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Exploring the Perceived Psychosocial Experiences of Recreational Runners with Patellofemoral Pain: A Grounded Theory Approach

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EXPLORING THE PERCEIVED PSYCHOSOCIAL EXPERIENCES OF RECREATIONAL RUNNERS WITH PATELLOFEMORAL PAIN: A GROUNDED THEORY APPROACH

by

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ABSTRACT

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Patellofemoral pain (PFP) is a specific type of patellar or retropatellar pain aggravated by at least one physical activity that loads the patellofemoral joint during weight bearing on a flexed knee such as running (Crossley et al., 2016). Previous PFP research has highlighted the importance of psychosocial variables among PFP populations including recreational runners (Vicenzino et al., 2022). Upon reviewing the existing literature, much of it appears to be atheoretical and lack construct clarity. The purpose of this dissertation was to explore the perceived psychosocial experiences of recreational runners with PFP. This dissertation aimed to (1) document recreational runners' perceived psychosocial experiences with PFP; (2) develop a theoretical model that conceptualizes recreational runners' perceived psychosocial experiences with PFP; and (3) critically evaluate the applicability of existing theoretical models of psychological responses to sport injury in conceptualizing recreational runners' perceived psychosocial experiences with PFP. Ten recreational runners with PFP (n = 4 females, n = 6 males) participated in semi-structured interviews. A Straussian Grounded Theory methodology (Corbin & Strauss, 2015) was used to develop the Conceptual Framework for Psychosocial Experiences

of Recreational Runners with Patellofemoral Pain. The conceptual framework suggests recreational runners are individuals *Who* have prominent personal characteristics that influence their perceived psychosocial experiences of recreational running with PFP. Dominant psychosocial responses are *What* recreational runners experience when running with PFP. Those experiences interrelate with *How* they address the perceived cause of their psychosocial responses and the reasons *Why* they respond the ways in which they do. Each category was described with pertinent connections to *Psychosocial Outcomes*. Following a comparative method analysis (Pennings et al., 2006), it was concluded that the conceptual framework has an all-encompassing presence that uses simple language to concisely conceptualize the perceived psychosocial experiences of recreational runners with PFP. The conceptual framework developed in this dissertation can be beneficial for future psychosocial PFP research to increase theoretical and construct clarity.

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Chapter I: Introduction

Patellofemoral pain (PFP) is a specific type of kneecap pain characterized by patellar or retropatellar pain (Crossley et al., 2016). The injury typically progresses from an insidious onset to constant or recurring discomfort. Signs may include mild effusion or antalgic gait but the core criterion of PFP is pain around or behind the patella (Crossley et al., 2016). To define PFP, pain is aggravated by at least one activity that loads the patellofemoral joint during weight bearing on a flexed knee such as squatting, walking, running, jumping, and/or ambulating stairs (Crossley et al., 2016).

Findings of a systematic review and meta-analysis of research databases suggested the incidence of PFP is one in 14 adolescents and one in five adults (Smith, Selfe et al., 2018). In the United States, the results of a five-year study suggested 19% (n = 410,852) of adults who sought knee related medical care received a PFP diagnosis (Glaviano et al., 2015). In the United Kingdom, 17% (n = 303) of adult knee related medical consultations across eight general practices in 2006 received PFP diagnoses (Wood et al., 2011). A recent self-report survey in Saudi Arabia found that 39% (n = 94) of the participants experienced clinical features of PFP (Mohammad & Elsais, 2021). Researchers have also stated that discrepancies in PFP incidence reporting exist, mainly due to sampling and methodological inconsistencies (Mohammad & Elsais, 2021; Smith, Selfe et al., 2018).

It is known that PFP is common among runners, but its prevalence among this population has been conflicting in the literature (Francis et al., 2019; Kakouris et al., 2021; Neal, Lack, et al., 2019). A recent systematic review of prospective and retrospective studies found that PFP accounted for approximately 17% (n = 1776) of all running related musculoskeletal injuries among non-ultramarathon runners (Kakouris et al., 2021). This is supported by an earlier

systematic review of retrospective survey studies that found PFP accounted for approximately 17% (n = 606) of all lower extremity injuries among recreational, collegiate, and professional runners (Francis et al., 2019). However, a meta-analysis of prospective PFP studies suggested that only 6% (n = 75) of 1,265 recreational runners developed PFP (Neal, Lack, et al., 2019). Researchers have also suggested that inconsistencies in populations sampled, methods utilized, and study durations have inhibited the synthetization of PFP prevalence research results (Smith, Selfe et al., 2018). For the purposes of this dissertation, a recreational runner has been defined as an individual who participates in distance running for a minimum of 15 km per week (Esculier et al. 2017; 2018).

Investigations into potential differences of PFP incidence between the sexes of recreational runners have also reported inconsistent results (Francis et al., 2019; Neal, Lack, et al., 2019; Smith, Selfe et al., 2018; Wu et al., 2022). A recent retrospective online self-report survey on injury incidence was conducted with middle school aged cross-country runners in Massachusetts, United States (Wu et al., 2022). Of those who self-reported previously sustaining an overuse injury (n = 1110), approximately 20% of girls (n = 175) and 8% of boys (n = 98) also reported having been diagnosed with PFP (Wu et al., 2022). This finding conflicts with previous systematic reviews and meta-analyses that have concluded that the relationship between PFP prevalence and sex lacks statistical significance (Francis et al., 2019; Neal, Lack, et al., 2019; Smith, Selfe et al., 2018).

Given the high prevalence of PFP worldwide, researchers have aimed to identify a range of biomechanical risk factors that may influence an individual's risk of developing PFP. The most empirically supported PFP risk factor is quadriceps weakness (Crossley et al., 2019; Esculier et al., 2018; Neal, Lack, et al., 2019). Prospective research evidence has also suggested

that hip and knee muscle strength influence PFP risk, but thus far results have been inconsistent (e.g., Boling et al., 2021; Ramskov et al., 2015; Rathleff et al., 2014; Thijs et al., 2011). For example, Rathleff et al. (2014) conducted a systematic review and meta-analysis and concluded that overall, both female and male adults with PFP have lower hip abduction strength compared to pain-free individuals. The same review also stated that despite the above, many of the studies included did not find an association between isometric hip strength and risk of developing PFP (Rathleff et al., 2014).

Risk research into the role of knee, ankle, and foot kinematics among those with PFP have also revealed incongruent findings (e.g., Martinelli et al., 2022; Neal et al., 2016; Noehren et al., 2013; Yang et al., 2022). Collectively, previous biomechanical PFP studies have suggested that having greater peak hip adduction during the stance phase of run gait (opposed to having less peak hip adduction) increases the risk of developing PFP among female recreational runners (Neal et al., 2016; Noehren et al., 2013). A recent study with female and male recreational runners with PFP found that when running *with* pain, the participants had an increased peak knee valgus angle when compared to running *without* pain and to matched controls (Yang et al., 2022). Likewise, peak rearfoot eversion during run gait has been found to both influence (Neal et al., 2016) and not influence (Noehren et al., 2013) PFP development. Additionally, a systematic review and meta-analysis focused on research investigating the role of foot and ankle alignment in patients with PFP concluded that the correlation between foot and ankle alignment and PFP was poor and conflicting (Martinelli et al., 2022).

Research investigating knee, ankle, and foot kinetics as potential PFP risk factors have also had inconsistent results (e.g., Dowling et al., 2014; Neal et al., 2016; Neal, Lack, et al., 2019; Yang et al., 2022). For example, when female and male recreational runners with PFP ran

with and *without* pain, neither condition displayed statistically significant differences in peak knee joint moments compared to matched controls (Yang et al., 2022). However, the systematic reviews of Dowling et al. (2014) and Neal et al. (2016) concluded that in comparison to non-injured recreational runners, runners with PFP had shorter time to vertical peak force at the lateral calcaneus during initial contact of run gait. In contrast, a meta-analysis found no significant associations between PFP development and time to vertical peak force at any region of the foot during run gait (Neal, Lack, et al., 2019).

Based on existing systematic reviews and meta-analyses, findings pertaining to the influence hip and knee muscle strength, kinematics, and kinetics have on the risk of developing PFP are inconclusive (Francis et al., 2019; Martinelli et al., 2022; Neal, Lack, et al., 2019; Smith, Self et al., 2018). Additionally, a synthesis of literature concluded that neither sex, height, weight, age, nor quadriceps angle (i.e., Q-angle) influenced the risk of developing PFP among recreational runners (Neal, Lack, et al., 2019). It was concluded that the biomechanical risks of developing PFP are not well understood and may be partial to the influences of psychosocial constructs (Neal, Lack, et al., 2019). Researchers of PFP have also called for future research to consider the influential associations among psychosocial constructs such as, pain catastrophizing, kinesiophobia, anxiety, and depression (Vicenzino et al., 2022).

In addition to identifying biomechanical PFP risk factors, researchers have also attempted to understand the prognosis of PFP. Research has been conducted using interventions focused on hip and knee muscle strengthening, run step rate, and patient education. Specifically, researchers have compared post-intervention outcomes of pain, perceived function, kinesiophobia, pain self-efficacy, hip and knee muscle strength, and run gait kinematics to their respective pre-intervention results. To further assess the causal influences of the aforementioned interventions,

researchers have also attempted to predict these post-intervention outcomes from their pre-intervention results (Bolgla et al., 2016; Bramah et al., 2019; dos Santos et al., 2019; Earl-Boehm et al., 2018; Esculier et al., 2017; 2018; Ferber et al., 2015; Hott et al., 2020; Khayambashi et al., 2014; Lack et al., 2014; Neal, Barton, et al., 2019; Roper et al., 2016; Saltychev et al., 2018).

In general, the results of PFP intervention studies are convoluted. Limited research suggests that benefits of hip and knee muscle strengthening interventions are sub-population dependent and some patients may benefit from knee muscle strengthening interventions and not hip muscle strengthening interventions, particularly when combined with other exercises (Earl-Boehm et al., 2018; Esculier et al., 2018; Ferber et al., 2015). Supportively, four meta-analyses concluded that combining hip and knee exercises is likely best for patients with PFP because no single intervention has been found to be effective for the entire PFP population (Lack et al., 2014; Manojlović et al., 2021; Saltychev et al., 2018; Winters et al., 2021). Among recreational runners with PFP however, decreases in pain and increases in perceived function observed following hip and knee muscle strengthening interventions have often lacked statistical significance (Bolgla et al., 2016; Hott et al., 2020; Khayambashi et al., 2014).

Previous research exploring run step rate interventions among recreational runners has also explored its effectiveness on pain and perceived function (dos Santos et al., 2019; Bramah et al., 2019; Neal, Barton, et al., 2019; Roper et al., 2016). These results appear to be more consistent - increasing step rate has been found to facilitate decreases in pain and increases in perceived function among recreational runners with PFP (Bramah et al., 2019; Neal, Barton, et al., 2019; Roper et al., 2016). For example, Bramah et al. (2019) found that increasing run step rate by 10% decreased pain and increased perceived function within three weeks following intervention, and these changes were maintained for at least 12 weeks.

Several studies have also used patient education interventions among recreational runners with PFP. Patient education is a cognitive-behavioral intervention generally defined as a structured learning experience aimed to influence knowledge and health-related behaviors (Sluijs, 1991). In PFP research, patient education refers to a clinician providing patient-specific advice on suspected etiologies, proposed options for treatment, and expectation management (Bosshardt et al., 2021). The findings of previous PFP research suggest patient education is beneficial for improving pain, kinesiophobia, perceived function, pain self-efficacy, and quadriceps muscle strength. Except for quadriceps muscle strength, these outcomes have lasted up to one year (Bosshardt et al., 2021).

Among recreational runners with PFP, comparisons between patient education intervention only, patient education + run gait training intervention, and patient education + lower extremity strength training intervention, have found no statistically significant differences between groups (Esculier et al., 2018; Hott et al., 2020). These findings are partially supported by a recent systematic review and meta-analysis that investigated the comparative effectiveness of treatments for PFP patients (runners and non-runners) with a clinical diagnosis of PFP (Winters et al., 2021). The results from the systematic review and meta-analysis concluded that patient education + exercise, orthoses, or patellar taping/mobilization is most effective at three months following diagnosis. As a standalone intervention, patient education is as effective as patient education in conjunction with any physical intervention at 12 months (Winters et al., 2021).

Collectively, the reviewed PFP prognosis research on hip and knee muscle strengthening, run step rate, and patient education interventions have found inconsistent results. Only increasing run step rate has consistently been found to decrease pain and increase perceived function among

recreational runners with PFP (Bramah et al., 2019; Neal, Barton, et al., 2019; Roper et al., 2016). Using patient education alone or in combination with other interventions including run step rate or hip and knee muscle strengthening, have been found to decrease pain and kinesiophobia; and increase perceived function, pain self-efficacy, and quadriceps strength. Despite their infancy, these results suggest that the prognosis of PFP is best if rehabilitation programs contain both physical (i.e., run step rate, hip and knee muscle strengthening) and psychological (patient education) interventions to address a range of biopsychosocial rehabilitation outcomes.

In conclusion, existing PFP research suggests that PFP incidence is likely high among female and male recreational runners, however synthetization of estimates is inconclusive (Crossley et al., 2019). Most prominent PFP risk factors among recreational runners include quadricep and hip abduction weakness, shorter time to vertical peak force at the calcaneus during contact, and peak hip adduction during stance of run gait. Much of the prognosis research has focused on exploring the effects of hip and knee muscle strengthening, run step rate, and patient education interventions on pain, perceived function, kinesiophobia, pain self-efficacy, run gait kinematics, and hip and knee muscle strength. The results are somewhat inconclusive however patient education, a cognitive-behavioral intervention, has been found to positively effect physical and psychological rehabilitation outcomes.

Systematic reviews and meta-analyses suggest the majority of existing PFP literature has been conducted from a pathomechanical perspective. Yet, it has also highlighted the presence and importance of psychosocial variables among PFP risk factors and successful prognoses. Since much of the PFP research to date has been quantitative in nature and explored only specific psychosocial variables, not much is known about the *what* and the *how* of psychosocial

constructs in the PFP experience (Crossley et al., 2019). Both, PFP risk factor and prognosis research findings appear to be inconsistent at best and one of the reasons for such inconsistency is suggested to be psychosocial constructs that have gone unexplored (Crossley et al., 2019; Hott et al., 2020; Neal, Lack, et al., 2019; Vicenzino et al., 2022).

1.1. Purpose Statement

The purpose of this dissertation was to explore the perceived psychosocial experiences of recreational runners with PFP.

1.2. Specific Aims

(1) To document recreational runners' perceived psychosocial experiences with PFP.

(2) To develop a theoretical model that conceptualizes recreational runners' perceived psychosocial experiences with PFP.

(3) To critically evaluate the applicability of existing theoretical models of psychological responses to sport injury in conceptualizing recreational runners' perceived psychosocial experiences with PFP (e.g., Brewer et al., 2002; Deci & Ryan, 1985; Richardson et al., 2008; Wadey et al., 2018; Wiese-Bjornstal et al., 1998).

1.3. Research Questions

To address specific aim 1, a qualitative study was conducted utilizing a Straussian Grounded Theory (SGT; Corbin & Strauss, 2015) methodology to answer the following research question:

(1) What are recreational runners' perceived psychosocial experiences with PFP?

To address specific aim 2, data from study one was used to answer the following research question:

(2) How can recreational runners' perceived psychosocial experiences with PFP be theoretically conceptualized?

To address specific aim 3, five existing theoretical models of psychological responses to sport injury were compared to the conceptual framework developed in study two to answer the following research question:

(3) How do existing theoretical models of psychological responses to sport injury compare to the conceptual framework in explaining recreational runners' perceived psychosocial experiences with PFP?

1.4. Delimitations

Data analysis, interpretation, and conceptualization were confined to one sample of recreational runners in the United States. Participants self-reported anterior or retropatellar pain during activities that place load onto the PFJ patella (e.g., running, squatting, stair-climbing). Given the specificity of the sample, transference of findings to other populations warrants caution.

1.5. Limitations

The limitations of studies one and two align with those of SGT (Corbin & Strauss, 2015). First, the previous clinical, educational, and empirical experiences of the primary researcher inherently influence the processes of, and conclusions drawn from research (Corbin & Strauss, 2015). Specifically, the personal experiences the primary researcher has had as a recreational runner, a licensed athletic trainer, and a psychosocial PFP researcher likely act as experiential evidence upon which decisions and outcomes of research are based. Only some of these experiences are managed through reflexivity and trustworthiness (Corbin & Strauss, 2015). Also, interviews are inherently influenced by participants' memory and truthfulness (Corbin &

Strauss, 2015). Additionally, the third study is limited by the paucity of techniques that exist to evaluate and compare the conclusions of qualitative research (Smith & McGannon, 2017). The recommendations of Shank (2006) were followed to conduct study three accordingly.

1.6. Assumptions

SGT assumes that understanding the actions and interactions of participants shapes the knowledge of the researcher (Corbin & Strauss, 2015). Even more so, SGT assumes what participants have to say and how participants act, are best understood through self-reflective dialogue (Corbin & Strauss, 2015). However, anything participants say is subject to their memory and honesty (Corbin & Strauss, 2015).

1.7. Practical Significance

The results of this dissertation will facilitate sports medicine and sport psychology professionals' understanding of the perceived psychosocial experiences of recreational runners with PFP. This dissertation proposes an evidence-based theoretical conceptualization to better understand the perceived psychosocial experiences of recreational runners with PFP and compares five existing theoretical models of psychological responses to sport injury to it. An empirical and theoretical understanding of recreational runners' perceived psychosocial experiences with PFP is gained. It then provides a solid conceptual framework for future research and clinical interventions to be theoretically grounded on.

Chapter II: Literature Review

As outlined in the introduction, in comparison to biomechanical and clinical PFP research, empirical research into the role of psychosocial constructs in PFP is limited (Vicenzino et al., 2022). The purpose of Chapter II is to review existing psychosocial PFP research. More specifically, Chapter II aims to (a) identify psychosocial constructs that have received attention in PFP research, (b) synthesize the current state of empirical and theoretical knowledge as it relates to psychosocial constructs in PFP research, and (c) provide a solid methodological rationale for this dissertation.

2.1. Fear-Avoidance Beliefs

Fear-avoidance beliefs have been defined as exaggerated perceptions of pain that motivate an individual to avoid experiencing pain or taking part in painful activities oppose to confronting them; often resulting in negative psychological and physical consequences over time (Lethem et al., 1983). Examples of such consequences include anxiety, depression, and loss of mobility. The original Fear-Avoidance model (Lethem et al., 1983) was developed considering patients with chronic low back pain and suggested that exaggerated perceptions of pain produced substantial fear toward an acute or chronic pain problem. Those fears were presumed to facilitate the execution of psychological and behavioral strategies to dissociate pain experiences and behaviors from potentially painful sensations (Lethem et al., 1983).

Limited research exists into fear-avoidance beliefs and PFP (Genoese et al., 2018). Much of the research to date (Glaviano et al., 2017; 2019; Glaviano & Saliba, 2018; Mansfield & Selhorst, 2018; Piva, Fitzgerald, Irrgang et al., 2009; Piva, Fitzgerald, Wisniewski et al., 2009; Selhorst et al., 2021; Selhorst et al., 2015) has used the Fear-Avoidance Beliefs Questionnaire (FABQ; Waddell et al., 1993), a 16-item self-report measure aimed to measure patients' beliefs

about their low back pain on two independent subscales: work and physical activity. The FABQ has since been modified to be used with patients experiencing knee pain during physical activity (FABQ-PA; e.g., Selhorst et al., 2021; Selhorst et al., 2015) and work (FABQ-W; e.g., Piva, Fitzgerald, Irrgang et al., 2009). Items such as, "physical activity makes my pain worse" are scored on a 7-point Likert scale (0 = *strongly disagree* to 6 = *strongly agree*), with high scores indicating high fear-avoidance beliefs (Waddell et al., 1993). The FABQ's minimal clinically important difference is unknown (Lantz et al., 2016) and cut-off scores discriminating individuals with high and low fear-avoidance beliefs have lacked consistency (e.g., Glaviano et al., 2019; Mansfield & Selhorst, 2018).

Research using the FABQ-PA (Glaviano et al., 2017; 2019; Glaviano & Saliba, 2018; Mansfield & Selhorst, 2018; Selhorst et al., 2015) and FABQ-W (Piva, Fitzgerald, Irrgang et al., 2009; Piva, Fitzgerald, Wisniewski et al., 2009) has predominantly focused on exploring relationships between fear-avoidance beliefs and PFP rehabilitation outcomes. For example, Piva, Fitzgerald, Wisniewski et al. (2009) aimed to identify potential changes in pain and perceived function based on fear-avoidance beliefs and biomechanical factors including muscular strength, flexibility, and movement quality. Following an eight-week standardized PFP rehabilitation program among 51 adult physiotherapy patients (n = 27 females, n = 24 males), the results from forward regression analyses revealed that when controlling for age, sex, height, and weight; fear-avoidance beliefs about physical activity were the strongest predictor of both, pain and perceived function (both $p < .00$).

Piva, Fitzgerald, Irrgang et al. (2009) repeated their study with a sample of 74 adult PFP physiotherapy patients (n = 39 females, n = 35 males). Predictor variables were added to assess structural and kinematic factors such as, Q-angle and foot pronation, as well as self-reported

perceptions of anxiety (henceforth referred to as "anxiety"). The results from forward multiple regression analyses found that while controlling for age and sex, none of the physical factors were associated with pain or perceived function. Fear-avoidance beliefs about physical activity and work predicted pain ($p < .05$). Fear-avoidance beliefs about work and physical activity along with anxiety predicted perceived function ($p = .03$). Piva, Fitzgerald, Irrgang et al. (2009) and Piva, Fitzgerald, Wisniewski et al. (2009) highlighted the importance of psychosocial constructs in both, patients' pain and perceived function.

Selhorst et al. (2015) conducted a pilot study to test the feasibility of adopting an ordered approach to address deficits in muscular strength, lower extremity kinematics, flexibility, and fear-avoidance beliefs among 21 adolescent PFP patients ($n = 14$ females, $n = 7$ males). Fear-avoidance beliefs as well as selected flexibility and select deficits in objective function were used to divide the sample into four experimental intervention groups: fear-avoidance group, flexibility group, functional malalignment group, and strengthening/functional progression group. All patients received physical therapy (PT) treatments twice weekly for six weeks and a daily home exercise program. Those identified with high fear-avoidance beliefs additionally received fear-avoidance education and graded exercise using a cognitive behavioral approach that included a gradual exposure to stimuli (Selhorst et al., 2015). Descriptive statistics observed post intervention suggested that personalized PFP rehabilitation programs facilitated positive outcomes in patients' perceived function and global rating of change. No clinically significant changes were noted at the six-week follow up for pain. In the Selhorst et al. (2015) study, patients with FABQ-PA scores ≥ 15 were identified as having high fear-avoidance beliefs. It is unknown how many of the participants had high scores, and since the fear-avoidance beliefs

were not reassessed following the fear-avoidance intervention, it is unclear if the intervention was able to target the identified fear-avoidance beliefs.

Previous research has also aimed to understand possible relationships between fear-avoidance beliefs, pain, perceived function, and physical activity participation (Glaviano et al., 2017). Glaviano et al. (2017) studied 20 adults with PFP (n = 15 females, n = 5 males) and 20 healthy controls by recording their daily step count with personal Fitbits over a two-week period. The results revealed that participants with PFP took less steps per day ($p < .01$) and completed fewer daily minutes of mild ($p < .01$) and high ($p = .01$) intensity physical activity compared to controls. Correlation analyses also revealed significant relationships between fear-avoidance beliefs, pain, and perceived function similarly to Piva, Fitzgerald, Wisniewski et al. (2009).

Glaviano and Saliba (2018) extended the above research by exploring fear-avoidance beliefs, daily step count, and kinematics of objective functions during single leg squatting, stepping-down, and running among 16 females with PFP. The results of stepwise multiple regression analyses found that step-down knee abduction and single leg squat hip adduction accounted for 37.5% of the variance in fear-avoidance beliefs ($R = 6.12$, $R^2 = 0.38$). Step-down knee abduction accounted for 61.3% of the variance in physical activity level ($R = -0.783$, $R^2 = 0.61$). Correlations suggested increases in hip adduction during single leg squatting ($p = .01$), knee adduction during stance phase of running ($p = .008$), and knee abduction while stepping-down ($p < .01$) were associated with decreases in daily step count. These results along with Glaviano et al. (2017) support the notion that fear-avoidance beliefs relate to poor objective function during running, stepping-down, and single leg squatting, and decreases in daily step count.

Mansfield & Selhorst (2018) conducted a retrospective study among adolescent PT patients with anterior knee pain (n = 341 females, n = 155 males). The research aimed to determine (a) levels of fear-avoidance beliefs among this population; (b) if fear-avoidance beliefs predicted the number of PT visits; and (c) if initial fear-avoidance beliefs about physical activity predicted perceived function at follow-up. The results revealed that the patients reported moderate fear-avoidance beliefs and 346 (70%) were diagnosed with PFP. A hierarchical multiple regression revealed that after controlling for age and sex; fear-avoidance beliefs did not predict patient visits (p = .22) but predicted perceived function at follow-up (p < .01; Mansfield & Selhorst, 2018). Consistent with previous research with adult PFP patients, Mansfield and Selhorst (2018) confirmed that fear-avoidance beliefs influence perceived function in adolescents (Glaviano et al., 2017; Piva, Fitzgerald, Irrgang et al., 2009; Piva, Fitzgerald, Wisniewski et al., 2009).

Glaviano et al. (2019) conducted an RCT among women with PFP (N = 16) to investigate the impact fear-avoidance beliefs have on lower extremity strength and squatting kinematics. The patients were grouped into two groups based on their fear-avoidance beliefs about physical activity (n = 9 high scores, and n = 7 low scores). In comparison to healthy controls and those in the low fear-avoidance belief group, participants in the high fear-avoidance belief group reported longer symptom durations (p < .05) and more pain during exercise completion (p < .05). It was also revealed that those with high fear-avoidance beliefs were weaker in lower extremity strength (knee extension p = .03, hip abduction p = .04) and displayed significantly greater ipsilateral trunk flexion during single leg squat (p = .01) compared to healthy controls and those with low fear-avoidance beliefs. In contrast, participants with low fear-avoidance beliefs demonstrated significantly less knee abduction compared to healthy controls and participants with high fear-

avoidance beliefs. The findings of Glaviano et al. (2019) suggest fear-avoidance beliefs are related to both ipsilateral trunk flexion during single leg squatting and hip abduction strength factors in females with PFP.

Selhorst, Fernandez-Fernandez et al. (2020) conducted PFP research on the fear-avoidance beliefs of 86 adolescents with PFP (n = 53 females, n = 33 males) and 72 parents. Selhorst, Fernandez-Fernandez et al. aimed to explore the relationships psychological constructs such as fear-avoidance beliefs, pain catastrophizing, and kinesiophobia; have with pain, perceived function, and objective functions including single leg hopping and lower extremity muscular strength. Spearman correlation coefficients revealed adolescents' fear-avoidance beliefs correlated with pain ($p < .01$), perceived function ($p < .01$), single leg hop distance ($p < .001$), hip abduction strength ($p < .001$) and quadriceps flexibility ($p < .03$).

Hierarchical regression analyses found that sex, pain, quadriceps strength, hip abduction strength, and quadriceps flexibility, predicted perceived function in adolescents ($p < .001$). The strength of this regression model increased when fear-avoidance beliefs, pain catastrophizing, and kinesiophobia ($\Delta R^2 = .25$; $p < .001$) were added to the model. Analyses did not find relationships among parents' fear-avoidance beliefs, adolescents' pain or self-reported/objective function. The results of Selhorst, Fernandez-Fernandez et al. (2020) suggested adolescents' fear-avoidance beliefs partially influenced their perceived function however, these perceptions were not influenced by parents' fear-avoidance beliefs.

Selhorst, Hoehn et al. (2020) conducted a study to determine if a brief psychologically informed video intervention would reduce adolescents' pain, perceived function, fear-avoidance beliefs, pain catastrophizing, and kinesiophobia. Twenty adolescent PFP patients (n = 10 females, n = 10 males) completed surveys prior to, directly after, and two weeks following, a

psychologically influenced video intervention aimed to educate patients about PFP and stress. Results of a repeated measures ANOVA revealed statistically significant reductions in fear-avoidance beliefs post video intervention ($p = .001$) and at two-week follow-up ($p < .001$).

Selhorst et al. (2021) extended the above research with a goal to determine if an addition of a brief psychologically informed video to traditional physical therapy influence participant's perceptions of pain, perceived function, fear-avoidance beliefs, pain catastrophizing, and kinesiophobia. A total of 66 adolescents with PFP ($n = 43$ females, $n = 23$ males) were randomly assigned to either the psychologically influenced video intervention or control group (Selhorst et al., 2021). Data was collected prior to, directly after, two weeks following, six weeks following, and three months following the videos. A multivariate analysis of variance (MANOVA) revealed that at two weeks, decreases in fear-avoidance beliefs ($p < .001$), pain catastrophizing ($p = .02$), and kinesiophobia ($p = .01$) were significantly greater among the intervention group compared to controls. Specifically, fear-avoidance beliefs decreased by 38.5% and 17.6% for the video intervention and control groups respectively. The findings of Selhorst, Hoehn et al. (2020) and Selhorst et al. (2021) suggest a psychologically informed video may improve the fear-avoidance beliefs of adolescents with PFP for at least two weeks.

A limited number of qualitative studies have been conducted to investigate the role of fear-avoidance beliefs among those with PFP. Robertson et al. (2017) qualitatively explored PFP patients' beliefs about crepitus and how these beliefs impacted their behavior. A total of 11 adult physiotherapy patients ($n = 7$ females, $n = 4$ males) participated in semi-structured interviews. Results from a thematic analysis (Braun & Clarke, 2006) revealed three main themes. Adult PFP patients (a) searched for and gave perceptual meanings to their crepitus, attributed their crepitus to aging, and typically had a negative emotional response to crepitus; (b) were influenced by

friends, family, as well as medical professionals; and (c) altered their movement through fear-avoidant behaviors to prevent audible crepitus. These findings suggest that fear-avoidance beliefs are one of several psychosocial constructs that can influence the behaviors and experiences of adult PFP patients.

Smith, Moffatt et al. (2018) interviewed 10 adult PFP physiotherapy patients (*n* = 7 females, *n* = 3 males) to investigate the experiences of living with PFP in the United Kingdom. Results from a thematic analysis (Braun & Clarke, 2006) revealed that PFP had impacted the lives of each participant in a range of ways. In addition to affecting their physical and functional ability, participants discussed how PFP affected their identity and created pain-related confusion as well as difficulty making sense of their pain. According to Smith, Moffatt et al., psychological constructs were found to be a pertinent part of pain-related cognitions as well as emotional responses, and included "pain-related fear, including fear-avoidance and 'damage' beliefs, inappropriate coping strategies, and fear of the future" (p. 1).

Expanding on their earlier research, Smith et al. (2019) qualitatively investigated potential barriers and facilitators to the implementation of interventions with PFP patients involved in a feasibility RCT. Semi-structured interviews were conducted with 10 adult PFP physiotherapy patients (*n* = 7 females, *n* = 3 males) who had participated in either a usual physiotherapy protocol (*n* = 5) or a loaded self-managed exercise programme (i.e., education and advice on physical activity) physiotherapy protocol (*n* = 5). Results from a thematic analysis (Braun & Clarke, 2006) revealed that regardless of the physiotherapy protocol, the most salient emergent theme among the participants was their (a) desire to maintain control. Other themes included (b) treatment expectations and preference, (c) engagement with the loaded self-managed physiotherapy, and (d) beliefs and attitudes toward pain. Based on participant accounts,

these beliefs and attitudes toward pain were described as a "need to avoid painful activities prior to initiating physiotherapy such as, climbing stairs", a description that is consistent with fear-avoidance beliefs and behaviors.

Glaviano, Holden, et al. (2022) used semi-structured interviews to explore the pain experience on physical activity and daily living of 16 (n = 13 females, n = 3 males) university adults with PFP. A phenomenological approach (Merriam, 2009) was used to code interview transcripts and four themes emerged including (a) maintaining function, (b) redefining their life, (c) experience with pain, and (d) barriers to care. When discussing participants' experiences with pain the entire sample expected pain to increase with physical activity and several participants reportedly avoided activities due to fear of pain. These findings suggest adults with PFP fearfully avoid certain physical activities, a behavioral response aligned with the presumptions of fear-avoidance beliefs.

2.1.1. Fear-Avoidance Beliefs: Synthesis of the Literature

Research into the role of fear-avoidance beliefs among the PFP population has primarily been conducted quantitatively and focused on the construct's relationships with a range of rehabilitation outcomes such as pain, perceived function, objective function, and physical activity participation. Findings support the notion that high fear-avoidance beliefs can negatively influence PFP patients' pain, perceived function, and physical activity participation (e.g., Mansfield & Selhorst, 2018; Piva, Fitzgerald, Irrgang et al., 2009; Piva, Fitzgerald, Wisniewski et al., 2009; Selhorst, Fernandez-Fernandez et al., 2020; 2021). Fear-avoidance beliefs have also been found to influence deficits in objective function and levels of physical activity intensity (e.g., Glaviano et al., 2017; 2019; Glaviano & Saliba, 2018). Likewise, PFP patients' fear-

avoidance beliefs may decrease after watching a psychologically informed video (Selhorst et al., 2021; Selhorst, Hoehn et al., 2020).

A robust limitation of existing research to date is its inability to explore or understand potential psychological constructs beyond those measured quantitatively. For example, Piva, Fitzgerald, Wisniewski et al. (2009) suggested that environmental factors such as, the busyness of a treatment facility influenced the experiences of PFP patients, but this was not measured in their research. Thus far, four studies have used qualitative methods to gain an understanding of fear-avoidance beliefs and PFP (Glaviano, Holden, et al., 2022; Robertson et al., 2017; Smith, Moffatt, et al., 2018; Smith et al., 2019). Among those studies, Smith et al. (2019) found that fear-avoidance beliefs are a psychological byproduct of PFP patients' desire to gain a sense of control over their injury, a finding that has not been previously identified in quantitative fear-avoidance belief-related PFP research.

Another limitation of existing PFP fear-avoidance beliefs research is its lack of coherence with existing theoretical frameworks explaining how fear-avoidance beliefs are related to patients' pain experience. The Fear-Avoidance model (Lethem et al., 1983) is founded on the premise that fear-avoidance beliefs are a consequence of exaggerated pain perceptions, which then facilitate the execution of psychological and behavioral strategies to dissociate pain experiences and behaviors from potentially painful sensations (Lethem et al. 1983). As existing research has not confirmed if fear-avoidance beliefs are a consequence of exaggerated perceptions of pain or other reasons, it fails to account for the key causes underlying such beliefs.

Much of the research has focused on the relationship between fear-avoidance beliefs and rehabilitation outcomes. However, it is unclear whether or not rehabilitation outcomes result from patients' psychological and behavioral strategies to dissociate from potentially painful

sensations. Without understanding the underlying mechanisms of how different psychological constructs influence PFP experiences, the results will continue to be convoluted and atheoretical; and clinical outcomes will remain suboptimal.

2.2. Pain Catastrophizing

Catastrophizing is a common cognitive distortion that is characterized by an inclination toward overestimation or magnification of serious potential consequences (Ellis, 1962). Pain catastrophizing has been defined as "an exaggerated negative mental set brought to bear during actual or anticipated painful experiences" (Sullivan et al., 2001, p. 52). Pain catastrophizing as a construct has long been accepted in chronic pain research, but its inaugural development is unknown and without theory (Sullivan et al., 2001). Early chronic pain literature has however, suggested that pain catastrophizing is an emotional state (Pincus et al., 2010; Sullivan et al., 2001; Vlaeyen & Linton, 2000); a characterization that is somewhat inconsistent yet complimentary with the definition of catastrophizing in general, as stated above.

The role of pain catastrophizing in PFP can be explained using the Fear-Avoidance Model of Chronic Pain (i.e., FAMC; Leeuw et al., 2007). The FAMC is an adaptation of the Fear-Avoidance Model and claims pain catastrophizing reflects the cognitive aspects (i.e., catastrophic thinking) of an individual's misinterpretation of chronic pain. Specifically, the FAMC presumes individuals appraise their chronic pain as either catastrophic or as nonthreatening. A non-threatening appraisal results in confronting one's pain and in turn, facilitates recovery. A catastrophic appraisal results in fear whereas, the anticipation of pain causes anxiety to develop. Fear/anxiety in turn, facilitate avoidance behaviors, disuse of the injured extremity, disability, and depression (Leeuw et al., 2007).

Research into catastrophizing and chronic pain was originally plagued with inconsistences among theory, measurement, and results (Leung, 2012; Quartana et al. 2009). Only recently have researchers begun to explore pain catastrophizing through the FAMC framework (Doménech et al., 2013; 2014; Maclachlan et al., 2018; 2020; Priore et al., 2019; Selhorst et al., 2021). To do so, researchers have used the Pain Catastrophizing Scale (PCS; Sullivan et al., 1995), a 13-item self-report measure with three independent subscales; rumination, magnification, helplessness. The subscales assess mechanisms through which catastrophic thinking are known to influence pain experiences. The items such as, "I feel I can't go on" are scored on a 5-point Likert scale (0 = *not at all* to 4 = *all the time*) with a high summed score (i.e., score of 30) indicating catastrophized thoughts. Specifically, 11 for rumination, 5 for magnification, and 13 helplessness are considered high scores respectively (Sullivan et al., 1995). The minimal clinically important difference associated with PCS scores remains unknown.

Thus far pain catastrophizing research in PFP is somewhat limited. Doménech et al. (2013) surveyed 97 adult outpatient orthopedic clinic patients with PFP (n = 80 females, n = 17 males) to evaluate the prevalence of several psychological constructs (including pain catastrophizing) and their relationship with pain and perceived disability. Results indicated a high prevalence of pain catastrophizing among the sample (Doménech et al., 2013). Specifically, *t*-tests revealed that patients classified as high in pain catastrophizing reported significantly greater pain (p = .0001) and perceived disability (p = .0001) compared to those classified as experiencing less pain catastrophizing. Multiple stepwise regression analyses revealed that of the psychological constructs measured, pain catastrophizing was the only predictor of pain ($p < .05$) whereas, pain catastrophizing and depression were found to predict perceived disability ($p < .05$).

Doménech et al. (2014) expanded the previous findings by longitudinally investigating if changes in psychological constructs including pain catastrophizing, kinesiophobia, anxiety, and depression were related to PFP rehabilitation outcomes such as, pain, perceived and disability among 47 adult patients (n = 42 females, n = 5 males). Survey data was collected prior to and six months after PFP rehabilitation. Spearman correlations revealed that pain catastrophizing had the strongest relationship with changes in both, pain ($p < .001$) and perceived disability ($p < .001$) post rehabilitation, compared to other variables. The results of hierarchical multiple regressions analyses found changes in pain catastrophizing to be the sole predictor of changes in pain ($p < .001$). Whereas, pain catastrophizing ($p < .001$) and anxiety ($p < .006$) predicted changes in perceived disability. Together, the results from Doménech et al. (2013; 2014) suggested that adult PFP patients experience pain catastrophizing to a varying degree. As rehabilitation progressed, pain decreased, and the extent of pain catastrophizing changed. These results suggested that perceived disability is influenced by pain catastrophizing, but only in conjunction with other psychological constructs such as anxiety (Doménech et al., 2014) and depression (Doménech et al., 2013).

When studying adult women with PFP (with/without crepitus; n = 65) and pain-free controls (with/without crepitus n = 51), de Oliveira Silva et al. (2018) compared pain catastrophizing and kinesiophobia to anthropometric characteristics, knee extensor strength, perceived function and stiffness, as well as objective functions including stepping down and forward hopping. Results of a one-way between groups ANOVA revealed that PFP groups reported more pain catastrophizing and kinesiophobia, less perceived function, and more knee stiffness compared to pain-free controls (all $p < .001$). Further group comparisons revealed that PFP patients (with/without crepitus) and pain-free controls with crepitus had poorer objective

function in stepping down ($p < .05$), forward hopping ($p < .05$), and knee extensor strength ($p < .05$) compared to pain-free and crepitus-free groups. The findings of de Oliveira Silva et al. suggest psychosocial responses to PFP such as, pain catastrophizing and kinesiophobia may be present without overt signs of PFP such as, crepitus.

Maclachlan et al. (2018) explored pain catastrophizing among 100 adults with PFP (n = 76 females, n = 24 males) and 50 healthy controls to compare psychological profiles across these populations and within PFP severity subgroups and aimed to explore relationships between pain catastrophizing, kinesiophobia, anxiety, depression and their contribution to pain and perceived disability. A cluster analysis grouped participants with PFP into more ($n = 43$) and less severe ($n = 57$) subgroups based on pain and perceived disability. The results of t-tests revealed no significant differences in psychological profiles between PFP patients and healthy controls. However, a statistically significant difference was observed within PFP subgroups ($p < .001$). Those with more severe PFP ($p \leq .001$) reported greater pain catastrophizing, kinesiophobia, anxiety, and depression, compared to those with less severe PFP. The results of a backward elimination multiple regression revealed that kinesiophobia ($p < .01$) and depression ($p = .03$) but not pain catastrophizing or anxiety predicted perceived disability (Maclachlan et al., 2018). The findings of Maclachlan et al. suggest PFP severity may be related to pain catastrophizing, kinesiophobia, anxiety, and depression in adults with PFP and their perceived disability is influenced by both, kinesiophobia and depression.

Maclachlan et al. (2019) provided an open-access, peer-approved information pamphlet to 84 adult PFP patients (n = 56 females, n = 28 males) to determine the intervention's effects on psychological constructs without physical rehabilitation. Baseline assessments took place during week one; the information pamphlet was given to participants in week 12; and data collections

took place during weeks 12 and 18. Priori orthogonal contrasts and Pearson's Chi-square analyses of frequency revealed that patient satisfaction increased but physical activity participation decreased (both $p = .001$) whereas, pain catastrophizing, pain, perceived disability, kinesiophobia, depression, pain self-efficacy, and knee-related quality of life, remained unchanged. Results suggested that PFP patients were satisfied with treatment despite levels of kinesiophobia and depression remaining unchanged and reportedly, took part in less physical activities during weeks 12 and 18 compared to baseline.

Priore et al. (2019) explored associations among objective functions including single leg hopping and stepping down with pain catastrophizing, and kinesiophobia in 55 adult females with PFP and 40 healthy controls. Pearson correlations suggested women with PFP displayed poorer objective function (all $p \leq .002$) and reported greater pain catastrophizing ($p < .001$) and kinesiophobia ($p < .001$) compared to healthy controls. However, no statistically significant correlations were observed between objective functions, pain catastrophizing, and kinesiophobia. The findings of Priore et al. support those of de Oliveira Silva et al. (2018), suggesting psychosocial responses such as pain catastrophizing, may be present in but not directly related to PFP patients' objective functions, such as single leg hopping.

Recently, de Oliveira Silva et al. (2020) conducted an intervention study to explore the effects of a self-directed web-based education and exercise therapy program on PFP patients'pain, perceived disability, pain catastrophizing, kinesiophobia, pa in self-efficacy, and kneerelated quality of life. A total of 35 adult PFP patients ($n = 27$ females, $n = 8$ males) participatedin a six-week virtual PFP self-management education including lessons on understanding one's pain and a self-directed exercise therapy program. Upon completion, those who reported being less than fully recovered ($n = 26$; 74%) received eight sessions of in-person

physiotherapy (n = 13) or tele-rehabilitation (n = 13) with a physiotherapist (de Oliveira Silva et al., 2020). Descriptive statistics suggested that patients' pain catastrophizing, pain, perceived disability, kinesiophobia, pain self-efficacy, and knee-related quality of life, improved post intervention. However, *t*-test results revealed no differences in treatment effects or outcomes between in-person and tele-rehabilitation physiotherapy groups (de Oliveira Silva et al., 2020). Results of de Oliveira Silva et al. suggested that psychosocial constructs such as pain catastrophizing were present during the initial phases of PFP rehabilitation but subsided over time and were indifferent to mode of treatment.

Maclachlan et al. (2020) expanded on their previous research (Maclachlan et al., 2018) by comparing pain catastrophizing, kinesiophobia, anxiety, and depression with somatosensory functions including hypersensitivity and pain self-efficacy in 150 adults with PFP (n = 97 females, n = 53 males) and 61 healthy controls. The results of a MANOVA revealed that adults with PFP reported significantly greater pain catastrophizing, anxiety, and depression, compared to healthy controls ($p < .001$). Similarly, relative risk analyses revealed the risk of reporting high pain catastrophizing and depression increased by 6% among the PFP group whereas, anxiety elevated by 23%. The results of a backward elimination multiple regression suggested that pain catastrophizing ($p < .05$), kinesiophobia ($p < .001$), pain self-efficacy ($p < .01$), and pressure pain threshold at the knee ($p < .01$), predicted PFP patients' perceived disability. The findings of Maclachlan et al. (2020) support those of Maclachlan et al., 2018, suggesting that pain catastrophizing may not be as prominent as other psychological constructs including kinesiophobia, anxiety, and depression among adults with PFP.

In addition to the fear-avoidance beliefs discussed earlier, Selhorst, Fernandez-Fernandez et al. (2020) investigated the relationship between pain, perceived function, objective function,

and pain catastrophizing among 86 adolescents with PFP. Similar to fear-avoidance beliefs about physical activity, Spearman correlations revealed that pain correlated with pain catastrophizing ($p = .001$). However, pain catastrophizing did not correlate with those of perceived function or objective function. Equally, adolescent PFP patients' pain, perceived function, and objective function, did not correlate with parents' pain catastrophizing.

Like fear-avoidance beliefs, the brief psychologically informed video intervention of Selhorst, Hoehn et al. (2020) also influenced pain catastrophizing among adolescent PFP patients. The results of a repeated measures ANOVA found a statistically significant reduction in pain catastrophizing ($p < .001$) with a clinically meaningful change observed directly following the video and at two-week follow up. Similar results were also found by Selhorst et al. (2021) who replicated their previous (2020) research with adolescent PFP patients. The results from MANOVA revealed that from baseline to week two, both the intervention and control group reported decreases in pain catastrophizing (27.1% and 21.6% respectively) that were statistically significant ($p = .02$).

Bagheri et al. (2021) added an eight-week mindfulness program to exercise therapy and explored its effects on pain, perceived function, perceived treatment effect, pain catastrophizing, kinesiophobia, and coping strategies. A total of 35 female recreational runners with PFP were assigned to either control group or mindfulness intervention group. Both groups received exercise, run, and load management training over 18 weeks. The mindfulness group also received eight weeks of breathing meditation, body scan meditation, yoga, sitting meditation, and walking meditation training. Data was collected at baseline, nine weeks, 18 weeks, and at two-month follow up. Mixed-model analyses of variance suggested the effects of intervention group were statistically significant on all measured constructs (all $p < .05$). Bonferroni corrections

revealed that in comparison to control group, the mindfulness intervention group had greater decreases in pain catastrophizing at week nine ($p < .01$), week 18 ($p = .01$), and two-month follow up ($p < .02$). These findings suggest that adding mindfulness training to exercise, run, and load management training for female recreational runners with PFP has the potential to decrease pain catastrophizing for at least two months.

James et al. (2021) conducted a pilot study to determine the feasibility of a RCT in comparing 12 weeks of standardized physiotherapy to a physiotherapy that also included patient education focused on pain catastrophizing and kinesiophobia. Nineteen PFP patients ($n = 14$ females, $n = 5$ males) from the United Kingdom were randomly assigned to control ($n = 8$) and intervention ($n = 11$) groups. In addition to standard physiotherapy treatment, both groups received a standardized treatment protocol that included an explanation of the PFP diagnosis, management plan, and individualized home exercise program. Additionally, the intervention group received an educational leaflet and one 30-minute patient education session with the physiotherapist who discussed (a) causes of pain, (b) beliefs about pain, (c) beliefs about noises from the joint, (d) impact of pain on activity, and the (e) influence of other family members' experience and beliefs about knee pain. Data on perceived function, pain catastrophizing, and kinesiophobia was collected at baseline and 12 weeks. The results from descriptive statistical analyses suggested similar reductions in pain catastrophizing for both groups, thus providing conflicting findings to previous research.

Holden et al. (2021) conducted a secondary mediation analysis to determine whether the effect of hip exercise for PFP is mediated by hip muscle strength or range of psychological characteristics including pain catastrophizing. A total of 218 adults with PFP ($n = 151$ females, $n = 67$ males) were randomized to a foot orthoses ($n = 109$) or hip exercise ($n = 109$) group. The

foot orthoses group received foot orthoses and a foot/ankle home exercise program. The hip exercise group completed hip exercises with a PT three times weekly for four weeks. Data for objective function and selected psychological constructs were collected at baseline and at 12 weeks. The results from regression analysis showed that hip external rotation muscle strength increased for the hip exercise group but not for the foot orthoses group ($p < .01$), and that there was no statistically significant relationship between intervention group and pain catastrophizing. These results suggest that pain catastrophizing does not mediate the effect of hip exercise on PFP.

Pazzinatto et al. (2022) conducted a cross-sectional observation study to investigate possible relationships between kinesiophobia and BMI, pain sensitivity, pain, perceived disability, pain catastrophizing, physical activity level, and health related quality of life. A total of 92 adult women with PFP were recruited from universities and social media and attended a one-time 45-minute data collecting session. Spearman correlations revealed that kinesiophobia correlated with pain catastrophizing ($p < .001$), perceived disability ($p < .001$), pain ($p = .045$), pain sensitivity (all $p < .01$), and health related quality of life ($p < .001$).

In addition to the quantitative research discussed above, two qualitative studies have considered a possible relationship between pain catastrophizing and PFP (Glaviano, Holden, et al., 2022; Smith, Moffatt et al., 2018). First, when Smith, Moffatt et al. (2018) interviewed 10 adult patients with PFP ($n = 7$ females, $n = 3$ males) they described experiences of immense pain-related confusion and difficulty making sense of their pain; but it was unclear if this confusion resulted in pain catastrophizing or not (Smith, Moffatt et al., 2018). This finding suggested that pain catastrophizing may not be a prominent psychosocial response.

Secondly, in contrast to the above, the results of the qualitative study conducted by Glaviano, Holden, et al. (2022) suggested that some of the 16 (n = 13 females, n = 3 males) interviewed university adults with PFP experienced pain catastrophizing. Specifically, few of the participants described how they ruminated and felt helpless in response to their PFP, regardless of symptom duration. Since rumination and helplessness are constructs of pain catastrophizing (Sullivan et al., 1995) it is likely that pain catastrophizing will be a psychosocial response to PFP among university adults with PFP.

2.2.1. Pain Catastrophizing: Synthesis of the Literature

Previous research into pain catastrophizing among the PFP population has quantitatively explored the construct's relationships with pain, perceived function, objective function, physical activity level, and kinesiophobia. Pain catastrophizing has been observed to be high during the initial phases of rehabilitation and to decrease over time. The findings of the reviewed research suggest that the influences of pain catastrophizing on individuals' experiences with PFP is minimal at best. This is supported by existing qualitative research – as only one study has supported its presence among PFP patients (Glaviano, Holden, et al., 2022).

Research into the role of pain catastrophizing in PFP also appears to be atheoretical. Research that exists, appears to have no explicit links between original substantive theory, research practices used, or results found. No PFP studies have been developed within the FAMC theoretical framework, nor has any other theory suitable to explain pain catastrophizing in chronic pain been considered (Quartana et al., 2009). Equally, it is unclear if pain catastrophizing reported via quantitative measurement reflects the catastrophic misinterpretations of chronic pain theorized by the FAMC (Leeuw et al., 2007). Statistically significant relationships between fear-avoidance beliefs, pain catastrophizing, and anxiety provide partial support for the FAMC

theoretical framework (Doménech et al., 2014; Maclachlan et al., 2018; Selhorst, Fernandez-Fernandez et al. 2020; Selhorst et al., 2021; Smith, Moffatt et al., 2018). However, this is speculative as no study has systematically conceptualized the psychosocial constructs that influence individuals' PFP experiences with a goal to create an overarching theoretical framework.

2.3. Kinesiophobia

Kinesiophobia refers to excessive feelings of injury or reinjury vulnerability that facilitate debilitatingly irrational fears toward physical movement and/or activity (Miller et al., 1991). Originally, kinesiophobia was presumed to be a phobic process that directly caused pain-related behaviors in chronic pain patients (Miller et al., 1991). Founded on the above definition, Vlaeyen et al. (1995) developed the Cognitive-Behavioral Model of Fear of Movement/(Re)injury (CBM) to explain how kinesiophobia moderates the relationship between chronic low back pain and physical activity avoidance behaviors. The CBM presumes that patients who exhibit pain catastrophizing, can develop kinesiophobia, which will lead to persistent avoidance of activities that would increase pain, resulting in disuse of the injured extremity, disability, and depression (Vlaeyen et al., 1995).

All research investigating the role of kinesiophobia in PFP has been conducted with the Tampa Scale for Kinesiophobia (TSK; Miller et al., 1991). The TSK is a 17-item unidimensional measure that assesses individuals' fear and vulnerability toward painful injury or reinjury. Items such as, "pain always means I have injured my body" are scored on a 4-point Likert scale (0 = *strongly disagree* to 3 = *strongly agree*) and sum scores > 37 suggest the existence of high kinesiophobia. However, the TSK's minimal clinically important difference is unknown (Lantz et al., 2016).

Much of the research investigating kinesiophobia in PFP has been conducted in conjunction with other psychological constructs. For example, in addition to pain catastrophizing Doménech et al. (2013) evaluated the prevalence of kinesiophobia and its relationship to pain and perceived disability. Kinesiophobia scores suggested more participants reported high (n = 80) compared to low (n = 17) kinesiophobia, and t-test comparisons suggested patients high in kinesiophobia reported more pain ($p < .01$) and perceived disability ($p = .0001$) compared to those with low kinesiophobia. However, multiple stepwise regression analyses could not identify kinesiophobia as a predictor of pain or perceived disability.

The longitudinal study of Doménech et al. (2014) investigated changes in kinesiophobia among the variables discussed earlier. Kinesiophobia was found to have strong relationships with both pain ($p < .05$) and perceived disability ($p < .001$), but not as strong as those with pain catastrophizing. The results of hierarchical multiple regressions analyses suggested that kinesiophobia did not predict pain or perceived disability (Doménech et al., 2014). Together, the results of Doménech et al. (2013; 2014) suggested that adult PFP patients experienced kinesiophobia to a lesser degree than other psychological constructs including pain catastrophizing, anxiety, and depression.

Maclachlan et al. (2018) also included kinesiophobia in their research and found greater kinesiophobia among patients with severe PFP compared to less severe PFP ($p \leq .001$). A backward elimination multiple regression suggested kinesiophobia ($p < .01$) and depression (p = .03) predicted perceived disability. The results of Maclachlan et al. (2018) suggested that kinesiophobia predicted perceived disability without the presence of pain catastrophizing or anxiety, contradicting the CBM (Vlaeyen et al., 1995). The CBM presumes kinesiophobia is an emotional response that occurs as a consequence of pain catastrophizing (cognitive appraisal),

leading to avoidance behaviors and causing disuse of the injured extremity, disability, and depression.

Kinesiophobia was also explored among PFP patients with crepitus by de Oliveira Silva et al. (2018). Results of a one-way between groups ANOVA suggested PFP groups reported less kinesiophobia and perceived disability but more kinesiophobia, pain catastrophizing, and knee stiffness compared to healthy controls (all $p < .001$). Like Lack et al. (2014), de Oliveira Silva et al. found those with PFP demonstrated less knee extensor strength compared to healthy controls ($p < .05$). Overt signs of PFP such as, crepitus may not influence the development of kinesiophobia but may be associated with biomechanical deficits such as, knee extensor strength among adult women with PFP.

Maclachlan et al. (2019) also included kinesiophobia among the variables of interest when examining the effects of an open-access, peer-approved information pamphlet on several psychological constructs without physical rehabilitation. Comparisons of standardized response mean results between the nonintervention period from baseline to week 12, but not the intervention period from weeks 12 to 18, suggested kinesiophobia decreased. The findings of Maclachlan et al. suggest that kinesiophobia may decrease on its own without formal intervention, and that any subsequent formal education may not have a further effect.

To progress their earlier research, de Oliveira Silva et al. (2019) investigated three-dimensional lower extremity kinematics during stair descension, as well as knee extensor strength, and kinesiophobia among adult women with PFP ($N = 40$). Pearson correlations suggested kinesiophobia was associated with kinematics including cadence, and peak knee flexion during stair descension ($p < .001$) but not knee extensor strength. The findings of de Oliveira Silva et al. suggest adult women with PFP might avoid certain movements when

descending stairs in response to kinesiophobia, supporting the CBM (Vlaeyen et al., 1995). However, de Oliveira Silva et al. did not conduct causal assessments to support this claim.

The above results conflict with those of Priore et al. (2019), who compared relationships between psychological constructs including kinesiophobia and pain catastrophizing with objective functions such as, single leg hopping, and stepping down among 55 adult females with PFP and healthy controls. Pearson correlations revealed no statistically significant relationships between kinesiophobia with pain catastrophizing or objectively functional tasks. These findings contrast earlier research and imply that kinesiophobia may be a task/activity specific phenomenon in a subgroup of adult women with PFP.

Barton et al. (2019) studied 11 adults with PFP (n = 6 females, n = 5 males) to evaluate the feasibility of a 12-week hip/trunk progressive resistance training program and assessed changes in several rehabilitation outcomes including kinesiophobia, perceived function, hip strength/power, and physical activity participation. Pre/post intervention paired t-test results suggested improvements occurred in pain, perceived function, abduction and extension dynamic hip strength and power (all $p < .05$). No statistically significant changes were found for kinesiophobia, isometric hip extension strength or physical activity participation. These findings suggest adults with PFP and high kinesiophobia may not recognize gains in *hip* strength/power as improvements to their PFP; a *knee* injury.

Hott, Brox, Pripp, Juel et al. (2019) conducted a PFP patient education intervention study among 112 PFP patients (n = 73 females, n = 39 males). Participants were grouped into three groups: (a) PFP patient education + hip exercise program (n = 39), PFP patient education + knee exercise program (n = 37), and (c) PFP patient education only (n = 37). Outcomes measured included psychological constructs such as, kinesiophobia and objective functions such as

stepping down, and biomechanical factors such as, isometric hip strength. PFP patient education was provided once, during the initial physical evaluation for all participants. Additionally, participants in the hip and knee exercise groups attended physiotherapy sessions three times weekly for six weeks. Paired-sample *t*-test results revealed no changes in kinesiophobia at six weeks post education session but found statistically significant reductions in the entire sample at three months ($p \leq .05$). Interestingly, changes in kinesiophobia observed by Hott, Brox, Pripp, Juel et al. did not achieve statistical significance for either physical intervention group.

Hott, Brox, Pripp, Juel & Liavaag (2019) extended the above study by collecting and analyzing the aforementioned data at 12 months post PFP patient education implementation. Compared to data collected at initial physical evaluation, a statistically significant improvement was observed in kinesiophobia among the knee exercise group, but not the hip exercise group at 12 months; supporting the claims of Barton et al. (2019). Additionally, a statistically significant improvement was observed in kinesiophobia among the PFP patient education group at 12 months compared to baseline and three-month post PFP patient education intervention. Hott et al. (2020) also used the same data to compare psychological constructs such as, kinesiophobia, pain, perceived function, and global rating of change at 12-month follow up. Backward elimination regression analyses revealed that psychological constructs at initial evaluation did not predict pain, perceived function, or global rating of change at 12-month follow up.

Priore et al. (2020) conducted a randomized clinical trial among 50 adults with PFP to investigate the effects of wearing a knee brace for two weeks (n = 18 females, n = 7 males) compared to receiving a standardized patient education leaflet (n = 19 females, n = 6 males) on kinesiophobia, perceived function, objective functions such as stepping down, and physical activity. Results of post intervention mixed-models and intention-to-treat ANOVAs found no

significant changes in any of the variables with one exception. A reduction in kinesiophobia was observed at two weeks and one-month post baseline for the knee bracing group (both $p < .01$). The results of Priore et al. suggested bracing, opposed to a standardized patient education leaflet, facilitated improvements in kinesiophobia among adults with PFP without rehabilitation.

Maclachlan et al. (2020) discussed previously, found a relationship between kinesiophobia and PFP. Results to a MANOVA revealed those in the PFP group had a 55% increased risk of reporting greater kinesiophobia ($p < .001$). Also, a backward elimination multiple regression found kinesiophobia ($p < .001$) to be one of several psychological variables that predicted perceived disability. Results of Maclachlan et al. suggested that kinesiophobia facilitated perceived disability in adults with PFP, but this study did not include analyses of causal directionality to support this theoretical conceptualization (Vlaeyen et al., 1995).

In addition to fear-avoidance beliefs and pain catastrophizing discussed earlier; Selhorst, Fernandez-Fernandez et al. (2020) also investigated relationships between kinesiophobia, pain, perceived function, and objective function, among adolescents with PFP. A hierarchal multiple regression analysis revealed kinesiophobia ($p < .001$) to be one of several variables that predicated perceived function, but to a lesser extent than that of pain and hip abduction strength (Selhorst, Fernandez-Fernandez et al., 2020).

The brief psychologically informed video intervention study of Selhorst, Hoehn et al. (2020) also assessed kinesiophobia in addition to fear-avoidance beliefs about physical activity and pain catastrophizing. A repeated-measures ANOVA revealed that adolescent PFP patients' kinesiophobia reduced immediately after ($p < .01$) and two weeks following the video intervention ($p < .001$) compared to baseline. Likewise, a statistically significant improvement was observed between the two-week follow-up and data collected directly after the intervention

(p = .02). Interestingly, clinically meaningful improvements were not observed until the two-week follow up. These findings suggest a brief psychologically informed video intervention can assist in improving kinesiophobia among adolescent PFP patients, but these improvements may not be noticeable for approximately two weeks. It is not known how kinesiophobia influenced the experiences of adolescent PFP patients prior to, directly after, and two weeks following the psychologically informed video intervention.

The brief psychologically informed video intervention study by Selhorst et al. (2021) also assessed the effects of the video intervention on kinesiophobia. The results from MANOVA revealed statistically significant differences in kinesiophobia (p = .01) between the groups. From baseline to week two, the intervention and control groups saw a 40.4% and 6.6% reduction in pain catastrophizing respectively. These results, along with those of Selhorst, Hoehn et al. (2020) suggest that a psychologically informed video is beneficial in decreasing kinesiophobia among adolescent PFP patients.

The research by Bagheri et al. (2021) also assessed kinesiophobia when examining the effects of adding eight-weeks of mindfulness training to an exercise, run, and load management intervention. Specifically, mixed-model analyses of variance (p < .01) suggested kinesiophobia decreased from baseline to week nine for the mindfulness intervention group (p = .001) but not for the control group. Bonferroni corrections suggested that the mindfulness intervention group had greater decreases in kinesiophobia compared to controls at week nine (p < .001), week 18 (p = .001), and two-month follow up (p < .01). These finding suggest mindfulness training assisted in kinesiophobia reduction among female runners with PFP while they engaged in exercise training, run-technique training, and run load management education.

The pilot study of James et al. (2021) also assessed kinesiophobia when determining the feasibility of a RCT in comparing 12 weeks of standardized physiotherapy (control group) to a physiotherapy that also included a patient education intervention. The result revealed a similar decrease in kinesiophobia from baseline and week 12 for both groups. These findings suggest patient education may not be effective in reducing adult PFP patients' kinesiophobia, however, since inferential statistics were not performed inferences cannot be made.

The secondary mediation analysis of Holden et al. (2021) also included kinesiophobia as a potential mediator variable when assessing the effects of hip exercise on patellofemoral pain. The results from the regression analysis suggest that kinesiophobia does not mediate the effect of hip exercise on patellofemoral pain.

Greaves et al. (2021) investigated the effect of an evidence-based rehabilitation program on running biomechanics, quadriceps strength and inhibition, pain, perceived function, and kinesiophobia. Data was collected from 16 adult hospital PFP patients (n = 7 females, n = 8 males) at baseline and at week seven follow-up including: (a) measurements of pain, perceived function, and kinesiophobia; (b) three-dimensional lower extremity kinematic/kinetic run analysis; and (c) quadriceps strength and autogenic muscle inhibition. At baseline, the participants received ankle weights, exercise bands, and an exercise booklet that guided them through an individualized six-week home exercise program. The results of two-tailed paired sample t-tests suggested that pre-post intervention differences in run speed, hip/knee peak joint angles, hip/knee joint moments during stance phase, and quadriceps strength were not statistically significant. Decreases in kinesiophobia, quadriceps autogenic muscle inhibition (p = .018), as well as pain (p = .001) and increases in perceived function (p = .001) were statistically significant. These findings suggest that an evidence-based home exercise program may be of

benefit in improving quadriceps autogenic muscle inhibition, perceived function, and decreasing kinesiophobia among adults with PFP.

Pazzinatto et al. (2022) investigated the relationship between kinesiophobia and BMI, pain sensitivity, pain, perceived disability, physical activity level, pain catastrophizing, and health related quality of life. The results from Pearson correlation analysis suggested that higher kinesiophobia scores were associated with higher levels of pain catastrophizing ($p < .001$).

Hott et al. (2022) extended their earlier research (Hott, Brox, Pripp, Juel et al., 2019) by using the data they previously collected from 112 PFP patients ($n = 73$ females, $n = 39$ males). The purpose of their research was to: (a) examine the levels of kinesiophobia, emotional distress, pain self-efficacy, and widespread pain and (b) determine their associations with measures of pain, perceived function, and health-related quality of life. The results of Spearman correlation analyses revealed that kinesiophobia negatively correlated with perceived function ($p < .01$) and health related quality of life ($p < .01$). However, these correlations were found to be weak and subsequently removed from the multiple linear regression models developed. These results question the salience of the kinesiophobia as a psychological construct among the PFP population (as measured by the TSK).

Thus far, only one qualitative study has explored kinesiophobia among adults with PFP. Smith, Moffatt et al. (2018) discussed previously, interviewed adult PFP physiotherapy patients ($n = 7$ females, $n = 3$ males) to investigate their experiences of living with PFP in the United Kingdom. Participants described experiencing PFP as a dilemma between wanting to participate in physical activity and feeling uncertain as to whether doing so would result in further injury. Some participants avoided physical activity whilst others continued to participate. Those who continued to participate subsequently discussed how they had developed symptoms that

characterize injury anxiety. These findings support the assumptions of the CBM (cognitions and emotions influencing behavior, and behavior resulting in subsequent cognitive-affective responses), but it is unclear if the responses discussed would be defined as kinesiophobia or can be ascribed to psychological responses such as worry, anxiety, apprehension or other.

2.3.1. Kinesiophobia: Synthesis of the Literature

Research into kinesiophobia among PFP patients has primarily been conducted quantitatively and focused on the construct's relationships with physical and psychological constructs including pain, perceived function, perceived disability, fear-avoidance beliefs, pain catastrophizing, physical activity participation, objective functions, and biomechanical factors such as lower extremity muscular strength. These relationships have reportedly been inconsistent (Barton et al., 2019; de Oliveira Silva et al., 2018; Doménech et al., 2013; 2014; Holden et al., 2021; Hott et al., 2022; Maclachlan et al., 2018; 2020). For example, when comparing adults with PFP to healthy adults, Maclachlan et al. (2018) found no statistically significant differences in kinesiophobia scores. However, Maclachlan et al. (2020) found the prevalence of kinesiophobia among adults with PFP to be higher when compared to healthy controls.

Interestingly, both quantitative and qualitative PFP research suggest that kinesiophobia is task/activity specific and subpopulation dependent (Bagheri et al., 2021; de Oliveira Silva et al., 2018; Greaves et al., 2021; Hott, Brox, Pripp, Juel & Liavaag, 2019; Priore et al., 2020; Smith, Moffatt et al., 2018). For example, the kinesiophobia among some PFP patients decreased following a patient education intervention (Hott, Brox, Pripp, Juel et al., 2019) and psychologically informed video intervention (e.g., Selhorst, Hoehn et al., 2020). Interestingly, like pain catastrophizing (de Oliveira Silva et al., 2018), kinesiophobia may also be indifferent to the physical aspects of PFP rehabilitation (Greaves et al., 2021; Holden et al., 2021; Hott, Brox,

Pripp, Juel, & Liavaag, 2019). Previous findings suggest kinesiophobia may be related to and/or influenced by psychosocial constructs beyond those measured in quantitative research (de Oliveira Silva et al., 2018; Hott, Brox, Pripp, Juel, & Liavaag; 2019, Hott et al., 2022; James et al., 2021). For example, previous qualitative research has suggested that a PFP patients' kinesiophobia may be related to their desire to participate in physical activity and uncertainty about whether doing so would result in further injury (Smith, Moffatt et al., 2018). However, these psychosocial relationships are yet to be theoretically and empirically understood.

Much like fear-avoidance beliefs and pain catastrophizing, kinesiophobia PFP research has not been conducted within a theoretical framework priori. As discussed earlier, the CBM (Vlaeyen et al., 1995) explains the role of kinesiophobia in chronic pain as being an emotional response to a pain catastrophizing, leading to behavioral avoidance, consequently causing disuse of the injured extremity, disability, and depression (Vlaeyen et al., 1995). Previous research results have suggested that several of these constructs are unrelated, robustly contradicting the CBM. The lack of research into *how* psychosocial constructs such as, pain catastrophizing influence kinesiophobia highlights an inconsistency in the literature. Inconsistent findings may also be a result of defining psychological constructs such as kinesiophobia, fear of movement, fear of activity, and fear of reinjury interchangeably. The development of an all-encompassing explanatory theory that explains the perceived experiences of those with PFP would facilitate a better understanding of these interrelated psychosocial constructs.

2.4. Anxiety and Depression

From a cognitive psychology perspective anxiety and depression are considered comorbid negative emotional states (Eysenck & Fajkowska, 2018). Anxiety refers to physiological hyperarousal or fear, often associated with hypervigilance and/or expectations of

future events (Eysenck & Fajkowska, 2018). Depression refers to an absence of positive affect or sadness, often associated with anhedonia (i.e., inability to feel pleasure) and/or thoughts of past experiences (Eysenck & Fajkowska, 2018). According to the Tripartite Model of Anxiety and Depression (i.e., the Tripartite Model; Clark & Watson, 1991), the symptoms of anxiety and depression are categorized by three factors: negative affect, positive affect, and physiological hyperarousal. Both anxiety and depression are characterized by negative affect and negative mood states including irritability, fear, and disgust. What differentiates the two, is positive affect and physiological hyperarousal. Along with negative affect, anxiety is characterized by physiological hyperarousal such as, increased heart rate, sweaty palms, shortness of breath, and lightheadedness. Depression is characterized by the absence of positive affect, and heightened presence of negative mood states such as loneliness and sadness.

Theoretically, the roles of anxiety and depression in PFP are explained through the FAMC (Leeuw et al., 2007). As discussed earlier in the pain catastrophizing section, fear of pain or pain anxiety are consequent to pain catastrophizing, the former in the presence of pain and the latter in anticipation of it. In turn, avoidance behaviors become a means of eluding pain; facilitating injured extremity disuse, disability, and depression (Leeuw et al., 2007).

Anxiety and depression in PFP have often been assessed using the Hospital Anxiety and Depression Scale (i.e., the HAD; Zigmond & Snaith, 1983). The HAD is a 14-item self-report measure designed to detect and manage emotional disorders of hospital patients on two independent subscales; anxiety and depression. Patients respond to items such as, "I feel tense or wound up" on a 4-point Likert scale (0 = *not at all* to 3 = *most of the time*) with subscale sum scores ≥ 10 indicating high anxiety and depression (Zigmond & Snaith, 1983). However, the HAD's minimal clinically important difference is unknown. PFP research has also used the Beck

Anxiety-Inventory (BAI; Beck et al., 1988) to measure anxiety. The BAI is a 21-item self-report measure designed to assess the presence and magnitude of symptoms related to anxiety. Patients respond to items such as, "unable to relax" on a 4-point Likert scale (0 = *not at all* to 3 = *severely*). Total sum scores range from 0 to 63 but cut-off scores discriminating individuals with high and low anxiety as well as, the BAI's minimal clinically important difference have not been reported.

In an intervention study with 81 PFP patients (n = 36 females, n = 45 males) Clark et al. (2000) used the HAD to determine the efficacy of different physiotherapy treatments on anxiety and depression; in addition to measures of pain, perceived function, and patient satisfaction. Participants were divided into four experimental groups: (1) exercise, patellar taping, and patient education leaflet; (2) exercise and patient education leaflet; (3) patellar taping and patient education leaflet; and (4) patient education leaflet alone. *T*-tests revealed that levels of anxiety and depression significantly improved for all groups from baseline to three-months, but only anxiety improved from three-month to 12-month follow up. Interestingly, separate ANOVAs did not find statistically significant differences for anxiety or depression between intervention groups. These results suggested regardless of intervention type; anxiety and depression improved in the short-term but only anxiety displayed long-term improvements.

Along with fear-avoidance beliefs, in their study with 74 adult PFP physiotherapy patients (n = 39 females, n = 35 males) Piva, Fitzgerald, Irrgang et al. (2009) also aimed to determine if anxiety was associated with pain and perceived function. Using the BAI (Beck et al., 1988) to measure anxiety, forward multiple regression analyses revealed anxiety and fear-avoidance beliefs predicted perceived function (p = .03). Unlike fear-avoidance beliefs about physical activity and work, anxiety did not predict pain (p > .05).

In addition to pain catastrophizing and kinesiophobia discussed previously, Doménech et al. (2013) evaluated the prevalence of anxiety and depression and their relationship with pain and perceived disability among 97 PFP patients. Using the HAD, it was found that approximately one third (30%; $n = 29$) of the patients reported high levels of anxiety, whereas 16% ($n = 16$) reported high levels of depression. Stepwise multiple regression analyses revealed depression to be a predictor of perceived disability but neither anxiety nor depression predicted pain. These results suggested depression may be less prevalent compared to anxiety among the PFP population but have a greater influence on perceived disability.

Doménech et al. (2014) also used the HAD to measure anxiety and depression in their longitudinal study with 47 adult patients. Spearman correlations suggested anxiety and depression correlated with pain and perceived disability post rehabilitation (both $p < .001$). Hierarchical multiple regression analyses revealed that along with pain catastrophizing ($p < .001$), anxiety ($p < .006$) predicted changes in perceived disability with anxiety being the stronger of the two predictors. This contradicts their previous research that found depression to be a predictor perceived disability (Doménech et al., 2013).

Maclachlan et al. (2018) also used the HAD to measure anxiety and depression with 100 adults grouped by PFP severity. Depression ($p = .03$) and kinesiophobia ($p < .01$) but not anxiety, predicted perceived disability. Although *t*-test results revealed no statistical differences in psychological profiles between PFP patients and healthy controls; the more severe PFP subgroup ($p \leq .001$) reported significantly more anxiety, depression, pain catastrophizing, and kinesiophobia compared to the less severe subgroup. Results of Maclachlan et al. suggested that PFP patients report no more anxiety or depression than healthy controls, but differences exist among PFP subgroups.

The intervention study of Maclachlan et al. (2019) discussed previously, also assessed depression with the HAD among several other psychological constructs such as, pain catastrophizing, kinesiophobia to determine the effects of a peer reviewed PFP informational pamphlet intervention without physical rehabilitation among 84 adult PFP patients. Comparisons of standardized response mean results between the nonintervention period from baseline to week 12, but not the intervention period from weeks 12 to 18 suggested decreases occurred in depression, pain catastrophizing, and kinesiophobia. The results of Maclachlan et al. support those of Clark et al. (2000) in that depression improved in the short but not long-term regardless intervention. The researchers did not list all the psychological constructs explored in this study, so it is unknown whether anxiety was assessed and found to be non-statistically significant or not investigated at all.

Wride & Bannigan (2019) conducted a virtual survey to evaluate the prevalence of anxiety and depression and their relationship with the pain and perceived function among 400 adults with PFP in the United Kingdom (n = 268 females, n = 132 males). Using the HAD, descriptive statistics suggested approximately 50% (n = 198) and 21% (n = 83) of participants reported both, high anxiety and depression. Pearson's Chi-square comparisons suggested females reported higher levels of anxiety (p = .001) compared to males. Results of t-tests suggested participants younger than 33 were related to high levels of anxiety (p > .05) in comparison to those over 35 who related to low levels of anxiety. Results of t-tests also suggested high levels of anxiety and depression were both related to lower perceived function (both p < .001). The results of Wride & Bannigan (2019) suggested anxiety and depression may be of equal importance considering perceived function among adults with PFP. Contrarily, previous research results suggested that the relationships anxiety and depression have with perceived disability vary in

their respective magnitudes (Doménech et al., 2013; 2014; Maclachlan et al., 2018). Unfortunately, directly comparing these outcomes is not possible because quantitative measures of function do not measure disability and vice versa.

More recently Maclachlan et al. (2020) compared pain self-efficacy and somatosensory functions such as, hypersensitivity with psychosocial constructs including pain catastrophizing, kinesiophobia, anxiety, and depression among 150 adults with PFP (n = 97 females, n = 53 males) and 61 healthy controls. Backward elimination multiple regression revealed that neither HAD scores for anxiety or depression predicted perceived disability, a finding consistent with previous research. However, in contrast to Maclachlan et al. (2018), a MANOVA revealed statistically significant differences in anxiety and depression among adults with PFP compared to healthy controls ($p < .001$). Relative risk analyses suggested those in the PFP group had a 23% and 6% increased risk of reporting high anxiety and depression respectively (Maclachlan et al., 2020).

The secondary mediation analysis by Holden et al. (2021) also assessed anxiety via the HAD, as a potential mediator for the effects of hip exercise on patellofemoral pain. The results suggested that participants in the hip exercise group had a greater decrease in anxiety compared to the foot orthoses group ($p = .01$), but anxiety's mediating role was not found to be statistically significant. These findings suggest that doing hip exercises (as opposed to wearing orthoses) may be more beneficial in decreasing the anxiety of adults with PFP.

In addition to the quantitative research presented above, three qualitative studies have explored anxiety but not depression in PFP (Robertson et al., 2017; Smith, Moffat et al., 2018; Smith et al., 2019). Along with fear-avoidance beliefs, Robertson et al. (2017) found that as PFP patients with crepitus searched for meaning to their crepitus, their feelings of uncertainty turned

into feelings of worry, emotional un-comfortability, and anxiety. As a result, these individuals constantly expected physical setbacks to occur whether reinjury did occur or not.

Similarly, the results from Smith, Moffatt et al. (2018) suggested 10 adult PFP physiotherapy patients (n = 7 females, n = 3 males) developed anxiety in response to feelings of uncertainty toward the cause of their PFP and audible crepitus. Interestingly, participants also described how inability to participate in physical or social activities due to PFP had a negative impact on their mood and subsequently, their self-identity. However, no conclusions were drawn linking prolonged/continuous mood disruption to negative impact on well-being or predisposition toward developing depression.

The most recent research to qualitatively investigate the role of anxiety in PFP (Smith et al., 2019) retrospectively interviewed 10 PFP physiotherapy patients (n = 7 females, n = 3 males) who had participated in different physiotherapy treatments. Thematic analysis revealed that the ways in which PFP participants discussed their anxiety and rehabilitation setbacks varied depending on the type of PFP physiotherapy treatment they had received. For example, a patient who had participated in the "loaded self-managed exercise programme" described setbacks as "niggling worries" that did not need to be addressed because they were not a cause for concern (Smith et al., 2019, p. 7). Whereas, a patient who had participated in the "usual physiotherapy protocol" became overtly frustrated that her knee was "not fine" (Smith et al., 2019, p. 5).

2.4.1. Anxiety and Depression: Synthesis of the Literature

Existing research into the role of anxiety and depression among the PFP population has quantitatively focused on the construct's relationships with pain, perceived and objective function, disability, fear-avoidance beliefs, pain catastrophizing, and kinesiophobia. Depression and anxiety have also been used as a potential outcome for research investigating the efficacy of

different rehabilitation interventions including patient education, patellar taping, and stretching/strengthening exercises. Qualitative research exploring anxiety among PFP patients is limited (Robertson et al., 2017; Smith, Moffatt et al., 2018; Smith et al., 2019) and depression is yet to be qualitatively explored.

Thus far the results related to role of anxiety and depression in PFP are convoluted. For example, neither anxiety nor depression have been found to predict pain (Doménech et al., 2013; 2014; Holden et al., 2021), but both have associated with perceived function (Piva, Fitzgerald, Irrgang et al., 2009; Wride & Bannigan, 2019). Interestingly, depression but not anxiety has been found to predict perceived disability (Doménech et al., 2013; Maclachlan et al., 2018). Interventions have reduced short and long-term anxiety regardless of the mode of treatment (Clark et al., 2000; Holden et al., 2021). Interventions have resulted in short but not long-term reductions of depression (Clark et al., 2000; Maclachlan et al. 2019). It remains unclear if adults with PFP experience more anxiety and depression compared to healthy controls (Maclachlan et al., 2018; Maclachlan et al., 2020).

The limited qualitative research that exists partially extends the above quantitative findings. Specifically, physical physiotherapy interventions may facilitate PFP patients' confidence in overcoming setbacks (Smith et al., 2019); providing an explanation as to why Clark et al. (2000) observed longitudinal reductions in anxiety among PFP patients. Qualitative research has also highlighted that individuals with PFP experience a great deal of anxiety in response to emotional un-comfortability, uncertainty, and worry (Robertson et al., 2017; Smith, Moffat et al., 2018). These qualitative findings yield support for a myriad of cognitions and emotions as being part of the PFP experience, thus warranting further research.

Much like the other psychological variables investigated in PFP research, anxiety and depression research also appears to be atheoretical. Holden et al. (2021) briefly mentioned the FAMC (Leeuw et al., 2007) but made no attempts to assess depression, a variable presumed to be a theoretically important outcome within the model. All other studies neither mentioned nor explored the FAMC (Leeuw et al., 2007) with respect to anxiety or depression. Partial support was found by Doménech et al. (2014) specifically, anxiety predicted perceived disability, but these results are contradictory to other existing research. Existing research has either revealed no differences in anxiety between PFP and healthy samples, questioning the validity of the FAMC (e.g., Maclachlan et al., 2018), or provided no support for the FAMC at all (e.g., Doménech et al., 2013; 2014; Piva, Fitzgerald, Irrgang et al., 2009). Given the conflicting and atheoretical findings, further understanding of the perceived experiences of those with PFP is necessary to understand potential relationships anxiety and depression have with other psychosocial and physical constructs.

2.5. Pain Self-Efficacy

Self-efficacy refers to individuals' beliefs in their ability to perform a specific task or behavior (Bandura, 1977). Self-efficacy of people in chronic pain (i.e., pain self-efficacy) "incorporates not just the expectation that a person could perform a particular behavior or task, but also their confidence in being able to do it despite their pain" (Nicholas, 2007, p. 153). Thus far, no explicit theoretical framework exists to explain the mechanisms through which pain self-efficacy influences individuals' experiences with PFP. However, the Self-Efficacy and Knee Pain Mediation Model, developed for osteoarthritic pain (SEKPM-Model; Rejeski et al., 1998), can explain how self-efficacy and pain influence health outcomes of patients with knee pain. The model suggests a linear relationship between exercise therapy and health outcomes is mediated

by the relationship between self-efficacy and pain. Patients who experience pain and have high self-efficacy are likely to perform exercise therapy tasks well leading to better functional outcomes. Patients who experience knee pain and have low self-efficacy are presumed to avoid painful tasks (Rejeski et al., 1998).

In PFP research, pain self-efficacy has been assessed with the Pain Self-Efficacy Questionnaire (PSEQ; Nicholas, 2007) and the Knee Self-Efficacy Scale (KSES; Thomeé et al., 2006). The PSEQ is a 10-item questionnaire that assesses individuals' confidence in their ability to perform tasks and behaviors despite experiencing pain on a 7-point Likert scale (0 = *not at all confident* to 6 = *completely confident*); with higher scores indicating greater confidence in one's ability. The KSES was developed to assess beliefs patients with anterior cruciate ligament injuries have about their ability to perform select activities despite experiencing pain/discomfort (Thomeé et al., 2006) and has been adapted for PFP research (Hott, Brox, Pripp, Juel & Liavaag; 2019; 2020; de Oliveira Silva et al., 2020). The KSES has four subscales including daily activities, sports and leisure activities, physical activities, and knee function in the future. The KSES is comprised of 22 items scored on an 11-point Likert scale (0 = *not at all certain* to 10 = *very certain*). Subscale scores are summed and divided by the number of respective items; higher scores indicating greater beliefs in one's ability.

Thus far, research into the role of pain self-efficacy in PFP is limited. In their PFP patient education physiotherapy intervention study discussed earlier, Hott, Brox, Pripp, Juel et al. (2019) used the KSES to measure patient pain self-efficacy. Paired sample *t*-tests revealed that pain self-efficacy increased for the entire sample from baseline to three months and baseline to 12 months; however, only PFP patient education group increased from three to 12 months ($p \leq .05$). These results suggested that regardless of intervention, pain self-efficacy improved over time. The

finding that patient education + hip or knee exercise programs did not facilitate improvements in patients' pain self-efficacy from the mid to long-terms but patient education in isolation did, stands to question the construct validity of the KSES.

The open-access, peer-approved informational pamphlet intervention study of Maclachlan et al. (2019) assessed pain self-efficacy in 84 PFP patients (n = 56 females, n = 28 males). Using the PSEQ, priori orthogonal contrasts and Pearson's Chi-square analyses of frequency revealed a reduction in pain self-efficacy following the initial 12-week non-intervention period compared to baseline (p not reported). No changes were observed in pain self-efficacy after the intervention period between weeks 12 to 18. The results of Maclachlan et al. suggest a patient education pamphlet does not facilitate the pain self-efficacy of those with PFP. Additionally, failure to include information pertaining to the measures used in this study is a robust limitation.

In contrast, Hott, Brox, Pripp, Juel & Liavaag (2019), a study reviewed earlier in relation to kinesiophobia, conducted an RCT to evaluate predictors of rehabilitation outcomes including pain, perceived function, pain self-efficacy one year after PFP patients participated in one of three patient education interventions. For example, one intervention included patient education and a hip exercise program. Ninety-eight participants attended the follow up. Using the KSES, results of backward elimination multiple regressions revealed high pain self-efficacy, but not low pain self-efficacy predicted greater global ratings of change at 12 months ($p < .01$). However, high pain self-efficacy did not predict changes in perceived function or worst pain. Interestingly, after controlling for baseline perceived function lower pain self-efficacy, greater pain duration, and more locations of pain significantly predicted low perceived function at 12 months ($p < .01$). The results of Hott, Brox, Pripp, Juel & Liavaag (2019) suggested that pain self-efficacy beliefs

influenced PFP patients' global rating of change but only influenced perceived function in conjunction with other pain factors such as, pain duration.

Maclachlan et al. (2020) discussed under pain catastrophization and kinesiophobia, conducted an RCT to evaluate predictors of rehabilitation outcomes including pain, perceived function, pain self-efficacy one year after PFP patients participated in one of three patient education interventions. Descriptive statistics using the PSEQ suggested among adults with PFP, the prevalence of low pain self-efficacy (9%) was less than that of high kinesiophobia (54%) and anxiety (34%), but greater than pain catastrophizing (7%) and depression (8%). Results of a backward elimination multiple regression revealed that pain self-efficacy ($p < .01$) predicted perceived disability to a greater extent than pain threshold at the knee ($p < .01$) and pain catastrophizing ($p < .05$), but less than kinesiophobia ($p < .001$) respectively. Notably, the findings of Maclachlan et al. suggest that among PFP patients, pain self-efficacy may predict rehabilitation outcomes such as perceived disability; but low pain self-efficacy among this population is not common.

De Oliveira Silva et al. (2020) discussed earlier, used the KSES when exploring the effects of a six-week self-directed web-based education and exercise therapy program on several psychosocial constructs including pain self-efficacy among 35 PFP patients. Descriptive statistics suggested that pain self-efficacy improved following the initial intervention but remained unchanged after additional in-person physiotherapy and tele-rehabilitation interventions. These results supported those of Maclachlan et al. (2019) in that, initial improvements in pain self-efficacy were not influenced by any subsequent interventions. However, it is not known if the short-term improvements in pain self-efficacy were directly influenced by the PFP self-management education and self-directed exercise therapy program.

The research by Hott et al. (2022) also used the KSES when extending their earlier research (Hott, Brox, Pripp, Juel et al., 2019) to (a) examine the levels of kinesiophobia, emotional distress, pain self-efficacy, and widespread pain, and (b) determine their associations with measures of pain, perceived function, and health-related quality of life. The results revealed that pain self-efficacy strongly correlated with perceived function ($p < .01$) and health related quality of life ($p < .01$). Multiple linear regressions showed that pain self-efficacy, number of pain sites, and pain duration predicted perceived function ($p < .01$). High pain self-efficacy with low emotional distress predicted health related quality of life ($p < .01$) and high pain self-efficacy with high knee extension strength predicted worst pain ($p < .01$). These findings suggest that high pain self-efficacy has a role in positively influencing pain, perceived function, and health related quality of life among adult patients with PFP supporting the SEKPM-Model (Rejeski et al., 1998).

Three qualitative studies have also explored pain self-efficacy among the PFP population. Smith et al. (2019) investigated potential barriers and facilitators to the implementation of interventions among 10 PFP patients ($n = 7$ females, $n = 3$ males) involved in a feasibility RCT; thematic analysis of interview transcripts revealed that the loaded self-managed physiotherapy group became comfortable in performing/progressing rehabilitation tasks (Smith et al., 2019). Results of Smith et al. suggested those in the loaded self-managed physiotherapy group became comfortable with their rehabilitation and developed confidence in their ability to progress themselves whereas, those in the typical physiotherapy group did not. These findings suggest a loaded self-managed physiotherapy program may play a role in the confidence aspect of pain self-efficacy in PFP patients. However, these findings do not reference outcome expectations, questioning the importance of the expectancy aspect of pain self-efficacy in this population.

Manojlović et al. (2022) conducted a qualitative study to document perceptions and experiences of 14 PFP patients (n = 10 females, n = 4 males) who participated in an eight-week therapeutic exercise program. Participants were first diagnosed by a sports physician, completed an eight-week individualized PFP therapeutic exercise program, and participated in one of three semi-structured focus groups. Results from a thematic analysis (Bryman, 2015) revealed three main themes: (a) PFP characteristics and their impact on patients' lifestyle, (b) experience of the therapeutic exercise program, and (c) PFP relief and patients' behavior after the conclusion of the therapeutic exercise program. Most of the PFP relief and changes in behavior at the conclusion of the therapeutic exercise program resulted from participants having developed confidence in their knees and their ability to run longer distances. These findings support the conceptualizations of the SEKPM-Model (Rejeski et al., 1998) among recreational runners with PFP.

Barber et al. (2022) also conducted a qualitative study to understand the experiences of pain self-efficacy among PFP patients. A total of 12 adults with PFP (n = 7 females, n = 5 males) participated in semi-structured interviews. Results from a thematic analysis (Braun & Clarke, 2006) identified three main themes including: (a) the value of the diagnosis; (b) the need for tailored (individualized) care; and (c) the role of education. Participants explained that individualized lower extremity exercises helped decrease pain and subsequently, increased confidence in their ability to complete exercises without causing further injury. This finding also supports the SEKPM-Model (Rejeski et al., 1998) suggesting that if pain decreases and pain self-efficacy increases for PFP patients participating in a therapeutic exercise program, their exercise-completion may also increase.

Leibbrandt & Louw (2019) conducted an intervention study with both, quantitative and qualitative outcome measures among 31 PFP patients (*n* = 18 females, *n* = 13 males) to determine the long-term effects of an individualized exercise intervention program on self-reported PFP recovery and subjective expectations/perceptions of recovery at six-month follow up. Each participant underwent clinical assessment, three-dimensional motion analysis, and a six-week individualized exercise intervention based on their specific biomechanical factors. At follow up participants received a phone call and were asked to rate their PFP recovery on a Likert scale (1 = *recovered completely* to 7 = *felt worse*) and were then interviewed to explore patients' expectations of physiotherapy, perceptions as to whether those expectations had been met, and how the intervention influenced their ability to perform difficult daily tasks. Interviews lasted 10 minutes and the primary researcher took notes which were analyzed using thematic analysis. Descriptive statistics suggested all but one PFP patient reported being recovered. Interview results suggested five participants hoped to learn how to self-manage their pain and the researchers presumed this was to promote pain self-efficacy however, whether they/it did was not reported.

2.5.1. Pain Self-Efficacy: Synthesis of the Literature

Existing research into the role of pain self-efficacy among those with PFP has primarily been conducted quantitatively using pre-post intervention designs. Pain self-efficacy has been explored in relation to pain, perceived function, kinesiophobia, anxiety and depression, and health-related quality of life. Pain self-efficacy has also been used as an outcome to measure the effectiveness of rehabilitation interventions such as patient education among PFP patients. Previous qualitative research into pain self-efficacy and PFP is limited to three studies (Barber et al., 2022; Manojlović et al., 2022; Smith et al., 2019). Overall, findings of the reviewed research

are conflicting suggesting that pain self-efficacy among individuals with PFP is not well understood.

Most quantitative research into pain self-efficacy among those with PFP suggests the construct's prevalence is low, nominal, and comparatively less common than other psychosocial constructs such as, anxiety (e.g., de Oliveira Silva et al., 2020; Hott, Brox, Pripp, Juel & Liavaag, 2019; Hott, Brox, Pripp, Juel et al., 2019; Hott et al., 2022; Maclachlan et al., 2019). Yet, the results of recent quantitative (Hott et al., 2022) and qualitative (Barbar et al., 2022; Manojlović et al., 2022) research suggest pain self-efficacy mediates the relationships exercise therapy and patient education have with pain and returning to run among recreational runner's with PFP.

None of the existing pain self-efficacy research has explored the known sources of self-efficacy among PFP patients. These sources include past accomplishments, vicarious experiences, physiological/affective states, and verbal feedback (Bandura, 1977). It is also not known if the patient education interventions that examined changes in pain self-efficacy were designed considering the theoretical assumptions of how self-efficacy is facilitated. Moreover, pain self-efficacy research among PFP patients appears to have been conducted without theory. It is unknown *how* pain self-efficacy mediates the relationship between rehabilitation activities and the rehabilitation outcomes, or how pain and self-efficacy are associated with each other. Without theory guiding the selection and implementation of research designs, findings related to pain self-efficacy PFP research are likely to remain convoluted and psychosocial PFP experiences misunderstood.

2.6. Coping Strategies

Coping refers to "cognitive and behavioral efforts to master, reduce, or tolerate the internal and/or external demands that are created by a stressful transaction" (Folkman, 1984, p.

843). Coping is typically divided into emotion-focused or problem-focused strategies individuals use in response to threatening or challenging situations (Folkman, 1984). Emotion-focused coping refers to strategies where an individual attempts to regulate their emotions whereas; problem-focused coping refers to strategies aimed at managing a cause of distress (Folkman, 1984). The Cognitive Theory of Stress and Coping (CTSC; Lazarus & Folkman, 1984) suggests coping strategies influence how individuals address stressful situations by mediating the relationship between one's controllability beliefs and the effectiveness of their cognitive and/or behavioral efforts.

Previous research into coping strategies in PFP is limited, and has been conducted with several quantitative measures including the Coping Strategies Questionnaire (CSQ; Rosenstiel & Keefe, 1983; Robinson et al., 1997; e.g., Bagheri et al., 2021; Doménech et al., 2013; 2014; Thomeé et al., 2002); the Cognitive Emotion Regulation Questionnaire (CERQ; Garnefski & Kraaij, 2007; e.g., van Middelkoop et al., 2017); the Pain Coping Inventory (PCI; Kraaimaat & Evers, 2003; e.g., Ak & No, 2018), and the Utrecht Coping List (UCL; Schreurs et al., 1993; e.g., Witvrouw et a., 2000).

The CSQ (Rosenstiel & Keefe, 1983) is a 50-item self-report instrument that assesses chronic low back pain coping strategies via six cognitive and two behavioral subscales. Items such as, "I worry all the time about whether it will end" are rated on a 7-point Likert scale (0 = *never* to 6 = *always*) with high subscale sum scores indicating use of the respective strategy. The CSQ was later revised (Robinson et al., 1997); the two behavioral subscales were removed, and remaining items rated on a 7-point Likert scale (0 = *never do that* to 6 = *always do that*). The CSQ has been used in four PFP studies and is the most used coping strategies measure in PFP research (Bagheri et al., 2021; Doménech et al., 2013; 2014; Thomeé et al., 2002).

Additionally, one study has been conducted with the CERQ (van Middelkoop et al., 2017), a 36-item questionnaire that assesses nine cognitive emotion regulation strategy subscales including acceptance. Items such as, "I think of what I can do best" are rated on a 5-point Likert scale (1 = *almost never* to 5 = *almost always*). Another study used the PCI (Ak & No, 2018), which is a 33-item questionnaire developed to assess a total of six cognitive and behavioral pain coping strategies divided into two subscales: passive pain coping and active pain coping. Items of the PCI are rated on a 4-point Likert scale (1 = *hardly ever* to 4 = *very often*). One study used the UCL (Witvrouw et a., 2000), which is a 44-item self-report measure aimed to assess stress in everyday life among patients with rheumatoid arthritis and fibromyalgia. Items such as "worrying about the past" are rated on a 4-point Likert scale (1 = *never* to 4 = *very often*).

Using the UCL, Witvrouw et al. (2000) conducted a prospective cohort study to determine if intrinsic risk factors including coping strategies, anthropometrics, and static patellar alignment facilitate the development of PFP among an athletic population. Participants included 282 (n = 131 females, n = 151 males) college students enrolled in physical education classes. Over a two-year observation period 24 students developed PFP (n = 13 females, n = 11 males) and the results of t-tests suggested those who developed PFP used more coping strategies such as seeking social support (p = .05) and distracting oneself (p = .03) compared to students who remained injury free. However, results of a logistic regression analysis revealed that these coping strategies did not predict the development of PFP among the sample. The findings of Witvrouw et al. suggest students who tend to manage their stress with social support are likely to develop PFP; a finding contradictory to the theoretical assumption that social support networks positively influence the experiences of those with injury (Wadey et al., 2018).

Thomeé et al. (2002) used the CSQ to evaluate how 50 PFP patients experience their pain, what coping strategies they use, and their degree of well-being by collecting survey data and reporting descriptive statistics including means and standard deviations. The sample included males and females but the exact *n* for each was not identified. The results of Thomeé et al. (2002) suggested that the most frequently used coping strategies were coping self-statements and ignoring sensations.

Doménech et al. (2013) also used the CSQ to explore the associations between psychosocial constructs including coping strategies, pain catastrophizing, kinesiophobia, pain, and perceived disability among 97 PFP patient (n = 80 females, n = 17 males). Spearman correlations revealed that the coping strategies of catastrophizing and praying/hoping respectively correlated with pain and perceived disability strongly and moderately (all $p < .001$).

The results of Doménech et al. (2013) were partially supported by Doménech et al. (2014) in that, moderate correlations were respectively observed among praying/hoping, pain and perceived disability pre-treatment. However, the coping strategy of catastrophizing correlated with pain and perceived disability pre/post treatment (all $p < .001$). Additionally, moderate correlations were observed between "ignoring pain" and pre-treatment disability as well as, "increasing activity level", pre-treatment pain, and pre/post treatment disability respectively. The results of Doménech et al. (2013; 2014) suggested patients with PFP primarily engaged in emotion-focused coping including catastrophizing, praying/hoping, and ignoring pain, in response to experiencing PFP.

Van Middelkoop et al. (2017) used the CERQ to investigate differences in coping strategies between 20 adolescents (n = 14 females, n = 6 males) and 44 adults (n = 21 females, n = 23 males) with PFP considering symptoms including duration of complaints, and perceived

function at a one year follow up. Descriptive statistics showed differences between adolescents and adults for all coping strategies however, *t*-tests revealed only the difference in concentrating on planning to be statistically significant ($p = .05$). The findings of van Middlekoop et al. suggest adults with PFP perceive their PFP as a problem that requires focus and concentration to address (Garnefski & Kraajj, 2007).

Ak & No (2018) conducted a cross-sectional survey study to determine the prevalence of PFP and coping strategies used among 203 ($n = 84$ females, $n = 119$ males) adult recreational runners (18-40 years old). Participants were recruited from four sports centers in Lagos State, Nigeria. The Survey Instrument for Natural History, Etiology, and Prevalence of Patellofemoral Pain Studies (SNAPPS; Dey et al., 2016), a 34-item self-report measure, was used to identify those eligible to participate. Descriptive statistics of the PCI revealed that among those with PFP, approximately 71% ($n = 65$) reported using passive pain coping strategies such as worrying and resting, and 24% ($n = 22$) used active pain coping strategies such as distraction. The authors concluded that Nigerian recreational runners predominantly use passive coping strategies, suggesting they aim to tolerate rather than reduce pain.

Bagheri et al. (2021) measured coping strategies using the CSQ when examining the effects of adding eight-weeks of mindfulness training to an exercise, run, and load management intervention among 35 female recreational runners with PFP. Specifically, mixed-model analyses of variance suggested that the experimental group effects on coping strategies were statistically significant ($p < .01$). Bonferroni corrections revealed that the mindfulness intervention group had greater increases in ignoring pain sensations compared to controls from baseline to week nine ($p < .001$), week 18 ($p < .001$), and two-month follow up ($p < .001$). In comparison to control group, the mindfulness intervention group also had greater increases in distracting from pain

from baseline to week nine ($p < .001$), week 18 ($p < .01$), and two-month follow up ($p < .001$). These findings suggest mindfulness training facilitated ignoring pain sensations and distracting from pain strategies among female runners with PFP during the exercise, run, and load management intervention and those increases lasted at least two months.

Three qualitative studies have investigated coping strategies among those with PFP (Johansen et al., 2022; Manojlović et al., 2022; Smith, Moffatt et al., 2018). Smith, Moffatt et al. (2018) interviewed 10 adult PFP physiotherapy patients ($n = 7$ females, $n = 3$ males). A thematic analysis (Braun & Clarke, 2006) revealed behavioral coping strategies to be one of five themes that emerged. The coping strategy most commonly used by participants was rest. Participants believed rest was necessary to avoid activities that aggravated their PFP so that the injury could heal. This is similar to the quantitative findings of van Middelkoop et al. (2017), in that adults may cope with PFP by developing and/or executing purposive behavioral strategies to facilitate recovery. Interestingly, Smith, Moffatt et al. (2018) also found there to be a potential link between coping strategies and other psychosocial constructs such as, fear-avoidance beliefs among the PFP population.

Manojlović et al. (2022) used focus groups when qualitatively exploring the effects of an eight-week therapeutic exercise program on the perceptions and experiences of 14 PFP patients ($n = 10$ females, $n = 4$ males). The three main themes that resulted were (a) PFP characteristics and their impact on patients' lifestyle, (b) experience of the therapeutic exercise program, and (c) PFP relief and patients' behavior after the conclusion of the therapeutic exercise program. When discussing their experience of the therapeutic exercise program participants noted that they viewed sessions as a challenge, kept a positive attitude, and/or were encouraged by others. These

findings suggest recreational runners with PFP engage in emotion-focused coping techniques while participating in a therapeutic exercise program.

Johansen et al. (2022) also qualitatively explored coping strategies among PFP patients. A participatory action research study was conducted to identify the challenges, barriers and possible facilitators related to managing PFP patients. Eight PFP patients (n = 4 females, n = 4 males) and 10 physiotherapists (n = 8 females, n = 2 males) participated in separate future workshops, in which the participants engaged in group activities that facilitated sharing experiences and developing ideas to promote change (Apel, 2004). Each group reviewed and commented on three PFP patient case vignettes. They then brainstormed ideas and concerns pertaining to the practical implementation of changes necessary to optimize respective case-outcomes. Thematic analysis (Braun & Clarke, 2006) results revealed four themes with the most consistent topic of discussion being the need for a therapeutic alliance between PFP patient and physiotherapist. Clinicians and PFP patients believed a collaboration was necessary to overcome challenges, manage PFP symptoms, remain accountable, and utilize appropriate resources. This finding suggests that a therapeutic alliance between PFP patient and clinician may be a means by which said patient regulates emotions (i.e., emotion-focused coping) and manages their PFP (i.e., problem-focused coping).

2.6.1. Coping Strategies: Synthesis of the Literature

Research investigating PFP coping strategies has primarily been quantitative and explored associations among coping strategies and pain catastrophizing, kinesiophobia, perceived function, and disability. Findings to date suggest that adult patients use both cognitive and behavioral strategies including resting, ignoring pain sensations, and distracting oneself to cope with PFP (Ak & No, 2018; Bagheri et al., 2021; Thomeé et al., 2002; Witvrouw et al.,

2000). Ignoring pain sensations and distracting from the pain may improve through participation in a mindfulness intervention program (Bagheri et al., 2021). Cognitive coping strategies including praying and hoping were found to be associated with pain and perceived disability (Doménech et al., 2013) but not perceived function (van Middelkoop et al., 2017).

Since existing research has used a myriad of coping measures, drawing comparisons and synthesizing the results is not possible. What is known, is that research into coping strategies and PFP has been descriptive and aimed to identify the types of coping strategies used by the PFP population (e.g., Ak & No, 2018; Bagheri et al., 2021; Thomeé et al., 2002; Witvrouw et al., 2000). Few studies have explored relationships between coping strategies and subsequent rehabilitation outcomes such as, perceived disability and function providing limited evidence as to *how* coping strategies can influence the PFP experience (Doménech et al., 2013; 2014; van Middlekoop et al., 2017).

Like other psychosocial constructs, research into coping strategies in PFP appears to be atheoretical. No studies have considered the CTSC (Lazarus & Folkman, 1984) or any other theory that explains how coping strategies influence one's psychosocial responses including cognitions, emotions, or behavior. Likewise, neither existing quantitative (Ak & No, 2018; Bagheri et al., 2021; Doménech et al., 2013; 2014; Thomeé et al., 2002; van Middelkoop et al., 2017) nor qualitative (Johansen et al., 2022; Manojlović et al., 2022; Smith, Moffatt et al., 2018) research has delved into the mechanisms through which coping strategies influence the PFP experience. More specifically, it remains unclear as to *how* PFP patients try to negate the potential negative effects of worrying, such as its impact on unsuccessful rehabilitation outcomes. With theoretical PFP coping strategy conceptualization lacking, future research should

focus on gaining a better understanding of *how* coping strategies influence the PFP experience and its prognosis.

2.7. Psychosocial PFP Research: Synthesis of the Literature

Systematic reviews, meta-analyses, and consensus statements on PFP all state that psychosocial constructs influence the PFP experience in ways that are not yet understood and have called for more research on the topic (Neal, Lack, et al., 2019; Crossley et al., 2019; Powers et al., 2017; Vicenzino et al., 2022). What follows is a synthesis of existing psychosocial PFP literature to date, a critique pertaining to its lack of construct and theoretical clarity, and the rationale for the current study.

Existing psychosocial PFP research is limited and primarily quantitative. It has aimed to identify and report the existence of fear-avoidance beliefs, pain catastrophizing, kinesiophobia, anxiety, depression, pain self-efficacy, and coping strategies among the PFP population (e.g., Hott et al., 2019; James et al., 2021; Maclachlan et al., 2018; Pazzinatto et al., 2022; Selhorst et al., 2020; de Oliveira Silva et al., 2019). Some studies have aimed to compare and/or investigate changes or differences in relationships between select psychosocial constructs and PFP outcomes (e.g., Bagheri et al., 2021; Doménech et al., 2014; Esculier et al., 2017; Glaviano et al., 2019; Greaves et al., 2021; Hott et al., 2022; Maclachlan et al., 2019; 2020; Mansfield & Selhorst, 2018; Priore et al., 2019; Witvrouw et al., 2000). Despite its efforts, quantitative psychosocial PFP research is yet to provide a robust empirical understanding of how psychosocial constructs may influence the PFP experience. Limited qualitative research has begun to explore the psychosocial constructs that influence the PFP experience beyond those measured quantitatively. Findings suggest there are more psychosocial constructs to consider, and that the psychosocial PFP experience is influenced by an interplay of cognitive, emotional, behavioral, and social

constructs. More research is needed to understand *how* the interrelations of psychosocial constructs influence the PFP experience in a given population.

In addition to the above, existing psychosocial PFP research also appears to be inconsistent in how it defines different psychosocial constructs. For example, pain catastrophizing has been referred to as a cognitive coping strategy, a cognitive appraisal related to pain, an emotional response, and even a behavior (e.g., de Oliveira Silva et al., 2018; Doménech et al., 2014; Piva, Fitzgerald, Irrgang et al., 2009; Priore et al., 2019; Selhorst et al., 2021). By definition, pain catastrophizing refers to a "pain exaggerated negative mental set brought to bear during actual or anticipated painful experiences" (Sullivan et al., 2001, p. 52), suggesting that pain catastrophizing is a situation specific maladaptive psychological state; thus highly malleable. This definition also highlights the ambiguity related to the construct. It is unclear if "negative mental set" refers to cognitions, emotions, behaviors, or a combination of these constructs. Similarly, kinesiophobia, defined as fear of movement, has been identified, theorized, and subsequently researched among PFP research as a cognitive appraisal (Miller et al., 1991; Vlaeyen et al., 1995; e.g., de Oliveira Silva et al., 2018; Hott et al., 2022; Selhorst, Hoehn et al., 2020). However, the Tripartite Model (Clark & Watson, 1991) suggests that fears such as kinesiophobia, are negative emotional states that develop in response to stressful situations.

The lack of consistency in construct clarity and the use of various definitions (or lack of) make true synthetization of previous psychosocial PFP research results impossible. It also begs to question which psychosocial constructs have been measured in previous PFP research? Without uniform definitions, it is impossible to provide conclusive evidence as to how a psychosocial construct or constructs influence the PFP experience among any population.

Without clear definitions and construct clarity, it is not surprising that existing psychosocial PFP research has also been somewhat atheoretical. Most of the PFP research reviewed in this chapter aimed to recognize the prevalence of psychosocial constructs in PFP. However, without comprehending or conceptualizing them in relation to other psychosocial constructs, empirical understanding of their influence on the PFP experience has been hindered. To this effect, psychosocial PFP research has lacked theoretically based research designs grounded in psychological theory despite the roles of all the reviewed constructs having been theoretically conceptualized (Clark & Watson, 1991; Lazarus & Folkman, 1984; Leeuw et al., 2007; Lethem et al., 1983; Rejeski et al., 1998; Vlaeyen et al., 1995). An absence of theoretical conceptualization has prohibited researchers from understanding *how* psychosocial constructs influence the experiences of the PFP population particularly; their responses to interventions and prognosis. Likewise, existing PFP research is yet to understand how psychosocial constructs influence the PFP experience precluding both, planning and implementing of intervention studies necessary to maximize PFP outcomes.

In conclusion, PFP incidence is known to be high and various biomechanical risk factors play a role in the development of PFP. It is not fully known how risk factors such as kinematics, kinetics, muscular strength, interact with the psychosocial constructs outlined in this review. It appears that this lack of understanding has been detrimental to PFP prognoses. Only patient education, a cognitive-behavioral intervention, has been consistently found to positively influence PFP rehabilitation outcomes. Existing PFP research also suggested several psychosocial constructs influence the PFP experience, and limited qualitative research indicates that there may be more psychosocial constructs that play a significant role in that experience. However, additional research is needed to understand how these constructs interact with one

another. Without clear definitions and construct as well as theoretical clarity lacking, future research would benefit from an all-encompassing theory that explains the perceived experiences of those with PFP. An evidence-based theoretical understanding can provide the framework needed for future PFP risk, intervention, and prognosis research to inform clinical decision making and optimize rehabilitation outcomes. Therefore, the purpose of this dissertation was to explore the perceived psychosocial experiences of recreational runners with PFP.

Chapter III: Research Paradigm

Driven by the literature reviewed in Chapter II, Chapter III aims to outline the philosophical assumptions and research paradigms that underlie this dissertation. A paradigm refers to the analytic perspective of conditions, actions–interactions, and consequences assumed to influence data and research outcomes as they relate to specific research questions (Corbin & Strauss, 2015). Chapter III presents the ontology, epistemology, and methodology for this dissertation. Chapter III also introduces strategies used to ensure trustworthiness and reflexivity. Lastly, Chapter III situates this dissertation into the wider research and development context.

3.1. Ontology

Ontology refers to the philosophical assumptions people make about the world they live in (Corbin & Strauss, 2015). These assumptions reflect a reality that encompasses, or is encompassed by, the world (Smith & McGannon, 2017). The literature review presented in Chapter II suggests biopsychosocial PFP experiences (including those pertaining to pain, function, and recovery) influence and are influenced by individuals' cognitions, emotions, behaviors, and social environment. This finding supports the ontological assumption that individuals with PFP psychosocially construct the world they live in. Based on the literature reviewed, this dissertation adopted a constructionist ontology. Constructionism assumes that nothing in the universe is strictly pre-determined, and that phenomena are partly determinable by analyzing and understanding how individuals participate in and construct their lives (Corbin & Strauss, 2015).

3.2. Epistemology

Epistemology refers to assumptions about the relationship that exists between the researcher and what is known (Smith & McGannon, 2017). These assumptions subsequently

drive how researchers design, conduct, and evaluate research (Bishop, 2015). Based on the literature reviewed in Chapter II, pragmatic and interactionist epistemologies were necessary to fulfill the purpose of this dissertation (Corbin & Strauss, 2015). A pragmatic epistemology assumes research is conducted in the manner that most practically facilitates achieving its respective purpose, such as interviewing recreational runners with PFP to better understand their experiences. An interactionist epistemology assumes individuals such as recreational runners with PFP, are sources of knowledge that researchers subjectively interact with to explore, understand, and conceptualize perceived psychosocial experiences.

3.3. Methodology

Methodology refers to a way of thinking about and studying social phenomena (Corbin & Strauss, 2015). The literature reviewed in Chapter II suggests a gap in existing psychosocial PFP research that warrants a qualitative, population specific, and theoretically grounded approach. Subsequently, this dissertation adopted a multi-methodological qualitative approach consisting of Straussian Grounded Theory (SGT; Corbin & Strauss, 2015) and a Comparative Method (CM; Pennings et al., 2006). The SGT methodology (Corbin & Strauss, 2015) facilitated achieving specific aims 1 and 2 by enabling the systematic construction of a conceptual framework that conceptualizes recreational runners' perceived psychosocial experiences with PFP. Sequentially, the CM methodology (Pennings et al., 2006) facilitated achieving specific aim 3 by comparing five existing theoretical models of psychological responses to sport injury to the conceptual framework developed in study 2 (Brewer et al., 2002; Deci & Ryan, 1985; Richardson et al., 2008; Wadey et al., 2018; Wiese-Bjornstal et al., 1998).

3.3.1. Straussian Grounded Theory

Grounded Theory (GT) is a qualitative methodology developed to construct theory grounded in data (Glaser & Strauss, 1967). Originally, GT was intended to theoretically provide sociological explanations of phenomena beyond what is already known to offer insight into the experiences of individuals (Glaser & Strauss, 1967) however, multiple variations exist today (e.g., Charmaz, 2006; Glaser, 1992; Strauss & Corbin, 1990). One variation is Straussian Grounded Theory (SGT), an approach to GT that enables researchers to systematically ask generative and concept-related questions while synchronously using an interpretive and dynamic coding process to attain a dense conceptual integration of conditions and consequences grounded in qualitative data (Strauss & Corbin, 1990). The goal of SGT is to uncover the meanings/conditions individuals assign to an event such as PFP by exploring the emotions and contextual factors that influence their interactions with, and actions in response to, that event (Corbin & Strauss, 2015). For example, in their research with adult patients with PFP, Smith, Moffatt et al. (2018) found that the participants had difficulty making sense of their pain. A SGT approach takes such findings a step deeper, by allowing the exploration of *how* the difficulty of making sense of pain influences and interacts with all aspects of life among those with PFP.

This dissertation also adopted SGT because of its previous empirical use in sport injury psychology literature. For example, Roy-Davis et al. (2017) used SGT to develop an empirically rigorous theory to explain how injured athletes experience sport injury-related growth (SIRG). Since then, SIRG has been used in numerous sport injury related research publications (e.g., Booth et al., 2018; Howells et al., 2020; Salim & Wadey, 2018; Wadey et al., 2019). In studies one and two, SGT was selected to explore the perceived psychosocial experiences of recreational runners with PFP and answer two specific research questions: (a) What are recreational runners'

perceived psychosocial experiences with PFP? (b) How can recreational runners' perceived psychosocial experiences with PFP be theoretically conceptualized?

3.3.2. Comparative Method

Comparative research refers to qualitatively comparing cases of systems, cultures, and/or sub-elements to promote patterns of thinking and acting (Esser & Vliegenthart, 2017). Methodologically, the goal of a CM approach is to determine, critically evaluate, and compare the coherence of theoretical models (Shank, 2006). Coherence refers to the applicability of a theoretical model to coherently provide a distinct, logical, and concise explanation of a phenomenon, apart from all existing interpretations (Braun & Clarke, 2006). To date, no theoretical model coherently provides a distinct, logical, and concise explanation of PFP among recreational runners apart from all existing interpretations. Therefore, a CM was selected to further this dissertation's exploration by individually comparing five existing theoretical models of sport injury to the conceptual framework developed in study two.

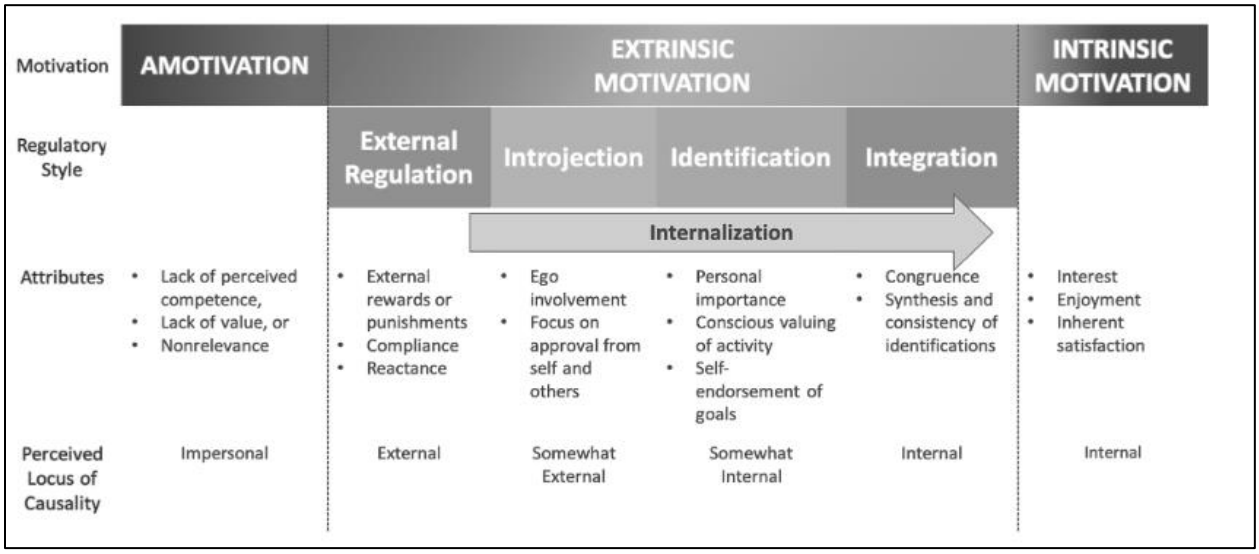
A CM was also selected because it has been used previously in sport psychology literature. For example, Anthony et al. (2016) used a CM to systematically review and evaluate the qualitative literature regarding key developmental factors and processes for mental toughness (MT) and found the theoretical underpinnings of MT to be non-explicit and inconsistent. In study three, a CM was used to answer the research question: how do existing theoretical models of psychological responses to sport injury compare to the conceptual framework in explaining recreational runners' perceived psychosocial experiences with PFP? The five comparative cases included Self-Determination Theory (henceforth referred to as SDT; Deci & Ryan, 1985); the Integrated Model of Psychological Response to the Sport Injury and Rehabilitation Process (henceforth referred to as the Integrated Model; Wiese-Bjornstal et al., 1998); the

Biopsychosocial Model of Sport Injury Rehabilitation (henceforth referred to as the Biopsychosocial Model; Brewer et al., 2002); the Overtraining Risks and Outcomes Model (henceforth referred to as the OT Risks and Outcomes Model; Richardson et al., 2008); and the Multilevel Model of Sport Injury (henceforth referred to as the MMSI; Wadey et al., 2018).

3.3.2.1. Self-Determination Theory. The first comparative case was SDT (Deci & Ryan, 1985), which is a broad integrated metatheory comprised of overlapping mini theories suggesting individuals have a natural tendency to develop an elaborate unified sense of self. In pursuing sense of self, individuals engage in actions that range (Figure 1) from nonself-determined to self-determined behaviors (Ryan & Deci, 2020). Nonself-determined behaviors are amovitated behaviors that lack value, willingness, or intentionality, often accompanied by beliefs that an individual's actions are indifferent or impersonal to subsequent outcomes (Deci & Ryan, 1985). Extrinsically motivated behaviors refer to those performed in pursuit of an outcome that is separate from the task at hand (Deci & Ryan, 1985). These behaviors range in motivation from external regulations such as seeking tangible rewards; to integration, which refers to internalizing and integrating external sources of information with an individual's sense of self, such as pride (Deci & Ryan, 2000). Conceptually, the perceived cause of a person's behavior (i.e., locus of causality) internalizes as extrinsic motivation is internalized across the self-determination continuum (Deci & Ryan, 1985). Intrinsically motivated behaviors are those performed without external contingencies and thus foster self-determination (Deci & Ryan, 1980).

Figure 1

Self-Determination Theory's Taxonomy of Motivation (Ryan & Deci, 2020)



According to SDT, a person's motivation to engage in behaviors is also influenced by social contexts and their basic psychological needs (Deci & Ryan, 2000). The social contexts include family, friends, teammates, organizations, and overarching cultural, political, and economic identifications (Ryan & Deci, 2017). Basic psychological needs include perceptions of competence, autonomy, and relatedness (Ryan & Deci, 2017). Competence refers to feeling effective in ongoing interactions with the social environment, opportunities, and expressions of personal capacities. Autonomy refers to perceiving oneself as the origin of behavior (Ryan & Deci, 2002). Relatedness refers to feeling connected to or belonging among others (Ryan & Deci, 2002). When competence, autonomy, and relatedness are consciously or unconsciously satisfied an individual is energized toward health, and well-being (Ryan & Deci, 2000). When basic psychological needs are not satisfied the lack thereof contributes to pathology and ill-being (Ryan & Deci, 2000).

Previous SDT sport injury research has focused on injured athletes' basic psychological needs and their psychosocial relationships with return to sport concerns following rehabilitation

from serious injury (Podlog & Eklund, 2006; Podlog et al., 2010; 2013). Findings suggest injured athletes' perceived competence, autonomy, and relatedness influence their psychological well-being and their socially contextual return to sport concerns (Podlog & Eklund, 2006; Podlog et al., 2010; 2013). Table 1 displays examples of injured athletes' socially contextual return to sport concerns considering their basic psychological needs.

Table 1
Basic Psychological Needs of Athletes Returning to Sport Following Serious Injury

Psychological Need	Concerns
Competence	Readiness to return, performing at pre-injury levels, re-injury concerns, confidence
Autonomy	Pressures to return, decision making processes, personal control over circumstances
Relatedness	Feeling isolated alienated, or separated from teammates, coaches, and/or competitors

Note. Adapted from Podlog and colleagues (Podlog & Eklund, 2006; Podlog et al., 2010; 2013; 2015).

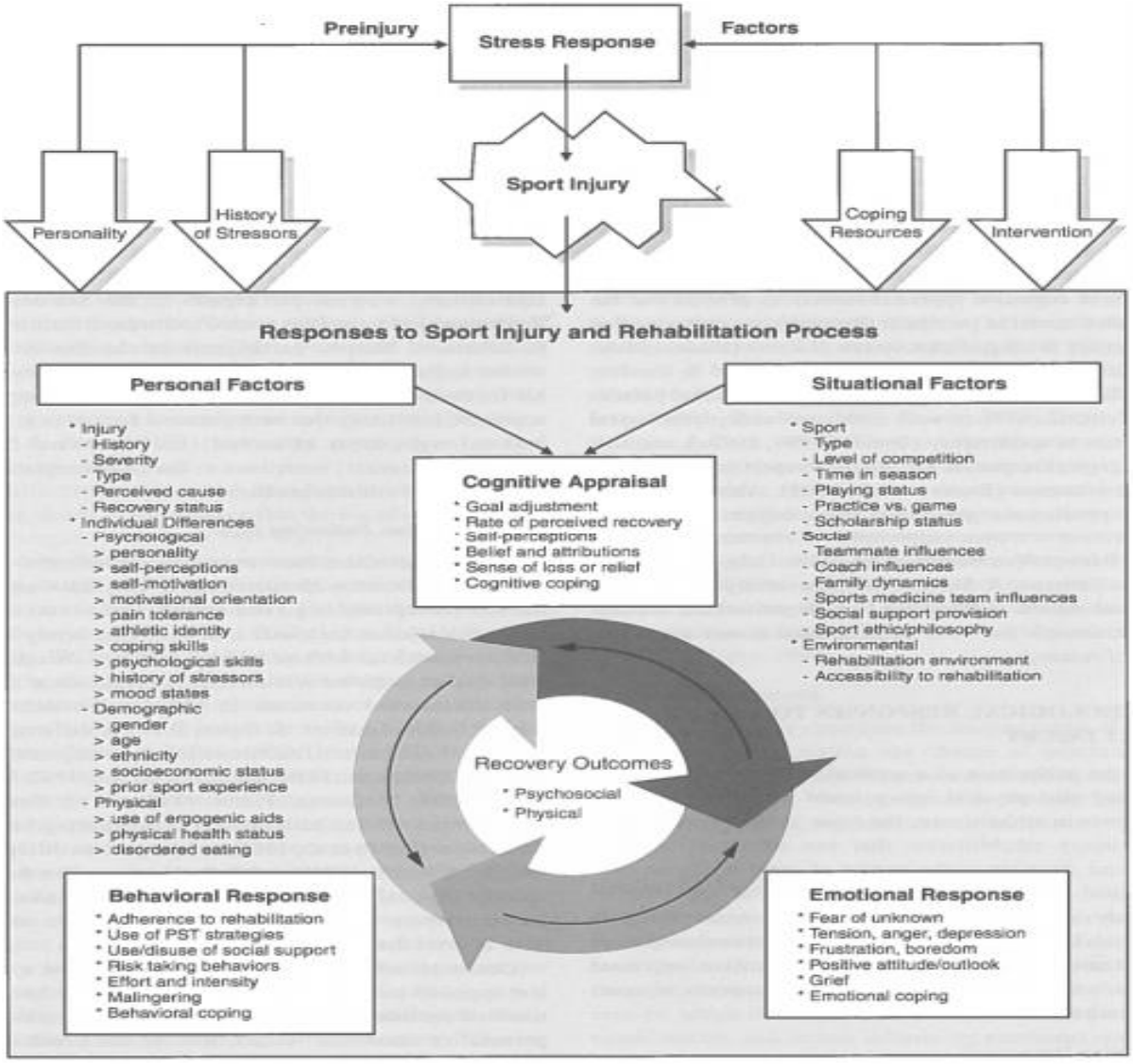
3.3.2.2. The Integrated Model of Psychological Response to the Sport Injury and Rehabilitation Process.

The second comparative case (Figure 2) was the Integrated Model (Wiese-Bjornstal et al., 1998). The model presumes preinjury factors including personality, history of stressors, coping resources, and interventions may influence a stress response leading to an injury. Sequentially, post-injury responses influence overall physical and psychosocial rehabilitation outcomes. The model presumes that the injury itself becomes a stressor that elicits a range of cognitive appraisals about the injury, its meaning, and impact (e.g., sense of loss, self-perceptions, cognitive coping). These cognitive appraisals are said to influence both emotional (e.g., fear of the unknown, frustration, emotional coping) and behavioral (e.g., increased effort, malingering, behavioral coping) responses in a bidirectional manner. Known as the dynamic core, the interaction between cognitive appraisals, emotional, and behavioral responses are

influenced by a range of personal (e.g., injury, individual differences) and situational (e.g., sport, social, environmental) factors. These dynamic interrelationships between pre- and post-injury factors are said to subsequently influence psychosocial (e.g., satisfaction, well-being) and physical (e.g., muscular strength, returning to sport) recovery outcomes (Wiese-Bjornstal et al., 1998).

Figure 2

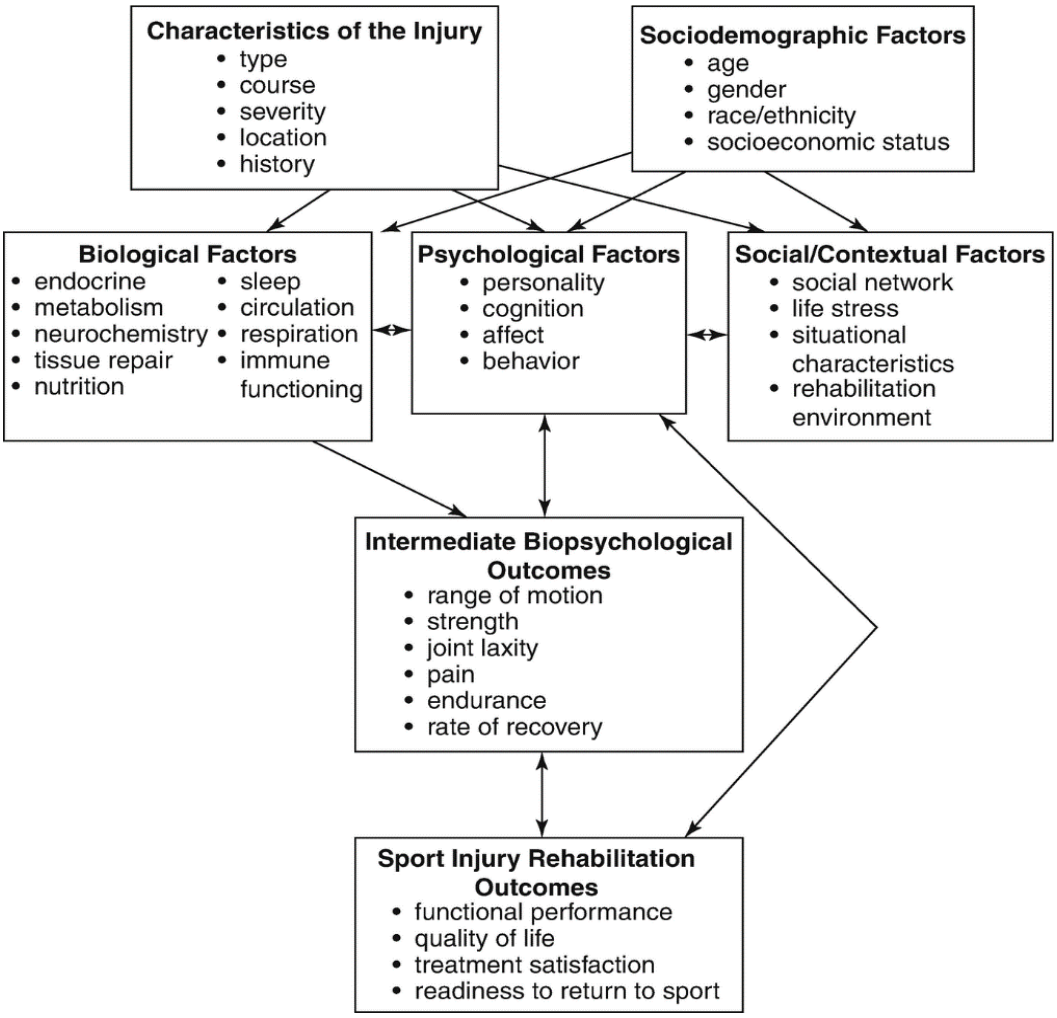
The Integrated Model of Psychological Response to the Sport Injury and Rehabilitation Process (Wiese-Bjornstal et al., 1998)



3.3.2.3. A Biopsychosocial Model of Sport Injury Rehabilitation. The third comparative case was (Figure 3) the Biopsychosocial Model (Brewer et al., 2002), which posits that bidirectional relationships exist between a range of biological (e.g., sleep, tissue repair, nutrition), psychological (e.g., personality, cognition, affect, behavior), and social/contextual (e.g., social network, life stress, situational characteristics) factors. These constructs are influenced by a range of injury characteristics such as severity and sociodemographic factors such as age. Biological, psychological, and social/contextual factors in turn, influence bidirectional relationships among intermediate biopsychosocial outcomes such as recovery rate and subsequent sport injury rehabilitation outcomes such as functional performance (Brewer et al., 2002). Psychological factors are also presumed to have a bidirectional relationship with sport injury rehabilitation outcomes.

Figure 3

The Biopsychosocial Model of Sport Injury Rehabilitation (Brewer et al., 2002)

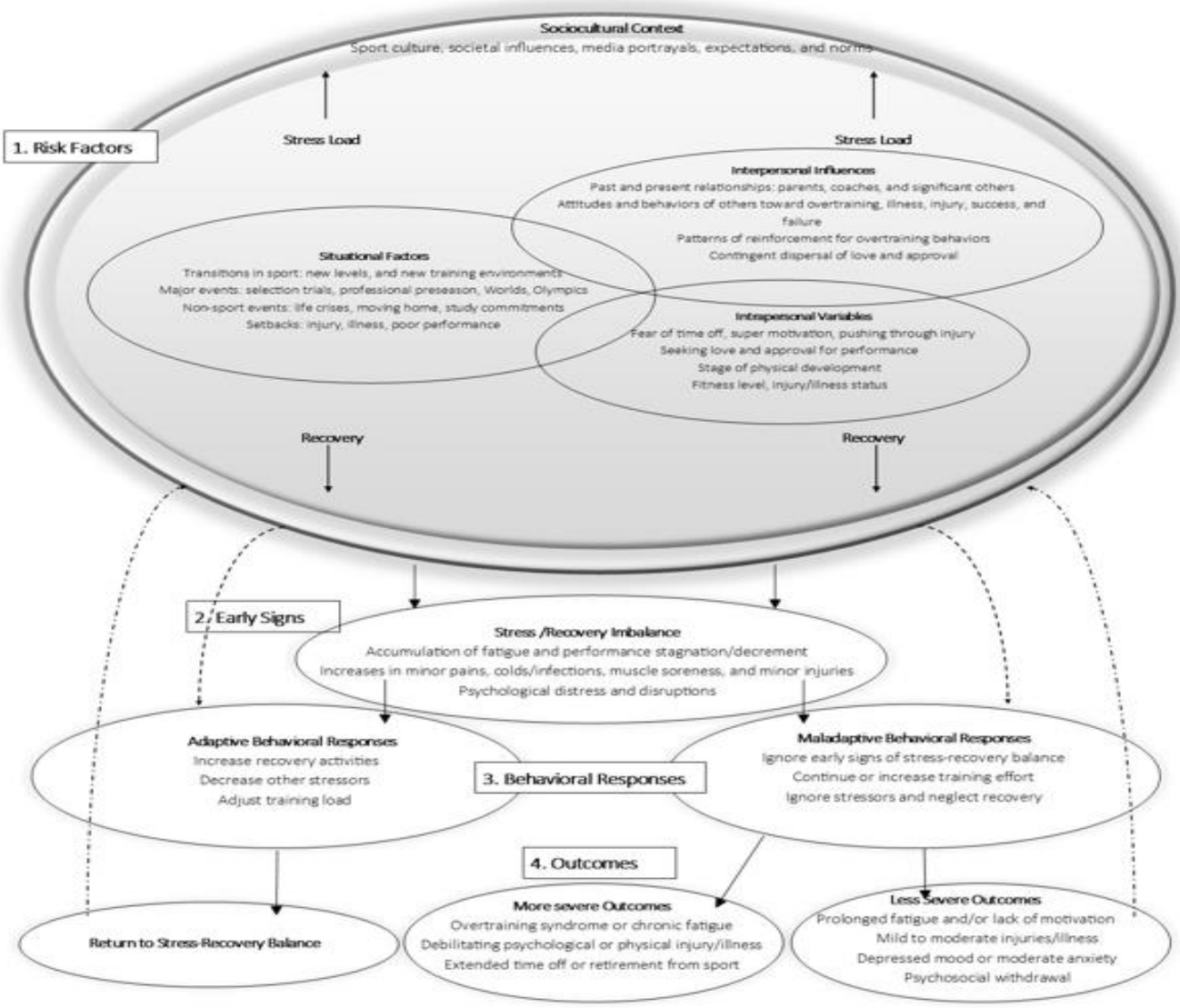


3.3.2.4. The Overtraining Risks and Outcomes Model. The fourth comparative case was (Figure 4) the OT Risks and Outcomes Model (Richardson et al., 2008). This model suggests that overtraining is a negative process or pattern of behavior that temporally facilitates stress-recovery imbalance over an athletic season causing fatigue, psychological distress, performance decrements, injuries, or illness (Richardson et al., 2008). Theoretically, this process occurs in four "parts" referred to as: risk factors, early signs, behavioral responses, and outcomes.

First, (a) interpersonal influences such as those with coaches; (b) intrapersonal influences such as personal beliefs; and (c) situational factors such as competition or life events; interrelate within sport's sociocultural context creating overtraining risk factors such as, the expectation that athletes will train when fatigued or injured. Second, sport's sociocultural context facilitates stress-recovery imbalance causing early signs of overtraining to develop such as soreness, fatigue, performance stagnation, or illness. Third, sport's sociocultural context and stress-recovery imbalance combine, causing athletes to engage in adaptive or maladaptive behavioral responses to early signs of overtraining. Fourth, adaptive responses lead to an outcome of stress-recovery balance whereas, maladaptive responses lead to outcomes that are more or less severe. More severe outcomes include chronic fatigue and debilitating psychological or physical illness or injury. Less severe outcomes include prolonged fatigue and mild to moderate illness or injury (Richardson et al., 2008). Overtraining outcomes in turn, influence sport's sociocultural context and the process starts over again (Richardson et al., 2008).

Figure 4

The Overtraining Risks and Outcomes Model (Richardson et al., 2008)

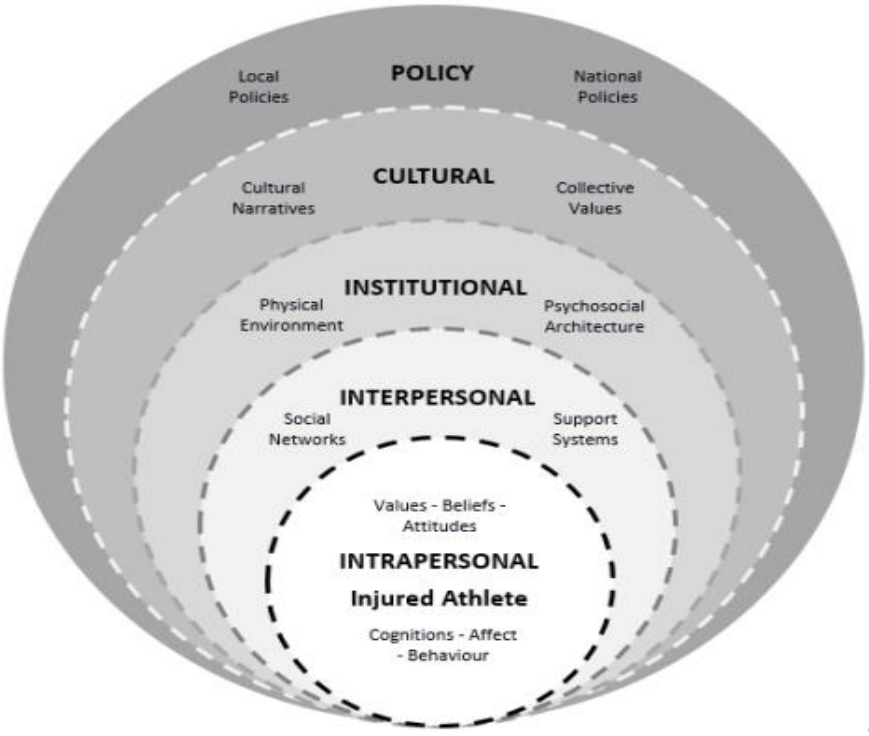


3.3.2.5. The Multilevel Model of Sport Injury. The fifth comparative case was (Figure 5) the MMSI (Wadey et al., 2018) which presumes that social-organizational-cultural levels influence and are influenced by the sport injury process. Specifically, the MMSI suggests that an athlete's response to injury results from the simultaneous influences of five nested levels including intrapersonal, interpersonal, institutional, cultural, and policy (Wadey et al., 2018). The intrapersonal level influences an athlete's response to injury via their individual characteristics

for example, cognitions, affect, and behavior. The interpersonal level influences an athlete's response to injury via formal or informal networks/systems such as social networks, and social support systems. The institutional level influences an athlete's response to injury via physical sport and institutional environments for example, universities and scholastic, as well as the psychosocial architectures that influence athlete welfare such as injury protocols. The cultural level includes both cultural narratives such as, the media and collective values including norms and traditions. The policy level is said to include a range of local clubs or leagues, national or international associations, and policies that either directly or indirectly influence the injured athlete and their rehabilitation process.

Figure 5

The Multilevel Model of Sport Injury (Wadey et al., 2018)



3.4. Trustworthiness and Credibility

Trustworthiness and credibility (Kerwin & Hoeber, 2015) refer to the authenticity and rigor of a qualitative researcher's analysis, results, findings, and conclusions (Sotiriadou & Brouwers, 2014). Rigor more specifically, refers to the extent to which a qualitative researcher establishes a high research quality (Smith & McGannon, 2017). To establish trustworthiness and credibility, five practices were used as in previous PFP (Dey et al., 2016) and sport injury psychology research (Podlog & Eklund, 2009; Podlog et al., 2013; 2015). These practices included establishing the existence of PFP for each participant; seeking alternatives; devil's advocating; member checking, and triangulation of data.

3.4.1. Establishing PFP

As outlined in Chapter I, PFP is characterized by an insidious onset of constant or recurring patellar or retropatellar pain aggravated by at least one activity that loads the patellofemoral joint during weight bearing on a flexed knee sometimes causing mild effusion and/or an antalgic gait (Crossley et al., 2016). To ensure trustworthiness and credibility of data, three distinct procedures were followed to ensure participants experienced PFP oppose to another knee injury. First, potential participants completed an online survey (Appendix A) including the Survey Instrument for Natural History, Aetiology and Prevalence of Patellofemoral Pain Studies (SNAPPS; Dey et al., 2016). The SNAPPS can differentiate PFP from other pathologies (k = .74, 95 % CI 0.52-0.91) with test-retest reliability in substantial agreement to other measures (ICC = 0.97, 95% CI 0.94-0.98) suggesting its results are reliable and consistent (Dey et al., 2016). The SNAPPS is also a valid measure for identifying PFP among runners with kneecap pain (ICC = 0.94; 95% CI 0.80-0.98, $p < 0.0001$; Yusuf et al., 20211). More specifically, the scores that identify clinical features in section 2 (ICC = 0.99; 95% CI 0.99-1.00, $p < 0.0001$) and knee pain

locations in section 4 (ICC = 0.93; 95% CI 0.87-0.97, $p < 0.0001$) have demonstrated excellent agreement among runners with PFP (Yusuf et al., 2021).

Second, potential participants completed Core PFP Criteria (Crossley et al., 2016) to determine the existence of clinical PFP signs and symptoms among each participant (see Appendix A). The Core PFP Criteria recommended by Crossley et al. (2016) have been used as inclusion/exclusion criteria in previous PFP research, but internal reliability consistencies have not been reported (e.g., Glaviano & Saliba, 2018; Glaviano, Simon, et al., 2022; Priore et al., 2019; Selhorst, Fernandez-Fernandez et al., 2020; Selhorst, Hoehn, et al., 2020).

Third, following the semi-structured interview with the participants, a virtual clinical examination was conducted, based on the clinical evaluation recommendations of Crossley et al. (2016). The clinical evaluation recommendations of Crossley et al. (2016) have been used as inclusion/exclusion criteria in previous PFP research, but internal reliability consistencies have never been reported (e.g., Bagheri et al., 2021; de Oliveira Silva et al., 2018; 2019; 2020; Ferreira et al., 2022).

3.4.2. Seeking Alternatives

Seeking alternatives refers to engaging in discussions that seek out alternative interpretations of the data collected (Podlog et al., 2015). In studies one and two, these discussions took place four times throughout the data analysis process with a PFP researcher-practitioner who has experience in qualitative PFP research. These conversations had two specific objectives. First, the PFP researcher-practitioner was sought to explore alternative explanations to the data. Second, discussions aimed to ensure interview results were rigorously subjected to alternative interpretations (Podlog et al., 2015).

3.4.3. Devil's Advocating

Devil's advocating refers to a researcher serving as an outside devil's advocate, challenging the appropriateness of claims prior to conclusions being drawn to ensure interpretations are rigorous (Podlog et al., 2013). In studies one and two, the actions required to conduct devil's advocating were two-fold. First, the PFP researcher-practitioner challenged claims based on their own qualitative PFP research. Secondly, interpretations were then justified using evidence in the data collected.

3.4.4. Member Checking

Member checking refers to participants being given the opportunity to modify or recant any statements made during their interview (Salim et al., 2016). In studies one and two, this action was taken by emailing each semi-structured interview transcript to their respective participant and providing them with the opportunity to make any modifications (Salim et al., 2016).

3.4.5. Triangulation of Data

Triangulation of data refers to the systematic use of strategies to reduce bias and distortion of data during qualitative analysis (Bennett et al., 2016). To establish triangulation of data in the current research, appropriate measures were selected, and their results considered in combination with those of semi-structured interviews. Specifically, empirical PFP identification techniques (Crossley et al., 2016; Dey et al., 2016) were used in combination with those of a theoretical psychosocial sport injury nature (Podlog & Eklund, 2009; Podlog et al., 2013; 2015; Salim et al., 2016) to obtain unbiased and non-distorted PFP data before interpreting results and drawing conclusions.

3.5. Reflexivity

Reflexivity refers to the drawing of a researcher's attention toward their involvement in the processes that produce knowledge across various contexts (Kerwin & Hoeber, 2015). Reflexive practices ensure qualitative results, findings, and conclusions are solely based on careful interpretations of the data collected (Kerwin & Hoeber, 2015). In this dissertation, my influence on the research process was divided into three overlapping roles: a recreational runner, a licensed athletic trainer, and a psychosocial PFP researcher.

As a recreational runner, I train for marathons, ultra-marathons, long course triathlons, and ironman triathlons. My training consists of a rigorous amount of swimming, cycling, running, and muscular strengthening with the goal of optimizing running performance. As part of my training, I often push myself close to my physical and psychological limits. I am aware that my quest for reaching and succeeding my limits is related to quest for success.

As a licensed athletic trainer, I work with athletes, including recreational runners, assisting them in recovering from injury. I have extensive training in lower and upper extremity injury prevention and treatment as well as, running biomechanics. My philosophical stance on athletic training is that for an injured athlete to be successful in their rehabilitation and return to sport, they need to progress within their physical limitations. I also believe that for an injured athlete to progress within their physical limitations and prevent further injury their cognitions, emotions, and behaviors need to be optimized.

As a psychosocial PFP researcher I have extensive training in the psychological and sociological aspects of injury and qualitative research methods. I have conducted, presented, and published my research for academic, research, and clinical audiences alike. Based on the knowledge I have, psychosocial PFP research had not adequately captured how an individual

experiences PFP. I believe my prior knowledge in qualitative research methods enables me to dig deeper into those experiences and share them with academic, research, and clinical audiences.

I am also aware that these three roles can simultaneously facilitate and hinder data collection, analysis, interpretation, and presentation, if not recognized and adequately addressed where relevant. As a recreational runner, my "run at all costs" was reinforced by participants. This is something I, as a researcher needed to be conscious of, as it had the potential to pigeonhole my line of questioning during interviews and close mindedly influence my analysis and interpretation of results. My views as a recreational runner are somewhat conflicting with my philosophy as an athletic trainer. When interviewing participants or analyzing data I needed to be mindful not to focus on the injury management aspects of running with PFP. Doing so had the potential to influence the opportunity to gain further knowledge on the psychosocial aspects of PFP among recreational runners.

As a psychosocial PFP researcher conducting qualitative research, it is my responsibility to be cognizant of how my understanding of psychosocial processes of injury, my experiences with recreational running philosophy, and those with athletic training can influence the data collection and analysis. By doing so, I am able to ensure my research was consistent with its aims and research methodology. Therefore, I engaged in three reflexive practices to ensure results, findings, and conclusions were solely based on careful interpretations of the data I collected. These reflexive practices included engaging in critical dialogue, composing reflexive memos, and keeping a research journal.

3.5.1. Critical Dialogue

Critical dialogue refers to a qualitative researcher engaging with another to actively reflect on both, the data collected as well as the analysis process itself (Podlog et al., 2015). The

aim of critical dialogue is to critically reflect on all possible data interpretations (Podlog et al., 2015). With the help of an established PFP researcher-practitioner, critical dialogue took place four times throughout the data analysis. The objective of each discussion was to ensure the analysis conducted addressed and explored previously researched psychosocial aspects of PFP.

3.5.2. Reflexive Memos

Reflexive memos assist researchers in identifying and learning from their thoughts, feelings, and behaviors in efforts to amend future research endeavors without imposing undue influence on research results (Corbin & Strauss, 2015). Specifically, reflexive memos enable monitoring of thoughts, feelings, and behaviors as they occur throughout the research process (Corbin & Strauss, 2015). In the current research, reflexive memos included writing down and/or typing up notes while conducting research related tasks (Roy-Davis et al., 2017).

3.5.3. Research Journaling

Research journaling expands on reflexive memos created by designating a time to reflect on and learn from an entire day as whole (Corbin & Strauss, 2015). In this dissertation, journal entries were completed after having time to reflect on reflexive memos, thoughts, feelings, and behaviors in general. Like developing reflexive memos, research journaling enabled the preparation and amendment of future research processes accordingly (Kerwin & Hoeber, 2015).

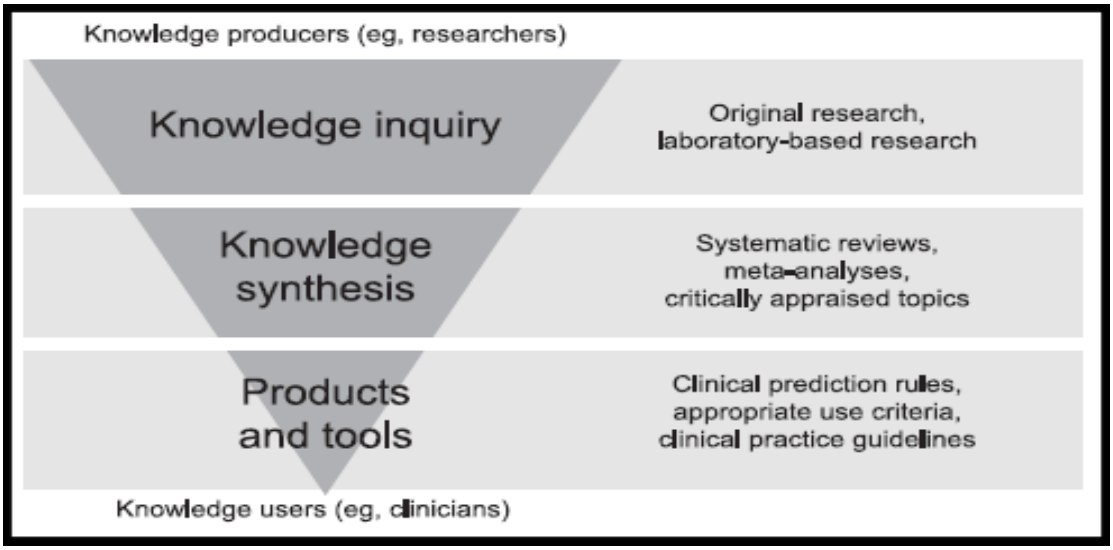
3.6. The Wider Research and Development Context

Healthcare research translates knowledge into evidence for clinicians and administrators to transfer into clinical decision making and policy development (Braithwaite et al., 2018). The process of knowledge translation into evidence-based clinical practice within athletic training was recently summarized using a stage model referred to as the *Knowledge Creation Process* (henceforth referred to as the KCP; Welch Bacon et al., 2021). The KCP (Figure 6) suggests

knowledge transfer is a sequential process from knowledge producers (e.g., researchers) to knowledge users (e.g., clinicians) and occurs in three stages: knowledge inquiry, knowledge synthesis, and products and tools. Within the *knowledge inquiry* stage, examples include original research and laboratory-based research. *Knowledge synthesis* stage examples include systematic reviews, meta-analyses, and critically appraised topics. The *products and tools* stage includes clinical prediction rules, appropriate use criteria, and clinical practice guidelines (Welch Bacon et al., 2021). In the context of the KCP, the research presented in this dissertation is classified within the *knowledge inquiry* stage as original research.

Figure 6

Examples of Each Progression Stage of the Knowledge Creation Process (Welch Bacon et al., 2021)



The knowledge transfer process has been further explained by the United States Department of Education (henceforth referred to as ED) and the U.S. National Science Foundation (henceforth referred to as NSF). The ED and NSF have suggested that the *knowledge inquiry* stage outlined by Welch Bacon et al. (2021) can be divided beyond simple classification of original research and laboratory research. The ED and NSF outline six main research types

(Table 2) that progress in sequential order informing the selection, development, and conduction of one another. According to the ED and NSF, knowledge gained from six research types translates into a spectrum of evidence that informs strategy and intervention development; and in turn applied practice guidelines (ED & NSF, 2013). Likewise, the knowledge gained from these six research types includes both, *knowledge synthesis* and *products and tools* as outlined by Welch Bacon et al. (2021). The spectrum of evidence created by the six research types may develop sequentially however, the evidence gained from an individual study is what justifies a subsequent study's research type (ED & NSF, 2013). Considering the purpose of each research type (see Table 2) this dissertation is situated as f*oundational research* in the wider research & development context.

Table 2
The Six Research Types

Research Type	Purpose
1. Foundational Research	To provide fundamental knowledge in the testing, developing, or refining of theories and methodologies that inform research and development.
2. Early-Stage or Exploratory Research	To investigate construct relationships and establish connections to outcomes that are supported by theory and research; providing a basis for intervention or strategy development, modification, and evaluation.
3. Design and Development Research	To draw on existing theory and research in the development or refinement of interventions and strategies; testing individual components to provide feedback for the development process.
4. Efficacy Research	To determine if an intervention or strategy can improve or replicate outcomes under ideal or altered conditions with a level of researcher involvement that is greater than that of normal circumstances.
5. Effectiveness Research	To estimate the impact of implementing an intervention or strategy under the circumstances of a target context without substantial researcher involvement to resemble its typical implementation.
6. Scale-up Research	To estimate the impact of implementing an intervention or strategy in a range of populations, contexts, and circumstances without substantial researcher involvement to generalize findings.

Note. Adapted from ED & NSF (2013)

Chapter IV: Study One and Study Two

Recreational runners' perceived psychosocial experiences with patellofemoral pain: A Grounded Theory Approach

Target Journal: Journal of Athletic Training

4.1. Abstract

Context: Patellofemoral pain (PFP) is a specific type of patellar or retropatellar pain aggravated by at least one activity (e.g., running) that loads the patellofemoral joint during weight bearing on a flexed knee (Crossley et al., 2016). Previous PFP research has primarily been quantitative and focused on the pathomechanical perspective but highlighted the presence and importance of psychosocial variables in the PFP prognosis (Neal, Lack, et al., 2019). Limited psychosocial PFP research has qualitatively extended some quantitative claims but overall, results are convoluted making synthetization of findings difficult. PFP researchers have called for additional qualitative exploration of individuals' perceived psychosocial experiences with PFP (Vicenzino et al., 2022). **Objective:** The purpose of this research was to explore the perceived psychosocial experiences of recreational runners with PFP. More specifically, this research aimed to: (a) document recreational runners' perceived psychosocial experiences with PFP and (b) develop a theoretical model to conceptualize recreational runners' perceived psychosocial experiences with PFP. **Design:** Qualitative study. **Setting:** Virtual. **Participants:** 10 recreational runners with PFP (n = 4 females, n = 6 males). **Data Collection and Analysis:** Semi-structured interviews and Straussian Grounded Theory (SGT; Corbin & Strauss, 2015) analysis. **Results:** NVivo codes were categorized into five overarching categories: *Who*, *What*, *How*, *Why*, and *Psychosocial Outcomes*. The overarching categories were then conceptualized into the Conceptual Framework for Psychosocial Experiences of Recreational Runners with Patellofemoral Pain. Theoretically,

Who recreational runners are, *What* they experience when recreational running with PFP, *How* they respond, *Why* they respond the ways in which they do, and their *Psychosocial Outcomes* combine. Their combination creates a set of interrelated overarching psychosocial constructs for which, a vast amount of subconstructs that might influence the perceived psychosocial experiences of recreational runners with PFP. **Conclusions:** The conceptual framework developed in this research provides a robust theoretical and empirical understanding of how psychosocial constructs may interrelate to explain the perceived psychosocial experiences of recreational runners with PFP.

4.2. Introduction

Patellofemoral pain (PFP) refers to patellar or retropatellar pain of an insidious onset that increases with at least one activity that loads the patellofemoral joint during weight bearing on a flexed knee such as squatting, walking, running, jumping, and/or ambulating stairs (Crossley et al., 2016). The core criterion of PFP is constant or recurring pain around or behind the patella from an insidious onset, but signs and symptoms can include mild effusion or antalgic gait (Crossley et al., 2016). While there is a high occurrence of PFP among physically active populations (Crossley et al., 2019), systematic reviews aiming to better understand PFP epidemiology have concluded that the true incidence and prevalence of PFP among men and women are unknown (e.g., Glaviano et al., 2015; Smith, Selfe et al., 2018). Complaints of PFP among recreational runners are more common than any other lower extremity injury including Achilles tendonitis and medial tibial stress syndrome (Crossley et al., 2019; Francis et al., 2019; Kakouris et al., 2021).

To better understand the prognosis of PFP, research has primarily focused on hip and knee musculature strength, run step rate, and patient education interventions (Manojlović et al.,

2021; Winters et al., 2021; Xiao et al., 2021). Most of this research has aimed to compare or predict post-intervention outcomes of pain, perceived function, kinesiophobia, pain self-efficacy, hip and knee muscle strength, and run gait kinematics from their respective pre-intervention results (Bramah et al., 2019; dos Santos et al., 2019; Earl-Boehm et al., 2018; Esculier et al., 2017; 2018; Holden et al., 2021 Hott et al., 2020; Neal, Barton, et al., 2019; Selhorst et al., 2021). Results suggest decreases in pain and increases in perceived function from hip and knee muscle strengthening interventions are sub-population dependent. Specifically, some individuals with PFP benefit from knee but not hip strengthening, particularly when combined with other exercises (Earl-Boehm et al., 2018; Esculier et al., 2018; Ferber al., 2015; Manojlović et al., 2021).

Among recreational runners, results of hip and knee muscle strengthening interventions have often lacked statistical significance (Bolgla et al., 2016; Hott et al., 2020; Khayambashi et al., 2014). In contrast, step-rate intervention research has demonstrated that increasing step rate by 10% results in decreases in pain and increases in perceived function (Bramah et al., 2019; Neal, Barton, Birn-Jeffery et al., 2019; Roper et al., 2016). Patient education has been most consistently shown to benefit pain and perceived function among recreational runners. Patient education is a cognitive-behavioral intervention generally defined as a structured learning experience aimed to influence knowledge and health-related behaviors (Sluijs, 1991). In PFP research, patient education refers to a clinician providing patient-specific advice on suspected etiologies, proposed options for treatment, and expectation management (Bosshardt et al., 2021). Results have consistently shown benefits of patient education among PFP populations whether delivered as a standalone-intervention or in conjunction with other interventions (Hott et al., 2020; Esculier et al., 2017; 2018; Winters et al., 2021).

Existing PFP intervention research has demonstrated that psychosocial constructs influence the prognosis of PFP. Many PFP researchers have also suggested that inconsistencies in existing biomechanical research findings may be partially attributed to psychosocial constructs (Crossley et al., 2019; Neal, Lack, et al., 2019; Powers et al., 2017; Vicenzino et al., 2022). To address this gap, limited psychosocial PFP research has been conducted to quantitatively identify, compare, and explore the effects of select psychosocial constructs among patients with PFP. These include: fear-avoidance beliefs, pain catastrophizing, kinesiophobia, anxiety, depression, pain self-efficacy, and coping strategies (e.g., Hott et al., 2019; 2022; Maclachlan et al., 2020; Selhorst et al., 2020; de Oliveira Silva et al., 2019). Much of the existing research has been however, inconsistent in construct definitions, atheoretical, and primarily quantitative in design.

In addition to quantitative research, limited qualitative research has also addressed psychosocial constructs in the PFP experience. The results of existing qualitative psychosocial PFP research (e.g., Robertson et al., 2017; Smith, Moffat et al., 2018) indicate that the role of psychosocial constructs in the PFP experience is much broader than existing quantitative research suggests. For example, Robertson et al. (2017) conducted qualitative interviews with PFP physiotherapy patients and found that the patients (a) searched for and gave perceptual meaning to their crepitus responding with a negative emotional response; (b) were influenced by friends, family, and medical professionals; and (c) altered their movement through fear-avoidant behaviors to prevent audible crepitus. Smith, Moffatt et al. (2018) also conducted qualitative interviews and found that PFP (a) created pain related confusion making it difficult to make sense of pain and (b) negatively influenced the identities of PFP physiotherapy patients. Both studies found that PFP physiotherapy patients expected to experience physical setbacks whether

re-injury occurred or not causing a great deal of anxiety in response to emotional un-comfortability, uncertainty, and worry (Robertson et al., 2017; Smith, Moffat et al., 2018). Together the findings of these studies suggest cognitive, emotional, behavioral, and social constructs influence the PFP experience in ways beyond what could be known by quantitative methods.

Taken together, existing psychosocial PFP research is yet to provide a robust theoretical and empirical understanding of *how* psychosocial constructs may influence the PFP experience, warranting more research. This is primarily due to inconsistent construct clarity and the atheoretical nature of existing psychosocial PFP research. Knowledge inquiry requires foundational research to address this gap and provide researchers with a conceptual framework for future research to be based on. This research was conducted to address two aims: (a) to document recreational runners' perceived psychosocial experiences with PFP, and (b) develop a theoretical model to conceptualize recreational runners' perceived psychosocial experiences with PFP.

4.3. Methods

4.3.1. Design

A Straussian Grounded Theory (SGT; Corbin & Strauss, 2015) design.

4.3.2. Participants

Following theoretical data saturation (Corbin & Strauss, 2015), a convenient sample (n = 10) of recreational runners –all of which had a bachelor's degree or higher – participated in this research (see Table 3). A recreational runner was defined as an individual who participates in running non-professionally for a minimum of 15 km per week (Esculier et al., 2017; 2018).

Table 3

Demographic Descriptors of Participants

	Percent of Sample
Gender	
Female	40% (4)
Male	60% (6)
Age	
20-24	30% (3)
25-29	10% (1)
30-34	10% (1)
41-45	40% (4)
Unknown	10% (1)
Symptom Duration	
2-3 Months	20% (2)
36-48 Months	50% (5)
60 Months	10% (1)
144 Months	10% (1)
218 Months	10% (1)
Self-Reported Usual Pain (Scale 0-10)	
0-3	10% (1)
1-2	10% (1)
2	10% (1)
2-3	10% (1)
3-4	20% (2)
4	20% (2)
4-6	10% (1)
5	10% (1)
Unilateral/Bilateral Complaints	
Unilateral Complaints	40% (4)
Bilateral Complaints	60% (6)
Previous Treatment	
Yes	60% (6)
No	40% (4)
Physical Activities	
Running	100% (10)
Yoga	30% (3)
Biking	20% (2)
Circuit Training	20% (2)
Hiking	20% (2)
Strength Training	20% (2)
Elliptical	10% (1)
Kayaking	10% (1)
Rock Climbing	10% (1)
Rowing	10% (1)
Skiing	10% (1)
Stairs	10% (1)
Swimming	10% (1)
Tennis	10% (1)
Volleyball	10% (1)

4.3.3. Materials

4.3.3.1. Survey Instrument for Natural History, Aetiology and Prevalence of Patellofemoral Pain Studies

The Survey Instrument for Natural History, Aetiology and Prevalence of Patellofemoral Pain Studies or SNAPPS (see Appendix A; Dey et al., 2016) was used to determine the existence of clinical PFP signs and symptoms among each participant. The SNAPPS is a 34-item self-report questionnaire with four sections. Section One consists of four demographic questions that are not scored. In this study, an additional question was added to ensure participants ran ≥ 15km per week (Esculier et al., 2017). Section Two has 10 items and identifies signs and symptoms of participants' knee injury. Each reported PFP sign or symptom is given a score (1), with a high total sum score of 7. Section Three is a list of 14 activities in which the participants are asked to identify whether or not engaging in the activity causes pain. This section is not scored. Section Four is a 6-item anatomical map that allows the participants to self-identify location(s) of their knee pain. Identifying the medial patella, lateral patella, and/or patellar tendon, is given a score (1), all other regions are scored (0), with a high total sum score of 6. Sections Two and Four are summed for a total possible score of 13, with scores ≥ 6 suggesting the existence of PFP.

The SNAPPS can differentiate PFP from other pathologies (k = .74, 95 % CI 0.52-0.91) with test-retest reliability in substantial agreement to other measures (ICC = 0.97, 95% CI 0.94-0.98) suggesting its results are reliable and consistent (Dey et al., 2016). The SNAPPS is also a valid measure for identifying PFP among runners with kneecap pain (ICC = 0.94; 95% CI 0.80-0.98, $p < 0.0001$; Yusuf et al., 20211). More specifically, the scores that identify clinical features in section 2 (ICC = 0.99; 95% CI 0.99-1.00, $p < 0.0001$) and knee pain locations in section 4

(ICC = 0.93; 95% CI 0.87-0.97, $p < 0.0001$) have demonstrated excellent agreement among runners with PFP (Yusuf et al., 2021).

4.3.3.2. Core PFP Criteria

Core PFP Criteria (Crossley et al., 2016) were used to determine the absence of clinical signs and symptoms unrelated to PFP (see Appendix A). Potential participants were asked to respond to six yes/no items. These items pertained to related clinical conditions such as neurological, meniscal, anterior cruciate ligament, hip or back injuries. Any yes responses resulted in exclusion from this study. The Core PFP Criteria recommended by Crossley et al. (2016) have been used as inclusion/exclusion criteria in previous PFP research but internal reliability consistencies have not been reported (e.g., Glaviano & Saliba, 2018; Glaviano, Simon, et al., 2022; Priore et al., 2019; Selhorst, Fernandez-Fernandez et al., 2020; Selhorst, Hoehn, et al., 2020).

4.3.3.3. Semi-Structured Interview Guide

A semi-structured interview guide was used to explore recreational runners' perceived psychosocial experiences with PFP (see Appendix B). The semi-structured interview guide contained four sections: icebreakers, running history, pain experience, and psychosocial experience. The ice breakers focused on questions related to participants daily lives (e.g., *what do you do for a living?*). Running history focused on participants' run experiences (e.g., *what role does recreational running play in your life?*). Pain experience sought to gain a deeper understanding of participants' previous experiences with pain and symptoms (e.g., *what kinds of symptoms do you experience?*). Psychosocial experience aimed to gain an insight into participants previous psychosocial experiences in response to PFP (e.g., *what modifications have you made because of your kneecap pain?*).

4.3.3.4. Virtual Clinical Examination

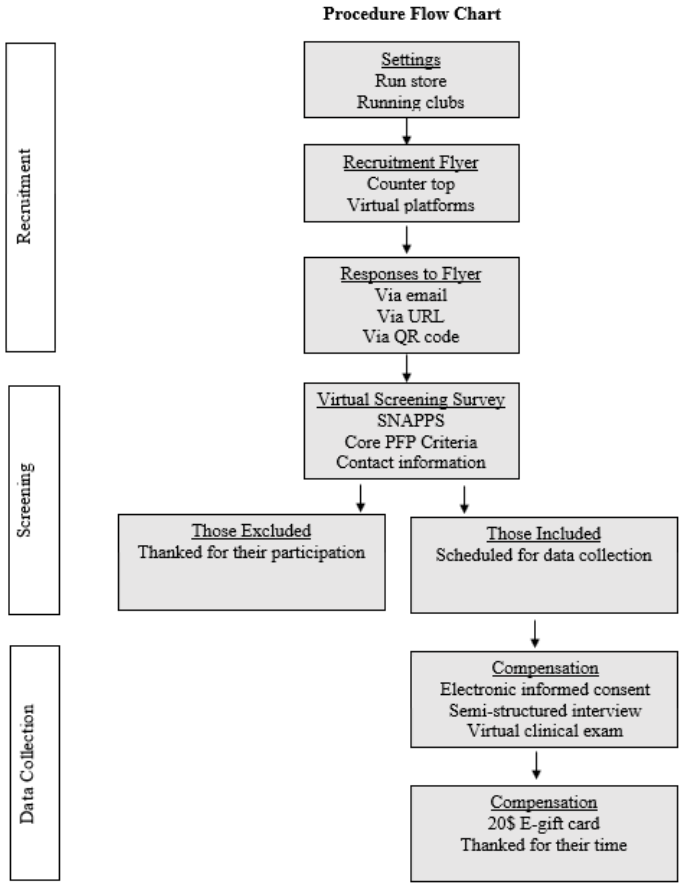
A virtual clinical examination based on the clinical evaluation recommendations of Crossley et al. (2016) was conducted to confirm the existence of signs and symptoms associated with PFP (see Appendix C). Participants (a) identified the involved knee, (b) acknowledged symptom duration, (c) conducted self-palpation for pain, (d) assessed their knee and surrounding area for swelling, (c) reported painful activities of daily living, (d) discussed their rehabilitation and/or treatment history and explained their current activity level. The virtual clinical examination was used to confirm that the participants interviewed did exhibit signs and symptoms of PFP and not a related condition. The clinical evaluation recommendations of Crossley et al. (2016) have been used as inclusion/exclusion criteria in previous PFP research but internal reliability consistencies have never been reported (e.g., Bagheri et al., 2021; de Oliveira Silva et al., 2018; 2019; 2020; Ferreira et al., 2022).

4.3.4. Procedures

Following institutional review board (IRB) approval, the participants were recruited from a convenience of run specialty stores and running clubs. What follows are details of the procedures used in this study for participant recruitment and data collection.

Figure 7

The Procedure Flow Chart



4.3.4.1. Participant Recruitment

4.3.4.1.1. Run specialty stores. Potential participants were recruited from two run specialty stores. The first run-store company was comprised of six locations in the greater metropolitan Milwaukee, Wisconsin, primarily populated with affluent, white recreational runners (United States Census Bureau, 2022a). The second run-store company had one location in Lexington Virginia, a small non-metropolitan rural town also primarily populated with affluent white recreational runners (United States Census Bureau, 2022b). Store owners and employees placed recruitment flyers atop each store's checkout counter and handed them to customers directly (see Appendix D).

4.3.4.1.2. Running clubs. Potential participants were also recruited from 200 recreational running clubs. The running clubs were located in non-metropolitan and rural areas across

Wisconsin and Virginia, and all contact information for the clubs was obtained from public websites. Emails were sent asking group representatives to forward the recruitment flyer to their members and post it on their social media platforms.

4.3.4.1.3. Participant screening. Using the URL link or the QR code from the recruitment flyer, all potential participants were directed to the online screening survey consisting of the SNAPPS (Dey et al., 2016) and the Core PFP Criteria (Crossley et al., 2016). Those who did not meet inclusion criteria at any point of the survey based on their responses, were excluded, and automatically directed to the end and thanked for their interest and time. The online screening survey took approximately 10 minutes. Those whose responses were identified as meeting the inclusion criteria, were asked to electronically provide their contact information (name, email, phone number) to schedule an online interview via Microsoft Teams. Of the 59 individuals who accessed the online screening survey, 23 fully completed all questions. Thirteen of the 23 were removed due to inclusion/exclusion criteria. The remaining 10 recreational runners (N_{male} = 6, N_{female} = 4) scheduled and participated in online semi-structured interviews.

4.3.4.2. Data Collection

4.3.4.2.1. Semi-structured interview. The email addresses provided by participants were used to schedule online interviews on Microsoft Teams. After an interview was scheduled, the participants were emailed a link to an IRB approved electronic consent form (see Appendix E). This form took approximately five minutes to review and complete, and all participants completed the consent prior to their semi-structured interview via Microsoft Teams. At the beginning of the interview, the researcher introduced himself, summarized the purpose of the study, and answered any participant questions. Upon consent, the audio recording function of

Microsoft Teams was turned on, demographic information was collected, and the semi-structured interview was conducted. Each interview lasted approximately 60-90 minutes.

4.3.4.2.2. Virtual clinical examination. To maintain role clarity (qualitative researcher vs. athletic trainer) of the researcher, each participant's virtual clinical examination was conducted immediately following their respective semi-structured interview via Microsoft Teams (for more on role clarity, see chapter III).

4.3.5. Data Analysis

Following interviews, participants were assigned pseudonyms in alphabetical order. Interviews were transcribed verbatim, and data managed, organized, analyzed, and synthesized using NVivo computer software. Interview transcripts were analyzed via the three coding processes of SGT (Corbin & Strauss, 2015). First, data were analyzed using *open coding* where transcripts were reviewed line-by-line to uncover excerpts that may be considered an idea or emerging concept (Roy-Davis et al., 2017). Second, open codes were re-assembled using *axial coding* to identify potential coding relationships referred to as concepts or code clusters (Corbin & Strauss, 2015). Thirdly, axial codes underwent *selective coding*, during which axial codes were grouped to develop subcategories. Subcategories were refined and integrated into categories to facilitate conceptualization (Corbin & Strauss, 2015). This process concluded when new selective NVivo codes ceased to emerge, and all coded data were explained via a uniform theoretical conceptualization explaining recreational runners' perceived psychosocial experiences with PFP.

4.3.6. Trustworthiness and Credibility

Trustworthiness and credibility practices in the current study included: establishing the existence of PFP for each participant, seeking alternatives, devil's advocating, member checking,

and triangulation of data. To establish the *existence of PFP* participants were recruited using the SNAPPS (see Appendix A; Dey et al., 2016) as well as Core PFP Criteria (Crossley et al., 2016). A virtual clinical examination was also completed following each interview (see Appendix C; Crossley et al., 2016). To *seek alternatives*, alternative explanations and interpretations of the data collected were sought by engaging in a critical discussion with a qualitatively experienced PFP researcher-practitioner (Podlog et al., 2015). For *devil's advocating*, an established PFP researcher-practitioner challenged claims and interpretations during the analysis, requiring evidence from the data collected to support all justification. For *member checking*, participants were emailed a copy of their interview transcript and given the opportunity to modify or recant any statements (Salim et al., 2016). One participant made a minor modification to their transcript (i.e., asked to redact their name and replace it with a pseudonym where it was missed by the researcher). *Triangulation of data* was conducted to reduce bias (Bennett et al., 2016). Specifically, existing valid and reliable PFP identification techniques (Crossley et al., 2016; Dey et al., 2016) were used along with theoretically credible psychosocial sport injury techniques (Podlog & Eklund, 2009; Podlog et al., 2013; 2015; Salim et al., 2016) to accumulate unbiased PFP data before interpreting results and drawing conclusions. Trustworthiness and credibility are outlined further in Chapter III.

4.3.7. Reflexivity

Three reflexive practices were used in the current study: critical dialogue, reflexive memos, and research journaling. For *critical dialogue*, the PFP researcher-practitioner assisted in critically reflecting on possible data interpretations to ensure previously explored psychosocial aspects of PFP were explored and addressed (Podlog et al., 2015). *Reflexive memos* were composed to monitor thoughts, feelings, and behaviors throughout data collection and analysis

(Corbin & Strauss, 2015). Thereafter, *research journaling* was conducted after having time to reflect on all aspects of research.

4.4. Results

Five theoretical categories explained participants' perceived psychosocial experiences of recreational running with PFP: *Who, What, How, Why,* and *Psychosocial Outcomes.*

4.4.1. Who

The theoretical category *Who* refers to the prominent personal characteristics of the participants *who* provided their psychosocial experiences of recreational running with PFP. *Who* was subcategorized by two interrelated NVivo Codes: run attitude and run-related emotions.

4.4.1.1. Run Attitude

The subcategory run attitude refers to the "run by any means necessary" that participants had toward running (Table 4). This attitude was maintained by each participant as they described continuing to run despite experiencing PFP. Collectively, participants believed running is a non-negotiable necessity to life.

Table 4

Examples of NVivo Codes (quotes) for Run Attitude

Participant	Run Attitude
Amber	"I'm always gonna go out for a run."
Edward	"You'll be sore you'll get over it …I'd rather have a good day and be in pain than have a bad day and miss my run."
Jasmine	"I can't have anything compromise me being able to run."
Lyle	"Whatever I'm doing I have to figure out how I'm gonna get running."

4.4.1.2. Run-Related Emotions

The subcategory run-related emotions refer to the emotional attachment to running participants conveyed when describing their perceived psychosocial experiences of running with PFP. Running was commonly associated with emotions such as accomplishment, happiness, and euphoria (Table **5**). For example, Bill noted that he felt accomplished because running makes him "fit, strong, ...and driven." Most described going out for a run as a means to emotionally stabilize themselves. The emotional connection to running was so strong that all but one participant overtly stated that they "loved to run."

Table 5

Examples of NVivo Codes (quotes) for Run-Related Emotions

Participant	Run-related Emotions
Gabby	"I feel like I'm in a better mood after I run."
Ian	"It helps calm me down"
Jasmine	"Oh, it's like my therapy …it makes me very happy."
Katrina	"Runner's high it's fun, it's addicting."

4.4.2. What

The theoretical category *What* refers to the dominant psychosocial responses participants experienced in response to their PFP. *What* was subcategorized by three NVivo Codes: uncertainty (Table 6), worry (Table 7), and perceived pain (Table 8).

4.4.2.1. Uncertainty

The subcategory uncertainty refers to the unacquaintedness or unknowingness participants experienced when continuing to run with PFP. All participants were uncertain as to whether training influenced their pain or vice versa. For participants, whether or not pain occurred while running was analogous to the results of a coin flip.

Table 6

Examples of NVivo Codes (quotes) for Uncertainty

Participant	Uncertainty
Amber	"Is it avoidable? I don't know. …As I continue to run, I don't know if it works itself out."
Bill	"Flip a coin really of which one [knee] might give me some trouble."
Chris	"Sometimes it gets better or gets worse but it's not clear exactly why."
Edward	"Sometimes longer and slower hurts more."
Gabby	"I just don't know why I'm 21 and overall healthy and trying to be in shape and it's causing me pain."
Ian	"I finished running and I was like oh my knee kinda hurts. It's only my right knee. I don't know why."
Jasmine	"I don't know how to describe it. I feel like something just needs to be cleaned up in there. I think it's behind the kneecap?"
Lyle	"Not sure the knee will tolerate all that much the high-volume training."

4.4.2.2. Worry

The subcategory worry refers to the genuine concern, nervousness, and/or anxiousness the participants experienced when continuing to run with PFP. Feelings of worry were often accompanied by those of frustration toward PFP. For some, the notion that pain could negatively

influence run training was a great worry, over which they became anxious and extremely frustrated. For others, it was a subtle concern that stayed at the back of their mind.

Table 7
Examples of NVivo Codes (quotes) for Worry

Participant	Worry
Amber	"I have a nervous feeling that if I were to train, I would ruin my knees."
Bill	"It never really hurts but it's always a little concerning."
Chris	"I'm always you know trying to make sure that I don't do too much but it's hard to know how much that is until you've gone passed it!"
Edward	"Sometimes it kind of ruins the enjoyment of it a little bit. It keeps me from getting excited to go on a run."
Gabby	"You might actually be like 40 and be like shoot I shouldn't have kept running when I was 20 ya know."
Jasmine	"Is it okay to do this? I am worried."
Katrina	"It's in the back of my mind you know."

4.4.2.3. Perceived Pain

The subcategory perceived pain refers to pain-related perceptions participants described having when continuing to run with PFP. Perceived pain fluctuated between low and high intensities and was experienced during training as well as activities of daily living. Low intensity pain was described as an uncomfortable dull ache or pressure that was annoying. High intensity pain was described as sharp, piercing, and hurtful.

Table 8
Examples of NVivo Codes (quotes) for Perceived Pain

Participant	Perceived Pain
Chris	"It's mostly under control in that it's low-level discomfort but it's there a lot of the time."
Edward	"Walking to class would be kinda tough."
Fernando	"After periods of sitting down it'll hurt to stand up."
Gabby	"I couldn't sit and do online class all day."

Jasmine	"…doing speedwork changing the speed too quickly sometimes that might tweak it."
Katrina	"…higher mileage the knee pain typically is kind of one of those inevitable things."

4.4.3. How

The theoretical category *How* refers to the means through which participants addressed what they perceived to be the cause of their dominant psychosocial responses (i.e., *What*). That is to say, each participant's knee was perceived to be the cause of their uncertainty, worry, and perceived pain. *How* then refers to the ways participants subsequently dealt with their PFP. *How* was subcategorized by three NVivo Codes: training responses (Table 9), physical responses (Table 10), and psychological responses (Table 11).

4.4.3.1. Training Responses

The subcategory training responses refer to training modifications participants made in response to uncertainty, worry, and perceived pain. Training modifications included cross-training, decreasing training, stretching, and/or moving around more often. Training modifications were conducted for participants to continue running despite experiencing PFP and were the most prominent means through which they described being able to do so.

Table 9

Examples of NVivo Codes (quotes) for Training Responses

Participant	Cross-training
Bill	"You might notice a difference in regards to pain in certain areas trying lower impact activities like swimming."
Fernando	"I started doing very low impact exercise instead of running so I started doing yoga."
Gabby	"I started a little bit in high school getting into rock climbing. ...easier on the knees I felt but a good total body workout."
Katrina	"A lot of strength training because that's the main thing that prevents knee pain is doing a lot of back squats for example."
Lyle	"I started doing things that are not running ...yoga, strength training, biking, swimming."
	Decreasing Training
Bill	"Stopping to walk or just stopping a bit and pausing my watch."

Gabby	"I go on the shock absorber treadmill, and I run two miles until I'm out of breath."
Ian	"I plan to do a six-mile run and oh my knee kinda hurts right now, I'll try to shorten it down."
Katrina	"Usually, they'll start aching and then I'll go oh no oh no. I'll back off for a day or two try it again see how it goes."
Lyle	"I think that I learned to internalize certain kinds of restrictions on running preventatively."
	Stretching or Moving Around
Chris	"If I'm on the couch or at my desk my knee is bent at a right angle so I try to put my foot up on something when I can."
Edward	"If I continue stretching consistently for like a long-time half an hour and up a day, then I've noticed it helps a lot."
Katrina	"I was sitting there doing squats and stuff in the middle of the EP lab when I was all scrubbed up ...I just needed to move the legs."

4.4.3.2. Physical Responses

The subcategory physical responses refer to attempts participants made to physically address the cause of uncertainty, worry, and perceived pain. Physical responses included taping or icing the knee, taking over-the-counter anti-inflammatories, and/or purchasing shoes, insoles, orthotics, or knee sleeves. Physical responses were the second most prominent means through which participants described being able to continue running despite experiencing PFP.

Table 10

Examples of NVivo Codes (quotes) for Physical Responses

Participant	Tape, Ice, and Medication
Edward	"I would say I do ice like after long runs."
Gabby	"I tried KT athletic tape to try to like tape up my knees. And I just powered through it."
Ian	"Oh, take an Ibuprofen or an Advil or ice it."
	Shoes, Insoles, and Orthotics
Amber	"Have you tried new shoes? That's always the number one thing."
Bill	"I did inserts once um trying to remember the brand, they were bright green."
Lyle	"…probably wearing not ideal shoes also."
	Knee Sleeves

Chris	"I did try to run a bunch last summer wearing a knee brace."
Katrina	"When I was younger …I was braced like in a brace."
Jasmine	"I just slide it over my knee to help hold it in place and it's better. If I don't do that it's sore afterwards."

4.4.3.3. Psychological Responses

The subcategory psychological responses refer to psychosocial techniques that participants used to manage uncertainty, worry, and perceived pain. Psychosocial techniques included seeking help from friends, teammates, family, and/or medical professionals; documenting training pace, duration, distance, weather, and/or how runs felt; and engaging in positive self-talk. Psychosocial techniques were executed to obtain information, monitor training, and motivate participants to run; but were the least prominent means through which participants described being able to continue running despite experiencing PFP.

Table 11
Examples of NVivo Codes (quotes) for Psychological Responses

Participant	Seeking Help
Bill	"When I relocate over the years, I have tried to seek out physicians that are either through their bios self-proclaimed athletes or athletically driven or working with people that are driven."
Chris	"I asked a friend who's a big runner and I said what do you do?"
Edward	"It's maybe a 4 [4/10 pain] nothing serious enough to make me see a doctor besides like an athletic trainer."
	Documentation
Bill	"We [my wife and I] have logbooks for like the last six years so."
Chris	"I have a GPS watch and all that, so I mean I do keep track of my times. I keep track of my mileage."
Jasmine	"I write down just the distance, the total time, and then the pace."
Lyle	"I write down weather conditions and what I wore and how I felt, which has been really helpful cause I can look it up."
	Self-talk
Amber	"I kinda like to stay positive with most things I mean I don't like having it [pain]."

Fernando	"At the beginning of this I think oh its actually probably a good thing for me. I can focus on my other parts of my training."
Ian	"Alright knee, work yourself out knock this off."
Katrina	"I was like okay I don't feel like it's severe enough that I'm gonna you know completely destroy them [knees]."

4.4.4. Why

The theoretical category *Why* refers to the reasons why participants responded to their dominant psychosocial responses (i.e., *What*) with training modifications; attempts to physically address their PFP; and psychosocial techniques to manage uncertainty, worry, and perceived pain. *Why* was subcategorized by four NVivo Codes: previous experiences (Table 12), extrinsic motivation (Table 13), intrinsic motivation (Table 14), and social influences (Table 15).

4.4.4.1. Previous Experiences

The subcategory previous experiences explains why both, previous training and past injury experiences influenced the ways participants dealt with their PFP (i.e., *How*) in response to their dominant psychosocial responses (i.e., *What*). More specifically, the participants discussed past recreational and competitive physical activities dating back four to 30 years; previous injuries that ranged in severity; and the lessons learned from said activities and injuries.

Table 12
Examples of NVivo Codes (quotes) for Previous Experiences

Participant	Training Experiences
Amber	"I feel like I always have been a runner. …I would say probably thirty plus years of running."
Edward	"When I'm looking for a plan it will be more like looking at the miles per week and the amount of time required."
Fernando	"The general plan of doing about one tempo run a week and one long run a week."
Jasmine	"I used to go to the gym, and I would do the elliptical. I'd be on it for an hour ...I mean how long could it take me to run a 5k? I'd never done one."

Lyle	"I will cap out mileage based on what I think will happen …I'll happily adjust training plans based on what's currently going on."
	Injury Experiences
Bill	"The only trauma that I can recall experiencing to that leg was um spraining it in third grade."
Chris	"It became really hard to run because the cold air aggravates asthma. I wouldn't run very much outside in the winter."
Gabby	"I didn't complain ever and then at 15 the bottoms of my feet started to hurt."
Jasmine	"I had a hernia, so I had to have surgery for that. And that impacted my running …I finally was getting back to it and then I got plantar fasciitis."
Katrina	"[modifying training], it's definitely a response to kind of this whole history of knee problems so because of that I'm being extra cautious."

4.4.4.2. Extrinsic Motivation

The subcategory extrinsic motivation explains why externally focused aspirations of achievement influenced the ways participants dealt with their PFP (i.e., *How*) in response to their dominant psychosocial responses (i.e., *What*). Extrinsic motivations included pace, frequency, distance, or completing a particular race. For example, Bill and Jasmine engaged in what they referred to as "run streaks" to see how many consecutive days they could run at least one mile. During these "streaks" low intensity runs were completed every day. Bill was approaching 16 months at the time of his interview and Jasmine had previously completed a 13-month run streak.

Table 13
Examples of NVivo Codes (quotes) of Extrinsic Motivation

Participant	Extrinsic Motivation
Amber	"I'm always checking to see if I'm better ...timewise I just kinda always wanna inch up on that quicker mile."
Bill	"My goal is to always be prepared for a half marathon."
Fernando	"In terms of my goals I want to keep getting better in my times."
Ian	"I decided on January 1st of 2021 I wanna run 772 miles in the year."
Jasmine	"I'm hoping to qualify for Boston although I have to shave quite a bit of time off my time."
Katrina	"Running right now it's negative splits for my miles so I'm not running too far."

4.4.4.3. Intrinsic Motivation

The subcategory intrinsic motivation explains why internally focused aspirations of achievement influenced the ways participants dealt with their PFP (i.e., *How*) in response to their dominant psychosocial responses (i.e., *What*). Intrinsic motivations included fitness, ability, fun, or injury prevention and were discussed substantially less often compared to extrinsic motivations.

Table 14
Examples of NVivo Codes (quotes) of Intrinsic Motivation

Participant	Intrinsic Motivation
Amber	"I want to make it that I always stay healthy and that my body stays healthy."
Chris	"I run for fitness and leisure just have some movement ...you know for fun and sanity."
Fernando	"My goal is to not be over-trained or get injured before cross country season."
Katrina	"Right now I'm just trying to very cautiously build that regular running base, so we are in injury prevention mode."

4.4.4.4. Social Influences

The subcategory social influences explains why individuals and media influenced the ways participants dealt with their PFP (i.e., *How*) in response to their dominant psychosocial responses (i.e., *What*). Social influences included friends, teammates, family, coaches, medical professionals, run-store staff, and internet/print media. Friends, teammates, family, and coaches were important sources of training and injury-related information as well as, comradery; and were the social influences discussed most often. Medical professionals provided injury-related information, peace of mind, and pain relief; and were discussed second most often. Run-store staff and internet/print media were the least discussed sources of training-related information.

Table 15

Examples of NVivo Codes (quotes) for Social Influences

Participant	Friends, Teammates, Family, and Coaches
Bill	"Just a really phenomenal running community so that's how we got connected."
Edward	"I was like alright I guess I gotta figure out how to meet some people who run."
Fernando	"A week into this injury and my mom was like do you want to go and see him [physical therapist]?"
Gabby	"My coach encouraged me to keep running."
	Medical Professionals
Edward	"Just like walk into the athletic training room and be like this is what's up."
Fernando	"I'd listen to a doctor who can I don't know the word, who does an evaluation on me."
Ian	"I always feel incredible after the chiropractor."
Jasmine	"I mean the ortho said I could still run and I did for a while but it made it worse."
	Run-store Staff and Internet/print Media
Chris	"They [run-store staff] did gait analysis and they recommended a pair of shoes with a bit more support."
Jasmine	"I've been using the same Runners World break four-hour plan for like the last four marathons that I've done."
Katrina	"I just printed out an example schedule that comes from some sort of French site."

4.4.5. Psychosocial Outcomes

The theoretical category *Psychosocial Outcomes* refers to the prominent psychosocial sequelae described by participants as integral to their experiences of recreational running with PFP. More specifically, *Psychosocial Outcomes* were integral to psychosocial PFP experiences described by participants considering *Who* they are, *What* they experienced, *How* they responded, and *Why* they responded the ways in which they did to PFP. *Psychosocial Outcomes* were subdivided by two NVivo codes: relatedness and acceptance.

4.4.5.1. Relatedness

Relatedness refers to the level of connectedness participants described having with others. All of the participants had a burning desire to run, socialize, and/or learn from running

groups, clubs, teams, friends, and/or family. Relatedness to others was the most prominent topic of conversation throughout the entire study. Participants described how they desired to train with like-minded individuals (i.e., *Who*); how connections with others kept them from fixating on uncertainty, worry, and perceived pain (i.e., *What*); learned myriad of ways to manage their PFP (i.e., *How*); and found a reason to continue running despite experiencing PFP (i.e., *Why*).

Relatedness was closely connected to accountability. Interpersonal relationships with other reactional runners were often established in running groups/clubs and gave participants an almost obligatory reason to train with others despite being busy in life, feeling tired, or experiencing pain. In addition, Amber, Bill, and Chris described how it was just as important to establish a strong sense of relatedness with family life and run training. Amber described molding her training needs to her family's vacations and explained how her family cheered her on during a virtual marathon she completed after the race she had trained for was cancelled. Bill and Chris always made time to run with their wives, even if it meant running multiple times in a single day.

Table 16

Examples of NVivo Codes (quotes) for Relatedness

Participant	Relatedness
Amber	"Welcome to the club right. You know its my nature to try to offer up some help."
Bill	"I was in the middle of that pack always but I did it, I was social. I was keeping active."
Chris	"Occasionally I'll do two runs in a day and I'll go with her [wife] for the second one."
Edward	"I joined the track club last semester that gave me something to train for and people to run with."
Fernando	"I think if there would have been a race that happened early in the season I woulda been jealous. If I couldn't have done the race while everyone else did."
Gabby	"I still talk to the girls that I ran with and some' of the guys from the boys' team."

Ian	"I think if I didn't have this friend there, I wouldn't be as I'm not concerned about completing the goal."
Jasmine	"We live in the same neighborhood and she's way faster than me but slows down to run with me."
Katrina	"I really like other runners as well, so I am happy."
Lyle	"We have a social circle here that is very much oriented around running."

4.4.5.2. Acceptance

Acceptance refers to participants' willingness to make the training accommodations necessary to minimize the discomfort of recreational running with PFP. All participants continued to run despite experiencing PFP however, accepting the need to make training modifications varied across participants. Acceptance was easiest for participants who maintained a sense of relatedness to other like-minded recreational runners (i.e., *Who*). Acceptance of the need to make training modifications reduced the frequency of and extent to which participants experienced uncertainty, worry, and perceived pain (i.e., *What*). Acceptance also resulted in participants continually making modifications to their training to minimize discomfort (i.e., *How*). Participants who accepted the need to make training accommodations demonstrated a shift from being predominantly extrinsically motivated to focusing more on intrinsic motivation and social influences (i.e., *Why*).

Acceptance was accompanied by an understanding that the prominent psychosocial responses of uncertainty, worry, and perceived pain could be minimized (i.e., *What*). Acceptance also meant that participants were knowledgeable of how their training would influence pain, and what level of pain would prevent them from training altogether. As recreational runners who were willing to run by any means necessary, this was a perspective shift that often resulted in training modifications such as cross-training (i.e., *How*). Participants described how maturely

readjusting training expectations with a goal to minimize pain resulted in peace of mind. When participants did not accept the need to make accommodations in training, they continued to train without modifications and became overwhelmed with uncertainty, worry, and perceived pain.

Table 17

Examples of NVivo Codes (quotes) for Acceptance

Participant	Acceptance
Amber	"I think I have peace with that because I've done it."
Bill	"Over a year or so I kinda started to notice patterns of okay sweet spot with pushing myself and having a good run but not being like so winded that I can't do anything after words."
Chris	"There's always gonna be discomfort, it's fine to just go through it. You just don't want to do that to where you're gonna get injured."
Edward	"I would say though its kind of changed my expectation over time where I've kinda come to accept pain."
Fernando	"I see it to be a possibly good thing in that I got a new winter hobby."
Gabby	"I don't push myself to [run] three miles. It's not high school where it's like run through the pain."
Ian	"I love running to work through that but you know there's sometimes where your just like nope can't do it."
Jasmine	"I think at this point if I had to take time off for the better of me being able to continue running."
Katrina	"I believe some famous philosophers said you can't always get what you want but if you try sometimes you'll get what you need ...I think I've just reset my expectations."
Lyle	"Nowadays I will have some amount of disappointment and some minor disappointment, but generally I'm pretty accepting of it."

4.4.6. The Conceptual Framework for Psychosocial Experiences of Recreational Runners with Patellofemoral Pain

Table 18

The Conceptual Framework for Psychosocial Experiences of Recreational Runners with Patellofemoral Pain

Categories	Subcategories
Who The prominent personal characteristics of the participants who provided their psychosocial experiences of recreational running with PFP.	**Run Attitude** The "run by any means necessary" attitude participants had toward running. **Run-Related Emotions** The emotional attachment to running participants conveyed when describing their perceived psychosocial experiences of running with PFP.
What The dominant psychosocial responses participants experienced in response to their PFP.	**Uncertainty** The unacquaintedness or unknowingness participants experienced when continuing to run. **Worry** The genuine concern, nervousness, and/or anxiousness the participants experienced when continuing to run. **Perceived Pain** The pain-related perceptions participants described having during training and activities of daily living.
How The means through which participants addressed what they perceived to be the cause of their dominant psychosocial responses.	**Training Responses** The training modifications participants made in response to uncertainty, worry, and perceived pain. **Physical Responses** The attempts participants made to physically address the cause of uncertainty, worry, and perceived pain. **Psychological Responses** The psychosocial techniques that participants used to manage uncertainty, worry, and perceived pain.
Why The reasons why participants responded to their dominant psychosocial responses with training modifications; attempts to physically address their PFP; and psychosocial techniques.	**Previous Experiences** Previous training and past injury experiences that influenced the ways participants dealt with their PFP. **Extrinsic Motivation** Externally focused aspirations of achievement that influenced the ways participants dealt with their PFP. **Intrinsic Motivation** Internally focused aspirations of achievement that influenced the ways participants dealt with their PFP. **Social Influences** The individuals and media that influenced the ways participants dealt with their PFP.
Psychosocial Outcomes	**Relatedness** The level of connectedness participants described having with others. **Acceptance** Participants' willingness to make the training accommodations necessary to minimize the discomfort of recreational running with PFP.

The Conceptual Framework for Psychosocial Experiences of Recreational Runners with Patellofemoral Pain suggests recreational runners are individuals *Who* have prominent personal characteristics that influence their perceived psychosocial experiences of recreational running with PFP. The conceptual framework also suggests that dominant psychosocial responses are *What* recreational runners experience when running with PFP. Those experiences interrelate with *How* they address the perceived cause of their psychosocial responses and the reasons *Why* they respond the ways in which they do. Each category was described with pertinent connections to *Psychosocial Outcomes*. Theoretically, *Who* recreational runners are, *What* they experience when recreational running with PFP, *How* they respond, *Why* they respond the ways in which they do, and their *Psychosocial Outcomes* combine to create a set of interrelated overarching psychosocial categories (i.e., constructs) for which, myriad of subcategories (i.e., subconstructs) might influence the perceived psychosocial experiences of recreational runners with PFP. The current findings suggest the order and sequential influence of the categories within the conceptual framework could vary from one individual to another.

Based on the participants of this study, interrelationships between the categories and subcategories can be conceptually explained as follows. Participants displayed a "run by any means necessary" attitude and an emotional attachment to running (*Who*). Their run attitude and run-related emotions were often discussed in conjunction with worries related to the effects their perceived pain would have on training (*What*). When the participants attempted to ignore their perceived pain (*How*) to continue training with others (*Why*), they described having subsequent increases in uncertainty, worry, and perceived pain (*What*). Worries were then discussed in reference to worrying about whether or not they would be able to race (*Why*). By expressing concern to members of their local run club (*How*) or by seeking help from medical professionals

(*How*) participants learned ways to manage their PFP (*Why*) including training modifications, icing, taking Advil, and physical therapy (*How*). From their run peers (*Why*), participants even learned to avoid overtraining (*How*) by focusing on injury prevention oppose to race outcomes (*Why*).

Participants also discussed shifts in focus from extrinsic motivation (e.g., race time, distance, or other outcome) to intrinsic motivation (e.g., injury prevention, health, or fitness; *Why*) that were accompanied by accepting training modifications necessary to minimize discomfort (*Psychosocial Outcomes*). Likewise, realizations that they did not have to manage their PFP in isolation (*Psychosocial Outcomes*) seemed to assist them in realizing that their PFP did not define them as individuals (*Who*). Accepting training changes and staying connected to other runners despite experiencing PFP (*Psychosocial Outcome*) appeared to be accompanied by accepting cross training (*How*) as an option to prevent further injury (*Why*). Specifically, participants believed that prospectively preventing further injury would decrease the intensity of perceived pain (*What*) that they would experience on race day (*Why*).

4.5. Discussion

The purpose of this research was (a) to document recreational runners' perceived psychosocial experiences with PFP and (b) to develop a theoretical model to conceptualize recreational runners' perceived psychosocial experiences with PFP. A Straussian grounded theory (Corbin & Strauss, 2015) analysis revealed a myriad of psychosocial constructs that may be pivotal to recreational runners' perceived psychosocial experiences with PFP. The results of this research enabled the development of a conceptual framework (Table 18) that augments what is known from previous psychosocial PFP research.

The conceptual framework explains *What* prominent psychosocial responses recreational runners experience in response to PFP. Previous psychosocial PFP research has focused on exploring fear-avoidance beliefs, pain catastrophizing, and kinesiophobia (e.g., Hott et al., 2019; James et al., 2021; Maclachlan et al., 2018; Pazzinatto et al., 2022; Selhorst et al., 2020; de Oliveira Silva et al., 2019), none of which were described by the participants interviewed in this research. Among the participants in this research, prominent psychosocial responses included uncertainty, worry, and perceived pain.

To date, previous quantitative PFP research has not identified or explored uncertainty as a possible psychosocial response to PFP. Consistent with the conceptual framework, previous qualitative PFP research has found that individuals with PFP develop feelings of uncertainty toward pain mechanisms and become uncertain as to whether physical activities such as running cause setbacks in recovery (e.g., Barber et al., 2022; Robertson et al., 2017; Smith, Moffatt et al., 2018). Worry has only been researched as a negative coping strategy for PFP (Ak & No, 2018; Bagheri et al., 2021; Doménech et al., 2013; 2014; Thomeé et al., 2002; van Middelkoop et al., 2017), and not as a psychosocial response to PFP. More research has explored perceived pain and its relationship with physical and psychosocial outcomes. The results of existing quantitative research suggest that perceived pain is related to perceived function, perceived disability, fear-avoidance beliefs, pain self-efficacy, coping strategies, and patient education but findings are inconsistent (e.g., Holden et al., 2021; Hott et al., 2022; Mansfield & Selhorst, 2018; Selhorst, Fernandez-Fernandez et al., 2020; 2021; van Middelkoop et al., 2017).

The conceptual framework also places an importance on understanding *Who* individuals with PFP are. Participants in this research presented with a run attitude and run-related emotions that strongly influenced who they perceived themselves to be. Run attitude and run-related

emotions have gone unexplored in previous quantitative and qualitative PFP research (e.g., Barber et al., 2022; de Oliveira Silva et al., 2020; Glaviano et al., 2019; 2022; Hott et al., 2022; Manojlović et al., 2022). Systematic reviews on psychological and behavioral correlates associated with recreational running and mental health suggest attitudes toward running are psychological antecedents that motivate individuals to run (Pereira et al., 2021); and run-related emotions are psychological outcomes that influence the well-being of recreational runners (Oswald et al., 2020). Findings of this research support these claims (Oswald et al., 2020; Pereira et al., 2021) by suggesting that run attitude and run-related emotions may have multi-dimensional relationships with the categories of the conceptual framework (i.e., *Who, What, How, Why, Psychosocial Outcomes* categories). This could be why previous research suggests athletic identity (i.e., degree to which an individual identifies with the athlete role; Brewer et al., 1993) is related to run attitude and run-related emotions (e.g., Lev, 2022; Ronkainen et al., 2017), and gives rise to exercise dependence (i.e., over-commitment to exercise; Allegre et al., 2006). Exercise dependence then creates a psychological risk for overuse injury among runners (Martin et al., 2021; Turton et al., 2017).

The conceptual framework developed in this research also explains *How* recreational runners respond to the perceived cause of their dominant psychosocial responses. Participants in this research assumed their PFP was either pathomechanical in nature or a consequence of their training. Participants discussed how they responded to PFP by modifying training (i.e., training responses), attempting to physically address their PFP (i.e., physical responses), and using psychosocial techniques (i.e., psychological responses) with a goal to manage psychosocial responses (*What*) of uncertainty, worry, and perceived pain. So far, previous quantitative psychosocial research has not focused on training or physical responses of recreational runners

with PFP. Previous quantitative recreational running research does, however, support the role of training modifications as a response to PFP (*How*; Linton & Valentin, 2018; Wickström et al., 2019). Recreational runners reportedly believe that overuse injury is influenced by biomechanics, high exercise load, and their "runner's personality" (Wickström et al., 2019); but are willing to reduce their training volume if perceived pain is overwhelmingly high (Linton & Valentin, 2018).

The conceptual framework also suggests that recreational runners with PFP seek help, document training, and/or engage in positive self-talk to prepare for competition without making their injury worse. These findings are partially supported in the existing psychosocial PFP research. For example, previous quantitative research suggests that recreational runners with PFP seek medical attention and those who are younger do so more often than those who are older (Wirnitzer et al., 2022). Previous qualitative research suggests recreational runners: (a) seek training advice from those with experience in race preparation and/or injury prevention (Simpson et al., 2014); (b) benefit from documenting goals, motivation, and emotions during training (Spillers & Asimakopoulos, 2014); and (c) use positive motivational self-talk during competition (Van Raalte et al., 2015). Together, the aforementioned findings support the claims of the *How* category as conceptualized in this research (Bagheri et al., 2021; Linton & Valentin, 2018; Simpson et al., 2014; Spillers & Asimakopoulos, 2014; Van Raalte et al., 2015; Wickström et al., 2019; Wirnitzer et al., 2022). It has also been suggested that using mindfulness (a psychosocial strategy) may benefit recreational runners with PFP when combined with exercise, running, and load management training (Bagheri et al., 2021).

The conceptual framework also provides insights into possible reasons *Why* recreational runners respond to PFP the ways in which they do. Interviews with participants in this study

suggest those reasons include previous experiences, extrinsic motivation, intrinsic motivation, and social influences. The quantitative research that has explored previous experiences among the PFP population suggests past injury and training experiences influence PFP development (e.g., Francis et al., 2019; Kunene et al., 2019; van der Worp et al., 2015). However, these findings were based on categorizing PFP patients by past injury type, injury location, and/or years of run experience without theorizing *Why* they influence the PFP experience. Among other quantitative PFP research, it has been stipulated that personal goals such as those that arise from extrinsic and intrinsic motivation are important factors that influence the PFP experience, but no research has investigated this topic (e.g., Bosshardt et al., 2021; Martinez-Cano et al., 2021). Previous qualitative psychosocial PFP research suggests PFP patients may be motivated by treatment expectations (Smith et al., 2019), perceptual meanings given to PFP (Robertson et al., 2017), and personally redefining life (Glaviano et al., 2022). These claims (Smith et al., 2019; Glaviano et al., 2022) are supported by qualitative research that suggests recreational running requires adopting and detaching from meaningful pursuits (Van Raalte et al., 2015). It could be that meaningful pursuits among participants in this research included pursuing and maintaining social relationships with other recreational runners, but this is speculative.

More explicitly, previous qualitative psychosocial PFP research (Johansen et al., 2022; Robertson et al., 2017) and the conceptual framework suggest friends and family socially influence the perceived psychosocial experiences of individuals with PFP. Supportively, previous quantitative intervention designs suggest exercise and medical professionals are social influences from whom recreational runners learn how to manage PFP (e.g., Hott et al., 2020; Winters et al., 2021). The reasons *Why* recreational runners respond to PFP the ways in which they do has also been partially supported in previous research (e.g., Francis et al., 2019; Glaviano

et al., 2022; Hott et al., 2020; Johansen et al., 2022; Kunene et al., 2019; Robertson et al., 2017; Smith et al., 2019; van der Worp et al., 2015; Winters et al., 2021).

The final category of the conceptual framework is *Psychosocial Outcomes.* Interviews with participants in this research suggest the *Psychosocial Outcomes* of relatedness and acceptance are integral to *Who* recreational runners are, *What* they experience when running with PFP, *How* they respond, and *Why* they respond the ways in which they do. Participants who stayed connected to others seemed to accept training limitations, modify their expectations, and experience their dominant psychosocial responses (i.e., uncertainty, worry, perceived pain) to a lesser extent compared to those who lacked acceptance. Thus far, no quantitative research has investigated the role of relatedness in PFP rehabilitation. This is somewhat surprising as research on the psychological aspects of sport injury has highlighted the importance of relatedness in the return to sport process (Galli et al., 2013; Podlog et al., 2010; 2015). Specifically, previous findings suggest relatedness directly and indirectly influences injured athletes' well-being (Galli et al., 2013; Podlog et al., 2010; 2015). There is previous qualitative PFP research that supports the relatedness claims of the conceptual framework (Glaviano, Holden, et al., 2022; Robertson et al., 2017; Smith, Moffatt et al., 2018). Interviews with PFP patients suggest the social aspect of running is both a stressor and motivator for PFP patients who typically feel like they are missing out due to their injury (Glaviano, Holden, et al., 2022; Robertson et al., 2017; Smith, Moffatt et al., 2018).

Acceptance has not been explored in previous psychosocial PFP research, but it has been speculated to be the reason why combining mindfulness with exercise, running, and load management training improves recreational runners' experiences with PFP (Bagheri et al., 2021). The acceptance claims of the conceptual framework are supported by previous qualitative

research that investigated long-distance runners' strategies for managing symptoms of injury and illness (Bargoria et al., 2020.) Specifically, a runner's' willingness to accept training and competition schedule adaptations was qualitatively determined to be essential for injury acceptance, management of training loads, and anxiety reduction (Bargoria et al., 2020.) It seems, relatedness and acceptance may be important to those who experience PFP (Bagheri et al., 2021; Glaviano, Holden, et al., 2022; Robertson et al., 2017; Smith, Moffatt et al., 2018), engage injury rehabilitation (Galli et al., 2013; Podlog et al., 2010; 2015), or recreationally run (Bargoria et al., 2020).

Overall, the conceptual framework developed in this research supports and extends the findings from previous qualitative psychosocial PFP research. It provides further insights into possible psychosocial constructs that influence the PFP experience and highlights the need to extend the examination of psychosocial variables previously explored in quantitative PFP research. The conceptual framework also confirms the critique that past quantitative psychosocial PFP research has been limited by focusing on select psychosocial constructs. It is the first of its kind to explain a previously unexplored interplay of broad and specific psychosocial constructs (i.e., categories and subcategories) that may be influential to the PFP experience.

It is interesting that participants' experiences particularly, those that led to the development of the *What* category, did not include fear-avoidance beliefs, pain catastrophizing, and kinesiophobia. The absence of these psychosocial factors, and the explicit focus on psychosocial PFP experience in this research may also explain the absence of patho-etiological factors known to influence the PFP experience. Previous research (albeit inconsistent) suggests fear-avoidance beliefs, kinesiophobia, and/or pain catastrophizing may influence patho-

etiological factors such as weak hip and knee muscle strength. (Barton et al., 2019; de Oliveira Silva et al., 2018; 2019; Greaves et al., 2021; Glaviano et al., 2019; Glaviano & Saliba, 2018; Hott, Brox, Pripp, Juel et al., 2019; Hott, Brox, Pripp, Juel & Liavaag 2019; Holden et al., 2021; Priore et al., 2019; Selhorst, Fernandez-Fernandez et al., 2020). Conceptually, the aforementioned findings suggest hip and knee muscle strength are psychosocial PFP outcomes that are influenced fear-avoidance beliefs, kinesiophobia, and/or pain catastrophizing; but these claims were not supported by this research.

The research did however, find behavioral responses (*How*) that could potentially interrelate with PFP outcomes like hip and knee muscle strength. For example, the recreational runners in this sample attempted to address the psychosocial constructs of uncertainty, worry, and perceived pain by modifying training. One of the ways in which they did that was cross-training, which included - but was not limited to - circuit and/or strength training (see Table 9). It is possible that recreational runners with PFP engage in circuit and/or strength training and invertedly address patho-etiological factors. It is also possible that the recreational runners in this researchers focused on the processes of modifying training (i.e. *How*) and/or preventing injury (i.e., *Why*), instead of focusing on addressing specific patho-etiological outcomes (e.g., hip or knee muscle strength)d specifically.

The limitations of this research are consistent with SGT (Corbin & Strauss, 2015) and foundational research (ED & NSF, 2013). Specifically, the prominent limitations of this research relate to participant sampling, inherit biases in research methodology, participant educational level, personal experiences of the researcher, and the type of research. Due to the sampling procedure used in this research, all participants ascribed to the sociocultural context of running. This is evidenced in the sampling from run specialty stores and run clubs It is also reflected in

sample demographics and the emergent subcategories: run-attitude, run-related emotions, relatedness, and social influences. The influence of sociocultural context of running has been recognized in previous qualitative research, as it has been suggested that recreational runners are drawn to one another, share advice, and train together (Simpson et al., 2014). Previous research on recreational running and mental health has also suggested that run attitude and run-related emotions influence a runner's behavior and health (Oswald et al., 2020; Pereira et al., 2021). Therefore, it was not surprising that run attitude and run-related emotions emerged as subcategories in this research.

Interviews are inherently subject to the language, memory, and honesty of participants as well as, the situations, events, and/or experiences that influence their lives (Corbin & Strauss, 2015). For example, all participants reported having a post-secondary education of a bachelor's degree or higher, which could have influenced the ways in which they described or interpreted their experiences with PFP (Corbin & Strauss, 2015). Likewise, the personal experiences the primary researcher has had as a recreational runner, licensed athletic trainer, and psychosocial PFP researcher likely acted as experiential evidence upon which the decisions and outcomes of this study were based. Practices of trustworthiness and reflexivity aimed to mitigate these influences to the greatest extent feasible (Corbin & Strauss, 2015).

Additionally, the conceptual framework developed in this research is in the knowledge inquiry stage of research and development (Welch Bacon et al., 2021). Given the specificity of the sample and the methodology used to conduct the foundational research of this study; transference of findings to other populations warrants caution (Corbin & Strauss, 2015; ED & NSF, 2013). The categories and subcategories of the conceptual framework might be useful or transferrable to non-running PFP populations but additional research is needed prior to making

such claims. For the conceptual framework to be transferable to other PFP subpopulations, the conceptual framework must be explored and further developed with samples of those subpopulations (ED & NSF, 2013). In the later stages of research and development, the conceptual framework may generalize to explain other overuse injuries (ED & NSF, 2013). The findings of this research suggest the conceptual framework may require adapting or expanding its overarching psychosocial categories (i.e., *Who*, *What*, *How*, *Why*, *Psychosocial Outcomes*) to include relevant subcategories for PFP and other overuse injury subpopulations.

Despite its limitations the foundational research of this study produced knowledge that future studies can build upon to advance science and clinical practice with regards to the psychosocial aspects of PFP. A key strength of this study was its use of valid and reliable PFP identification techniques (Crossley et al., 2016; Dey et al., 2016) with theoretically credible psychosocial sport injury techniques (Podlog & Eklund, 2009; Podlog et al., 2013; 2015; Salim et al., 2016) to accumulate unbiased psychosocial PFP data. That data led to developing a robust theoretical and empirical understanding of *how* psychosocial constructs may influence the PFP experience.

In conclusion, the conceptual framework fills a gap in PFP research by providing researchers an evidence-based conceptual framework that facilitates both construct and theoretical clarity. It is not yet known if psychosocial constructs like fear-avoidance beliefs, pain catastrophizing, kinesiophobia, or patho-etiological factor such as, hip and knee muscle strength are subcategories in the conceptual framework for other PFP populations. Future theoretical research should provide insight into this as well as any other potentially influential psychosocial constructs that were not present among the participants of this research. Next steps *toward* extending the generalizability of the conceptual framework is to critically evaluate the

applicability of existing theoretical models of psychological responses to sport injury in conceptualizing recreational runners' perceived psychosocial experiences with PFP (e.g., Brewer et al., 2002; Deci & Ryan, 1985; Richardson et al., 2008; Wadey et al., 2018; Wiese-Bjornstal et al., 1998).

Chapter V: Study Three

Recreational runners' perceived psychosocial experiences with patellofemoral pain: A critical comparison of theoretical explanations

Target Journal: Social Science and Medicine

5.1. Abstract

Introduction: Patellofemoral pain (PFP) is a specific type of patellar or retropatellar pain aggravated by at least one activity that loads the patellofemoral joint during weight bearing on a flexed knee such as squatting, walking, running, jumping, and/or ambulating stairs (Crossley et al., 2016). Previous quantitative and qualitative psychosocial PFP is limited and fails to provide a clear conceptual and theoretical understanding of how and why psychosocial constructs influence the psychosocial PFP experience. Recently, the Conceptual Framework for Psychosocial Experiences of Recreational Runners with Patellofemoral Pain (i.e., henceforth referred to as the PERR-PFP framework) was developed to provide a robust theoretical and empirical understanding of how psychosocial constructs may influence the PFP experience. To analyze and explain alternative explanations to the PERR-PFP framework; the purpose of this research was to critically evaluate the applicability of existing theoretical models of psychological responses to sport injury in conceptualizing recreational runners' perceived psychosocial experiences with PFP (Brewer et al., 2002; Deci & Ryan, 1985; Richardson et al., 2008; Wadey et al., 2018; Wiese-Bjornstal et al., 1998). **Method:** A Comparative Method (CM; Pennings et al., 2006) was used to individually compare five existing theoretical models of psychological responses to sport injury to the PERR-PFP framework. **Results:** Existing theoretical models of psychological responses to sport injury coherently explain PFP as an injury that happens to an individual within the confines of a particular perspective. Those perspectives

include the cognitive behavioral aspects of sport injury and rehabilitation; the sociocultural context of sport; and/or the language used in motivational psychology. Comparatively, the PERR-PFP framework uses simple language to concisely conceptualize PFP as an all-encompassing experience lived by the individual. **Discussion:** Existing theoretical models of psychological responses to sport injury are confined to particular perspectives when conceptualizing the perceived psychosocial experiences of recreational runners with PFP. However, the categories/subcategories of the PERR-PFP framework interrelate within an all-encompassing theoretical presence that can adapt, change, or extend based on the results future research.

5.2. Introduction

Patellofemoral pain (PFP) is a specific type of kneecap pain characterized by patellar or retropatellar pain that is aggravated by at least one activity that loads the patellofemoral joint during weight bearing on a flexed knee such as squatting, walking, running, jumping, and/or ambulating stairs (Crossley et al., 2016). The occurrence of PFP is high among physically active individuals for example, PFP is a common lower extremity injury among recreational runners (Crossley et al., 2019; Francis et al., 2019; Kakouris et al., 2021).

Findings of previous systematic reviews and meta-analyses that have explored the PFP prognosis suggest recreational runners with PFP may benefit from patient education, gait retraining, and personalized rehabilitative exercise programs that target core, hip, and/or knee strength (Davis et al., 2020; Lack et al., 2014; Manojlović et al., 2021; Na et al., 2021; Saltychev et al., 2018; Winters et al., 2021). Results of the studies within these reviews however, lack consistency and have often lacked statistical significance among the recreational running population (Bolgla et al., 2016; Hott et al., 2020; Khayambashi et al., 2014). It has been

suggested that inconsistencies among existing PFP research may be partly due to psychosocial constructs and as a consequence, researchers have started to explore influential associations between the PFP prognosis, pain catastrophizing, kinesiophobia, anxiety, and depression (Vicenzino et al., 2022).

Thus far, however previous research exploring relationships between the PFP prognosis, pain catastrophizing, kinesiophobia, anxiety, and depression have not been theoretically grounded (e.g., Bagheri et al., 2021; Barton et al., 2019; Hott et al., 2020; 2022; Esculier et al., 2017; 2018). Existing research has also lacked and/or used varied construct definitions for psychosocial variables, making synthetization of previous findings conceptually difficult. Lack of construct clarity has also hindered theoretical conceptualization of the psychosocial PFP experience. Consequently, existing research fails to provide a clear conceptual and theoretical understanding of *how* and *why* psychosocial constructs influence the psychosocial PFP experience. To address this gap, a Straussian Grounded Theory research design (Corbin & Strauss, 2015) was used to develop a conceptual framework that conceptualizes recreational runners' perceived psychosocial experiences with PFP. In this research, 10 (n = 4 females, n = 6 males; age range 20-45) participated in one-on-one interviews. Participants ran at least 15km per week and the presence of their PFP was determined by the SNAPPS (Dey et al., 2016), Core PFP Criteria (Crossley et al., 2016), and a virtual clinical examination following the recommendations of Crossley et al. (2016).

The Conceptual Framework for Psychosocial Experiences of Recreational Runners with Patellofemoral Pain (henceforth referred to as the PERR-PFP framework) suggests recreational runners are individuals *Who* have prominent personal characteristics that influence their perceived psychosocial experiences of recreational running with PFP. The PERR-PFP

framework also suggests that dominant psychosocial responses are *What* recreational runners experience when running with PFP. Those experiences interrelate with *How* recreational runners address the perceived cause of their psychosocial responses, and the reasons *Why* they respond the ways in which they do. Each category was described with pertinent connections to *Psychosocial Outcomes*. Theoretically, *Who* recreational runners are, *What* they experience when recreational running with PFP, *How* they respond, *Why* they respond the ways in which they do, and their *Psychosocial Outcomes* combine to create a set of interrelated overarching psychosocial constructs. The overarching categories contain a vast amount of subconstructs that may interrelate with the perceived psychosocial experiences of recreational runners with PFP (see Table 18). Findings suggest the interrelationships among the constructs within the PERR-PFP framework are unique for each individual.

The PERR-PFP framework has several strengths. For example, it provides a robust theoretical and empirical understanding of *how* psychosocial constructs may influence the PFP experience. The construct clarity and psychosocial relationships described within the PERR-PFP framework suggest previous quantitative psychosocial PFP research (e.g., Holden et al., 2021; Hott et al., 2022; Maclachlan et al., 2020) has been limited by focusing only on select psychosocial constructs. The PERR-PFP framework extends previous qualitative psychosocial PFP research by explaining a previously unexplored interplay of broad and specific psychosocial constructs that influence the PFP experience. Still, it is unknown *if* and *how* the PERR-PFP framework critically differs from existing theoretical models of psychological responses to sport injury in explaining recreational runners' perceived psychosocial experiences with PFP. Indeed, grounded theory researchers have previously suggested that comparing the results of grounded

theory research to relevant literature and other perspectives provides an opportunity to support, challenge, or extend the ideas that lead fields of research (Charmaz & Thornberg, 2020).

The most prominent existing theoretical models of psychological responses to sport injury that can be used to explain recreational runners' perceived psychosocial experiences with PFP include Self-Determination Theory (henceforth referred to as SDT; Deci & Ryan, 1985); the Integrated Model of Psychological Response to the Sport Injury and Rehabilitation Process (henceforth referred to as the Integrated Model; Wiese-Bjornstal et al., 1998); the Biopsychosocial Model of Sport Injury Rehabilitation (henceforth referred to as the Biopsychosocial Model; Brewer et al., 2002); the Overtraining Risks and Outcomes Model (henceforth referred to as the OT Risks and Outcomes Model; Richardson et al., 2008); and the Multilevel Model of Sport Injury (henceforth referred to as the MMSI; Wadey et al., 2018). Although each of the aforementioned models have been empirically supported by acute sport injury research (e.g., Blevins et al., 2020; Booth et al., 2018; Brewer et al., 2017; Podlog et al., 2015; Salim & Wadey, 2021), none of the models have been specifically developed (or tested) to explain recreational runners' perceived psychosocial experiences with PFP.

With the PERR-PFP framework having limited empirical support, the purpose of this research was to critically evaluate the applicability of existing theoretical models of psychological responses to sport injury in conceptualizing recreational runners' perceived psychosocial experiences with PFP (Brewer et al., 2002; Deci & Ryan, 1985; Ildefonso et al., 2023; Richardson et al., 2008; Wadey et al., 2018; Wiese-Bjornstal et al., 1998). More specifically, this research aimed to answer the following research question: How do existing theoretical models of psychological responses to sport injury compare to the PERR-PFP framework in explaining recreational runners' perceived psychosocial experiences with PFP?

5.3. Method

5.3.1. Design

A comparative method research design (Pennings et al., 2006) was used to critically evaluate the applicability of existing theoretical models of psychological responses to sport injury in conceptualizing recreational runners' perceived psychosocial experiences with PFP. Specifically, five existing theoretical models of psychological responses to sport injury were compared to the PERR-PFP framework (e.g., Brewer et al., 2002; Deci & Ryan, 1985; Richardson et al., 2008; Wadey et al., 2018; Wiese-Bjornstal et al., 1998).

5.3.2. Data

Data for this study included the PERR-PFP framework (Ildefonso et al., 2023); SDT (Deci & Ryan, 1985); Integrated Model (Wiese-Bjornstal et al., 1998); the Biopsychosocial Model (Brewer et al., 2002); the OT Risks and Outcomes Model (Richardson et al., 2008); and the MMSI (Wadey et al., 2018).

5.3.3 Analysis

Shank (2006) suggested the applicability of theoretical models can be determined by comparing one model's coherence to that of another model. In this research, the theoretical coherence of SDT (Deci & Ryan, 1985); the Integrated Model (Wiese-Bjornstal et al., 1998); the Biopsychosocial Model (Brewer et al., 2002); the OT Risks and Outcomes Model (Richardson et al., 2008); and the MMSI (Wadey et al., 2018) were individually compared to the PERR-PFP framework developed in Study 2. As discussed in chapter III, coherence refers to the applicability of a theoretical model to coherently provide a distinct, logical, and concise explanation of a phenomenon, apart from all existing interpretations (Braun & Clarke, 2006). Following the recommendations of Shank (2006) the theoretical coherence of each comparative

case was evaluated by (a) examining each model's ingredients and (b) determining each model's presence.

5.3.3.1. Examining Ingredients

Examining ingredients is a bottom-up approach to understanding a theory by explaining a theoretical model as a holistic manifestation of its smaller elements (Shank, 2006). For example, athletes' psychosocial responses to athletic injury were originally thought to follow the chronological stages of grief (i.e., large components) typically associated with psychosocial responses to death and dying (Kübler-Ross, 1969). This has since been refuted, as existing theoretical models of psychosocial responses to injury have been found to include a range of smaller elements that can be categorized as cognitions, affect, behaviors (e.g., Brewer et al., 2002; Wadey et al., 2018; Wiese-Bjornstal et al., 1998).

5.3.3.2. Determining Presence

Determining presence is a top-down approach used to determine a model's uniqueness by identifying the freedom that exists within the model to adapt, change, integrate, and/or expand to provide explanations of a topic over time (Shank, 2006). The extent of a model's presence or freedom is confined to its systematic set of concepts as well as, the language used to explain it. Existing theoretical models systematize the influences thoughts, emotions, and behaviors (Deci & Ryan, 1985; Wiese-Bjornstal et al., 1998); biological factors (Brewer et al., 2002); and wider sociocultural factors (Deci & Ryan, 1985; Richardson et al., 2008; Wadey et al., 2018) have on the sport injury process. However, the freedom, confines, and language that permit these models to explain runners' psychosocial responses to PFP is yet to be reported.

5.3.4. Trustworthiness and Credibility

Trustworthiness and credibility practices of this research included seeking alternatives and devil's advocating. To *seek alternatives,* alternative explanations and interpretations of the data were sought by engaging in a critical discussion with a leading psychology of sport injury researcher after the primary researcher developed each comparative case (Podlog et al., 2015). For *devil's advocating* the leading psychology of sport injury researcher challenged claims based on their own research, academic, and applied sport psychology experiences.

5.3.5. Reflexivity

Three reflexive practices were used in this research including critical dialogue, reflexive memos, and research journaling. For *critical dialogue,* a leading psychology of sport injury researcher assisted in critically reflecting on possible data interpretations to ensure previously explored psychosocial aspects of PFP were explored and addressed (Podlog et al., 2015). *Reflexive memos* were composed to monitor thoughts, feelings, and behaviors throughout data collection and analysis (Corbin & Strauss, 2015). Thereafter, *research journaling* was conducted after having time to reflect on all aspects of research.

5.4. Results

5.4.1. Comparative Case One: SDT

A few concepts *explicitly* exist in both the PERR-PFP framework and SDT. Both suggest social contexts, extrinsic motivation, intrinsic motivation, and perceived relatedness influence the behaviors of recreational runners with PFP. Comparatively, SDT suggests these concepts influence their sense of self, self-determination, health, and well-being. There is also *implicit* conceptual similarities within both conceptualizations. *Who* recreational runners are suggests their run attitude and run-related emotions developed from having internalized external aspects of the recreational runner status quo (e.g., "Its who I am" or "It's what I do"). *Who* recreational

runners are also reflects their sense of self, which influences and is influenced by *How* they respond to *What* they experience. Specifically, they engage in *autonomous* training, physical, and psychological responses to address uncertainty, worry, and perceived pain. By accepting that they need to adjust training expectations and meet new goals to minimize pain; recreational runners develop, achieve, and maintain a new sense of running *competence*. The ingredients of the PERR-PFP framework are therefore explicitly and implicitly supported by SDT but the PERR-PFP has a wider presence.

5.4.2. Comparative Case Two: The Integrated Model

Several concepts *explicitly* exist in both the PERR-PFP framework and the Integrated Model. Both include the personal characteristics of recreational running, PFP, perceived cause of injury, injury severity, physical health status, self-motivation, motivation orientation, and previous experiences. Emotional responses in both models include feelings of frustration and emotional coping by way of maintaining a positive outlook. Behavioral responses in both models include behavioral coping by reducing training effort and intensity. The social influences of teammates and sports medicine professionals are also present in both models. Comparatively, the Integrated Model suggests personal factors, emotional responses, and behavioral responses influence a recreational runners' psychological response to PFP and in turn, their physical and psychosocial recovery outcomes. The Integrated Model does not however, provide examples of explicit outcomes that result from interactions among personal factors, emotional responses, and behavioral responses.

There are also *implicit* similarities in the PERR-PFP framework and the Integrated Model. *What* recreational runners with PFP experience in the PERR-PFP framework are classified under cognitive appraisals (i.e., uncertainty, worry, and perceived pain) in the

Integrated Model. The integrated model recognizes relationships between cognitive appraisals and personal, situational, and pre-injury factors, which in the PERR-PFP framework is implied in the interconnectedness between *Who*/*Why* categories. Recreational runners with PFP respond to these cognitive appraisals with strategies outlined in the *How* category (e.g.., adjusting training, cross-training, bracing, taking medication, and/or seeking help). These strategies are all behaviorally mediated, and thus behavioral responses in the Integrated Model. The PERR-PFP framework then suggests that runners' history of stressors, personal factors, and emotional responses drive them to maintain a positive attitude despite experiencing PFP and having to adjust training. Theoretically, this refers to *Who/Why* influencing *What,* and *How* influencing *Who* again. Similarly, the Integrated Model suggests pre-injury factors, personal factors influence cognitive appraisals, which influence behavioral responses and in turn, emotional responses that subsequently influence cognitive appraisals again. In both models this process seems to influence and be influenced by psychosocial outcomes; but only the PERR-PFP framework suggests those outcomes include perceptions of relatedness and acceptance. Both of these constructs are however, types of cognitive appraisals, suggesting that the Integrated Model explicitly and implicitly supports both the ingredients and the presence of the PERR-PFP framework.

5.4.3. Comparative Case Three: The Biopsychosocial Model

The concepts that *explicitly* exist in the PERR-PFP framework and the Biopsychosocial Model include injury characteristics of PFP, injury severity, and injury history. Psychological factors pertaining to affect; and social/contextual factors including social network, life stress, and situational characteristics; are also present in both models. Comparatively the Biopsychosocial Model suggests these concepts, along with biological factors, influence bidirectional

relationships that exist among intermediate biopsychosocial outcomes (e.g., strength, pain) and sport injury rehabilitation outcomes (e.g., readiness to return to sport).

There are robust *implicit* similarities among these models as well. The PERR-PFP framework suggests recreational runners are individuals *Who* have a run by any means necessary attitude and an emotional attachment to running. The same can be similarly explained by combinations of psychological factors (i.e., personality, cognitions, affect, and behavior) within the Biopsychosocial Model. Similarities suggest that psychological factors in the Biopsychosocial Model account for aspects of *Who, What,* and *How* in the PERR-PFP framework. Likewise, injury characteristics from the Biopsychosocial Model reflect *Who* and *Why* from the PERR-PFP framework. The same can be said for social contextual factors in the Biopsychosocial Model representing combinations of *How* and *Why* in the PERR-PFP framework. Both, the PERR-PFP framework and the Biopsychosocial Model suggest run groups, teammates, sports medicine professionals, social contextual norms, and injury characteristics; influence the *Who, What, How*, and *Why* of recreational running with PFP. Theoretically, relatedness and acceptance would be sport injury rehabilitation outcomes in the Biopsychosocial Model but this is speculative. In its entirety, most but not all concepts within the Biopsychosocial Model are also in the PERR-PFP framework. The Biopsychosocial Model therefore, supports the ingredients and presence of the PERR-PFP framework.

5.4.4. Comparative Case Four: The OT Risks and Outcomes Model

The concepts that *explicitly* exist in PERR-PFP framework and the OT Risks and Outcomes Model include sport culture, norms, competitions, major events, non-sport events, family, psychological distress, attitudes, behavioral responses, adjusting training load, and outcomes. Comparatively, the OT Risks and Outcomes Model suggests these concepts influence

and/or are influenced by (a) the sociocultural context of recreational running that creates OT risk factors; (b) stress-recovery imbalances among recreational runners that create early signs of OT; (c) the ways in which recreational runners behaviorally respond to signs of OT; and (d) the outcomes that subsequently result from said behavioral responses. This is conceptually similar to *Why* influencing *What* then *How* and subsequently *Psychosocial Outcomes* in the PERR-PFP framework. Both, the PERR-PFP framework and the OT Risks and Outcomes Model suggest that *some* recreational runners respond to PFP by engaging in adaptive behavioral responses that increase recovery, decrease stress, and/or adjust training loads to return to stress/recovery balance. In the OT Risks and Outcomes Model however, these assumptions do not account for *Who* recreational runners are.

Implicitly, Who recreational runners are in the PERR-PFP framework could be a sociocultural OT risk factor. However, the run attitude and run-related emotions subcategories of the PERR-PFP framework are conceptually different from the intrapersonal variables of "super-motivation" and "pushing through injury" in the OT Risks and Outcomes Model. Super-motivation refers to a combination of perfectionism and unrealistic goals. This definition conflicts with *Who* recreational runners are and *Why* they respond to PFP the ways in which they do in the PERR-PFP framework. Furthermore, the PERR-PFP framework suggests recreational runners with PFP adjust their training to reduce pain and increase their ability to run on race day. In its entirety, the OT Risks and Outcomes Model provides some conceptual support for the PERR-PFP framework. However, the overarching assumptions of the OT Risks and Outcomes Model predominantly conflict with the overarching assumptions of PERR-PFP framework. This means that the OT Risks and Outcomes Model supports the ingredients and presence of the

PERR-PFP framework but conflicts with how the two conceptualize to explain the perceived psychosocial experiences of recreational runners with PFP.

5.4.5. Comparative Case Five: The MMSI

The concepts that *explicitly* exist in the PERR-PFP framework and the MMSI include cognitions, affect, behaviors, values, beliefs, attitudes, social networks, support systems, and culture. Comparatively, the MMSI suggests the cognitions, affect, behaviors, values, beliefs, and attitudes of recreational runners with PFP are nestled within systems of interpersonal, institutional, cultural, and policy influences. Conceptually, both the MMSI and the PERR-PFP framework suggest *Who* recreational runners are; *What* they experience when running with PFP; *How* they respond, *Why* they respond the ways in which they do, and the *Psychosocial Outcomes* they experience, are all simultaneously influenced by sociocultural factors. The PERR-PFP framework goes on to suggest that the interconnections between its *Who*, *What*, *How*, *Why*, *Psychosocial Outcomes* categories are individually unique at any point in time. Theoretically, the MMSI suggests that all sociocultural factors influence recreational runners with PFP at all times but the power of said influences as well as their social proximity to the recreational runner with PFP, constantly vary.

Implicit similarities between the PERR-PFP framework and the MMSI are limited, this is likely a result of the nestled aspects of social influences differing within each model. Theoretically, the PERR-PFP framework conceptualizes the cognitions, affect, behaviors, values, beliefs, and attitudes of the MMSI; but from the experiential perspective of the recreational runner. Social influences are explicitly a subcategory of *Why* recreational runners respond to PFP the ways in which they. However, the PERR-PFP framework *implicitly* acknowledges the wide array of diversity that social influences can have on the perceived psychosocial experiences of

recreational runners with PFP. This is conceptualized in the PERR-PFP framework via relations among the *Psychosocial Outcomes* recreational runners experience, *How* they respond to their PFP, and the reasons *Why* they respond the ways in which they do. The MMSI may oversimplify the perceived psychosocial experiences of recreational runners with PFP. However, there is no doubt that the MMSI fully supports the claims of the PERR-PFP framework. This means that the ingredients and presence of the PERR-PFP framework are supported by the MMSI but the two conceptualize them from different perspectives and have conflicting assumptions.

5.4.6. Synthesis of Results

5.4.6.1. Theoretical Ingredients

Each model uses a manifestation of smaller social contextual, psychological, and/or biological elements to explain recreational runners' perceived psychosocial experiences with PFP. The PERR-PFP framework, the Integrated Model, the Biopsychosocial, and the OT Risks and Outcomes Model suggest that the influences of said elements manifest from both, past and present experiences. The number, power, directionality, and sequential influence of the smaller elements within each model varies. Comparatively, the PERR-PFP framework, SDT and the MMSI use fewer smaller elements, and provide simpler explanations to the power, directionality, and sequential influence of those elements. For example, perceived relatedness is extremely powerful in the PERR-PFP framework and SDT. In SDT, relatedness goes on to directionally and sequentially motivate individuals to engage in self-determined behaviors. In the PERR-PFP framework, relatedness interconnects with *Who* recreational runners are, *What* they experience, *How* they respond, *Why* they respond the ways they do, and their *acceptance* of the training accommodations necessary to minimize discomfort. Theoretically, PFP is considered a smaller element referred to as an *injury type* in the Integrated Model and Biopsychosocial Model. It is

convolutedly represented as an *injury status*, *minor injury*, and *mild to moderate injury* in the OT Risks and Outcomes Model. However, both injury and PFP completely lack representation in SDT and the MMSI.

5.4.6.2. Theoretical Presence

The PERR-PFP framework uniquely conceptualizes PFP as an all-encompassing experience opposed to a smaller element within the theory. Unlike the other models it systematizes elements to explain the psychosocial experiences of recreational runners with PFP. For example, the Integrated Model and Biopsychosocial Model systematize bio/psychological responses to *any* sport-related injury and their influence on the rehabilitation process. The PERR-PFP framework suggests injury and rehabilitation are but two potential aspects of recreational runners' perceived psychosocial experiences with PFP. This all-encompassing conceptual systematization empowers the PERR-PFP framework to uniquely differentiate itself from the other models; particularly in terms of its freedom to adapt, change, integrate, and expand over time. Each model has a potential to integrate and/or expand by incorporating more concepts overtime. However, the Integrated Model and the Biopsychosocial Model will always be confined to the cognitive behavioral aspects of sport injury and rehabilitation; the OT Risks and Outcomes Model and the MMSI to the sociocultural context of sport; and SDT to its own language in motivational psychology (e.g., *competence*, *autonomy*, *acceptance*, *regulation, self-determination*). With their respective confinements, each model's adaptability and/or changeability would theoretically be limited at some point in time. The simple language used to encapsulate the perceived psychosocial experiences of recreational runners with PFP, prevents this from occurring with the PERR-PFP framework.

5.5. Discussion

The purpose of this research was to critically evaluate the applicability of existing theoretical models of psychological responses to sport injury in conceptualizing recreational runners' perceived psychosocial experiences with PFP (Brewer et al., 2002; Deci & Ryan, 1985; Ildefonso et al., 2023; Richardson et al., 2008; Wadey et al., 2018; Wiese-Bjornstal et al., 1998). Results of this research suggest smaller social contextual, psychological, and biological elements create a set of biopsychosocial components from which the perceived psychosocial experiences of recreational runners' with PFP can be theoretically conceptualized and logically explained. Findings of this study suggest that existing theoretical models of psychological responses to sport injury provide coherent conceptualizations of recreational runners' perceived psychosocial experiences with PFP but respectively differ. Differences seem to be largely due to their theoretical presence (Brewer et al., 2002; Deci & Ryan, 1985; Ildefonso et al., 2023; Richardson et al., 2008; Wadey et al., 2018; Wiese-Bjornstal et al., 1998). The PERR-PFP framework however, dons an all-encompassing theoretical presence and concisely conceptualizes the perceived psychosocial experiences of recreational runners with PFP using simple language. In its entirety, the PERR-PFP framework summarizes the perceived psychosocial experiences recreational of runners with PFP using five simple overarching categories (i.e., *Who, What, How, Why, Psychosocial Outcomes*) that succinctly organize their respective subcategories.

There are a tremendous number of smaller social contextual, psychological, and biological elements among existing theoretical models of psychological responses to sport injury. The PERR-PFP framework parsimoniously identifies those needed to explain the perceived psychosocial experiences of recreational runners' with PFP and streamlines their theoretical conceptualization. Comparisons in this research revealed that apart from the PERR-PFP framework, the ingredients and presence of existing theoretical models of psychological

responses to sport injury can conceptualize some but not all aspects of recreational runners' perceived psychosocial experiences with PFP. If the PERR-PFP framework were not to exist, navigating the other models in ways that truly conceptualize recreational runners perceived psychosocial experiences with PFP would be extremely difficult. The claims of the PERR-PFP framework therefore support, extend, and are supported by, those of existing theoretical models of psychological responses to sport injury.

The limitations of this qualitative study align with SGT (Corbin & Strauss, 2015) and the CM (Shank, 2006). The personal experiences of the researcher inherently influence SGT research, even if the researcher engages in trustworthiness and reflexivity to manage said influence (Corbin & Strauss, 2015). The knowledge gained from the CM does not directly improve the transferability or generalizability of the PERR-PFP framework to non-running or other over use injury populations. The results of this research suggest that in comparison to existing models of psychological responses to sport injury; the PERR-PFP framework is more applicable in explaining the perceived psychosocial experiences of recreational runners with PFP. Future psychosocial PFP research should adopt the PERR-PFP framework to provide additional evidence for its coherence. Future psychosocial PFP studies may also use the PERR-PFP framework to assist in developing research designs.

Despite its limitations, this study identified implicit and explicit similarities and differences among existing theoretical models of psychological responses to sport injury in conceptualizing recreational runners' perceived psychosocial experiences with PFP. In so doing, this study developed robust theoretical support for the PERR-PFP framework. The research that will be conducted because of this study's findings will assist in the accumulation of evidence

necessary to make the PERR-PFP framework transferable to non-runners and generalizable to other overuse injury populations.

Chapter VI: Discussion

6.1. Research Findings

The purpose of this dissertation was to explore the perceived psychosocial experiences of recreational runners with PFP. Studies one and two aimed to document recreational runners' perceived psychosocial experiences with PFP and develop a theoretical model that conceptualizes recreational runners' perceived psychosocial experiences with PFP. Study three critically evaluated the applicability of existing theoretical models of psychological responses to sport injury in conceptualizing recreational runners' perceived psychosocial experiences with PFP.

Utilizing a SGT (Corbin & Strauss, 2015) design, study one revealed that recreational runners' perceived psychosocial experiences with PFP include a run attitude, run-related emotions, uncertainty, worry, perceived pain, training responses, physical responses, psychological responses, previous experiences, extrinsic motivation, intrinsic motivation, social influences, relatedness, and acceptance. By extending the SGT design of study one, study two conceptualized the perceived psychosocial experiences of recreational runners with PFP to develop the PERR-PFP framework.

The PERR-PFP framework conceptualizes recreational runners' perceived psychosocial experiences with PFP via five simple overarching categories: *Who*, *What*, *How*, *Why*, and *Psychosocial Outcomes*. The *Who* category captures prominent personal characteristics that influence perceived psychosocial experiences of recreational running with PFP. The *What* category captures the runner's subsequent psychosocial responses to PFP. The *How* category captures the myriad of ways in which the recreational runners respond to the perceived cause of their psychosocial responses. The *Why* category captures the reasons for the *How*. The *Who*,

What, *How*, and *Why* categories. Each category was described with pertinent connections to *Psychosocial Outcomes*.

Utilizing a comparative method research design (Pennings et al., 2006), study three individually compared five existing theoretical models of psychological responses to sport injury to the PERR-PFP framework (Brewer et al., 2002; Deci & Ryan, 1985; Richardson et al., 2008; Wadey et al., 2018; Wiese-Bjornstal et al., 1998). Study three revealed that several smaller social contextual, psychological, and biological elements are explicitly and implicitly captured across existing theoretical models of psychological responses to sport injury *and* the PERR-PFP framework. Findings of study three suggest each model confines these elements to a particular perspective and from said perspective, provides a coherent conceptualization of recreational runners' perceived psychosocial experiences with PFP.

However, existing theoretical models of psychological responses to sport injury either conceptualize *injury* (e.g., PFP) as a smaller element or do not conceptualize the term at all. In so doing, existing theoretical models of psychological responses to sport injury provide isolated explanations of the PFP experience from the motivational (Deci & Ryan, 1985), cognitive behavioral (Wiese-Bjornstal et al., 1998), biopsychosocial (Brewer et al., 2002), and/or sociocultural (Richardson et al., 2008; Wadey et al., 2018) perspectives. Isolated explanations fail to capture the simultaneous, all-encompassing, and ever-changing perspective of the recreational runner; limiting what could be known about the perceived psychosocial experiences of recreational runners with PFP.

Comparatively, study three revealed that the PERR-PFP framework conceptualizes PFP as a simultaneous, all-encompassing, and ever-changing experience. Rather than identifying PFP within its framework, the PERR-PFP framework encapsulates the PFP experience as its

conceptual framework. In other words, in the PERR-PFP framework PFP is considered a part of the individual. This deviates from existing theoretical models of psychological responses to sport injury, where an injury (such as PFP), is something that happens to the individual. This inherit difference provides the PERR-PFP framework a unique perspective that presents, describes, and navigates the psychosocial experiences of recreational runners with PFP beyond existing models. As a result, the PERR-PFP framework identifies and explains the psychosocial constructs that may be pertinent to the PFP experience with a level of clarity that is not possible when examined through existing theoretical models of psychological responses to sport injury.

6.2. Theoretical Contributions

By simply labeling PFP as an injury type, the theoretical presence of existing models of psychological responses to sport injury inherently restrict understanding the PFP experience to the confines of motivational (Deci & Ryan, 1985), cognitive-behavioral (Wiese-Bjornstal et al., 1998), biopsychosocial (Brewer et al., 2002), and/or sociocultural (Richardson et al., 2008; Wadey et al., 2018) perspectives. The PERR-PFP framework contributes to sport injury psychology literature by establishing an all-encompassing theoretical presence that inaugurally conceptualizes the psychosocial constructs that may be pertinent to the PFP experience. In so doing, this research revealed and explained a previously unexplored interplay of broad and specific psychosocial constructs (i.e., categories and subcategories) that may interconnect to shape the perceived psychosocial experiences of recreational runners with PFP.

For example, theoretically the sociocultural context of sport creates an environment that presumably facilitates overtraining among endurance athletes like recreational runners (Richardson et al., 2008). The OT Risks and Outcomes Model assumes recreational runners predominantly ignore early signs of overtraining oppose to engaging in attempts to address them.

Shedding new light on this assumption the PERR-PFP framework suggests that recreational runners predominately engage in attempts to address early signs of PFP oppose to ignoring them. Furthermore, the PERR-PFP framework suggests the theoretical presence that accompanies the overtraining perspective does not take into consideration *Who* recreational runners are or *How* they typically respond to experiencing PFP. Despite their sociocultural environment, a recreational runner's run by any means necessary attitude seems to facilitate their willingness to cross-train, decrease training, and increase stretching so that they can decrease their pain and increase their ability to run despite experiencing PFP. This example shows how the theoretical presence of existing models (e.g., the OT Risks and Outcomes Model) may hinder understanding the perceived psychosocial experiences of recreational runners with PFP. On the contrary, the same example suggests that the all-encompassing theoretical presence of the PERR-PFP framework provides a theoretical clarity that did not exist prior to this research.

Unlike existing theoretical models of psychological responses to sport injury, the clarity of the PERR-PFP framework allows it to act as a conceptual and foundational psychosocial PFP framework for future research to build upon. If/when future researchers explore and identify population specific subcategories that exist with respect to the model's overarching: *Who, What, How*, *Why*, and *Psychosocial Outcomes*; the conceptual framework will adapt to explain and incorporate said findings without infringing on its construct or theoretical clarity. For example, pain self-efficacy may turn out to be a subcategory of *Who*; anxiety a subcategory of *What*, coping strategies - subcategories of *How*; and kinesiophobia a subcategory of *Why* for some PFP populations but these presumptions are speculative. The PERR-PFP framework's ability to adapt over time may be its greatest contribution to the current state of psychosocial PFP literature. All theoretical models in study 3 were found to have the ability to modify, adapt, or integrate

overtime. However, only the presence of the PERR-PFP framework seemed to account for potential for differences that may emerge from the all-encompassing experiential perspectives of those with PFP.

6.3. Recommendations for Psychosocial PFP Researchers

This dissertation research aligns with the definition and purpose of foundational research (see Table 2). Outcomes of foundational research include advances in theory, methodology, and/or understandings of important constructs that have the potential to serve as a basis for future studies (ED & NSF, 2013). Specifically, this dissertation provided fundamental knowledge in the developing of theory to inform future psychosocial PFP research and development. By using a multi-methodological qualitative approach (Corbin & Strauss, 2015; Pennings et al., 2006), this dissertation advanced psychosocial PFP theory and methodology. The understanding of important psychosocial constructs that influence the PFP experience were advanced by defining and conceptualizing the categories and subcategories of the PERR-PFP framework.

Unlike existing psychosocial PFP research, the SGT methodology applied in studies one and two uncovered and explained meanings and conditions that may be pertinent to the perceived psychosocial experiences of recreational runners with PFP. The critique was confirmed that past quantitative research has been limited by focusing on select psychosocial constructs (e.g., Glaviano et al., 2019; Greaves et al., 2021; Hott et al., 2022; Maclachlan et al., 2019; 2020; Mansfield & Selhorst, 2018; Priore et al., 2019). Theoretically, the PERR-PFP framework extends the findings of previous qualitative psychosocial PFP research that may have lacked the framework necessary to optimize interpretation of results (e.g., Barbar et al., 2022; Glaviano, Holden et al., 2022; Johansen et al., 2022; Manojlović et al., 2022; Robertson et al., 2017; Smith, Moffatt et al., 2018; Smith et al., 2019).

Next steps in psychosocial PFP research should be to conduct early-stage and exploratory research (see Table 2) on the PERR-PFP framework (ED & NSF, 2013). Early-stage or exploratory research advances knowledge in a way that affords the *establishment* of potential conceptual and theoretical connections between constructs and outcomes. Those connections can be explored qualitatively or quantitatively. For example, a study using an inductive-deductive thematic analysis (Braun & Clarke, 2006) would allow for investigating the PERR-PFP framework's categories and subcategories while accounting for the possible presence of previously investigated psychosocial constructs (e.g., pain self-efficacy, anxiety, coping strategies, and kinesiophobia). Depending on what psychosocial constructs are found in future research, additional subcategories may need to added to the overarching categories of the PERR-PFP framework.

Following early-stage research, quantitative exploratory research can be conducted to explore possible associations among the adapted, refined, and/or confirmed categories and subcategories of the PERR-PFP framework. Results may need to be replicated with different PFP subpopulations. By determining the applicability of the PERR-PFP framework in conceptualizing the perceived psychosocial experiences of other PFP populations, psychosocial PFP researchers can explore if population specific modifications and/or adaptations are necessary.

When research findings with statistical associations support the PERR-PFP framework, research should advance to design and development research (see Table 2). Design and development research facilitates implementing theoretically based research designs to pilot test specific interventions among particular subpopulations (ED & NSF, 2013). Statically significant causal inferences from multiple studies can be used to identify possible entry points for the

development and implementation of interventions that are theoretically based on the PERR-PFP framework (ED & NSF, 2013). For example, previous research (e.g., Bosshardt et al., 2021; Esculier et al., 2018; Hott et al., 2020; Winters et al., 2021) and the PERR-PFP framework has suggested that medical professionals are social influences (i.e., *Why*) that use patient education interventions to help recreational runners manage PFP (i.e., *How*) and decrease pain (i.e., *What*). While promising, further design and development research is needed determine how the assumptions of the PERR-PFP framework can be assessed through theoretically based intervention research designs.

Following pilot testing, efficacy research should be conducted to help determine if piloted interventions support the PERR-PFP framework among PFP subpopulations (ED & NSF, 2013). Efficacy research will also improve or replicate outcomes under ideal or altered conditions (ED & NSF, 2013). This should be followed by research on effectiveness to estimate the impact of implementing interventions in typical applied practice setting (ED & NSF, 2013). Thereafter, scale-up research can be conducted to generalize findings to the general population (ED & NSF, 2013). Scale-up research provides evidence to draw conclusions about intervention implementation in the broadest of routine environments (ED & NSF, 2013). Considering the psychosocial aspects of PFP, scale-up research may include medical clinics, individuals diagnosed with PFP by a physician, or individuals who may have PFP but have not sought the help of a medical professional.

6.4. Recommendations for Sports Medicine Professionals

Sports medicine professionals (SMPs) refer to medical professionals who may be involved in the care of an injured athlete including but not limited to athletic trainers, chiropractors, occupational therapists, physical therapists, physicians, physiotherapists,

rehabilitators, sports therapists, and surgeons. As foundational research the knowledge gained from this dissertation should not directly influence applied practice guidelines (ED & NSF, 2013). However, the stages of the KCP (figure 6) suggest that the knowledge gained from original research will lead to laboratory-based research, systematic reviews, meta-analyses, critical appraisals, appropriate use criteria, and clinical practice guidelines for SMPs (Welch Bacon et al., 2021). After the PERR-PFP framework accumulates research evidence that is synthesized and critically appraised, it can be applied to appropriate use criteria and clinical practice guidelines for SMPs (Welch Bacon et al., 2021). At this stage in the KCP, findings of this dissertation suggest the PERR-PFP framework may benefit guidelines pertaining subjectively obtaining information from recreational runners with PFP.

However, this research can provide practicing SMPs a loose framework for asking intake questions from PFP patients in a purposeful way. By accounting for the *Who, What, How,* and *Why* aspects of the PERR-PFP framework during subjective interactions with recreational runners who have PFP; practicing SMPs could begin to apply a theory into practice (Kim, 2012). Specifically, those working with this patient population may benefit from asking questions about *Who* the individual is; *What* they have experienced when recreational running with PFP; *How* they have responded to those experiences; and the reasons *Why* they have responded the ways in which they have. The findings of study two and thus, the PERR-PFP framework suggest the answers to these questions provide insight into (a) personal characteristics that influence recreational running with PFP, (b) prominent complaints about recreational running with PFP, (c) attempts to behaviorally and/or emotionally address those complaints, and (d) the previous experiences, motivation, and social influences related to those attempts.

6.5. Recommendations for Sport Psychology Professionals

Sport psychology professionals (SPPs) refer to professionals trained to attend to the psychosocial needs of athletes with injuries including mental performance consultants, licensed mental health professionals, and licensed sport psychology professionals. As previously stated in section 6.4., the knowledge gained from foundational research should not directly influence applied practice (ED & NSF, 2013). The findings of study two suggest that as the evidence in support of the PERR-PFP framework accumulates, practicing SPPs may benefit from understanding the framework's *Who, What, How, Why*, and *Psychosocial Outcomes* categories.

It is in the scope of practice for trained SPPs to assist recreational runners with the psychosocial aspects of sport performance and in some cases, sport injury. As such, SPPs would be ideally positioned to help recreational runners with PFP in identifying and *psychosocially* optimizing *Who* they perceive themselves to be; *What* they experience when recreational running with PFP; *How* they respond to those experiences; and the reasons *Why* they respond the ways in which they do. The PERR-PFP framework suggests that if SPPs assist this population in identifying their respective *Psychosocial Outcomes*, they could potentially assist them in strategizing to optimize said outcomes and their overall PFP experience. The findings of study two suggest that SPPs could benefit from teaching recreational runners with PFP psychosocial strategies that enable them to better accept the training accommodations necessary to minimize discomfort. Likewise, this population could benefit from assistance in developing and maintaining personally meaningful connections to others. The PERR-PFP framework suggests strategies that enable recreational runners with PFP to accept the training accommodations necessary to minimize discomfort are (in some way) interconnected with: *Who* they are; *What* they experience; *How* they respond; and the reasons *Why* they respond the ways in which they do. By assisting recreational runners with PFP in identifying, strategizing, and optimizing their

accept of the training accommodations necessary to minimize discomfort, SPPs can positively influence the *Psychosocial Outcomes* and overall PFP experience of recreational runners with PFP.

6.6. Issues for Further Considerations

There may be two key issues that require further consideration. First, a specific set of five psychosocial concepts might exist among theoretical models of psychological responses to sport injury in conceptualizing recreational runners' perceived psychosocial experiences with PFP. When all models *including* the PERR-PFP framework are considered simultaneously all theories seem to focus on: (a) social influences, (b) injury and training characteristics, (c) personal psychological factors, (d) psychological factors related to injury and training, and (e) to some extent psychosocial outcomes.

Conceptually, social influences include contextual, situational, and/or interpersonal psychosocial constructs. Injury and training characteristics include all past and present constructs related to injury or run training. Personal psychological factors include psychological constructs such as motivation, values, beliefs, attitudes, cognitions, and affect. Psychological factors related to injury and training include psychosocial responses or cognitive appraisals in response to injury or run training such as, distress, frustration, and/or emotional and behavioral coping.

Theoretical models of psychological responses to sport injury assume specific social influences; injury and training characteristics; personal psychological factors; psychological factors related to injury and training; and psychosocial outcomes influence and/or are influenced by the behaviors of recreational runners with PFP. That is why identifying and understanding the psychosocial relationships among these concepts is of vital importance. Presumably, the behaviors of recreational runners with PFP can be optimized to positively influence these

psychosocial concepts and vice versa. Indeed, the PERR-PFP framework conceptualizes each of the aforementioned concepts in its conceptualization of recreational runners' perceived psychosocial experiences with PFP.

Second, the run by any means necessary attitude identified within the PERR-PFP framework may require further clarification and research. Interview results from this research suggest recreational runners with PFP have a run by any means necessary attitude toward running. When that attitude is translated from their discourse into layman's terms it actually means that recreational runners with PFP are willing to do what it takes to figure out the ways in which they can decrease their pain so that they can continue to run. Conceptually, this is the psychosocial opposite of the "no pain no gain" stereotype which suggests athletes develop a predisposition to push through pain and ignore early signs of stress recovery imbalance (Richardson et al., 2008). Therefore, it should not be assumed that recreational runners with PFP will continue to run through pain despite experiencing negative physical and psychological consequences. Likewise, communicating with this population is tremendously important as their discourse may not directly translate into layman's terms.

6.7. Research Limitations

As anticipated, the limitations of this research align with those of SGT (Corbin & Strauss, 2015), the CM (Shank, 2006), and foundational research (ED & NSF, 2013). The prominent limitations of this research relate to participant sampling, inherit biases in research methodology, participant educational level, personal experiences of the researcher, and the type of research.

All participants ascribed to the sociocultural context of running which previous research suggests may influence attitudes, behaviors, and emotions (Oswald et al., 2020; Pereira et al., 2021; Simpson et al., 2014). Despite attempts to accumulate a diverse sample, recruiting from a

convenience of run specialty stores and running clubs does not account for all types of individuals who recreationally run. For example, no participants had previous running experience at the intercollegiate level.

Additionally, all participants reported pursuing or having received a bachelor's degree or higher in postsecondary education. Past personal experiences (like those related to education), may have influenced the descriptions and interpretations provided by participants during interviews (Corbin & Strauss, 2015). Likewise, the previous clinical, educational, and empirical experiences of the primary researcher may have also influenced the processes of, and conclusions drawn from this research (Corbin & Strauss, 2015). Practices of reflexivity and trustworthiness (Corbin & Strauss, 2015) aim to manage these influences to the greatest extent feasibly possible.

Lastly, the results of this research are not directly transferable to other PFP populations or generalizable to overuse injuries. This dissertation assisted in the accumulation of evidence necessary for future research to make the PERR-PFP framework transferable to non-runners and generalizable to other overuse injury populations.

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Appendix A

Virtual Screening Survey

University of Wisconsin – Milwaukee

Virtual Screening Survey

Study Title: Exploring the Perceived Psychosocial Experiences of Recreational Runners with Patellofemoral Pain: A Grounded Theory Approach

Person Responsible for Research: PI, Kenneth Ildefonso MA, LAT; Advisor/Co-PI Dr. Monna Arvinen-Barrow PhD, C. Psychol, UPV Sert.

Survey instrument for Natural history, Aetiology, and Prevalence of Patellofemoral Pain Studies (Dey et al., 2016)

Section 1 SNAPPS: Demographic Information

1. Are you over 18 years of age?

(Select "Yes" or "No")

2. Are you over 45 years of age?

(Select "Yes" or "No")

3. How old are you? (in years)

(Text box for entry)

4. Have you had pain or problems in the last year in or around the knee? (Please only choose one)

(Select "Yes" or "No")

5. Do you currently run approximately 15km per week or more? (Please only choose one)

(Select "Yes" or "No")

Scoring: There are no points awarded to responses to these questions. Those who respond "No" to the questions asking if they are over 18, have experienced knee pain in the past year, or run at least 15km a week, will be excluded from the continuing the survey. Likewise, if they answer "Yes" to being over 45 years old, they will be excluded from continuing with the survey.

Section 2 SNAPPS: Clinical Questions

12. In which knee have you had pain or problems? (Please only choose one of the options listed below)

(Select "Left knee only", "Right knee only", or "Both knees")

Scoring: A score of 1 is awarded if "Both knees" is selected. A score of 0 is awarded for any of the other responses.

13. Have you ever had surgery to your knee? (Including arthroscopy, scope surgery, camera in your knee) (Please choose only one option)

(Select "No", "Left knee only", "Right knee only", or "Both knees")

Scoring: A score of 1 is awarded if "No" is selected. A score of 0 is awarded for any of the other responses.

14. Have you ever had a kneecap that has gone out of place (dislocated)? (Please choose only one option)

(Select "No", "Left knee only", "Right knee only", or "Both knees")

Scoring: A score of 1 is awarded if "No" is selected. A score of 0 is awarded for any of the other responses.

15. Since your knee problem started, does your knee ever swell up? (Please choose only one option)

(Select "No, "Yes, Left knee only", "Yes, Right knee only", or "Yes, Both knees")

Scoring: A score of 1 is awarded if "No" is selected. A score of 0 is awarded for any of the other responses.

16. Have you ever had pain and discomfort for more than one month? (Please choose only one option)

(Select "No, "Yes, Left knee only", "Yes, Right knee only", or "Yes, Both knees")

Scoring: A score of 1 is awarded if either "Yes, Left knee only", "Yes, Right knee only", or "Yes, Both knees" is selected. A score of 0 is awarded for "No".

17. How long have you had pain and discomfort in your knee(s)? Please report in number of months.

(Text box for entry)

This item is not scored.

We are now going to ask you some questions about each knee, starting with your RIGHT knee.

18. Thinking about your right knee, what do you consider is your main problem with your knee? (Please choose only one option)

(Select "Pain or discomfort", "Locking", "Giving way or feeling like it will give way", or "No problem in this knee")

Scoring: A score of 1 is awarded if "Pain or discomfort" is selected. A score of 0 is awarded for any of the other responses.

19. Thinking about your right knee, did your current knee problem come on: (Please choose only one option)

(Select "Because of sudden injury e.g. twist, fall or accident that you needed to see a doctor about", "Gradually over a period of time", "Neither gradually or the result of a sudden injury", "Not sure, can't remember", or "No problem in this knee")

Scoring: A score of 1 is awarded if "Gradually over a period of time" is selected. A score of 0 is awarded for any of the other responses.

Now we are going to ask some questions about your LEFT knee.

20. Thinking about your left knee, what do you consider is your main problem with your knee? (Please choose only one option)

(Select "Pain or discomfort", "Locking", "Giving way or feeling like it will give way", or "No problem in this knee")

Scoring: A score of 1 is awarded if "Pain or discomfort" is selected. A score of 0 is awarded for any of the other responses.

21. Thinking about your left knee, did your current knee problem come on: (Please choose only one option)

(Select "Because of sudden injury e.g. twist, fall or accident that you needed to see a doctor about", "Gradually over a period of time", "Neither gradually or the result of a sudden injury", "Not sure, can't remember", or "No problem in this knee")

Scoring: A score of 1 is awarded if "Gradually over a period of time" is selected. A score of 0 is awarded for any of the other responses.

Scoring for Section 2: The scores for each of the scored items are added up for this section, with a maximum score possible of 7 for Section 2.

Section 3 SNAPPS: Activities

22. Because of your knee problems would you suffer from pain or difficulty with sitting for a long time? (Please choose only one option)

(Select "No, "Yes, Left knee only", "Yes, Right knee only", or "Yes, Both knees")

23. Because of your knee problems would you suffer from pain or difficulty with going up stairs? (Please choose only one option)

(Select "No, "Yes, Left knee only", "Yes, Right knee only", or "Yes, Both knees")

24. Because of your knee problems would you suffer from pain or difficulty with going down stairs? (Please choose only one option)

(Select "No, "Yes, Left knee only", "Yes, Right knee only", or "Yes, Both knees")

25. Because of your knee problems would you suffer from pain or difficulty with squatting? (Please choose only one option)

(Select "No, "Yes, Left knee only", "Yes, Right knee only", or "Yes, Both knees")

26. Because of your knee problems would you suffer from pain or difficulty with standing for long periods? (Please choose only one option)

(Select "No, "Yes, Left knee only", "Yes, Right knee only", or "Yes, Both knees")

27. Because of your knee problems would you suffer from pain or difficulty with walking on a level surface? (Please choose only one option)

(Select "No, "Yes, Left knee only", "Yes, Right knee only", or "Yes, Both knees")

28. Because of your knee problems would you suffer from pain or difficulty with getting up out of a chair? (Please choose only one option)

(Select "No, "Yes, Left knee only", "Yes, Right knee only", or "Yes, Both knees")

29. Because of your knee problems would you suffer from pain or difficulty with kneeling? (Please choose only one option)

(Select "No, "Yes, Left knee only", "Yes, Right knee only", or "Yes, Both knees")

30. Because of your knee problems would you suffer from pain or difficulty with walking on uneven surfaces? (Please choose only one option)

(Select "No, "Yes, Left knee only", "Yes, Right knee only", or "Yes, Both knees")

31. Because of your knee problems would you suffer from pain or difficulty with walking *down* slopes? (Please choose only one option)

(Select "No, "Yes, Left knee only", "Yes, Right knee only", or "Yes, Both knees")

32. Because of your knee problems would you suffer from pain or difficulty with walking *up* slopes? (Please choose only one option)

(Select "No, "Yes, Left knee only", "Yes, Right knee only", or "Yes, Both knees")

33. Because of your knee problems would you suffer from pain or difficulty with hopping? (Please choose only one option)

(Select "No, "Yes, Left knee only", "Yes, Right knee only", or "Yes, Both knees")

34. Because of your knee problems would you suffer from pain or difficulty with jumping? (Please choose only one option)

(Select "No, "Yes, Left knee only", "Yes, Right knee only", or "Yes, Both knees")

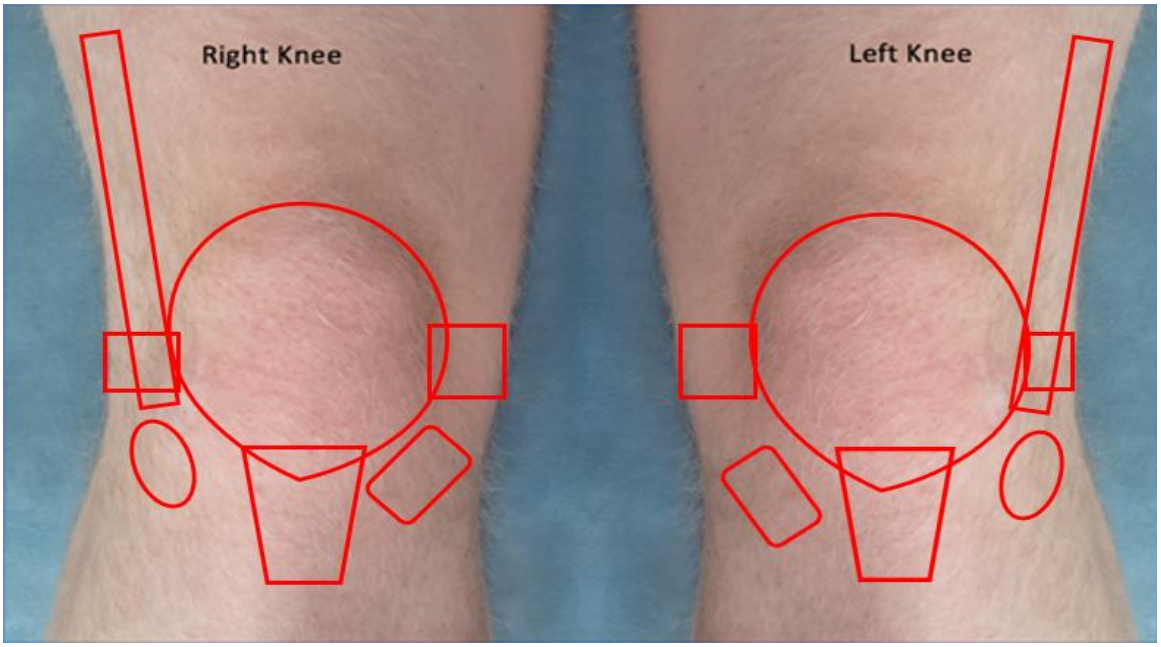
Because of your knee problems would you suffer from pain or difficulty with running? (Please choose only one option)

(Select "No, "Yes, Left knee only", "Yes, Right knee only", or "Yes, Both knees")

Scoring for Section 3: This section is not scored. These responses are used for demographic and classification purposes only.

Section 4 SNAPPS: Knee Pain Map

Please take a moment to think about where you get your knee pain. We would like you to imagine that this is a picture of your knees. Please click to mark where you feel your knee pain on this Diagram. You can use several clicks if needed. When you have finished, please click on the double arrows at the bottom right of the page.



Scoring for Section 4: On the image of the right knee, a score of 1 is given for each region on the knee pain map marked by the participant which corresponds with the medial patellar, lateral patella, and patellar tendon on the right knee. The maximum score available for the right knee is 3. The same scoring is applied to the image of the left knee. A score of 1 is given for each region on the knee pain map marked by the participant which corresponds with the medial patella, lateral patella and patella tendon. The maximum score available for left knee is 3. The scores for the right and left knee are then added together for the Section 4 score (maximum score of 6 possible).

SNAPPS Scoring: The scores for Section 2 and 4 will be added together to determine the total score for SNAPPS. The maximum score possible for SNAPPS total score is 13. Any participant who scores greater than or equal to 6 will be classified as having PFP.

Section 5: Core PFP Criteria (Crossley et al., 2016)

6. Do you currently have an injury to your meniscus in your knee or any of the cartilage within the knee joint?

YES NO

If YES, send to bottom thanking them for their interest in our study.

If NO, continue to #2.

7. Do you currently have an injury to any of the ligaments of the knee (including anterior cruciate ligament (ACL), posterior cruciate ligament (PCL), medial collateral ligament (MCL), or lateral collateral ligament (LCL))?

YES NO

If YES, send to bottom thanking them for their interest in our study.

If NO, continue to #3.

8. Are you currently diagnosed with Osgood-Schlatter, Sinding-Larsen-Johansson syndrome, osteoarthritis of the knee?

If YES, send to bottom thanking them for their interest in our study.

If NO, continue to #4.

9. Do you currently have effusion (major swelling) of your knee joint?

If YES, send to bottom thanking them for their interest in our study.

If NO, continue to #5.

10. Do you currently experience pain in the knee caused by an injury to your hip or lower back?

If YES, send to bottom thanking them for their interest in our study.

If NO, continue to #6.

11. Have you had surgery to your lower extremity (hip, knee, ankle, or foot) in the past 24 months?

If YES, send to the bottom thanking them for their interest in our study.

If NO, continue to #7.

IF YES TO ANY #1-8 ABOVE: Thank you for your interest in our study. Unfortunately, you do not meet the eligibility criteria for participation. Thank you for your time!

IF NO TO #1-8 ABOVE: Thank you for your time! You are eligible to participate in our study. Please fill in the information below to confirm your contact information so we can schedule your session in the lab.

Section 6: Contact Information

NAME:

EMAIL:

PHONE:

Preferred method of contact: Email Phone

Appendix B

Semi-Structured Interview Guide

University of Wisconsin – Milwaukee

Semi-Structured Interview Guide

Study Title: Exploring the Perceived Psychosocial Experiences of Recreational Runners with Patellofemoral Pain: A Grounded Theory Approach

Person Responsible for Research: PI, Kenneth Ildefonso MA, LAT; Advisor/Co-PI Dr. Monna Arvinen-Barrow PhD, C. Psychol

Semi-structured Interview Guide:

Icebreakers
1. What do you do for a living? (Prompt: job, title, roles, responsibilities)
2. How did you get into recreational running? (Prompt: history of school sports, fitness)
Running History
1. What role does recreational running play in your life? (Prompt: competition, leisure, goals)
2. Describe what recreational running was like prior to your kneecap pain. (Prompt: all business, leisure, priority)
3. Tell me about your current run training. (Prompt: frequency, mileage, duration, and intensity)
Pain Experience
1. Tell me about how your knee pain started. (Prompt: onset, difficulties with activities)
2. About how long ago did your knee pain start? (Prompt: months)
3. What kind of symptoms do you experience. (Prompt: severe, mild, often, infrequent, predictable)
4. On a scale from zero to 10 with zero indicating no pain and 10 excruciating pain, what do you rate your usual pain over the past week?
5. On a scale from zero to 10 with zero indicating no pain and 10 excruciating pain, what do you rate your worst pain during running?
6. What medical care have you had for your knee pain?
7. What advice have you received from friends, family, coworkers, or others about your kneecap pain?
Psychosocial Experience
1. Describe how running makes you feel. (Prompt: good, bad, indifferent)
2. How did your kneecap pain progress? (Prompt: while running, after running, during other activities, slow, fast)
3. How has kneecap pain affected your running? (Prompt: unchanged, increased difficulty, increased challenge, decreased enjoyment)
4. How have you coped with your kneecap pain? (Prompt: medical treatment, modified training, rest, ignoring sensations)
5. What modifications have you made because of your kneecap pain? (Prompt: intensity, mode, frequency, duration, rest)
6. When thinking about your kneecap pain, what thoughts and feelings come to mind? (Prompt: annoyance, frustration, fear)
7. How has kneecap pain affected your attitudes and feelings toward running? (Prompt: negatively, indifferently)
8. How has kneecap pain affected your life in general? (Prompt: no change, substantial change, specific changes)
9. What do you think are the key factors that have influenced your kneecap pain experience? (Prompt: running form, flexibility, strength, posture, shoes, aggressiveness, head strong, passive, competition)

10. What do you think is the worst aspect of having kneecap pain and being a recreational runner? (Prompt: pain, influences on training, daily activities, emotions)
11. If a recreational runner that you know told you they have developed kneecap pain what might you tell them?

Appendix C

Virtual Clinical Examination

University of Wisconsin – Milwaukee

Virtual Clinical Examination

Study Title: Exploring the Perceived Psychosocial Experiences of Recreational Runners with Patellofemoral Pain: A Grounded Theory Approach

Person Responsible for Research: PI, Kenneth Ildefonso MA, LAT; Advisor/Co-PI Dr. Monna Arvinen-Barrow PhD, C. Psychol

Clinical Examination Script **Participant Code:**

1. Ask the participant to confirm which knee(s) is the involved knee. If they reply both, note which one is the most painful. (Note SNAPPS scores too in case of bilateral pain – make sure the knee you are examining meets the SNAPPS criteria)

2. Ask the participant "How long have you experienced symptoms in the involved knee"?

3. Palpation: "I am going to show you a slide with an image of two knees. I will guide you through the image with animations to highlight the region of the knee I will ask you to touch. I would like for you to press on your knee in the following locations with enough force to indent the skin in the view of your camera so I can verify you are pressing on the correct location. As you press on each of the locations, I will ask you if you experience any tenderness with the pressure from your fingers. We will start with your knees straight out in front of you as you are seated."

- **Patella (medial and lateral borders and facets, inferior pole, superior border/quad tendon)**
  "Start at the bottom middle edge of your kneecap. Press around the outside, including the edges, going around in a circle. Next press down along the middle of the knee cap, hitting all of the front of the knee cap, and let me know if you feel tenderness with that pressure of your fingers."

- **Patellar tendon**
  "Next, I want you to start at the bottom middle edge of your kneecap, and follow along down the tendon underneath the kneecap. Press down along the middle, and each side of the tendon."

- **Gerdy's tubercle**
  "Now, starting from the tendon we just pressed on, I would like you to move your fingers towards the outside of your knee from the tendon. You should feel a small bony bump on the bone. Press down on this bump.

- **Distal IT band**
  "Moving up from the bump we just pressed on, I want you to follow up the side of your knee and just past your knee cap along the outside of your knee. You should feel a band of tissue, this is your IT band. Press along this band until you are just past the knee as illustrated in this picture."

- **Pes anserine**
  "Now we will go back to the tendon below the kneecap that we pressed on earlier. Move your fingers over towards the inside of your knee, feeling for a soft plateau on the bone. Press on this plateau area as illustrated in the picture.

- **Lateral joint line**
  "Next I will ask you to bend your knee so it is at a 60-90 degree angle. Starting on the knee cap, I would like you to move just outside of the middle of the kneecap until you feel the divot between the thigh bone and the shin bone. Starting at the point nearest to the kneecap, press on this divot moving to the outside of your knee."

- **Medial joint line**
  "Now we will do the same thing on the inside of the knee. Start on the knee cap, move your fingers just inside of the middle of the kneecap until you feel the divot between the thigh bone and the shin bone. Starting at the point nearest to the kneecap, press on the divot moving to the outside of the knee.

    - If tender, confirm where by asking and visually observing where they are pointing.
    - Also use my own knee to demonstrate if they are having trouble finding the landmarks.

4. Effusion: Ask them if they notice any swelling of their knee. Ask them to position the camera so I can see their knees side by side to look for any visible signs of swelling.

5. *Presence of retropatellar or peripatellar pain*: Ask the participant:
    - "Do you experience knee pain during or after any activity?" If yes, "Where do you experience that pain?"
    - "Do you experience knee pain with prolonged sitting?" If yes, "Where do you experience that pain?"
    - "Do you experience knee pain with walking up or down stairs?" If yes, "Do you experience pain when walking up stairs? What about walking down stairs? Where do you experience your pain?"
    - "Do you experience knee pain with kneeling?" If yes, "Where do you experience your pain?"
    - "Please perform a double leg squat. Does this cause you any pain?" If yes, "Where do you experience your pain?"

    - *Palpation of medial and lateral facets – this is noted during the palpation part of the exam.*
    - *Step-down from a 20cm height – I have the participant step down from the stairs in the lab to determine if this is painful.*

6. Rehabilitation/Treatment history: "Have you completed any rehabilitation or treatment for your knee pain?" If so, what did you do? When/how long ago did you do this? How often? Was it helpful?

7. Current physical activity level: "What is your current physical activity level? What activities do you do, and how often per week, for how long?"

University of Wisconsin – Milwaukee

Virtual Clinical Examination - Notes

Study Title: Exploring the Perceived Psychosocial Experiences of Recreational Runners with Patellofemoral Pain: A Grounded Theory Approach

Person Responsible for Research: PI, Kenneth Ildefonso MA, LAT; Advisor/Co-PI Dr. Monna Arvinen-Barrow PhD, C. Psychol

Clinical Examination Notes **Participant Code:**

Involved knee(s): Right Left Both

Duration of current symptoms: _____

Point tenderness:

_____

_____

_____

Effusion of knee joint: Y N

Presence of retropatellar and/or peripatellar pain:

- During or after activity Y N
- Prolonged sitting Y N
- Navigating stairs Y N
- Kneeling Y N
- Double Leg Squatting Y N
- Palpation of patellar facets Y N
- Step-down from a 20-cm box Y N

Current or past treatment or rehabilitation for knee pain: _____

Current physical activity level: _____

Appendix D

Recruitment Flyer

UNIVERSITY of WISCONSIN
UWMILWAUKEE

Are you a recreational runner with kneecap pain?

A study is being conducted to explore recreational runners' psychosocial responses to patellofemoral pain.

Eligible participants who complete a 60-80 minute telephone interview will receive a $20 eGift card.

To determine eligibility contact : Ken Ildefonso: keijr@uwm.edu or www.(url here)

IRB approval number here

QR code goes here

Appendix E

Electronic Informed Consent

University of Wisconsin – Milwaukee

Electronic Informed Consent

Study Title: Exploring the Perceived Psychosocial Experiences of Recreational Runners with Patellofemoral Pain: A Grounded Theory Approach

Person Responsible for Research: PI, Kenneth Ildefonso MA, LAT; Advisor/Co-PI Dr. Monna Arvinen-Barrow PhD, C. Psychol, UPV Sert.

Electronic Letter of Informed Consent:

Introduction

We are asking you to take part in a research study, Exploring the Perceived Psychosocial Experiences of Recreational Runners with Patellofemoral Pain: A Grounded Theory Approach. Kenneth Ildefonso at the University of Wisconsin-Milwaukee is leading the study.

- You are asked to be in the study because you have experiences recreational running with patellofemoral pain.
- You can decide whether or not to take part in this study. Even if you join the study, you may stop at any time.
- The reason we are conducting this study is to explore the perceived psychosocial experiences of recreational runners with patellofemoral pain.
- This study will not help you, but we hope information from this study will help sports medicine professionals to understand the psychosocial aspects of female and male runners' responses to experiencing kneecap pain.

What will happen in this study?

- If you decide to participate in this study, we will ask you to take part in a virtual interview about and clinical examination of your patellofemoral pain.
- Answer questions pertaining to how your patellofemoral pain has affected your running as well as, the thoughts and feelings you have toward your patellofemoral pain. If any questions make you uncomfortable you don't have to answer them.
- The interview will take you about 60-80 minutes.
- A virtual clinical exam will be conducted following the interview to identify the clinical presentations of your patellofemoral pain and take you about 10-15 minutes.

Will I be paid for taking part in this study?

You will receive a $20 run-store eGift card for taking part in this study.

Confidentiality

- Your answers will be linked to your name, but your information will not be shared with anyone outside the study staff.
- Collecting interview data using the internet involves the same risks that a person would encounter in everyday use of the internet, such as information being unintentionally seen by others.
- Your name or any other identifying information will not be used in any articles or talks.

What if I have questions or concerns?

If you have questions about the study, feel free to contact Kenneth Ildefonso at 475-223-0022 or keijr@uwm.edu.

If you have questions about your rights as a study participant or want to report any problems or complaints, you can call the IRB (Institutional Review Board; provides ethics oversight) at 414-662-3544 or irbinfo@uwm.edu.

How do I agree to be in the study?

If you would like to take part in this study, please click the Agree button. If you change your mind and decide not to participate, you can withdraw from the virtual interview or clinical exam at any time.

Thank you for taking time to consider taking part in this research study.