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Faculty of Health Sciences
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THE DEVELOPMENT OF A SYMPTOM-PREVENTION HAND THERAPY PROGRAMME FOR THUMB CARPOMETACARPAL JOINT OSTEOARTHRITIS

Submitted in fulfilment of the requirements for the degree
M. Occupational Therapy

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Co-supervisor: Ms Corrianne van Velze

DECLARATION

DECLARATION

I, Janette Erasmus, student number u98001745 hereby declare that:

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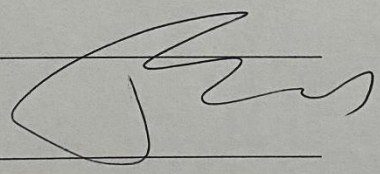

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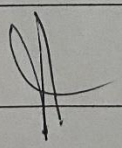

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ADRIAAN ERASMUS

XXXDATEXXX 15 October 2021

ETHICS STATEMENT

The author, Janette Erasmus, whose name appears on the title page of this dissertation, has obtained, for the research described in this work, the applicable research ethics approval.

The author declares that she has observed the ethical standards required in terms of the University of Pretoria's Code of ethics for researchers and the Policy guidelines for responsible research.

Ethics Number: 437/2020

DEDICATION

I dedicate this research to my children, Jané and Lisa. You make me want to be the best version of myself every day.

I hope that the content of this research and results from this and future research will also benefit you and your health when you're older.

ACKNOWLEDGEMENTS

Firstly, I must express my sincere gratitude to my primary supervisor Prof Kitty Uys and my co-supervisor Ms Corrianne van Velze for their constant support and guidance. Their patience and dedication throughout the process of my research was inspiring and helped me complete this project with so much joy and enthusiasm.

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Lastly, but very importantly, my work partner and friend Mary Jane. Her unfailing support, encouragement, sacrifices and friendship enabled me to have the time and opportunity to do this work and I will be forever grateful.

SYNOPSIS

Title: Developing a symptom prevention hand therapy programme for thumb carpometacarpal joint osteoarthritis

Candidate: Janette Erasmus

Supervisor: Prof. Kitty Uys

Co-supervisor: Ms. Corrianne van Velze

Degree: M Occupational therapy

Background: Thumb carpometacarpal joint (CMC-1) Osteoarthritis (OA) is a debilitating condition that causes pain and loss of hand function. Unfortunately, the global prevalence of this condition is significant, affecting 33-40% of women over the age of 50 years. Risk factors for the development of the condition are well known and at-risk individuals can be identified. Several conservative treatment techniques have been proven to reduce the symptoms successfully. However, the question arises – is it possible to delay/prevent CMC-1 OA symptom onset if at-risk individuals are taught strategies that could mitigate the risk factors before onset of symptoms? The problem identified by the researcher is that to date, no symptom prevention hand therapy programme (SPHTP) has been published.

Aim of study: To develop a SPHTP, aimed at delaying or preventing the onset of symptoms of CMC-1 OA.

Research objectives: 1) To gather expert opinions on what to include in a symptom-prevention hand therapy programme**;** 2) To develop a symptom-prevention hand therapy programme based on data from Objective 1 and current

literature**;** 3) To confirm the validity of the content of the newly developed symptom prevention programme using a Content Validity Index.

Design: A sequential two stage mixed methods QUALquan study.

Setting: Since this is a condition affecting the global community, remote contact with globally based hand therapists via online focus groups and email correspondence were used in both stages of the study.

Participants: International hand therapists who work with and/or have a special interest in the treatment of the thumb or arthritic hand conditions. Experts known for their interest in the OA thumb, based on prior publications and/or training on the subject, were consulted to assist in the development of content for a SPHTP. Stage 1: n=19; Stage 2: n=10

Methods: In this study, a two-stage approach was followed in the development of content for a SPHTP. In stage 1, the development stage, which was divided in two phases, a qualitative approach was employed. This was followed by a quantitative approach in stage 2, where the outcome of an empirical estimate of the content validity was pursued.

In stage 1, phase 1: Globally located hand therapists were recruited via the snowballing method and divided into two groups (n=10 and n=9) for online focus groups, based on times and dates that suited them. Online Focus groups (OFGs), were conducted in an asynchronous way, asking open ended questions, using the

University of Pretoria online interaction platform Blackboard™, to establish what participants would include in a SPHTP for CMC-1 OA. This took place in September 2020. Participants were able to log in and participate at times that suited them best during a 10-day period and were encouraged to return to the OFG multiple times and to also respond to comments made by other participants.

In stage 1, phase 2: Content for a new symptom-prevention- hand therapy programme (SPHTP) for CMC-1 OA was developed. Data from phase 1 were analysed using Braun and Clarke's six steps of thematic analysis and results were compared with current literature, to develop proposed content for a SPHTP

In stage 2: Twelve of the original nineteen participants in stage 1 were invited to continue participation in stage 2. 10 participants proceeded to take part in this stage. The completed proposed content for a SPHTP was sent to these participants in Word format via email. They were asked to rate each category and item for its relevance to achieve the goal of delaying or preventing symptom onset in CMC-1 OA on a 4-point Likert scale. All scores were returned within three weeks. Their scores were used to calculate the content validity index (CVI) of each item and the programme content as a whole. – The purpose was to establish the content validity index of the newly developed programme

Results: Data from online focus groups in stage 1 – phase 1, resulted in two main domains: education and exercises, each with five subthemes. In stage 1 – phase 2 these were compared to current literature and developed into content for a SPHTP consisting of 46 items in two domains (Education and Exercises) and seven categories: basic information; risk factors; what is dynamic stability of the thumb and

why this is important; how to improve dynamic stability; hand ergonomics; exercises and resources.

During stage 2, this proposed content was sent to specialist hand therapists, and they provided feedback and scores for each of the forty-six items based on the following 4-point Likert Scale:

1: Strongly agree 2: Agree 3: Disagree 4: Strongly disagree

Scores were collated and the item content validity index (Item CVI or i-CVI) for individual questions was calculated. This was defined as the proportion of raters (experts) that gave a response of Strongly agree as well as Agree. Items with an i-CVI larger than 0.75, were deemed valid and were accepted. Items with an i-CVI between 0.70-0.75 were reviewed and revised, and those below 0.70 were excluded. Comments by experts were considered during review and revision of each item to ensure that scoring was understood correctly. As a result, 7 items were either excluded or amalgamated with other items. The i-CVI scores of final items were then used to calculate the scale content validity index (s-CVI) for each category of items, as well as for the programme overall. The calculation was used to establish the average of the item-CVI scores.

Changes that were made following the Content Validity Index scoring in stage 2, resulted in an end product of 40 proposed items with a combined s-CVI of 0.937, indicating a high content validity of the developed SPHTP.

Conclusion: To date, there has not been a published SPHTP for CMC-1 OA and developing one was the first step to explore whether hand therapy intervention aimed at at-risk individuals before they become symptomatic, could prevent or delay symptom onset in the first place.

If a symptom prevention hand therapy programme proves successful, it will help at-risk individuals across the globe. In addition, when the programme is followed, it is likely to benefit the individual and the broader health community financially.

The developed content with high content validity index from this mixed methods study, provides a valuable tool to continue the search for a pathway where CMC-1 OA can be prevented or at the very least, delay the onset of symptoms.

Key Words: Osteoarthritis, Thumb carpometacarpal joint, Thumb CMC osteoarthritis, symptom prevention hand therapy programme, online focus group, content validity index

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LIST OF ABBREVIATIONS

Acronym	Meaning
AP	Adductor Pollicis Muscle
APB	Abductor Pollicis Brevis Muscle
APL	Abductor Pollicis Longus Muscle
CMC-1	Thumb or First Carpometacarpal joint
CVI	Content Validity Index
EPB	Extensor Pollicis Brevis Muscle
EULAR	European League against Rheumatism
FDI	First Dorsal Interosseus muscle
i-CVI	Individual item content validity index
IPJ	Interphalangeal joint
MCPJ	Metacarpal-phalangeal joint
OA	Osteoarthritis
OFG	Online Focus Group
s-CVI	Overall programme content validity index
SPHTP	Symptom Prevention Hand Therapy Programme
WHO	World Health Organisation

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CHAPTER 1: INTRODUCTION

1.1. BACKGROUND

Our thumbs are the most mobile and most important digit for function in our hands, contributing more than 50% to our hand function.[1] Osteoarthritis (OA) at the base of the thumb, specifically called first carpometacarpal joint (CMC-1) OA is a highly prevalent condition., The dominant symptom is pain at the base of the thumb that frequently influences the thumbs' mobility.[1] This often leads to increasing difficulty or eventually an inability to participate in activities of daily living involving hand function, such as turning taps or keys, using scissors, gardening, kitchen tasks, activities requiring sustained gripping, and many more.[2] The global prevalence is high, especially in women, affecting 33-40% of women over the age of 50years[1,3-4], making this a global problem with far reaching health and financial implications.[5]

Literature suggests causes and risk factors for the development of CMC-1 OA, but the exact etiology of this disease remains a mystery. We now know that it is more of a systemic disease and not just caused by wear and tear.[6] Despite these unknowns, literature does suggest a series of risk factors associated with an increased risk of developing the condition including genetics, aging, gender, high body mass index, ligament laxity (or hypermobility) causing thumb instability and bone impingement [1,6-7] – the latter being made worse by activities causing an increase in bone impingement. Taking these documented risk factors into consideration, it is possible to identify individuals who may be more at risk of developing the disease.

Conservative treatment has been proven successful in addressing pain and reduced function through a combination of treatment approaches, including joint protection education, correcting the thumb's alignment, correction of the abnormal movement patterns, improving dynamic stability of the thumb, neuromuscular control and strengthening correct muscles. [2,8-10] In some cases, pain improve significantly

enough that patients decide against proceeding with surgery.[11] The European League Against Rheumatism (EULAR), in their latest updated recommendations for the treatment of this condition, suggested that conservative treatment should always be used as an option prior to surgical solutions, regardless of the stage of the disease.[12]

Unfortunately, in the researchers' experience, individuals who suffer from this condition, are rarely seen prior to symptom onset and all conservative strategies are normally applied after individuals present in the health system with existing symptoms of pain with or without loss of function.

Due to the high prevalence of the disease globally and the far-reaching health and financial implications, prevention of OA has been identified as a research priority in Osteoarthritis research.[5,13] To date research on prevention strategies published in literature focusses on pharmacological intervention and nutrition in relation to lower limb OA[14-16] . The literature search performed by the researcher did not yield any results on addressing risk factors for CMC-1 OA in the non-symptomatic population. If the high prevalence of the disease, the proven success of conservative treatment and the knowledge available on identifiable risk factors are considered, the questions that originally arose were:

- Can a strategy be implemented where individuals at-risk have access to relevant hand therapy intervention before symptoms arise?
- Can this strategy prevent or delay symptom onset in the first place?

1.2. PROBLEM STATEMENT

To the best of my knowledge and following an in-depth review of literature in this field, it is believed that to date, there is no published symptom prevention hand therapy programme aimed to delay or prevent symptoms of CMC-1 OA. Before a prevention strategy involving hand-therapy intervention could be further explored, it was necessary to develop a symptom prevention hand therapy programme (SPHTP) first.

To our knowledge, no symptom prevention hand therapy programme (SPHTP) for CMC-1 OA has been published. To find out whether earlier hand therapy intervention, before symptom onset, can have a preventative/delaying effect on the

development of CMC-1 OA symptoms, a SPHTP had to be developed first. Research was required to develop content for a programme that had high content validity. Once a programme with high content validity has been developed, it could be used in future strategies aimed at delaying the onset of CMC-1 OA symptoms globally. This could have far-reaching economic implications.

1.3. RESEARCH QUESTION

What content should be included in a symptom-prevention hand therapy programme (SPHTP) to prevent or delay the onset of symptoms associated with degeneration in the thumb carpo-metacarpal joint (CMC-1) caused by Osteoarthritis (OA)?

1.4. AIM

To develop and confirm content validity of a symptom-prevention hand therapy programme (SPHTP) that will prevent and/or delay the onset of symptoms associated with degeneration in the thumb carpo-metacarpal joint (CMC-1) caused by Osteoarthritis.

1.5. OBJECTIVES

a) To gather expert opinions on what to include in a symptom-prevention hand therapy programme

b) To develop a symptom-prevention hand therapy programme based on data from Objective a) and current literature.

c) To confirm the content validity of the newly developed symptom prevention programme.

1.6. DEFINITION OF KEY TERMS / CONCEPTS

Prevention: Education or health promotion efforts which are designed to identify, reduce or prevent the onset of unhealthy conditions, risk factors, diseases or injuries.[17]

CMC-1: The first carpo-metacarpal joint (CMC-1), also known as the base of thumb joint or Trapeziometacarpal joint. It is referred to as the first CMC-1 because the thumb is known as the first digit of the hand and involves the base of the thumb metacarpal and the Trapezium.[1] (Bakri and Moran 2015)

Osteoarthritis (OA): A degenerative disease of synovial joints, involving various joint tissues including cartilage, underlying bone, synovium, and ligaments. The disease causes pain and stiffness which result in loss of function.[13]

Risk factors: Those variables which are associated with an increased risk of developing a disease or infection, in this case CMC-1 OA.[18]

Dynamic stability: Referring to a stable anatomic joint position and the ability to perform controlled isometric muscle contraction.[8]

Hypermobility: Also known as joint laxity where a joint is more mobile than what is expected of the comparative norm.[18]

"At risk" individuals: Those individuals in a general population who have risk factors.

Symptom Prevention Hand therapy Programme (SPHTP): A hand therapy intervention programme with content aimed to mitigate risk factors and prevent the symptoms of CMC-1 OA before they occur.

1.7. CONTEXT / SETTING

CMC-1 OA is a condition affecting the global community. Risk factors for the development of the disease are known and may be identified in individuals who do not yet have symptoms of CMC-1 OA. There are proven intervention strategies to treat the early symptoms of the disease and one may argue these inadvertently also addresses the original risk factors, but there is no published and validated symptom prevention programme for this condition. Therefore, a programme needs to be developed.

Since this is a condition affecting the global community, South African and international hand therapists who work with and/or have a special interest in the treatment of arthritic hand conditions, will be consulted to assist in the development of such a programme.

1.8. ASSUMPTIONS

Since this is a Mixed Methods study (QUALquan), philosophical assumptions are discussed:

Paradigmatic approach: A constructivism-interpretivism approach is followed in this study where the researcher will aim to develop/construct a new programme by interpreting and co-constructing participants' subjective experiences, and opinions of the content of the programme.[19]

Ontological assumptions: Meanings are constructed by human beings about their social world as they engage with this world [20] and their social reality is a product of their subjective experience[21]. The current reality is that OA is a global problem, affecting many people. The disease has a significant impact on direct and indirect healthcare costs, yet there is no existing programme to prevent or delay this impact. There are multiple realities, and each individual hand therapist experiences his/her realities in different ways. Constructing meaning from these multiple realities will be attempted.

Epistemological assumptions: Human beings make sense of their social world and construct meaning to their experiences based on their own historical and social perspectives and the setting they live in.[20] Developing a symptom prevention hand therapy programme will add knowledge to the global hand therapy community. Education of our clients by sharing this new knowledge, will form part of the prevention of symptoms.

Methodological assumptions: As a researcher, beginning with the individual hand therapists practicing in the field of interest, an attempt will be made to understand their interpretations and opinions. A further attempt will be made to co-construct and uncover deeper meaning of these interpretations, using amongst others, open-

ended questions. Sequential to this, the aim will be to assign an empirical value to the validity of the content of the new programme.

1.9. DELINEATION

The purpose of this study is to develop valid content for a SPHTP aimed at individuals who are at risk of developing CMC-1 OA, but who do not yet have diagnosed symptoms. Testing the newly developed programme in an appropriate population will not be included in this study. This study does also not include pharmacological and nutritional intervention for the treatment or prevention of OA, nor is the aim to treat patients with existing hand OA by means of this programme.

1.10. SIGNIFICANCE / CONTRIBUTION

There is no existing publication on a symptom-prevention hand therapy programme for CMC-1 OA. Prevention of OA is a relevant topic and an identified research priority internationally.[5] A programme developed to prevent or delay the onset of CMC-1 OA symptoms, will make a significant contribution to current knowledge on the subject and open the way for further research.

Furthermore, we know that OA in general is a debilitating condition affecting the global community. An estimated 250 million people are affected across the globe, it is further estimated to be the fourth leading cause of years lived with disability by 2020[5,13,22]. Hand OA is one of the top three arthritic conditions most likely to occur[6]. This suggests a substantial direct and indirect healthcare cost globally. With no prevention programme available and with increasingly aging populations, the cost to society is likely to increase. A programme that can successfully prevent symptom-onset of CMC-1 OA may have a significant savings effect on the healthcare cost normally associated with this condition.

1.11. OPERATIONAL FRAMEWORK

An inductive process of pattern theory will be followed with new theory, as in a newly developed symptom prevention hand therapy programme, as the end point. In the table below it is demonstrated how the work of Creswell[20] was used to structure the phases in the methodology of this study:

Table 1: Inductive process followed in pattern theory (adapted from Creswell Fig 3.5. p63)[20]

1. Researcher gathers information and literature
2. Researcher asks open-ended questions to participants (in online focus group)
3. Researcher analyses data to form themes or categories
4. Researcher looks for broad patterns, generalizations or theories from themes or categories (information from focus groups compared with literature and/or own experiences)
5. Researcher poses new theories from past experiences (Online focus group results) and literature as a new SPHTP
6. Researcher asks hand therapists to score the new programme to confirm content validity of the newly developed programme, using a content validity index.

1.12. OVERVIEW OF THE CHAPTERS

Chapter one describes an overview of the topic and background of this master's dissertation.

Chapter two discusses available literature on the subject, especially with regards to any available literature on prevention of CMC-1 OA symptoms, risk factors and current conservative treatment methods.

The first qualitative stage of the research is presented in Chapter three and covers the first two research objectives. This includes a description of research methodology followed, findings and discussion of results where the initial proposed content for a SPHTP were the outcome.

Chapter four describes/discusses the second stage of the QUALquan study where the content was sent to global experts for their review and scoring. Research methodology and findings will be discussed.

Chapter five includes a final summary and conclusions of the overall research study. This will include discussion of main findings, recommendations, study limitations as well as indications for future research.

1.13. CONCLUSION

In Chapter 1 we introduced why developing a symptom prevention programme for CMC-1 OA is important, the assumptions and framework that formed the basis of the study design.

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CHAPTER 2: LITERATURE REVIEW

2.1. INTRODUCTION

This chapter discusses detailed information from current literature on the functional importance, anatomy, and biomechanics of the thumb. Osteoarthritis is explained, including the etiology and risk factors of specifically thumb carpometacarpal joint osteoarthritis (CMC-1 OA). In addition, the most up to date research on conservative treatment strategies and published information on prevention of CMC-1 OA are discussed.

The researcher searched for literature using online databases including CINAHL, MEDLINE, WorldCAT, PUBMED etc, using the keywords: “Prevention of thumb osteoarthritis”; “Osteoarthritis”; “Thumb Carpometacarpal joint”; “Trapeziometacarpal joint”; “Osteoarthritis prevalence”; Osteoarthritis prevalence in South Africa”; “Osteoarthritis Prevention”; “Thumb stability”; “Thumb Dynamic Stability”; “Early intervention Thumb Osteoarthritis”; “Osteoarthritis risk factors”; “Thumb CMC osteoarthritis risk factors”; “online focus groups”; content validity index”; “modifiable risk factors” amongst others. The search period 2010 – 2021 was applied, but in some cases, the search period was excluded to include all previous publications, especially where limited or no literature could be found for the searched topic.

2.2. THUMB BIOMECHANICS AND ANATOMY

The hand has five metacarpals and each of these five metacarpals has a set of phalanges. A metacarpal bone with its associated phalanges is often referred to as a ray.[1] The thumb, also sometimes referred to as the first digit of the hand, consists of the first metacarpal bone and two associated phalanges, making up the thumb ray.

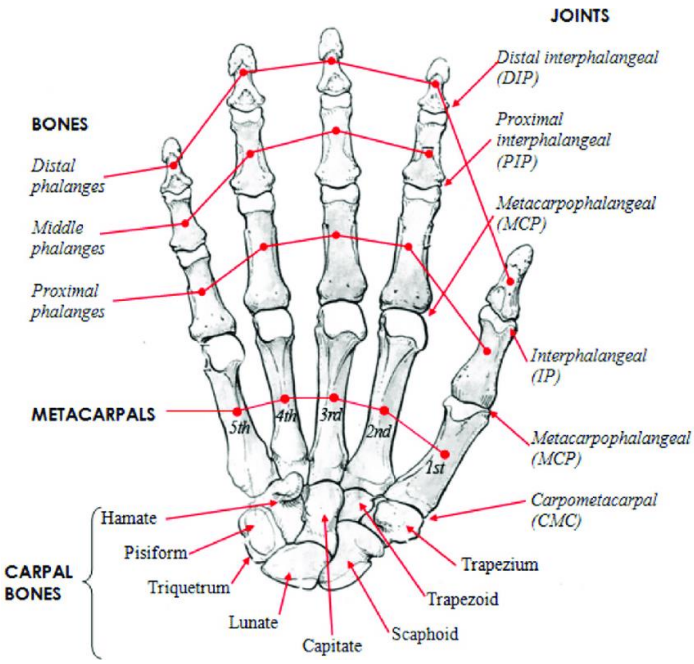

Fig 1: The bones and joints of the hand and wrist (from Nanayakkara et al Fig 2)[2]

At the base of the thumb the bottom of the first metacarpal bone forms a very special and interesting joint with the Trapezium which is one of the carpal bones. This joint is referred to as the first carpometacarpal joint (1-CMC) or the Trapeziometacarpal joint or the basal or base of thumb joint[1,3-4] and are often referred to as the saddle joint because of its biconcavo-convex shape.[4]

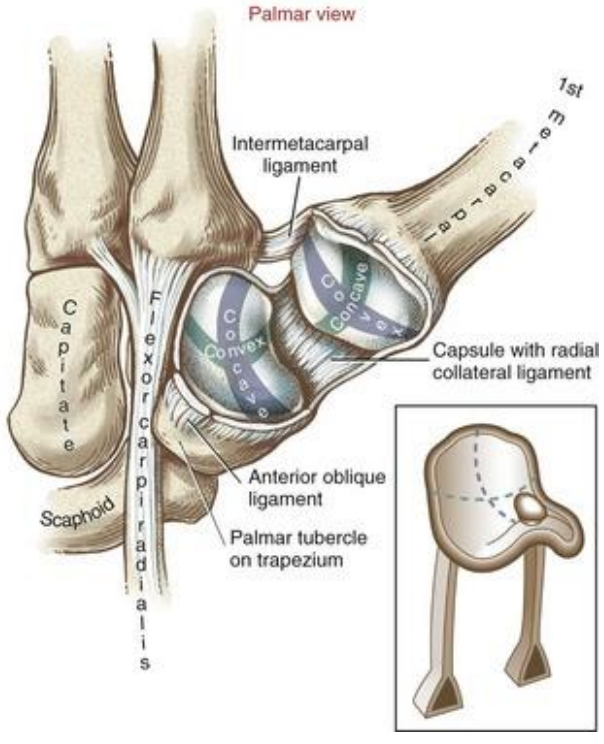

Fig 2: The base of thumb joint – the saddle joint (Neumann fig 8-15)[1]

The thumb is regarded as the most important and most mobile digit of the hand, accounting for more than 50% of overall hand function.[3] The reason for this is the unique biomechanics of this saddle joint that allows multiple movements on various planes, incl. flexion, extension, abduction, adduction and rotation of the metacarpal on the Trapezium, also known as circumduction or opposition.[3-4] Much like the shoulder, the joint at the base of the thumb has inherent osseous instability and relies heavily on soft tissue and neuromuscular support for stability and strength[5], sacrificing stability for mobility.[4] There are sixteen ligaments providing static ligamentous restraint[6] and ten muscles that motorise the thumb, innervated by three nerves.[7]

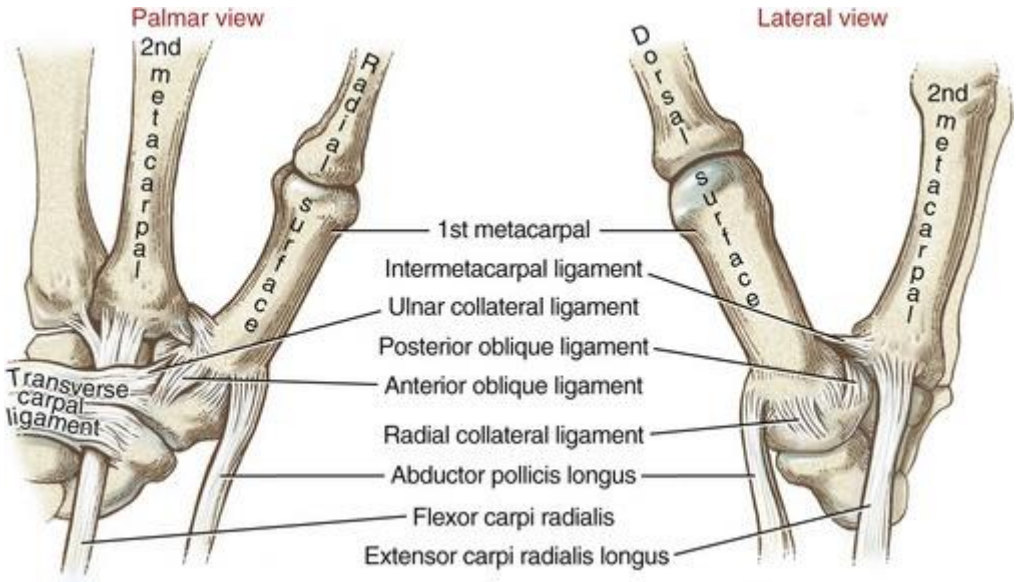

Fig 3: Palmar and lateral views of the most obvious ligaments of the carpometacarpal joint of the right thumb (Neumann fig 8-14)[1]

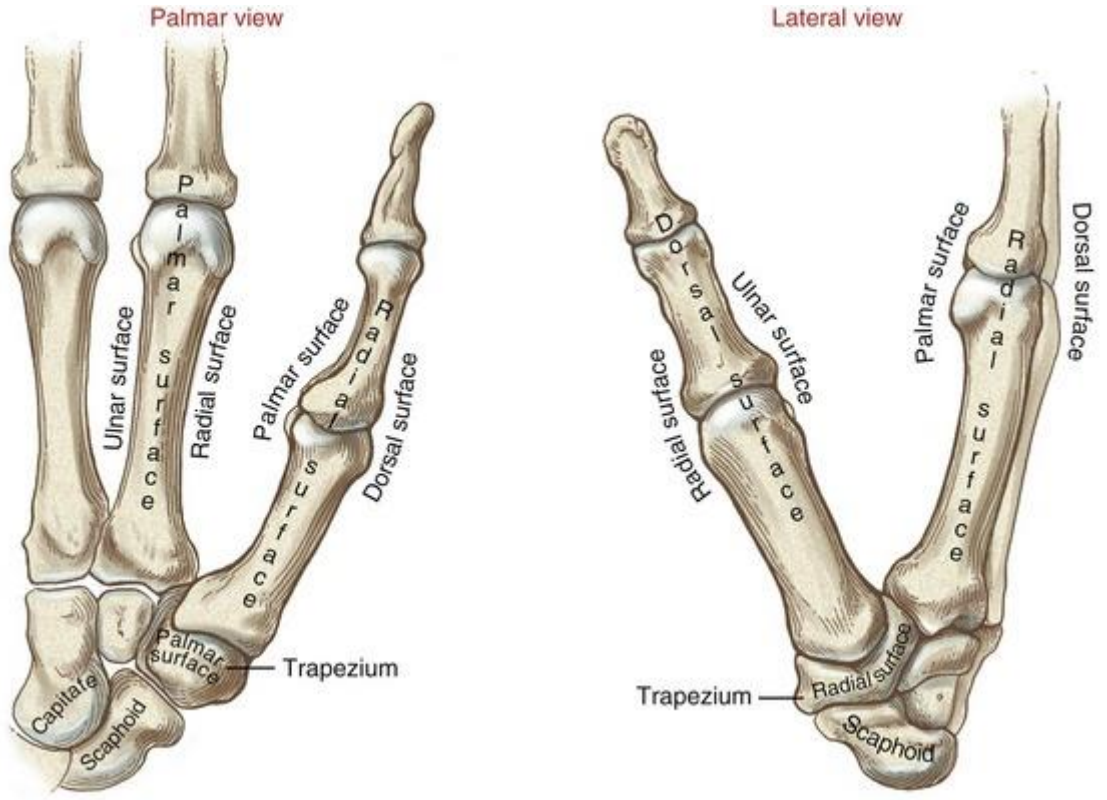

Fig 4: Palmar and lateral views of the right thumb indicating the bony surfaces and demonstrating the osseus instability (from Neumann fig 8.7)[1]

This articular configuration of the thumb base allows subluxation, specifically radial subluxation, unless the surrounding ligaments adequately stabilise the joint (see above Fig 3 and 4).[8-9] Cantilever forces at this joint can lead to progressive ineffectiveness of some of the most important ligaments, which causes the thumb metacarpal to migrate dorsally and proximally (subluxing) over time.[3] The distal portion of the metacarpal is then held in an adducted position, resulting in compensating hyperextension of the thumb metacarpal phalangeal joint (MCPJ) and potential flexion of the thumb IPJ.[3]

Fig 5: Radiographic evidence of thumb metacarpal adduction deformity and thumb MCPJ hyperextension deformity in a patient with stage 3 CMC-1 OA [3](fig 3 in Bakri and Moran 2015)

2.3. WHAT IS OSTEOARTHRITIS?

Osteoarthritis (OA) is the most common joint disorder globally, accounting for more disability amongst the elderly than any other condition,[3,10-12] typically diagnosed after 50 years of age.[13] It used to be described as primarily a passive degenerative disease of the synovial joints.[14] The primary pathogen was cited as “wear and tear” in areas of high mechanical stress and associated with aging.[14] More recently, it is recognised that OA rather is an active dynamic degeneration in the joint resulting from the imbalance between repair and destruction of several joint tissues[11-12] . It typically is an inflammatory disease of the synovial joints and there is increasing evidence that multiple phenotypes of the disease exist.[15]

Pain is the most dominant symptom of OA and is the key driver of health interventions.[13] Pain can be both intermittent and constant[11] and is often described as interfering with participation in activities of daily living.[3,9,11,16-17] This then becomes the main reason for patients to seek help.

The WHO estimated that by 2020, OA will be the fourth leading cause of 'years lived with disability' globally.[18] With a global aging population, it has been recognised that better ways need to be found to deal with the enormous individual and societal impact of the disease. Research priorities agreed upon and published following the 2017 Australian OA summit include prevention of OA.[12-13]

2.4. THUMB CARPOMETACARPAL JOINT OSTEOARTHRITIS (CMC-1 OA)

2.4.1. CMC-1 OA

Thumb carpometacarpal joint (CMC-1) Osteoarthritis (OA) is a condition that causes pain and reduced hand function, sometimes to such a degree that it results in a complete inability to participate in activities of daily living where hand function is required.[3] Pain is the dominant symptom and often results from tasks such as writing, opening jars, activities requiring sustained gripping, kitchen tasks, gardening, turning taps and others.[17]

CMC-1 OA involves the joint between the base of the thumb metacarpal bone and the Trapezium bone in the distal carpal row in the wrist. It is a common disorder which typically presents between the ages of 50-70 years[3] and affects women more than men.[3,19] Pain, at the base of the thumb and the consequent functional limitations lead to a high degree of disability in these patients.[20] The pain frequently interferes with the ability to perform various activities of daily living, including writing, turning taps, turning a key, opening jars, gardening, cooking and driving.[21]

2.4.2. Prevalence

It is generally agreed that there is a high prevalence of CMC-1 OA associated with aging, which affects more women than men.[16] The radiographic prevalence of CMC-1 OA among women over the age of 50 years is between 33-40%[8,22].
A recent large USA study found that the lifetime risk to develop hand OA by the age of 85 years is 1:2 for women and 1:4 for men.[16] Although this does not exclusively indicate base of thumb OA, we know that the base of the thumb is the most affected joint by OA in the hand[8] and therefore can agree the prevalence and incidence of CMC-1 OA is significant. To our knowledge, no literature or data on specific prevalence of CMC-1 OA in South Africa is available. However, a 2015 systematic

review indicated that in South Africa, osteoarthritis was the most prevalent form of arthritis with a prevalence of 55.1% in urban settings whilst in rural settings prevalence is between 29.5% and 82.7% in adults over 65yrs.[23]

2.5. RISK FACTORS

There are three theories regarding the etiology of CMC-1 OA. These include ligamentous laxity; joint compression and lack of neuromuscular control.[20] Ligament laxity and joint compression (or bone impingement) have been highlighted in more than one study as instigators of progressive degeneration at the CMC joint.[20,24] This is likely due to the fact that these often causes radial subluxation, which is another known risk factor.[19]

Aging remains the main evidential risk factor, mostly because of the cumulative effect of several other factors over time [12] with the female gender being the other well-known risk factor.[19] Lately more literature refers to evidence suggesting that increased body mass index have also been proven as a risk factor in the development of CMC-1 OA.[19,25-26]

Reflecting on the definition of OA as the degeneration that occurs in multiple joint tissues due to the imbalance between destruction and repair, [11-12] it is obvious that the etiology theories focus on the specific issues that contribute to and increase the pace of destruction of tissues. When each theory is investigated further, one can identify more detailed risk factors, other than female gender and aging, for the development of CMC-1 OA. These include: overall joint hypermobility[27], thumb hypermobility[8,28-29], weakness of thenar muscles[16,29], occupations requiring repetitive workloads or repetitive thumb movements[29-31], occupations exposing the thumb to greater than normal forces[28-31], inadequate interphalangeal joint (IPJ) extension combined with excessive mobility or hyperextension at the MCPJ [28,32-33], hyperextension at the IPJ[31], weak pinch grips and specifically weak first dorsal interossei (FDI) muscles.[34-35] Subluxation[8-9] and general instability of the thumb joints (identified by the inability to hold the thumb stable during pinch or other tasks), are also seen as risk factors.[29,33]

The fact that these risk factors are known means that it should be possible to identify individuals who will be more at risk of developing CMC-1 OA.

2.6. TREATMENT OF CMC-1 OA

Conservative treatment focuses on alleviating pain and helping patients to regain function by means of a combination of patient education, joint protection advice, activity modification, use of assistive devices, strengthening, range of motion and stabilising exercises, manual therapy and splinting or orthotics.[36-37] Several studies have indicated that radial nerve mobilisation may be successful.[38-39] More recently, there has been a call to introduce treatment of central sensitization in the treatment of chronic pain for this condition.[40]

Education on the disease and contributing factors is essential to help patients understand the need for activity modification and/or the use of assistive devices in order to regain function.[17] Several studies confirm the success of conservative treatment to address the main symptoms, namely pain and reduced function, by using different variations of exercise programmes with and without splinting.[3,5,20,24,37,41-48] However, there is not consensus on the exact exercises to include in a programme[44]. Most of the recent studies recommend the inclusion of exercises that target "dynamic stability".[5,20,34,45] The core principles of these are a stable anatomic joint position and controlled isometric muscle contraction.[24] Addressing the neuromuscular control and specific pain mechanisms are also recommended.[11,40] Several authors target the First Dorsal Interossei (FDI) muscle in particular, as a primary stabilising muscle.[5,24,34,49] A recent study suggests greater effectiveness in reducing pain when exercise therapy is combined with an orthosis or splint.[45]

The reality is that evidence exist to prove that conservative, non-surgical, non-pharmacological treatment of CMC-1 OA is successful, and this was confirmed when the European League against Rheumatism (EULAR) recently published updated recommendations for the treatment of hand OA, including CMC-1 OA. They advise to always start with conservative treatment, irrespective of the stage of

the disease and for surgical intervention to follow only if other modalities have failed to sufficiently relieve pain.[36]

2.7. PREVENTION

2.7.1. What is prevention?

Prevention, according to the Occupational Therapy Practice Framework, includes education or health promotion attempts which are devised to identify, reduce or prevent the onset and the incidence of unhealthy conditions, risk factors, diseases or injuries.[50]

2.7.2. Prevention of Osteoarthritis – research so far

A few studies have been done on the prevention of OA in general, but thus far, these have focussed mainly on lower limb OA, specifically knee and hip OA. Suggested preventative strategies focus on nutrition, pharmacological input, supplements and targeting the inflammatory pathways. Elements of education, joint protection and weight loss advice are also included.[51-56]

With regards to CMC-1 OA, no literature was found on hand therapy interventions aimed at preventing symptom development of CMC-1 OA in the general population. The prevalence of this condition under Physiotherapists has been investigated in several countries[28-29,31] and the need for prevention in this population, including some proposed prevention strategies, have been documented by a few authors.[28,57] None of these studies are recent, nor do they sufficiently address prevention in the wider general population.

2.7.3. Can CMC-1 OA be prevented?

Whether CMC-1 OA can be prevented and what to include in a prevention programme still needs to be determined. One can assume that the nutritional and pharmacological preventative strategies recommended for knee OA[52,55] could apply to hand OA too. However, the specific biomechanics that apply to CMC-1 OA is different from any other joint.

In searching to identify risk factors of injury or osteoarthritis - in relation to prevention, it is important to clarify which risk factors are modifiable and which ones are non-modifiable[54,58]. This is true also for CMC-1 OA.

Countering the impact of the known modifiable risk factors to CMC-1 OA, such as hypermobility and instability, forms the cornerstone of proven successful conservative hand therapy intervention strategies[5,20,24] for individuals with diagnosed CMC-1 OA. It is therefore reasonable to argue that if individuals who exhibits modifiable risk factors, but without symptoms or a diagnosis of CMC-1 OA, are introduced to a symptom prevention hand therapy programme that targets the countering of risk factors BEFORE symptom onset, symptoms may in fact be delayed or prevented.

The first step to test the above argument, is to develop a trustworthy symptom prevention hand therapy programme.

2.8. CONCLUSION

In this chapter we looked at what current literature says about the unique biomechanics and anatomy of the thumb in order to understand how these may affect the specific risk factors of developing CMC-1 OA. We reviewed the recent literature with regards to documented risk factors for the development of osteoarthritis and the known proven conservative strategies to mitigate these risk factors and successfully treat the dominant symptoms of pain and functional loss of the disease. Lastly, we also investigated and reported on the absence of literature on hand therapy prevention strategies for CMC-1 OA to demonstrate the importance of our research study in starting the journey to develop a hand therapy symptom prevention strategy for CMC-1 OA.

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CHAPTER 3: RESEARCH STUDY STAGE 1 - PAPER 1

(In preparation for submission to Journal of Hand therapy)

Full title of manuscript: Developing content for a hand therapy programme to prevent the symptoms of thumb carpometacarpal joint osteoarthritis

Short title: CMC-1 OA Symptom prevention hand therapy programme

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3.1. ABSTRACT

Introduction:

Patients suffering from thumb carpometacarpal joint osteoarthritis (CMC-1 OA) often present with pain and loss of function, but rarely present for treatment before symptoms start. Early conservative intervention for CMC-1 OA significantly improves symptoms and may mitigate the need for surgery. It is currently unclear if treating CMC-1 OA before the onset of symptoms will delay or prevent the progression of symptoms. To explore the value of pre-symptomatic intervention, the authors had to develop a symptom prevention hand therapy programme (SPHTP) because there is currently no published SPHTP.

Methods:

To develop a SPHTP, we conducted a two-stage, mixed methods QUALquan study. The first stage is presented here. Asynchronous online focus groups were held with purposively selected international experts to establish what content should be included in a SPHTP. Transcripts of the interviews were thematically analysed, and results were compared to literature review results to develop proposed content for a SPHTP.

Results:

Two main domains emerged from the data: education and exercise, each with five subthemes. These themes were integrated with literature review results and developed into content for a SPHTP consisting of 45 items in two domains, Education and Exercise. The SPHTP had seven proposed categories: basic information; risk factors; what is dynamic stability of the thumb and why it is important, how to improve dynamic stability; hand ergonomics; exercises; and resources.

Discussion:

Using expert knowledge, the content for a SPHTP were developed. Experts agreed that a SPTHP should contain two parts, namely an education and an exercise part.
Keywords: Thumb Carpometacarpal joint; Osteoarthritis; Prevention; CMC joint, online focus groups

3.2. INTRODUCTION

Thumb carpometacarpal joint (CMC-1) osteoarthritis (OA) is a common condition that causes pain and reduces hand function, often leading to difficulty in everyday tasks such as writing, opening taps, turning keys and activities requiring sustained gripping.[1-2] CMC-1 OA mostly presents between the ages of 50 -70 years[1] when individuals start seeking treatment to ease the pain. The causes, aggravating factors and risk factors for developing this disease have been reported,[3-7] but there is still uncertainty surrounding who will develop CMC-1 OA. At best, it may be possible to identify people who may have a higher risk of developing CMC-1 OA and a preventative programme may help to prevent or delay the onset of symptoms.

For people presenting with symptoms, early intervention and conservative treatment have shown good long-term results.[8] Over the past decade, several studies have described rehabilitation programmes designed for treating CMC-1 OA. These protocols recognise the importance of dynamic stability of the thumb[9-10], targeting the correct stabilising muscles[9,11-13], education on hand ergonomics[14], neuromuscular control of the thumb[15-16], exercise therapy with and without the use of orthosis[9,17-18] and exploring radial nerve stimulation and treating central sensitization of pain.[19-20] Existing programmes target people who present at medical or rehabilitation facilities to treat their symptoms. There are no guidelines for “symptom prevention programmes” for CMC-1 OA, targeted at people with known risk factors but who do not yet experience any symptoms.

CMC-1 OA is thought to be caused amongst others by genetic and physiological factors.[3-4,21] Although a hand therapy programme is unlikely to prevent the expression of genetic or physiological factors, a prevention strategy targeting ‘at risk’ individuals may prevent the onset of symptoms. Before implementing and

testing a prevention strategy, the researchers needed to explore which aspects in current early treatment strategies could also be applied in prevention strategies to develop a symptom prevention hand therapy programme (SPHTP).

Developing treatment or rehabilitation guidelines is a complex process requiring input from multiple stakeholders. In this study, the authors used a sequential mixed methods QUALquan research approach to develop trustworthy content for an SPHTP. Online focus groups were held with purposefully selected global experts to explore their opinions on which content should be included in an SPHTP. Literature was also reviewed, and the researchers combined expert knowledge with current literature to develop potential content for an SPHTP. The aim of this paper is to report on the process followed and the findings of the qualitative stage of the larger mixed methods study.

3.3. METHODS

Content for a proposed SPHTP for CMC-1 OA was developed in two phases. During phase one, the researchers conducted asynchronous online focus groups (OFG) with hand therapists from across the world to establish what content should be included in a prevention programme. In phase two, data from the OFG's were analysed and incorporated with findings from current literature.

3.3.1. Sampling method and participant demographics:

Hand therapists (both occupational therapists and physiotherapists) from around the world were purposively selected using a snowballing method. All the participants are known for their special interest in thumb or arthritic hand conditions, either through publications or teachings on the topic at international courses and conferences. Participants who were actively working or teaching in the field of hand therapy and who had at least 5 years' experience in hand therapy were included.

Written informed consent was obtained from all participants. The study was approved by the institutional ethics review board in accordance with principles in the Declaration of Helsinki (Ethics number 437/2020).

Data was collected using online focus groups (OFGs) which allowed participants from across the world to participate asynchronously via discussion software. Participants were able to take part in the same conversation despite different timelines. Online focus groups allowed for greater participant diversity, participants could choose to remain anonymous, more time for reflection, the opportunity to return and clarify responses after adequate "thinking time" and the need for transcribing was eliminated.[22]

Due to the documented high "no show" rates during online focus groups,[22] the researchers contacted 40 potential participants and invited them to participate. Of the 40, 20 responded favourably, but only 19 proceeded to participate.

The total group (n=19) included physiotherapists (n=3) and occupational therapists (n=16). Nine participants had published on the topic and 84% (n=16) of participants had postgraduate qualifications in hand therapy ranging from Diplomas; American, European and Swiss Certification in Hand therapy; Master's degrees and PhDs. Most participants (52%) had more than ≥ 25 years of clinical experience in hand therapy. Fourteen percent of participants had between 15 and 20-years' experience; 29% pf participants had between 10- and 15-years' experience and 5% of participants had less than five years' experience. Participants were from around the world including South Africa, Australia, USA and Europe (incl. Great Britain, Netherlands, Norway, Spain, and Switzerland).

3.3.2. Phase 1: Online focus groups

Participants were divided into two groups to achieve the ideal sample size of ten to fifteen participants per group[22] and assigned a participant number (e.g. P10). The two focus groups (Group 1: n=10 and Group 2: n=9) were held in September 2020, two weeks apart. Participants were assigned to a group with the starting date of their choice depending on which time suited them best. Both groups were presented with the same pre-determined questions.

The focus groups were hosted on Blackboard Learn™. Each participant received unique login details and instructions to access the online secure platform. Participants responded to questions over a 10-day period. Five pre-determined open-ended questions were presented sequentially. These questions were determined based on domains normally included in hand therapy programmes for early intervention of CMC-1 OA. Questions included were:

- *With your knowledge about CMC-1 OA and from working with individuals affected by the condition - What do you think should be included in a programme that is aimed at preventing the onset of symptoms of this condition in individuals who do not yet have symptoms?*

- *Literature suggests that the risk factors for developing CMC-1 OA may include instability; general hypermobility; reduced mobility at the MPJ; or hyperextension at the MPJ combined with reduced or hypermobility at the IPJ.*
    - *Do you think symptom free individuals are aware of what the risk factors for developing CMC-1 OA are?*
    - *In your opinion, how can we make them more aware of the risk factors?*
    - *What are the signs that individuals should be made aware of?*

- *Would you include exercises such as strengthening or stabilising or dynamic stabilising exercises in a SPHTP (Symptom Prevention Hand Therapy Programme)?*

If yes, please list which ones in your opinion should be included and your suggested frequency for these exercises?

- *Would you include joint protection principles in a Symptom Prevention Hand Therapy Programme? If yes, which ones would you include?*

- *How can non-symptomatic, at-risk individuals be motivated to incorporate recommendations from a SPHTP in their daily lives?*

The researcher only prompted when answers were vague or to explore the concept further. Participants were encouraged to comment on other participants' responses.

3.3.3. Phase 2: Programme content development

The researcher thematically analysed data from the OFGs using Braun and Clarke's six steps of thematic analysis[23]: 1) reading through transcripts repeatedly until familiar with the data; 2) generate initial codes; 3) sort codes into themes and subthemes; 4) the research team discusses initial themes and subthemes, which are then reviewed and refined; 5) label themes and subthemes in relation to the study question; 6) report the findings in narrative descriptions supported by direct quotes. Following this process, main themes were further categorised and grouped into two sections called "domains" which the authors felt was a more user-friendly word when used in the format of a programme.

Subsequently, the findings from the OFGs were then compared and mapped to current literature[24]. The researcher searched for literature using online databases including CINAHL, MEDLINE, WorldCAT, PUBMED etc, using the keywords: "Prevention of thumb osteoarthritis"; "Osteoarthritis"; "Thumb Carpometacarpal joint"; "Trapeziometacarpal joint"; "Osteoarthritis Prevention"; "Thumb stability"; "Thumb Dynamic Stability"; "Early intervention Thumb Osteoarthritis"; "Osteoarthritis risk factors"; "Thumb CMC osteoarthritis risk factors" amongst others.

The researchers found several studies on osteoarthritis at the base of the thumb, early intervention of thumb carpometacarpal joint osteoarthritis, dynamic stability of the thumb and risk factors of osteoarthritis.

3.4. FINDINGS

3.4.1. Phase 1: Online focus groups

Two domains emerged from the OFG data regarding which content to include in a SPHTP, namely education and exercise. Table 1 and 2 below are the outcomes of Braun and Clarke's six steps and aim to explain the findings of the thematic analysis, naming themes and subthemes that emerged from the data, supported by quotations from participants.

Domain 1: Education

Participants emphasized the inclusion of educational content in the SPTHP. This domain had five primary themes ranging from education on the nature of the disease, how it progresses, the signs and risk factors, the importance of stability in the thumb, joint protection and where to find help. Table 1 below captures this domain with themes and sub themes, which are supported by participants' comments.

Table 3.1.: Participants' opinions on the educational content (Domain 1) that should be included in an SPHTP for CMC-1 OA.

Domain	Theme	Subtheme	Quotation
Education	General information	Thumb anatomy	Understand the saddle joint and the pros and cons of such a mobile yet vulnerable joint. **P17**
		CMC-1 OA – what is it?	I think the most important with patients not presenting with symptoms is education... and can include signs and symptoms of OA… **P14**

			Teach them about diagnosis and prognosis, medication, and surgery. **P18**
		Pathomechanics (including correct thumb posture and force systems)	The program should give the participants time to see a thumb in the "wrong" and "right" position. **P10** Forces are multiplied from the tip to the base of the thumb and can lead to degradation of the joint, pain and disability. **P13**
	Risk factors	Family history of hand OA	Literature only suggests risk factors, but we really don't know the risk factors. **P13** The only well-known risk factor is genetics. **P18**
		Age 40+	Family history, along with age 40+ may still be the simplest way to signpost people **P5**
		Overuse and misuse of thumb	Tasks or jobs requiring significant load on the thumb and repetitive tasks. **P4**
		General hypermobility	
		Instability of the thumb	An inability to maintain alignment of joints of the first ray when loaded. **P11** Forced hyperextension of the |MCPJ with pinch. **P3**
		Thenar weakness	Weakness may predispose to symptomatic CMCJOA--- having read references that refer to this being the reason why the non-dominant hand is the symptomatic one often. **P5**
		Compromised sensory branch of the radial nerve	New emerging evidence suggests compromised sensory branch of the radial nerve… **P13**
	Signs	Thumb pain (with or without pinch)	Most signs are accompanied by pain usually. **P11**
		Collapse of the thumb ray during pinch	Many people with hyperextension of the MCP joint are unaware that this is problematic, they also cannot voluntarily not hyperextend the MCP joint without some assistance and coaching. **P3**
		Weakness when pinching or grasping	Difficulty opening jars or packages. **P12**
		Tension in the web space	Participants listed the following signs

		Oedema around base of thumb	
		Enlarged bony appearance at base of thumb	
		Reduced ROM in thumb	
	Dynamic stability – what it is and how to maintain it	What is dynamic stability	We can assume all thumbs can learn to be more stable, especially if taught before pain starts **P13** Continuing to use the thumb in the most optimal way to maintain stability may reduce the onset of thumb pain. **P13**
		Maintain the width of the first web space	Evidence has shown that if we: - maintain the width of the 1st webspace - use the right muscles of the thumb to stabilize the thumb appropriately - learn to use the thumb in an arched position when in opposition or lateral pinch to promote the optimal position of the CMC joint and - not allow the MCP to collapse when pinching all have a part to maintain stability for this most mobile joint. **P13** exercises for the general public for thumb stability will need to be accompanied by some visuals of the correct position. **P3**
		Use the correct muscles of the thumb to stabilize	
		Use thumb in an arched position	
		Do not allow metacarpal phalangeal joint to collapse when pinching	
	Joint protection principles or Hand ergonomics	Use your hands in everyday activities and do not stop using your hands	"It's all about ergonomics of movement. **P13** Basic principles are good to hear but focus on good grips - "O" and 5 finger pinch. **P10**
		Use larger joints	
		Use more joints	
		Respect pain and let it prompt you to act or stop	The earliest sign of pain should be paid attention to. **P13** Stop or find a different way to do the activity if it elicits pain/symptoms. **P2**
		Use tools	Use labour-saving gadgets when it is possible, for example electrical appliances or gadgets like a food processor or an electrical can opener **P14**
		Frequent breaks	Balance activity and rest **P8**

		Avoid tight gripping	Use objects with larger, built-up handles made from plastic or foam to reduce joint stress **P14**
	Resources	Local hand therapists and when to see them	Education… with signposts to other educ (Versus Arthritis) or when to re-present if symptoms appear. **P10**
		Websites	

Domain 2: Exercise

Participants identified a second domain, namely that content on exercise be included in an SPHTP, which was further divided into five primary themes. These included stretching the adductor pollicis (AP) muscle, strengthening, specifically the first dorsal interossei; opponens pollicis (OP); abductor pollicis brevis (APB); extensor pollicis brevis (EPB) and abductor pollicis longus (APL), maintaining range of motion, stability including motor control, activation of the correct muscles, proprioception and frequency. Most participants agreed that as hand therapists, we do not yet have an answer on dosage but made different suggestions.

Table 3.2.– Participants' opinions on the exercise (Domain 2) content that should be included in an SPHTP

Domain	Theme	Subthemes	Quotation
Exercises	Stretching	Stretch adductor pollicis (AP)	Release the adductor to keep the webspace wide and supple **P13** Stretch after repetitive adducted pinch grips in the way you would stretch when exercising e.g. running **P5**
	Strengthening	First dorsal interossei (FDI); opponens pollicis	Resist the Opponens in the Capital C position …and doing exercises for the FDI and OP as both work as a counterforce to maintain the metacarpal centred on the trapezium.

		(OP); Extensor pollicis brevis (EPB) Abductor pollicis brevis (APB) Abductor pollicis longus (APL)	**P13** Rather than exercises for the asymptomatic, I might teach the tennis ball trick as this can be left next to the TV and picked up and used regularly and easily. **P19**
	Stability	Motor control	"Stabilizing exercises aimed at preventing collapse of the MCP joint into hyper extension during pinch (30 attempts once a day) - this could be progressed to dynamic stabilization exercises once one is able to maintain appropriate biomechanics during a static pinch" **P8** Focus on motor control and stability **P10**
		Activation of all correct muscles	Perfect “O” exercise - Focus on motor control and stability. **P10** Making an O with the thumb and index finger and pinching, **P3** Use the “Capital C” position**. P13**
		Proprioception	in my experience, in initial stages, the cause of instability is usually a lack of thumb proprioception. **P20**
	Maintain range of motion		Maintain joint mobility in the thumb. **P18** Use hands in daily activities **P16**
	Frequency		not complex, or too lengthy, but an opportunity to focus on the thumb on a daily basis. **P17** We don't know the answer for dosage to improve or maintain the small muscles of the hand, but 2-3x/week and starting with 3 sets of 15-20 may be a good place to start **P13**

			They may be encouraged to do it as frequently as they work out other muscles 3 x a week for example **P12** Do once a day in association with a routine task done daily **P8**

3.4.2. Phase 2 – Developing programme content

Using expert opinion from OFGs and combining this with current literature, the researchers compiled 45 items as proposed content for the SPHTP (Table 3). The developed content is presented factually correct, but jargon free, because the eventual target population of a programme would most likely be non-medical people. Similarly, content was condensed to include essential information and exercises that could be completed in ten minutes.

3..4.2.1. Education

The largest part of the proposed content for the SPHTP focussed on creating awareness about CMC-1 OA among non-symptomatic 'at risk' people, what to look out for, how to continue to use their hands and thumbs in the most stable and effective way, and where to go for help if they struggle.

Basic information:

In agreement with the literature, participants felt that the SPHTP should include general information about CMC-1 OA as a highly mobile saddle joint, a basic explanation of osteoarthritis, and the signs and symptoms of CMC-1 OA.[1,25]

Risk factors:

Although there are known risk factors for developing CMC-1 OA, some people with apparent risk factors may not develop symptoms. The researchers carefully considered how to describe risk factors without scaring people, when sharing information. According to the literature, risk factors for developing CMC-1 OA

include age and genetics[1,4], high body mass index[1,6], ligament laxity[26] which we called general hypermobility; using the thumb in ways that causes increased bone impingement and dorsal-radial subluxation[5,27], instability[9,26] and muscle weakness.[28] Most literature suggests that patients often display symptoms from the age 50+.[1] Since this SPHTP targets people before the onset of symptoms, the researchers suggest that the SPHTP be made available for people aged 40 years and older. Gender was not included as a risk factor, despite CMC-1 OA being more common in women[29-30], because the participants did not mention gender during the OFGs.

Hand ergonomics

Education about how to safely use our hands, or joint protection principles, is a well-known and essential part of hand therapy for patients with CMC-1 OA. The European League against Rheumatism (EULAR) also recommends joint protection principles as a key component of treatment.[14] Specific joint protection principles that were mentioned by participants in the OFGs were included in the SPHTP. These include using larger joints, using more joints, respecting pain, using tools, taking frequent breaks and avoiding tight gripping during everyday activities.

Dynamic stability of the thumb

Dynamic stability of the thumb is the ability to use your thumb during various functional activities, without experiencing pain or causing one of the thumb joints to collapse, using the surrounding muscles in such a way that the saddle joint stays correctly aligned and thus limits the damage that may occur from instability at the base of the thumb. [11,16]

Participants frequently mentioned dynamic stability during the OFGs, which led to the inclusion of dynamic stability as a separate subtheme. Current literature also

supports the use of this approach for patients with CMC-1 OA.[16,31] Teaching people how to use their thumbs in a more stable way is the foundation of the exercise section of the SPHTP.

3.4.2.2.. Exercise

Over the past decade, there has been increasing evidence supporting the use of the dynamic stability approach and using dynamic stability exercises to treat pain and increase function.[9,11,16,31] O'Brien et al. [11] describe how the dynamic stability approach helps to restore the length of the AP and re-educate the OP, APB and the FDI muscles. In a prevention programme, this approach can be implemented to improve the overall stability of the thumb.

A hyper-mobile CMC-1 joint relies heavily on ligaments and muscles for stability because of the unique osseous anatomy where the articular joint surface sacrifices stability for mobility.[25] Bone impingement and ligament laxity are associated with CMC-1 joint instability which in turn instigates progressive degeneration.[16] Several studies have proven the importance of strengthening the FDI muscle in therapy, recognising the FDI as the primary stabilising muscle of the thumb.[9,13] Radiographical evidence shows that activating the FDI reduces subluxation of the CMC-1 joint.[9] Mobargha et al. [13] recommend against strengthening the APL specifically, as it may destabilize the thumb CMC joint. Both the current literature and OFG participants mentioned that some hand therapists still include strengthening the APL in treating patients with CMC-1 OA.[12,32]

In the SPHTP, the researchers limited the time spent on exercises to ten minutes at most. Based on the participants' feedback and current literature, five simple exercises were chosen. The FDI is the only muscle targeted for strengthening, however, other muscles will be activated through exercises, as described below:

Stretching of web space: Massage the muscle in your web space to release the tight muscle and maintain the squeeze for 10 seconds.

Activate the correct muscles with the ***Capital C exercise****:* Hold your hand in the shape of a Capital C and tighten the muscles in this position. Progress to working against an elastic band which is wrapped around all the fingers.

Activate the correct muscles and practice control with the ***Perfect O exercise****:* Press your thumb and index finger together in opposition to form a perfect O. Start to pinch them together. If your metacarpal phalangeal joint (MPJ) in your thumb collapses, stop and repeat. Press only until just before the joint starts to bend backwards. Continue to practice until your muscles can perform a firm tip pinch without the MPJ bending backwards.

Improving stability and practicing motor control with the ***Tennis ball tracing exercise***: Holding a tennis ball in your hand and using your thumb in an arched position, gently trace along the lines of the tennis ball in an outward direction, keeping the thumb in an arched position avoiding the collapse of any joint.

The proposed content for a SPHTP, including all the above information, integrated information that was acquired from the OFG and current literature. The content of the SPHTP is presented in Table 3 below, which will be used to determine the content validity index in a subsequent research phase, not reported on in this article.[24]

Table 3.3: Proposed content of an SPHTP to prevent pain and degeneration associated with CMC-1 OA

Domain	Content subheading
EDUCATION: Basic information	General information – what is a joint, what is arthritis and what happens when you start developing arthritis at the base of your thumb
	Saddle joint – anatomic position and function
	Thumb contribution to hand function
	Force systems impacting on the thumb
	Signs and symptoms of OA of CMC-1
EDUCATION: Risk Factors	Family history of hand arthritis
	Age 40+
	Incorrect use of thumb
	General hypermobility
	Instability of the thumb
	Thumb muscle weakness
EDUCATION: Thumb dynamic stability	The ability to use your thumb during various functional activities without experiencing pain or causing one of the thumb joints to bend completely backwards
EDUCATION: Improving dynamic stability of the thumb	Maintain width of the first web space
	Use the correct muscles of the thumb to stabilize
	Use the thumb in an arched position when gripping
	Do not allow your metacarpal phalangeal joint (middle joint) to collapse when pinching or gripping
EDUCATION: Hand ergonomics	
	Use your hands in everyday activities, but do it correctly
	Use larger joints
	Use more joints
	Respect pain
	Use tools
	Frequent breaks
	Avoid tight gripping
EXERCISES	Stretching the web space 1. Using your hand or a peg to squeeze and massage the Adductor pollicis
	Stability - Activation of all correct muscles 2. “Capital C” exercise
	Stability - Activation of all correct muscles 3. “Perfect O” exercise
	Strengthening

	4. First Dorsal interosseous muscle from a Capital C position start point
	Stability – Motor control 5. Tennis ball tracing exercise
	Frequency: 2-3 times per week, 3 sets of 20 repetitions of each exercise.
	Progression: Stop exercises when thumb feels stronger, but continue with hand ergonomic principles
EDUCATION Resources	- When to seek help - Where to find a local therapist - Websites with additional information

3.5. DISCUSSION

In this article, the authors describe the process of developing content for a programme to prevent the development of symptoms associated with CMC-1 OA. We engaged with international experts and reviewed current literature to develop content for a programme that addresses both education and exercise.

During the OFGs, participants raised the issue of engaging with at risk, non-symptomatic individuals. Despite the perceived challenges in engaging and motivating non-symptomatic patients, many participants agreed a preventative programme that will increase dynamic stability in the thumb, can have far-reaching benefits for potential patients whether they are at risk of developing CMC-1 OA or have a previous hand injury.

As hand therapists, when taking into consideration the thumb's inherent osseous instability[11] and the significant impact of pain on someone's decision to convert to surgery[8], we can assume all thumbs can learn to be more stable, especially if taught before pain starts. Multiple participants from various countries reported coming across more and more individuals who want to stay fit and who crave information

to help them prevent discomfort, disability, future surgery and helping them to carry on doing the things they enjoy. Possible financial benefits of this prevention programme to healthcare systems and the wider health economy were also mentioned by participants, validating what was suggested of prevention in literature.[33-34]

Developing content for an SPHTP is far from simple, especially when hand therapists have different opinions and various degrees of knowledge and practices when it comes to appropriate early intervention programmes for CMC-1 OA.[9,32,35-38] Participants had different opinions on which muscles to target during exercise and about the semantics of sharing information about risk factors. There were however common threads between suggested content from the OFG themes and the content of published early conservative intervention programmes, excluding the use of orthoses .[9,11,14,17-18] In this study, the researchers developed content and constructed a framework for an SPHTP, which has the potential to be developed into a programme that can be used to prevent symptom onset of CMC-1 OA. Although this content represents international knowledge and opinions, eventual programmes may have to be tailored to suit specific countries and cultures.

3.6. CONCLUSION:

This qualitative study with literature review identifies important content for an SPHTP aimed at preventing the onset of symptoms associated with CMC-1 OA. Hand therapists may be able to use this SPHTP as an educational tool for the family members of patients who are already being treated for pain associated with CMC-1 OA, since the condition seems to be genetic in nature. The proposed SPHTP focusses on education and exercises to maintain the dynamic stability of the thumb.

These exercises are simple and easy to perform and have the potential to prevent debilitating pain associated with CMC-1 OA.

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CHAPTER 4: RESEARCH STUDY STAGE 2 - PAPER 2

(In preparation for submission to SAGE Hand therapy Journal)

Establishing the content validity index of a symptom prevention hand therapy programme for thumb carpometacarpal joint osteoarthritis

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KU: study planning, manuscript, manuscript review and editing
TB: data analysis including statistical analysis, data interpretation, manuscript review

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The authors declare that there are no competing interests.

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4.1. ABSTRACT

Introduction

Thumb carpometacarpal joint (CMC-1) osteoarthritis (OA) causes debilitating pain for many patients. Preventing CMC-1 OA largely focusses on pharmacology and nutrition, with hand therapy receiving little attention. The authors recently developed a symptom prevention hand therapy programme (SPHTP) for CMC-1 OA. Stage 2 of the development process is presented here where we established the content validity index (CVI) of the proposed content of an SPHTP.

Methods

This mixed methods QUALquan study included hand therapists from around the world who are specialists in thumb or arthritic hand conditions. These participants were involved in developing the content of the SPHTP. Participants were asked to rate the relevance of the content of the proposed SPHTP for preventing or delaying symptoms of CMC-1 OA. These scores were used to calculate the i-CVI of each proposed item and the s-CVI of the overall programme.

Results

The initial s-CVI for the overall programme was very high (0.91). Despite this, some changes were made to the SPHTP based on comments and scores. The final SPHTP content included two domains (Education and Exercises) in seven categories, made up of 40 items with an s-CVI of 0.937 indicating excellent content validity.

Discussion

The authors quantitatively assessed the content validity of the proposed SPHTP. The proposed SPHTP has excellent content validity and may be a valuable tool for ongoing research in preventing or delaying CMC-1 OA symptoms.

Keywords*:* Thumb carpometacarpal joint; osteoarthritis; prevention; content validity index

4.2. INTRODUCTION

Thumb carpometacarpal joint (CMC-1) osteoarthritis (OA) is a common condition. A recent meta-analysis reported that women have a 30% higher chance of developing radiographic CMC-1 OA than men with the risk of developing the disease increasing by 6% every year for males and females.[1] Patients usually present to medical facilities from age 50 to seek help with pain and loss of function.[2] The World Health Organisation predicted that by 2020, OA would be the world's fourth leading cause of disability[3] with one in two women and one in four men at risk of developing symptomatic hand OA by the age of 85[4], with the base of thumb being the most affected joint.[5]

Considering an aging global population and the cost of treatment to the wider health economy, preventing osteoarthritis was suggested as one of the top three research priorities at the 2017 Australian OA summit.[6] Most prevention studies focus on targeting inflammatory pathways through pharmacological and dietary treatment[7-10], but few studies have addressed the role of hand therapy in preventing OA, particularly CMC-1 OA. Developing CMC-1 OA is associated with several risk factors,[1, 11-14] even though some people may not develop clinical symptoms. It may be possible to identify at-risk individuals using these known risk factors including family history, ligament laxity or hypermobility, having a high impact job leading to bone impingement and thumb weakness.

Unfortunately, most patients do not seek treatment until they present with symptoms. Like other joints affected with OA, patients and treating professionals readily accept that pain and disability are inevitable in aging and OA.[15] Is it possible to delay or prevent symptoms if at-risk people implement a hand therapy prevention programme?

To test if a symptom prevention hand therapy programme (SPHTP) would be effective, a validated SPTHP is needed. To our knowledge, there is no published, validated SPHTP for CMC-1 OA.

In hand therapy the content validity index methodology is most often used to establish the validity of assessment or screening tools and only sometimes for treatment programmes. [16-18] It has however been used in other fields to establish the CVI of treatment programmes [19, 20] and was deemed to be an appropriate tool for this study too. The authors recently developed content for an SPHTP in a qualitative stage of a larger mixed methods study.[21] This article reports on the second stage of the larger study where the aim was to establish the content validity of the proposed SPHTP and thus strengthening the recently developed programme with the additional scrutiny of a quantitative stage.

4.3. METHODS

Newman, Pineda [22] suggests that content validity is best established using a mixed methods approach. The authors used a two-stage sequential QUALquan mixed methods design to develop trustworthy content for an SPHTP and to establish content validity. Here we report on the process followed to establish content validity.

Following the development of content in 2020 [21], a quantitative approach was followed to establish content validity. The content was divided into two themes, seven categories and forty items. Experts in hand therapy were asked to grade each item using a four-point Likert scale. These scores were used to calculate the content validity index (CVI) of each proposed item as well as the CVI of the overall programme.

Sampling of participants

To develop content in the first phase of the study, the researchers used snowballing sampling to purposively select internationally located hand therapists (occupational and physiotherapists), known for their special interest in the thumb and arthritic conditions, because of their publications and/or teachings. From this group of participants, 12 hand therapists, who had actively participated in the online focus groups during the first stage of the study, were invited to continue with the second stage. Bias was addressed by the fact that there are a limited number of experts on this particular topic internationally and the researcher attempted to include everyone that was available and willing to participate. In addition, objective quantitative data were obtained during the first stage with data saturation reached before online focus groups were ended in stage one of the larger study.

The expert group (n=10) consisted of two physiotherapists and eight occupational therapists; five of whom had published on the topic of CMC-1 OA. All participants had postgraduate qualifications (n=3 PHDs; n=5 masters degrees; and n=2 CHTs). Eight participants had more than 25 years' experience and two had between 10 and 15 years of experience in hand therapy. Participants represented the global community and were practicing in Great Britain, Norway, South Africa, Switzerland and the USA.

All participants gave informed consent and the subsequent process was managed anonymously. This stage was approved as part of the larger study by the University of Pretoria, Faculty of Health Sciences Research Committee in accordance with principles in the Declaration of Helsinki (Ethics number 437/2020).

Content validity index calculation

The newly developed content of the SPHTP was sent to the expert group in the first quarter of 2021. Each expert received the proposed content in an editable Microsoft Word document via email with a detailed explanation of what was required of them. The document consisted of the proposed programme content and a scoring section. Scoring indicated the level to which the participants agreed with the **relevance** of each of item of the proposed programme to prevent/delay the onset of CMC-1 OA symptoms using the following 4-point Likert Scale: 1: Strongly agree, 2: Agree, 3: Disagree, 4: Strongly disagree. All data were returned within 3 weeks.

Scores were collated and the item content validity index (i-CVI) for individual questions was calculated. I-CVI was defined as the proportion of experts who responded “Strongly agree” and “Agree”. Items with an i-CVI larger than 0.75, indicated that 75% of the experts agreed and strongly agreed that the item was relevant. These items were deemed valid and were accepted. Items with an i-CVI between 0.70-0.90 were reviewed and revised, and those below 0.70 were excluded. Expert comments were considered during review and items were reviewed to ensure that scoring was understood correctly. Seven items were either excluded or amalgamated with other items.

The i-CVI scores of final items were then used to calculate the scale content validity index (s-CVI) for each category of items as well as for the whole SPHTP. s-CVI was calculated as the average of all the i-CVI scores. An s-CVI score of ≥ 0.75 was required for a set of questions to have excellent content validity[23] and this was set as the aim for this stage of the study.

4.4. RESULTS

The expert group (n=10) received the SPHTP content which comprised forty-seven (V1-V47) items grouped in seven categories. The feedback from the ten experts can be seen in Figure 1, which indicates the number of experts who scored the items as either strongly agree and agree, or disagree and strongly disagree. The 10 experts who reviewed the proposed content all provided detailed feedback and scoring as requested.

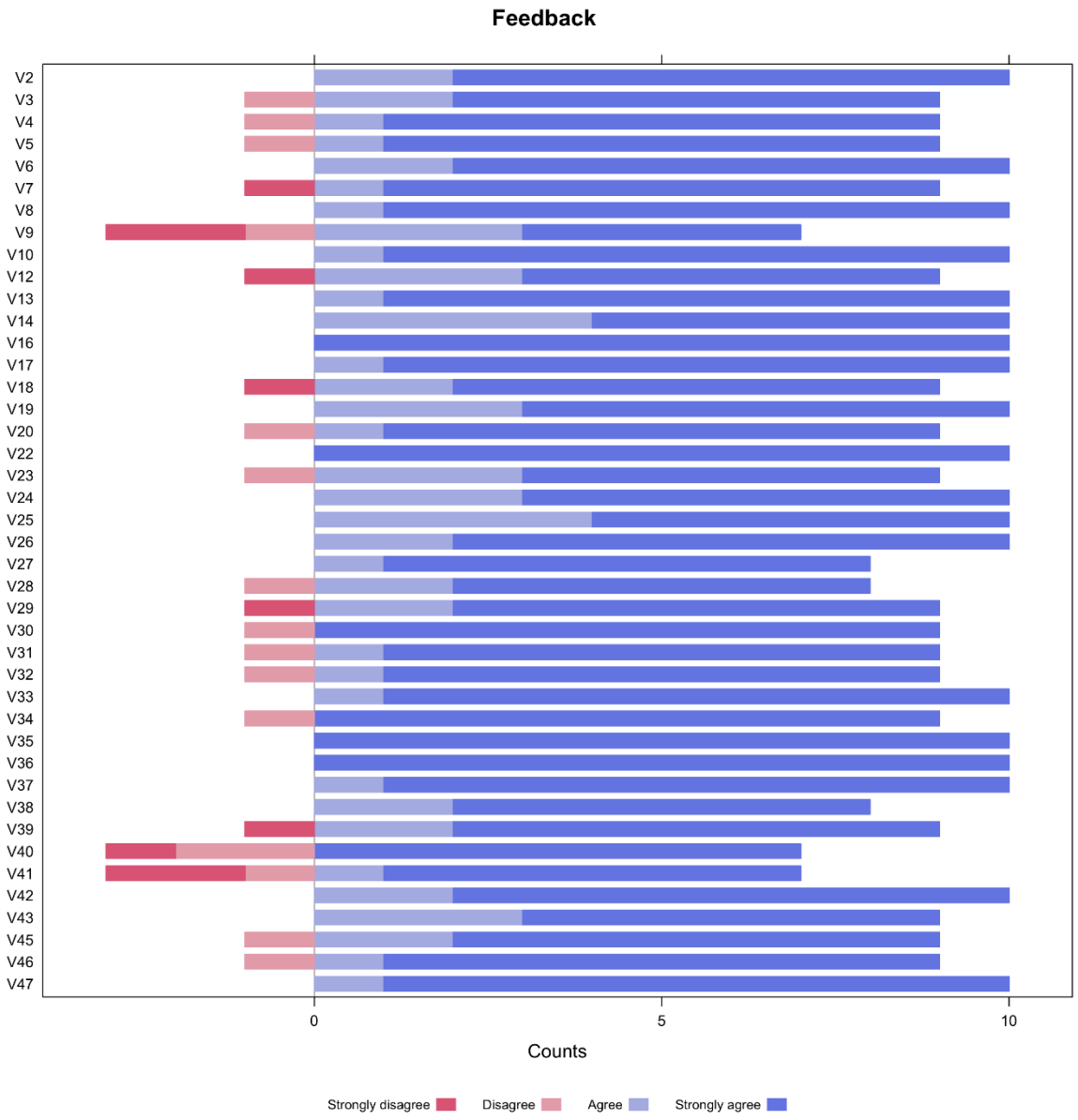

Figure 4.1 Reponses of expert hand therapists on the relevance of the 47 items included in the SPHTP for CMC-1 OA.

The authors excluded V1 and V15 because they were category headings rather than items needing to be scored. Initially, the overall s-CVI was 0.91, indicating an agreement of 91% suggesting excellent content validity index for the proposed content. This was before excluding low scoring items.

Table 4.1: Initial i-CVI for all items of proposed content of a SPHTP

	Domain	Subheading	Item-CVI results
V1	EDUCATION Basic information	General information	
V2		A joint is…	1
V3		When you start developing arthritis…	0.9
V4		Saddle joint	0.9
V5		Hand function	0.9
V6		Force systems	1
V7		Implication of force for a thumb with instability	0.9
		Signs and symptoms	
V8		Pain at base of thumb	1
V9		Thumb ray collapse with pinch	0.7
V10		Weakness with pinch or grasp	1
V11		Tension or tightness in web space	0.667
V12		Swelling at base of thumb	0.9
V13		Enlarged bony appearance	1
V14		Reduced ROM	1
V15	EDUCATION – How do I know if I am at risk?	Risk factors	
V16		Family history of hand arthritis	1
V17		Age 40+	1
V18		Incorrect use of thumb	0.9
V19		General hypermobility	1
V20		Instability of the thumb	0.9
V21		Example	0.667
V22		Thumb weakness	1
V23	EDUCATION – What is Dynamic Stability and why is it important?	Dynamic Stability (the ability to use your thumb during various functional activities, without experiencing pain or causing one of the thumb joints to collapse)	0.9
V24		If your thumb is stable while you use it in everyday tasks, it may reduce the onset of pain and/or prevent this condition from developing	1
V25		In this programme you will learn how to use your hands correctly and which exercises can help you to improve the stability	1
V26	EDUCATION What can I do to prevent the early	Maintain width of the 1st web space	1
V27		Use the correct muscles of the thumb to stabilize	1
V28		Use the thumb in an arched position when gripping	0.88

V29	development of CMC-1 OA?	Do not allow your metacarpal phalangeal joint (middle joint) to collapse when pinching	0.9
V30	EDUCATION – What can I do to prevent the early development of arthritis	Hand ergonomics	0.9
V31		Use your hands in everyday activities, but do it correctly (good “O” grip and all 5 fingers where possible)	0.9
V32		Use larger joints	0.9
V33		Use more joints	1
V34		Respect pain	0.9
V35		Use tools	1
V36		Frequent breaks	1
V37		Avoid tight gripping	1
V38	EXERCISES	Stretching the webspace	1
V39		Stability - Activation of all correct muscles “Capital C” exercise	0.9
V40		Stability - Activation of all correct muscles “Perfect O” exercise	0.7
V41		Strengthening (specifically of FDI; OP; ~~APL~~; APB and EPB) “FDI strengthening” exercise	0.7
V42		Stability – Motor control	1
V43		Frequency	1
V44		Progression	0.5
V45	EDUCATION Where can I find more advice, help or assistance?	Resources	0.9
V46			0.9
V47			1

Despite the initial high s-CVI score for the SPHTP, experts’ scoring and comments were reviewed to further refine content based on the following decisions:

- All items with an i-CVI of below 70% were excluded. These included items 11, 21 and 44.
- Items with an i-CVI between 70% and 90% were reviewed and minor changes made to clarify content. This affected items 9, 40 and 41.
- Items that scored 90% and higher that generated many expert comments were also reviewed and some changes made. This affected items 18, 20, 29 and 42.
- Items 45-47 which are the items in the last category Education – Resources, were amalgamated into one item to simplify content.

After making changes, the combined s-CVI score was 0.937, indicating excellent content validity.

4.5. DISCUSSION

Here the authors report on the process followed to establish content validity of a SPHTP for CMC-1 OA. The process involved the input of experts in hand therapy, where more than 70% of experts had to agree or strongly agree for an item to be included in the SPHTP. The intensive content development process is described in detail elsewhere, but the high level of agreement achieved here, indicates that the content development process was satisfactory. The experts' scores and comments were largely focussed on reducing the jargon used in the SPHTP and directed towards semantic changes rather than factual content. The authors thus closely monitored the comments alongside scores to ensure that we understood the reasoning behind the suggested changes.

Items changed:

The authors reviewed items that had i-CVI scores between 70 and 90%, and adapted these items to reflect reviewers' comments. Both items 9 and 40 were changed to exclude any phrase referring to the thumb "collapsing" since lay persons are unlikely to understand what this means. The authors wanted to avoid using a negative term that may instil fear or lead to confusion as has been reported to happen in some studies reviewing patient experiences and the use of medical terminology.[24, 25]

Item 41 refers to muscle strengthening. The proposed exercise targets mainly the First Dorsal Interossieus (FDI) muscle which is important for stabilising the thumb.[26] Literature strongly suggests that thumb CMC-1 OA rehabilitation programmes should

avoid strengthening the Abductor Pollicis Longus (APL) muscle to avoid destabilizing the thumb.[26] Despite this evidence, exercises to strengthen both muscles in item 41 were included and experts were asked to comment on this item specifically. Early intervention for CMC-1 OA usually includes exercises to strengthen a range of muscles including: FDI, APL, Abductor Policis Brevis (APB), Extensor Policis Brevis (EPB) and Opponens Policis (OP). [13, 27-29] The researcher took into account the potential amount of time that asymptomatic people would spend on daily exercises and decided to keep the exercise part of the SPHTP as short as possible and only include essential exercises. Since the FDI muscle is the main stabilizing muscle of the thumb [14], the experts' guidance were followed and only exercises focusing on this one muscle were included.

Lastly, items 18, 20, 29 and 42 were reviewed as per expert opinion. Phrases originally used such as "collapse of the thumb" or "incorrect use of the thumb" in items 18 and 20 were changed to align with new words used in items 9 and 40 to ensure uniform wording throughout the programme. For item 20, the researcher added a picture of thumb interphalangeal joint hyper extension to clarify the content and for item 42, the choice of using a ping pong ball for smaller hands instead of a tennis ball were added. Core content was not changed and scoring was not affected.

Final proposed content and CVI calculation:

The authors took care to ensure that they did not change the content of the items, but rather clarified the content of the proposed items. The original i-CVI for these items did not change and did not influence the overall s-CVI of the proposed SPHTP. After removing category headings (items 1 and 15) and items with low i-CVIs (items 11, 21 and 41), the authors recalculated the s-CVI for the remaining 40 items, which resulted

in a high s-CVI of 0.937. This CVI indicates a high content validity. See final proposed SPHTP in Annexure B.

4.6. CONCLUSION

The research team developed an SPHTP with a high content validity index. The researcher engaged with several international experts who commented at various stages. Some participants were doubtful that such a programme would be effective because literature only suggests risk factors for the development of CMC-1 OA, but the exact risk factors have not yet been determined. Several participants felt that it would be difficult to find people who are at risk of developing CMC-1 OA and then trying to motivate them to participate in an SPHTP if they don't have symptoms. Aside from these challenges, most experts agreed that the proposed SPHTP was relevant for preventing the symptoms of CMC-1 OA. This study also highlights the importance of educating the public on this topic and establishing a pathway to keep the thumb strong.

The next step of the process is to use the developed content in an actual SPHTP. This will help us to test the efficacy of the SPHTP for non-symptomatic, at-risk people which will lead to fine-tuning and further research. In the content validity process, experts mostly commented on the wording or semantics of the proposed SPHTP. The authors propose that public involvement may help to fine-tune the SPHTP before taking the programme to trial.

Content was developed for an SPHTP for CMC-1 OA, which involved interventions normally associated with hand therapy. However, it is known that CMC-1 OA is considered to be a systemic condition[10] and the authors suggest that future

interventions also consider the newest research on diet and weight loss advice[8, 30] as part of a prevention programme. This SPHTP may be a valuable tool for identifying a pathway where CMC-1 OA can be prevented or at the very least, delay the onset of symptoms.

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CHAPTER 5: FINDINGS, LIMITATIONS, STRENGTHS, CONCLUSION AND RECOMMENDATIONS

The aim of this study was to develop content for a symptom prevention hand therapy programme (SPHTP) for thumb carpometacarpal joint (CMC-1) osteoarthritis (OA) with a high content validity index (CVI).

5.1. PRIMARY FINDINGS

All results from this study are novel findings in the absence of any other published symptom prevention hand therapy programme for CMC-1 OA.

The primary findings regarding developed content for a SPHTP for CMC-1 OA are as follows:

1. Two main themes for a SPHTP identified from OFG data included education and exercises.
2. Education subthemes included:
    1) Osteoarthritis: General information including what the disease is and how it progresses.
    2) Signs and risk factors of CMC-1 OA.
    3) The importance of dynamic stability in the thumb.
    4) Joint protection.
    5) Resources – where to find help.
3. Exercise subthemes included:
    1) Stretching the Adductor Pollicis muscle.

2) Strengthening the correct muscles (specifically First Dorsal Interosseous and the activation of Opponens Pollicis, Extensor Pollicis Brevis, Abductor Pollicis Brevis and Abductor Pollicis Longus).
3) Stability exercises for motor control and proprioception.
4) Range of motion exercises.
5) Frequency of exercises.

4. Both themes and their subthemes were compared to current literature and further developed into content for a SPHTP consisting of 47 items, grouped into seven categories under two domains (Education and Exercises).
5. The seven categories included:
    1) basic information,
    2) risk factors,
    3) what is dynamic stability of the thumb and why is it important?
    4) how to improve dynamic stability,
    5) hand ergonomics,
    6) exercises and
    7) resources.

The primary findings regarding the content validity index of the newly developed content for a SPHTP are as follows:

1. Initial calculation of the content validity index (S-CVI) for the overall programme content consisting of 45 items were 0.91.
2. From expert participant feedback, several decisions were made to improve the final content of a SPHTP. Decisions included:

a. All items with an item-CVI (i-CVI) of below 0.7 were excluded. Three items were excluded namely item 11 (Tension or tightness in the web space listed as a sign of CMC-1 OA); item 21 (example of instability of the thumb as it is a repeat of item 20) and item 44 (Progression of exercises).
b. Items with an i-CVI between 0.7 and 0.9 were reviewed and minor changes made to clarify content. This affected 3 items namely item 9 and 40 (wording was changed to not mention the thumb ray "collapsing") and item 41 (reference of any other muscles was excluded and clarified that only strengthening of the FDI muscle are included).
c. Items that scored 0.9 and above that generated many expert comments were also reviewed and some changes made. This affected 4 items, namely items 18, 20, 29 (in all three of these, wording was changed to not refer to the thumb "collapsing" or used "incorrectly", rather described as avoiding the thumb bending completely backwards) and item 42 (it was added that a ping pong ball can be used instead of a tennis ball to do the same exercise for individuals with small hands).
d. Three items in the category Education: resources were amalgamated into one item.

3. Changes made based on above decisions led to a final product of 40 items with a combined S-CVI of 0.937, indicating a high content validity of the developed SPHTP.
4. The final programme can be seen in Annexure B.

5.2. LIMITATIONS

Since OA affects the global community, it was important to the researcher to recruit participants representative of the global community. Whilst we were able to do this, there are still a few countries such as India, China, Taiwan, New Zealand, South America and Africa (excl. South Africa) where we did not manage to find therapists who were able to participate.

5.3. STRENGTHS/SIGNIFICANCE OF THE STUDY

There are not many therapists (Occupational Therapists or Physiotherapists) who specialise in hand therapy who also have a special interest in the thumb or arthritic hand conditions. Through purposive sampling, many of the known experts in this field, from eight different countries, were recruited and participated in multiple in-depth discussions, which is a strength of this study

Hosting the first stage of this study online was also a strength as it enabled us to include these known experts from across the globe.

A major strength of our study is the mixed methods research design which not only provided multiple forms of evidence in the development of valid content for a SPHTP, but also gave opportunity for global expert hand therapists to comment during two different stages, minimising the risk of single researcher bias during stage 1's interpretation and analysis of the OFG data.

As far as we know, this study is the first of its kind with the specific focus of developing a SPHTP for CMC-1 OA and as such provides a valuable tool to base further research on in the process of finding a strategy to prevent or delay CMC-1 OA. Finding a strategy that could prevent or delay CMC-1 OA will have far-reaching health and economic benefits globally.

5.4. CONCLUSION

The aim of developing content for a SPHTP for CMC-1 OA was achieved and the research question was successfully answered. Since there is no other published SPHTP for CMC-1 OA, the outcome of this study provides a very valuable tool on which to build a strategy for delaying or preventing symptoms of CMC-1 OA.

The content of the proposed programme will be developed into an easy-to-follow programme, including photos and pictures to clarify instructions.

This programme was not developed to be gender-specific, despite multiple evidence from literature[1-2] indicating that females are more at risk of developing CMC-1 OA, since many studies found a higher prevalence in women[1,3]. The reason why the programme is not gender-specific is that prevention is for the whole population.

5.5. RECOMMENDATIONS

The essential next step following this study is to take the content of this SPHTP and test the efficacy, ideally in a randomised control trial.

Before taking the programme content to trial, we recommend involving members of the public in the final revision of the programme to ensure all medical jargon is clearly explained and instructions easy to understand. In addition, it is recommended that the latest research in other specialist fields on the prevention of OA are considered for inclusion, such as nutrition; to consider also including valid diet and weight-loss advice in a general prevention programme.[4-5]

The findings of this study are important for therapists working in the field of hand therapy who see patients with CMC-1 OA. We recommend that therapists use the content of this programme during their therapeutic sessions with individuals who may be at risk of developing CMC-1 OA. These may include individuals who have

symptomatic CMC-1 OA in the contralateral hand or individuals who present with other diagnoses, but who display some of the risk factors.

The findings will also be valuable for general medical practitioners, and training is recommended to create awareness that earlier intervention is effective, and that advice is available for individuals who do not yet have symptoms. This may affect their existing patient's younger family members or patients who currently have symptoms on one side only.

Groups of people who may also benefit from the findings and implementation of the SPHTP are those involved in job tasks or hobbies with high repetitive hand tasks or force-required tasks such as oral hygienists, dentists, physiotherapists, quilters, crocheters, surgeons etc. and we suggest that hand therapists who are invited to address these groups, use our results as part of health promotion.

5.6. REFERENCES

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ANNEXURES

ANNEXURE A: Letter from editor - Journal of Hand therapy

Janette Erasmus | EL Hand Therapy

From: em.handthe.0.76d41c.c581b0e4@editorialmanager.com on behalf of Journal of Hand Therapy <em@editorialmanager.com>
Sent: 22 October 2021 15:59
To: Janette Erasmus | EL Hand Therapy
Subject: Confirming submission to Journal of Hand Therapy

This is an automated message.

Developing the content for a hand therapy programme to prevent the symptoms of thumb carpometacarpal joint osteoarthritis

Dear Mrs Erasmus,

We have received the above referenced manuscript you submitted to Journal of Hand Therapy.

To track the status of your manuscript, please log in as an author at https://www.editorialmanager.com/handthe/, and navigate to the "Submissions Being Processed" folder.

Thank you for submitting your work to this journal.

Kind regards,
Journal of Hand Therapy

More information and support

You will find information relevant for you as an author on Elsevier's Author Hub: https://www.elsevier.com/authors

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Here you can search for solutions on a range of topics, find answers to frequently asked questions, and learn more about Editorial Manager via interactive tutorials. You can also talk 24/7 to our customer support team by phone and 24/7 by live chat and email

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To ensure this email reaches the intended recipient, please do not delete the above code

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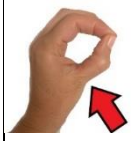
In compliance with data protection regulations, you may request that we remove your personal registration details at any time. (Use the following URL: https://www.editorialmanager.com/handthe/login.asp?a=r). Please contact the publication office if you have any questions.

ANNEXURE B: Final proposed SPHTP for CMC-1 OA (s-CVI: 0.937)

	Domain	Subheading	Item details
	EDUCATION Basic information	**General information**	What is arthritis at the base of the thumb?
1			A joint is where two bones move around each other and if there is no problem, allows smooth gliding pain-free movement.
2			When you start developing arthritis at the base of your thumb, the joint lining is altered, and movement becomes less smooth. This can feel like stiffness and/or pain in your thumb.
3		Saddle joint	The saddle joint at the base of our thumbs (CMC joint) is very important as it allows movement in more than one direction. Like the shoulder, the thumb relies very much on the muscles and ligaments surrounding it, to give the thumb stability and strength
4		Hand function	The thumb contributes 50% to our overall hand function, but it also means that this saddle joint is at greater risk of degeneration and development of arthritis.
5		Force systems	The way in which we use our thumbs is very important. A force applied to the tip of the thumb, translates to a force up to 12 times more at the saddle joint
6			If your thumb is not stable, this force may increase the rate in which damage occurs to the saddle joint
		Signs and symptoms	
7			Pain at the base of the thumb
8			The whole thumb may appear to bend backwards at its middle or end joint
9			Weakness when you pinch or grasp something
10			Swelling around the base of your thumb
11			Enlarged bony appearance at the base of the thumb
12			Reduced range of motion in the thumb
13			

	EDUCATION – How do I know if I am at risk? (Risk factors)	Family history of hand arthritis	Do you have a family history of arthritis and pain at the base of the thumb?
14		Age 40+	Are you over 40 years old?
15		Incorrect use of thumb	Do you have a job or hobby that requires repetitive hand/thumb movements or pressure applied with your thumb? Do you know that there are safe ways to use your thumb in everyday activities without being forced to stop your participation in any of them?
16		General hypermobility	Can your joints bend or open more than other people's joints you know? Do you have very supple joints?
17 (‡20)		Instability of the thumb	 Does your thumb look like this when you pinch or press on something?  Picture added
18		Thumb weakness	Do your hands feel weak, or do you find it difficult to open jars, taps/faucets, or packages?
19	EDUCATION – What is dynamic stability and why is it important?	**Dynamic Stability (**the ability to use your thumb during various functional activities, without experiencing pain or causing one of the thumb joints to collapse)	One of the most important things that we can do about these risks, is to use our thumbs in the most optimal way to maintain a stable thumb where the surrounding muscles are used in such a way that the saddle joint is aligned correctly, thus limiting the damage that may occur from instability at the base of the thumb
20			If your thumb is stable while you use it in everyday tasks, it may reduce the onset of pain and/or prevent this condition from developing

21			In this programme you will learn how to use your hands correctly and which exercises can help you to improve the stability in your thumb to prevent or delay the onset of this condition for as long as possible
22	EDUCATION What can I do to prevent the early development of CMC-1 OA?	Maintain width of the 1st web space	1st web space explained with photos
23		Use the correct muscles of the thumb to stabilize	See exercises
24		Use the thumb in an arched position when gripping	To explain with a photo
25		Do not allow your metacarpal phalangeal joint (middle joint) to collapse when pinching	To explain with photos
26	EDUCATION – What can I do to prevent the early development of arthritis?	Hand ergonomics	The way in which you use your hands can greatly contribute to the health of your thumbs. If you make use of ergonomic principles, you can avoid placing unnecessary and additional strain on the joints.
27		Use your hands in everyday activities, but do it correctly	Use a good “O” grip between thumb and index finger. When possible, use all 5 fingers to grip items.
28		Use larger joints	i.e., carry shopping bags on your arm not with your fingers
29		Use more joints	i.e., carry a plate from underneath with a flat open hand, rather than holding on to the edge (or rim).
30		Respect pain	Let pain prompt you to stop what you are doing or change how you are doing it

31		Use tools	There are multiple labour-saving gadgets available that you could use such as a food processor. Photographs of these examples to be included
32		Frequent breaks	Take regular breaks from repetitive tasks
33		Avoid tight gripping	Avoid using tight grips like those used when holding a pen, knife, toothbrush, shopping bags or gardening equipment. Rather use objects with larger, built-up handles made from plastic or foam to reduce joint stress.
34	EXERCISES	Stretching	Stretch out your web space. Use your other hand or a peg to squeeze and massage the muscle in your web space to release the tight muscles. Maintain the squeeze for 10 seconds. V38
35		Stability - Activation of all correct muscles	Capital C exercise: Hold your hand in the shape of a Capital C and tighten the muscles in this position. - Progress to using an elastic band around all the fingers.
36		Stability - Activation of all correct muscles	Perfect O exercise: Hold your thumb and index together in a Perfect O, start pressing them together. Press just until you notice the thumb getting out of the arched position, where neither the middle nor the end joint start to bend backwards. Hold there. - Progress by gradually pressing harder as you get stronger and can maintain the position. - Progress onto strengthening of these muscles by holding a peg whilst still maintaining a Perfect O position.
37		Strengthening (specifically of FDI)	In addition to above exercises, we want to specifically target the First Dorsal Interossei muscle as this is seen as the most important stabilising muscle of our thumbs. Do this by starting in the Capital C position, with your hand on its side on a table, pinkie against the table. - Now lift your index finger away from your middle finger and

			then slowly lower it back to the middle finger. - Keep your index finger in the bent position (as when in the Capital C position) whilst lifting and lowering. When this becomes easy, you can progress by placing an elastic band around the base of your fingers and lifting your index finger up against the elastic band resistance
38		Stability – Motor control	Tennis ball/ping pong ball tracing exercise with the thumb held in an arched position. Holding a tennis ball in your hand, gently trace along the lines of the tennis ball in an outward direction (away from your palm), keeping the thumb in an arched position, avoiding the collapse of any joint.
39		Frequency	- 2-3 times per week, 3 sets of 20 repetitions of each exercise It works best if you plan to do your exercises once a day in association with a routine task you do daily, such as a mealtime.
40	**EDUCATION Where can I find more advice, help or assistance?**	**Resources**	You may wish to see a local hand therapist if your symptoms increase or all the efforts you are making, are no longer effective. This could be more pain, instability, weakness or you are concerned Look for a local specialist hand therapist online or using …. (link as appropriate for country programme is used in) - You can find a therapist close to you in South Africa at: https://www.sasht.org.za More information may be found on the following web sites: https://www.arthritis.org.za https://saraa.co.za www.versusarthritis.co.uk

ANNEXURE C: Ethics approval certificate

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Health Sciences

Institution: The Research Ethics Committee, Faculty Health Sciences, University of Pretoria complies with ICH-GCP guidelines and has US Federal wide Assurance.

- FWA 00002567, Approved dd 22 May 2002 and Expires 03/20/2022.
- IORG #: IORG0001762 OMB No. 0990-0279 Approved for use through February 28, 2022 and Expires: 03/04/2023.

30 July 2020

Approval Certificate
New Application

Ethics Reference No.: 437/2020
Title: The development of a symptom-prevention hand therapy programme for thumb carpometacarpal joint osteoarthritis

Dear Mrs J Erasmus

The **New Application** as supported by documents received between 2020-06-26 and 2020-07-29 for your research, was approved by the Faculty of Health Sciences Research Ethics Committee on 2020-07-29 as resolved by its quorate meeting.

Please note the following about your ethics approval:

- Ethics Approval is valid for 1 year and needs to be renewed annually by 2021-07-30.
- Please remember to use your protocol number (437/2020) on any documents or correspondence with the Research Ethics Committee regarding your research.
- Please note that the Research Ethics Committee may ask further questions, seek additional information, require further modification, monitor the conduct of your research, or suspend or withdraw ethics approval.

Ethics approval is subject to the following:

- The ethics approval is conditional on the research being conducted as stipulated by the details of all documents submitted to the Committee. In the event that a further need arises to change who the investigators are, the methods or any other aspect, such changes must be submitted as an Amendment for approval by the Committee.

We wish you the best with your research.

Yours sincerely

Dr R Sommers
MBChB MMed (Int) MPharmMed PhD
Deputy Chairperson of the Faculty of Health Sciences Research Ethics Committee, University of Pretoria

The Faculty of Health Sciences Research Ethics Committee complies with the SA National Act 61 of 2003 as it pertains to health research and the United States Code of Federal Regulations Title 45 and 46. This committee abides by the ethical norms and principles for research, established by the Declaration of Helsinki, the South African Medical Research Council Guidelines as well as the Guidelines for Ethical Research: Principles Structures and Processes, Second Edition 2015 (Department of Health)

ANNEXURE D: Data collection instrument: Online Focus group questions

Thread 1:

With your knowledge on the subject of CMC-1 OA and from working with individuals affected by the condition - What do you think should be included in a programme that is aimed at preventing the onset of symptoms of this condition in individuals who do not yet have symptoms?

Thread 2:

Do you think symptom free individuals are aware of what the risk factors for developing CMC-1 OA are?

- In your opinion, how can we make them more aware of the risk factors?
- What are the signs that individuals should be made aware of?
- Literature suggests that the risk factors for developing CMC-1 OA may include instability; general hypermobility; reduced mobility at the MPJ; or hyperextension at the MPJ combined with reduced or hypermobility at the IPJ

Thread 3:

Would you include exercises such as strengthening or stabilising or dynamic stabilising exercises in a SPHTP (Symptom Prevention Hand Therapy Programme)?

If yes, please list which ones in your opinion should be included and your suggested frequency for these exercises?

Thread 4:

Would you include joint protection principles in a Symptom Prevention Hand Therapy Programme? If yes, which ones would you include?

Thread 5:

How can non-symptomatic, at-risk individuals be motivated to incorporate recommendations from a SPHTP in their daily lives?

ANNEXURE E: Informed consent form

PARTICIPANTS' INFORMATION AND INFORMED CONSENT DOCUMENT FOR A RESEARCH STUDY INVOLVING AN ONLINE FOCUS GROUP INTERVIEW AND THE ASSESSMENT OF A NEWLY DEVELOPED PROGRAMME

Study title: **DEVELOPING A SYMPTOM PREVENTION HAND THERAPY PROGRAMME FOR THUMB CARPOMETACARPAL JOINT OSTEOARTHRITIS**

Principal Investigator: **JANETTE ERASMUS**

Supervisor: **PROF KITTY UYS and CORRIANNE VAN VELZE**

Institution: **UNIVERSITY OF PRETORIA; DEPARTMENT OF OCCUPATIONAL THERAPY**

DAYTIME AND AFTER-HOURS TELEPHONE NUMBER(S):

Daytime number/s: **+27 83 2569826**

Afterhours number: **+27 83 2569826**

Date and time of informed consent discussion:

TBC			**:**	
date	**month**	**year**	**Time**	

Dear Prospective Participant

1) INTRODUCTION

You are invited to volunteer for a research study. I am doing this research for a Master's in Occupational Therapy degree purposes at the University of Pretoria. The information in this document is provided to help you decide if you would like to participate. Before you agree to take part in this study you should fully understand what is involved. If you have any questions, which are not fully explained in this document, do not hesitate to ask the investigator. You should not agree to take part unless you are completely happy about what we will be discussing during the online focus group discussion.

2) THE NATURE AND PURPOSE OF THIS STUDY

The aim of this study is to develop a symptom-prevention hand therapy programme (SPHTP) that will prevent and/or delay the onset of symptoms associated with degeneration in the thumb carpo-metacarpal joint (CMC-1) caused by Osteoarthritis (OA).
There will be two stages to this study that requires input from hand therapists working or teaching in this particular field of study. As you are a registered hand therapist with an interest in treating arthritic hand conditions (Occupational Therapist or Physiotherapist) with a minimum of 5 years' experience, you are invited to participate in both stages of the study:

Stage1:
The first stage of the study will be an asynchronous online focus group discussion. An online focus group is where a few people – usually about 8 or 10 – discuss a specific topic with the Researcher, using an online platform such as Blackboard. Hosting it in an asynchronous way means that participants from across the globe, who live in different time zones, can all have sufficient time to comment at a time that suits them, usually within 24-48 hours after commencement to respond to questions and again 24-48 hours later to respond to other participant's answers. This means the online focus group discussion may last for a period of approximately 1 week before it is concluded.

The discussion will be arranged for dates that is convenient to you and will take place online. You will be sent a link to join the specific chat room in advance and will be able to choose whether you want to join anonymously or be known in the group as yourself. Other participants

will be able to see your comments and be able to respond to what you have said as will you be able to respond to the questions asked and the comments made by other participants.

Following stage 1, the data collected will be analyzed and combined with current literature. This will then be used to develop a new Symptom Prevention Hand therapy Programme for 1-CMC OA.

Stage 2:
Once the programme has been developed, we want to ensure that the content of the new programme is valid and trustworthy. This will be assessed by calculating the content validity index of the new programme. To do this, we need your input again. You will receive a copy of the newly developed programme together with a scoring sheet. You will be required to score each item as well as the entire programme, using a 4-point Likert scale to indicate your level of agreement/disagreement to the validity of the content in the programme.
The assessment tool and programme will be sent to you via an online platform such as Poltrex or Google Forms and you will be able to complete your scoring and comments directly on the form. You will be able to do this in your own time and will be given a week to complete the assessment. Your scoring and comments will be kept confidential and will not be visible to other participants.

3) EXPLANATION OF PROCEDURES AND WHAT WILL BE EXPECTED FROM PARTICIPANTS

If you agree to participate in Stage 1 (online focus group), you will be asked to participate in an online focus group discussion which will take approximately 60-90 minutes (divided into two or three episodes as convenient to you) of your time over the course of 1 week. You and the other participants will be asked questions about your opinion regarding what categories and what specific items under each category, should be included in a symptom prevention hand therapy programme to prevent/delay the onset of symptoms of first carpo-metacarpal joint Osteoarthritis.
We will not ask any questions about your personal experience. Transcripts of all written comments of the discussion will be kept as record of the discussion.

If you agree to participate in Stage 2 (content validity stage), you will be sent a copy of the newly developed programme as well as a Content Validity Assessment tool. You will be asked to score each category and item in the newly developed programme at the hand of a 4-point Likert scale to indicate your agreement to the item/category's RELEVANCE,

CLARITY, and correct application of FREQUENCY. This assessment tool will take approximately 60-90 minutes of your time.
You will be able to provide additional comments with your scores.

4) RISKS AND DISCOMFORTS INVOLVED

We do not think that taking part in the study will cause any physical or emotional discomfort or risk.
You do not have to share any knowledge you are not comfortable with.
If questions feel too personal or make you uncomfortable, you do not have to answer them.
You need to be aware that due to the nature of an online focus group, if you choose to join the group “anonymously”, there is a risk that others may guess or find out your identity.

5) POSSIBLE BENEFITS OF THIS STUDY

You will not benefit directly by being part of this study. But your participation is important for us to better understand what specific aspects should be included in a Symptom prevention hand therapy programme to mitigate the risk factors and help to delay/avoid symptoms of CMC-1 OA.

There is currently no published symptom prevention hand therapy programme for CMC-1 OA and the information you give will firstly in Stage 1 help the researcher to develop a new programme and secondly in Stage 3, help to ensure the content validity of the new programme.

6) COMPENSATION

You will not be paid to take part in the study. There are no costs involved for you to be part of the study.
You will receive a copy of the new programme after completion.

7) VOLUNTARY PARTICIPATION

The decision to take part in the study is yours and yours alone. You do not have to take part if you do not want to. You can also stop at any time during the interview without giving a reason. If you refuse to take part in the study, this will not affect you in any way.

8) ETHICAL APPROVAL

This study was submitted to the Research Ethics Committee of the Faculty of Health Sciences at the University of Pretoria, Medical Campus, Tswelopele Building, Level 4-59, telephone numbers 012 356 3084 / 012 356 3085 and written approval has been given by

that committee. The study will follow the Declaration of Helsinki (last update: October 2013), which guides doctors on how to do research in people. The researcher can give you a copy of the Declaration if you wish to read it.

9) INFORMATION ON WHO TO CONTACT

If you have any questions concerning this study, you should contact:

Janette Erasmus: +27 83 2569826

10) CONFIDENTIALITY

We will not record your name anywhere and no one will be able to connect you to the answers you give (other than those participating in the online focus group with you). Your answers will be linked to a fictitious code number or a pseudonym (another name) and we will refer to you in this way in the data, any publication, report or other research output.
All records from this study will be regarded as confidential. Results will be published in medical journals or presented at conferences in such a way that it will not be possible for people to know that you were part of the study.

The records from your participation may be reviewed by people responsible for making sure that research is done properly, including members of the Research Ethics Committee. All of these people are required to keep your identity confidential. Otherwise, records that identify you will be available only to people working on the study, unless you give permission for other people to see the records.

All hard copy information will be kept in a locked facility at the Department of Occupational Therapy at the University of Pretoria, for a minimum of 15 years and only the research team will have access to this information.

Although all participants of the online focus group discussion will be requested to keep the discussion confidential, the researcher cannot guarantee that they will do so. I therefore request that you do not disclose any information of a very personal or sensitive nature.

11) CONSENT TO PARTICIPATE IN THIS STUDY

- I confirm that the person requesting my consent to take part in this study has told me about the nature and process, any risks or discomforts, and the benefits of the study.
- I have also received, read, and understood the above written information about the study.
- I have had adequate time to ask questions and I have no objections to participate in this study.
- I am aware that the information obtained in the study, including personal details, will be anonymously processed, and presented in the reporting of results.
- I understand that I will not be penalised in any way should I wish to discontinue with the study.
- I am participating willingly.
- I have received a copy of this informed consent agreement.

_____ _____

Participant's name (Please print) Date

_____

Participant's signature

_____ _____

Researcher's name (Please print) Date

_____

Researcher's signature

ANNEXURE F: Letter of statistical support

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA
Denkleiers • Leading Minds • Dikgopolo tša Dihlalefi

DEPARTMENT OF STATISTICS

Letter of Co-Authorship Acknowledgement

Thank you for applying for statistical support from the Internal Statistical Consultation Services. As per our guidelines, the nature and extent of the research should be such that it is publishable as an article in a journal. It is expected that the contribution of the statistical consultant/s is acknowledged by granting co-authorship. This entails at least editing the statistical section of the article by the statistical consultant/s. For record-keeping purposes we require that an electronic copy of the final article be send to us on completion of the project.

Please complete the following form, and return it to the ISCS (Internal Statistical Consultation Services) in order for an appointment to be set up to discuss the project.

Which journals are you planning to submit the article to?

HAND (Sage Journals)

What is the planned date of submission?

2021

I hereby confirm that co-authorship will be granted to the statistical consultant/s.

Student/ ~~Staff~~ Name: Janette Erasmus Student/ Staff Number: u98001745

Signature Date: 08/05/2020

Supervisor Name: Prof CJE Uys

Supervisor Signature Date: 8 May 2020

Co-Supervisor Name: _____

Co-Supervisor Signature Date: _____

Head of Department Name: _____

**Head of Department Signature* Date: _____

**Required for the application to be processed*

ANNEXURE G: Participant demographic information questions and instructions on Qualtrics

Instructions:

You are receiving this email because of your confirmed interest in participating in the upcoming Online, asynchronous Focus Group where we will be discussing opinions on the content of a new Symptom Prevention Hand therapy Programme for CMC-1 OA.

Please carefully read through the attached informed consent document. If you are happy to participate, please press "submit"

Once you have read and agreed to the consent form, you will be asked several questions with regards to demographic information. Please answer these by Friday 28 August 2020.

Once your feedback has been received, you will be sent a link as well as a Username and Password with instructions on how to join the upcoming Focus group. The Username will be anonymous and you will be able to choose whether you divulge your true identity during the focus group when you participate.

There will be two focus groups and confirmed participants will be randomly divided into the two groups.

FOCUS GROUP START DATE:

The proposed start date for the focus groups are Monday 31 August 2020, TIME…..

The online platform will be kept open for 7 days. I realise everyone is very busy, but would appreciate if you would agree to log in 2- 3 times over the course of the 7 days. Initially within the first 48 hours to provide answers to the questions that will be posted and then again approx. 48 hours later to comment on others' answers.

Demographic information questions

1. Are you an Occupational Therapist or a Physiotherapist?
    a. OT
    b. Physio

2. What setting do you work in?
    a. Private Practice
    b. Public health service
    c. Outpatient clinic
    d. Hospital
    e. Education
    f. Other_____
3. Do you have any post-grad qualifications in hand therapy? If yes, please name your post grad qualifications:
    a. No
    b. Yes – Post grad diploma
4. How many years of experience do you have in hand therapy?
    a. 0-5yrs
    b. 5-10yrs
    c. 10-15yrs
    d. 15-20yrs
    e. 20-25yrs
    f. 25+yrs
5. Do you have a special interest in treating arthritic hand conditions and/or Thumb CMC-1 OA?

6. How often do you treat patients with Thumb CMC-1 OA?
    a. Less than once a month
    b. Once a month
    c. Weekly
    d. Daily

7. Have you published on the topic of Thumb CMC-1 OA?