ISSN: 2474-9206

Research Article

Journal of Anesthesia & Pain Medicine

Telehealth Group-Based Pain Management Programs: Pre-Intervention Readiness to Change Maladaptive Pain Behaviors

Marnin Joseph Romm[1]*, Kathryn Roach[2], Lawrence Patrick Cahalin[3], Ira Fiebert[3], Mark D Bishop[4]

[1]PhD, MSc Pain, MSc Physiotherapy, BA (Hons) Clinical Psychology, University of Texas Medical Branch, School of Health Professions.*

[2]PhD, University of Miami, Physical Therapy Department, USA.

[3]PhD, PT, University of Miami, Physical Therapy Department, USA.

[4] PhD, PT, University of Florida, Physical Therapy Department, USA.

[*]Corresponding Author
Marnin Joseph Romm, University of Texas Medical Branch, School of Health Professions.

Submitted:27 Feb 2023; **Accepted:**07 Mar 2023; **Published:**27 Mar 2023

Citation: Romm, M. J., Roach, K., Cahalin, L. P., Fiebert, I., Bishop, M. D. (2023). Telehealth Group-Based Pain Management Programs: Pre-Intervention Readiness to Change Maladaptive Pain Behaviors. *J Anesth Pain Med*, *8*(2), 88-106.

Abstract

Objectives: *Telehealth platforms have become a crucial part of healthcare since the onset of the COVID-19 pandemic. The primary aim of this cohort study was to investigate pain outcomes, following telehealth group-based pain management programs (GPMPs) with a focus on comparing subjects who were readier to change (RTC) maladaptive pain behaviors prior to intervention versus those subjects who were less ready to change.*

Methods: *Subjects were divided at baseline into one of 2 cohort groups; the exposed group (more RTC) and unexposed group (less RTC). There were 5 separate telehealth GPMP groups each consisting of subjects from both cohort groups. Each group met once a week via zoom software and ran over a course of 6 weeks in which Chronic Pain (CP) self-management techniques were taught. Pain outcome measures were taken at baseline and at after the final telehealth GPMP.*

Results: *The unexposed group scored greater magnitude in change of scores from pre-to-post intervention in which these changes all signified improvements in scores following the telehealth GPMPs. The primary pain constructs examined being pain self-efficacy, pain catastrophizing and pain kinesiophobia all showed moderate to large effect sizes between the groups; Cohen`s d= 0.55, 0.77 and 0.65 respectively.*

Conclusions: *Within and post the COVID-19 pandemic, telehealth GPMPs have a clinically relevant role to play in the self-management treatment of patients with CP. Understanding individuals` levels of RTC prior to running telehealth GPMPs, seems to be an important factor in predicting improvements in various CP outcomes.*

Keywords: Telehealth, Group Pain Management, Chronic Musculoskeletal Pain, Readiness to Change, Maladaptive Pain Behaviors.

Introduction

Chronic musculoskeletal pain, a multifaceted experience, has substantial consequences on patients themselves, as well as on their families, relationships, social and professional lives, and ultimately causes a decline in quality of life (QOL) for both the patients and their families [1, 2]. National estimates of high-impact chronic pain (CP) can help distinguish individuals with restrictions in major life domains including work, social, recreational, and self-care activities from those people whom seem to preserve normal life activities despite their CP experiences [3]. This provides better insight into populations who seem to be in need of pain services [3].

One of the central goals of pain management intervention is to increase patients` readiness to engage in pain self-management [4].

Group-based self-management practices developed within behavior modification and behavior medicine have been used substantially in the management of a wide variety of common medical disorders with encouraging results. The use of group therapy allows the emergence of self-reliance to be brought about within patients with CP. Patients experiencing CP commonly feel isolated and misunderstood. Thus, group therapy fulfils a supportive role by permitting disclosure of thoughts and feelings to others who have mutual circumstances. This in turn leads to a heightened sense of legitimacy for the patient, internal locus of control and, therefore allows for peer group support and encouragement [5, 6].

Although there is limited research that examines group-based pain management telehealth program interventions, there is general support for telehealth care in general medical practice [7, 8]. Based on restrictions set up during the COVID-19 pandemic, such as the necessity for social distancing, telehealth became and has continued to be an essential and integral component of healthcare delivery. In addition, common geographical barriers and access to healthcare for patients in the community who are living with CP, consultations with pain specialists, is often difficult. Notably, pain specialists are generally concentrated in urban areas [9, 10]. Ultimately "TelePain" bridges physical distances through the use of video, web and telephone conferencing technologies to increase access to chronic pain management" [9].

Telehealth, in terms of pain management, has been found not only efficacious in monitoring and adjusting analgesic medication, but also for the delivery of non-pharmacological treatments such as pain self-management strategies. These self-management strategies include Cognitive Behavioral Therapy (CBT), mindfulness based intervention, acceptance commitment therapy and motivational instructions for exercise based treatment [11-17]. The research that has been completed to date, examines, for the vast majority of cases, only one-on-one pain management telehealth consultations. However, with reference to the COVID-19 pandemic social distancing guidelines, there have been a few quantitative and qualitative studies where group-based telehealth programs were investigated. Overall, these studies revealed that subjects did receive benefit and a feeling of safety from the group-based telehealth programs and had positive experiences [18, 19]. Furthermore, these studies also demonstrated the encouraging result that telehealth group interventions increase population numbers and accessibility to pain management, particularly for those individuals who may face geographical barriers to healthcare [18, 19].

A recent scoping review around group and individual telehealth for CP, found a total of 446 studies with merely 2 of these studies analyzing group-based telehealth interventions [20]. Wallace et al (2022) identified as one of 4 main themes emerging from the studies, the notion of managing behavior in patients with CP. The above studies further highlight the need for the current research to examine telehealth group-based pain management programs (GPMPs) with potentially an even more focused lens on maladaptive pain behaviors. The current research sought to understand if pain outcomes following telehealth GPMPs were readier to change maladaptive pain behaviors at baseline, versus those who were less ready to change.

The Transtheoretical Model (TTM) is aimed at understanding individuals behavioral changes and describes how people move dynamically through five different stages of behavioral modification [21, 22]. This might occur as a result of a direct intervention/behavioral changes or may occur naturally. The TTM is understood to go through a number of stages of readiness to change (RTC) including, precontemplation (not intending to make changes or denying the need to change), contemplation (seriously considering making changes), preparation (starting to make small changes), action (actively engaging in changes for less than 6 months) and maintenance (maintaining changes for more than 6 months) [22]. Notably, the current research was not designed to predict which subjects with CP may move through the TTM stages. However, it must be emphasized that the TTM acts as a central guideline to positive health-behavior changes, including CP behavioral changes [22]. Therefore, this theoretically suggests that the TTM can be used prior to a pain management intervention as a possible predictor of changes in patients` pain outcome measures because of the intervention, rather than specifically investigating subjects` movement through the TTM stages.

Thus, rather importantly, the current research used the The Pain Stages of Change Questionnaire (PSOCQ), which is based on the TTM theoretical framework, to divide subjects at baseline into the 2 cohort groups (see Materials and Methods section). To emphasize, this study did not aim to use the instrument to analyze if subjects moved through the TTM stages because of the intervention. The PSOCQ instrument stipulates that individuals move through discrete "stages-of-change" when altering maladaptive pain behaviors. Table 1 compares the stages presented in the TTM with the stages in the PSOCQ. The PSOCQ has been found to be a useful tool in assessing those individuals who may or may not be likely to join or positively partake in a pain self-management course [23]. Therefore, the primary aims of this study, using the PSOCQ at baseline, was to identify if subjects who are readier to change maladaptive pain behaviors at pre-intervention versus those who were less ready, would benefit most in their pain outcome scores following our telehealth GPMP.

Table 1: Comparison Between the Stages Underlying the Transtheoretical Model for Change (TTM) and the Pain Scale of Change Questionnaire (PSOCQ).

The Transtheoretical Model (TTM) of Change Stages:	The Pain Scale of Change Questionnaire Stages:
Precontemplation	Precontemplation
Contemplation	Contemplation
Preparation	----------
Action	Action
Maintenance and Relapse Prevention	Maintenance

CBT generally follows through a series of stages that highlight 'reconceptualization' of pain as manageable and subject to self-control [24]. 'Reconceptualization 'is proceeded by 'skills acquisition' and 'skills practice' phases that enhance behavioral and sustainability of change [25]. The above embraces the motivation and anticipated results of a GPMP such as the one proposed in this current telehealth study.

In summary, telehealth group-based pain management programs are a relatively new treatment approach for patients with CP. This has limited research attached to it, specifically when assessing subjects` pre-intervention maladaptive pain behaviors with reference to telehealth interventions. Therefore, the main goal of this research was to examine whether subjects who are readier to change maladaptive pain behaviors at pre-telehealth GPMP intervention, result in better pain outcome measures than those subjects who are less ready to change maladaptive pain behaviors at baseline or vice versa (between group analyses). Secondary aims of this study were to investigate change in pain outcomes within groups following the intervention. Finally, patient demographics and clinical characteristics have been found to be correlated with reported reduced QOL and greater pain severity [26]. Included in these clinical characteristics is emotional well-being (EWB) at baseline. It has been suggested that emotional distress and disturbed emotional processing, may influence the outcome of pain management treatment [27, 28]. The present research therefore also investigated EWB as a construct at baseline, as a potential Independent Variable (IV) that may have contributed to patients` pain outcomes following telehealth GPMPs. We aimed to analyze baseline pain outcome measures in relation to those readier to change maladaptive pain behaviors versus those less ready to change, with reference to baseline EWB in connection to the 2 cohort groups.

Materials and Methods

Institutional Review Boards approval (IRB number: RNI00004802) was granted to complete this research study.

Subject Recruitment

The target population for this study was patients with chronic musculoskeletal pain (localized anywhere in the body or widespread). Non-probability sampling, based on convenience, placed subjects into one of five telehealth group-based treatment groups. Due to this research having aimed to examine telehealth via Zoom software (Zoom Video Communications, San Jose California, USA), GPMPs based on the COVID-19 crisis, there were no geographical restrictions as to where subjects were recruited from. Therefore, subjects were recruited globally. The aim was to have between 8 to 12 subjects in each GPMP group. Research assistants (RAs) were trained by the lead clinician on standardized screening procedures. The GPMP groups, each included subject from the exposed group and the unexposed group, and each received the exact same treatment. The lead clinician, with approximately 20 years of clinical interdisciplinary pain management experience, was a CP management expert with academic training in a variety of healthcare professions that each contribute to the treatment of patients with CP. Furthermore, the lead clinician`s background included development and running of in-person GPMPs for numerous in-patient and out-patient pain clinics. The lead clinician was blinded in terms of participants baseline EWB scores, as well as whether participants were in either the exposed or the unexposed cohort group. Subjects were also unaware of which group they fell in. This produced a `double-blinded` type of study.

Inclusion Criteria

1. Subjects who had musculoskeletal pain (spine and extremities) including osteoarthritis (OA) and rheumatoid arthritis (RA) for 3 months or more.
2. Subjects ranging from the age of 20 and upwards.

3. Subjects with or without referred pain.
4. Post-surgical pain persisting for longer than 3 months.
5. No major changes in existing medication or other treatments during the course of the intervention.
6. Subjects who were willing to participate in a group-based telehealth program.

Exclusion Criteria

1. Subjects who were unable to understand or speak English.
2. Pain due to malignancy.
3. Subjects who were waiting to undergo surgery or having had surgery within the past 3 months prior to the commencement of the intervention.
4. Subjects who were scheduled to start other types of treatment such as offered by Physical Therapists, etc. during the program.
5. Subjects with cognitive pathology.
6. Subjects who had unmanaged or unstable mood disorders, including clinical depression and anxiety). Subjects with such conditions were excluded if these conditions remained untreated via the means of professional help such as therapeutic counselling with a psychologist, for example, or medication prescribed by a psychiatrist or other relevant mental healthcare practitioner.
7. Subjects who had no access to internet or unable to use the Zoom software.

Inclusion and exclusion criteria were not officially verified. However, during recruitment, the RAs did ask subjects to be as transparent as possible. In addition, this request was further stipulated by the lead clinician during every session. Subjects were made to feel at ease with this by the RAs and lead clinician notifying subjects that they can contact either the RAs or lead clinician confidentially away from the group sessions.

Division of Subjects into 2 Cohort Groups

A Prospective Cohort Prognostic study design in which two groups followed over time, was conducted. Based on the PSOCQ scoring at baseline, as will be described, subjects were divided into the contemplation/action group (exposed group) and the the contemplation group (unexposed group).

The PSOCQ

The PSOCQ has 4 subscales: 1. Precontemplation: The 7 items represent the belief that management of the pain problem is primarily the responsibility of medical professionals. 2. Contemplation: The 10 items suggest consideration of adopting a self-management approach, but reluctant to give up a medical solution. 3. Action: The 6 items indicate that subjects are beginning to attempt to improve self-management skills. Maintenance: The 7 items represent commitment to pain self-management. The PSOCQ is scored using a 5-point Likert scale ranging from strongly agree (1 point) to totally disagree (5 points). Each subscale generates its own score by finding the mean value for each subscale based on the items answered falling under each sub-scale. The PSOCQ has demonstrated moderate to strong reliability and validity (Carr et al., 2006; Jensen et al., 2000; Robert D. Kerns & Rosenberg, 2000) [23, 29-31]. No cut-off scores have yet to be established for each sub-scale. In addition, it has been suggested that the tool may not necessarily be equipped sufficiently to classify subjects into a single discrete stage of behavioral change [29]. Thus, the tool may not be able to divide subjects, specifically with CP, into only one of the four phases when it comes to readiness to change maladaptive behavioral patterns [29]. In addition, no total score is made possible as part of the scoring system for the PSOCQ. With the above pitfalls in the scoring system of the PSOCQ, the measure is still acknowledged to be a useful tool in reference to patients who may be more ready to self-manage their CP symptoms, including maladaptive pain behaviors [31, 32]. Therefore, the current research, while acknowledging the potential problems in identifying subjects into solely one of the four PSOCQ sub-scales, and for further reasons outlined below, the two cohort groups in this research were formed.

Division into the Exposed Group and the Unexposed Group

Although all subjects completed the entire PSOCQ at pre-intervention, we realized that all 4 sub measures would not be of relevance to the main question surrounding this research; do subjects who are readier to change maladaptive pain behaviors at baseline, compared to those who are less ready, have greater changes in pain outcomes following our telehealth GPMP intervention? We recognized that the pre-contemplation sub measure results would not be useful for this research as we hypothesized that high scores in the pre-contemplative sub measure suggested no thoughts of even wanting to change maladaptive pain behaviors. a Thus, with respect to these particular subjects, the intervention would likely not be of value to change pain outcomes. Subjects needed some degree of readiness to change maladaptive pain behaviors, even a degree to where they were only contemplating change i.e. in the contemplative phase of the TTM. In addition, maintenance scores did not feasibly make sense for this intervention as these scores suggest that subjects who scored highest in this sub-measure have most likely already changed their behaviors. Furthermore, these subjects most likely already achieved improvements in managing to maintain better pain behaviors and therefore improved pain outcomes. As previously described, the PSOCQ does not have a total score attached to the instrument and no cut off scores for each sub measure. Therefore, for the main purpose of this research, to create two cohort groups (one being readier to change maladaptive pain behaviors and the other being less ready to change maladaptive pain behaviors) we theoretically and in turn methodologically calculated two equal and fair cohort groups as follows:

For our two cohort groups, to place subjects into either the exposed group or the unexposed group, we concentrated on the contemplation and action sub measure scores, with the mathematical methodology outlined below. Both these sub measures suggest that subjects with CP may be positioned to go through a telehealth GPMP to work on managing their overall pain experiences, and potentially change their pain outcomes. Again, it is worth noting, based on previous research, that the PSOCQ may not be sensitive

enough to allocate subjects into only one individual sub measure [29]. Therefore, as will be made clear below, our methodology for allocation of subjects into either the exposed or unexposed group, intertwines the scores in the contemplation and action sub measures of the PSOCQ.

Mathematical/Statistical Explanation; The Development of The Cut Off Scores for This Research

To establish the 2 cohort groups following subjects` completion of the PSOCQ, the action scale scores were subtracted from the contemplation scale scores to create the difference variable. The larger the difference, the greater a subject was based in the contemplation stage versus the action stage of RTC. On analysis of the data, the median value for the difference variable was 0.70. At 0.70, there was a noticeable break in the data distribution where the next score above was 0.87 and the next score below was 0.67. Therefore, 0.70 was set as the cut-point. Thus, subjects who scored 0.70 or more for the contemplation score versus the action score, were classified as being in the contemplation group (unexposed group). If the difference between the action score and contemplation score was less than 0.70, then those subjects were categorized as in the contemplation/action group (exposed group). When comparing the two groups, the contemplation subscale mean score was similar between the 2 groups. However, the action subscale mean score was almost a full point higher in the exposed group which further justified viewing the groups separately. Both theoretically and practically, it may be argued that those participants who were moving further towards the action subscale scores, as described above, had greater RTC maladaptive pain behaviors. Hence, these subjects were allocated in the exposed group rather than the unexposed group, as defined for the purposes of this research. The above calculations and distribution of subjects into either the exposed or unexposed group, further correlates with the previous study referred to earlier in which subjects do not necessarily fall into merely one of the PSOCQ sub-categories and hence the potential for overlap, as established in this research [29].

Dividing the sample into these two groups allowed us to identify subjects who fall into `high` and `low` RTC groups at baseline which enabled us to examine if RTC maladaptive pain behaviors produced significant differences in pain outcomes between the two cohort groups following telehealth GPMPs. As outlined previously, the association between PSOCQ scores and in-person intervention outcomes has been studied in the past, and has displayed mixed results [29, 30, 33]. To highlight once again, as a novel undertaking and primary aim of this current research, was to address the potential difference between the established cohort groups` changes in various pain manifestations following specifically telehealth GPMPs, not in-person GPMPs. To emphasize further, the 2 cohort groups that were formed were based on the degree of RTC maladaptive pain behaviors, as calculated at baseline.

Intervention Description: This 6-week telehealth GPMP intervention, initially developed for in-person group-based pain management programs, was established by the lead clinician of this research. The head clinician, over approximately the past 20 years, has been targeted by various international pain clinics to develop, coordinate, and run in-person GPMPs for both in-patient and out-patient programs. In addition, these in-person intervention programs have and continue to be implemented within the lead clinician`s own private clinical practice.

Table 2 identifies the key topics and therapeutic interventions for this telehealth GPMP intervention study. These topics are based on the in-person programs that were created and led by the study`s lead clinician, as described above. All study subjects, on a weekly basis (further description to follow), in telehealth GPMP sessions, were educated and taught various pain self-management intervention skills by the same lead clinician across all the groups in the same order and manner. In addition, within each weekly telehealth group-based intervention session, amongst all 5 groups, subjects were free to ask any questions to the lead clinician, and in turn relevant answers were provided.

Discussion amongst group members was also always encouraged and navigated by the lead clinician to facilitate group cohesion. Between each weekly session, subjects practiced the skills that had been taught in the previous session. Subjects then reported back to the group and lead clinician in their following weekly session, and necessary feedback was provided by the lead clinician to each group member. Importantly, a large proportion of these treatment modalities mentioned in Table 2, are beneficial for changing maladaptive pain behaviors and in turn benefiting various pain outcomes. For example, through educational models such as making subjects aware as early on in the program if they generally fit into the over-activity or/and under activity cycles, subjects gain conscious understanding around how their maladaptive behaviors may land up in a vicious circle of chronic pain [34]. As such, once subjects become mindful of their activity patterns surrounding their pain experiences, they are able to learn different psycho educational and physical therapeutic modalities to aid in changing their specific maladaptive behavioral patterns. This process encapsulates subjects moving through the stages of the TTM model, and ultimately aims to break their pain cycle, improve their pain outcomes and gain a better quality of life. Psychoeducational modalities such as Therapeutic Pain Neuroscience Education (TPNE), teaches the subjects through intensive pain neuroscience education about their physiological/molecular chronic pain mechanisms [35].

This importantly identifies that their pain is not a meter for tissue damage. Subjects having this knowledge immediately reduces fear and anxiety around their pain and opens the door to change maladaptive pain behaviors such as kinesiophobia due to fear of causing further tissue damage. Further psychoeducational modalities noted in Table 2 include graded exposure, graded activity and pacing [35- 42]. All these 3 therapeutic interventions, aid subjects to find correct baselines of different activities in their life, including education on physical exercise [43-45]. Again these modalities

assist with changing their over and/or under activity cycles, thereby also morphing their maladaptive pain behaviors [46-49], thereby improving overall pain outcomes. Psychological interventions, have been proven to empower patients with CP to become more active in their management and to use evidence-based psychological-behavioral management skills to employ throughout their lives [50, 51]. Psychological interventions, also noted in Table 2, such as Cognitive Behavioral Therapy (CBT), Dialectical Behavioral Therapy (DBT) and Acceptance Commitment Therapy, all taught in the program, are psychological treatments that have been proven to assist patients with CP to aid in changing their maladaptive thoughts and affects around their pain [50-57]. Therefore, most of the topics covered in the telehealth GPMPs are geared towards changing pain behaviors through practice and repetition from week to week. Achieving this goal ultimately allows movement through the TTM stages and improves pain manifestations.

For the purposes of this research, a telehealth group-based program format via Zoom software was used. The RAs, when needed, trained subjects on how to use the system, prior to the intervention beginning. The telehealth GPMP, delivered by the lead clinician, included 6 sessions (1 session a week), 3 hours per session. Shortly prior to the first session (1-2 days prior to the 1st session), participants were required to complete online, via Qualtrics software (Qualtrics Software Company, Provo Utah, USA), various pain outcome measures at baseline. A Power Point Presentation (PPP), produced by the lead clinician, was used to navigate each session in combination with a supplementary pain management manual for each subject, also developed by the lead clinician. The main topics that were covered in the telehealth GPMP sessions (and within the manual) are displayed in Table 2. The manual also incorporated homework tasks for the subjects to undertake between sessions, and to practice various skills that had been taught to them during the weekly get-together sessions. At the end of the final session (1-2 days following the last session) each subject was again required to complete the outcome measures mentioned earlier. Subjects' completion of the program required they miss no more than 1 of the 6 required sessions. In addition, if a session was missed, the subject had to make up the 1 session they missed by reading the specific content in the manual, as well as having an individual one-on-one telehealth session with the lead clinician to clarify any questions the subjects may have regarding missed subject matter. To note, besides the same dosage of treatment being administered to all groups and mean adherence (attendance) being calculated, no other measures of fidelity were used.

Table 2: Group-based Pain Management Programs Content.

Content within (Telehealth) Group-Based Pain Management Program: Discussions and Sessions
General group Introduction: Ice-breakers
Subjects introduce themselves
Clinician introduced himself/herself
Outline of aims of the program
Shared Group goals
Agreed upon group-rules
Impact of Pain on individuals` lives: Biopsychosocial impact
Pain cycles and activity cycles: over and under activity leading to `Boom and Bust` idea
Changing Maladaptive Pain Behaviors
SMART goal setting: Short-term, medium-term and long-terms goal setting
Pain diaries: Yes or No?
Therapeutic Pain Neuroscience Education (TPNE): What is pain?
The importance of exercise and movement: exercise and movement principles for chronic pain
Graded Activity, Graded exposure and Pacing: Use to achieve SMART goals without flaring up pain
Thoughts, Feelings and Behavior: Cognitive Behavioral therapy (CBT) and Dialectical Behavioral Therapy (DBT); Challenging unhelpful thoughts.
Psychological relaxation/stress management exercises and techniques; including mindfulness, meditation and other relaxation exercises
Flare-Up Management
Diet and Chronic Pain
Other topics and questions that group members requested to be covered through the course of the program

Abbreviations: SMART goals: Specific, Measurable, Attainable, Realistic, Time-based; TPNE: Therapeutic Pain Neuroscience Education; CBT: Cognitive Behavioral Therapy; DBT: Dialectical behavioral Therapy; GPMP: Group-Based Pain Management program

Outcome Measures

The primary outcome measures chosen for this study included the Tampa Scale of Kinesiophobia (TSK), the Pain Catastrophizing Scale (PCS) and the Pain Self-Efficacy Questionnaire (PSEQ). Although the intervention targets the whole pain experience, evidence has revealed that the biopsychosocial nature of GPMPs, has a greater impact on psychosocial variables than pain intensity. Pain intensity seems to be be a far more rigid pain variable to significantly clinically modify through pain management programs and other CP interventions [50, 58-60]. The secondary outcome measures for the purpose of this study were the Visual Analogue Scale (VAS) and the Short Form Health Survey -36 (SF-36-total). Baseline outcome measures included: the PSEQ, the PCS, the TSK, the SF-36 total, and the VAS. The SF-36 well-being sub measure was used to measure subjects` EWB at baseline. Score results for the questionnaires suggest the following: Lower scores on the VAS, PCS-total and TSK suggest less pain intensity, less pain catastrophizing and less kinesiophobia respectively. Thus, change in these scores with a negative value represent improvement in these three outcome measures (post-treatment scores minus pre-treatment scores). Higher scores on the PSEQ, and SF-36 total suggest greater pain self-efficacy and greater QOL. Therefore, change in scores with positive values suggest improvements in these two outcome measures (again post treatment scores minus pre-treatment scores).

Subject Demographic and Clinical Characteristics

Subject demographics were also collected by the RAs in the screening process. The main demographics and clinical characteristics required for collection were gender, age, ethnicity (country of origin/nationality), site of pain on the body, number of months with pain, and EWB at baseline. EWB was measured through the SF-36 EWB subscale as described previously.

Statistical Procedures

In addition to tests for normality of data distribution, all underlying assumptions for each statistical test were also examined before conducting the specific statistical examination. Eta-squared values were used to measure the association between EWB and the 2 groups. In addition, Independent T-tests were used to compare the means for EWB at baseline between the 2 groups. Again, the primary aim in this study was to highlight the change in mean pain outcome scores from pre- to post-intervention rather than just the post-intervention means scores for each group. This was done to allow us to interpret, to a greater clinical extent, whether subjects who have higher RTC versus lower RTC at baseline appear to have greater or less change in their various pain outcomes measures following telehealth GPMPs. For the difference in scores between the 2 cohort groups at each stage in the intervention, independent T-tests were used. Dependent T-tests were also used for the within subjects` comparison for each group at post-treatment. Cohens d effect sizes were calculated (the online calculator found at https://www.socscistatistics.com/effectsize/) to determine Cohen`s d effect size for both independent and dependent T-tests. In medical psychoeducation research studies, including pain management programs, that compare different educational interventions, the effect size is the size of the difference between groups. The absolute effect size is the difference between the average, or mean, outcomes in two different intervention groups [61]. The current research was not designed to compare groups with different interventions. All telehealth GPMP groups received the exact same intervention and therefore, Cohen`s d values were not intended to function as absolute values.

Cohen`s d, specifically in this study, was used as the primary statistical measure to evaluate the effectiveness of the same intervention provided to all the telehealth GPMP groups and to understand the magnitude of the effect size between the 2 cohort groups receiving the same intervention. Effect sizes are believed to be the most crucial outcome of empirical studies [62]. The most important advantage of most effect sizes is that they do not rely on the sample size of a study, and therefore they can express the magnitude of an effect independent of the size of the study [63]. Effect sizes also manage to avoid the challenging and often arbitrary rationality of inferential statistics such as tests for significance [63]. Effect sizes allow researchers to present the size of reported effects in a standardized metric, which can be interpreted regardless of the scale used in the dependent variable [62]. This allows researchers to provide the practical and/or clinical significance of the results instead of only reporting the statistical significance [62]. In the case of the present research, the statistical significance, although reported, is potentially of less importance due to the moderate sample size and does not necessarily provide the reader with as valuable information as does the Cohen`s d results. Based on the benchmark set by Jacob Cohen in 1988, Cohen`s d results are commonly interpreted as small effect sizes (d=0.2), medium effect sizes (d=0.5) and large effect sizes (d=0.08) [62].

As a secondary statistical measure in this research, statistical significance set at $p<0.05$ with a 95% Confidence Interval (CI). Finally, Chi-Square was used to analyze the groups based on the nominal clinical and demographic characteristics at baseline.

Results

Table 3 outlines the main demographic statistics comparing the exposed and unexposed groups. Based on dividing the subjects into the 2 groups, there were 22 subjects allocated into the exposed group and 20 subjects within the unexposed group. No attrition was present in the program. Some subjects did miss a single session at various stages. The mean attendance amongst all subjects was 5.54 sessions (SD: 0.70). Focusing on EWB at baseline, the exposed group scored 64.45 (19.12) and the unexposed group scored 53.80 (17.61). These differences did not meet statistical significance ($p>0.05$), however the effect size for the difference between the groups was moderately large for EWB ($d=0.60$; $\eta^2=0.34$). A variance in EWB (IV) of 38.7% was explained by group membership at baseline. Associations between EWB for the 2 groups with respect to the various pain outcomes are presented in Table 4. The exposed group had greater associations between

EWB and change in pre-post treatment outcome scores for most of the outcome measures. However, based on how the calculations were executed for each instrument, although statistically significant ($p<0.05$), positive and moderate correlations were found for 2 of the primary pain outcome measures with EWB (PCS-Total; r=0.50 and the TSK r=0.50). The positive correlation suggests a decrease in change from pre-to post-intervention for the exposed group (reduced improvements associated with greater EWB).

Table 3: Main Demographic Statistics and Comparison Between the Contemplation/Action Group (Exposed Group) and Contemplation Group (Unexposed Group) at Baseline.

	Whole group N=42 Mean (sd), Freq (n, %)	Exposed Group Mean (sd), Freq (n, %), N=22	Unexposed Group Mean (sd), Freq (n, %) N=20	• Association between Groups (DV) and age, length of time with pain and EWB at baseline (IVs): Eta and Eta-Squared. • Difference between the groups based on Age, length of time with pain and Emotional wellbeing: t-statistic, degrees of freedom (df), p-value, 95% Confidence Interval (CI). Cohen`s d effect size. • Association between Groups (DV) and Gender, Country of Origin and Site of Pain (IVs): p-value and Chi-squared
Age (years)	51.47 (16.27)	48.59 (14.93)	54.35 (17.61)	• Eta=0.92, Eta-squared=0.860 (86.0%) • t=1.14, df=40, p=0.26, 95% CI: -4.40 to 15.91, *d*=0.35
Length of Time with Pain (years)	15.30 (14.16)	13.02 (11.06)	17.45 (16.92)	• Eta=0.64, Eta-squared=0.408 (40.8%) • t=1.01, df=40, p=0.31, 95% CI: -4.41 to 13.26, *d*=0.31
Emotional Well-being (SF-36 EWB)	59.38 (18.60)	64.45 (19.12)	53.80 (17.61)	• Eta=0.62, Eta-squared=0.387 (38.7%) • t=-1.91, df=40, p=0.06, 95% CI: -21.91 to 0.60, *d*=0.60
Gender				
• Male	• n=9 (21.4%)	• n=4 (18.2%)	• n=5 (20%)	p=0.59
• Female	• n=33 (78.6%)	• n=18 (81.8%)	• n=15 (80%)	Chi-square=0.28
Country of Origin				
• SA	• n=27 (64.3%)	• n=13 (59.1%)	• n=14 (70%)	p=0.46
• Other	• n=15 (35.7%)	• n=9 (40.9%)	• n=6 (30%)	Chi-square=0.54
Site of Pain				
• Multiple sites:	• n=26 (61.9%)	• n=15 (68.2%)	• n=11 (55%)	
• Upper limb only:	• n=1 (2.4%)	• n=0 (0%)	• n=1 (5%)	
• Lower limb only:	• n=1 (2.4%)	• n=1 (4.5%)	• n=0	
• Spine (1 or more regions):	• n=11 (26.2%)	• n=5 (22.7%)	• n=6 (30%)	
• Other:	• n=3 (7.1%)	• n=1 (4.5%)	• n=2 (10%)	
Site of Pain divided into:				
➢ Multiple sites:	• n=26 61.94%)	• n=15 (68.2%)	• n=11 (55%)	
➢ Other (Spinal, extremities, other):	• n=16 (38.1%)	• n=7 (31.8%)	• n=9 (45%)	p=0.38 Chi-square=0.77

Abbreviations: n= number of subjects, sd= standard deviation, Freq=Frequency, EWB= emotional well-being, df=degrees of freedom, 95% CI=95% Confidence Interval

Table 4: Pearson`s Correlation Table for Baseline Emotional Well-Being (IVs) and Pain Outcome Measures as the DVs; Contemplation/Action Group (Exposed Group) versus the Contemplation Group (Unexposed Group).

Variable of Interest	Group	Measurement time	VAS: r (p-value)	PSEQ: r (p-value)	PCS-Total: r (p-value)	TSK: r (p-value)	SF-36 Total: r (p-value)
Emotional well-being at baseline (SF-36 EWB sub-measure)	Exposed group	Pre-treatment	0.13 (0.55)	-0.28 (0.20)	0.31 (0.20)	0.31 (0.16)	*-0.50 (0.02)
		Post-treatment	0.01 (0.94)	-0.30 (0.22)	0.33 (0.13)	0.10 (0.72)	-0.35 (0.10)
		Pre-post difference	-0.30 (0.20)	0.28 (0.21)	*0.50 (0.03)	*0.50 (0.03)	*0.65 (0.00)
	Unexposed group	Pre-treatment	-0.30 (0.24)	*0.50 (0.03)	-0.33 (0.15)	-0.31 (0.20)	*0.51 (0.02)
		Post-treatment	0.14 (0.56)	0.10 (0.78)	-0.20 (0.44)	-0.10 (0.80)	0.22 (0.36)
		Pre-post difference	-0.42 (0.07)	-0.42 (0.07)	-0.20 (0.45)	-0.21 (0.40)	-0.30 (0.24)

Abbreviations: VAS=Visual Analogue Scale, PSEQ= Pain Self-Efficacy Questionnaire, PCS= Pain Catastrophizing Scale, TSK= Tampa Scale of Kinesiophobia, SF-36 Total= Total SF-36 Score (Overall Quality of Life), SD= Standard Deviations, 95% CI= 95% Confidence Interval). *Significance Set at $p<0.05$

Independent-Samples T-Tests Comparing the Groups on Pain Outcome Measures (Pain Manifestations) at Baseline

A comparison of the mean scores at baseline (pre-treatment) for pain manifestations between the 2 groups are displayed in Figure 1. Table 5 presents the baseline mean outcome scores and standard deviations for both the exposed group and the unexposed group. To note, all measures at baseline, presented with better scores (less pain manifestations) in the exposed group than the unexposed group. The Cohen`s d effect sizes between the 2 groups at baseline, ranged from large (0.81), to extremely large in magnitude (1.31). The primary outcome measures had large to extremely large effect sizes; PSEQ (d=0.81), PCS-Total (d=1.31) and TSK (d=1.11). Independent-samples t-test results, as well as Cohen`s d effect sizes for the baseline differences between the 2 groups are presented in Table 5. There was a statistically significant difference between the 2 groups for all baseline pain outcome measures ($p<0.05$), with the unexposed group having poorer results for all outcome measures.

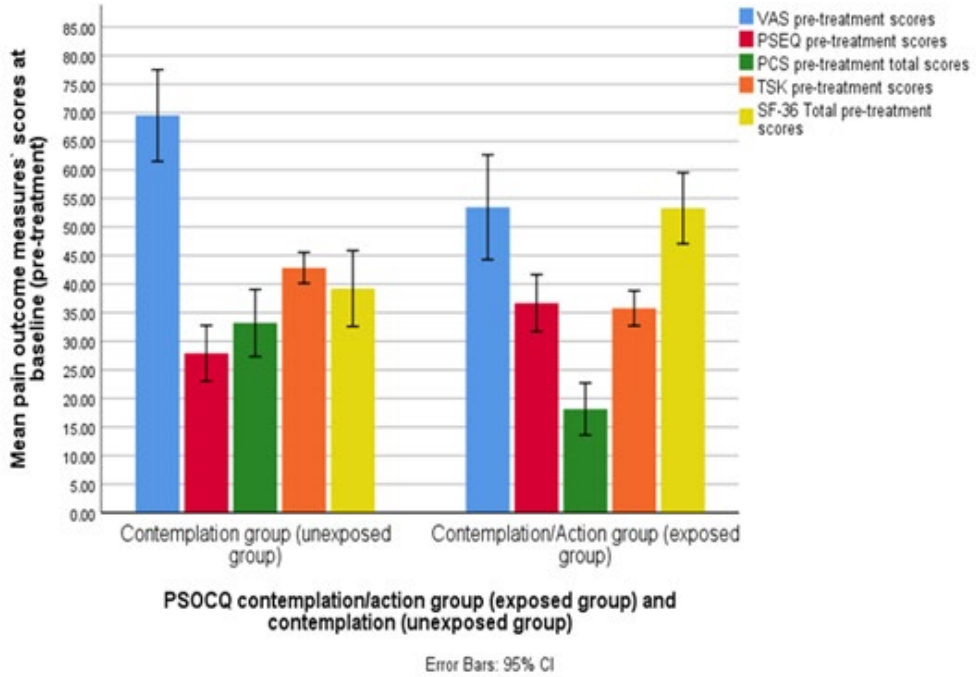

Figure 1: Mean scores and error bars at the 95% Confidence Interval (95% CI) of all pain outcome measures at baseline (pre-treatment) with a comparison between the unexposed group (contemplation group) and the exposed group (contemplation/action group).

Abbreviations: VAS=Visual Analogue Scale (pain intensity), PSEQ=Pain Self Efficacy Questionnaire, PCS=Pain Catastrophizing Scale, TSK=Tampa Scale of Kinesiophobia, SF-36 Total- Overall/Total SF-36 score (overall Quality of Life).

Table 5: Main Statistics for the Contemplation/Action Group (Exposed Group) versus the Contemplation Group (Unexposed Group); Between Group Comparisons for baseline Pain Outcome Measure Scores (Pain Manifestations).

Pain Outcome Measures (Pain Manifestations)	Exposed Group (Contemplation/Action Group); n=22	Unexposed Group (Contemplation Group); n=20	Independent Samples-T-Test Results Between Group Comparisons for Baseline Scores. (t score, p-value, 95% CI of the mean difference, Cohen`s *d* effect size)
VAS ❑Baseline (pre-treatment) Mean (SD):	• 53.45 (20.65)	• 69.50 (17.12)	**Baseline:** *p=0.00, 95% CI: 4.14 to to 27.94, *d*=0.84
PSEQ ❑Baseline (pre-treatment) Mean (SD):	• 36.68 (11.26)	• 27.90 (10.40)	**Baseline:** *p=0.01, 95% CI: 15.56 to -1.99, *d*=0.81
PCS-Total ❑Baseline (pre-treatment) Mean (SD):	• 18.13 (10.30)	• 33.20 (12.51)	**Baseline:** *p=0.02, 95% CI:7.94 to 22.18, *d*=1.31
TSK ❑Baseline (pre-treatment) Mean (SD):	• 35.77 (6.89)	• 42.85 (5.78)	**Baseline:** *p=0.00, 95% CI= 3.08 to 11.06, *d*=1.11
SF-36 Total (Overall) ❑Baseline (pre-treatment) Mean (SD):	• 53.28 (14.01)	• 39.22 (14.15)	**Baseline:** *p=0.00,95% CI=-22.85 to -5.27 *d*=0.99

Abbreviations: Means Standard Deviations (SDs), Significance around Independent-Samples T-Test Results and Effect Sizes (Cohen`s d Results); VAS=Visual Analogue Scale (Pain Intensity), PSEQ=Pain Self-Efficacy Questionnaire, PCS=Pain Catastrophizing Scale, TSK=Tampa Scale of Kinesiophobia, SF-36 Total=Overall/Total SF-36 Score (Overall Quality of Life). *Significance Set at p<0.05

Independent-Samples T-Tests Comparing the Groups on Change in Pain Outcome Scores (Pain Manifestations) from Pre- to Post-Treatment

The change in scores for all outcome measures, showed greater change in scores for the unexposed group versus the exposed group. Figure 2 demonstrates the scores at post-treatment for each group. Table 6 indicates that all pain outcome measures revealed a larger difference in scores (improvements) from pre to post intervention for the unexposed group. The effect sizes (Cohen`s d effect size) between the 2 groups for the difference in mean scores from pre-to post-treatment for each pain outcome measure evaluated, ranged from medium (d=0.54) to very large (d=0.74). The primary outcome measures displayed moderately large effect sizes between the groups; PSEQ (d=0.55) and was not statistically significant (p>0.05), PCS-Total (d=0.70) and was statistically significant (p<0.05), and the TSK (d=0.65) and was not statistically significant (p>0.05). Table 6 summarizes the results of the independent-samples t-test and Cohen`s d effect sizes for the pre to post treatment difference mean scores. Based on the independent-samples t-test statistical analyses, apart from the PCS-Total scores and SF-36 Total, all differences in mean scores from pre-treatment to post-treatment did not have statistically significant differences between the groups.

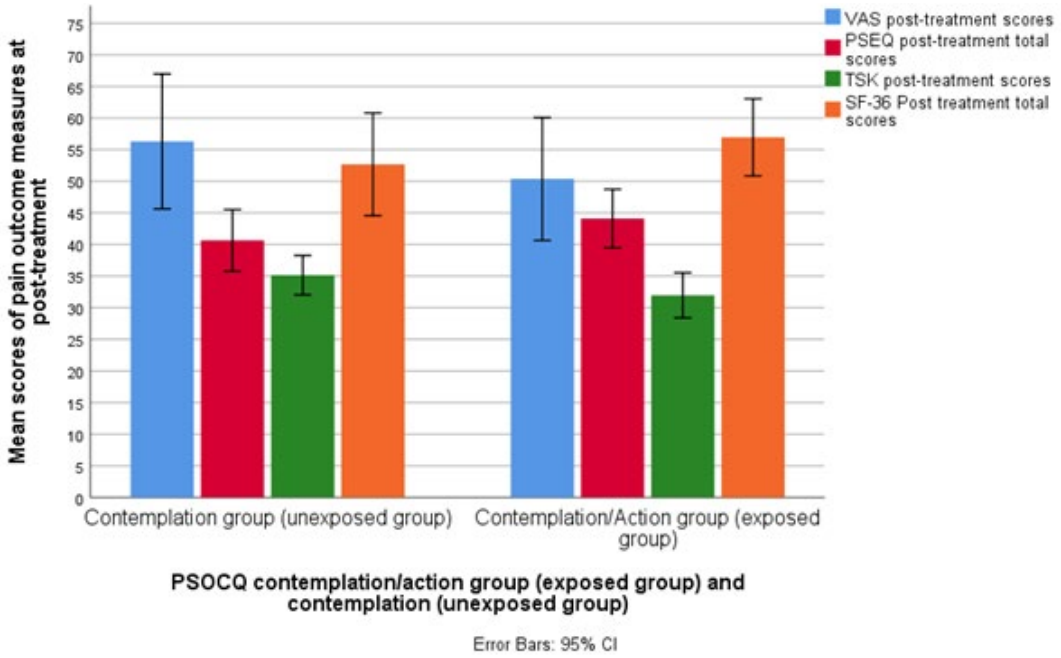

Figure 2: Mean scores of all pain outcome measures and error bars at the 95% CI at post-treatment with a comparison between the unexposed group (contemplation group) and the exposed group (contemplation/action group).

Table 6: Main Statistics for the Contemplation/Action Group (Exposed Group) versus the Contemplation Group (Unexposed Group); Between Group Comparisons for change in scores from baseline to post-treatment.

Pain Outcome Measures (Pain Manifestations)	Exposed Group (Contemplation /Action Group); n=22	Unexposed Group (Contemplation Group); n=20	Independent-Samples T-Test Between Groups Comparisons: Pre-Post Treatment Score Mean Differences (p-value, 95% CI of the mean difference, Cohen`s *d* effect size) between the Groups for:
VAS			
❑Baseline (pre-treatment) Mean (SD):	• 53.45 (20.65)	• 69.50 (17.12)	
❑Post-treatment Mean (SD):	• 50.36 (21.89)	• 56.30 (22.79)	
❑Pre-treatment Post-Treatment Difference Mean (SD):	• -3.09 (20.45)	• -13.20 (16.64)	❑**Pre-treatment post treatment difference:** p=0.17, 95% CI: -19.41 to 3.62, *d*=0.54
PSEQ			
❑Baseline (pre-treatment) Mean (SD):	• 36.68 (11.26)	• 27.90 (10.40)	
❑Post-treatment Mean (SD):	• 44.09 (10.45)	• 40.65 (10.39)	
❑Pre-treatment Post-Treatment Difference Mean (SD):	• 7.40 (8.23)	• 12.75 (10.82)	❑**Pre-treatment post treatment difference:** p=0.10, 95% CI: -1.08 to 11.69, *d*=0.55
PCS-Total			
❑Baseline (pre-treatment) Mean (SD):	• 18.13 (10.30)	• 33.20 (12.51)	
❑Post-treatment Mean (SD):	• 13.13 (10.77)	• 18.70 (11.63)	
❑Pre-Treatment Post-Treatment Difference Mean (SD):	• -5.00 (7.64)	• -14.50 (11.51)	❑**Pre-treatment post treatment difference:** *p=0.01, 95% CI: -16.13 to -2.86, *d*=0.70
TSK			
❑Baseline (pre-treatment) Mean (SD):	• 35.77 (6.89)	• 42.85 (5.78)	
❑Post-Treatment Mean (SD):	• 31.95 (8.04)	• 35.15 (6.64)	
❑Pre-Treatment Post-Treatment Difference Mean (SD):	• -3.81 (4.53)	• -7.70 (7.03)	❑**Pre-treatment post treatment difference:** p=0.10, 95% CI: -8.14 to 0.37, *d*=0.65
SF-36 Total (Overall)			
❑Baseline (pre-treatment) Mean (SD):	• 53.28 (14.01)	• 39.22 (14.15)	
❑Post-Treatment Mean (SD):	• 56.94 (13.75)	• 52.67 (17.35)	
❑Pre-Treatment Post-Treatment Difference Mean (SD):	• 3.65 (11.42)	• 13.45 (14.60)	❑**Pre-treatment post treatment difference:** *p=0.03, 95% CI: 0.93 to 19.66 *d*=0.74

Abbreviations: Means Standard Deviations (SDs), Significance around Independent-Samples T-Test Results and Effect Sizes (Cohen`s d Results); VAS=Visual Analogue Scale (Pain Intensity), PSEQ=Pain Self-Efficacy Questionnaire, PCS=Pain Catastrophizing Scale, TSK=Tampa Scale of Kinesiophobia, SF-36 Total=Overall/Total SF-36 Score (Overall Quality of Life). *Significance Set at p<0.05

Dependent-Samples T-Tests for Each Group Based on Post-Treatment Changes in Scores; Difference in Scores for Pain Outcome Measures (Pain Manifestations) from Pre-to Post Treatment.

The 5 pain outcome measures assessed at post-treatment displayed better scores for the exposed group. A comparison of the mean scores at post-treatment for pain manifestations between the 2 groups are presented in Figure 2 and Table 7. It is noted that the exposed group scored better on all post-treatment outcome measures than the unexposed group. However, although the post-treatment scores were higher for the exposed group than the unexposed group, the magnitude of change from pre to post intervention was greater for the unexposed group. As noted in Table 7, the Cohen`s d effect sizes for the exposed group ranged from small (d=0.14) to moderately large (d=0.68). The effect sizes for the unexposed group ranged from moderately large (d=0.65) to extremely large (d=1.23). Highlighting the primary outcome measures, all effect sizes in the unexposed group were extremely large; PSEQ (d=1.22), PCS (d=1.20) and the TSK (d=1.23). In addition, all 3 were found to be statistically significant ($p<0.05$). In comparison, although statistically significant changes were noted ($p<0.05$), the exposed group displayed moderate effect sizes for the primary outcome measures; PSEQ (d=0.68), PCS (d=0.47) and the TSK (d=0.51) (refer to Table 7).

Although not a Randomized Control Trial, we have also included, as a supplementary document, a CONSORT checklist. Please see **Supplementary Document 1.**

Table 7: Main Statistics for the Contemplation/Action Group (Exposed Group) and the Contemplation Group (Unexposed Group) for changes in scores from pre- to post-treatment; Within Group Comparisons.

Pain Outcome Measures (Pain Manifestations)	Exposed Group (Contemplation/ Action Group); n=22	Unexposed Group (Contemplation Group); n=20	Paired Samples-T-Test Results Within Group Comparisons for (p-value, 95% CI, Cohen`s *d* effect size)
VAS			
❑Baseline (pre-treatment) Mean (SD):	• 53.45 (20.65)	• 69.50 (17.12)	❑**Exposed Group:** p=0.48, 95% CI: -5.98 to 12.16, *d*=0.14
❑Post-treatment Mean (SD):	• 50.36 (21.89)	• 56.30 (22.79)	❑**Unexposed Group:** *p=0.00, 95% CI: 5.36 to 21.03, *d*=0.65
❑Pre-treatment Post-Treatment Difference Mean (SD):	• -3.09 (20.45)	• -13.20 (16.64)	
PSEQ			
❑Baseline (pre-treatment) Mean (SD):	• 36.68 (11.26)	• 27.90 (10.40)	❑**Exposed Group:** *p=0.00, 95% CI: -11.52 to -3.30, *d*=0.68
❑Post-treatment Mean (SD):	• 44.09 (10.45)	• 40.65 (10.39)	❑**Unexposed Group:** *p=0.00, 95% CI: -18.04 to -7.45, *d*=1.22
❑Pre-treatment Post-Treatment Difference Mean (SD):	• 7.40 (8.23)	• 12.75 (10.82)	
PCS-Total			
❑Baseline (pre-treatment) Mean (SD):	• 18.13 (10.30)	• 33.20 (12.51)	❑**Exposed Group:** *p=0.02, 95% CI: 0.68 to 9.31, *d*=0.47
❑Post-treatment Mean (SD):	• 13.13 (10.77)	• 18.70 (11.63)	❑**Unexposed Group:** *p=0.00, 95% CI: 9.11 to 19.89, *d*=1.20
❑Pre-Treatment Post-Treatment Difference Mean (SD):	• -5.00 (7.64)	• -14.50 (11.51)	
TSK			
❑Baseline (pre-treatment) Mean (SD):	• 35.77 (6.89)	• 42.85 (5.78)	❑**Exposed Group:** *p=0.00, 95% CI: 1.25 to 6.38, *d*=0.51
❑Post-Treatment Mean (SD):	• 31.95 (8.04)	• 35.15 (6.64)	❑**Unexposed Group:** *p=0.00, 95% CI: 4.14 to 11.23, *d*=1.23
❑Pre-Treatment Post-Treatment Difference Mean (SD):	• -3.81 (4.53)	• 7.70 (7.03)	
SF-36 Total (Overall)			
❑Baseline (pre-treatment) Mean (SD):	• 53.28 (14.01)	• 39.22 (14.15)	❑**Exposed Group:** p=0.26, 95% CI: -10.26 to 2.95, *d*=0.26
❑Post-Treatment Mean (SD):	• 56.94 (13.75)	• 52.67 (17.35)	❑**Unexposed Group:** *p=0.00, 95% CI: -20.07 to -6.83, *d*=0.84
❑Pre-Treatment Post-Treatment Difference Mean (SD):	• 3.65 (11.42)	• 13.45 (14.60)	

Abbreviations: Means Standard Deviations (SDs), Significance around Dependent-Samples T-Test Results and Effect Sizes (Cohen`s d Results); VAS=Visual Analogue Scale (Pain Intensity), PSEQ=Pain Self-Efficacy Questionnaire, PCS=Pain Catastrophizing Scale, TSK=Tampa Scale of Kinesiophobia, SF-36 Total=Overall/Total SF-36 Score (Overall Quality of Life). *Significance Set at $p<0.05$

Discussion

Prior research demonstrated short-term benefits surrounding an in-person 8-week interdisciplinary pain program [64]. According to the TTM of change, subjects who score lower on the precontemplation phase and higher on the contemplation and action stages, tend to be more adaptable subjects in terms of selection for and improvement through pain self-management programs [65-67]. The above may lie in contrast to the current telehealth GPMP study which defined the sample into two distinct groups: the unexposed group and the exposed group. Overall, the results show that the unexposed group (less RTC) had greater improvement in scores from pre- to post-intervention than the exposed group (greater RTC).

Emotional Wellbeing

Pre-intervention EWB is witnessed to be stronger in those subjects in the exposed group than those in the unexposed group (see raw mean scores Table 3). This theory may lend itself to the notion that a stronger psychological sense of self, is associated with heightened RTC at specifically pre-intervention. A recent investigation found that greater EWB at baseline, predicted lower risk of severe pain at long term follow up [68]. This result is further supported by other past research which suggest that people with ultimately greater subjective well-being showed significantly lower pain intensity linked to reduced pain catastrophizing which further mirrors the present research (see raw mean scores in Tables 6 and 7) [69]. Therefore, when looking at EWB at baseline, the current telehealth GPMP research correlates with the above findings. Subjects who were in the exposed group were found to have better raw and mean scores in EWB at baseline suggesting stronger EWB is associated with greater RTC.

The current research also found that, although having weaker EWB at baseline (unexposed group), subjects who are less ready to change at pre-intervention appear to improve in PCS-Total, TSK and SF-36 Total pain outcome scores more than subjects with greater EWB at baseline (those in the exposed group). This result may be due to subjects in the unexposed group forming tighter therapeutic alliances (TAs) with their clinician. The stronger TA may be based on starting with weaker EWB, thus requiring heightened support from the clinician which in turn aids in improving changes in pain manifestations. This process may be considered a sub-conscious mechanism that possibly plays out between the subjects and the clinician running the telehealth GPMPs. Clinicians may not have to be fully aware of patients` EWB and RTC status at the start of the intervention for a greater TA to develop. Further research may be required to examine this interplay between clinicians and subjects with chronic pain. Another hypothesis may be that subjects less ready to change maladaptive pain behaviors at pre-intervention, may gain from being part of a group format. For example, the relationships formed via group dynamics may serve as a strong foundation for subjects with weaker EWB at baseline. In turn, this may strengthen their capacity for emotional growth through the intervention and ultimately show improvements in the various pain outcomes following GPMPs. Further research to support this theory would be of great relevance to dissect this topic further.

Baseline Measures` Comparisons Between the Groups; Between Group Comparisons

Prior to the telehealth group-based pain management program (GPMP), subjects in the exposed group scored better in all their pain manifestations than those in the unexposed group. Patients with CP who score higher in RTC maladaptive pain behaviors, such as those whom are in the exposed group versus those in the unexposed group, may in fact embrace a cognitive shift in terms of thinking about alternate ways of dealing with the consequences of their CP [23]. This in turn may further explain the baseline pain outcome measures` results. The current research suggests that there was a statistically significant difference ($p<0.05$) between the 2 groups on all baseline outcome measures. The exposed group scored better on all 3 primary outcome measures than the unexposed group. To note, the exposed group versus the unexposed group had larger effect size differences when comparing their baseline scores. Potentially, a cognitive change, described previously, including subjects understanding and meaning behind their pain, may be core elements to explore around these results. Both insight into neurophysiological and psychosocial factors, may act as catalysts into this alteration when it comes to creating a sense of meaning underlying one`s pain. It has been demonstrated in previous studies that early changes in pain acceptance, such as prior to the start of a pain management program, were associated with better pain outcomes [70]. Therefore, it may be fair to hypothesize that these individuals have an overall better pain perception/experience prior to self-management interventions and thus score higher in the PSOCQ contemplation and action sub-scales, and hence are placed in the exposed group. Consequently, it may be better understood why there were superior pain outcomes in the exposed group at baseline versus those individuals in the unexposed group. Individuals in the unexposed group at baseline, may be seen to be at a different stage, cognitively, underlying their pain insights, and thus score worse on baseline pain outcome measures.

Pre-Post Treatment Difference in Scores from Baseline to Post-Intervention; Between Groups Comparisons

The pain outcome instruments used in this study are understood to allow clinicians and researchers to demonstrate both statistically and clinically significant portrayals of both pre-treatment measures and post-treatment effects [60]. Previous research has noted that patients` attitudes towards CP self-management at the start of treatment, has been found to influence the extent to which they improve [33]. This implies that patients who potentially score higher on the PSOCQ at baseline (i.e., subjects in the exposed group) may have more positive attitudes towards changing their maladaptive pain behaviors and should therefore have a greater difference in change in the pain outcomes, in contrast to those subjects who might not be as ready to change their pain behaviors.

It is clear through previous in-person pain management studies,

that pain outcome measures such as the TSK and PSEQ, for example, showed statistically significant changes and were predicted by baseline PSOCQ scores [71]. Previous research suggests that patients who predominantly fall under a high PSOCQ-action category, ultimately end up following in-person pain management interventions with elevated improvements in various pain outcome measures such as pain severity, interference and activity level [72]. Following in-person intervention, subjects showed improvements in pain catastrophizing, kinesiophobia, and self-perceived disability (pain self-efficacy) [64, 71, 73]. An increased allegiance to self-management of CP, may serve as a facilitator to successful treatment [25, 30]. Therefore, with reference to the current research findings focusing purely on the post-intervention scores, it appears that subjects who fell within the exposed group i.e., subjects who have larger commitment to self-managing their pain and willingness to change their behaviors, have superior outcome results following the telehealth intervention. However, importantly, although our telehealth GPMPs research revealed an overall improvement in the pain outcomes, for both the exposed and unexposed group, it was the unexposed group that had the larger magnitude of improved changes and effect sizes in the primary pain outcome measures from baseline to post-treatment.

This included the PSEQ, PCS and TSK scores (d=1.22, d=1.20 and d=1.23 for pain self-efficacy, pain catastrophizing and pain kinesiophobia respectively (refer to Table 7). In addition, as for the secondary outcome measures, the unexposed group also demonstrated greater changes in scores than the exposed group. These greater changes in magnitude in the unexposed group may reflect a greater scope for change based on lower pre-intervention scores in comparison to the exposed group. This potential increased room for difference in scores in the unexposed group from pre to post intervention may be a suggested by the group`s increased positive response to the intervention; potentially having moved through the precontemplation phase further towards the action phase, therefore increasing the amount of change in the pain outcome scores. Further reasoning underlying the above result is expanded upon in the following section.

Exposed Versus Unexposed Group; Within Groups Comparison

When analyzing the actual change in scores of the primary outcome measures when comparing the two groups (Table 7), there was once again notably larger pre-treatment-post-treatment difference in scores in the unexposed than the exposed group. The above results, therefore, echo the previous research around in-person interdisciplinary pain management programs having a positive effect on psychosocial pain outcome measures,[35, 58, 74-76] and therefore highlights that telehealth GPMPs seem to also have the same effect on these pain outcome measures. Previous research has supported the argument that some individuals, prior to the start of rehabilitation, might already be at high levels of RTC, specifically based within the action stage [66].

Therefore, during the research referenced above, these subjects only required minimal encouragement and support to reach goals they had set for themselves and hence less difference in scores from baseline to post-treatment were noted [66]. Therefore, it may be argued that through clinical, mathematical and statistical measures, subjects in the unexposed group versus those in the exposed group may have greater capacity for change in pain manifestations, based on potential ceiling effects for the exposed group. When addressing the action stage (subjects falling within the exposed group), research has suggested that positive alterations from the precontemplation or contemplation stage in RTC, towards the action stage may be a result of improvements in individuals` mood through the course of a pain management program which may also add to positive changes in pain outcomes [77]. To recall, subjects in the unexposed group scored less in EWB at baseline versus those in the exposed group. Therefore, subjects who start off a telehealth GPMP intervention being less ready to change their pain behaviors i.e. subjects in the unexposed group, seem to land up with greater changes in the majority of their pain manifestations following a telehealth GPMP. This may further reflect what Burns et al. has suggested [76].

Whether CP is treated via an interdisciplinary pain management program or through conventional medical treatment, it has been found that both treatment types have somewhat limited benefits in pain reduction. However, interdisciplinary programs have shown benefits for other pain outcome measures such as reduction in psychological distress, increasing return to work and activity and reducing medication usage [78, 79]. The current telehealth research, however, showed that for there was a moderately large effect size (d=0.65) for the VAS within the unexposed group based on changes from baseline to post-treatment ($p<0.05$).

In contrast, the exposed group has a small effect size (d=0.14, p=0.48). Although the VAS results are positive in the unexposed group, it is valuable to note, as described previously in this paper, that a decrease in pain intensity is extremely difficult to achieve through non-pharmaceutical and non-invasive pain management interventions and even more so to maintain due to the physiological neuroscientific mechanisms underlying CP [50, 58-60]. However, it may be of interest moving forward to further examine this specific result in terms of exclusively focusing on maintaining pain intensity reduction through, for example, booster telehealth or in-person GPMPs.

Limitations

Limitations of the study include a modest sample size. This may have resulted in a type 2 error, therefore reducing the likelihood of statistically significant results for differences between the exposed group and unexposed group from pre-to post-treatment, for the majority of the pain outcome measures. In addition, a type 2 error, based on a fairly small number of subjects, the specific nominal clinical and demographic characteristics` (gender, nationality and site/location of pain on the body) sub-groups, may have occurred in the analyses of these variables. Although the sample size may be

a possible limitation, having a broad array of participant nationalities may be viewed as a strength, especially in a telehealth format. Furthermore, although Cohen`s d was the main statistical measure in the study and does not rely on a large sample size, the use of a correction factor may have been useful to further strengthen the interpretation of the Cohen`s d results.

Effect sizes from previous studies within the same or similar research field, when the number of studies is large enough, can be used when planning a new study. An a-priori power analysis can provide an indication of the average sample size a study needs to observe a statistically significant result with a desired likelihood [62]. However, due to the current research being only one of a limited number of studies specifically evaluating telehealth GPMPs, we did not complete a priori-power analysis as we did not believe we had sufficient amount of effect sizes for the various outcome measures in our research. A post-hoc power analysis may have been potentially useful as a retrospective follow up evaluation to further understand potential Type 2 errors that may have occurred. However, there is considerable dispute in the literature as to whether a post hoc power analysis is actually indicative of true power for detecting statistical significance, thus does not necessarily provide further useful information [80, 81].

We therefore did not complete a post-hoc power analysis in this research. Formal verification of the inclusion and exclusion criteria was not completed during enrollment, during and after the intervention phase. However, subjects were requested to be as honest as possible with the RAs during the recruitment phase. If there were any changes through the intervention such as receiving further external treatment, for example, subjects needed to notify the lead clinician or RA. Finally, as mentioned in the Methods section, subjects who failed to attend a session during the program, were required to make up the missed content through reading that material in their manuals or via one-on-one sessions with the lead clinician. A limitation underlying these approaches in catching up missed material, may be that they lacked the value of the group dynamics shared by other participants.

Recommendations

It would be useful to conduct a randomized control trial in the future which would compare in-person GPMPs versus telehealth GPMPs using the same classifications of the exposed group and unexposed group, as well as the addition of a control group. We also recommend that long term follow up may result in clearer and statistically significant differences between the 2 groups when it comes to pain intensity, as well as the other explored pain manifestations. Thus, further research exploring the maintenance of improved pain intensity levels following telehealth and in-person GPMPs seems to be a topic worth pursuing. The use of a minimally important difference (MID) provides valuable information for understanding differences in mean scores and provides an estimate of how much change or difference people consider clinically meaningful [82].

Therefore, the MID, in summary, helps determine the minimum change value necessary to achieve meaningful improvement within outcome instruments [83]. Importantly, the minimal clinically important difference (MCID) is both determined from and dependent on patient-reported outcome instruments, which identifies its use as a patient-centered form of analysis [84]. This is particularly key when it comes to a condition such as CP which entails an extremely subjective impression of the multifaceted pain perception by the patient. MID estimates can be used to evaluate treatment effectiveness and differences between groups such as in the current research [81]. With our focus in this research being on the change in the various pain outcome mean scores between the two cohort groups, it is recommended that the MID is used in further studies that investigate changes in pain outcome measures from pre-to-post intervention, particularly when comparing groups.

As with previous research by Burns et al (2005), understanding how all the stages of RTC (PSOCQ scores/phases) may fluctuate during a telehealth GPMP may be an important dimension to investigate [76]. This would assist in further understanding how the exposed group and unexposed group may distinctly differ in terms of their motivation to self-manage their pain throughout the course of such treatment. Future research, using a regression model, should also assess the degree of RTC at baseline as a predictor of pain outcome measures following telehealth GPMPs. The use of ANCOVA would be appropriate to analyze the above, for a study that is focusing on the significance of post-test mean scores between 2 groups. To add the statistical process known as ANCOVA-Change, would be a useful analysis to conduct in future studies that potentially accounts for the change in scores for each group whilst considering possible covariates at baseline, such as pre-treatment values [85]. This may further help assess the validity of similar results moving forward. Diving deeper into conducting further research around baseline EWB in relation to readiness to change and its impact it has on pain outcomes following such intervention, would assist in unravelling this subject-matter in more detail. Finally, as alluded to earlier, once further research in this growing field is completed and reported, future studies should attempt to complete a priori-power analysis to meet an appropriate sample size so to potentially eliminate the possibility of Type 2 errors.

Conclusions

Motivation to change may act as a moderator underlying the efficacy of biopsychosocial therapy including telehealth GPMPs [85]. The current research found that subjects classified in the exposed group had better pain outcome measures` scores at baseline and at post-treatment than those in the unexposed group. However, whether subjects were classified in either of the 2 cohort groups, the study found that all pain outcome measures` scores explored in the study, improved from pre-treatment (baseline scores) to post-treatment for both groups. However, the unexposed group had a larger magnitude in change of scores from pre-to post-treatment than the exposed group. The study also found that both groups, when ana-

lyzed separately, displayed statistically significant changes in pain outcome measures from pre-to post-intervention. Notably, EWB at baseline in the unexposed group versus the exposed group, was associated with greater changes in pain outcomes. Ultimately, through telehealth GPMPs, patients with CP may act to undertake what they have learned through such intervention, thereby improving various pain symptoms, and in this manner changing maladaptive pain behaviors and improve their overall QOL.

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