IntechOpen *Journals*

Digital Medicine and Healthcare Technology

RESEARCH PAPER

Telehealth Group-Based Pain Management Programs Using the Therapeutic Alliance and Group Dynamics as Key Predictor Variables

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

1 University of Miami, Physical Therapy Department, Coral Gables, Miami, FL, USA
2 University of Florida, Physical Therapy Department, Gainesville, FL, USA
*Correspondence: 100 Sudbury Street, Apartment 1705, Boston, MA 02114, USA.
E-mail: marninromm@gmail.com

Abstract

Introduction: Telehealth pain management has become instrumental in managing patients with chronic pain (CP) since the onset of the COVID-19 pandemic. The primary aim of this study was to investigate whether various covert therapeutic variables aid in the efficacy of telehealth group-based pain management programs (GPMPs). The therapeutic alliance (TA), group dynamics (GDs), attendance and change in pain neuroscience knowledge were evaluated as potential predictor covert variables of change in pain outcome measures and readiness to change (RTC) maladaptive pain behaviors.

Methods: Telehealth GPMP groups met once a week for 3 hours via zoom software and ran over a course of 6 weeks in which CP self-management techniques were taught. Pain outcome measures were taken at baseline and after the final telehealth GPMP. In addition, the measures around pain neuroscience understanding were examined at baseline and post-intervention. Finally, the TA and GDs were examined at post-treatment using the Therapeutic Group Context Questionnaire (TGCQ). Various statistical procedures were utilized to determine the predictive nature between the specific variables.

Results: The TA and GDs showed statistically significant ($p < 0.05$) predictive relationships with improved changes in maladaptive pain behaviors and pain self-efficacy. There was also a statistically significant ($p < 0.05$) predictive relationship between maladaptive pain behavioral changes and improvements in pain self-efficacy, pain catastrophizing and pain kinesiophobia.

Discussion: This research suggested that covert components in a telehealth GPMP such as changes in readiness to change (RTC) maladaptive pain behaviors, the TA, and GDs are all strong predictors of improvements in pain outcome measures following such an intervention.

Citation
Marnin Joseph Romm, Ira Fiebert, Kathryn Roach, Mark D Bishop and Lawrence Patrick Cahalin (2023), Telehealth Group-Based Pain Management Programs Using the Therapeutic Alliance and Group Dynamics as Key Predictor Variables. *Digital Medicine and Healthcare Technology* 2023(2), 1–29.

DOI
https://doi.org/10.5772/dmht.15

Published
3 April 2023

Keywords: telehealth, group-based pain management programs, chronic musculoskeletal pain, therapeutic alliance, group dynamics

1. Introduction

The Global Burden of Disease Study 2016 highlights the prominence of pain and pain-related diseases and disorders as the foremost cause of disability and disease burden globally [1]. In 2016, the Centers for Disease Control and Prevention (CDC) analyzed the National Health Interview Survey (NHIS) data to estimate the occurrence of chronic pain (CP) in the USA; an estimated 20.4% (50 million) of US adults suffered from CP and 8% of US adults (19.6 million) had high-impact CP [2]. These figures highlight the need for greater access to interventions that target CP. 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 [2, 3]. Group-Based Pain Management Programs (GPMPs) have been found to aid patients with self-management approaches for CP [4, 5].

Research, in the recent past, has advocated for an examination into wider treatment factors related to GPMPs, however, there are limited studies and insights into this critical area of interest [3]. In particular, therapeutic contextual factors (TCFs), such as the therapeutic alliance (TA) and group dynamics (GDs) have received little attention within pain research and clinical practice [4], specifically within telehealth GPMPs, necessitating a need for further exploration in this area. With the onset of COVID-19 at the beginning of 2020, in-person access to pain management programs was and still is widely reduced, for which reason telehealth and therefore, the exploration of telehealth GPMPs in particular is warranted.

A treatment is never administered in a neutral environment, but rather in a multifaceted composite of TCFs [5], that have cognitive neuroscientific effects on patients with all health problems including CP. These effects powerfully influence outcomes and are consequences of the brain-mind responses (i.e. potentially placebo mechanisms) to the *context in which a treatment is given, rather than to the specific intervention itself* [2]. Relational TCFs such as the TA between the healthcare provider and patient has been shown to have positive outcomes following various medical and psychological interventions. Previous studies have also largely shown that clinical empathic engagement with the patient, which is core to developing rapport with patients, is beneficial to the patient in terms of adherence, positive clinical outcomes, and less complications [3–6]. Therefore, the TA appears to be of great importance when treating patients with CP and should be explored in more detail. In addition, it has been revealed through previous research that even through a single-session

group-based program, patient pain outcome measures can improve as subjects clearly suggested that various aspects of the group-based session were helpful [7].

Group therapy fulfills a supportive role by permitting disclosure of thoughts and feelings to others who have mutual circumstances, which 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 [8, 9]. Newton-John and Geddes [1] add that the effects taking place in a group pain management program are more diverse and complex than solely positive regard from the therapist and mutual sharing of experiences by group members [10]. Yalom (1995; cited in Newton-John and Geddes [1]) suggests that 'group cohesiveness' is the main curative factor in group therapy [1]. Group cohesiveness encompasses shared experiences and goals, mutual respect, acceptance, supportive feedback and interaction, reality testing, and vicarious learning [1]. Patients in groups can gain from sharing their common experiences, monitoring/observing each other, and expressing themselves in a safe and non-threatening atmosphere [1]. The above confirms the ideas around social observational learning theories, additionally highlighting the significant impact that group-based intervention can have on patients with CP through matters underlying the entity of group dynamic factors. Ultimately, in opposition to a lay leader, "... when a skillful practitioner uses the group process to move clients beyond mutual empathy and toward regaining of function, a crucial component of the psychosocial treatment for chronic pain is served" (Thorn and Kuhajda [2], p. 1356]).

Modern learning theories understand learning as a result of changes in behavior that take place as a consequence of patterns in an individual's environment [3, 4]. Therefore, the therapeutic environment including GDs within a GPMP should be taken into account when examining subjects' potential changes in behavior based on the therapeutic contextual environment. Behavior, in the above description, refers to both observable deliberate and automatic responses or neuronal activity (brain activity) [3, 4]. This notion is in keeping with the pivotal work of Albert Bandura, the foremost theorizer, and writer of this theory [4]. Bandura defined observational learning as "changes in patterns of behavior that are a consequence of observing the behavior of others" (Goubert *et al.* [4], p. 167–168]). Research has demonstrated that the social models of the pain experience have an impact on autonomic and psychophysical measures of sensory processing of painful events [4, 5]. Therefore, based on the above, it is clear that observational learning of pain influences both visible expressions of pain as well as the overall experience of pain [4]. According to Bandura's model, it is necessary via clinical practice and research to comprehend social observational learning. Understanding social observational learning must be accounted for through overt and/or subconscious experiences that may explain behavioral, perceptual as well as psychosocial changes in pain perception, and therefore alterations in outcome measures following GPMPs. Social interactions that

might include observational learning have an impact on the psychophysiological mechanisms underlying pain perception and therefore speaks to the theories around placebo analgesic effects (or even nocebo effects/ hyperalgesic effects) as a possible consequence of social observational learning as a mechanism within the GPMP therapeutic contextual environment. Expanding upon the topic of patient expectations, anticipation may be facilitated by a variety of psychological and cognitive mechanisms including learning by instructions, learning through experience, and *social and observational learning* [6, 7].

The recent development of The Therapeutic Group Context Questionnaire (TGCQ) allows researchers and clinicians to evaluate how subjects in telehealth GPMPs perceive the amount that the TA and GDs has on their overall pain experience [8]. This questionnaire has been shown to be a valid and reliable instrument for subjects with CP, as assessed through telehealth GPMPs [8].

As well as the strong need for GPMPs, recent meta-analytic studies that we have conducted and published, display the strong need for therapeutic pain neuroscience education (TPNE) in pain management intervention [9, 10]. TPNE is a treatment modality used in pain management so to enhance patients' knowledge and understanding of the underlying pain processes and mechanisms [11]. By doing so, it is suggested that clinicians are able to reduce negative cognitions of patients with CP, such as the threat and fear value of pain [11]. Therefore, investigating subjects' pain knowledge and changes in pain physiology knowledge through our study's telehealth GPMP intervention, was a core factor to aid in understanding whether or not subjects' changes in pain neuroscience knowledge predicts positive pain outcomes, following telehealth GPMPs.

Finally, attendance/adherence to the telehealth GPMPs was another variable we considered as a potential predictor of pain outcomes following intervention. Lack of independent function, as one possible example for the reason behind lack of attendance, has been shown to be a barrier for some CP patients arriving for their pain management programs [12, 13]. The inability to attend sessions on a regular basis might in fact possibly fall under exclusion criteria, as these subjects might not get the full benefit from in-person GPMPs. However, our current study being telehealth in nature, potentially may reduce these barriers and thus have an impact on the overall outcomes of our intervention.

Therefore, the purpose of this study was to examine if these 'covert ingredients/factors/variables' (baseline pain neuroscience knowledge, relational TCFs, and attendance of sessions) in telehealth GPMPs, predict change in Readiness to Change (RTC) maladaptive pain behaviors and change in subjects' pain neuroscience knowledge. In addition, the study aimed to assess if specific components (therapeutic relational contextual factors and attendance of sessions) of telehealth GPMP interventions are related to change in pain outcome measures.

2. Methodology

2.1. Subject recruitment

The target population for this study was patients with chronic musculoskeletal pain (localized anywhere in the body or widespread). The sampling process was non-probability sampling based on convenience, and subjects were placed into a single treatment group. Based on the COVID-19 crisis and social distancing parameters at the time, the research aimed to examine telehealth GPMPs through the use of Zoom software (Zoom Video Communications, San Jose California, USA). Therefore, there were no geographic restrictions as to where subjects were recruited from, and thus subjects were recruited from different countries. All included subjects were placed in the treatment group consisting of 5 separate GPMPs. The aim was to have between 8 to 12 subjects in each GPMP.

2.2. Inclusion and exclusion criteria

Inclusion criteria: (1) Subjects with or without referred pain (surgical or non-surgical) for 3 months or more. (2) Subjects with chronic musculoskeletal pain (spine and extremities) including osteoarthritis (OA) and rheumatoid arthritis (RA). (3) Subjects ranging from the age of 20 and upwards. (4) No major changes in existing medications or other treatment during the course of the intervention and (5) Subjects willing to participate in a group-based telehealth program.

Exclusion criteria: (1) Subjects unable to understand or speak English. (2) Pain due to malignancy. (3) Subjects 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 pain-related treatment such as Physical Therapy or any other healthcare treatment geared towards their CP. (5) Subjects with cognitive pathology. (6) Subjects diagnosed with psychiatric conditions (e.g. psychosis) and, (7) Subjects with no access to the internet or unable to use the Zoom software.

2.3. Intervention description

2.3.1. Intervention setting

The intervention was carried out through a telehealth format (Zoom software). Each group received the exact same treatment. The telehealth GPMPs included 6 sessions (1 session a week), and for approximately 3 hours per session. Prior to the first session (1–2 days prior to the 1st session), participants were required to complete online, via Qualtrics (*Qualtrics Software Company, Provo Utah, USA*), various outcome measures at baseline (described below). Some of the topics covered throughout the course of the intervention are displayed in Table 1 below.

Table 1. Group-Based Pain Management Program 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.

Notably, this is not an all-inclusive list but rather core topics that were required for each group in the program. At the beginning of each session following session 1, subjects were provided with the opportunity to summarize their week and how their use of the tools taught to them in the previous session went. They also had the opportunity to ask questions at which point the clinician was able to answer the questions and/or other group members aided in facilitating the answers. A PowerPoint (PPT) presentation was used to navigate each session in combination with a supplementary pain management manual for each subject, which has been developed over many years by the primary author of this paper. The manual was designed to consolidate subjects' knowledge and tools around self-management strategies. The manual also incorporated homework tasks for the subjects to

undertake between sessions so as to practice various skills that had been taught to them during the weekly get-together sessions. To note, when it came to the exercise education component in each week's session (5–10 min in each session), subjects were to undertake this in the space that they were located in by observing what the clinician was doing on the screen. Although this might have been a potential barrier, the actual exercise sessions were not created to act as a specific treatment modality as part of the GPMPs. Rather, the exercise component was instituted to merely educate subjects on how to exercise with CP and potentially reduce their likely fear-underpinning exercise through graded exposure, graded activity, and pacing techniques. At the end of the final session (1–2 days following the last session) each subject was again required to complete the same outcome measures that were used at baseline, but this time the TGCQ was also incorporated to address the TA and GDs.

2.3.2. Outcome measures

Prior to the start of the intervention, baseline pain outcome measures were completed by the subjects. These included: Pain Stages of Change Questionnaire (PSOCQ), Pain Self-Efficacy Questionnaire (PSEQ), the Pain Catastrophizing Scale (PCS), the Tampa Scale of Kinesiophobia (TSK), the Short Form Health Survey –36 (SF-36) Total, and the Visual Analogue Scale (VAS). The primary outcome measures for this study were pain self-efficacy, pain catastrophizing, and kinesiophobia. The secondary outcome measures for the purpose of this study were the VAS and SF-36-Total. Change in the pain outcome scores from pre-to post-intervention were considered the dependent variables (DVs) in this study. Score results for the pain outcome questionnaires suggest the following: Lower scores on the VAS, PCS-Total and TSK suggest less pain intensity, less pain catastrophizing and less kinesiophobia respectively, and thus change in scores (pre-intervention scores subtracted from post-intervention scores) with a negative value represent an improvement in these three outcome measures. Higher scores on the PSEQ, and SF-36 Total suggest greater pain self-efficacy and greater QOL and therefore change in scores (pre-intervention scores subtracted from post-intervention scores) with positive values suggest improvements in these two outcome measures results. The PSOCQ was used to determine the RTC stage for each subject. The PSOCQ, is based on the transtheoretical model (TTM) of behavior change, which stipulates that individuals move through discrete "stages-of-change" when altering maladaptive pain behaviors [13, 14]. Analysis of the PSOCQ reveals four distinct scales that reflect upon the TTM of behavior change: (1) "*Precontemplation*" which suggests that an individual is not considering or unwilling to change or take on a self-management approach, (2) "*Contemplation*" represents an evaluation of self-management skills but still has resistance to stop looking for a medical cure, (3) "*Action*" reflects accepting a self-management approach and motivated to develop associated skills and (4) "*Maintenance*" includes the consolidation of the self-management techniques that

the individual has acquired [14]. Improved PSOCQ-Action scores from pre-to-post-treatment (change in scores) are presented with a positive value. The Revised Neurophysiology of Pain Questionnaire (RNPQ) was also measured at baseline and post-treatment to get measures of the subjects' pain neuroscience knowledge prior to starting the program and after the program. Following the completion of the 6 sessions, subjects were once again asked to complete the above questionnaires, as well as the TGCQ, which examined the therapeutic relational factors (TA and GDs). The PSOCQ-Action sub-measure change in scores, the TA and GDs from the TGCQ, session attendance (adherence), and pain science knowledge were considered the independent variables (IVs) for the purpose of this research.

2.3.3. Attendance (Adherence)

The maximum sessions that were allocated to each telehealth GPMP was 6 sessions. Therefore, attendance was recorded for each subject as a continuous variable, to use within the analyses of this study.

2.4. Statistical procedures

Relevant tests for normality of distribution of the outcome measures' data for pre-post-test changes in the primary and secondary pain outcome measures, RNPQ, TGCQ scores and change PSOCQ-Action scores, were first conducted. In addition, underlying assumptions for each statistical test were also examined before conducting the specific statistical examinations.

For the Pearson's correlation coefficient values, a magnitude (−1 to +1) and significance or lack thereof amongst the relationships was noted. In terms of strength of the relationship, 0.7 iwas considered strong, between 0.5 and 0.7 was moderate in strength and less than 0.4 was a weak or no correlation. Based on Pearson's correlation coefficients that displayed statistically significant results, multiple linear regression was used for the DVs that had more more than one IV significantly correlated with it. The regression analyses were conducted to examine whether or not there was a predictive relationship between the variables at hand.

To reiterate examining the change in scores, pre-treatment scores were subtracted from post-treatment scores. A positive mean difference for PSEQ, SF-36, and PSOCQ-Action subscale, and a negative mean difference for VAS, PCS-Total, TSK, and RNPQ represented an improvement in these outcome measures.

3. Results

A total of 42 participants, 33 female patients and nine male patients were included in this study. The mean age was 51.47 years and subjects were from multiple countries. The mean duration that patients had pain was 15.30 years.

A summary of various descriptive statistics is presented in Table 2.

Table 2. Descriptive statistics around the covert components of the telehealth GPMPs.

Covert Components` measures in Telehealth GPMPs	➢ Means (SD) For Baseline scores, post-treatment scores and change in scores.
Revised Neurophysiology Pain Questionnaire:	
• **Baseline:**	• 5.50 (2.67)
• **Post-Treatment:**	• 8.04 (2.29)
• **Change in scores:**	• 2.54 (2.42)
Therapeutic Group Context Questionnaire-Total Score:	
• **Post-Treatment:**	• 216.45 (31.40)
Therapeutic Group Context Questionnaire-Total –Therapeutic Alliance Sub-measure:	
• **Post-Treatment:**	• 114.29 (14.53)
Therapeutic Group Context Questionnaire-Total –Group Dynamics Sub-Measure:	
• **Post-Treatment:**	• 102.33 (18.72)
Pain Scale of Change Questionnaire-Action Sub-Measure:	
• **Baseline:**	• 3.43 (0.67)
• **Post-Treatment:**	• 4.32 (0.72)
• **Change in scores:**	• 0.89 (0.92)
Attendance (Maximum 6 sessions)	
• **Post-Treatment:**	• 5.54 (0.70)

Abbreviations: RNPQ = Revised Neurophysiology of Pain Questionnaire, TGCQ-Total = Therapeutic Group Context Questionnaire Total Score, TGCQ-TA = Therapeutic Group Context Questionnaire-Therapeutic Alliance sub-measure, TGCQ-GD = Therapeutic Group Context Questionnaire-Group Dynamics sub-measure, PSOCQ-Action = Pain Scale of Change Questionnaire-Action sub-measure, Attendance, N/A = Not Applicable.

Assessment of the relationship between specific intervention covert components (relational therapeutic contextual factors, attendance of sessions of the telehealth GPMP interventions, baseline pain neuroscience knowledge) with change in pain neuroscience knowledge and readiness to change maladaptive pain behaviors:

The assumptions were met to carry out Pearson‘s Correlation Coefficient analyses. A summary of the correlations are presented in Table 3 and the statistically

Table 3. Correlation results table; covert components (readiness to change maladaptive pain behaviors, pain neuroscience knowledge, therapeutic alliance, group dynamics and session attendance).

Covert Components' Measures:	PSOCQ-Action Change from Baseline to Post-Treatment	RNPQ change from Baseline to Post-Treatment
RNPQ pre-treatment	r= 0.20, p=0.18	r= -0.60, *p=0.00
TGCQ-Total (taken at post-treatment)	r= 0.60, *p=0.00	r= -0.11, p=0.48
TGCQ-TA (taken at post-treatment)	r= 0.57, *p=0.00	r= -0.21, p=0.17
TGCQ-GD (taken at post-treatment)	r= 0.57, *p=0.00	r= -0.02, p=0.89
Attendance	r= 0.50, *p=0.00	r= -0.21, p=0.17

Abbreviations: RNPQ = Revised Neurophysiology of Pain Questionnaire, PSOCQ-Action = Pain Scale of Change Questionnaire-Action sub-measure, TGCQ-Total = Therapeutic Group Context Questionnaire Total Score, TGCQ-TA = Therapeutic Group Context Questionnaire Therapeutic Alliance sub-measure, TGCQ-GD = Therapeutic Group Context Questionnaire Group Dynamics sub-measure, attendance. *Significant p-value set at $p < 0.05$.

significant correlations ($p < 0.05$) between variables are highlighted. Of interest, all therapeutic relational factors (TGCQ-Total, the TA, and GDs), had moderate strength and positive associations with the change in score for the PSOCQ-Action sub-scale and were all statistically significant ($p < 0.05$); TGCQ-Total: $r = 0.60$, TGCQ-TA: $r = 0.57$, TGCQ-GD: $r = 0.57$ and attendance: r= 0.50 (Table 3). These results suggest that the greater the relational therapeutic factors in a telehealth GPMP, the greater the change in scores in the PSOCQ-Action sub-scale, suggesting greater RTC following a telehealth GPMP, and vice versa. In addition, higher attendance of sessions resulted in greater changes in PSOCQ-Action scores ($r = 0.50$, $p < 0.05$). Figures 1, 2, 3 and 4 display the statistically significant correlations outlined above. Attendance did not display any statistically significant correlations with a change in pain neuroscience knowledge but was correlated in an inversely weak relationship with changes from pre-to-post intervention in RNPQ scores. A small effect size was noted for this relationship ($r = -0.21$). Baseline RNPQ scores displayed a moderate and inverse association with RNPQ change ($r = -0.60$) and was statistically significant ($p < 0.05$) (Table 3). This result is expected as subjects who score high at baseline would have less room to change their scores to higher scores implying a potential ceiling effect for these 2 variables. Conversely, if subjects score low on baseline RNPQ scores, the change in RNPQ scores would be greater as there is more scope to improve.

Multiple Linear Regression Analyses for Relational TGCFs with change in Maladaptive pain behaviors:

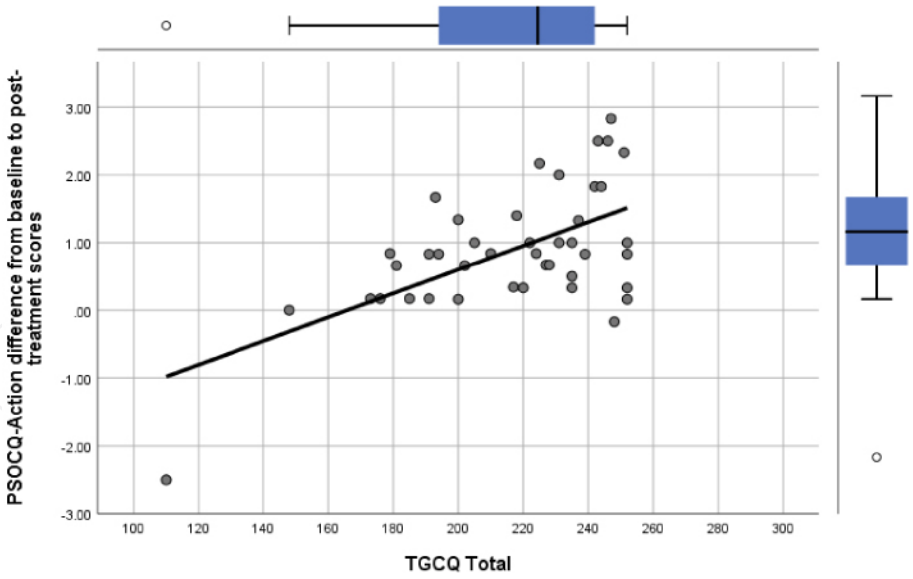

Figure 1. Scatter plot and Box and Whisker plot presenting the statistically significant association between TGCQ-Total (IV) and the PSOCQ-Action pre-post treatment difference in mean scores (DV) and an overall visual summary of this regression model's data set.

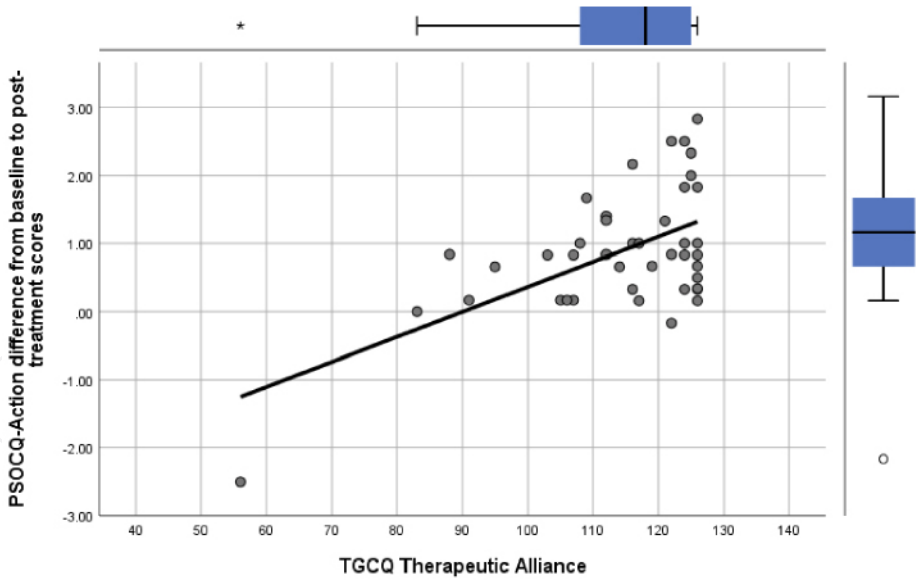

Figure 2. Scatter plot and Box and Whisker plot presenting the statistically significant association between the IV TGCQ-Therapeutic Alliance (TA) and the PSOCQ-Action pre-post treatment difference in mean scores (DV) and an overall visual summary of this regression model's data set.

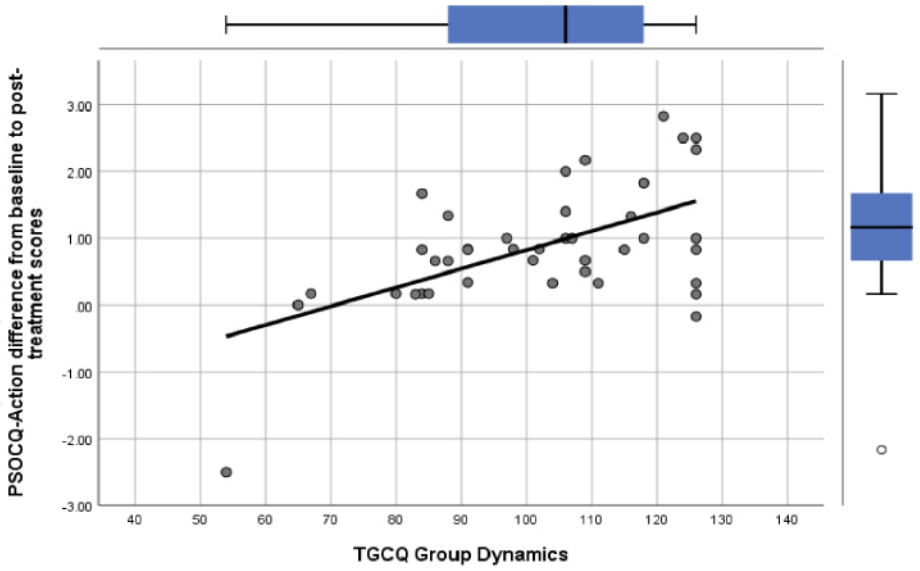

Figure 3. Scatter plot and Box and Whisker plot presenting the statistically significant association between the IV TGCQ-Group Dynamics (GD) and the PSOCQ-Action pre-post treatment difference in mean scores (DV) and an overall visual summary of this regression model's data set.

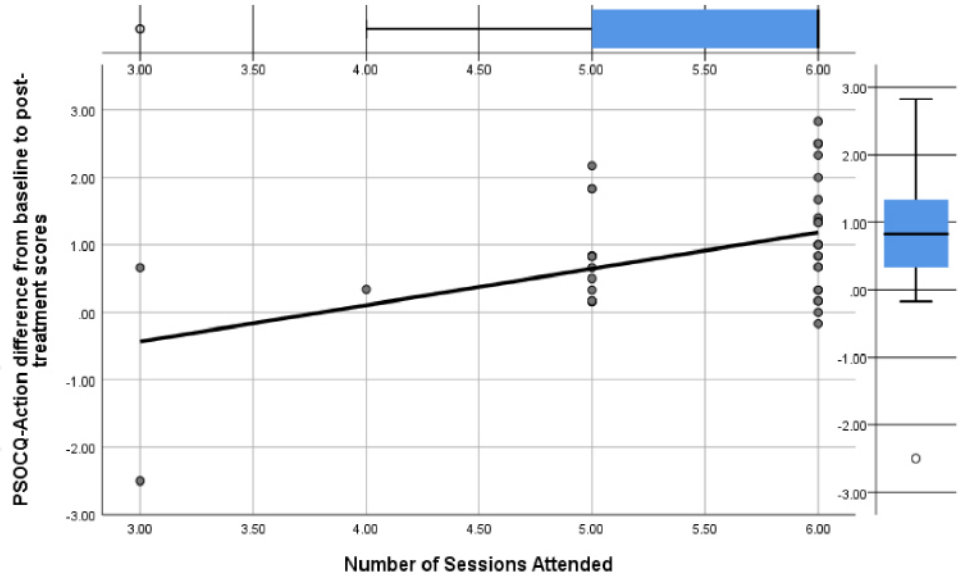

Figure 4. Scatter plot and Box and Whisker plot presenting the statistically significant association between the IV Attendance and the PSOCQ-Action pre-post treatment difference in mean scores (DV) and an overall visual summary of this regression model's data set.

All the assumptions underlying the use of multiple regression analysis were met except for collinearity and therefore, the multiple regression analysis should be interpreted with caution. The collinearity assumption was violated for TGCQ-Total score with each of its sub-measures; TGCQ-TA and TGCQ-GD. The TGCQ-Total score was included in the analysis as there was statistically significant correlation found initially for the total score under Pearson's Correlation Coefficient analysis (Table 3). In addition, the total score captures the group therapeutic contextual experience on a broader level. However, attendance did not appear to have multicollinearity problems. Multiple linear regression was completed for the DV of change in PSOCQ-Action scores (used to measure change in maladptive pain behaviors), as this variable displayed statistically significant correlations with the IVs: TGCG-Total, TGCQ-TA, TGCQ-GD and attendance. Table 4 summarizes the multiple regression results. As noted in Table 4, there were no statistically significant predictor variables (IVs) in the model, however the model's overall relationship between the DV and the IVs was statistically significant ($p < 0.05$) and was positive and moderate in magnitude ($r = 0.65$, $p < 0.05$).

Table 4. Multiple regression analysis for PSOCQ-action change in scores as the dependent variable and TGCQ-total, TGCQ-TA, TGCQ-GD and attendance as the independent variables.

Multiple Regression Statistics	PSOCQ-Action Change in Score from Pre-to Post Intervention (DV)
-IV Variables entred into the model:	• TGCQ-Total, TGCQ-TA, TGCQ-GDs, Attendance
-Model overall correlation:	• r=0.65
-F statistic (p-value):	• 6.97 (*p=0.00)
-R-squared, % variation explained by the model on the DV, and p-value final model:	• 0.43, 43%, (*p=0.00)
-Unstandardized Beta, t-value, p-value, 95% CI :	➢TGCQ-Total: B= -0.15, t= -1.41, p=0.16, 95% CI= -0.37 to 0.06 ➢TGCQ-TA: B= 0.17, t= 1.56, p=0.13, 95% CI= -0.05 to 0.40 ➢TGCQ-GD: B= 0.16, t= 1.52, p=0.14, 95% CI= -0.05 to 0.40 ➢Attendance: B= 0.24, t= 1.42, p=0.16, 95% CI= -0.10 to 0.58
-Tolerance for each variable:	➢TGCQ Total: 0.001 ➢TGCQ-TA: 0.005 ➢TGCQ-GD: 0.003 ➢Attendance:0.773
-VIF:	• TGCQ-Total: 890.04 • TGCQ-TA: 198.20 • TGCQ:GD: 307.87 • Attendance: 1.30

Abbreviations: PSOCQ-Action = Pain Scale of Change Questionnaire-Action sub-measure, TGCQ-Total = Therapeutic Group Context Questionnaire Total Score, TGCQ-TA = Therapeutic Group Context Questionnaire Therapeutic Alliance sub-measure, TGCQ-GD = Therapeutic Group Context Questionnaire Group Dynamics sub-measure. *Significant p-value set at $p < 0.05$.

Table 5. Descriptive Statistics around the active components of the Telehealth GPMPs.

Pain Outcome Measures Change in Scores from pre-to-post intervention	➢ Means (SD) change in scores.
VAS • **Change in scores:**	• -7.90 (18.65)
PSEQ • **Change in scores:**	• 9.95 (10.52)
PCS-Total • **Change in scores:**	• -9.52 (10.52)
TSK • **Change in scores:**	• -5.66 (6.90)
SF-36 Total • **Change in scores:**	• 8.56 (13.06)

Abbreviations: VAS = Visual Analogue Scale, PSEQ = Pain Self Efficacy Questionnaire, PCS-Total = Pain Catastrophizing Scale-Total, TSK = Tampa Scale of Kinesiophobia, SF-36 Total = Short Form Health Survey-36 Total Score (Overall Quality of Life).

Assessment of the relationship between specific covert components (relational therapeutic contextual factors and attendance of sessions of the telehealth GPMP interventions with change in pain outcome measures:

A summary of various descriptive statistics is presented in Table 5.

The assumptions, once again, were met to carry out Pearson's Correlation Coefficient analyses. Table 6 summarizes all the Pearson's Correlation results with regard to the associations between therapeutic relational factors (TGCQ-Total, TGCQ-TA and TGCQ-GD), and attendance with change in scores for all pain outcome measures. Notably, the PSEQ (one of the primary outcome measures in this study) change in scores as the DV was statistically significantly associated with the therapeutic relational scores but not attendance of sessions; r = 0.39 (p = 0.00) for the TGCQ-Total, r = 0.35 (p = 0.02) for the TGCQ-TA and r = 0.40 (p = 0.01) for the TGCQ-GD (Table 6). This suggests that as all therapeutic relational factors improved, the magnitude of change in PSEQ increased. Attendance of sessions did not have statistically significant associations with any change in outcome measure scores. The magnitude of the above results were positive and weak to moderate in strength overall. The only additional statistically significant correlation was found between the TGCQ-GD and change in TSK scores; r = 0.31 (p = 0.04) indicating a

Table 6. Correlation results table; TGCQ outcomes and attendance with change in pain outcome measures' scores.

Active Component Measures (change ins cores from baseline/pre-treatment to post-treatment)	VAS Pre-Treatment- Post-Treatment Difference; (r, p-value)	PSEQ Pre-Treatment- Post-Treatment Difference; (r, p-value)	PCS-Total Pre-Treatment-Post-Treatment Difference; (r, p-value)	TSK Pre-Treatment-Post-Treatment Difference; (r, p-value)	SF-36 Total Pre-Treatment- Post-Treatment Difference; (r, p-value)
TGCQ-Total	r= 0.07, p=0.62	r= 0.39, *p=0.00	r= 0.07, p=0.63	r= 0.27, p=0.08	r= 0.13, p=0.40
TGCQ-TA	r= 0.01, p=0.94	r= 0.35, *p=0.02	r= 0.04, p=0.78	r= 0.18, p=0.25	r= 0.04, p=0.76
TGCQ-GD	r= 0.12, p=0.45	r= 0.40, *p=0.01	r= 0.09, p=0.57	r= 0.31, *p=0.04	r= 0.18, p=0.25
Attendance	r= 0.08 , p=0.60	r= 0.21, p=0.16	r= 0.19, p=0.22	r= 0.05, p=0.72	r= 0.13, p=0.41

Abbreviations: TGCQ-Total = Therapeutic Group Context Questionnaire Total Score, TGCQ-TA = Therapeutic Group Context Questionnaire Therapeutic Alliance sub-measure, TGCQ-GD = Therapeutic Group Context Questionnaire Group Dynamics sub-measure = , VAS = Visual Analogue Scale (Pain Intensity), PSEQ = Pain Self-Efficacy Questionnaire, PCS-Total = Pain Catastrophizing Scale Total Score, TSK = Tampa Scale of Kinesiophobia, SF-36 Total = Short Form Health Survey-36 Total Score (Overall Quality of Life). *Significant p-value set at $p < 0.05$.

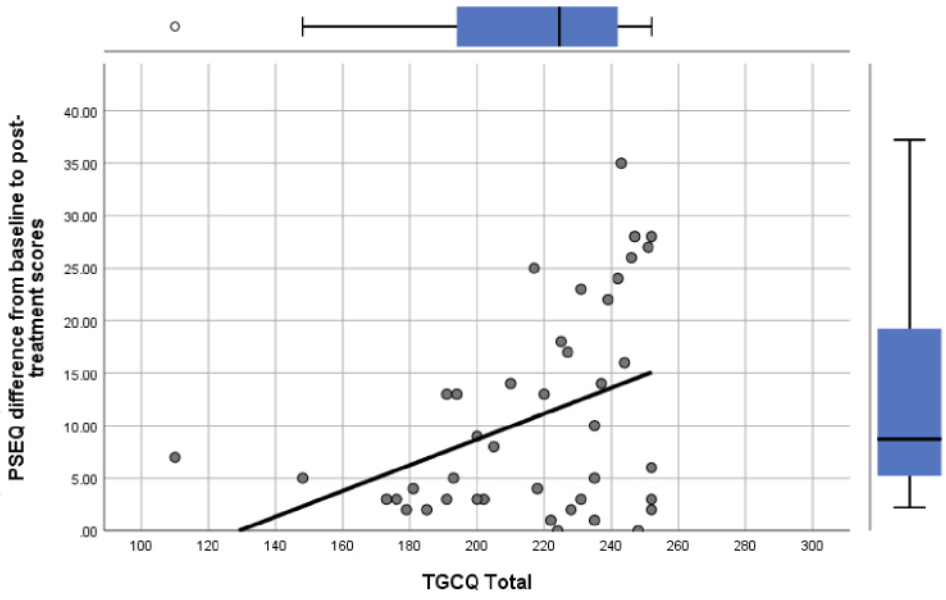

Figure 5. Scatter plot and Box and Whisker plot presenting the statistically significant association between the IV TGCQ-Total and the PSEQ pre-post treatment difference in mean scores (DV) and an overall visual summary of this regression model's data set.

positive weak relationship. Figures 5, 6 and 7 display the identified statistically significant associations for the PSEQ.

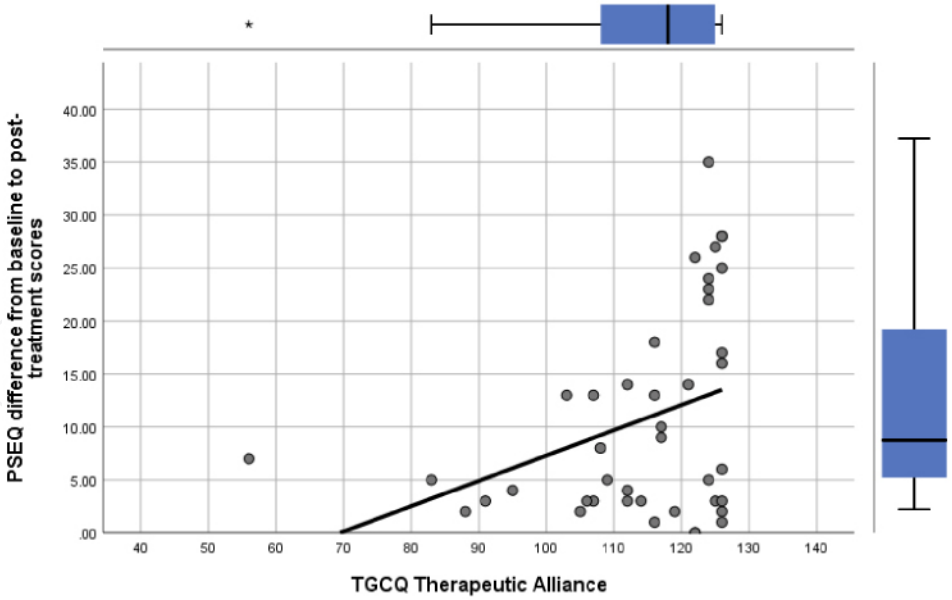

Figure 6. Scatter plot and Box and Whisker plot presenting the statistically significant association between the IV TGCQ-Therapeutic Alliance (TA) and the PSEQ pre-post treatment difference in mean scores (DV) and an overall visual summary of this regression model's data set.

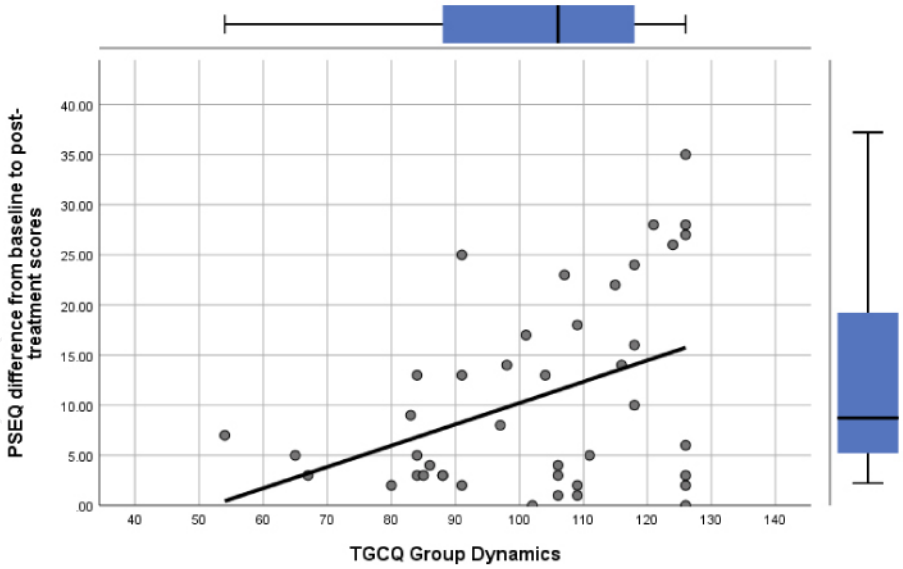

Figure 7. Scatter plot and Box and Whisker plot presenting the statistically significant association between the IV TGCQ-Group Dynamics (GD) and the PSEQ pre-post treatment difference in mean scores (DV) and an overall visual summary of this regression model's data set.

Multiple Linear Regression Analyses for Relational TCFs with change in Pain Self-Efficacy (PSEQ scores):

All the assumptions underlying the use of multiple regression analysis were met except for collinearity and therefore, the multiple regression analysis should be interpreted with caution. The collinearity assumption was violated as there was cross-over between the TGCQ-Total score with each of its sub-measures; TGCQ-TA and TGCQ-GD. Multiple linear regression was completed for the DV of change in PSEQ scores with the TGCQ-Total, TGCQ-TA and TGCQ-GD-Action scores, as these IVs were all statistically significantly correlated with change in PSEQ scores. Table 7 reveals an overall model correlation of r = 0.52 (positive and moderate in magnitude) with all the variables, noted above, entered into the model. In addition, the total model was statistically significant ($p < 0.05$). The model explained 27.6% of the variance on the DV (change in PSEQ scores). Each of the IVs in the model had a statistically significant prediction on the DV ($p < 0.05$). As suggested through Table 7, when looking at the TGCQ sub-measures (TGCQ-TA and TGCQ-GD) separately, for each point increase in both these sub-measures, the PSEQ change in score would increase by at 3.09 and 3.12 units respectively.

Table 7. Multiple regression analysis for PSEQ change in scores as the dependent variable.

Multiple Regression Statistics	PSEQ Change in Score from Pre-to Post Intervention (DV)
-IV Variables entered in the model:	• TGCQ-Total, TGCQ-TA, TGCQ-GDs
-Model overall correlation:	• r=0.52
-F statistic (p-value):	• 4.82 (*p=0.00)
-R-squared, % variation explained by the model on the DV, and p-value final model:	• 0.276, 27.6%, (*p=0.00)
-Unstandardized Beta, t-value, p-value, 95% CI :	➢TGCQ-Total: B= -3.00, t= -2.35, *p=0.02, 95% CI= -5.58 to -0.42 ➢TGCQ-TA: B= 3.09, t= 2.38, *p=0.02, 95% CI= 0.46 to 5.72 ➢TGCQ-GD: B= 3.12, t= 2.48, *p=0.01, 95% CI= 0.58 to 5.66
-Tolerance for each variable:	• TGCQ-Total (0.001), TGCQ-TA (0.005), TGCQ-GD (0.003)
-VIF:	• TGCQ-Total (888.01), TGCQ-TA (197.17), TGCQ-GD (307.76)

Abbreviations: PSEQ = Pain Self-Efficacy Questionnaire, TGCQ-Total = Therapeutic Group Context Questionnaire Total Score, TGCQ-TA = Therapeutic Group Context Questionnaire Therapeutic Alliance sub-measure, TGCQ-GD = Therapeutic Group Context Questionnaire Group Dynamics sub-measure. *Significant p-value set at $p < 0.05$.

Table 8. Correlation results table; changes in pain neuroscience knowledge (RNPQ) and changes in readiness to change (PSOCQ-Action) with change in pain outcome measures' scores.

Active Component Measures (change in scores from baseline/pre-treatment to post-treatment)	VAS Pre-Treatment- Post-Treatment Difference; (r, p-value)	PSEQ Pre-Treatment- Post-Treatment Difference; (r, p-value)	PCS-Total Pre-Treatment-Post-Treatment Difference; (r, p-value)	TSK Pre-Treatment-Post-Treatment Difference; (r, p-value)	SF-36 Total Pre-Treatment- Post-Treatment Difference; (r, p-value)
PSOCQ-Action	r= -0.22, p=0.14	r= 0.60, *p=0.00	r= -0.36, *p=0.02	r= -0.35, *p=0.02	r= 0.43, *p=0.00
RNPQ	r= 0.06, p=0.72	r= 0.15, p=0.32	r= -0.07, p=0.63	r= -0.17, p=0.28	r= 0.26, p=0.10

Abbreviations: VAS = Visual Analogue Scale (Pain Intensity), PSEQ = Pain Self-Efficacy Questionnaire, PCS-Total = Pain Catastrophizing Scale Total Score, TSK = Tampa Scale of Kinesiophobia, SF-36 Total = Short Form Health Survey-36 Total Score (Overall Quality of Life), RNPQ = Revised Neurophysiology of Pain Questionnaire, PSOCQ-Action = Pain Scale of Change Questionnnaire-Action sub-measure, *Significant p-value set at $p < 0.05$.

Assessment of the relationship between specific covert components (changes in RTC/PSOCQ-Action sub-measure) and changes in pain neuroscience knowledge, with change in pain outcome measures:

Descriptive statistics in terms of changes in the pain outcome measures are reflected in Table 5, and changes in the PSOCQ-Action sub-measure and RNPQ are shown previously in Table 2.

Once again, the assumptions were met to carry out *Pearson's Correlation Coefficient analyses.* Therefore, this test was used to calculate the initial relationships between the variables at hand. Table 8 summarizes all the Pearson's Correlation results with regards to the associations between changes in scores of the RNPQ and PSOCQ-Action (IVs) with change in scores for all pain outcome measures (DVs). The statistically significant correlations ($p < 0.05$) regarding the primary outcome measures were the PSEQ, PCS-Total and TSK change in scores (DV) with the PSOCQ-Action change in scores (IV). These associations revealed a moderately strong positive correlation ($r = 0.65$), a moderately strong positive correlation for the SF-36Total (r = 0.43), moderately weak inverse correlations for the PCS-Total ($r = -0.36$) and a moderately weak inverse correlation for the TSK ($r = -0.35$) (Table 8). Therefore, when change in scores in the PSOCQ-Action sub-scale went up, so did the change in scores in the PSEQ and SF-36 Total. However, change in scores for the PCS-Total and TSK went down and vice versa.

Simple Linear Regression Analysis for the Primary Outcome Measures' Change in Scores (DV) with the PSOCQ-Action Change in Scores:

All assumptions underlying simple linear regression for the variables being the PSEQ change in scores (DV) and PSOCQ-Action change in scores (IV) were met. The R-squared value for the PSEQ change in scores with the PSOCQ-Action change

in scores was 0.35 suggesting that the IV explained 35.0% of the variance in the DV. The overall model had a F-value of 21.70 and was statistically significant ($p < 0.05$). The unstandardized B value was 6.73 which suggested that for every one-unit increase in PSOCQ-Action score changes, the PSEQ change in score would increase by 6.73 units based on how the measure functions (higher PSEQ scores suggest better PSEQ results post-treatment; PSEQ scores at post-treatment minus pre-treatment PSEQ scores produces a positive change in score); $t = 4.65$, $p < 0.05$, 95% CI = 3.81 to 9.66. Figure 8 shows the relationship between the above DV and IV. *A simple linear regression analysis* was then completed for the primary outcome measure of the PCS-Total change in scores (DV) with respect to the IV of PSOCQ-Action change in scores. All assumptions underlying simple linear regression were met. The *R*-squared value for the PCS-Total change in scores with the PSOCQ-Action change in scores was 0.37, suggesting that the IV explained 36.8% of the variance in the DV. The overall model had a *F*-value of 6.28 and was statistically significant ($p < 0.05$). The unstandardized B value was −4.59. The negative value was based on how the PCS-Total instrument works and thus, how the change in scores for the PCS-Total was calculated. This negative value still shows improvements in the magnitude of change in scores for the PCS-Total. Therefore, this suggested that for every one unit increase in PSOCQ-Action score changes, the magnitude of the change in the PCS-Total would increase by 4.59 units; $t = -2.50$, $p < 0.05$, 95% CI = −8.29 to −0.89. Figure 9 shows the relationship between the above DV and IV. Notably, the plot appears as an inverse relationship between the 2 variables due to the negative Beta value, however, as described above, this is due to the manner in which the PCS-Total change in scores was calculated. Thus, the graph should be interpreted rather as a positive relationship. *A simple linear regression analysis* was then completed for the primary outcome measure of the TSK change in scores (DV) mentioned above with respect to the IV of PSOCQ-Action change in scores. All assumptions underlying simple linear regression were met. The R-squared value for the TSK change in scores with the PSOCQ-Action change in scores was 0.12 suggesting that the IV explained 12.0% of the variance in the DV. The overall model had a *F*-value of 5.74 and was statistically significant ($p < 0.05$). The unstandardized B value was −2.64, and again, the negative value needs to be interpreted as per the PCS-Total score based on how the instrument functions and therefore how the change in score was calculated. Thus, this suggested that for every one unit increase in PSOCQ-Action score changes, the change in TSK would increase by 2.64 units; $t = -2.39$, $p < 0.05$, 95% CI = −4.87 to −0.41. Figure 10 shows the relationship between the above DV and IV. Emphasizing once more that although the figure shows an inverse association, it should be interpreted as a positive relationship based on the above analysis of the negative Beta value.

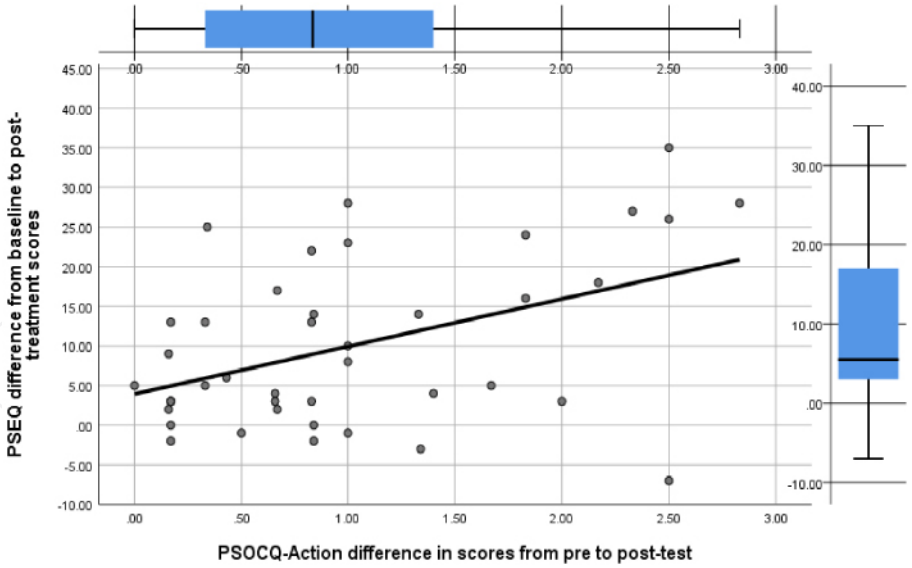

Figure 8. Scatter plot and Box and Whisker plot presenting the statistically significant association between the IV PSOCQ-Action score changes and the PSEQ pre-post treatment difference in mean scores (DV) and an overall visual summary of this regression model's data set.

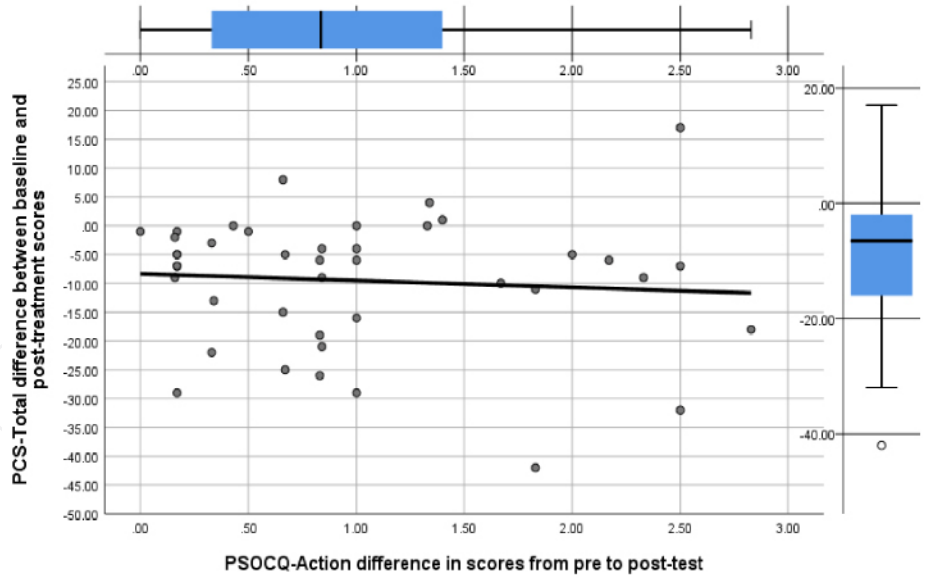

Figure 9. Scatter plot and Box and Whisker plot presenting the statistically significant association between the IV PSOCQ-Action score changes and the PCS-Total pre-post treatment difference in mean scores (DV) and an overall visual summary of this regression model's data set.

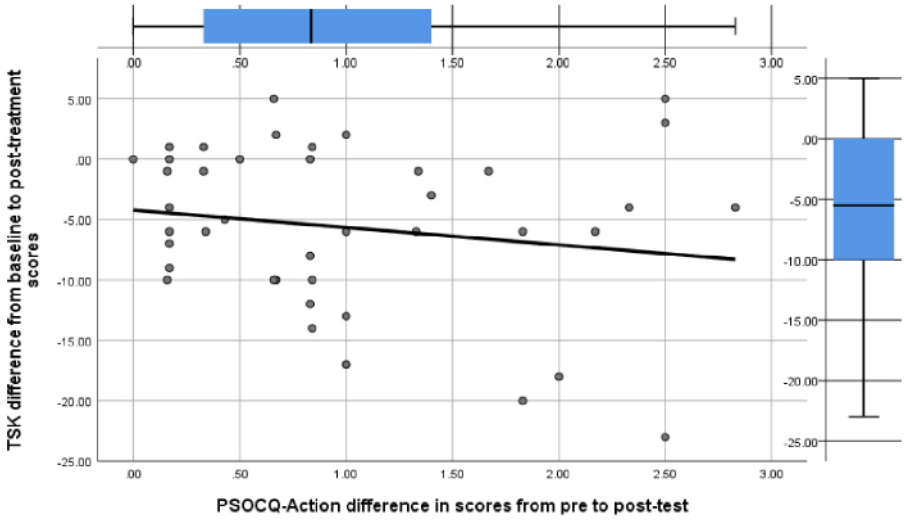

Figure 10. Scatter plot and Box and Whisker plot presenting the statistically significant association between the IV PSOCQ-Action score changes and the PCS-Total pre-post treatment difference in mean scores (DV) and an overall visual summary of this regression model's data set.

4. Discussion and summary

Multidisciplinary pain management programs, based on biopsychosocial principles, formed the foundation underlying the telehealth GPMPs used in this study. The above biopsychosocial model has been found in previous studies to most likely enhance patients' overall Quality of Life (QOL) as well as general well-being [15, 16]. This was once again noted in the current research. Strand *et al.* [17] found that higher readiness to change (RTC) (or changes in RTC during a pain management program), examined by the PSOCQ-Action measure, has been associated with greater fluctuations in the pain experiences within patients with CP [17]. Strand *et al.* [17] also revealed statistically significant changes in self-efficacy, pain catastrophizing, and pain kinesiophobia associated with changes in RTC. A previous in-person study supported the hypothesis that readiness to self-manage one's CP increases from pre- to post-multidisciplinary . Readiness to self-manage one's CP, may be equated to the RTC measure being the PSOCQ-Action sub-measure, where subjects are in a stage where they are likely to take action to change their maladaptive pain behaviors and thus, self-manage their symptoms. The current research specifically focused on change in PSOCQ-Action sub-measure scores as this score is believed to most likely represent subjects being most clinically RTC pain-related behaviors. The results of the current telehealth research, which incorporated a biopsychosocial/multidisciplinary approach, reflect that of the above-described in-person pain management research.

Changes in PSOCQ-Action Scores in Relation to Relational Contextual Factors:

The current study aimed to find the best predictor/s for change in the PSOCQ-Action scores through telehealth GPMPs. Jensen *et al.* [18] found that PSOCQ-action and maintenance scores increased over the progression of treatment [18]. The current study found that PSOCQ-Action scores did improve over the course of the telehealth GPMPs (refer to Table 2). This suggests that telehealth GPMPs potentially allows for positive progression in subjects' RTC maladaptive pain behaviors, which are commonly part of the CP experience. This research found a statistically significant ($p < 0.05$) and positive moderate strength relationship between score differences for the PSOCQ-Action sub-measure from baseline to post-treatment with relational therapeutic contextual factors (TCFs) such as the TGCQ-Total measure as well as its sub-measures; TGCQ-TA and TGCQ-GD. Previous research has hypothesized that contextual factors within a clinical environment, such as an empathic patient-practitioner relationship, can have a direct physiological response on the subject, which mediates analgesic mechanisms in itself [19]. Groups with stronger group cohesion, have been found to allow subjects within the group, to create change in an easier manner [20], which potentially explains the above result of this research.

Previous meta-analytic research has demonstrated the positive impact that in-person GPMPs can have on multiple pain outcome measures following intervention [9]. Although the aforementioned meta-analysis did not include RTC maladaptive pain behaviors as a potential outcome measure, the study still supports the use of telehealth GPMPs (based on the statistically significant results including the TGCQ-GD sub-measure) when it comes to managing CP. Further research has demonstrated the importance of patient expectations and the TA within group-based cognitive behavioral therapy for insomnia [21]. The current research intervention, performed by the primary author, incorporated group-based CBT treatment to help manage subjects' CP symptoms including sleep. The current research suggested that all pain outcome measures improved from pre-treatment to post-treatment.

The Relationship Between Changes in RTC Pain Behaviors, Pain Self-Efficacy, pain catastrophizing, and pain kinesiophobia:

This particular study suggests that changes in RTC pain behaviors (PSOCQ-Action scores), through telehealth GPMPs, seem to produce statistically significant changes in pain self-efficacy, pain catastrophizing, and pain kinesiophobia. Higher levels of pain self-efficacy, specifically related to greater relational TCFs such as the TA and GDs, have been found to be associated with improved pain outcomes [22]. The present research also suggests that changes in pain self-efficacy had a statistically significant predictive relationship with all the

TGCQ measures (TGCQ-Total, TA, and GD); relational TCFs predict, specifically, better pain self-efficacy outcomes following telehealth GPMPs. Stronger emotional well-being has been found to improve pain outcome measures [23–25]. Greater pain self-efficacy may be hypothesized to represent and be associated with overall better emotional well-being. Potentially, a greater TA and GDs may improve pain self-efficacy through subjects' perceptions of heightened emotional and physical support via the clinician and the group as a whole. In addition, as the results of the study suggest, changes in RTC predict greater changes in pain self-efficacy. If an individual becomes more RTC through pain management intervention, then pain self-efficacy potentially improves as a consequence. This association may be the result of CP subjects feeling more empowered to take on more self-management of their symptoms and therefore their internal locus of control improves, thus strengthening their self-efficacy relating to their pain. A previous review has suggested that effective coping and self-management rely on self-efficacy beliefs [26], and therefore the above association may be clinically relevant to subjects with CP. Evidence has speculatively revealed that observational learning appears to have a significantly large impact on the attainment and treatment of pain behaviors (Craig, 1986 cited in Goubert *et al.* [4]). Therefore, the significant predictability model around GDs and changes in RTC (PSOCQ-Action sub-measure), as noted in this current study, may reflect theories underlying social observational learning and its positive impact on changing maladaptive pain behaviors.

Social Observational Learning and Changes in Pain Kinesiophobia:

Social support and observational learning, via group-based programs and TA, such as in the current study, have been shown to contribute to placebo analgesic effects [27]. The results of this study suggest that GDs, as measured through the TGCQ-GD sub-measure, in a telehealth GPMP is significantly associated with improvements in pain kinesiophobia. According to the social observational learning theory model, placebo analgesic effects can be learned through observations of other patients having an analgesic response to a particular treatment [6, 28–30]. Treatments for which this has been observed include medication, invasive treatment, manual treatment, exercise, cognitive behavioral treatment, and other psychoeducational treatments for CP. Based on previous social learning theory work by Albert Bandura, Bajcar, and Babel [30], outlines a model of social observational learning that explains the mechanisms and factors relating to observational learning, that contributes to placebo analgesic effects [30]. In addition, the model importantly includes the role of expectancies and the individual characteristics of the observing subject in the production of placebo analgesia as well as nocebo hyperalgesia brought on by social observational learning [30]. Thus, the notion of witnessing other patients having an improvement in their pain symptomology and in turn a reduction in the observer's symptomology [29–33], should stimulate the topic around the

positive effects of GPMPs, and therefore further use of GPMP intervention. This should include telehealth GPMPs as evidenced by the positive results of this current research. Learning can be achieved through observation and replication of others' behavior patterns [34]. As for kinesiophobia specifically, based on the results of this study, it is suggested that subjects witnessing other subjects in their group having less fear to move encourages other subjects to move with less threat via social observational learning theory mechanisms, as was seen in the present study.

Group-Based Pain Management Programs as Predictors of Change in pain Science Knowledge, Readiness to Change Maladaptive Pain Behaviors, Quality of Life, and Pain outcome Measures:

The results in this analysis correspond to the results of a previous meta-analysis that was recently published where in-person GPMPs acted as a statistically significant moderator on pain outcomes based on Therapeutic Pain Neuroscience Education (TPNE) [10]. TPNE, a modality used within our telehealth GPMPs, results in advantageous clinical effects, where the intervention is provided to a group of patients with diverse CP conditions [9, 10, 35]. The meta-analysis mentioned above focused on the efficacy of TPNE on pain outcome measures and demonstrated that TPNE has an overall beneficial effect on subjects' pain following such intervention [10]. However, the current telehealth GPMP research did not support the results of previous in-person GPMP studies. It may be hypothesized that TPNE provided within in-person GPMPs is more efficacious than TPNE provided in telehealth GPMPS. This result may be due to a potentially stronger TA built within in-person GPMPs and potentially easier to explain pain neuroscience to subjects with CP when in-person rather than via a telehealth format. Previous research, based on outpatient in-person pain management, found that the program favorably affected motivation to change and in turn impacted positively on subjects' QOL [36]. This was also evidently reflected in the results of the current study despite being telehealth in nature. Overall QOL, assessed via the SF-36 Total, encompasses a biopsychosocial model of pain, in which the physiological, psychological, and social effects of CP were evaluated. Therefore, through this research, it is suggested that telehealth GPMPs, through using TPNE as one of the treatment modalities, can aid in improving subjects' lives in a holistic manner.

Attendance/Adherence to Telehealth Group-Based Pain Management Programs:

Adherence to following through with the treatment skills taught in pain management programs incorporates self-report, behavioral (including attendance of sessions), and clinical outcomes [37]. Patient education and motivation, including TPNE and other treatment modalities within a pain management program (PMP), play essential roles in engaging patients in the self-management of their CP [38]. In addition, self-management is catalyzed further by the patient-healthcare provider

communication process [38]. Patients' adherence and attendance to PMPs, seem to become stronger through more solid and positive provider-patient relationships [38].

The current study showed a statistically significant correlation between attendance of sessions and the magnitude of change in PSOCQ-action scores. Attendance of sessions was high for the majority of subjects through this study with the mean attendance being 5.45 and the mode being 6 (maximum telehealth sessions was 6 sessions). Apart from implementing in their everyday lives the materials and techniques taught through the pain management sessions, attendance of sessions may play a key role in the improvement of the pain outcome scores through improved RTC. Most subjects in this research attended the majority of their prescribed sessions. Pain practitioners commonly face challenges concerned with noncompliance with directed clinical guidance and nonadherence (lack of attendance) to pain management treatment plans whether non-pharmacologically based or medication based [37]. Previous research has demonstrated that patient engagement and attendance to pain management sessions correlate with improved pain outcomes and are additionally influenced by the clinician-patient relationship [37, 38]. Thus, potentially as a result of the high attendance of sessions in this telehealth study, the overall effectiveness of the intervention may be partly associated with the attendance of sessions. The above factors suggest patients should attend all if not most of the GPMP sessions, and in turn further instill pain self-management strategies to further enhance subjects' benefits from PMPs, such as evidenced in the current telehealth GPMPs research.

A previous meta-analysis, as well as other research, has found that there was a moderate but reliable relationship between a good TA and positive therapeutic outcomes for psychotherapy [39–43]. To note, pain management intervention should include psychological intervention, specifically when it comes to managing patients' anxiety, stress, and depression levels. The TA, in a previous systematic review, was found to produce better exercise adherence in musculoskeletal physical therapy [44]. The current study found that the TA was associated with overall improvements in pain outcome measures, specifically pain self-efficacy changes as described previously. Of interest, it has been established that clinician variability in the alliance is suggested to be more important than patient variability, for superior patient pain outcomes [45].

Study limitations:

The multiple regression analysis when assessing the model of change in PSOCQ-Action scores as the DV and the TGCQ-Total, TGCQ-TA, and TGCQ-GD as the IVs, should be interpreted with caution. The inflated collinearity factors, at certain points in the analyses, such as the Variance Inflation Factor (VIF) and

tolerance, were at times slightly outside the normal range. Therefore, the assumption for collinearity was questionable at times. This may be the result of the various TGCQ scores (the 3 IVs) all being related, as they come from the same instrument. A modest sample size may have resulted in various outcome measures not showing statistically significant results based on the predictive models and this may be due to a type 2 error.

Recommendations:

Future research should potentially examine at which point in time during a telehealth or in-person GPMP, that changes in PSOCQ-Action scores take place. In addition, it may be useful to gain insight into which part/s of a GPMP produces the changes in their RTC scores. Implementing a control group in future studies would possibly help further enhance the clarity around the specific active component predictor variables within a telehealth or in-person GPMP, that determine changes in RTC, changes in pain science knowledge, and ultimately changes in various pain outcome measures.

Finally, comparing telehealth versus in-person GPMPs would be an informative task to complete. Comparing these 2 formats with respect to various overt (active) and covert treatment variables and modalities in the actual intervention that predicts various outcome measures, such as the use of TPNE, would also be a useful task. Completing the above would potentially give further insight into the strength of the predictor variables, which potentially depend on the format of the GPMPs.

Conclusions:

Making a positive change in maladaptive pain behaviors is what motivates most healthcare professionals involved in pain management [46]. Only through appropriate assessment, can we establish whether TPNE has truly made a difference to patients [46]. The research suggested that what might be understood as 'covert' components in a telehealth GPMP such as the TA, GDs, and, RTC behavior are all predictors of pain outcome measures following such an intervention. Therefore making a stronger effort in clinical practice when using GPMPs to use these therapeutic tools, specifically building an enhanced TA and working with the group of patients to form tightened GDs, whether in-person GPMPs or through telehealth formats, should be encouraged in order to further improve the overall QOL in patients with CP conditions.

Conflict of interest

The authors declare no conflict of interest.

Support and funding

No sources of external support or funding.

Acknowledgements

There are no additional acknowledgements to be made.

References

1 Newton-john T, Geddes J. The non-specific effects of group-based cognitive-behavioral treatment of chronic pain. *Chronic Illn*. 2008;**4**: 199–208.

2 Thorn B, Kuhadjda MC. Group cognitive therapy for chronic pain. *J Clin Psychol*. 2006;**62**(11):1355–1366.

3 De Houwer J. The propositional approach to associative learning as an alternative for association formation models. *Learn Behav*. 2009;**37**(1):1–20.

4 Goubert L, Vlaeyen JWS, Crombez G, Craig KD. Learning about pain from others: an observational learning account. *J Pain [Internet]*. 2011;**12**(2):167–174. doi:10.1016/j.jpain.2010.10.001.

5 Craig KD, Prkachin KM. Social modeling influences on sensory decision theory and psychophysiological indexes of pain. *J Pers Soc Psychol*. 1978;**36**(8):805–815.

6 Klinger R, Stuhlreyer J, Schwartz M, Schmitz J, Colloca L. Clinical use of placebo effects in patients with pain disorders. *Int Rev Neurobiol*. 2018.;**139**: 107–128.

7 Colloca L, Klinger R, Flor H, Bingel U. Placebo analgesia: psychological and neurobiological mechanisms. *Pain*. 2013;**154**(4):511–514.

8 Romm M, Cahalin LP. The development of the therapeutic group context questionnaire: reliability and validity measures based on telehealth group-based pain management programs. *J Telemed Telecare*. 2021;1–13. doi:10.1177/1357633X211027410.

9 Romm MJ, Ahn S, Fiebert I, Cahalin LP. A meta-analysis of group-based pain management programs: overall effect on quality of life and other chronic pain outcome measures, with an exploration into moderator variables that influence the efficacy of such interventions. *Pain Med*. 2020;**22**(2):407–429.

10 Romm MJ, Ahn S, Fiebert I, Cahalin LP. A meta-analysis of therapeutic pain neuroscience education, using dosage and treatment format as moderator variables. *Pain Pract*. 2021;**21**(3):366–380.

11 Butler D, Moseley L. *The evidence base for explain pain [Internet]*. Adelaide: Noigroup Publications; 2003. Available from: http://www.nppt.com/files/pdf/pain.pdf.

12 Knight LD, Guildford BJ, Daly-Eichenhardt A, McCracken LM. Assessment and patient selection process for a pain management programme: a case study in specialty care. *Br J Pain*. 2019;**13**(2):74–81.

13 Prochaska JM, Prochaska JO, Levesque DA. A transtheoretical approach to changing organizations. *Adm Policy Ment Health*. 2001;**28**(4):247–261.

14 Gersh E, Hons BA, Arnold C, Gibson SJ. The relationship between the readiness for change and clinical outcomes in response to multidisciplinary pain management. *Pain Med*. 2011;**12**(1):165–172.

15 Hadi MA, McHugh GA, Closs SJ. Impact of chronic pain on patients' quality of life: a comparative mixed-methods study. *J Patient Exp*. 2019;**6**(2):133–141.

16 Hadi MA, Alldred DP, Briggs M, Marczewski K, Closs SJ. "Treated as a number, not treated as a person": a qualitative exploration of the perceived barriers to effective pain management of patients with chronic pain. *BMJ Open*. 2017;**7**(6):e016454.

17 Strand EB, Kerns RD, Christie A, Haavik-Nilsen K, Klokkerud M, Finset A. Higher levels of pain readiness to change and more positive affect reduce pain reports — A weekly assessment study on arthritis patients. *Pain*. 2007;**127**(3):204–213.

18 Jensen MP, Nielson WR, Turner JA, Romano JM, Hill ML. Changes in readiness to self-manage pain are associated with improvement in multidisciplinary pain treatment and pain coping. *Pain*. 2004;**111**(1–2):84–95.

19 Watson A, Power A, Brown C, El-Deredy W, Jones A. Placebo analgesia: cognitive influences on therapeutic outcome. *Arthritis Res Ther*. 2012;**14**(3):1–7.

20 von Greiff N, Skogens L. Understanding the concept of the therapeutic alliance in group treatment for alcohol and drug problems. *Eur J Soc Work [Internet]*. 2019;**22**(1):69–81. doi:10.1080/13691457.2017.1341388.

21 Constantino MJ, Manber R, Ong J, Kuo TF, Huang JS, Arnow BA. Patient expectations and therapeutic alliance as predictors of outcome in group cognitive-behavioral therapy for Insomnia. *Behav Sleep Med*. 2007;**5**(3):210–228.

22 Kalapurakkel S, Carpino EA, Lebel A, Simons LE. "Pain Can't Stop Me": Examining pain self-efficacy and acceptance as resilience processes among youth with chronic headache. *J Pediatr Psychol*. 2014;**40**(9):926–933.

23 Larsson B, Dragioti E, Gerdle B, Björk J. Positive psychological well-being predicts lower severe pain in the general population: a 2-year follow-up study of the SwePain cohort. *Ann Gen Psychiatry [Internet]*. 2019;**18**(1):1–11. doi:10.1186/s12991-019-0231-9.

24 Furrer A, Michel G, Terrill AL, Jensen MP, Müller R. Modeling subjective well-being in individuals with chronic pain and a physical disability: the role of pain control and pain catastrophizing. *Disabil Rehabil*. 2019;**41**(5):498–507.

25 Lumley M, Cohen J, Borszcz G, Cano A, Radcliff A, Porter L, et al. Pain and emotion: a biopsychosocial review of recent research. *J Clin Psychol*. 2011;**67**(9):942–968.

26 Okifuji A, Ackerlind S. Behavioral medicine approaches to pain. *Anesthesiol Clin*. 2007;**25**(4):709–719.

27 Medoff Z, Colloca L. Placebo analgesia: understanding the mechanisms. *Pain Manag*. 2015;**5**(2):89–96.

28 Bingel U, Colloca L, Vase L. Mechanisms and clinical implications of the placebo effect: Is there a potential for the elderly? A mini-review. *Gerentology*. 2011;**57**: 354–363.

29 Schenk LA, Krimmel SR, Colloca L. Observe to get pain relief: current evidence and potential mechanisms of socially learned pain modulation. *Pain*. 2017;**158**(11):2077–2081.

30 Bajcar EA, Babel P. How does observational learning produce placebo effects? A model integrating research findings. *Front Psychol*. 2018;**9**(OCT):1–8.

31 Colloca L, Benedetti F. Placebo analgesia induced by social observational learning. *Pain [Internet]*. 2009;**144**(1–2):28–34. doi:10.1016/j.pain.2009.01.033.

32 Klinger R, Stuhlreyer J, Schwartz M, Schmitz J, Colloca L. Clinical use of placebo effects in patients with pain disorders. *Int Rev Neurobiol*. 2018;**139**: 107–128.

33 Yakunchikov DY, Olechowski CJ, Simmonds MK, Verrier MJ, Rashiq S, McWilliams LA, et al. The effect of social observational learning, empathy and catastrophizing in chronic pain patients during acute pain induction. *Pain Med*. 2017;**18**(5):871–878.

34 Cordier L, Diers M. Learning and unlearning of pain. *Biomedicines*. 2018;**6**(2):1–7.

35 Fletcher R, Braithwaite FA, Woodhouse M, MacInnes A, Stanton TR. Does readiness to change influence pain-related outcomes after an educational intervention for people with chronic pain? A pragmatic, preliminary study. *Physiother Theory Pract [Internet]*. 2021;**37**(5):608–619. doi:10.1080/09593985.2019.1636436.

36 Küchler A, Sabatowski R, Kaiser U. Chronic pain patients' readiness to change after multimodal treatment. Short- and long-term effects. *Schmerz*. 2012;**26**(6):670–676.

37 Cosio D, Demyan A. Adherence and relapse - How to maintain long-term gains in patients with chronic conditions. *Pract Pain Manag*. 2020;**20**(6): Available from: https://www.practicalpainmanagement.com/treatments/psychological/adherence-relapse-how-maintain-long-term-gains-patients-chronic-conditions.

38 Dorflinger L, Kerns RD, Auerbach SM. Providers' roles in enhancing patients' adherence to pain self management. *Transl Behav Med*. 2013;**3**(1):39–46.

39 Ardito RB, Rabellino D. Therapeutic alliance and outcome of psychotherapy: historical excursus, measurements, and prospects for research. *Front Psychol*. 2011;**2**(270):1–11.

40 De Bolle M, Johnson JG, De Fruyt F. Patient and clinician perceptions of therapeutic alliance as predictors of improvement in depression. *Psychother Psychosom*. 2010;**79**(6):378–385.

41 Constantino MJ, Arnow BA, Blasey C, Agras WS. The association between patient characteristics and the therapeutic alliance in cognitive-behavioral and interpersonal therapy for bulimia nervosa. *J Consult Clin Psychol*. 2005;**73**(2):203–211.

42 Green C, Polen M, Janoff S, Castleton D, Wisdom J, Vuckovic N, et al. Understanding how clinician-patient relationships and relational continuity of care affect recovery from serious mental illness: stars study results carla. *Psychiatr Rehabil J [Internet]*. 2008;**32**(1):9–22. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3624763/pdf/nihms412728.pdf.

43 Howgego IM, Yellowlees P, Owen C, Meldrum L, Dark F. The therapeutic alliance: the key to effective patient outcome? A descriptive review of the evidence in community mental health case management. *Aust N Z J Psychiatry*. 2003;**37**(2):169–183.

44 Babatunde F, MacDermid J, MacIntyre N. Characteristics of therapeutic alliance in musculoskeletal physiotherapy and occupational therapy practice: a scoping review of the literature. *BMC Health Serv Res*. 2017;**17**(1):1–23.

45 Del Re AC, Flückiger C, Horvath AO, Symonds D, Wampold BE. Therapist effects in the therapeutic alliance-outcome relationship: a restricted-maximum likelihood meta-analysis. *Clin Psychol Rev [Internet]*. 2012;**32**(7):642–649. doi:10.1016/j.cpr.2012.07.002.

46 Briggs E. Evaluating the impact of pain education: how do we know we have made a difference? *Br J Pain*. 2012;**6**(2):85–91.