COMPARISON OF AQUATIC AND THERA-BAND EXERCISES ON PAIN, ENDURANCE AND QUALITY OF LIFE AMONG OBESE PEOPLE WITH KNEE OSTEOARTHRITIS

KOGILAVANI A/P S. KRISHNAN

UNIVERSITI PENDIDIKAN SULTAN IDRIS

2023

COMPARISON OF AQUATIC AND THERA-BAND EXERCISES ON PAIN, ENDURANCE AND QUALITY OF LIFE AMONG OBESE PEOPLE WITH KNEE OSTEOARTHRITIS

KOGILAVANI A/P S. KRISHNAN

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

DISSERTATION SUBMITTED IN FULFILLMENT OF THE REQUIREMENT
FOR THE DEGREE OF MASTER OF SCIENCE
(MASTER BY RESEARCH)

FACULTY OF SPORT SCIENCE AND COACHING
UNIVERSITI PENDIDIKAN SULTAN IDRIS

2023

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

UNIVERSITI PENDIDIKAN SULTAN IDRIS

Please tick (√)
Project Paper
Masters by Research
Master by Mixed Mode
PhD

INSTITUTE OF GRADUATE STUDIES

DECLARATION OF ORIGINAL WORK

This declaration is made on the ...07th.....day of...March.....20..23.

i. Student's Declaration:

I, Kogilavani A/P S.Krishnan, M20151001460, Faculty of Sport Science and Coaching (PLEASE INDICATE STUDENT'S NAME, MATRIC NO. AND FACULTY) hereby declare that the work entitled Comparison of Aquatic and Thera-Band Exercises on Pain, Endurance and Quality of Life among Obese People with Knee Osteoarthritis is my original work. I have not copied from any other students' work or from any other sources except where due reference or acknowledgement is made explicitly in the text, nor has any part been written for me by another person.

Kogi

Signature of the student

ii. Supervisor's Declaration:

I Dr. Fariba Hossein Abadi (SUPERVISOR'S NAME) hereby certifies that the work entitled Comparison of Aquatic and Thera-Band Exercises on Pain, Endurance and Quality of Life among Obese People with Knee Osteoarthritis (TITLE) was prepared by the above named student, and was submitted to the Institute of Graduate Studies as a * partial/full fulfillment for the conferment of Master of Science (PLEASE INDICATE THE DEGREE), and the aforementioned work, to the best of my knowledge, is the said student's work.

07/03/2023

Date

Signature of the Supervisor

UPSI/PS-3/BO 31
Pind.: 01 m/s: 1/1

UNIVERSITI PENDIDIKAN SULTAN IDRIS

INSTITUT PENGAJIAN SISWAZAH /
INSTITUTE OF GRADUATE STUDIES

BORANG PENGESAHAN PENYERAHAN TESIS/DISERTASI/LAPORAN KERTAS PROJEK
DECLARATION OF THESIS/DISSERTATION/PROJECT PAPER FORM

Tajuk / *Title*: Comparison of Aquatic and Thera-Band Exercises on Pain, Endurance and Quality of Life among Obese People with Knee Osteoarthritis

No. Matrik /*Matric's No.*: M20181001460

Saya / *I*: Kogilavani A/P S.Krishnan
(Nama pelajar / *Student's Name*)

mengaku membenarkan Tesis/Disertasi/Laporan Kertas Projek (Kedoktoran/Sarjana)* ini disimpan di Universiti Pendidikan Sultan Idris (Perpustakaan Tuanku Bainun) dengan syarat-syarat kegunaan seperti berikut:-
acknowledged that Universiti Pendidikan Sultan Idris (Tuanku Bainun Library) reserves the right as follows:-

1. Tesis/Disertasi/Laporan Kertas Projek ini adalah hak milik UPSI.
   The thesis is the property of Universiti Pendidikan Sultan Idris
2. Perpustakaan Tuanku Bainun dibenarkan membuat salinan untuk tujuan rujukan dan penyelidikan.
   Tuanku Bainun Library has the right to make copies for the purpose of reference and research.
3. Perpustakaan dibenarkan membuat salinan Tesis/Disertasi ini sebagai bahan pertukaran antara Institusi Pengajian Tinggi.
   The Library has the right to make copies of the thesis for academic exchange.
4. Sila tandakan (√) bagi pilihan kategori di bawah / *Please tick (√) for category below:-*

☐ **SULIT/*CONFIDENTIAL*** — Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub dalam Akta Rahsia Rasmi 1972. / *Contains confidential information under the Official Secret Act 1972*

☐ **TERHAD/*RESTRICTED*** — Mengandungi maklumat terhad yang telah ditentukan oleh organisasi/badan di mana penyelidikan ini dijalankan. / *Contains restricted information as specified by the organization where research was done.*

☑ **TIDAK TERHAD / *OPEN ACCESS***

Kogi

(Tandatangan Pelajar/ Signature)

Tarikh: 15/03/2023

(Tandatangan Penyelia / *Signature of Supervisor*)
& (Nama & Cop Rasmi / *Name & Official Stamp*)

DR FARIBA HOSSIEN ABADI Ph.D
SENIOR LECTURER
FACULTY OF SPORT SCIENCE AND COACHING
SULTAN IDRIS EDUCATION UNIVERSITY
35900 TANJONG MALIM PERAK

Catatan: Jika Tesis/Disertasi ini SULIT @ TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh laporan ini perlu dikelaskan sebagai SULIT dan TERHAD.

Notes: If the thesis is CONFIDENTAL or RESTRICTED, please attach with the letter from the organization with period and reasons for confidentiality or restriction.

ACKNOWLEDGMENTS

With God blessing, my journey has come to an end although it is just a beginning of new page of my research experience. Firstly, I would like to express my sincere gratitude to Dr. Fariba Hossein Abadi, my advisor for the continuous support of my Master study, for her patience, tremendous help, inspiring motivation, and immense knowledge. Her guidance helped me in every time of research and writing of the thesis. I could not have imagined having a best advisor and mentor for my Master study like her. I want to thank Assoc. Prof. Dr. Lee Ai Choo for their generous guidance and encouragement throughout the study process. I would also like to express my gratitude to University Pendidikan Sultan Idris for providing me guidance and a lot of presentation based on research guidelines.

My special regards to Dr Nurul Fadhilah binti Abdullah and Dr Fairus Fariza binti Zainudin for their insightful comments and encouragement, but also for the hard question which incented me to widen my research from various perspective especially in term of the literature reviews, novelty of my research the findings and the format in writting thesis.

My sincere thanks also go to the Head of Taiping Hospital and Clinical Research Taiping Hospital for their approval and constant support. I would also like to thank all participants who were involved in this study. Without the assistance, cooperation and opportunity given, this study could have never been possible.

Finally, I would like to express my gratitude and appreciation to all who have involved directly and non- directly in my research development and indeed is a dream come true.

I hope that this little contribution could give an update on physiotherapy treatment on Knee Osteoarthritis in the future. Thank you once again to all. The deepest appreciation to my lovely parents and family and other individuals who helped me directly or indirectly during this period. I hope this research will increase my knowledge in this field and helps my clients and patients out there.

ABSTRACT

Knee Osteoarthritis (KOA) causes pain, stiffness and muscular weakness which results in reduced activities of daily living (ADL). This study aims to compare the effect of aquatic exercise (AqE) and Thera-band exercises (TbE) on pain intensity, endurance, and quality of life (QoL) among obese people with KOA. In this cross-sectional study, a total of forty-five obese participants (n = 45; male = 22, female = 23) with KOA (BMI $\geq$ 27.5 $kg.m^{-2}$) were purposively recruited and randomly assigned into three groups; Aquatic exercise group (AqG), Thera-band exercise group (TbG), and the control group (CG). For the analysis of results, using the Mixed ANOVA method, it revealed that there is a significant effect between AqE and TbE on pain intensity (F: (2/42) = 34.18, $p < 0.001$), endurance (F:(2/42) = 11.425, $p < 0.001$) and quality of life (F:(2/42) = 32.148, $p < 0.001$) with control group. Even though there was not a significant difference between AqG and TbG in pain intensity (p=0.896), and endurance (p=0.072), there was significant difference in QoL between both intervention groups (p=0.022). In addition, the results revealed a significant improvement among AqG compared to CG in pain intensity (p=0.001), endurance (p=0.046) and QoL(p=0.000). The MANCOVA results displayed a significant interaction of group × time effect on all sub-domains of QoL. In addition, pairwise comparisons between groups among QoL sub-domains revealed that there was a significant difference between AqG and TbG in all dimensions of QoL (pain, symptom, ADL, sport/recreation and knee related QoL. To conclude, progressive AqE and TbE can alternatively be suggested for improvement of pain intensity, endurance, and quality of life among people with KOA while the effect size of AqE program was slightly greater in both variables.

PERBANDINGAN SENAMAN AKUATIK DAN SENAMAN *THERA-BAND* DALAM SKALA KESAKITAN, DAYA KETAHANAN DAN KUALITI HIDUP DIKALANGAN PESAKIT OBES YANG MEMPUNYAI SAKIT LUTUT

ABSTRAK

Sakit lutut merupakan faktor yang menyumbang kepada sakit, kekerasan, kelemahan otot yang boleh mengurangkan aktiviti kerja. Tujuan kajian ini adalah bagi melihat keberkesanan senaman akuatik dengan senaman *Thera-band* dalam kesakitan, daya ketahanan dan kualiti hidup dikalangan pesakit obes yang mempunyai sakit lutut. Rekabetuk kajian ini ialah cross-sectional study, yang melibatkan 45 peserta (jumlah=45; lelaki =22, perempuan=23) yang mempunyai sakit lutut (Index Jisim Tubuh 27. 5kg.m-2). Mereka telah dibahagikan kepada tiga kumpulan iaitu kumpulan akuatik, kumpulan *Thera-band* dan kumpulan kawalan. Hasil dapatan menggunakan Mix-ANOVA menunjukkan perbezaan yang signifikan diantara kesan dari senaman aquatik dan senaman *Thera-band* bagi skala kesakitan (F: (2/42) = 34.18, p<0.001), daya ketahanan (F:(2/42) =11.425, p<0.001) and kualiti hidup (F:(2/42) =32.148, p<0.001). Disamping itu, hasil dapatan membuktikan tiada perubahan signifikan di antara kumpulan akuatik dan kumpulan *Thera-band* dalam skala kesakitan (p=0.896), daya ketahanan (p=0.072), tetapi terdapat perubahan signifikan di dalam kualiti hidup (p= 0.022). Pada masa yang sama, terdapat perubahan yang signifikan di kalangan kumpulan akuatik dalam skala kesakitan (p=0.001). daya ketahanan (p=0.046) dan kualiti hidup (p=0.000). Hasil keputusan MANCOVA menunjukkan terdapat perhubungan yang signifikan diantara kumpulan dengan masa bagi kesemua domain kualiti hidup terhadap keberkesanan senaman senaman *Thera-band.* Kajian ini juga menunjukan terdapat perbezaan signifikan di antara kumpulan akuatik dan kumpulan *Thera- band* terhadap kesemua domain kualiti hidup (kesakitan, gejala, sukan / rekreasi dan kualiti hidup berkaitan penggunaan lutut). Kesimpulannya, senaman akuatik dan *Thera-band* boleh dijalankan sebagai latihan alternatif bagi mengurangkan inetnsiti kesakitan, daya tahan dan kualiti hidup dikalangan pesakit obes yang mempunyai masalah sakit lutut.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

6MWT	6 Minutes' Walk Test
AAOS	American Academy of Orthopaedic Surgeon
ACI	Autologous Chondrocyte Implantation
ADL	Active Daily of Living
APTA	American Physical Therapy Association
AqE	Aquatic Exercise
AQG	AE Group
ASU	Avocado soy unsaponifiable
BMI	Body Mass Index
CI	Confidence Interval
COPCORD	Community Orientated Programme for Control of Rheumatic Diseases
COX-2	Cycho-Oxygenase2
CRP	C-reactive protein
GAG	Glycosaminoglycans
HA	Hyaluronic Acid
IA	Intra-Articular
ICF	International Classification of Functioning, Disability and Health
IL-1B1	Interleukin -1
IL-6	Interleukin – 6
KOA	Knee Osteoarthritis
KOOS	Knee Injury and Osteoarthritis Score
MOS	Medical Outcomes Study

NHMS 111	Malaysian Third National Health and Morbidity Survey
NNT	Umber needed to treat
NSAIDs	Non-Steroidal Anti-Inflammatory Drugs
OA	Osteoarthritis
PNF	Proprioceptive Neuromuscular Facilitation
PRP	Platelet Rich Plasma
PT	Physiotherapy
QoL	Quality Of Life
RCT	Randomized Controlled Trial
TbE	Thera-band Exercise
TbG	Thera-band Group
TNF	Tumour Necrosis Factor
TNF-a	Tumour Necrosis Factor Alpha
VAS	Visual Analogue Scale
WHO	World Health Organization

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

LIST OF APPENDIXES

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Knee osteoarthritis (KOA) is a 'wear and tear' disease and individuals with KOA often experience joint discomfort, swelling, tenderness, and stiffness which can lead to disability and negatively impact their quality of life (QoL) (Archanah, Shashikiran, Prashanth, & Chandrakanth, 2018). In addition, pain is main symptom of KOA and it is due to the knee joint rubbing together with only a thinned layer of cartilage left. Pain causes discomfort and affects an individual's functional mobility such as walking and ambulation and also their QoL with physical, psychological, social and environmental effects (Khuruakhorn & Chiwarakranon, 2021).

Osteoarthritis (OA) is a highly common Rheumatic Disorder that affected 303 million people globally in 2017 (Kloppenburg & Berendaum, 2020). It is a continuing

and degenerative joint disease and represents one of the main socioeconomic health-care burdens in the world. Ageing, strain, obesity, trauma, articular cartilage, joint deformities, and congenital joint abnormalities, resulting from many kinds of factors such as the degradation of damaged articular cartilage and bony edges in reactive hyperplasia (Fransen, Mcconnell, & Simic, 2015; Gu, Chen, Meng, & Ge, 2017). Knee joint is the most used joint in the body and 11th largest contributor to global disability, with ageing populations anticipated to reach up to fourth place by 2020 (Kulkarni, Karssiens, Kumar, Pandit, & Maturitas, 2016).

The Arthritis Foundation of Malaysia (AFM) stated that one in ten older people aged of 60 and above have KOA and The Community Orientated Programme for Control of Rheumatic Diseases (COPCORD) study on musculoskeletal pain noted that the knee is responsible for majority of all reported complaints of the joints, and on further examination more than half of those had KOA (Nik Mohd Hatta & Che Hasan, 2019).

Moreover, according to the World Health Organization (WHO), an estimate of 18 percent of women and 9.6 percent of men aged 60 and above present OA symptoms. It is also one of the most prevalent musculoskeletal disorders for patients who seek primary care (Kadir et al., 2018). Musculoskeletal disease, specifically OA, is the second leading cause of disability, and evidence of OA is increasing as the population ages and obesity cases persist. Dissatisfaction with QoL is one of the primary reasons people seek medical help for obesity (Kushner & Foster, 2000). Approximately 80% of people with OA will have movement impairments and 25% will be unable to perform their major daily activities (Kadir et al., 2018).

Furthermore, in most populations studied up to now, the prevalence of KOA is higher than hip OA, but this is more marked in Asian populations. It was also reported that the occurrence of KOA is the highest in Malaysia compared to other Asian countries (Veerapen, Wigley, & Valkenburg, 2007). Yet, there is still no exact number of patients with KOA in Malaysia recorded, however, the Community Orientated Programme for Control of Rheumatic Diseases (COPCORD) has reported 9.3% of Malaysian adults complained of knee pain with a sharp increase in pain rate to 23% among 55 years old and 39% in those over 65 years (Zakaria et al., 2009). Additionally, the prevalence of obesity and overweight are higher among women (30.3 percent), hence women are more likely to experience KOA compared to men (Masiero et al., 2018).

KOA is a common type of arthritis that causes significant social and health issues towards the elderly (Bennell et al., 2011). OA symptoms can negatively impact a patient's QoL and lead to psychiatric issues such as anxiety, depression, and despair among the elderly (Wan Awatif et al., 2019). In this study, an effort was made to examine the effect of the two methods of intervention treatments chosen for obese people with KOA.

1.2 Problem Statement

Osteoarthritis (OA) is a degenerative joint condition that has become one of the world's major socioeconomic healthcare burdens (Gu et al., 2017). People with KOA experience frequent pain, extreme joint discomfort, stiffness, and muscular weakness

that contribute to physical health impairments (Bliddal, Leeds, & Christensen, 2014; Fransen et al., 2011) and reduced physical activities (Roos & Arden, 2016). OA also has a multifactorial aetiology and obesity has been identified as one of the main factors (Hacken, Edwards, Rogers & Chinchilli, 2014). Obesity increases the stress on joints and the pain intensity in those living with KOA (Zdziarski, Wasser, & Vincent, 2015), leading to weight gain and weakened muscles.

OA sufferers are often unable to execute activities of daily living such as walking upstairs or standing from a seated position, and they may also be unable to complete the physical activities prescribed as part of the treatment plan for their OA disease. OA patients tend to walk at slower speeds than healthy subjects and patients with KOA have been shown to demonstrate both altered ground reaction forces and shorter stride lengths (Lee et al., 2020). The other problems faced by obesity patients are known as fall (Fjeldstad et al., 2008). Obese people with KOA will have difficulties while doing TbE (Liao et al., 2020). They are prone to fall during performing exercise, while in water will be much supported and less fear of fall during AqE due to water properties (Asar et al., 2020).

While there are various pharmacological and non-pharmacological treatment for KOA, physical and exercise therapy have been shown be the most effective way to reduce pain, improve muscular conditioning, balance, joint proprioceptive input, and boost functional capacity in KOA patients (Gremeaux et al., 2011; Jansen et al., 2011; Hall et al., 2020). Therefore, the current therapeutic management of KOA emphasizes non-pharmacological treatments like therapeutic exercises, physical therapy, strengthening muscle, and weight loss

(Farr, Miller, & Block, 2013; Wluka, Lombard, & Cicuttini, 2013). In addition, recent literature have found that the therapeutic exercise can also be performed in water-based condition to improve muscle strength, balance, weight loss, and QoL among people particularly those who are obese and have difficulty doing land-based exercises (Abadi, Sankaraval, Fariza, & Elumalai, 2019). Moreover, according to the gate control theory, the gentle flow of moving water can reduce the pain of the injured limb and prevents pain sensation from traveling to the central nervous system (Sufka & Price, 2002). In that, AqE due to the low-impact property of underwater fitness and the viscosity and resistance of water can be consider as an effective form of exercise (Bender et al., 2005)

Besides that, there are evidence that have said that Thera-band exercise (TbE) is a convenience type of gym training programme to increase muscular strength, mobility (Candace et al., 2017), as well as a self-management joint protection to improve knee pain and knee function among people who suffering from KOA (Dhar et al., 2015). Furthermore, TbE is a simple and inexpensive method to design and create a self-exercise programme similar to PNF pattern exercise with a user-friendly equipment to have a beneficial treatment for rehabilitation purpose (Barati et al., 2021), and it also improves chronic non-specific pain (Khan et al., 2014). TbE as a resistance exercise using elastic bands with four colours (colours' depending on resistance starting from low to high) can significantly improve the function of the lower extremity among females with mild to moderate knee pain (Chang et al., 2012).

However, TbE as a land-based exercise might add to the feeling of joint discomfort and increase the risk of falls among obese KOA patients who have knee

pain (Bennell et al., 2012; Candace et al., 2017). Meanwhile, aquatic therapy technique in a slow and coordinated manner may improve the stability in standing as well as the gait pattern and balance and prevent risk of falling (Pérez-de la Cruz et al., 2021). This is where water-based exercise as a rehabilitation modality can be reasonable, since immersion in warm water temperature also enhances blood circulation and reduces muscle spasm and joint contact stress (Lee & Kim, 2021). AqE or water-based exercise is accredited as a safe and effective approach in the management of KOA (Bartels et al., 2016). Moreover, in the past two decades, AqE has been identified as a non-weight bearing exercise with the unique physical properties of water such as temperature, buoyancy, viscosity as resistance forces and depth and hydrostatic pressure (Abadi et al., 2020).

However, despite contradictory findings between the effects of aquatic and land-based exercise on KOA improvement, to date, there have been only a few studies to assess the effects of various types of land-based and water-based exercise for management of KOA. Furthermore, it is unclear if AqE as non-bearing weight and higher viscosity and resistance or Thera-band as a resistance exercise are more effective on the pain intensity, endurance, and quality of life (QoL) in obese people with KOA. Since the reduction of pain and improvement of endurance are the key issue in improvement of health conditions among obese people with KOA, it is a need to discover if there is a greater effect of AqE compared to TbE on improvement pain intensity, endurance and QoL for obese people who suffering from KOA. In another words, this study aimed to investigate the effect of an eight-week AqE and TbE (two sessions weekly) on pain intensity, endurance and QoL among obese people with KOA. It hopes that the findings of research study will seek to serve as an eye-opener

for the obese KOA population as an effective therapeutic intervention program.

1.3 Significance of the Study

Knee osteoarthritis (KOA) is a substantial health burden to patients and places an economic burden on the healthcare system as it adds to more than 27 billion in annual healthcare costs, with expenditures related to total knee arthroplasty exceeding 11 billion annually (Malanga et al., 2020). To the best of our knowledge, studies on the cost-effectiveness of blended interventions for patients with KOA are still lacking (Kloek et al., 2018). To reduce KOA related pain and disability, exercise is an effective first-line intervention endorsed by professional organizations including the American Academy of Orthopaedic Surgeons, American College of Rheumatology, Osteoarthritis Research Society International, and the European League Against Rheumatism (Bove et al., 2018).

Physical rehabilitation interventions such as physiotherapy exercise, lower limb orthoses (knee braces), and integrated rehabilitation programmes can be cost-effective strategies for older adult patients with hip and/or KOA. Furthermore, the use of rehabilitation interventions reduces the need for joint replacement surgery and in some cases, it can prevent such procedures (Shahabi et al., 2021).

KOA symptoms include pain, loss of function, and joint stiffness, all of which can make daily activities difficult (Helminen et al., 2013). The primary goal of physiotherapy treatment for KOA is to reduce pain, improve physical

function, prevent disability, and improve QoL (Shamliyan et al., 2012). The increasing loss of cartilage, synovial inflammation, and modification of subchondral bone are all due to OA (Pan et al., 2012). Joint pain and stiffness are clinically related with growing functional limitation and a loss in life quality, according to the National Institute for Health and Care Excellence 2014.

Some research investigations have indicated the benefits of AqE for persons with hip and KOA (Bartels et al., 2014). Only land-based exercise demonstrated some improvement in pain and muscle strength compared to the control group in the studies by Lund et al (2008) and Wang et al (2011), but no clinical benefits were detected following AqE compared to the control group. Progressive AqE, on the other hand, was found to be an effective intervention programme to lower the severity of back pain and to improve caring, sitting, standing, sleeping, and employment abilities in obese low back pain women. (Abadi et al., 2019).

Resistance workouts with TB are used to restore muscle and joint function, as well as for muscle strength and conditioning. Elastic band exercises are convenient since they can be done anywhere, and despite being simple, it still produces similar results as other resistance exercises. The water exercise has been shown to be useful in treating different kinds of musculoskeletal pains, however, the use of the Thera-band in obese patients with KOA has yet to be established. To date, there has limited research comparing the effects of various types of exercise on KOA (Wang et al., 2011). There is also limited study that compares the effectiveness of both interventions in obese patients with KOA. Therefore, the

study's novelty is in looking at the greater effectiveness of two types of medium resistance exercise which is AqE and TbE. The study also have a structured program on managing obese people with KOA comparing with two different resistance exercise.

1.4 Research Objectives

The objectives of the study are as below:

1. To compare the effect of AqE and TbE on pain intensity among obese people with KOA.
2. To compare the effect of AqE and TbE on endurance among obese people with KOA.
3. To compare the effect of AqE and TbE on knee related quality of life among obese people with KOA.

1.5 Research Hypothesis

Ho1: There is no significant difference between the effect of AqE and TbE on pain intensity among obese people with KOA.

Ho1: There is no significant difference between the effect of AqE and TbE on endurance among obese people with KOA.

Ho1: There is no significant difference between the effect of AqE and TbE on quality of life among obese people with KOA.

1.6 Limitation

It is critical to recognise the limitations of a research work. The study's internal and external validity are frequently cited as limitations. Internal validity concerns with the study's rigour, whereas external validity refers to the findings' applicability to larger populations (Connelly et al., 2013). During this research study, there were a few limitations identified. For starters, it was beyond the researcher's skills; due to time constraints, each participant was treated for eight weeks. The intervention period should be extended to determine the effectiveness of each intervention.

Second, because pain is very subjective and cannot be assessed using standard equipment or technique, hence, this study relied on self-report measurements. Pain perception or pain intensity differs from person to person; therefore, people may describe pain levels based on their own beliefs and feelings which influences the findings of the investigation (Theofanidis & Fountouki, 2018). This limitation must be addressed and mentioned properly so that the findings and conclusion made at the end of this study are relevant.

Thirdly, this study was carried out during the ongoing COVID-19 pandemic, where extra protocol and medical disciplines were implemented by the government, this probably added stress during the intervention. To add on, mental health was not covered in this research study. Fourthly, even though the frequency and duration of exercise programmes were performed during the intervention protocol, the participants prescribed with TbE were advised to continue with it at home as a home

exercise programme. Since all participants were given a home exercise programme hand-out to perform the exercise at home at least three times per day, then the home exercise programme was not fully supervised hence can be considered as another limitation of this study.

1.7 Delimitation

Delimitation refers to when the researcher sets boundaries or limitations to the study so that the aim and objectives become possible to achieve. In this case, it can be argued that delimitations are in the researcher's control. It may be related to the study's theoretical background, objectives, research questions, variables under study, and study sample (Theofanidis & Fountouki, 2019).

For obese participants with KOA, PT treatment includes a variety of interventions. PTs also use alternative exercise methods or pain management methods such as circuit training, thermal modalities, and strengthening exercises using weights. The therapist selected the TbE training programme, which is classified as a land exercise programme. This is because several prior studies have shown that they are beneficial in relieving pain and reducing functional impairment for most illnesses. However, the effectiveness of both AqE and the TbE programme (as the resistance exercises) in pain reduction for obese participants with KOA was not compared. Hence, the reason why AqE and TbE were selected as a comparison to find out the effectiveness in reducing pain, enhancing endurance, and improving QoL in obese participants with KOA.

1.8 Operational Definition

The operational definitions (terms) of the study were obtained from electronic search engines on medical dictionaries and free journal searches.

1.8.1 Obesity

Obesity has been defined as abnormal condition of fat storage or excessive fat accumulation in human body that presents a risk to health. Obesity is measured by calculating the body mass index (BMI) from a person's weight (kg) and height (m). Body Mass Index (BMI) is a measure to estimate the appropriate weight and for diagnosing obesity. It involves dividing body weight in kilograms by height in square meters (Oxford English-Malay Dictionary, 2015). The obese people in this study were selected based on the Southeast Asia BMI class (BMI: 27.5 kg/m^2) (Yusuf et al., 2011; Yi, Stella, & Kwon, 2015).

1.8.2 Knee Osteoarthritis (KOA)

KOA is defined as degenerative joint disease and it is the most common rheumatic disease, affecting the articular cartilage and, as a result, the subchondral bone of the synovial joint, eventually leading to joint failure. People with symptomatic KOA have discomfort and difficulty with everyday functional tasks as the disease progresses (Fransen et al., 2015). In this study, the people

with KOA were clinically diagnosed with KOA grade II through a detailed radiography report which include medial tibiofemoral and patellofemoral joint space narrowing as well as subchondral new bone formation, occurrence of lateral subluxation of the tibia and osteophyte formation medially, loss of cartilage tissue, subchondral bone formation and marked osteophyte formation also occurs.

1.8.3 Aquatic Exercise (AqE)

AqE are exercises that are performed in the water. It is a very beneficial form of exercise especially for low pain tolerance people to obtain effective rehabilitation, the intrinsic qualities of water such as buoyancy, hydrostatic pressure, viscosity, fluid dynamics, and resistances makes the exercises easier (Chiquoine et al., 2018). In this study, the AqE was performed as a resistance and non-weight bearing exercise in a shallow hydrotherapy pool adjusting depth of water and with water temperature of 36ºC.

1.8.4 Thera-band exercise (TbE)

TbE is a versatile physical training instrument and is easy to use (Uchida, Nishida, Sampaio, Moritani, & Arai, 2016). Resistance bands are a great alternative to free weights and weight machines since they are simple to use, convenient, and portable. TbE can be used in the clinic, at home, and wherever else it's available. TbE exists in eight colour-coded levels of increasing

resistance, allowing the user to see their progress from one level to the next and develop as they get stronger. In this study, TbE was applied as resistance exercise via different levels of resistance based on the colour such as yellow, red, and green.

1.8.5 Knee Injury and Osteoarthritis Outcome Scores (KOOS)

The Knee Injury and Osteoarthritis Outcome Score (KOOS) was created as a follow-up to the WOMAC OA Index with the goal of assessing short and long-term symptoms and performance in people who have knee injury or OA. Pain, other symptoms, ADL, function in Sport and Recreation (Sport/Rec), and knee related QoL are the five subscales of the KOOS (Collins, Prinsen, & Christensen, 2016), which measured as QoL in this study.

1.8.6 Rehabilitation

The process of assisting a person who has lost or has impaired abilities due to a disease or accident in regaining maximal self-sufficiency to help with their functional and daily activities is known as rehabilitation (Patil, Nirmale, & Kore, 2020). In this study, AqE and TbE were considered as the rehabilitation methods of KOA, which can assist the patients in improvement of walking and resuming functional activities.

1.8.7 Endurance

The duration for which the muscles groups may perform work maximally is known as muscular endurance (Teeli et al., 2019). In this study, the six-minute walk test was done, and the results are used to measure the level of endurance among the participants.

1.8.8 Level of Disability

The term 'disability' is defined differently in different studies. It is described in this study as having difficulty in executing one or more daily tasks, such as walking across a room, bathing, eating, dressing, toileting, and transferring in and out of bed (Rafael et al., 2013). It also relates to the inability to do functional duties such as squatting, climbing stairs, and walking. In this study, the level of disability was measured using KOOS, and the changes were detected after an intervention.

1.8.9 Pain

Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage. The pain intensity and unpleasantness of graded noxious temperatures are measured using the 0 - 10

Visual Pain Analogue Scale (VAS) (Hawker et al., 2011). This is where pain is classified as either no pain (zero) or severe pain (ten) (Hawker et al., 2011).

1.8.10 Daily Physical Activity

Individuals' ability to be functional in any physical task related to activities of daily living with certain legitimate needs of balance, strength, and level of endurance is referred to as physical performance (Dunlop et al., 2011). It refers to the participants' capacity to complete daily functional tasks in terms of functional strength, balance, and endurance as measured by the KOOS questionnaire (sub-scale).

1.8.11 Quality of Life (QoL)

QoL is defined as a major topic influenced by a person's physical health, psychological state, amount of independence, social interactions, personal views, and relationship to important characteristics of their surroundings in a complicated way (Sol, Na, & Litoral, 2010). In this study QoL was considered as total of five sub-sections (pain, symptoms, ADL, function in sport and recreation, and knee related QoL), and measured via KOOS.

1.9 Summary

As highlighted in this chapter, KOA causes pain, stiffness, muscular weakness, and difficulty in walking which results in physical inactivity and increases the risk of obesity. Various approach has been recognised in treating obese person with KOA such as land exercise or water-based exercise to improve muscle strength and pain reduction as the effective factors in improving the QoL. However, while obesity is one of the causes of KOA, it can still be managed. Therefore, this study needs to be done to explore the unique and effect of AqE and TbE under resistance training on pain intensity, endurance, and QoL among obese people with KOA.