The Effects of Online Exercise Prescription on Well-being in Healthy Adults

Fadi Bahi

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Abstract

Background: Positive well-being is associated with living a healthy and happy life; increased sedentary behaviour can negatively impact physical and mental health. Therefore, increased engagement in physical activity is necessary to improve quality of life and overall well-being. With the COVID-19 pandemic, it has become apparent that alternative means of health delivery are necessary. Online health delivery can be very effective in reducing limitations associated with in-person care, such as cost of use and travel, waiting time, and lack of availability within rural areas. Despite the benefits, online health delivery is similarly limited in aspects such as the inability of physical inspections and dependence on smart devices and an internet connection. The concept of online exercise delivery remains relatively novel, however, and needs to be further explored. Therefore, the objectives of this study were to determine the effects of online exercise prescription on well-being and understand participant perspectives and opinions on the use of online health delivery.

Methods/Design: Seventeen healthy participants were recruited for this study. Nine participants (male = 4, female = 5, mean age = 44 years) were allocated to the online group (INT) and 8 participants (male = 4, female = 4, mean age = 40 years) were allocated to the self-monitoring group (ACON). This study utilised an interpretivist phenomenological approach. All participants attended a 60-minute pre-intervention data collection session where cardiorespiratory (VO_{2Max}), blood pressure, blood flow and well-being data was collected. Well-being data was derived via a holistic questionnaire completed by participants upon arrival to the laboratory. Cardiorespiratory fitness was assessed via the 6-minute Astrand Rhyming Cycle test and blood flow measures were recorded via a Uscom 1A ultrasound. Participants were also informed which group they were assigned to and provided with an equipment pack containing a Swiss ball, skipping rope, and resistance bands to use throughout the 12-week program. INT participants attended a weekly 20-minute Zoom session where long and short-term goals were set, exercises were prescribed and demonstrated, and feedback was provided. After each weekly session, participants were provided with a link to a YouTube video demonstrating the exercises along with a document containing step-by-step instructions for said exercises. Self-monitoring participants were provided with a 12-week exercise program upfront during the pre-intervention session, and a weekly check-up email was sent to assess progress and determine whether any assistance was needed. The 12-week program consisted of various strength training exercises and progressively increased in resistance throughout the intervention. Online focus group sessions were conducted by a research assistant via Zoom to assess participant perspectives on their respective delivery methods. This data was transcribed and then analysed via phenomenological thematic analysis using Braun and Clark's process, incorporating codes to identify themes. The initial aim of this study was to determine the effects of online exercise prescription on blood pressure and cardiorespiratory fitness in participants. However, due to a COVID-19 lockdown being announced during the post-intervention data collection period which meant closure of the Massey University laboratory and mandatory social distancing and limited gatherings, we were unable to gather the necessary post-intervention data and hence the study employed a qualitative approach. Hence, the aim of this study was to determine the effects of online exercise prescription on well-being and to understand the varying perspectives of participants on this method.

Results: Through phenomenological analyses, the themes identified for the INT group were perceived advantages of online exercise prescription and acceptance of online sessions as a form of health delivery. In the self-monitoring group, the themes consisted of self-monitoring physical activity and using online health delivery in the future. Age and availability of smart devices did not appear to be barriers for online group participants as weekly online Zoom sessions were easily accessed. Overall, online health delivery was well received by participants and most thought it to be effective in improving well-being. Weekly online sessions were considered important in increasing adherence to exercise through accountability, motivation, and feedback. Participants did not want to disappoint the practitioner and therefore effectively completed their prescribed exercises ahead of weekly sessions. In contrast, self-monitoring participants experienced difficulty engaging in physical activity and, as a result, did not perceive any changes in physical well-being, however, interestingly, some did note an improvement in mental well-being. The increased participation in physical activity within the online group led to increased energy levels and physical fitness and strength.

Conclusion: Our findings suggest that online health delivery has great potential in the management of health conditions such as hypertension and improving overall well-being in individuals. The online intervention appeared more effective in eliciting a positive physical well-being response compared to the ACON group. It is imperative that further research be undertaken to further expand on the literature and determine whether prescribing physical activity via an online intervention can be implemented in the health sector, and whether this would be effective for those residing in rural locations.

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Abbreviations

INT – Online intervention

ACON – Active control

CVD – Cardiovascular disease

BP – Blood pressure

QoL – Quality of life

SBP – Systolic blood pressure

HbA1c – Hemoglobin A1c

BPM – Beats per minute

RPE – Rate of perceived exertion

Chapter 1: Introduction

1.1 Background

Having a positive well-being is associated with living a healthy and happy life (Medvedev & Landhuis, 2018). Well-being encompasses factors that deal with the overall quality of life such as physical and mental health (Ruggeri, Garcia-Garzon, Maguire, Matz & Huppert, 2020). Positive mental well-being is the state in which an individual is capable of being productive and free of stress and accordingly being fit to contribute to society (Galderisi, Heinz, Kastrup, Beezhold & Sartorius, 2015). Physical well-being denotes the ability to engage in physical activity without experiencing any hindrances, such as physical pain or fatigue. While there are a number of ways to develop well-being such as adequate sleep, hydration and nutrition, active participation in physical activity is one of the most effective methods (Sharma, Madaan & Petty, 2006). Based on the 2020 well-being statistics in New Zealand, approximately 20% of New Zealand adults suffered from poor mental well-being. Additionally, 13% of New Zealanders aged 18 and above indicated having fair or poor physical well-being (Well-being statistics: June 2020 quarter | Stats NZ, 2021). Literature has shown that positive well-being reduces risk of cardiovascular disease (CVD) and improves performance output through productivity (Rippe, 2018). Hence, promoting an active improvement of well-being yields an increase in survivability amongst the general population (Trudel-Fitzgerald et al., 2019).

Physical activity is widely recommended by health professionals as a form of primary and secondary prevention for non-communicable diseases (Alves et al., 2016). These can include high blood pressure and CVD (Warburton et al., 2006). Hypertension is the leading cause of mortality across the world and can be developed through a variety of factors (Chulvi-Medrano, Sanchis-Cervera, Tortosa-Martínez & Cortell-Tormo, 2016). Obesity, stress and physical inactivity are aspects that elevate blood pressure in both male and female individuals, regardless of age (Singh, Shankar & Singh, 2017). Consequently, a sedentary lifestyle also negatively impacts both physical and mental well-being, increasing the risk of mental health disorders (Wu et al., 2017). Physiological adaptations often occur with frequent physical activity, helping to mitigate the risk of disease and improve cardiovascular fitness (Rivera-Brown & Frontera, 2012). Some studies have also shown a correlation between physical activity and reduced stress along with improved self-esteem through change in body image (Shang, Xie & Yang, 2021). These factors are synonymous with positive mental well-being. Improving these factors positively influences mental well-being and can help both adolescents and adults reduce the risk of mental health issues. Physical activity is able to do this through forming a sense of accomplishment by completing a set of exercises, which can improve one's mood and remove negative thoughts.

Despite the known benefits of exercise, there is a high number of people worldwide that are consistently physically inactive (Guthold, Stevens, Riley & Bull, 2018). This can be attributed to a variety of factors such as time commitment, lack of facilities and motivation and the COVID-19 pandemic (Amini et al., 2021). Hence, a need for an alternative form of health delivery has become necessary to manage these obstacles. Online exercise prescription, a relatively new concept yet to be vastly explored has potential to expand access to healthcare (Fischer et al., 2019). Remote online delivery has shown to break down barriers often associated with face-to-face delivery, like cost and time commitment, through use of technological devices such as smart phones and tablets (Kichloo et al., 2020). As such, it has gained popularity in rural areas where access to facilities are limited, making this alternative delivery highly desirable (Bagchi, 2020). However, while technology has become a commonplace in modern society, they may not always be accessible in all households given the financial requirement (Gu, 2021). Furthermore, the need for a good internet signal is essential for this method, something that is likely limited in rural areas (Almathami, Win & Vlahu-Gjorgievska, 2020).

1.2 Significance of the Problem

With the ensuing pandemic and factors such as cost and limited facilities, the ability to be physically active has become rather difficult. The effect online exercise prescription can have on the well-being of individuals is not yet known. This study will help expand the theory around this area of interest and provide a suitable alternative to in-person health delivery. Those who want to maintain a healthy lifestyle and remain active but struggle to access facilities will benefit from the findings of this study. The potential remote delivery can have on increasing their well-being and improving quality of life is substantial. The concept of the 12-week program and use of online delivery can be used by healthcare providers to aid those with various health conditions. It's ease of access through availability, reduced cost and travel time can expand the reach of healthcare through the adoption of this method by health practitioners.

1.3 Literature Analysis

While studies have shown the benefits of online health delivery, there are a limited number of studies that explore the effectiveness of online exercise prescription on the well-being of individuals. A study by Chrisman et al. (2021) explored the feasibility of online exercise prescription on youth with concussions. Exercises were prescribed on a weekly basis through an online video call. Results showed full compliance of participants with the online delivery concept. Interestingly, participants valued the use of Fitbits as it proved to be an efficient tool to monitor weekly progress. Technical difficulties were also stated to be rarely experienced, strengthening the concept of online prescription. Jennings et al. (2020) conducted a study similarly exploring the feasibility of online exercise prescription on elderly veterans through weekly online group classes during the COVID-19 pandemic. Online sessions were led by two individuals, whereby one would carry out the exercise prescription, and the other to mandate potential technical complications. This is certainly a unique approach that can potentially lead to less complications in the future, such as reduced drop out in audio/visual connection, leading to a more efficient session.

1.4 Research Question and Hypothesis

Evidently, implementation of online health prescription has considerably increased with the presence of the COVID-19 virus. However, it remains unclear how effective exercise prescription is through an online medium. Current literature lacks detail in this regard, and hence would need to be explored further in the future. Based on this, the aims of this study consisted of determining the effect of online exercise prescription on well-being. We hypothesised that individuals engaging in online exercise prescription will exhibit an improvement in their well-being.

The initial premise of this study was to explore the effect of online exercise prescription on blood pressure and cardiorespiratory fitness. However, during the data collection stage of this study, a COVID-19 lockdown was announced which required all individuals to remain in household bubbles, two-meter social distancing, and closure of services such as the Massey

University laboratory. As a result, we were unable to gather post-intervention participant blood pressure and cardiorespiratory fitness data, which led to a shift in the study premise.

1.5 Research Objectives

In this study, there are two primary objectives which have been assessed:

- Determine the effects of online exercise prescription on well-being
- To understand participant perspectives and opinions on the use of online health delivery

1.6 Thesis Structure

This thesis has been arranged into four chapters. Chapter one consists of an introduction and background to the research topic that provides the necessity behind conducting this study. Chapter two is a narrative review critically evaluating the use of a telehealth approach to lowering blood and improving overall quality of life and well-being. Chapter three presents the manuscript for the research study. This section explores the effects of online exercise prescription on well-being and evaluates the perspectives of participants in regard to this delivery method. Additionally, the methodology of the study along with the analyses and discussion of results are presented. Chapter four contains the overview, limitations and conclusion of the thesis as well as future areas of interest.

1.7 Contributors to the research

Contributor	Thesis contribution
Fadi Bahi	Concept and research design of the study, ethical application, execution of the study, Recruitment, screening and testing of participants, data entry and analysis, statistical analysis, interpretation of results, author of the thesis
Prof Ajmol Ali	Primary thesis supervisor, concept design, advisor, revision and approval of thesis
Dr Jennifer Roberts	Thesis co-supervisor, advisor for qualitative component of research, revision
Kelly Irwin	Development of exercise program, exercise video recording, Focus groups
Sajedul Khan	Focus groups, advisor for qualitative component of research
Wendy O'Brien	Facilitation of participant testing
Luke Stanaway	Power analysis

Chapter 2: Evaluating the Use of a Telehealth Approach to Lowering Blood Pressure and Improving Well-being

2.1 Introduction

Healthcare has progressively advanced over time and continues to do so with the implementation of alternative means of health delivery such as telehealth. Healthcare practitioners have struggled to provide a means of care to those who lack access to their service, hence the reason why an innovative method of health delivery such as telehealth can be effective. Telehealth encompasses a wide range of telecommunication technology to deliver an array of health services and education to individuals remotely (Serper & Volk, 2018). Methods can include video or phone conference consultations, application-based monitoring of health parameters, and communication via messages or email (Holtz, Laplante, & Whitten, 2010). This concept of healthcare can become a fundamental component within the health sector due to the benefits it can provide.

Standard healthcare delivery is limited in terms of reach and availability, even more so during the COVID-19 pandemic (Orlando, Beard, & Kumar, 2019). So, the purpose of this alternative method is to ease the delivery of health services primarily in remote locations where residents struggle to access them. Furthermore, the global presence of chronic health conditions (Hajat & Stein, 2018) has placed a strain on health providers to meet the growing needs of patients (Kichloo et al., 2020). Consequently, healthcare providers employ the use of online health delivery to mitigate the strain placed on them, as well as to protect patients from contracting further illnesses (Ahmed, Sanghvi, & Yeo, 2020). Much like standard face-to-face specialist visitation, telehealth consultations can similarly aim to treat various health conditions (Orozco-Beltran, Sánchez-Molla, Jesus Sanchez, & Mira, 2017). Additionally, telehealth seeks to minimise the required cost of healthcare through reducing the need to travel, which may permit more individuals to seek this method, furthering trust, and demand (Delgoshaei et al., 2017).

High blood pressure (BP), or hypertension, is a common condition experienced primarily by older adults and is the number one cause of mortality globally (Hegde & Solomon, 2015). It is the condition where systolic/diastolic BP is at 140/90 mmHg or above (Carey, Muntner, Bosworth, & Whelton, 2018). Regular monitoring of BP is important to determine whether an individual is hypertensive as this condition generally does not have any known symptoms

(Granados-Gámez, Roales-Nieto, Gil-Luciano, Pedro, & Márquez-Hernández, 2015). Hypertension has several underlying causes, one of which is a lack of physical activity (Rissardi et al., 2018). Being physically inactive for extended periods of time results in the mismanagement of weight and can lead to obesity and diabetes, further risk factors of hypertension and poor well-being (Re, 2009). Long-term hypertension, coupled with no lifestyle changes, can lead to the development of cardiovascular disease (CVD) and a subsequent increased risk of mortality (Gupta & Guptha, 2010).

The purpose of this literature review is to explore the various means of telehealth, its feasibility, convenience, and its potential impact on BP and well-being. The review will explore factors that lead to high BP, effects it can have on well-being as well as different ways of combatting hypertension. Furthermore, this review will look at how exercise interventions can be used in conjunction with telehealth delivery to effectively counteract hypertension and lead to improved quality of life (QoL). This literature review topic was selected in conjunction with our thesis to expand on the narrative and identify potential gaps. However, due to a COVID-19 lockdown, we were unable to gather post-intervention cardiovascular data given the mandatory social distancing and closure of the data collection laboratory. Therefore, our thesis study design was shifted to a qualitative approach, incorporating questionnaires and focus groups to assess the effects of online exercise prescription on well-being and understand the perspectives of participants with this delivery method. This change in design meant there was a difference in focus for the literature review and overall thesis. The literature review primarily examined the effect of telehealth on lowering blood pressure while the thesis explored the effects of online exercise prescription on overall well-being. A limitation of the study consisted of the novel concept of telehealth. Given that it is a relatively new service, we focused our observations to literature primarily from the last decade. This may have limited our findings. Furthermore, literature looking at the impact of telehealth on hypertension was scarce, hence, this hindered the scope of our review

Google Scholar, Massey Library, PubMed, BMJ and Sage Journals were sources used to explore previous research for this review. Specific keywords such as “telehealth”, “hypertension”, “exercise”, and “healthcare” “online delivery” were used to help reduce the scope of literature. Search for this reviewed looked at the common effects of hypertension, its management, and the use of telehealth as a means of improving self-management of hypertension. Passed research was selected provided it expressed information regarding the underlying causes of hypertension, its means of management, and the effectiveness of telehealth in lowering BP towards more normative levels (Systolic BP < 120 and Diastolic BP < 80).

2.2 Effects of Hypertension on Well-being

Hypertension brings about many health risks such as myocardial infarction (heart attacks), kidney disease and angina, some of which can lead to death (Ahuja, Ayala, Tong, Wall, & Fang, 2018). Elevated BP can affect both the heart and blood vessels leading to adverse effects on an individual's health (Kitt, Fox, Tucker, & Mcmanus, 2019). Blood vessels are capable of being dilated to accommodate the flow of blood passing through; high BP places a significant amount of strain on these vessels, leading to the accumulation of fat and cholesterol on the vessel walls (Nakanishi et al., 2017). These harden and form plaque which occludes the passageway of vessels, limiting blood flow to the heart and increasing BP in the process; this process is known as atherosclerosis (Bergheanu, Bodde, & Jukema, 2017).

With the increased systemic vascular resistance via atherosclerosis, the left ventricle of the heart is required to pump a greater amount of blood due to the limited supply, resulting in hypertrophy of the heart muscle (Drozdz & Kawecka-Jaszcz, 2013). This process can overwork the heart, causing a large sum of strain which can result in the heart muscles not meeting the required contraction demand and failing, causing heart failure (Georgiopoulou, Kalogeropoulos, & Butler, 2011). In some instances, blood clots can form when the plaque formation ruptures, obstructing blood flow to the heart, preventing oxygen delivery to the heart tissue, killing it in the process leading to a heart attack (Serda et al., 2013). Moreover, this limited blood flow, a consequence of plaque build-up, can lead to angina, a condition often associated with chest pain (Ahuja, Ayala, Tong, Wall, & Fang, 2018). Chronic chest pain and reduced capacity for physical activity often associated with angina lead to a large negative impact towards health-related QoL within individuals (Tendera et al., 2016).

Hypertension can also adversely affect the kidneys (Pugh, Gallacher, & Dhaun, 2019). Kidney disease is a condition where the kidneys function inadequately and is generally not associated with any known symptoms during the earlier stages (Fraser & Blakeman, 2016). Kidneys use nephron structures to effectively filter out waste products and excess fluid from the body; these nephrons are comprised of blood vessels and when damaged by hypertension, they become ineffective (Schnaper, 2013). The kidneys release the hormone aldosterone that acts to regulate BP and maintain an equilibrium, however with kidney disease, this does not happen, and BP is hence not controlled (Laurent & Boutouyrie, 2015). In some instances, progress of kidney disease has been shown to impact physical and social functions and lead to frequent physical discomfort (Kefale, Alebachew, Tadesse & Engidawork, 2019).

2.3 Management of Hypertension

Hypertension, fortunately, is a condition that can be managed (Nguyen, Dominguez, Nguyen & Gullapalli, 2010). By incorporating lifestyle changes, those diagnosed can work to reduce BP and mitigate its associated risks (Wen & Wang, 2017). BP arises because of the resistance to blood flow from blood vessels (systemic vascular resistance). Maintaining constant monitoring of BP, whether at home or clinic, is an appropriate approach to counteracting hypertension (Kitt, Fox, Tucker, & Mcmanus, 2019). Awareness of BP levels is important as counteractive measures such as a change in lifestyle can be taken should levels reach a critical point. Should an individual notice a rise in their BP levels through symptoms such as dizziness, fatigue, and frequent headaches, they can then employ lifestyle changes as a means of self-management to help reduce it. An important change that can be made is improving physical well-being through active engagement in physical activity (Gupta & Guptha, 2010). This can often be challenging for individuals who lack the knowledge, support, and motivation to establish and follow an exercise routine. Hence, the availability of exercise interventions is important in situations such as these to help manage hypertension (Hegde & Solomon, 2015). Physical activity initiates physiological adaptations that not only help reduce BP, but also reduce the risk of developing diabetes, and in turn, CVD (Warburton, 2006). Frequent participation in physical activity also improves both physical and mental well-being which contribute towards positive quality of life and the mitigation of hypertension risk factors such as obesity, reducing the risk of CVD (Sin, 2016). With prolonged exercise engagement, the heart muscle, along with the left ventricle, increase in size, improving strength of the heart as well as the strength of contraction in the process (Nystoriak & Bhatnagar, 2018). As the left ventricle increases in size, more blood can enter and with increased contractility, a greater quantity of blood is ejected per contraction (stroke volume) (Vieira et al., 2016). With an improved stroke volume, resting heart rate is reduced as the heart can eject an efficient amount of blood per minute (cardiac output) at a lower rate, reducing the strain placed on it and potentially lowering BP (Reule & Drawz, 2012). Systemic vascular resistance is also reduced with adherence to physical activity as it stimulates the relaxation of blood vessels reducing the resistance against blood flow lowering BP levels (Chaudhary, Kang, & Sandhu, 2010).

Other means of counteracting high BP consist of a change in diet (Appel et al., 2006). Excess consumption of processed foods and foods high in sodium and oil has been shown to be associated with hypertension (Bazzano, Green, Harrison, & Reynolds, 2013). Naturally, opting to reduce the consumption of these types of food, and instead choosing to consume healthier and more balanced alternatives such as fruits and vegetables, can be an effective approach to lowering BP and the risk of hypertension. Stress has in some instances also been shown to negatively influence diet and lead to poor well-being and weight gain which can increase the risk of hypertension (Schweren et al., 2021). Dietary sodium causes water to be retained within the body and increases the volume of the blood (Farquhar, Edwards, Jurkovitz, & Weintraub, 2015). When blood travels through the blood vessels, the now larger blood volume exerts greater amount of pressure on the vessel walls, leading to an increase in BP and an increased risk of hypertension (Grillo, Salvi, Coruzzi, Salvi, & Parati, 2019). Hence, by employing a dietary change and reducing consumption of sodium-filled food, over time, BP can be lowered as blood volume would not have increased (Schwingshackl, Chaimani, Hoffmann, Schwedhelm, & Boeing, 2017).

2.4 Effect of Physical Activity on Hypertension

Although hypertension is a condition that can be managed through pharmacological means, it may not always be the most adequate approach given the extent of cost and potential side effects of drug consumption (Kirkland et al., 2018). Physical activity on the other hand is commonly recommended by health practitioners as an effective deterrent of high BP and its associated health benefits on well-being have become widely accepted (Choudhury & Lip, 2005). In New Zealand, the national guidelines suggest that adults should be active for a total of 150 minutes per week if performing moderate intensity physical activity or 75 minutes per week if performing high intensity physical activity (Ministry of Health, 2017). Meeting this requirement can provide better health management and reduce potential risk of future health problems (Reiner, Niermann, Jekauc & Woll, 2013).

According to Ruivo & Alcântara (2012), the immediate response of BP, more precisely systolic BP, to physical activity is for it to rise due to the increased oxygen and glucose demand of skeletal muscles causing an increase in cardiac output. Glucose and oxygen also act as a fuel source to allow for efficient muscle contraction (Richter & Hargreaves, 2013). This is initiated through receptors in vessels that send a signal to the brain, activating the sympathetic nervous system (Kim & Ha, 2016). Signals are then sent to blood vessels where nitric oxide and prostaglandin production increases, initiating an increase in vessel diameter (vasodilation), thereby reducing vascular resistance, and allowing more blood flow and lowering BP in the process (Kim & Ha, 2016). At rest, the increased rate of nitric oxide and prostaglandin production remains, and so systemic vascular resistance would have decreased and so too would BP, positively affecting hypertension (Hermann, Flammer, & Lscher, 2006, Ruivo & Alcântara, 2012). Physical activity can also actively prevent or manage hypertension through reducing an individual's weight (Mittendorfer & Peterson, 2008). A shift from obesity to a healthy weight level reduces the amount of adipose tissue stored within the body which reduces the risk of plaque build-up inside blood vessels; as this happens, there would be no rise in systemic vascular resistance, blood flow would not be occluded, and consequently, BP does not elevate (Cohen, 2017).

2.5 The Varying Models of Telehealth

With the abundance of technology, telehealth services and programs can be administered in several ways, increasing the accessibility of healthcare in the process (Mechanic, 2020). One of the ways telehealth can be conducted is through real-time conferences. This refers to the use of a telecommunication device such as phone, tablet, or personal computer to communicate with a healthcare practitioner either via a video conference session or a simple phone conversation (Taylor et al., 2015). With increased integration of technology, video conferencing has become an effective method within healthcare to reach those in remote locations (Ignatowicz et al., 2019). It can be used to both diagnose and discuss potential treatment options for health conditions much like standard healthcare (Mallow et al., 2016). A subvariant of live video conference sessions is the use of asynchronous videos or images and is often referred to as the "store-and-forward" method (Janda et al., 2019). This delivery method consists of patients and practitioners recording videos or capturing images and sending them off to be interpreted (Deshpande et al., 2009). Capturing images and videos can be facilitated via smart devices and securely transmitted to the recipient (Beijer & Rietveld, 2014). Mobile health (mHealth) utilises health-based applications found in smart devices such as mobile phones or tablets to maintain a record of health measures (Han & Lee, 2018). Maintaining a record of health measures conveniently in smart devices helps to improve the rate of communication and monitoring between patient and health practitioner as well as increase the level of health information readily available to allow self-regulation (Marcolino et al., 2018). Another model of telehealth delivery which became more common during the COVID-19 pandemic is through direct communication with a patient via telephone (White, Byles & Walley, 2022). This method can be used as an alternative to video consultations due to the limiting factor of not being able to see the individual being consulted. However, when compared to the other models of telehealth, it is plausible to suggest that telephone communication is most reliable based on the unlikelihood of connection drops. Phones are also more accessible than smart devices in households and can potentially be more suitable for low-income families (Marler, 2018).

2.6 Cost-effectiveness of Telehealth

Evidently, telehealth has been shown to be an effective tool in not only improving the management of health conditions, but also reducing healthcare cost in some instances (de la Torre-Díez, López-Coronado, Vaca, Aguado, & de Castro, 2015). Although the affordability and cost-effectiveness of telehealth services is dependent on people’s income and location. In large, the primary cost saving draw of telehealth is the reduction of patient visits to the emergency department and paying the cost of healthcare. Interestingly, evidence shows that telehealth can be cost effective when implemented in certain healthcare areas such as cardiology, however not quite as much in other areas such as cancer healthcare (Delgoshaei et al., 2017).

In rural communities, access to health specialists may not always be available to patients, and so they would need to travel long distances to seek access to a consultation. However, with telehealth allowing the possibility of videoconferencing, the need to travel is removed as consultations are conducted remotely. Rural patients who access remote healthcare also lessen the cost associated with travel and parking as appointments would take place digitally from their home and there would be no need to physically visit an emergency department or other healthcare facility (Buvik et al., 2019). This is similarly applicable to practitioners who personally visit patients for specialised care. House call visits by practitioners are much less common in recent times, however, there remain some that continue to do so (Seah, 2020). The need to travel, let alone to rural locations, can be very costly as previously mentioned. Online health delivery would be most ideal in this circumstance given that consultations with patients can effectively be completed remotely as aforementioned. Remote monitoring similarly removes the need for making in-person appointments with a healthcare practitioner to record physiological measures. Instead, this data is remotely sent to the practitioner where monitoring can take place without the patient needing to be present. As such, patients benefit from the reduction in the associated costs that would have otherwise been spent on scheduling an appointment (Neville, 2018).

2.7 Accessibility to Telehealth

Access to healthcare was limited due to the frequent COVID-19 outbreaks exhibited and practitioners opting to stop in-person healthcare to prevent further spread of the disease (Monaghesh & Hajizadeh, 2020). This expedited the use of telehealth as a means of healthcare delivery.

Availability of mobile phones and tablets offer a unique infrastructure for healthcare delivery and education. The average cell phone provides users with the ability to send and receive messages and download applications. Healthcare practitioners can take advantage of this via targeted messages that promote physical activity and encourage participation (Gur, Nir, & Teleshov, 2016). Health-related applications can be downloaded to help individuals track their health conditions and diagnose themselves, making healthcare information easily accessible. The rise in internet and mobile data accessibility has propelled accessibility to various communication-based health delivery methods further. With mobile data, video conferences can be conducted virtually from any location whether during a lunch break at work or when on a walk (Winter et al., 2019). Likewise, asynchronous videos received from a health practitioner can be downloaded and viewed from essentially any location without the restriction of having to be in a specific location. This shows that an internet connection data grants constant access to the many facets of telehealth delivery.

2.8 Feasibility and Convenience of Telehealth

With the telehealth concept being a relatively new form of health delivery within healthcare, it is difficult to surmise its long-term feasibility. Should this method not be deemed feasible and convenient by the general population and healthcare practitioners, then its cost effectiveness and applicability in healthcare would be considered meaningless (Head et al., 2011). Incorporating telehealth programs within healthcare facilities is difficult as it depends on the willingness of healthcare practitioners to switch their method of healthcare delivery and their access to the required technology (Hah, Goldin, & Ha, 2019; Merrell, 2015). Feasibility for patients depends on whether they would receive quality healthcare that enables positive outcomes. Short-term interventions (Kelly et al., 2019, Kumar et al., 2020) have been conducted on patients living with different conditions to assess feasibility of telehealth programs and they have shown favourable results. Patients in these interventions generally showed high levels of adherence towards the interventions and cited telehealth programs as acceptable alternatives to in-person healthcare delivery. Telehealth delivery has the potential to foster a deeper relationship between patient and practitioner (Toh, Pawlovich & Grzybowski, 2016). Healthcare delivery via voice calls and text messages were positively received as it helped patients develop a more personal relationship with their practitioner. Kelly et al. (2019) found participants in their study appreciated communication via telephone calls and text messages as they were considered more personal. These participants further expressed that receiving feedback and support through a variety of communication methods was effective in increasing adherence to the intervention and promoting lifestyle changes. Kelly et al.'s (2019) intervention was short-termed however; further research is necessary to assess whether long-term remote contact with patients continues to increase engagement.

Delivery of healthcare remotely can allow for flexibility, reduction in cost and overall comfort, which may encourage more individuals to access healthcare and manage their health conditions. Evidence shows that people seek a level of convenience when dealing with healthcare which is what makes telehealth delivery an asset for healthcare providers (Powell, Henstenburg, Cooper, Hollander, & Rising, 2017). Connecting with a healthcare practitioner with whom they are familiar with and has knowledge of their medical history from the comfort of their own home increases engagement and comfort (Powell et al., 2017). Patients also suggest convenience lies in the time commitment associated with video conferences where they do not need to shower and change clothes to see a practitioner and state the benefit of not having to take time away from work to go to their appointment (Powell et al., 2017).

2.9 Utilisation of Telehealth

Living with chronic health conditions and lacking access to a more personalised form of healthcare is difficult (Mallow et al., 2016). Changes to an individual's lifestyle such as increasing physical activity are necessary to reduce chronic conditions like hypertension (Wen & Wang, 2017). However, with the spread of the COVID-19 virus and scarcity of healthcare facilities for those living in rural areas, engaging in health-inducing interventions becomes difficult, and so these conditions can be left untreated, possibly leading to low quality of life. Although by utilising telehealth, this struggle with healthcare access can be alleviated. Communication through video conferences is ideal in that it can reduce the distance between the individual and healthcare facility. As such, it would be applicable to individuals seeking health services who are situated in rural locations to utilise this method of health delivery (Müller, Alstadhaug, & Bekkelund, 2016). Furthermore, with the rapid rise in the elderly population (Jaul & Barron, 2017), older individuals would benefit greatly from telehealth. Visiting a healthcare practitioner for an elderly individual can be a struggle whether it is due to a lack of mobility or fear of exposure to diseases such as COVID-19 (Bujnowska-Fedak & Grata-Borkowska, 2015). Consequently, practitioners can employ this telehealth method when dealing with the elderly to not only increase their access, but also limit further risk to their health by removing the need of in-person visits (Monaghesh & Hajizadeh, 2020). Additionally, practitioners can make use of videoconference group sessions where several individuals can partake in exercise sessions together, although this make take away from the personalised touch of sessions.

2.10 Using Telehealth to Reduce Blood Pressure

Telehealth can be an effective tool to manage non-emergency conditions and can be used in numerous fields within healthcare. Many people suffer from hypertension, and some may lack the required help to manage this condition, increasing their risk of developing cardiovascular disease and negatively influencing well-being (Ruan et al., 2018). Primary and secondary prevention of hypertension requires ongoing monitoring, self-management and access to healthcare, factors that can be provided through telehealth (Mckoy et al., 2015). With its ease of access and breakdown of location barriers, more hypertensive individuals can gain the benefits provided by telehealth to appropriately manage this condition. Videoconference consultations can provide individuals the opportunity to share data on daily behaviour such as dietary intake or exercise routines (Augestad & Lindsetmo, 2009). Practitioners can subsequently review these data and provide feedback through videoconference, phone calls or messages with suggestions on whether certain health interventions should be integrated. Specialists can also communicate with these individuals through email or videoconferencing to discuss dietary programs and initiate exercise interventions to promote weight loss and reduce risk of further disease development through high BP (Alencar et al., 2017). Additionally, frequent video meetings with a specialist and clinical team that remotely monitors vital signs can perhaps instil a sense of accountability in an individual, which may influence their adherence to dietary regimen (Omboni et al., 2020, Gell, Hoffman & Patel, 2021). For those living in rural areas, access to specialised physical activity programs is scarce, however, making use of different telehealth methods can supplement physical activity (Orlando, Beard, & Kumar, 2019).

An online exercise intervention can be conducted to promote change in lifestyle and increase physical activity participation; this can be held by wellness coaches who develop exercise plans for patients (Alley, Jennings, Plotnikoff & Vandelanotte, 2014) .Regular one-on-one communication helps develop a better understanding of the patient's condition and capabilities, allowing the wellness coach to approach their condition with more adequate strategies that can have higher rates of success (Khaylis, Yiaslas, Bergstrom, & Gore-Felton, 2010). Moreover, wellness coaches can provide feedback to their patients that help develop exercise technique and self-efficacy, all of which can increase confidence and work through possible barriers (Thom et al., 2016).

Online-based interventions also provide the individual with the opportunity to include family members in the program to potentially help increase motivation and adherence to the routine (Banbury, Nancarrow, Dart, Gray, & Parkinson, 2018). Different telehealth methods can also be used together to promote physical activity such as providing exercise demonstrations via asynchronous video recordings and exercise education through messages/emails or a specific application (Cottrell, Chambers, & O'Connell, 2012). Additionally, setting SMART[1] goals can help promote motivation and enjoyment in participants which could possibly increase adherence to an exercise program (Wilson & Brookfield, 2009). This way, the individual gains access to all the necessary tools to engage in physical activity. With easily accessible healthcare from the comfort of their home, patients may be more inclined to seek help with their conditions.

[1] SMART goals are designed to be specific, measurable, achievable, realistic, and timely.

2.11 Clinical Effectiveness of Telehealth

The emergence of the COVID-19 pandemic and advancements made in technology have furthered the use of telehealth and increasing access to healthcare (Middleton, Simpson, Prvu Bettger, & Bowden, 2020). Given its ability of reaching a wide range of individuals, telehealth becomes effective in treating chronic health conditions through non-pharmacological means (Bashshur et al., 2014). Conditions such as hypertension, type-2 diabetes, CVD, and stroke share similar risk factors in obesity and lack of physical activity (Kearns, Dee, Fitzgerald, Doherty, & Perry, 2014). While these can be treated and controlled in-person, difficulty of access and the COVID-19 virus can make management of health conditions challenging. Regular monitoring and communication made possible through telehealth can potentially increase engagement and adherence. Table 2.1 portrays the effects of telehealth interventions on improving QoL and overall well-being.

Table 2.1 The Effects of Telehealth Interventions on Improving Quality of Life and Well-being

Author	Participants	Study Design	Summary	Findings	Limitations
Choi & Kim (2014)	Participants with hypertension n = 49 Male = 17 Female = 32 >65 years	Non-equivalent control group pre-test/post-test, Quasi-experimental study	Two weekly videoconference consultations as well as received remote monitoring of their BP	Online intervention led to ↓ SBP, ↑sleep and ↓ depression	Participants were also taking antihypertensive drugs which may have been the cause of reduced SBP
Rasmussen, Lauszus, & Loekke (2016)	Participants with type 2 diabetes mellitus n = 40 Male = 27 Female = 13 36 - 83 years	Randomized trial	Compared the quality of home-based type-2 diabetes rehabilitation via video conferencing with standard care rehabilitation.	Video conferencing found to be almost equally effective as standard care. Intervention led to ↓HbA1c and ↓cholesterol levels	Very short intervention length of 3 weeks

Barnason, Zimmerman, Schulz, Pullen, & Schuelke (2019)	Post cardiac event overweight and obese participants n = 43 Male = 30 Female = 13 47–81 years	Repeated measures experimental control trial	Participants provided dietary information on maintaining caloric levels and offered electronic device with daily telehealth sessions. Phone coaching was held at commencement, ninth and 12th week of the intervention	Telehealth intervention led to significant ↓weight and ↑diet control compared to control group	Intervention participants were not provided with exercise demonstrations.
Hickman et al (2021)	Participants with a liver transplant n = 35 Male = 25 Female = 10 21–70 years	Randomized controlled trial	35 Participants randomised into intervention and control group. Feasibility and safety of exercise telehealth sessions were assessed across a 12-week period.	↑QoL in mental component. No ↑ in physical well-being Telehealth exercise and nutrition programs found to be feasible.	Small sample size – 8 of the 35 participants dropped out, leaving a total of 27.

SBP = Systolic blood pressure, HbA1c = hemoglobin A1c, QoL = Quality of life

Rasmussen, Lauszus, & Loekke (2016) showed that telehealth consultation was as effective as face-to-face interactions in terms of achieving planned goals. Despite both methods having a similar level of effect on participant conditions, the attendance rate for the telehealth group was greater than that of the clinical based group. This may be attributed to the fact that those attending online sessions were able to do so from the comfort of their homes, and therefore would have likely had a greater incentive to attend the session. Clinic-based participants may have been more reluctant to attend some sessions based on the time commitment associated with driving to the location and waiting for the appointment. It is pointed out by the researchers that it took approximately 3-5 minutes for clinic-based participants to enter the consultation room. Wait times such as this can be a large motivator for some individuals to prefer online consultations over face-to-face contact, especially if they can save the cost of driving to the clinic location (Khairat et al., 2021). While both methods are similar in terms of providing a result, it becomes redundant if the individual is less likely to attend. However, given the sample size of this study, it would be difficult to conclude the time benefits of the online method, and so it would perhaps be an interesting area to observed in the future with a greater sample size.

Choi & Kim (2014) similarly explored the concept of telehealth to assess its feasibility and benefits in low-income households. Results showed telehealth was moderately effective in that it was able to successfully reduce systolic BP, improve sleep and reduce depression levels. Scheduling two-weekly sessions with participants may have contributed to the improvement observed in SBP. Participants were able to receive relevant health related information that helped change behaviour and lead a healthier lifestyle. In addition, participants were also able to receive frequent feedback and motivation during these sessions, which has been shown to increase adherence to exercise (Collado-Mateo et al., 2021). It may be why no BP change was observed in the control group as participants received no guidance or motivation throughout the study. Control group participants did not receive relevant information regarding factors that increased BP and hence were unable to alter their daily habits to elicit a positive response. With multiple sessions per week, individuals may experience a more significant change not only in BP but other health factors such CVD markers. Perhaps session frequency is an area that can be further expanded in the future in relation to how it impacts BP management. Participants in this study (Choi & Kim, 2014) were considered to be uneducated as they had not completed basic schooling. Nevertheless, all participants were capable of using the telemonitoring equipment after training and successfully reported back their data. This suggests that tele-monitoring equipment is simple to use and easily accessible. Given its simplicity, this method of health delivery can effectively be employed in various sectors. Furthermore, the average age was reported as 60 years, further showing that for telehealth, age may not necessarily act as a barrier. However, the population primarily consisted of female participants, which may be difficult to generalise to the general public. Future studies should explore online health delivery on both males and females so that findings may be more applicable.

Hickman et al., (2021) further assessed the feasibility and safety of a telehealth exercise and nutrition program. The population size (n = 35) for this study was relatively small, especially after eight participants dropped out, hence the findings may not be entirely generalizable. However, the ages of participants (21-70 years) consisted of a wide range which may improve applicability. This study also effectively showed the reach of telehealth by recruiting participants from a wide range of locations. A total of eight participants either withdrew or were lost to follow-up after completing at least one weekly exercise and nutrition session. This loss may be attributed to the long duration of weekly sessions. Research has found that individuals tend to prefer shorter length sessions perhaps given their convenience (Galloway et al., 2019). Longer durations may have been considered a significant commitment by these participants. Furthermore, shorter sessions allow for greater adherence to the program. Perhaps with shorter sessions, these participants would have remained in the study. The exercise sessions were conducted in groups rather than one-on-one sessions. While group sessions can be effective in eliciting a positive health and behavioural response, individual exercise sessions in this case may have been more appropriate. Perhaps this is why no physical well-being improvement was noted in the telehealth group. Individual exercise sessions would allow the practitioner to adjust the program to suit the participant, potentially increasing their adherence. Future research can look to contrast whether group-based exercise sessions would be more effective than individualised sessions. Telehealth exercise sessions were deemed to be safe given that no adverse effects occurred amongst participants. This may be attributed to the fact that participants were required to undergo a screening test with an exercise physiologist. Screening for health risks may be necessary in the future should telehealth be used as a form of delivery to prevent any potential injuries. If an individual were to experience a serious event, it would be difficult to provide them the necessary help given the differences in location.

The ever-growing prevalence of obesity continues to reduce physical, cognitive, and motor function (Wang, Chan, Ren & Yan, 2016) and can lead to early mortality through development of chronic conditions (Kearns, Dee, Fitzgerald, Doherty, & Perry, 2014). Lack of health facilities that offer appropriate interventions to promote weight loss, especially within rural communities and due to the COVID-19 pandemic, proves to be a challenge. Fortunately, with telehealth, online interventions can be used to overcome this obstacle and help facilitate weight loss. Barnason, Zimmerman, Schulz, Pullen, & Schuelke (2019) employed a health intervention in overweight individuals living in rural areas using a 12-week program. Participants were provided dietary information on maintaining the correct caloric levels and offered an electronic device with daily telehealth sessions. Phone coaching was held at commencement, 9th and 12th week of the intervention to educate and promote self-monitoring and self-regulation. This intervention proved to be effective in reducing weight, but not very effective in increasing physical activity levels. Perhaps the lack of physical activity improvement can be attributed to the fact that participants were not provided with a demonstration of the exercises to perform, or that communication between participant and nurse only occurred on three occasions during the duration of the program. Regular communication would likely be needed to observe a more favourable result.

2.12 Home-based Exercise Interventions to Reduce BP and Improve Well-being

Telehealth services can effectively be used to construct and deliver exercise interventions that help improve well-being and lower BP. Exercise interventions could do this through establishing a physical activity routine that mitigates risk factors of hypertension and facilitates a change in behaviour (Howlett, Trivedi, Troop & Chater, 2018).

Previous research has shown that home-based exercise interventions can be just as effective as clinic-based interventions at reducing BP and improving physical well-being (Avila et al., 2019, Galloway et al., 2019). Interventions do so through increasing the patients rate of engagement in physical activity. A four-week home exercise intervention led to an improvement in both physical and mental well-being as well as an increase in patient motivation for exercise (Wilke et al., 2022). Additionally, an eight-week home-based cardiac rehabilitation intervention found patients with CVD successfully increased their cardiorespiratory fitness (Batalik, Konecny, Dosbaba, Vlazna & Brat, 2021). Improvement in well-being through these online exercise interventions can be explained through the fact that they promote accountability and self-efficacy which not only increases adherence to the program, but also allows patients to develop the confidence needed to engage in physical activity routinely without any added pressure (Bonnevie et al., 2021). This is valuable in ensuring that hypertension risk factors such as obesity can be managed efficiently and increase quality of life.

Home-based exercise sessions can be administered through a smart device by a health practitioner using audio/visual software such as Zoom. Sessions may be conducted weekly with a group of patients, or through a more personalised one-on-one session. Pre-hypertensive patients can ensure safety during sessions through undergoing screening tests and including a support person to help should they injure themselves at any point. The benefit of participating in online exercise interventions is that patients are not confined to one location, they are able to choose any open space, whether at home or outside to conduct their session. Prior interventions have included sessions where the practitioner prescribes and demonstrates exercises to patients, ensuring they are completed safely, and offers additional health advice and goalsetting.

The use of tele-monitoring technology such as heart rate monitors and smart watches permit patients to record their BP and physical activity data that is remotely viewed by the practitioner (Duncker et al., 2021). From the data, practitioners can assess the condition and progress of patients and determine whether any alterations would be needed to the program.

2.13 Effect of Cardiovascular Health on Well-being

Good cardiovascular health is often associated with having blood pressure levels below 120/80 mmHg, exercise participation, and a healthy weight and diet (Ren et al., 2016). Furthermore, the link between frequent engagement in physical activity and improvement in cardiovascular health has previously been established (Nystoriak & Bhatnagar, 2018). Participation in physical activity must, however, be maintained to sustain positive cardiovascular health, which in turn can also positively impact well-being (Sin, 2016).

With positive cardiovascular health, individuals can engage in a greater capacity for physical activity, which enhances well-being (Cheng, Chiu & Su, 2019). Regular physical activity improves blood flow and transportation of oxygen around the body through greater cardiac output, increasing energy levels and productivity throughout the day (Nystoriak & Bhatnagar, 2018). Additionally, physical activity works to strengthen bones and muscles, reducing the risk of potential injuries such as fractures, and improving quality of life (Russo, 2009). Physical activity also promotes positive mental well-being through reducing stress. Furthermore, maintaining a healthy diet and weight further impacts quality of life and improves overall well-being (Firth, Gangwisch, Borsini, Wootton & Mayer, 2020). A nutritious diet helps to reduce symptoms of depression and anxiety which may lead to a lower risk of developing mental illness (Ljungberg, Bondza & Lethin, 2020).

2.14 Patient Perspectives on Telehealth Services

While telehealth services may be effective as a means of alternative health delivery, patient satisfaction and approval are integral to the wider implementation of this concept. Perspectives offer an insight as to how the service can be improved to further future use within the health sector. A recent study (Phenicie, Acosta Wright & Holzberg, 2021) of 562 patients who had previously received video or phone visit telehealth visits reported an 87% rate of satisfaction with 88% of patients finding the quality of care from telehealth services being equivalent to or better than in-person care.

Live-streamed online physical activity classes have been considered as effective in promoting accountability and increasing adherence (Gell, Hoffman & Patel, 2021). Patients attending online exercise classes with other individuals have suggested feeling obligated to complete all exercises given that everyone else was doing it. Maintaining a sense of accountability, especially with physical activity is important to increase motivation and facilitating a change in behaviour (Painter et al., 2018). With no clear difference to in-person sessions, online exercise delivery, and use of telehealth services in general, has been viewed favourably, especially with the added benefit of accessing sessions from virtually any location (Ahmad, Wysocki, Fernandez, Cohen & Simcock, 2021).

Safety was another factor of importance for patients given the COVID-19 pandemic. Many patients have expressed preferring a telehealth consultation over a regular face-to-face visit given the reduced likelihood of contracting COVID-19 (Perrone, Zerbo, Bilotta, Malta & Argo, 2020). Online delivery reduces this spread of infection through removing the need to remain in waiting rooms with potentially infected individuals. This is an apparent draw given that telehealth-related physician consultations have exponentially increased since the rise of COVID-19 (Jiménez-Rodríguez et al., 2020).

2.15 Limitations of Telehealth

While telehealth may be a growing form of health delivery that shows a lot of promise and potential, there remains to be some obstacles to accessing the benefits of this alternative means of delivery. Despite their vast similarities, online health delivery and in-person care do have their differences. The high cost of smart technology and the internet, coupled with the low-income of some families, may prove to be difficult in terms of utilising this service (Collins, Yoon, Rockoff, Nocenti, & Bakken, 2016). Online health delivery is susceptible to network drops and technical glitches which may make sessions difficult to follow (Almathami, Win & Vlahu-Gjorgievska, 2020). Hospitals employing telehealth consultations may be susceptible to these issues given the heavy load simultaneous connections can have on servers (Zhang, Mosier & Subbian, 2021). Furthermore, rural areas may struggle with sustaining a reliable internet connection given that such areas tend to lack an adequate network structure (Annaswamy, Verduzco-Gutierrez, & Frieden, 2020). Inadequate funding may prove to be difficult in relation to establishing telehealth services within rural areas and the associated cost of training staff with the necessary equipment proves to be a barrier for future implementation (Shah & Tomljenovic-Berube, 2021). In instances where a physical check-up could be needed, physicians may struggle to accurately identify an issue through a screen, leading to a misdiagnosis of conditions; causing patients to have a negative view of telehealth (Bull, Dewar, Malvey, & Szalma, 2016). Not every form of medical testing can be completed using telehealth, e.g., blood tests and imaging can only be conducted in person given. Future telehealth studies will need to address the number of limitations that currently undermine telehealth services, especially if this form of delivery is intended to be offered alongside or even surpass in-person care.

2.16 Conclusion

The purpose of this narrative review was to explore and understand the hypertension condition and its underlying causes and treatments as well as to evaluate the effectiveness of the telehealth concept in lowering high BP and managing other conditions. Hypertension is a prevalent condition that is one of the primary causes of mortality globally. It is a condition that can be managed with lifestyle changes like physical activity and dietary change which can be promoted via online based interventions through use of the telehealth delivery methods such as videoconferences. Standard in-person healthcare delivery is a common and well-known method for individuals to receive necessary care for a wide range of health conditions. However, this method of care may not be readily available to everyone due to the growing costs, waiting times, or distance needed to travel for those living in rural areas. Such disadvantages leave a desire for an alternative, more accessible form of health delivery. Telehealth is a growing method of health delivery and may afford various advantages to manage several conditions such as hypertension. With the COVID-19 pandemic limiting accessibility to healthcare within the public, telehealth would be an ideal to reduce the risk of spread. Research on telehealth effectiveness in lowering blood pressure and managing hypertension is very limited. Future research can look at this concept further and perhaps assess the long-term effects of online based exercise intervention on blood pressure.

Chapter 3: The Effects of Online Exercise Prescription on Well-being in Healthy Adults: A Pilot Study

3.1 Abstract

Background: Online exercise prescription is a novel concept that can be effective in expanding the reach of health delivery. However, there is limited research on the efficacy of this method. The aim of this study was to determine the effects of online exercise prescription on well-being and understand participant perceptions on online health delivery.

Methods: Seventeen healthy participants were recruited for this study. Nine participants (male = 4, female = 5, mean age = 44 years) were allocated to the online group (INT) and 8 participants (male = 4, female = 4, mean age = 40 years) were allocated to the self-monitoring group (ACON). INT participants attended weekly 20-minute Zoom sessions where exercises were prescribed and demonstrated and long-term fitness goals were set. Online focus group sessions were conducted to gather participant perspectives on their respective delivery method. Due to a COVID-19 lockdown occurring during the post-intervention period of this study, we were unable to fully assess post-intervention data and therefore, the study design and aim was altered to a qualitative approach.

Results: Online health delivery was well received by participants and was perceived to be effective in improving well-being. Weekly online sessions were considered important in increasing adherence to exercise through accountability, motivation, and practitioner feedback. Increased engagement in physical activity within the INT group led to increased energy levels, physical fitness, and strength. Long-term fitness goals were achieved by 89% of INT participants

Conclusion: Our findings suggest that online exercise prescription has great potential in improving overall well-being within individuals. Furthermore, this method appears to be feasible and accepted as an alternative means of health delivery. In spite of that, research in this area, especially in online exercise prescription, remains scarce. It is imperative that further research be undertaken to further expand on the literature.

Key words: Healthcare, health coach, goal setting, digital health, physical activity

3.2 Introduction

Well-being plays an important role in daily life and is the state whereby an individual is considered to be physically healthy and mentally comfortable (Ruggeri, Garcia-Garzon, Maguire, Matz & Huppert, 2020). Many factors, such as a leading a sedentary lifestyle can negatively impact well-being and reduce quality of life, increasing risk of disease development and disability (Bell, Audrey, Gunnell, Cooper & Campbell, 2019). Highly sedentary lifestyles tend to be associated with numerous health conditions such as hypertension, obesity, and depression (Sohn et al., 2014). Well-being levels in New Zealand are relatively low, a recent New Zealand well-being survey showed that 30% percent of respondents reported moderate to severe psychological distress and 16% reported moderate to high levels of anxiety (Every-Palmer et al., 2020).

It is well known that regular physical activity plays an important role in developing healthy routines (Weyland, Finne, Krell-Roesch & Jekauc, 2020). However, not everyone has the same level of access to physical activity, whether that is due to a lack of access to health facilities or access to a health coach who can provide activity plans and motivation to be active (McDonough, Helgeson, Liu & Gao, 2021). To circumvent these barriers, health delivery via telecommunication devices has become more accessible across the world, chiefly with the prevalence of COVID-19 (Kichloo et al., 2020). Utilising this method of communication can aid in widening the reach of health delivery, and has the ability of reducing cost (McDonough, Helgeson, Liu & Gao, 2021). Online delivery has the potential to reduce the strain placed on the healthcare system given its ability to provide convenience and flexibility in appointment scheduling (Greiwe, 2022). Individuals would not only benefit from having access to healthcare practitioners from their own homes, but also have the added benefit of reducing cost of travel and time spent in transportation and waiting rooms (Shah, Erinjeri, Guan, Otto & Solomon, 2020).

There are a very limited number of studies exploring the concept of online health delivery (Rasmussen, Lauszus, & Loekke., 2016; Choi & Kim., 2014; Barnason, Zimmerman, Schulz, Pullen, & Schuelke., 2019; Hickman et al 2021). Hence, there is a dearth of information that helps determine the efficacy of this delivery method and how well-being may be impacted. A randomised pilot trial (Baez et al., 2017) explored the potency of online exercise delivery on well-being in older adults. An improvement was observed in both physical and mental well-being among the participants, and they showed great adherence to the program. However, this study only spanned a period of eight weeks, and it would be worthwhile to observe the rate of adherence and improvement in a longer program. Furthermore, only older adults aged 60 years and above were included in the study by Baez et al (2017) so it is unclear what effect online exercise prescription may have on a wider age range. Perhaps using a health coach on a weekly basis rather than virtually delivering the exercises may have elicited a greater response.

Online exercise-based interventions have often been conducted in home-based settings on individuals of various ages and health conditions, e.g., hypertension (Amorese & Ryan, 2022; Morrison, Paterson & Toohey, 2020). These interventions have been of relatively short duration with minimal patient follow-up. Additionally, studies examining the effects of online exercise interventions on a generally healthy population are scarce. Face-to-face care has been compared to online exercise interventions in previous research, however there has been a mixed response. Some studies (Fang, Huang, Xu, Li & Au, 2019) have found virtually delivered exercise interventions to be more effective than face-to-face care in terms of improving physical activity engagement and eliciting a positive health response. Elsewhere, literature (Androga et al., 2022) has shown online and face-to-face interventions as having comparable levels of efficacy in improving quality of life. Further observations are necessary to develop the theoretical and practical framework of online exercise prescription.

Therefore, the aim of this study was to determine whether online exercise intervention effects well-being in a group of healthy individuals. We hypothesised that individuals in the intervention group would exhibit an improvement in well-being compared to those in the active control group, who received a comparable standard treatment.

3.3 Methods

3.3.1 COVID-19

The COVID-19 pandemic largely affected the processes of this study. The initial aim of the study was to examine the effect of online exercise prescription on blood pressure and cardiorespiratory fitness in individuals aged 30 years and above. Hence, pre-intervention data collection consisted of gathering blood pressure and blood flow measures as well as estimated VO_{2Max}. However, a lockdown occurred during the latter stages of this study which prevented the post-intervention data collection from taking place. Given this, we did not have the relevant post-intervention data to maintain the initial premise of this study. Well-being and post-intervention focus group sessions were still completed as both were conducted online. Therefore, the aim of this study was altered to better fit the situation.

3.3.2 Research Ethics

This project was approved by the Massey University Human Ethics Committee: Southern A, Application 20/56.

Participation in this study was voluntary and participant consent was acquired via a consent form (Appendix A) with the right to withdraw from the study at any point. Participant consent regarding recording of focus groups was also obtained. Privacy was upheld through removal of any potentially identifying features and use of encrypted folders and restricting data access to only the primary researcher.

To ensure participant safety, participants were recommended to seek prior approval from their healthcare provider in regards to their ability to participate in this study. This was to prevent any potential injuries from occurring during the study. A health fact sheet was also provided to participants detailing guidelines to follow should they feel unwell during the study intervention. Additionally, contact details of a household support person were gathered to ensure that should any injury occur, an individual would be available to assist the participant. With the COVID-19 pandemic, safety in the laboratory where data collection took place was ensured through more stringent cleaning of equipment and adhering to the NZ government's COVID-19 health guidance.

3.3.3 Study Design

This study incorporated a randomised control trial experimental design to identify whether online exercise prescription had an effect on cardiorespiratory fitness and blood pressure. To identify the effects of online exercise prescription, quantitative measures such as cardiorespiratory fitness, blood pressure, and blood flow parameters were used. However, due to a COVID-19 lockdown restricting interactions and closing the Massey University Sport and Exercise Science laboratory, the study design was changed to a qualitative approach.

Consequently, this study employed an interpretivist phenomenological approach to conduct focus groups and questionnaires with individuals from the Auckland region. This method helped to identify a particular phenomenon within research by gathering and understanding participant perspectives through qualitative methods to gain an understanding behind their motivation (Neubauer, Witkop & Varpio, 2019). With this approach, preconceived assumptions are disregarded and the lived experiences of participants are taken into consideration to further understand the phenomenon. A phenomenological approach was chosen as we sought to gather participant experience with online exercise prescription and develop an understanding of the motivation behind their views and opinions.

Participants were randomised to either an online intervention group (INT) or self-monitoring group (ACON). Randomisation occurred based on participant age and gender. This was done via an online randomiser (www.randomiser.org). The primary researcher and participants were both aware of which group each participant was allocated to. There was one primary dependent variable measured in this study, the perceived improvement in well-being experienced by participants derived from focus group and questionnaire responses.

Using G*Power (effect size of 2.65, alpha level of 0.05 and power of 0.99) along with the data from Choi & Kim (2014) who included a total of 50 participants in their study, we estimate a total of 12 participants will be required for our study. This value was attributed to the uniqueness of this type of study and the fact that Choi & Kim exhibited a large change of 18.82 mm Hg in systolic blood pressure within the experimental group which resulted in a skewed power level. To account for this and any potential participant drop out, we aimed to recruit a total of 40 participants aged 30 years and above for this study.

3.3.4 Participants

A total of 17 male and female individuals of mixed backgrounds with a mean age of 43 ± 11.4 years were enrolled in this study. Participants were recruited from the Auckland region of New Zealand.

Inclusion criteria consisted of systolic blood pressure ranging from 110 mmHg to 139 mmHg and diastolic blood pressure ranging from 70 mmHg to 89 mmHg. Furthermore, participants who took blood pressure medication, were pregnant, or were expecting to be pregnant throughout the duration of the study were excluded. Participants were also required to be over 30 years of age, speak English, and capable of being physically active.

Consent for participation in the study intervention and focus group sessions were obtained in written form prior to commencement. In this study, participant names were not disclosed to maintain privacy as per their request. Instead, they were referred to by a randomly assigned number. Additionally, no attrition was recorded as all those who volunteered successfully completed the study.

3.3.5 Recruitment

Recruitment occurred over a six-month period until 30th September 2021. Advertising posters were placed at various locations within the Auckland region including various neighbourhoods, libraries, shopping malls, retirement villages, community centres, GP clinics, hospitals and churches. Additionally, the poster was placed on social media websites such as Facebook and LinkedIn. An advertisement was also placed on the Massey University newsletter. Interested participants were provided with the study information sheet (Appendix B) and two health screening questionnaires (Appendix C and D).

3.3.6 Baseline Data

Data regarding blood pressure levels, cardiac output, stroke volume, systemic vascular resistance, mean arterial pressure, heart rate and estimated VO_{2Max} was recorded. This data was collected during the baseline data collection period by the primary researcher. Participant blood pressure and heart rate were recorded via a BP monitor (Rudolf Riester GmbH, Jungingen, Germany) while estimated VO_{2Max} was measured through a 6-minute Astrand-Rhyming cycle test on a Monark EC-1200 cycle ergometer (Catey Co. Ltd, Japan). Cardiac output, stroke volume, systemic vascular resistance and mean arterial pressure were measured using an ultrasound device (Uscom 1A, Uscom Ltd, Australia).

3.3.7 Meke Wellness Meter Well-being Survey

The Meke Wellness Meter survey (Forrest et al. 2016) was completed pre and post-intervention period. This survey contained questions regarding the social, mental and physical well-being of participants. The post-intervention well-being survey contained additional questions assessing participant perceptions on the efficacy of the 12-week exercise program on their physical fitness and mental well-being.

This survey was provided to participants upon arrival at the Massey University laboratory during the pre-intervention data collection period. Participants were informed of the survey structure and were asked to evaluate how they perceived their physical, mental, and social well-being from 1 to 10, where 10 was feeling very positive. The survey was completed within a five-minute period.

After completion of the intervention, the well-being survey was emailed to participants rather than completed in person due to COVID-19. The email provided once more explained the outline of the survey to participants, and upon completion, the survey was returned to the primary researcher via email.

3.3.8 Focus Group Discussions

Focus group sessions took place prior to and post completion of the 12-week intervention. Sessions were moderated by the research assistant with questions chosen by the primary researcher. Post-intervention focus group sessions were conducted to gather participant experience with their respective intervention and develop an understanding of the limitations and future directions of the method of delivery. To gather this information, open-ended questions (Appendix E) were asked to provide participants the opportunity to share opinions in detail and deliver new insights regarding their respective delivery method.

Participants were allocated into groups consisting of approximately three to four participants within their respective intervention. An email was sent by the primary researcher to each participant to schedule an appropriate meeting time and send a Zoom invitation. Subject to participant availability, focus group sessions occurred during weekdays and weekends. Prior to commencement of each focus group, the research assistant informed participants that their session would be recorded and obtained verbal consent. Participants were also informed that they were able to cease recording at any given point. Each session commenced with research assistant and participant introductions and questions were subsequently asked.

3.3.9 Procedures

Each individual expressing interest in the research study was provided with two health screening questionnaires to determine their eligibility. When eligibility was met, participants were invited to attend a 30-minute pre-intervention online focus group session via Zoom. A

Zoom link was sent to the participant via email. Focus group sessions all followed the same protocol throughout, and the same questions were asked to maintain consistency, and sessions were run by the same research assistant. The research assistant in this study had a Master's degree in Social Sciences as well as prior experience conducting online focus group discussions in research.

Participants were invited to attend the 60-minute pre-intervention data collection visit at the sport and exercise science laboratory on the Massey University Albany campus. Upon commencement of the session, the general outline of the visit was explained to the participants and were invited to ask any questions should they have had any. Following this, participants completed a simple holistic well-being survey (Meke Meter) (Appendix F) and had their height and weight measured.

As data collection was completed, the participant was informed of which group they were randomly assigned to and were provided the Swiss ball, jump rope and resistance bands to use for the 12-week period. A weekly date and time for Zoom sessions was scheduled with participants in the INT group during the laboratory visit. In the ACON group, participants were also provided the entire 12-week program (Appendix G) along with video links and instructions for each exercise at the end of the visit. A flow diagram outlining the study procedures is presented in Figure 3.1.

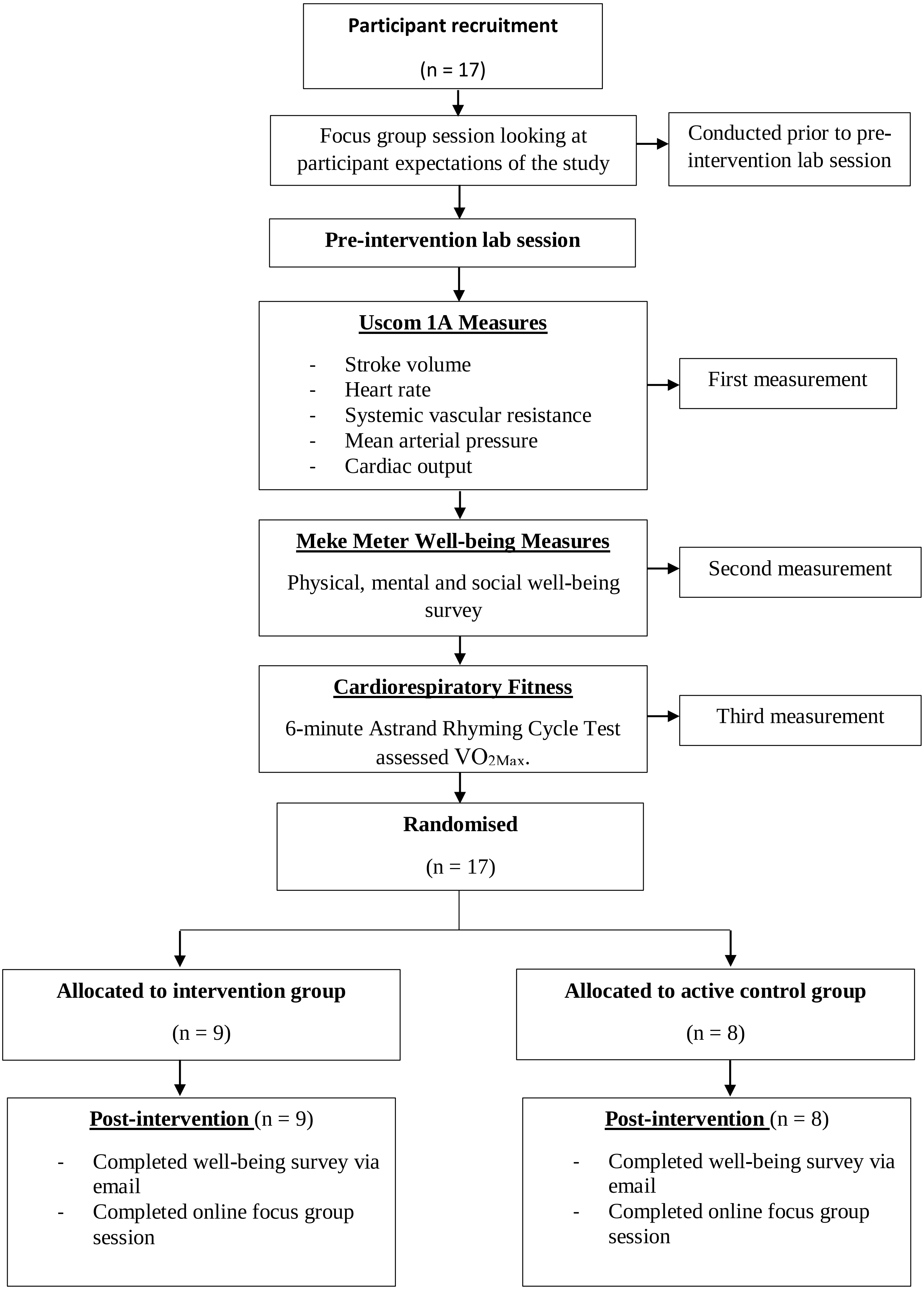


Figure 3.1 Study Procedures

3.3.10 Blood Pressure Measurement

Systolic and diastolic BP was measured using an automatic blood pressure monitor (Rudolf Riester GmbH, Jungingen, Germany). Participants were instructed to sit on a chair with their back straight and supported, have their legs uncrossed, and plant their feet flat on the ground. Following a minute's rest, BP was recorded from the participants' right arm which was placed flat on the surface of a table. These measures were repeated three times per participant with a one-minute rest period between each measure. The average reading was recorded. Using the collected data, the participant's target heart rate for the Astrand-Rhyming cycle test was calculated.

3.3.11 Blood Flow Measurement

Blood flow was measured using an ultrasound device (Uscom 1A, Uscom Ltd, Australia). Each participant was asked to lay down flat in a supine position on a massage bench and the ultrasound procedure was explained. Initially, the suprasternal notch was located on the participant. Lubricant was subsequently placed on the transducer and pressed onto the suprasternal notch, aiming directly down and the ultrasound was then turned on. The Doppler flow profile was observed on the flow tracer screen until the ultrasound signal reached an evenly curved peak, then recording was stopped. Once measuring was completed, blood flow data was recorded from the Uscom output screen, and the participant was able to sit up. The standard operating procedures for the Uscom 1A ultrasound device are presented in Appendix H.

3.3.12 Cardiorespiratory Fitness Measurement

After completion of blood flow measurement, the participant was asked to mount the cycle ergometer (Catery Co. Ltd, Japan) and seat height was adjusted to ensure maximum comfort. Participants were provided with a chest strap heart rate monitor with the reverse side wet with water to improve connectivity with Bluetooth display. The Astrand-Rhyming cycle test was explained to the participant and they were permitted to warm up on the ergometer until reaching a heart rate of 100 beats per minute (bpm). Once reaching the required heart rate, the participant was informed that the cycle test had commenced and the resistance was applied. During the initial two minutes of the cycle test, resistance level was adjusted so that heart rate was elevated to a minimum of 120 bpm. At each minute, participant heart rate, rating of perceived exertion (RPE) (Borg, 1998), and resistance level were noted. After completion of the six minutes, the resistance was reduced and the participant was given two minutes to cool down.

3.3.13 Intervention

The 12-week exercise program was developed by the primary researcher and a research assistant with experience in personal training. Strength training exercises were the primary activities included in the program and were selected as they were effective in building muscle and improving overall health and well-being.

A weekly Zoom link and reminder was sent to participants in the INT group via email before the scheduled meeting time. During the initial meeting, the general outline for the 20-minute session was explained to the participant again and they were invited to ask questions. A long-term goal for the 12-week period was set, followed by a weekly short-term goal. Short and long-term goals were set by participants upon consultation with the practitioner. Participants were informed of SMART goals and asked whether there were specific factors in regard to their well-being or physical fitness they sought to improve. From there, long-term goals were established accordingly. Weekly goals were set to help supplement progress towards long-term goals e.g., one participant set weekly goals that progressively increased the distance and duration of walks until reaching and sustaining their long-term goal of walking 30-minutes three times per week. During the final online Zoom session with participants, long-term goals were reviewed and assessed.

Exercises for each week were demonstrated and explained with participants repeating these exercises to ensure they were carried out adequately. The instructions and YouTube demonstration video for the exercises were provided via email to participants after completion of each weekly video session. In each subsequent week, participants were asked how they perceived the exercises, and were also asked to discuss whether they felt they achieved their set weekly goal. If met, a new goal would be set for the following week, and if not, the current goal was readjusted and set once more. This process was repeated for each week of the exercise program. During the final video session, the initial long-term goal was reviewed with the participant and a further laboratory visit date was scheduled.

For ACON participants, a weekly email informed the participant that they had finished the current week of the program as well as inviting them to ask any questions if they had any.

3.3.14 Data Analyses

All statistical analyses were conducted using Microsoft Excel. Descriptive analysis was conducted for participant characteristics. Mean and standard deviation were used to examine the continuous variables, whereas percentages were used for categorical data. Between group comparison was not assessed as no post-intervention data was able to be collected due to the COVID-19 lockdown.

Focus group recordings were transcribed in their entirety by the research assistant. Each line from the transcripts was organised and coded by the primary researcher via thematic analysis using Braun and Clark's process (Braun & Clarke, 2006) facilitated by Nvivo software (QSR International, Australia). The thematic analysis approach was used to effectively visualise themes derived from each focus group session. Initially, focus group transcripts were read to gain familiarity with the data. Using Nvivo, the meaningful aspects located in transcripts were coded systematically to narrow down the scope of data. Following the coding process, generated codes were thoroughly examined, identifying interesting patterns that looked to discern the similar and varying opinions of participants as themes in the process. With the themes identified, they were once more reviewed to ensure their clarity and effectiveness in portraying a particular point. Themes were further refined and grouped with accompanying subthemes that reinforced their purpose. Lastly, with the themes and subthemes clearly derived, the narrative for this study was drawn.

3.4 Results

Demographic data for participants in this study is presented in Table 3.1

Table 3.1. Participant Characteristics (n = 17)

Variable	INT	ACON	Total
Male, n (%)	4(50)	4(50)	8
Age range (years), n (%)			
30-40	2(50)	2(50)	4
40-50	1(25)	1(25)	2
50-70	1(25)	1(25)	2
Height (cm)	178.3 ± 8	179.1 ± 5	
Weight (kg)	84.9 ± 14	85.9 ± 22	
Female, n (%)	5(55)	4(44)	9
Age range (years), n (%)			
30-40	3(60)	2(50)	5
40-50	1(20)	2(50)	3
50-70	1(20)	0(0)	1
Height (cm)	160.4 ± 4	162.4 ± 6	
Weight (kg)	72.4 ± 16	67.7 ± 9	

Height and weight values are presented in mean ± SD

3.4.1 Participant Survey Response

Participant survey responses to whether the 12-week program influenced stress and motivation is depicted in Table 3.2. No participant from either group found the 12-week program to be ineffective in improving stress and motivation. Within the INT group, 2 out of 9 participants found the program to be very effective in improving motivation, while none found it very effective in reducing stress. A total of 8 participants considered the program somewhat effective in reducing stress and 6 participants found it somewhat effective in improving motivation. Two out of 8 (25%) ACON participants found the 12-week program very effective in reducing stress, while the program was only effective in improving motivation for 1 participant. Six out of 8 (75%) of ACON participants found the 12-week program somewhat effective in improving motivation, while only 3 out of 8 (37%) found it somewhat effective in reducing stress.

Table 3.2 Post-Intervention Survey Response on Effectiveness of the Program on Stress and Motivation

	INT		ACON	
	Reduce stress	Improve motivation	Reduce stress	Improve motivation
Very effective	0	2	2	1
Somewhat effective	8	6	3	6
Neither effective nor ineffective	1	1	3	1
Somewhat ineffective	0	0	0	0
Not effective	0	0	0	0

Additionally, participant perceptions on health level is portrayed in Table 3.3. No participant from either group found the 12-week program to negatively influence their health; only 1 INT (11%) participant found their health remained the same after completing the program. Fifty-six percent (5 out of 9) of INT participants considered their health to be slightly better after the 12-week program compared to 87% in the ACON group. Three INT participants felt much better health-wise after the 12-week program compared to only 1 participant in the ACON group.

Table 3.3 Post-intervention Survey Response on Perceived Health

How do you view your current health after the 12-week program?	INT	ACON
Much better	3	1
Slightly better	5	7
About the same	1	0
Slightly worse	0	0
Much worse	0	0

3.4.2 Fitness Goals

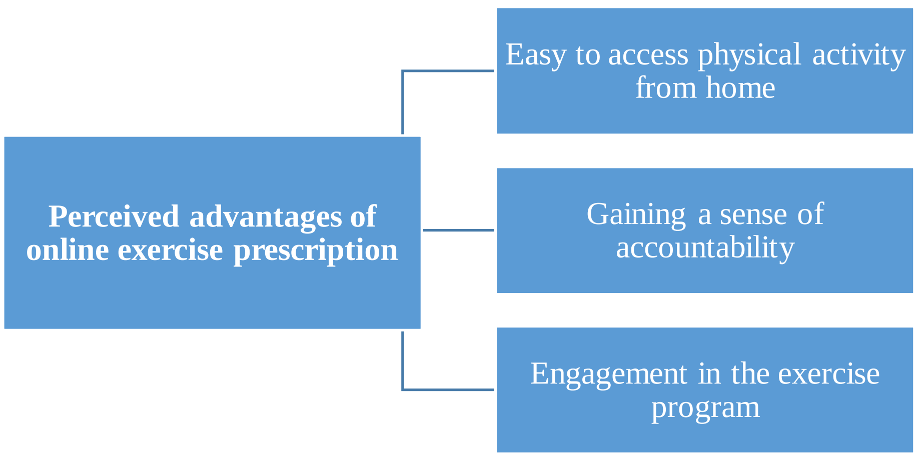
Participant long-term fitness goals set during the initial online session along with the outcome are portrayed in table 3.4. Results show that 89% (8/9) of INT participants successfully achieved their outlined goal. One participant was unable to meet their goal as it was set in relation to their BP, which was not measured post intervention due to the change in study design as a result of COVID-19, and therefore was not able to be included in the final analysis. Participants managed to meet their goals by the 12th week of the intervention. Weekly goals were set with participants to increase progress towards achieving their set long-term goal.

Table 3.4 INT Participant long-term fitness goal outcome

Participant	Fitness goal	Met	Not met
1	Exercise 20-minutes, 3 times per week	✓	
2	Go on 30-minute walks 5 times per week	✓	
4	Be physically active daily for 20-minutes	✓	
7	Be physically active daily for 30-minutes	✓	
8	Be physically active daily for 30-minutes	✓	
9	Go for 60-minute walks 3 times a week without feeling fatigued	✓	
11	Go on 30-minute walks every weekday without puffing	✓	
12	Lower BP to within normal range	**N/A**	
17	Consistently exercise 3 times per week	✓	

3.4.3 Primary Themes Identified from Focus Groups

Through analysing the focus group data, two primary themes were determined for each group. For the INT group these included perceived positives of online exercise prescription and acceptance of online sessions as a form of health delivery. Each of these themes includes 3 subthemes. The INT group themes are displayed in Figure 3.1.



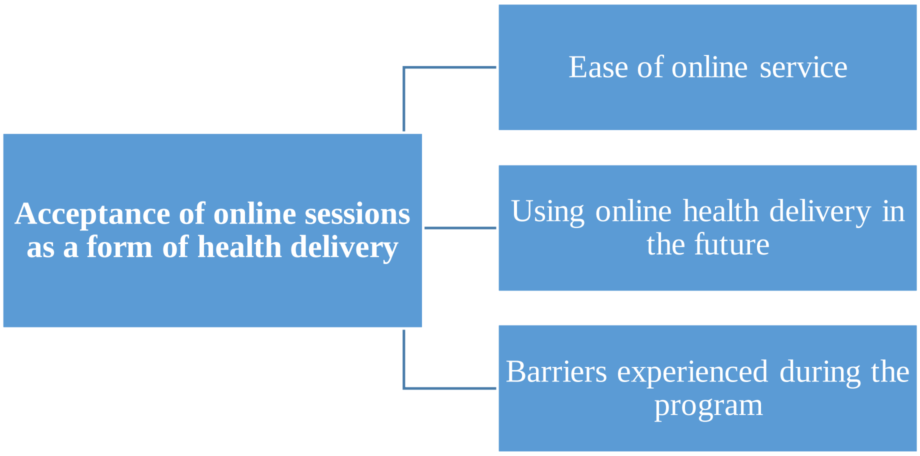


Figure 3.2 Themes and subthemes of INT participants Focus Group

Key Themes from INT Focus Groups

3.4.3.1 Theme 1: Perceived positives of online prescription

Ease of online service. INT participants found accessing the weekly online session to be quite easy and straightforward. Initially, the value of online delivery was not understood by some, however, with their personal experience of the online sessions, this perception changed. Participants did not experience any difficulties with Zoom connections. As participants received exercise prescription during weekly sessions, they were able to recognise that physical activity was not confined to the gym, but could be conducted from the comfort of their homes. Participant 2 explains,

> *This was not a concept I had considered before; when I was approached about this, I didn't understand how it would benefit me without going to the gym, but I learned that it does have value.*
>
> - Male, 31 years

The availability of exercise equipment at home was considered effective in diversifying exercise routine. Participant 8 in particular appreciated the inclusion of the exercise band stating:

The additional equipment also helped with not only being able to do cardio, but also putting resistance into the exercises as well. I think that was good.

- Female, 33 years

Additionally, with the nationwide lockdown due to the COVID-19 pandemic, participants were able to appreciate an alternative means of being active where they were not required to be outdoors or at a gym. This meant they were able to engage in daily exercise whilst remaining safe. There was also no indication from participants of requiring any further equipment than those provided to increase their engagement in exercise. Participant 1 describes:

I prefer it over having to get changed, go out, go to the gym; I prefer doing it from the comfort of my own home, and it's good to have someone to check in with.

- Female, 32 years

Gaining a sense of accountability. Throughout the 12-week program, participants felt a sense of accountability when thinking about doing their daily exercise tasks. They mentioned that having the practitioner available weekly during online sessions helped them gain responsibility over controlling their daily physical activity and managed to allocate enough time to complete their exercises. It was felt that not completing the exercises each week would disappoint the researcher which led to increased motivation. Participant 1 expressed that they would have unlikely engaged in any physical activity if they did not have to meet with the researcher during each session:

Yeah definitely, I think if I didn't have to catch up with him once a week, I might have gotten a bit lazy about it. Yeah, because I knew I was going to see him at the end of the week, I'd be like, oh, I better go do this.

- Female, 32 years

Other participants felt that through being held accountable for their activity, they were able to establish and sustain an efficient routine that saw them complete their daily exercises. Accountability helped increase exposure to exercise and by meeting weekly goals, there was a greater acceptance of physical activity. Through this, participants would have experienced a positive behavioural change that helped lead a healthier lifestyle. Participant 11 describes how accountability to the practitioner impacted them:

> *Making me do exercise each day, that was very valuable, because I thought I better not let him down, and also because once you start, you want to make sure you carry on. It was valuable in that it made me remember that I had to do exercise each day, because I could quite easily do no exercise.*
>
> - Female, 63 years

Engagement in the exercise program. With frequent engagement in physical activity, some participants experienced an increase in their physical fitness and well-being. Confidence in exercise ability was cited as an area of improvement along with physical strength. It was also apparent that over the period of the exercise program, participants were able to complete exercise demonstrations much more fluidly during weekly online sessions. For Participant 1, weight loss and increased strength was a benefit:

> *Oh yes, looking at before, I am feel better* [sic]*, I lost 2 kilos actually - it was* [a] *positive outcome. I feel I just got stronger and able to do more by the end.*
>
> - Female, 32 years

Other participants also perceived an improvement in energy level given they were less fatigued throughout the day. The improvement in energy was a result of reduced sedentary behaviour and increased physical activity. Participants became more aware of the effects physical activity had on physical fitness and energy output during throughout day. In some instances, energy drink consumption was reduced amongst some participants due to no longer feeling exhausted and tired. However, the 12-week program may not have had an overly large effect as energy drinks continued to be consumed. Participants 2 and 11 explained:

Occasionally I am very tired. I took an energy drink in the middle of the day to get me through, and now I don't think that I need to as often for sure.

- Male, 31 years

Beforehand, I would feel tired, or dragging myself around, and I remember saying about halfway through that actually, I'm feeling better, I'm not feeling tired, and that hasn't come back, so it was definitely a positive.

- Female, 63 years

One participant felt that participating in the program was not particularly effective on their physical well-being. This conclusion was drawn by this participant as no physical well-being improvement was observed. Participant 7 said,

I am not sure if it can really improve my health, because my physicality is, I think, still the same.

- Male, 35 years

3.4.3.2 Theme 2: Acceptance of online sessions as a form of health delivery

Ease of online sessions. The length of each weekly online session was favourably seen by the participants. It was observed that participants were able to complete all components of the session (exercise review, demonstration and goal setting) within the 20-minute time frame and were able to remain focused throughout. Participants 2 and 12 illustrate these points:

Ten to 15-minutes was good; I think if it was any longer it would have been a pain.

- Male, 31 years

Yes, it was good, as long as I needed it to be, no more than 15-minutes, so it was very good, yes.

- Male, 48 years

Participants did not view these short sessions as a burden to their schedule, instead they were seen as easy to attend and commit to. All participants successfully attended all weekly sessions, and no session was skipped. This reinforced the finding that shorter length sessions were ideal. One to two sessions per week suggested to be plenty for receiving exercises prescription through online videos. Participants 12 and 9 expressed:

> *I think it was a good length, about 10-minute catch ups, easy to commit to.*
>
> - Male, 48 years
>
> *Weekends would be fine, maybe once or twice a week would be fine enough for exercise through online video.*
>
> - Male, 60 years

Using online health delivery in the future. While initially showing some difficulty understanding the concept of online exercise prescription, participants observed the benefits of communicating with a practitioner from their place of comfort. It increased motivation to be physically active as getting changed and travelling was not necessary. Participants 8 and 1 further expressed that this was a service they would consider again in the future, even for other means of health delivery:

> *I think yes, it's the way to go now, we're getting to this new era where everything is online so it's not so weird to think that it's going to be like this in the future. It's a good chance to have that extra exercise program through this.*
>
> - Female, 33 years
>
> *I prefer to do this because I do not need to go to gym. I prefer to do something online, and like this, it is good to have someone to do it with.*
>
> - Female, 32 years

It was further suggested by some that online health delivery would be an ideal method to receive health and exercise prescription. The pandemic forced people to remain indoors and made travelling more difficult. They felt that as they would have no access to the gym, receiving exercises online would be a beneficial substitute. It was considered much easier to use online delivery as smart devices and internet connections were readily accessible by all participants. Participant 17 said, *I think it's good, especially during this Corona* [sic] *time, we don't go to the gym, so online exercise is much easier.*

- Female, 37 years

Some participants were open to using online health delivery in the future. Face-to-face communication was however preferred when dealing with some health conditions. Participant 9 expressed concern that health practitioners would find it difficult to accurately diagnose certain conditions, leading to wrongly prescribed medication,

It is a good idea for online health delivery [sic]*, but sometimes, you know, for some health conditions, it might be easier to see your general health practitioner face-to-face for getting the right results prescription wise.*

- Male, 60 years

Barriers experienced during the program. No assistance was needed to access the weekly Zoom invitations. Although participants were able to attend all weekly sessions, some indicated experiencing barriers that prevented them from fully engaging in the program. The primary barrier faced was time management. Between work responsibilities and other daily tasks, participants struggled to find the time to fit exercising into their daily routines, and were often too tired by the end of the day. Participant 4 found:

The barrier was mainly the time, in the morning I go to church and then work, by the time I came back, I had limited time to do the exercises.

- Female, 58 years

Similarly, participants with children expressed having limited time available to fully engage in the program. This was apparent during weekly sessions as some participants shared not being able to complete all exercise sets and repetitions, but rather completing the most they could with their available time. These participants were capable of adapting their schedules over time to improve their engagement in the 12-week program. Participant 1 said, *Finding the time and the motivation. I have kids as well. I'm really tired by the end of the day, so finding the time and energy.*

- Female, 32 years

The two main themes developed from the ACON group data were self-monitoring own physical activity and using online health delivery in the future. Within these themes further subthemes became apparent. The themes and subthemes identified for the ACON group are displayed in Figure 3.2.

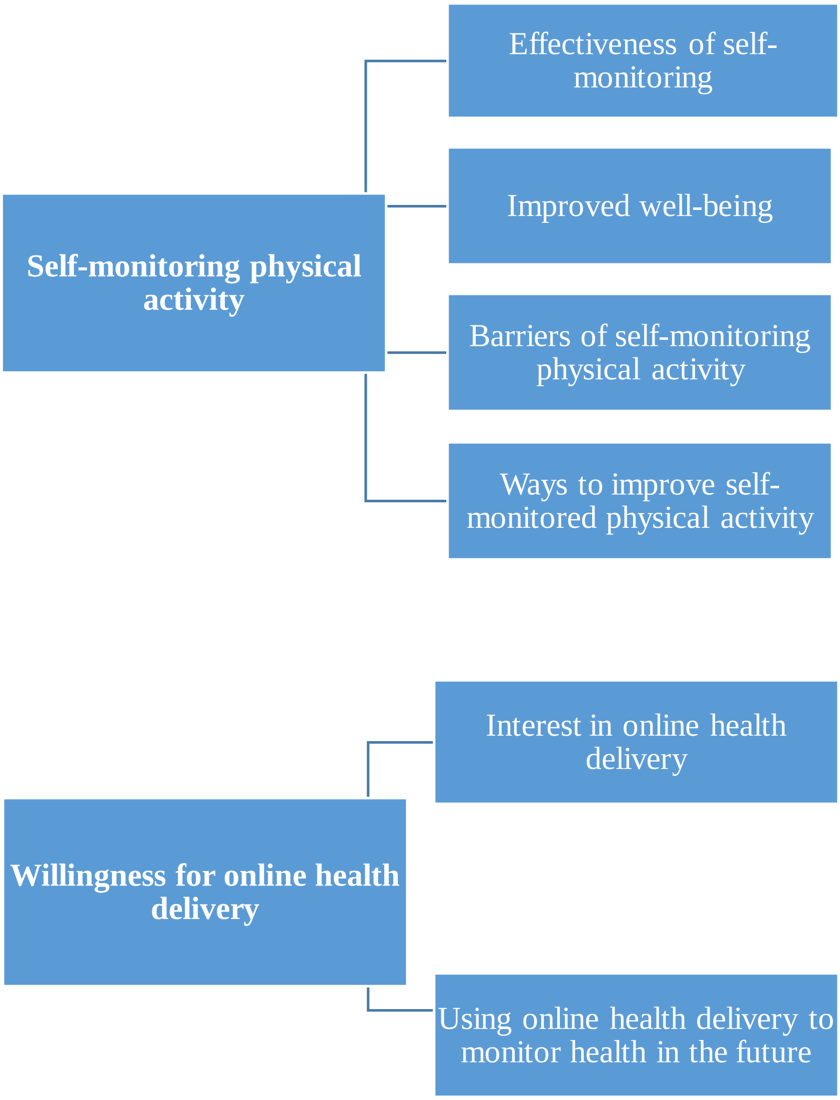


Figure 3.3 Themes and Subthemes of ACON Participant Focus Group

Key Themes from ACON Focus Groups

3.4.4.3 Theme 1: Self-monitoring own physical activity

Effectiveness of self-monitoring. Five ACON participants found that they struggled with the concept of self-monitoring their daily activity. Exercises were often changed to suit their capabilities. In some instances, exercises were substituted with household chores that fit into their daily life. Maintaining a record of daily achieved physical activity was considered by one participant as a way to help visualise their progress and establish a daily routine, increasing daily activity output. Participants 14 describes how they altered their program:

> *I think just adjusting the exercises to suit what I felt I could do so I wasn't always doing like 2 or 3 different rotations of the complete sets because, I think, sometimes I felt with 2 sets, I was done.*
>
> - Female, 47 years

Other participants had contrasting views. Self-monitoring did not prove to be a difficult task and they were content with doing so across the 12 weeks. Prior experiences with sport proved useful as regular experience with training helped with discipline. Participant 10 said,

> *For me, it was alright because I used to do training for football, so I just keep doing the exercises in my house.*
>
> - Male, 30 years

Participant 6 also illustrated that self-monitoring their physical activity provided a challenge for them to try and achieve. They found that they had all the necessary information to successfully engage in and effectively monitor the prescribed activities:

> *I think it is a good method because it is increasing the difficulty of the exercise. It is like you have a lot of information, the details about how to follow the program, so it should be followed by anyone and the exercise are* [sic] *really easy to follow to do - so I think it is a good option.*
>
> - Male, 35 years

Improved well-being. No clear improvement in well-being was found after completion of the 12-week program, Self-monitoring proved to be difficult, especially for those who primarily led a sedentary lifestyle. It was difficult to initiate a behaviour change in those who were previously sedentary as they lacked support and motivation. Participant 6 shared:

> *You can feel in your body that it is kind of getting used to the exercise, but yeah, no more than that.*
>
> - Male, 35 years

Only two participants in the ACON group reported experiencing positive changes in their physical and mental well-being after engaging in the program. Participants 13 and 10 said,

> *During the study, I think I definitely felt a bit stronger in myself; yeah, I think that was definitely an improvement.*
>
> - Female, 34 years
>
> *For me, it was like a wonderful change in my mind; it was always an escape when my mind is going somewhere else.*
>
> - Male, 30 years

Barriers of self-monitoring physical activity. Some participants shared that they struggled with the concept of self-monitoring activity. It helped them gain an insight into which areas in particular they struggled with most. Most indicated their primary barrier with being physically active and self-monitoring was finding enough time to schedule it into their day. Participant 14 states

> *Probably just the time, the time in the day to do it. I think different people's lives are different time but I think by the time I get home and make dinner, we take the children to hockey practice and netball. Sometimes we're home and it's like 9 O'clock and we're doing jobs, it's just because we're busy people. I think with that, it's hard to make time to do this. As you said, if I'm at school, I'm walking around a lot during the day, so pretty tired by 9pm or 9:30pm to try and do the exercises. So, just timing I guess.*

- Female, 47 years

Additionally, maintaining a daily exercise routine was another noted barrier. Other responsibilities and a general lack of motivation prevented some participants from starting daily activities. This was attributed to participants lacking sufficient discipline to push them to complete daily exercises.

I think the biggest barrier for me is the discipline, it is hard to get that discipline to do it every day.

- Male, 46 years

Ways to improve self-monitored physical activity. After having to self-monitor their physical activity for 12-weeks, some participants felt that in order to be more active whilst at home, they required access to various types of exercise equipment. Despite receiving the same exercise equipment as the INT group, some participants felt a wider variety of equipment would have helped motivate them to engage more in daily exercises. Participant 6 shared:

Yes, it is hard to find motivation, maybe to have some kind of weights, maybe a static bicycle, you know, to combine the exercises. Yes, I think that would help me.

- Male, 35 years

Others found that engaging in specific exercises did not particularly interest or motivate them. Instead, it was felt they would gain more through focusing effort on household chores instead. As such, a program developed around day-to-day activities would potentially increase daily activity, as Participant 5 explained:

It may not be exercise as prescribed such as you can do some push up [sic]*, but again like digging some plants or something like it, like sitting up and down, it all contributes to me being like, you know, physically active, rather than just 'set-up' exercise. Things like being active around the house doing things, I do things mostly on my own, work around my house and climbing up the roof and just washing the roof or things like that. I'm active that way, that's where I find* *certain amount of physical activity which you choose to do at home. Like vacuum cleaning, it does keep you physically active.*

- Male, 55 years

Participant 13 suggested that while time management was a contributing barrier, they would suggest fitting in multiple bouts of activity throughout the day so as to not overstretch themselves. Additionally, participant 15 found that logging their activity would have potentially improved their self-monitoring ability as they would be able to see what they achieved:

I think just trying to break it down and do smaller bits of activity throughout the day rather than one big exercise session. I guess for me, with time management, that's a bit easier to manage than a full half an hour or hour, just even 10 minutes, you know, a few times a day.

- Female, 34 years

I think we could have logged these things a bit better, kept more of a record of how well I was going. I would just do it and forget about it, I wasn't really recording how well it went and I think I would have more had I logged it better or actually just wrote down "I achieved this".

- Male, 46 years

3.4.4.4 Theme 2: Willingness to try online health delivery

Interest in using online health delivery. Self-monitoring activity showed participants that it can be a difficult process. They considered the concept of online health delivery and expressed that this type of method may have been more beneficial compared to self-monitoring physical activity. Face-to-face contact with a health coach was considered positive to impose a sense of accountability. Without it, they found themselves lacking the desire to actively engage in the program and on some days, skipping the prescribed exercises entirely. Participants 15, 5 and 3 stated:

Yes, I think so, definitely, I think that potentially for me that would be the missing motivation, that little prod you need to go "oh right, I've got to do these things." A bit of accountability, yeah.

- Male, 46 years

Yes, in fact because now you're answering to somebody, you're right in front of the camera and talking, the person is certainly advising you.

- Male, 55 years

Yes, I think the video session is very important to encourage us to do all the exercises.

- Female, 48 years
-

Using online health delivery to monitor health in the future. Although the benefits of online health delivery were recognised, participants suggested it was not a delivery method they would personally use in the future. This was attributed to their preference for in-person interaction with health practitioners as it reduces the risk of misdiagnosis. Although, for less serious health conditions or engagement in physical activity, participant 3 was open to the idea of online health delivery.

Yes, I think with online consultation, you can use it just in the lockdown period. We prefer if we need anything, we have to go to the doctor and see them face-to-face, but if it is like doing some exercise online, it is OK, it is very good and helpful.

- Female, 48 years

This view was not shared by all participants however, as others were open to utilising online health delivery in the future. Participant 13 considered the idea of home based exercise delivery could be effective in increasing motivation.

I think it is much easier to access from home than going out, especially in times like this (lockdown). I think if you can have an online health coach to check in with, it might just be some extra medication or extra support that some people may need.

- Female, 34 years

3.5 Discussion

3.5.1 Research Problem and Study Aims

The aim of this research study was to explore the effectiveness of online exercise prescription on the well-being of individuals. To do this, 17 participants were randomised to either the INT or ACON group and underwent a 12-week physical activity program. Participants in the INT group attended a 20-minute weekly Zoom session where exercises were prescribed and demonstrated, goals were set, and feedback regarding exercise technique was provided. ACON participants received the 12-week exercise program upfront along with a weekly check-up email.

The literature review topic was selected in conjunction with our thesis to expand on the narrative and identify potential gaps. However, due to a COVID-19 lockdown, we were unable to gather post-intervention data given the mandatory social distancing and closure of the data collection laboratory. Therefore, our thesis study design was shifted to a qualitative approach and looked to assess the effects of online exercise prescription on well-being and understand the perspectives of participants with this delivery method. To achieve this, focus group sessions were conducted prior to and after completion of the 12-week program. The similarities and differences of opinions were contrasted both within and between intervention groups.

3.5.2 Research Findings and Overview

Online exercise prescription is a novel concept, and, to our knowledge, there have been no studies exploring the effects on well-being in a generally healthy population. The findings of this study suggest that online exercise prescription had a positive effect on well-being. Focus group responses indicated that seven out of nine participants in this group experienced an overall improvement in their physical well-being after the 12-week program. In contrast, only one out of eight participants in the ACON group reported experiencing positive physical well-being changes. Our results highlighted several physical improvements, the most common being an increase in energy level. This is in line with previous research examining the effects of physical activity (Loy, O'Connor & Dishman, 2013). One participant expressed no longer experiencing fatigue when walking up flights of stairs, something they were unable to do prior to the 12-week program. Another participant reduced the amount of energy drinks consumed per week as they no longer found them a necessary source of energy. A contributing factor to this increase in energy may lie with the increased participation in physical activity (Puetz, Flowers & O'Connor, 2008). It is possible that these participants lead a sedentary lifestyle prior to commencing in the study and hence would have likely had feelings of low energy and fatigue (Wennberg et al., 2016). Given the negative influence fatigue can have on motivation, it is plausible to suggest that it could have been difficult for these participants to actively engage in physical activity on their own (Engberg, Segerstedt, Waller, Wennberg & Eliasson, 2017). The online sessions appeared to be effective in easing participants towards being physically active and gradually increasing their engagement which possibly led to the improvement in well-being.

An additional area of physical well-being improved was physical strength. Four INT participants shared that over the 12-week period, they had gradually increased the number of exercise repetitions they could perform without feeling fatigued. Such improvement suggests that online prescription was effective in increasing muscle strength and imposing a change in behaviour. This finding coincides with those of Hong, Kong & Yoon. (2018) where participants exhibited an increase in muscle size and strength through participating in a home-based exercise program. Access to exercise equipment was beneficial for some participants given that it not only provided an alternative method of exercising, but some participants preferred the added difficulty as they could witness the extent, they were able to push themselves. It was suggested by participants that accessibility of exercise sessions from the comfort of their homes was a source of motivation for exercise. It was effective in removing the barriers experienced by participants such as time constraints, low motivation, and family responsibilities. Home-based physical activity allowed participants to engage in physical activity more frequently given that they did not have to travel to another location. More so, participants found that watching television whilst exercising helped them increase time spent being active. Physical activity can appear tedious for some individuals, hence adding a source of distraction can be a psychologically effective method to increase both enjoyment of exercise and adherence (Rider et al., 2016). Additionally, with the spread of COVID-19, lockdowns, and closure of services such as gyms, there was a negative impact towards physical activity motivation and participation and increased sedentary behaviour (Stockwell et al., 2021). Online prescription was essential in bringing physical activity closer to those who otherwise did not have access.

Based on the well-being questionnaire response, participants from both groups found the 12-week program effective in reducing stress and improving motivation. The COVID-19 lockdown forced individuals into isolation, separating them from friends and family. Being isolated in this manner can cause high levels of stress and depression, especially in those living alone (Pietrabissa & Simpson, 2020). One INT participant made clear that conversing with the practitioner during the weekly sessions was helpful in developing clarity over the exercises which in turn helped ease their stress. Another participant similarly understood the benefit online sessions could have during lockdowns, explaining that it would be important to have someone to talk to and build a relationship and understanding with. Furthermore, having access to exercise prescription even during lockdowns could prove to be effective in regulating mental well-being and providing relief of stress. Similarly, one ACON participant shared that exercising daily was effective in clearing their mind from the stress of their job and helped reduce them to manage stress levels.

This study reported high levels of satisfaction with online exercise prescription amongst participants. Age did not appear to be a barrier as participants were able to use their smart device to connect to online sessions without experiences and technical difficulties or connection dropouts. It is possible to suggest that the ease of access observed in this study increases confidence in the applicability of this on a wider scale. However, given that no participant in this study resided in a rural location, it would be difficult to ascertain how accessible this method would be in such locations based on this finding alone. The weekly sessions were found to be effective in establishing a routine for regular exercise. Maintaining a routine can incite a change in behaviour, and potentially elevate motivation and engagement in physical activity (Arlinghaus & Johnston, 2018). In addition, the availability of the practitioner during individualised weekly sessions was considered valuable and effective in increasing participant motivation. This is similarly seen in prior research exploring online health delivery (Lewis, Hassmén & Pumpa, 2021). Reporting back to the practitioner instilled a sense of accountability within participants, encouraging them to complete their daily exercise tasks. Through accountability, individuals often gain responsibility over their actions, and hence feel obligated to exercise daily to maintain a level of respect with the practitioner (Oussedik et al., 2017). Furthermore, participants noted that receiving feedback from the practitioner was beneficial in developing exercise skills, garnering autonomy, and further increased motivation (Lai et al., 2018). Performance related feedback was key to developing participant self-efficacy (Collado-Mateo et al., 2021). A higher sense of self-efficacy has ability to impact an individuals' adherence to physical activity through increased confidence and enjoyment in exercising (Lai et al., 2018). This is in line with previous research that found participants with high self-efficacy remained active even 12 months after their intervention (Neupert, Lachman & Whitbourne, 2009). Individualised sessions may have influenced participant satisfaction with the intervention. With more personalised sessions, individuals may be able to develop a positive relationship with the practitioner and establishing a level of trust that promotes more communication; with that, there would be a greater probability for an effective behavioural change or continued improvement (McClaran, 2003). Perhaps this is why little improvement was observed among the ACON group as there was a lack of open communication and feedback.

Duration and frequency were further aspects of the online sessions appreciated by participants. All participants commented on favouring shorter length sessions lasting between 15 to 20 minutes as opposed to longer sessions. Shorter sessions can be more practical than longer sessions given that they permit participants greater scheduling flexibility. Flexibility adds a great deal of convenience for participants as they can adapt to fit sessions into their daily schedules (Almathami, Win & Vlahu-Gjorgievska, 2020). This was also evident when a participant was unable to attend a session due to an unforeseen circumstance, and they were able to reschedule to another time in the same day or week. Furthermore, focus group responses showed that participants preferred having a maximum of two online sessions per week citing that any more would have proven to be a burden. It is possible that the commitment of multiple sessions per week could be overwhelming and therefore reduce enjoyment for physical activity, thus, potentially leading to decreased adherence. Goal setting was similarly appreciated by participants given that it provided an objective for them to work towards.

Seven out of 9 INT participants expressed that they would be open to using online health delivery in the future. The continued interest in using this delivery method reinforces the notion that the intervention was effective in improving well-being. It may further show that the structure of online sessions proved to be feasible and engaging for participants, albeit there being no out of pocket costs implemented in this study, which could change their perception. Increased interest in this alternative means of delivery may increase its implementation in the health sector, which could potentially lead to reduced healthcare expenditure for individuals. Contrastingly, only half of the ACON participants would consider using online health delivery in the future. This may be attributed to the fact that not many individuals have had personal experience using this service given its availability; hence there being a sense of unfamiliarity and disinclination to future use. However, this may change should these participants develop a better understanding of this service through personal use.

3.5.3 Conclusion

Online health delivery is a rapidly growing concept that is paving its way into the health sector. Despite this growth, there have been no studies exploring the effects of online exercise prescription on well-being in a healthy population. Our results provided an in-depth insight into the effects of online exercise prescription, and the perceptions of participants regarding this concept. The online intervention was successful in improving perceived physical and mental well-being in participants. Physical strength and energy level were the two primary improvements reported by participants. Additionally, all participants were successful in achieving their long-term goals. Accountability from the practitioner was considered an asset in increasing adherence and motivation towards engagement in the 12-week exercise program. These findings suggest it may be beneficial for health practitioners to make use of online exercise prescription as an alternative form of delivery. However, further research is necessary to reinforce these findings and further expand on the online health delivery concept.

3.5.4 Limitations of the Research

Several limitations were identified in this study. Participant recruitment took place from only one regional location in New Zealand and the acquired sample size was considerably small. With a small sample size, the findings increase in variability and therefore can impact the accuracy and generalisability of the results as they are not indicative of the wider population. Given this, our findings should be interpreted with caution. The length of the intervention was relatively short spanning just 12 weeks and, as such, this study does not provide any information regarding the effectiveness of a longer intervention. Long-term and weekly goals were set with INT group participants during the online sessions; however, this was not done with the ACON participants. This meant that we were unable to contrast the progress made between the two groups and therefore could not determine whether there was an in-between group difference in terms of ability to meet target goals. Additionally, this study did not have a control group with no intervention or face-to-face intervention to compare results. Due to the small sample size of this study, focus groups were comprised of four to five participants, and on one occasion, a focus group with only one participant. The small focus group sizes may have impacted the quality of discussion generated.

3.5.5 Recommendations for Future Research

Future online exercise prescription research should consider incorporating a larger sample size. This may help reduce variability and improve reliability of results. A longer intervention (>12 weeks) can be implemented in the future to assess the long-term effects of online exercise prescription on participants. Follow-up data collection can also be taken mid-way and post intervention to assess any changes from the intervention. Given the COVID-19 pandemic and possible lockdowns, future research may consider utilising data collection procedures that can be conducted remotely to potentially prevent data loss and unplanned protocol alterations. For example, measuring cardiorespiratory fitness via the Canadian home fitness step test, which can be completed with a participant through videoconferencing. Our study found that INT participants benefited from setting weekly goals, to contrast between groups, future studies can look to set long-term and weekly goals for both intervention groups rather than just in the INT group. Furthermore, studies could also make use of a three-arm study design which may include two intervention groups and a control group to assess the difference and efficacy of exercise delivery methods.

Chapter 4 – Overview and Recommendations

The purpose of this study was to determine the efficacy of online exercise prescription on the well-being of healthy individuals. In addition, this study sought to examine the varying perspectives of participants engaging in either self-monitored physical activity or physical activity prescribed via weekly online video sessions. Focus group interviews were conducted after completion of the intervention to gather these opinions.

Focus group data showed that participants were partial to having weekly online exercise sessions. Simplicity of scheduling sessions was an encouraging factor for attendance due to their convenience and accessibility. Furthermore, participants greatly appreciated reporting back to the researcher during sessions as they felt it made them accountable and increased adherence. Interestingly, it was suggested that without the practitioners' presence in weekly sessions, participants would have likely not completed the prescribed program. Short sessions lasting approximately 20-minutes were the preferred option, with some participants suggesting that longer sessions would have been a burden. With one of the primary barriers experienced being the lack of available time, short session durations helped with flexibility and commitment. Following completion of the 12-week program, seven out of nine participants were satisfied with their well-being progress. Every participant successfully met their long-term goals set during the initial online session. Motivation, energy level and overall physical fitness were areas improved through the program as evident from the survey and focus group responses. From this, it is evident that online exercise prescription was generally well received by participants in the INT group. Participants expressed interest in using online health delivery in the future, whether for exercise prescription or other health services such as physician consultations.

Interestingly, four out of eight ACON group participants were content with monitoring their own physical activity on a daily basis. One participant even indicated using self-monitoring as a challenge to help increase intensity of the program. Much like the INT participants, the ACON group similarly struggled with time management, citing that family and work responsibilities often meant they had limited time for physical activity. Others expressed that a lack of discipline hindered their ability to be physically active as they were not motivated to engage in the exercise program. One participant suggested having access to equipment such as weights and stationary bikes would have helped motivate them to be more active. Regular household chores were also preferred over the prescribed exercises by some participants including activities like walking their dogs or mowing the lawn i.e., activities that often coincided with their responsibilities. Despite satisfaction with self-monitored physical activity, participants acknowledged the benefits of online delivery. Six ACON participants felt that online sessions would lead to increased accountability and adherence to the program. They also considered that sessions with the researcher would have provided additional support for the program. In spite of that, participants nonetheless preferred face-to-face contact when communicating with health professionals, especially for concerning medical conditions. However, they remained open to receiving online health delivery in relation to physical activity in the future. Their hesitance with the service may be given that these participants had not previously used online health delivery, hence their preference for standard care, although perhaps if given the chance, their opinions may change.

4.1 Changes to Health

Various studies have already demonstrated the benefits of using online delivery as a means of providing health services to individuals (Galiano-Castillo et al., 2016, Lu, Chen & Hsu, 2017, Rawstorn, Gant, Direito, Beckmann & Maddison, 2016). However, studies exploring the effectiveness of online exercise programs, specifically on well-being are scarce. Focus group responses showed that seven INT participants experienced improvement in physical well-beingafter completing the exercise program. There was an indication of increased energy levels amongst two participants. One participant illustrated that they often felt tired throughout the day and would consume several energy drinks to maintain concentration. However, after engaging in the online intervention, that feeling had dissipated and they no longer found it as necessary to consume energy drinks to sustain their vitality, demonstrating the effectiveness of the program. Interestingly, despite the suggested improvement, this participant continued to consume energy drinks, albeit in lower quantities. That may suggest the length of the program was insufficient to sustain prolonged energy and a longer program could have been more effective. Another participant shared that they were able to climb several flights of stairs without puffing and feeling exhausted, something they were unable to do prior to the online intervention. This improvement further emphasises the effectiveness of online exercise delivery and the participant considered it a personal achievement they could be proud of.

What the improvement in energy also suggested was that participants were engaging more in physical activity compared to before the online intervention. The provided exercise equipment, particularly the resistance bands, were found to be effective by participants in facilitating their exercises. Physical strength was an additional aspect of physical well-being found to have been improved. Four out of nine participants felt that over the duration of the 12-week exercise program, they were gradually able to complete more exercise repetitions. Physical activity has previously been shown to increase muscle size through specific muscle-strengthening exercises (Mayer et al., 2011). The mixture of endurance and resistance exercises prescribed in this study appear to have increased participant exercises endurance, hence the participants' ability to progressively increase the rate of repetitions achieved (Hughes, Ellefsen & Baar, 2017).

The well-being questionnaire showed that INT participants found the program effective in reducing stress levels and improving motivation. With mental health issues growing larger in society, especially with the ongoing COVID-19 pandemic isolating families and friends from one another (Czeisler, Howard & Rajaratnam, 2021), using online health delivery to promote physical activity appears to have a positive effect on mental well-being. It is interesting to note that ACON participants also showed positive improvements in mental well-being. One ACON participant found that through being active, they were able to have a mental escape from their work life. Workplace responsibilities can often be overwhelming and lead to heightened stress and anxiety, reducing quality of life (Park & Jang, 2019). However, through physical activity, stress can be mitigated, improving mood (Childs & de Wit, 2014). This was an interesting response and shows that physical activity can be an effective form of management to improve mental well-being (Smith & Merwin, 2021). It is possible that transitioning from sedentary behaviour to a more active lifestyle, even slightly, could positively impact mental well-being. This may explain why three ACON participants reported improvement in mental well-being but not physical well-being through focus groups. Nonetheless, the practicality of online exercise prescription shows that it has the potential to be a suitable substitute to in person consultations in individuals wishing to improve mental well-being, particularly through expanding access (Arafat, Zaman & Hawlader, 2021).

4.2 Aspects of the Online Program

Weekly sessions were found to be helpful and enjoyable by all participants. Three participants found the weekly sessions helped them establish a daily routine where they could regularly exercise, which effectively reduced sedentary behaviour and increased engagement in activity. Establishing a daily routine has been found to be essential in maintaining a healthy lifestyle (Takayanagi, Kitamura, Yamauchi & Tokimitsu, 2018). It helps ease physical activity into daily life and improves the body's capacity for activity, leading to a growth in exercise tolerance and extended bouts of activity (Pinckard, Baskin & Stanford, 2019). Maintaining this routine can lead to further health-related improvements such as reduced risk of cardiovascular disease (Morris & Froelicher, 1993). Being able to motivate participants and transition them to a more active lifestyle may reinforce the efficacy of online exercise prescription.

Having a clear objective to work towards on a weekly basis was another motivational factor for participants. Setting goals with an established deadline can provide a sense of accountability that may be the driving factor to increase physical activity output (Swann et al., 2020). What's more is that achieving these goals grants a sense of fulfilment which further contributes towards motivation and adherence to physical activity (Wilson & Brookfield, 2009). All participants successfully achieved their long-term goals by the end of the 12-week program. One participant was excluded as their set goal referred to a change in BP levels, which was not measured post-intervention due to COVID-19. Compared to participants in the ACON group, INT participants appeared to engage in physical activity more frequently.

Another important element to these improvements may be directly related to the availability of the practitioner during weekly video sessions. Through the focus group responses, it was evident that five out of nine participants benefited from the accountability and feedback provided by the practitioner. Receiving advice and feedback during weekly sessions was important for participants to develop their physical activity skill set (Collado-Mateo et al., 2021). In doing so, participants were more confident in their ability, increasing their self-efficacy (VanRavenstein, Brotherton & Davis, 2020). Self-efficacy is a strong determinant of maintaining positive healthy behaviour and participants with high self-efficacy are more likely to frequently engage in physical activity, further increasing adherence to the program.

4.3 Areas of Improvement

While online exercise prescription appeared to be effective in improving well-being, this was not the case for all INT participants. In total, two participants found their physical well-being remained the same after the 12-week period and one participant felt their physicality had remained the same. The lack of change could be due to the participants' baseline physical capacity. In other words, if the participant had a positive physical well-being level prior to commencement, then they may not exhibit a clear improvement over a 12-week moderate intensity program. Perhaps with a higher intensity program or including participants who are less physically fit, there would have been a more favourable response. Another participant similarly found no improvement in their physical well-being which was attributed to living a sedentary lifestyle on account of their occupation. The transition to an active lifestyle is often considered a difficult process for some, perhaps a single weekly session may have been insufficient in this case. Multiple weekly video sessions can potentially relay a greater level of motivation through the practitioner and may even improve adherence to the exercise program. Research in this area is limited however, and further studies would need to be undertaken. In contrast, one ACON participant suggested that while their body became used to the exercises, they did not experience any physical improvements. It is possible that they may have led a sedentary lifestyle prior to the study, and hence were less motivated to engage in the program. That would suggest self-monitoring physical activity can be rather ineffective due to the difficulty of building motivation and the general lack of support (Mohr et al., 2013).

4.4 Satisfaction with Online Exercise Prescription

INT group participants showed overall satisfaction with the benefits experienced through online exercise prescription. Connection to weekly Zoom sessions were easily achieved and connection dropout was not experienced at any point. What's more was that age did not appear to be a barrier in relation to use of technology. All participants had access to a video-capable smart device, and none required assistance setting up video sessions, an essential component of this concept (An, You, Park & Lee, 2021). As aforementioned, the practitioner's availability was essential for accountability given the need for participants to report progress weekly. Similar findings have been presented in previous literature (Lai et al., 2018). Participants did not want to attend sessions not having completed their tasks as they felt they would disappoint the practitioner. Research has also shown the practitioners' presence during physical activity increases motivation through active support and encouragement (Lachman et al, 2018). Frequent access to a practitioner elicits a positive behavioural change in individuals allowing an increased awareness of living a healthier lifestyle through access to regular advice (Liddy, Johnston, Irving, Nash & Ward, 2015). In contrast, participants in the ACON group explained they often found their engagement in exercise was impeded due to a lack of discipline and motivation. To cope with this barrier, three participants altered the prescribed exercise sets to alleviate difficulty and other exercises were skipped entirely. In doing so, effectiveness of the program would have been reduced given the reduced engagement. Absence of accountability and support evidently lead to a lack of urgency and desire to exercise within the ACON group (Marashi, Nicholson, Ogrodnik, Fenesi & Heisz, 2021).

4.5 Convenience of Online Health Prescription

The convenience offered by online exercise prescription was another aspect highlighted by participants. Online exercise prescription effectively showed that leaving the house was not necessary to be physically active and that exercising at home yielded similar productivity. This eliminated factors that are often considered barriers to physical activity such as access to facilities, time constraints, and personal responsibilities, reduced travel time and sustainability through reduced petrol usage, thus making online exercise prescription an ideal method (Jennings et al., 2020). Two participants found it particularly convenient that they could watch television and exercise simultaneously. Watching a screen whilst exercising is an effective method similarly employed by gyms that offer treadmills with screens. This is a uniquely effective method as it has the ability to alleviate the boredom often associated with exercising (Steeves et al., 2016). Research has shown that audio and visual stimulation such as watching television can reduce the exertion felt from exercising and increases positive emotions, making exercising more tolerable (Hutchinson, Karageorghis & Jones, 2014).

Short video sessions lasting approximately 20 minutes were found to be the ideal length. All participants had various time constraints such as work and family responsibilities, making long sessions unfavourable. The primary barrier identified in both groups was allocating time towards physical activity, a common factor found amongst other individuals (Mailey, Huberty, Dinkel and McAuley, 2014). A duration of 20 minutes allows sessions to be scheduled more easily and provides ample flexibility for participants to manage other commitments. Physically attending a gym or exercise venue can be a time-consuming process (Iversen, Norum, Schoenfeld & Fimland, 2021). The duration of travel to and from the gym, as well as the time spent exercising may be considered a barrier and reduce engagement in physical activity (El Ansari & Lovell, 2009). Short online exercise sessions are a much less time-consuming process compared to attending the gym. There is a likelihood of increasing attendance rates with online exercise delivery given that participants can come to a session, receive the required information, and continue with their day. In some instances, participants were unable to attend their scheduled sessions due to unforeseen reasons. In this case, sessions were rescheduled to another time either in the same day or week. This was a highly appreciated aspect of the program as it further granted flexibility. Also with flexible scheduling, the stress of maintaining an appointment can be reduced and individuals are more capable of attending to other responsibilities.

4.6 Acceptance of Online Exercise Prescription

Our current findings further reinforce the feasibility and acceptance of online exercise prescription along with the benefits it has towards well-being. INT participants conveyed total satisfaction with weekly online sessions led by the researcher. Online exercise delivery was an unknown concept to the participants hence, there was a level of uncertainty towards its efficacy. One participant acknowledged post completion that it was a concept they had not considered previously, but have since been made aware of its potential. Prior to the COVID-19 pandemic, the concept of online health delivery was not widely implemented in healthcare, and as such, the general public were relatively unaware of this delivery method (Fischer, Ray, Mehrotra, Bloom & Uscher-Pines, 2020). Moreover, studies exploring the effects of this concept on healthy individuals is not present. Participants gaining personal experience with online delivery was important to increase their awareness and dispel possible misconceptions with the concept. Greater acceptance for this method is important as it may suggest that participants would be more willing to engage with the program and increase adherence (Wade, Cartwright and Shaw, 2012). A primary factor for participants accepting this method of delivery was the low session frequency each week. Participants reported that one to two video sessions per week would be sufficient and ideal. This is similar to another study exploring online exercise delivery which found that participants preferred three short sessions per week (Galloway et al., 2019). Lower session frequency per week might be preferred given that they could reduce the burden of scheduling and attending several appointments. Based on this feedback, it may be plausible to suggest individuals attending multiple sessions per week may reduce their acceptance of the program, and possibly even reduce adherence.

While the general consensus was that online prescription was an acceptable form of delivery, one INT group participant preferred face-to-face interactions for more serious health conditions. This was not surprising given past literature on online health delivery (Khoshrounejad et al., 2021). Face-to-face interaction with physicians was considered to deliver a more reliable diagnosis of conditions. As such, physician-prescribed medication was thought to be more accurate and effective than medication prescribed via online delivery. This is a common concern found amongst individuals when considering online health delivery (Gajarawala & Pelkowski, 2021).

It is possible that with online delivery, conversing across a digital device lack a personal feel, especially amongst older individuals who are more accustomed to traditional face-to-face interactions (McLachlan et al., 2021). While it is evident that online health delivery appears to be accepted by most participants, perhaps being the sole method of delivery would not be ideal. It may be more beneficial to instead consider using a balance of online and face-to-face appointments within health services, but, this requires further investigation to examine the specific ratio, order and timings. Implementation of online delivery within the health sector however would similarly have its own cost for use. It is important to note that this study did not infer a charge for use of the service. Given that, the acceptance of this method by participants may not be entirely generalizable and can potentially change when associated with cost of use.

4.7 Conclusion

To our knowledge, there have been no studies exploring the effects of online exercise prescription on well-being in a generally healthy population. Prior studies have primarily observed the effects of online health delivery on populations with various health conditions such as Peng et al. (2018), Lai et al. (2018) and Torriani-Pasin et al (2021). Age did not appear to be a barrier as participants all had sufficient technical ability to set up the Zoom application and access video invitations. These findings show that exercise programs can be administered effectively through online means, even with older individuals. They would also benefit from including a health coach to elevate motivation and increase adherence. Perhaps by including an individual to supervise video sessions, more people would be inclined to use online delivery as they may appreciate communicating face to face, albeit digitally, with a health professional.

4.8 Limitations of the Research

This study had several limitations. The sample size included in this study was relatively small which increased the variability of the results and impacted its accuracy and generalisability as they were not indicative of the wider population. Therefore, our findings should be interpreted with caution. Moreover, participant recruitment for this study was conducted in only one region of New Zealand, which limited variability in the population. In addition, the recruitment methods utilised appeared to be insufficient to gather the intended number of participants, and not every location where the study was advertised was followed up. A full COVID-19 lockdown of Auckland was issued during this study which included two-meter social distancing, limited gatherings, having to remain in a household bubble, mandatory mask use and closure of facilities such as the University laboratory. These restrictions affected the post-intervention data collection phase of our study as participants were not able to complete observations given the closure of the data collection laboratory. In consequence, we could not examine the effects of online exercise prescription on blood pressure and cardiorespiratory fitness, which was the intention of this study. These unforeseen changes led to a modification of the study premise, shifting it to a more qualitative approach with a larger focus on participant perceptions of the intervention and online exercise delivery concept. A quantitative analysis contrasting the pre and post-intervention changes was not possible given the limited data available, thus we could not determine whether a change in physical well-being was observed. The 12-week intervention period was considerably short, therefore, the findings of this study do not expand on possible effects of a longer intervention. While long-term and weekly goals were set with participants of the INT group, we did not implement this with ACON participants. As a result, we could not effectively compare the progress achieved in each group and therefore could not assess if there was an in-between group difference in participant ability to achieve set goals. This study also did not include a face-to-face intervention or control group to contrast results. An out of pocket cost for online health delivery was not considered. Given this, participant satisfaction with this concept may not be generalizable. Focus group sessions were not organised based on a specific factor (such as age or gender), therefore they included a mixture of participants. Also, focus groups were relatively small, containing four to five participants, and on one, a focus group included only one participant due to scheduling difficulties. As a result, the quality of discussion in these focus group sessions may have been impacted. With the spread of the COVID-19 pandemic during this study, participant perceptions may have been affected, and as such, may not represent their opinions prior to the lockdowns. Lastly, to evaluate online sessions with the practitioner, participants were provided feedback surveys weekly, however these were no longer completed after the second week of intervention. Due to this, online sessions could not be adapted to suit the needs of participants.

4.9 Future Recommendations

Future online exercise prescription studies should look to include a large population size. Doing so could improve the accuracy and generalisability of the findings. To achieve this, a variety of recruitment methods should be included in studies. It may also be important for future studies to extend recruitment to several regions to gather a wider variety of participants and increase generalisability of results. Potential risk of future COVID-19 lockdowns should be considered, and remote data collection methods may need to be incorporated in future studies to prevent loss of data and changes to research design. For example, cardiorespiratory fitness may be assessed via a video conference using the Canadian step test. Employing a long intervention (> 12 weeks) in the future studies with follow up testing can aid in examining the long-term effects of online exercise prescription. Goal setting was an effective tool in our study online intervention participants, future research may consider setting long and weekly goals for all groups to assess the difference in program adherence. In addition, a three-arm study design can be utilised to effectively contrast the effects of online exercise delivery by including an intervention, standard-care, and control group. Focus group sessions can look to include many participants as they may offer a more in-depth understanding of participant perception on online exercise prescription. Furthermore, organising focus groups based on a given factor (age or gender etc) can reduce participant inhibition and enhance response. Finally, studies looking to gather participant feedback of online delivery sessions via surveys may consider using email reminders to ensure they are completed. This cam provide data that helps in future online session design.

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Appendix A: Participant Consent Form

The Effects of Online Exercise Prescription on Blood Pressure and Cardiorespiratory Fitness in Individuals Aged 30 Years and Above

CONSENT FORM FOR STUDY VOLUNTEERS

This consent form will be held for a period of five (5) years

I have read the Information Sheet and have had the details of the study explained to me. My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I understand that I have the right to withdraw from the study at any time and to decline to answer any particular questions (if I choose to withdraw I cannot withdraw my data from the analysis after the data collection has been completed).

I agree to provide information to the researcher on the understanding that my name will not be used without my permission. (The information will be used only for this research and publications arising from this research project.)

I agree to participate in this study under the conditions set out in the Information Sheet.

Signature: ____ Date____________________

Full Name (printed) ____

Phone Number_______________________ Age _______________ Date of Birth _________

Appendix B: Participant Information Sheet

The Effects of Online Exercise Prescription on Blood Pressure and Cardiorespiratory Fitness in Individuals Aged 30 Years and Above

PARTICIPANT INFORMATION SHEET

Researcher Introduction
My name's Fadi Bahi and I'm currently completing my postgraduate diploma in Health Science at Massey University. I have previously completed my Bachelor's degree in Exercise and Sport Science. My supervisors are Associate Professor Ajmol Ali (School of Sport, Exercise and Nutrition) and Dr Jennifer Roberts (School of Nursing).

Research Background
Exercise prescription refers to the development of a physical activity plan designed for a specific purpose. Physical activity is essential for numerous physical and physiological adaptations and reduces the risk of diseases such as cardiovascular disease (CVD). Access to physical activity specialists can be difficult for some due to cost of travel or being out of reach. Therefore, providing online exercise prescription as well as an exercise intervention can allow these individuals to engage in regular physical activity.

With the high rate of CVD-related deaths, reducing associated risk factors can help reduce the mortality rate and allow improved quality of life (QoL). A prominent risk factor of CVD is hypertension where blood pressure (BP) is higher than the normative level of 120/80 mm Hg, and if unchanged, can lead to heart disease. Hypertension can occur as a result of lifestyle choices such as lack of physical activity, therefore imposing a change in lifestyle at earlier stages (prehypertension, BP of 120-139/80-89 mm Hg) may help stop the development of hypertension and CVD.

The aims of this study are to examine the effects of online exercise prescription on blood pressure and cardiorespiratory fitness in prehypertensive individuals as well as to understand how participants perceive this method of health delivery.

Participant Recruitment
Forty men and women (aged 40 and above) who are prehypertensive (BP of 120-139/80-89 mm Hg) are invited to participate in this study. If eligible for the study you will be allocated to an online or paper delivery group (20 participants per group). If you are hypertensive (BP ≥ 140/90 mm Hg), or have any of the conditions listed on the "health questionnaire" then you should not volunteer to participate. If you are unsure about any of the listed conditions, then you should consult with the researchers. Please read this information sheet carefully before deciding to volunteer for this study. You will be asked to refer to your GP to determine the amount of physical activity you can engage in per week and whether there are exercises you should or should not be carrying out. Furthermore, you will also be referred to your GP to determine whether you are prehypertensive, alternatively, you may choose to measure your own BP. This will be verified during your initial lab visit.

Project Procedures and Participant Involvement
If you agree to participate, you will be asked to attend a total of two focus group sessions and two data collection visits at the Sport and Exercise laboratory located at the Recreation Centre, Massey University, Albany Highway, Albany.

Should you accept, you will be invited to attend a total of two focus group sessions (90 minutes each, pre and post intervention). Two research assistants who are not involved with the main intervention of the study will be recruited to carry these out. This is to allow you to speak freely and express more detailed answers about the study. The pre intervention focus group session will be about your current exercise levels, challenges you face and your expectations of the study while the post intervention focus group session will explore feedback on the study.

In the initial visit (1 hour), you will be randomly allocated to either the online or paper delivery group. The study outline will be explained to you as well as the protocol to follow should you feel unwell during the exercise sessions. You will also be asked to complete a consent form. Testing will consist of a 6-minute cycle test which will assess your cardiorespiratory fitness. Blood pressure will be measured across a 24-hour period using an ambulatory blood pressure machine. Other data such as heart rate, stroke volume, systemic vascular resistance, mean arterial pressure and cardiac output will also be collected using an ultrasound device. Physical, mental and social wellbeing data will be collected via a questionnaire on the Meke Meter website. Sleep and exercise levels will also be collected via an Actigraph device that we will ask you to wear for a seven-day period before and after the 12-week exercise prescription period. You will be provided with an exercise pack containing an exercise band, skipping rope, and two 5-kg dumbbells to use throughout the study. The second visit (1 hour) will take place at the end of the 12-week program, and follow the same data collection procedure.

If you are in the online delivery group, you will be asked to participate in a 20-minute weekly video conferencing session. During each session, a weekly exercise plan will be provided and exercises will be explained as well as demonstrated to ensure you perform them safely and correctly. Your weekly goals will be discussed and set and reviewed in the subsequent session. You will also have the opportunity to discuss any areas of concern you may have about the study or exercises.

If you are in the paper delivery group, you will be provided with exercise recommendations and the participant pack at the end of your initial visit. You will also be provided with the exercise outline for the 12-week program.

If you participate, what are the benefits?
You will be offered the exercise pack provided to you at the start of the study to keep as a token of appreciation (koha).

If you participate, how will your data be managed and stored?
Raw data will be stored securely in password protected electronic files or locked filing cabinets for five years after completion of the project, when it will be destroyed by the supervisors.

Participant’s Rights
You are under no obligation to accept this invitation. Should you choose to participate, you have the right to:

- decline to answer any particular question
- decline to participate in any focus group session
- withdraw from the study at any time, even after signing a consent form (if you choose to withdraw you cannot withdraw your data from the analysis after the data collection has been completed)
- ask any questions about the study at any time during participation
- provide information on the understanding that your name will not be used unless you give permission to the researcher
- be given access to a summary of the project findings when it is concluded

Confidentiality

All data collected will be used solely for research purposes. All personal information will be kept confidential by assigning numbers to each participant. No names will be visible on any papers on which you provide information. All data/information will be dealt with confidentiality and will be stored in a secure location for five years on the Massey University Albany Campus. After this time, it will be disposed of by an appropriate staff member from the School of Sport, Exercise and Nutrition.

Project Contacts

If you have any questions regarding this study, please do not hesitate to contact either of the following people for assistance:

Student researcher:
Fadi Bahi
fadi_bahi@hotmail.com
021 230 9531

Supervisors:
A/Prof Ajmol Ali (School of Sport, Exercise and Nutrition, Massey University)
a.ali@massey.ac.nz
(09) 4140800 ext. 43414

Dr Jennifer Roberts (School of Nursing, Massey University)
J.Roberts@massey.ac.nz
(04) 801 5799 ext. 85342

Committee Approval Statement

This project has been reviewed and approved by the Massey University Human Ethics Committee: Southern A, Application xx/xx. If you have any concerns about the conduct of this research, please contact Dr Negar Partow, Chairperson, Massey University Human Ethics Committee: Southern A, telephone 64 4 801 5799 x 63363, email humanethicsoutha@massey.ac.nz

Compensation for Injury

If physical injury results from your participation in this study, you should visit a treatment provider to make a claim to ACC as soon as possible. ACC cover and entitlements are not automatic and your claim will be assessed by ACC in accordance with the Accident Compensation Act 2001. If your claim is accepted, ACC must inform you of your entitlements, and must help you access those entitlements. Entitlements may include, but not be limited to, treatment costs, travel costs for rehabilitation, loss of earnings, and/or lump sum for permanent impairment. Compensation for mental trauma may also be included, but only if this is incurred as a result of physical injury.

If your ACC claim is not accepted, you should immediately contact the researcher. The researcher will initiate processes to ensure you receive compensation equivalent to that to which you would have been entitled had ACC accepted your claim.

Appendix C: Health Screening Questionnaire

The Effects of Online Exercise Prescription on Blood Pressure and Cardiorespiratory Fitness in Individuals Aged 30 Years and Above

Health Screening Questionnaire

Name: ____

Address: ____

Phone: ______________________________

Age: _______________

Gender:______________

Please read the following questions carefully. If you have any difficulty, please advise the medical practitioner, nurse or exercise specialist who is conducting the exercise test.

Please answer all of the following questions by ticking only <u>one</u> box for each question:

The questions are based upon the Physical Activity Readiness Questionnaire (PAR-Q), originally devised by the British Columbia Dept. of Health (Canada), as revised by [1]Thomas *et al.* (1992) and [2]Cardinal *et al.* (1996), and with added requirements of the Massey University Human Ethics Committee. The information provided by you on this form will be treated with the strictest confidentiality.

Q1. Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?

Yes ☐ No ☐

Q2. Do you feel a pain in your chest when you do physical activity?

Yes ☐ No ☐

Q3. In the past month have you had chest pain when you were not doing physical activity?

Yes ☐ No ☐

Q4. Do you lose your balance because of dizziness or do you ever lose consciousness?

Yes ☐ No ☐

Q5. Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?

Yes ☐ No ☐

Q6. Have you been hospitalised recently?

Yes ☐ No ☐

Q7. Do you have a bone or joint problem (for example, back, knee or hip) that could be made worse by a change in your physical activity?

Yes ☐ No ☐

Q8. Have any immediate family had heart problems prior to the age of 60?

Yes ☐ No ☐

Q9. Do you have any issues exercising or completing any physical activity?

Yes ☐ No ☐

Q10. Are there any issues that may prevent you from completing an approximately 6 min moderate effort cycle (adjusted for your fitness level)? If yes, please explain.

Yes ☐ No ☐

Q11. Have you had any COVID-19 related symptoms such as new or worsening cough, fever, sore throat, temporary loss of smell, difficulty breathing, and runny nose?

Yes ☐ No ☐

Q12. in the 14 days have you had close contact with a confirmed or probable COVID-19 case, had international travel, or had direct contact with a person who has travelled overseas

Yes ☐ No ☐

____

____

____

I have read, understood and completed this questionnaire.

Signature *(Participant):* ____ Date: ___________________

References

1. Thomas S, Reading J and Shephard RJ. Revision of the Physical Activity Readiness Questionnaire (PAR-Q). *Can J Sport Sci* 17(4): 338-345.
2. Cardinal BJ, Esters J and Cardinal MK. Evaluation of the revised physical activity readiness questionnaire in older adults. *Med Sci Sports Exerc* 28(4): 468-472

Appendix D: Participant Screening Questionnaire

Participant Screening Questionnaire

The Effects of Online Exercise Prescription on Blood Pressure and Cardiorespiratory Fitness in Individuals aged 30 Years and Above

Name: ____

Phone: ______________________________

Please answer all of the following questions by ticking only <u>one</u> box for each question:

Q1. What gender do you identify as?

Male ☐ Female ☐ Gender diverse ☐

Q2. Are you aged 30 years or above?

Yes ☐ No ☐

Q3. Could you realistically travel to the Massey University Albany laboratory to participate in pre and post-test testing during the weekdays?

Yes ☐ No ☐

Q4. Are you able and willing to take part in a 12-week physical activity program?

Yes ☐ No ☐

Q5. Are you able and willing to connect to the Internet on a regular basis?

Yes ☐ No ☐

Q6. Do you have access to a device that allows for videoconferencing?

Yes ☐ No ☐

Q7. Are you able and willing to participate in a focus group session before and after the intervention?

Yes ☐ No ☐

Q8. Are you currently pregnant or have plans to become pregnant in the next six months?

Yes ☐ No ☐

Q9. Are you currently participating or scheduled to participate in any research projects in the next six months?

Yes ☐ No ☐

I have read, understood and completed this questionnaire.

Signature *(Participant):* ____
Date:___________________

Appendix E: Post-Intervention Focus Group Questions

Post-Intervention Focus Group Questions – Online Group

Questions about the exercise programme

1. To start with, tell me about how you found the exercise programme?
2. What did you value about the programme?
3. What did you find least enjoyable?
4. Have you experienced any changes since commencing this study?
5. Were there any barriers that prevented you from engaging in the prescribed exercises?

Questions related to the delivery (online)

1. In terms of the online sessions, how did you feel these went?
2. How was the length of each weekly video session?
3. What do you think are the benefits of online exercise prescription/session? Why/why not?
4. Where there any negative aspects?
5. Would you recommend changing anything?
6. Do you think the weekly video sessions helped towards your accountability of exercising daily?

Questions related to future use

1. Would you consider using online health delivery in the future? Why/why not?
2. How often would you want to use this kind of health delivery method? (weekends/Weekdays only)
3. What have you learnt/gained from participating in this study?
4. Is there anything else you want to say about the programme?

Post-Intervention Focus Group Questions – Self-monitoring Group

Questions about the exercise programme

1. To start with, tell me about how you found the exercise programme?
2. What did you value about the programme?
3. What did you find least enjoyable?
4. Have you experienced any changes since commencing this study?
5. Were there any barriers that prevented you from engaging in the prescribed exercises?

Questions related to the delivery (paper)

1. How did you feel about receiving the full 12-week program upfront?
2. How did you feel about the weekly check-up emails?
3. How did you feel about self-monitoring your exercises?
4. Do you think this is an ideal method of exercise prescription? Why/why not?

Questions related to future use

1. What would help to increase physical activity while at home/work?
2. Do you think having weekly video sessions with a health coach online would have increased your engagement?
3. What have you learnt from participating in this study?
4. Would you consider using online health delivery in the future? Why/why not?

Appendix F: Meke Meter Survey

My Wellbeing Today

Rate yourself out of 10.
1 feeling low, 10 feeling meke

Physical Health

Fitness ____ ☐

Self-Image ____ ☐

Wellbeing Health _____________________________________ ☐

Nutritional Health _____________________________________ ☐

Addiction Free ____ ☐

1. How do you view your health currently in comparison to before the 12-week program?

    a. Much better
    b. Slightly better
    c. About the same
    d. Slightly worse
    e. Much Worse

2. How much time do you spend doing moderate to vigorous-intensity sports, fitness or recreational activities on a typical day?

    a. Less than 10 minutes
    b. 10 – 20 minutes
    c. 20 – 40 minutes
    d. 40 – 60 minutes
    e. More than 60 minutes

Social Well Being

Recreation/Fun/Sport ________________________________ ☐

Work/Career/School ___________________________________ ☐

Cultural Identity ____________________________________ ☐

Finances ____ ☐

Family/Friends ______________________________________ ☐

Mental Health

Stress Free ____ ☐

Happiness ____ ☐

Motivation ____ ☐

Self-Esteem ____ ☐

Spirituality ____ ☐

1. Do you feel like the 12-week program has been effective in managing your stress levels?

    a. Very effective
    b. Somewhat effective
    c. Neither effective nor ineffective
    d. Somewhat ineffective
    e. Very ineffective

2. Do you feel like the 12-week program has been effective in improving your motivation for physical activity?

    a. Very effective
    b. Somewhat effective
    c. Neither effective nor ineffective
    d. Somewhat ineffective
    e. Very ineffective

Name Date

Appendix G: 12-Week Exercise Program

Week	Exercise	Repetition
Week 1	1. Wall Push Ups 2. Seated Squats 3. Seated Rotations	15 15 20
Week 2	1. Banded Chest Fly 2. Banded Squats 3. Standing Banded Wood Chops	20 20 15 each side
Week 3	1. Seated Banded Row & Fly 2. Step Ups 3. Calf Raises 4. Standing Banded Oblique's	15 20 30 20
Week 4	1. Incline Chair Push Up 2. Seated Shoulder Press 3. Standing Side Leg Raises 4. Standing Rear Kick Backs 5. Seated Rotations	15 10 30 each side 15 each side 40
Week 5	1. Banded Bicep Curl 2. Seated Banded Row 3. Crab Walk 4. Wide Squat 5. Chair Plank Knee Raises 6. Single Leg Knee Raises	15 20 20 15 20 each side 10 each side
Week 6	1. Banded Front & Side Lateral Raises 2. Seated Chest Press 3. Step Ups 4. Standing Rear Kick Backs 5. Standing Banded Oblique's 6. Standing Banded Wood Chops	10 20 30 20 each side 15 each side 30 each side
Week 7	1. Seated Banded Row & Fly 2. Seated Shoulder Press 3. Banded Standing Side & Rear Leg Raise 4. Squat with band 5. Swiss ball Leg Extensions 6. Calf Raises	20 20 30 each side 20 20 each side 30

Week 8	1. Incline Chair Push Up 2. Seated Banded Bicep Curl & Lateral Raise 3. Swiss ball Squat 4. Seated Banded Leg Extension 5. Standing Banded Wood Chops 6. Standing Reach Overs	20 15 20 30 each side 20 each side 20
Week 9	1. Seated Chest Press & Chest Fly 2. Seated Banded Row 3. Crab Walk 4. Step Ups 5. Seated Cross Overs 6. Standing Banded Wood Chops	20 20 30 30 20 20 each side
Week 10	1. Banded Front & Side Lateral Raises 2. Banded Bicep Curl 3. Swiss ball Wide Squat 4. Swiss ball Banded Kick backs 5. Standing Banded Oblique's 6. Swiss ball Plank Up & Down	15 20 20 30 each side 20 each side 20
Week 11	1. Incline Chair Push Up 2. Swiss ball Squat 3. Seated Banded Row 4. Step Ups 5. Swiss ball Seated Twist 6. Swiss ball Plank Up & Down	20 20 30 30 40 15
Week 12	1. Seated Banded Leg Extension 2. Standing Cross overs 3. Seated Banded Bicep Curl & Lateral Raise 4. Front & Side Leg Lateral Raises 5. Swiss ball Rear Kick Backs 6. Standing Banded Wood Chops	20 each side 30 20 15 each side 20 each side 30 each side

Note

The colour of each week represents the colour of the resistance band to be use when carrying out the exercises.

Aims

Weeks 1 – 4: Try to complete 4 sets of each exercise

Weeks 5 – 9: Try to complete 3 sets of each exercise

Weeks 10 – 12: Try to complete 2-3 sets of each exercise

Appendix H: USCOM 1A Standard Operating Procedures

Massey University
COLLEGE OF SCIENCES
School of Sport Exercise, and Nutrition
Te Kura Hangarau o Kai-orangā-ā-tāngata
Human Nutrition & Health

HUMAN NUTRITIONAL STUDIES LABORATORY PROCEDURE

Obtaining a USCOM 1A Measure

BACKGROUND

The purpose of obtaining a beat-to-beat cardiac haemodynamics in adult participants. Its recording and storage of patient information provides trending information of cardiovascular performance for quantitative evaluation in a safe and effective manner to assist in the diagnosis and ongoing management of an adult patient.

SCOPE

Applies to all medical practitioners, staff, who perform USCOM 1A measures on trial participants of adult age.

AUTHORITIES AND RESPONSIBILITIES

It is expected that all staff performing USCOM 1A measures should have undertaken suitable training and have been evaluated as competent to perform this procedure by a competent user.

At SSEN, the laboratory clinician, laboratory manager and associated research scientists who are trained in the use of the USCOM 1A may perform this procedure. From time to time, trained third party individuals will be contracted to perform this procedure on trial participants.

Each trial participant must be familiarised with the procedure of the USCOM 1A prior to use. If aortic stenosis is known to be present in participant, pulmonary measure should be undertaken. If the pulmonary measure is too complex for the level of skill of the person performing the procedure, then the patient must be referred to a more experienced health professional.

The laboratory's scientific staff are responsible for maintaining the equipment and ordering consumables required. They are also responsible for safe storage and protection of participant data in accordance with MUHEC.

PREREQUISITES

The following key points must be considered prior to USCOM 1A measures:

If aortic stenosis is known to be present in participant, pulmonary measure should be undertaken. If the pulmonary stenosis is also present the participant should be excluded as these issues would affect results.

If the participant feels the pulmonary measure is too invasive for them with the person performing the procedure, then the patient must be referred to a more appropriate operator (i.e. a female participant may feel more comfortable with a female operator).

PROCEDURE

Equipment

- USCOM A1 Monitor
- Battery
- Power Supply
- Transducer Kit
- Stylus
- Transducer
- Transducer Handle
- Ultrasound Gel
- User's Guide

Health and Safety:

Trial Participant

1) There are no known harmful effects from ultrasound frequencies. Use diagnostic ultrasound only when it is safe to do so.

2) For safe operation follow "Guidelines for the safe use of diagnostic ultrasound equipment", The British Medical Ultrasound Society.

Warnings

1) Grounding reliability can only be achieved when equipment is connected to an equivalent receptacle marked "HOSPITAL GRADE". Do not open the unit.

2) Only qualified personnel should service the unit.

3) Do not modify this equipment without authorisation of the manufacturer. If this equipment is modified, appropriate inspection and testing must be conducted to ensure continued safe use of the equipment.

4) To avoid electrical shock, use only the supplied power cord.

5) To avoid the risk of electric shock, this equipment must only be connected to a mains supply with protective earth.

6) If the integrity of the external power supply and/or its connection is unknown or in doubt, disconnect the power supply and operate the unit using the internal battery.

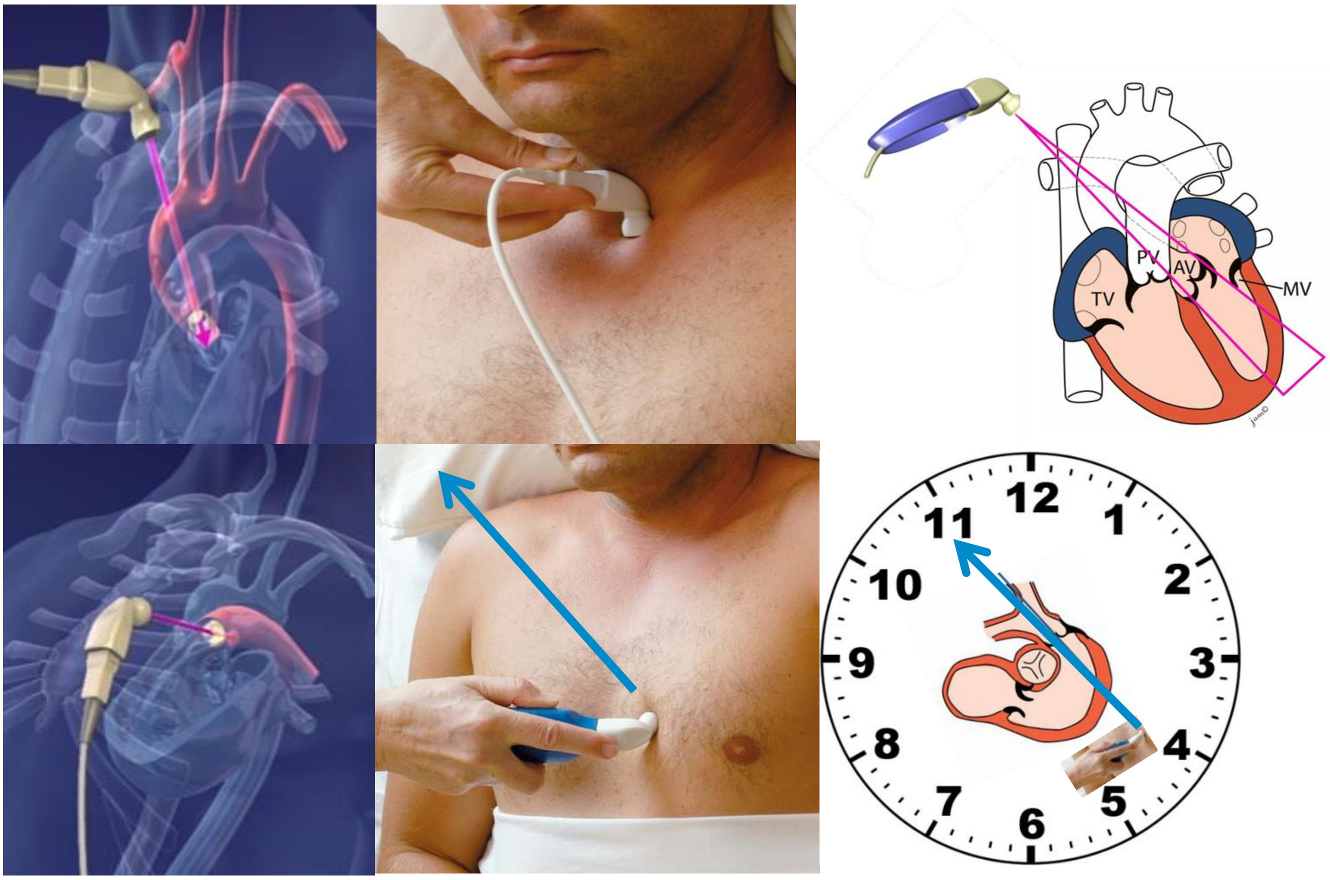
7) Do not operate the unit if the transducer is cracked or damaged.

8) The recommended operating distance is greater than 300mm from the unit.

USCOM Ultrasound Sites

For adults, measure is usually taken from the aortic site (refer to the diagram below).

Aortic Site



Performing the Procedure

1) Accurately identify the trial participant by accessing the participant in one of three ways: RUN – access the Examination screen prior to login or selecting/creating a patient. (Note: You will be required to login to save the Examination). 2. NEW PATIENT – create a new patient's details in USCOM prior to performing the examination. (Note: Login is required before you can access NEW PATIENT). 3. OPEN – select a patient that already exists in USCOM. (Note: Login is required before you can access OPEN).

3) Have the patient lie comfortably supine.

4) Apply ultrasound gel to the underside of the transducer.

5) Locate the transducer on the patient at the suprasternal notch for aortic artery insonation or left parasternal acoustic access point (3rd to 4th intercostal space) for pulmonary artery insonation.

6) Target the transducer at the aortic or pulmonary valve so as to acquire optimum signal. This is obtained when the transducer beam is directed parallel to the flow through the valve.

7) It is important that prior to saving an examination the optimal signal is received.

8) From the Examination screen, touch START to commence sampling data on the Doppler spectral display.

9) While observing the Doppler spectral display, orientate the acoustic beam (20° cephalad) and/or move the transducer to optimise the signal.

10) Allow the USCOM to collect data until at least 20 seconds of stable trace has been observed.

11) Touch FREEZE to stop acquiring data, the last 20 seconds of data will be available.

12) Use FlowTracer or TouchPoint to obtain measures. See Using FlowTracer to capture Doppler Flow data and Using TouchPoint to capture Doppler Flow data.

13) Touch SAVE to store the results for the examination.

14) Clean gel off participant and transducer and allow participant to sit up.

REFERENCES

USCOM user guide version 4.0 (2018)