pairwise Comparisons of the IM Group on Perceived Stress Level

		Paired Differences				t	df	Sig. (2-tailed)
				95% Confidence Interval of the Difference				
		Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	Baseline Stress Level Score - Midpoint Stress Level Score	5.04	0.91	-0.56	3.14	1.43	30	0.164
Pair 2	Midpoint Stress Level Score - End of Study - Stress Level Score	5.56	0.99	0.87	4.94	2.91	30	0.007
Pair 3	Baseline Stress Level Score - End of Study - Stress Level Score	7.07	1.27	1.59	6.79	3.30	30	0.002

3.4.2 Within Group Analysis for the MA Group

There was a statistically significant effect of time on PSL, Wilk's Lambda = .60, F (2, 29) = 9.53, p = .001, ηp^2= .40. The results of the repeated measures ANOVA showed that there was a significant main effect of time on the level of perceived stress [F(1.73, 51.84)=13.66, ηp^2= .31, p < .001]. When comparing mean scores within the group across all the measurement time points, there was a statistically significant difference, except between midpoint (week 2) and end point (week 4), even though the results show a numerical decrease (Table 9). At baseline mean PSL was 27 ± 1.05 with a confidence interval of 95% [24.85, 29.15]. At midpoint mean PSL was 24.29 ± .83

with a confidence interval of 95% [22.59, 25.99]. At endpoint mean PSL was 22.94 ± .83 with a confidence interval of 95% [21.24, 24.62] (Table 9). Three paired sample t-tests were conducted to make post hoc comparison between conditions. A first paired samples t-test indicated that there was a significant difference between the PSL score at baseline (*M*=27, *SD*=5.87) and at midpoint (*M*=24.29, *SD*=4.64); *t*(30)= 3.41, *p*= .002. A second paired samples t-test indicated that there was no significant difference between the PSL score at midpoint (*M*=24.29, *SD*=4.64) and at end point (*M*=22.94, *SD*=4.60); *t*(30)= 2.12, *p*= .043. A third paired samples t-test indicated that there was a significant difference between the PSL score at baseline (*M*=27, *SD*=5.87) and at end point (*M*=22.94, *SD*=4.60); *t*(30)= - 4.43, *p*= .000 (Table 10). These results support the hypothesis that time affects levels of perceived stress.

Table 10: Estimates of the MA Group on Perceived Stress Level

			95% Confidence Interval	
Time Point	M[1]	SE[2]	Lower Bound	Upper Bound
Baseline	27.00	1.05	24.85	29.15
Midpoint[3]	24.29	0.83	22.59	25.99
Endpoint[4]	22.94	0.83	21.25	24.62

[1] Mean
[2] Standard Error
[3] Week 2
[4] Week 4

Table 11: Pairwise Comparisons of the MA Group on Perceived Stress Level

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	Baseline Stress Level Score - Mid-Point Stress Level Score	2.71	4.42	0.79	1.09	4.33	3.41	30	0.002
Pair 2	Mid-Point Stress Level Score - End of Study -Stress Level Score	1.36	3.56	0.64	0.05	2.66	2.12	30	0.043
Pair 3	End of Study - Stress Level Score - Baseline Stress Level Score	4.07	5.11	0.92	-5.94	-2.19	-4.43	30	0.000

3.5 Evaluation of Between Group Differences

To examine the third hypothesis, that participants who completed the IM intervention would produce statistically significant reductions in PSL in comparison to those who completed the MA intervention, a one-way analysis of covariance (ANCOVA) was conducted. The ANCOVA allowed for the inclusion of participants' baseline scores as a covariate in the computation. This was important to do given that the experimental groups differed with regard to baseline PSL scores, and thus the ANCOVA would control for the potential impact of these baseline differences. The result of this analysis showed no significant difference between the two groups, $F(1, 59)=.002$, $p=.96$, $\eta p^2= .000$. Thus, despite both individual modes of intervention having produced reductions to participant PSL, when post-intervention scores were

compared and baseline scores controlled for, the breathing delivery method (IM or MA) did not significantly differ. This result suggests that both intervention methods were equally effective in reducing PSL, and thus hypothesis 3 was rejected.

3.6 Follow-up Survey

A follow-up questionnaire was sent to the participants three months after the end of the study to analyze the long-term effect of the experiment and understand if the participants got some benefits from the breathing exercises. Only one participant out of the 62 did not answer the questionnaire.

The results showed that 56% of the participants continued to practice breathing after the end of the study, with a majority of 31% practicing once per week, 16% practicing twice per week, and 12% practicing three times per week. When asked if they would like to go back to a breathing training, 85% of them stated yes, with 71% willing to practice on their own and 21% with a trainer.

Chapter 4: Discussion

The purpose of this study was to compare the difference in efficacy of a 4-week breathing training intervention delivered online with a trainer and delivered using a consumer-based mobile application (i.e., Breathe: Relax and focus). The sample consisted of French-speaking individuals living in Abu Dhabi (UAE) with a moderate to high level of stress. It was hypothesized that as a result of the intervention, the IM group would have a lower PSL when compared with the MA group. There were insignificant differences between the two groups on the main outcome variable. Findings suggest that both delivery methods were equally successful in reducing participants' PSL (PSS-14 scores), with no differences between the two groups. This conclusion indicates that the delivery method may not matter when it comes to reducing PSL. Given the relatively sparse data on breathing delivery methods comparison, this study could be considered innovative. In the current literature, there were no studies of this nature comparing IM and MA interventions concerning perceived stress and the possibility of reducing it. More importantly, we have not found studies comparing different breathing techniques aiming at reducing stress levels. In contrast, previous research have studied the effectiveness of mobile apps in reducing stress (Coelhoso et al., 2019) or evaluated the effectiveness of a mobile app-based stress management program (Hwang & Jo, 2019; Serino et al., 2015). Other researches focused on evaluating mobile apps for breathing training (Chittaro & Sioni, 2014). In terms of breathing, previous researches aimed at studying specific breathing techniques to reduce stress, such as YB, diaphragmatic breathing, or mindfulness breathing (Brown & Gerbarg, 2005; Christakis et al., 2012; Ma et al., 2017; Maqbool Kermane, 2016; Peterson et al., 2017).

This study is one of the first to compare two breathing delivery methods (i.e., IM and MA). Improvement in PSL from baseline to endpoint (week 4) was observed with no differences between the groups. The decrease of the PSS-14 scores in both groups showed that both delivery methods were equally effective in reducing perceived stress in the IM and MA groups. The implementation of the study protocol can explain these results. In our study, the IM group participants were instructed to attend one live breathing session with the researcher through a videoconference tool and to continue practicing on their own two other times per week following the instructions given. As novices in breathing practice, we believe that engaging in such exercises on their own can be challenging to sustain over several weeks. Therefore, even though breathing is simple and easy to learn, it is crucial for neophytes to practice for a short time. The results showed that from the beginning of the experiment to the end of the protocol, adherence regarding the frequency of the number of practices per week dropped from 68% adherence during the first week to 29% during the last week. Contrary to the IM group, the MA group was constant in the protocol adherence, with a rate of 45% adherence during the first week to 42% during the last week. Regarding the length of practice (i.e., 5 minutes per breathing session), both groups were almost equal in the protocol adherence, with 71.8% for the IM group and 79% for the MA group. It is possible that with a different protocol, the IM group would have had a different outcome. The literature on the comparison of interventions between different delivery methods is very limited; we were nonetheless able to find a study focused on the effectiveness of three different interventions on infant feeding outcomes, face-to-face versus smartphone app versus combined. The study's results showed no significant differences between the three intervention groups (Scott et al., 2021). Given the limited number of studies that have investigated different delivery methods in

breathing, the results of this study have important implications for future work in this field.

Attrition and adherence to a protocol are capital to the success of an experiment. In our study attrition was very low. Congruent findings were reported in a previous research that evaluated the effect of an app on stress (Ly et al., 2014). However, studies reporting attrition are usually not in line with our study (Coelhoso et al., 2019; Fuller-Tyszkiewicz et al., 2020; Heber et al., 2016; Proudfoot et al., 2013). These results could be explained by the creation of a WhatsApp group created for each group, where the researcher would motivate the participants to engage in their breathing exercises. A reminder was sent once per week, asking participants if they had practiced breathing, clear expectations were sent alongside encouragement to continue the practice. This message would prompt answers from the participants who played a role in reminding those who were not following the protocol. Moreover, during the live practice with the IM group, part of the session was dedicated to exchanges between the participants who would share their experiences, struggles, and successes. It has been proven that social presence (the presence of another person) plays an important role in encouraging adherence (Fry & Neff, 2009). One participant commented on the encouragement provided during the experiment, “Thank you for encouraging me to incorporate the discipline of breathing!”.

Participants in this study were satisfied with the experiment, found it helpful, and felt a sense of relaxation after their practice. The notion of satisfaction and helpfulness is captured by one participant who stated, “It is a very good and lovely connection with the moment,” another participant wrote, “It helped me reduce daily tension and stay calm in some situations.” These findings cannot be corroborated with other studies, as such interventions are not yet common in the scientific literature.

However, if looking into mobile app-based interventions, other studies are in line with our research (Harrer et al., 2018; Rung et al., 2020).

Our results showed no statistical significance on the comparison of the groups, however as the numbers show, there was a clinical significance. Pintea (2010, p. 101) stated that "for many years, statistical significance testing was the golden standard in analyzing data for many research domains, including clinical psychology and psychotherapy." The non-significance of the results may nevertheless indicate that the participants benefited from the intervention. One of the proofs would be the information given at three months follow-up, where participants were asked if they wished to go back to a breathing training. 85.2% of them responded positively to this question, with 70.5% wishing to continue practicing on their own. Practically, these numbers tell us that, in a way, participants realized the benefit of breathing over their stress levels and reaped positive benefits from this experience. The main objective of the study was to understand whether one intervention outperformed another. Our results were clinically interesting as today, the world is at a turning point in terms of communication. It has been almost two years since the world was forced to find different ways of working, learning, and communicating. Given the relative newness of what we call telehealth, the field of clinical psychology is in the process of evaluating its effectiveness. A shift has been seen in mental health care. From face-to-face to online, practitioners, as well as clients, are adapting to new ways of working, "online treatment remains a powerful and potentially necessary solution" (Feijt et al., 2020, p. 861). The future of psychological interventions is only at its inception; blended forms of therapy are the new norm to follow. Governments and universities are developing mobile apps that are a reliable source of adjunct help for people seeking to decrease their levels of stress and anxiety (Wright & Caudill, 2020).

4.1 Limitations

To fully understand the study's results, some limitations should be considered. The recruitment of participants resulted in a sample where more than half of the persons were Lebanese. While Lebanese are francophones, they are also Arabic speakers. For feasibility reasons, answers were self-reported. Althubaiti (2016) argued that self-report is unreliable and can conclude in self-reporting bias. In our study, when answering about the protocol adherence and when completing the PSS-14 questionnaire, many participants may have been influenced by social desirability. However, the researcher had to know each participant's results to process the data; therefore, there was no anonymity at data collection. The short duration of the intervention (i.e., four weeks) led us to interpret the results with caution. Persons who are inexperienced with breathing exercises may need time for adaptation to the practice. Moreover, the IM group may have needed a different protocol with more online practices that would have provided more insight into the potential of human interaction. Lastly, one key limitation of the present study was the lack of a control group. This was due to time constraints and the limited availability of francophone participants.

4.2 Suggestions for Future Research

Research in breathing practices to reduce stress shows promise in the field of clinical psychology. A step towards comparing delivery methods and comparing breathing techniques needs to be taken. In future studies, application of the following should be implemented: 1) in terms of sample populations when choosing to study participants with a specific language, recruit a sample with this specific language as the only spoken language, 2) when possible, along with self-report of stress, use

physiological measures of stress (e.g., heart rate, salivary cortisol levels), 3) the length of an intervention being important, implement longer interventions, 4) in the case of inexperienced practitioners, increase the time of each breathing practice over the weeks (e.g., 5 minutes per breathing session the first two weeks, 8 minutes the following weeks), 5) when choosing a delivery method, stick to the specific delivery method, do not blend different methods, 6) consider adding a control group, 7) consider adding a waitlist group.

Chapter 5: Conclusion

Despite the need for more controlled clinical trials to report the benefits of different methods of breathing delivery, the evidence suggests that IM and MA are two effective delivery methods to reduce stress. Overall, this study has important clinical implications regarding adjunct methods to be used in clinical psychology. Psychological treatments are already seeing changes thanks to the availability of digital technology (Fairburn & Patel, 2017). The concept of service delivery in mental health is under transformation. The rapid growth of mobile healthcare applications is impacting how clinical psychologists should view their practice, and the use of such media should be seriously considered. Numerous benefits exist for both the psychologists and the patients, who, in turn, become more active in their treatment process.

Apps have the advantages of allowing users to have easier access to care and the convenience to complement the face-to-face treatments (Bush et al., 2017). This study shows that an MA-based program is as effective as an IM interaction. Although social presence is essential in treatment, as it enhances and encourages adherence and increases motivation (Mohr et al., 2011), the near future of treatment, as Bush et al. (2019, p. 193) claimed, is "moving toward a more platform-agnostic merging of technologies in which the consumer shares even more of their health management with their clinician." Adherence comes with a good therapeutic alliance; therefore, combining technology with human interaction and support will positively impact commitment and involvement in treatment. The technology found its place in psychology; however, it will never supersede face-to-face interactions. Blended treatment modalities are, therefore, the future of clinical practice.

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Appendices

Appendix A

Consent to Participate in a Research Study
Please read carefully before signing the Consent Form!

Effect of Breathing Exercises on Perceived Stress Level Among the French-Speaking Community in Abu Dhabi, UAE: A Comparative Study Between Online and Mobile Application Delivery Methods

You will be asked to provide or deny consent after reading this form.

Topic of the research, the researcher and the location

You have been invited to take part in a study to investigate the impact of breathing on stress level. This study will be conducted by Nathalie El Asmar in Clinical Psychology, United Arab Emirates University, Al Ain.
The study will be conducted through an online video conferencing tool, once a week and for four consecutive weeks. Participation in this study will take 20 minutes, each time a meeting is set: 5 minutes for the welcoming of participants, 5 minutes for the breathing exercises, and 10 minutes for discussion with the researcher afterwards.

Benefit of the research

Breathing exercises are an excellent way to manage stress. They are easy to learn, without the need of special equipment and are accessible to you at any time of the day. Breathing encourages the body to relax, which brings many health benefits in the long run.

Procedure

Online breathing exercises session will be conducted by the researcher, you will have to exercise *on your own* 2 other times per week. Your involvement in the study will be of 4 weeks.

Safety Information

There are no physical or psychological risks to this research.

Confidentiality and Privacy Information

Personal information will not be revealed.

Right to Withdraw

You can withdraw at any stage in the process without being penalized.

Contact and Questions

At this time, you may ask any questions you may have regarding this study. If you have questions later, you may contact the researcher: 055 338 9549 or breathingandwellbeing@gmail.com

Informed Consent

1. I am 18 years old or older.
2. I confirm that I have read and understood the above information sheet and have had the opportunity to ask questions.
3. I know that once I sign and return the approval form, it shall be kept by the researcher.
4. I am aware that my participation shall include filling in the online questionnaire form (2 times as per regulations in use), and I agree that the researcher may use the results as clearly and smoothly explained in the previous document.
5. I understand that my participation is voluntary and that I am free to withdraw from the project at any time without giving any reasons, and that I may also withdraw any information that I previously submitted.
6. I was informed that the objective of the project is a scientific research and nothing else.
7. I understand that my data will be kept confidential and if published, the data will not be identifiable as mine.
8. I agree for the data I provide to be archived at the UAE University data-bank.
9. I understand that other researchers will have access to this data only if they agree to preserve the confidentiality of that data and if they agree to the terms I have specified in this form.

I agree to take part in this study:

_____ _____

(Name and signature of participant) (Date)

_____ _____

(Name and signature of person taking consent) (Date)

Appendix B

Consent to Participate in a Research Study
Please read carefully before signing the Consent Form!

Effect of Breathing Exercises on Perceived Stress Level Among the French-Speaking Community in Abu Dhabi, UAE: A Comparative Study Between Online and Mobile Application Delivery Methods

You will be asked to provide or deny consent after reading this form.

Topic of the research and the researcher
You have been invited to take part in a study to investigate the impact of breathing on stress level. This study will be conducted by Nathalie El Asmar in Clinical Psychology, United Arab Emirates University, Al Ain.

Benefit of the research
Breathing exercises are an excellent way to manage stress. They are easy to learn, without the need of special equipment and are accessible to you at any time of the day. Breathing encourages the body to relax, which brings many health benefits in the long run.

Procedure
You will use the "Breathe: relax & focus" mobile application at home or any place you feel comfortable doing the exercise. Participation in this study will not exceed 5 minutes per breathing exercise, 3 times a week and for 4 consecutive weeks.

Safety Information
There are no physical or psychological risks to this research.

Confidentiality and Privacy Information
Personal information will not be revealed.

Right to Withdraw
You can withdraw at any stage in the process without being penalized.

Contact and Questions
At this time, you may ask any questions you may have regarding this study. If you have questions later, you may contact the researcher: 055 338 9549 or breathingandwellbeing@gmail.com

Informed Consent
1. I am 18 years old or older.
2. I confirm that I have read and understood the above information sheet and have had the opportunity to ask questions.
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5. I understand that my participation is voluntary and that I am free to withdraw from the project at any time without giving any reasons, and that I may also withdraw any information that I previously submitted.
6. I was informed that the objective of the project is a scientific research and nothing else.
7. I understand that my data will be kept confidential and if published, the data will not be identifiable as mine.
8. I agree for the data I provide to be archived at the UAE University data-bank.
9. I understand that other researchers will have access to this data only if they agree to preserve the confidentiality of that data and if they agree to the terms I have specified in this form.

I agree to take part in this study:

_____ _____

(Name and signature of participant) (Date)

_____ _____

(Name and signature of person taking consent) (Date)

Appendix C

PSS-14 Items

1. In the last month, how often have you been upset because of something that happened unexpectedly?
2. In the last month, how often have you felt that you were unable to control the important things in your life?
3. In the last month, how often have you felt nervous and stressed?
4. In the last month, how often have you dealt successfully with irritating life hassles?
5. In the last month, how often have you felt that you were effectively coping with important changes that were occurring in your life?
6. In the last month, how often have you felt confident about your ability to handle your personal problems?
7. In the last month, how often have you felt that things were going your way?
8. In the last month, how often have you found that you could not cope with all the things that you had to do?
9. In the last month, how often have you been able to control irritations in your life?
10. In the last month, how often have you felt that you were on top of things?
11. In the last month, how often have you been angered because of things that happened that were outside of your control?
12. In the last month, how often have you found yourself thinking about things that you have to accomplish?
13. In the last month, how often have you been able to control the way you spend your time?
14. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?