Tampere University

MAIJU MARTTINEN

Aspects of Pain in Special Age Groups

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ACADEMIC DISSERTATION
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of Tampere University,
for public discussion in the Auditorium 1
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ACADEMIC DISSERTATION
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Dedication

To Aron and Vuokko

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Helsinki 12 October 2019

Maiju Marttinen

ABSTRACT

Special age groups (children, adolescents, older adults) have special characteristics when it comes to pain assessment, pain experience, and pain management. The first objectives of the current study were to examine pain coping in children and to identify factors related to pain in older adults, in order to improve the understanding of the pain experience in these special age groups. First, the factor structure of the Finnish translation of the Pain Coping Questionnaire (PCQ), the first validated pain coping measurement developed specifically for children, was determined and validated. Secondly, the pain intensity and interference as well as pain-related factors according to the SF-36 were examined among community-dwelling older adults. In addition, purchases of prescribed analgesics among older adults were considered in order to estimate the analgesic administration prevalence in the aging population. The main focus was in opioid purchases due to the known increase in opioid use among older adults.

Exploratory factor analysis was used for the first-order and higher-order classification of 91 juvenile idiopathic arthritis patients and patients with chronic non-inflammatory musculoskeletal pain symptoms, aged 8–15. A total of 1,420 randomly selected community-dwelling older adults self-reported SF-36 bodily pain (pain intensity and pain-related interference) during the previous month. Based on the pain reports, four pain groups were formed (group I [0–45, moderate to very severe pain intensity and interference], group II [47.5–70], group III [77.5–90], and group IV [100, no pain at all]). The relationship between questionnaire and clinical data in these groups was explored. Data regarding older adults' analgesic purchases for six months prior to and six months after the self-report were retrieved from the Social Insurance Institution of Finland. Analgesic purchases were examined separately in three age groups (62–66, 72–76, and 82–86 years). Factors related to analgesic purchases were explored.

With 38 items, the exploratory factor analysis of the PCQ provided a both culturally and statistically satisfactory structure of eight first-order factors (Internalizing/Catastrophizing [IC], Positive Self-Statements [PSS], Information Seeking [IS], Seeking Social Support [SSS], Cognitive Distraction [CD], Externalizing [EXT], Behavioural Distraction [BD], Problem Solving [PS]) and three higher-order

factors (Approach [APP], Emotion-Focused Avoidance [EFA], Distraction [DIS]) in the Finnish translation. Regarding older adults, the overall pain prevalence was 78% (SF-36 bodily pain < 100); 17% had experienced both moderate to severe pain intensity and pain-related interference. The prevalence of cohabiting as well as socioeconomic status decreased, and obesity and morbidity increased with increasing SF-36 bodily pain. In total, 84% of the participants had purchased at least one prescribed analgesic over the period of one year; 77% had purchased non-steroidal anti-inflammatory drugs (NSAIDs), and 32% had purchased opioids. Of all examined factors, only morbidities were independently associated with analgesic purchases. Age did not make a marked difference in drug distribution or purchasing prevalence. Of the opioid purchasers, 16% had reported no pain of any intensity and 30% no pain-related interference. Metabolic syndrome and morbidities were independently associated with opioid purchases among these participants.

Children may lack understanding and the means to deal with ongoing unwanted physical and mental health conditions. A valid pain coping scale may enhance the distinguishing of vulnerable pain coping at the very early stage of pain becoming chronic. In older adults, a high prevalence of intense and interfering pain was reported. Multiple factors that were found to relate to pain are known to associate with social exclusion. Increasing efforts should be targeted towards identifying these factors in persons with pain. The use of NSAIDs and opioids emerged as being substantial in the older adult population. Careful deliberation in terms of contraindications and potential risks needs to be executed when prescribing NSAIDs and opioids to older adults, especially in older adults with a lower socio-economic status, obesity, and metabolic syndrome.

TIIVISTELMÄ

Kivun arviointiin, kipukokemukseen ja kivun hoitoon liittyy erityispiirteitä ja haasteita erityisikäryhmissä (lapset, ikääntyneet). Tutkimuksen tavoitteena oli tutkia kipuun sopeutumista lapsilla ja nuorilla sekä löytää tekijöitä, jotka ovat yhteydessä koettuun kipuun ikääntyneillä. Tutkimuksen tavoite oli siten kehittää keinoja ymmärtää paremmin näiden erityisikäryhmien kipukokemusta. Tutkimuksessa määritettiin englannista suomeksi käännetyn kipusopeutumismittarin (PCQ) faktorirakenne, ja suomenkielinen PCQ validoitiin. PCQ on ensimmäinen nimenomaan lapsille kehitetty kipusopeutumismittari. Tutkimuksessa tarkasteltiin myös ikääntyneiden SF-36-mittarilla arvioitua kivun voimakkuutta ja haittaavuutta sekä näihin liittyviä tekijöitä. Lisäksi tarkasteltiin ikääntyneiden reseptikipulääkeostoja, jotta saataisiin enemmän tietoa ikääntyvän väestön kipulääkkeiden käytöstä sekä kipulääkeprofiilista. Päähuomio kohdennettiin opioidiostoihin, sillä opioidien käytön tiedetään lisääntyneen ikääntyneessä väestössä.

Lastenreumaa sairastavien ja pitkittyneestä kivusta kärsivien lasten (N=91, ikä 8–15 vuotta) kipuoireet jaoteltiin ensimmäisen ja korkeamman asteen luokkiin käyttäen eksploratiivista faktorianalyysiä. Satunnaisotannalla valikoidut, kotona asuvat ikääntyneet (N=1420) raportoivat SF-36-mittarilla kokemaansa ruumiillista kipua viimeisen kuukauden ajalta. Kipuraportoinnin perusteella tutkittavat jaettiin neljään kipuryhmään (ryhmä I [0–45, kohtalainen–erittäin kova kivun voimakkuus sekä kipuun liittyvä haitta], ryhmä II [47,5–70], ryhmä III [77,5–90], ryhmä [100, ei lainkaan kipua]). Ikääntyneiden raportoimia kyselytietoja sekä kliinistä aineistoa tarkasteltiin suhteessa kipuun. Ikääntyneiden reseptikipulääkeostot kuudelta kuukaudelta ennen kyselykaavakkeen täyttöä ja kuudelta kuukaudelta sen jälkeen kerättiin Kansaneläkelaitoksen reseptitietokeskuksesta. Kipulääkeostoja tarkasteltiin erikseen kolmessa ikäryhmässä (62–66-, 72–76- ja 82–86-vuotiaat).

Kulttuurisesti ja tilastollisesti tyydyttävä suomenkielisen PCQ:n ensimmäisen ja korkeamman asteen faktorirakenne saavutettiin 38 muuttujalla. Ikääntyneistä 78 % raportoi kokeneensa kipua viimeisen kuukauden aikana (SF-36 kipu < 100); 17 % oli kokenut sekä kohtalaista tai erittäin kovaa kipua että kohtalaista tai erittäin voimakasta kipuun liittyvää haittaa. Ne henkilöt, jotka raportoivat eniten kipua,

asuivat useammin yksin, sijoittuivat matalampaan sosioekonomiseen luokkaan ja olivat useammin ylipainoisia sekä monisairaampia. Ikääntyneistä 84 % oli vuoden aikana noutanut apteekista jotakin reseptillä määrättyä kipulääkettä; 77 % oli noutanut tulehduskipulääkkeitä ja 32 % opioideja. Ainoastaan sairauksien määrä oli itsenäisesti yhteydessä kipulääkeostoihin. Eri ikäryhmien välillä ei löytynyt mainittavaa eroa kipulääkejakaumassa tai noutojen esiintyvyydessä. Metabolinen oireyhtymä ja yleinen sairastavuus olivat itsenäisesti yhteydessä opioidien käyttöön niillä henkilöillä, jotka olivat noutaneet reseptillä määrättyjä opioideja mutta eivät olleet raportoineet lainkaan kipua.

Lapsilta voi puuttua keinoja käsitellä epämiellyttäviä fyysisiä ja psyykkisiä kokemuksia. Validi kipusopeutumismittari voi edistää heikon kivun käsittelykyvyn tunnistamista ennen kuin kipu kroonistuu. Merkittävä osa ikääntyneistä oli raportoinut kipua viimeksi kuluneen kuukauden aikana. Useiden tekijöiden, joiden todettiin olevan yhteydessä kipuun näillä henkilöillä, tiedetään olevan yhteydessä sosiaaliseen syrjäytymiseen. Huomiota tulee kiinnittää kyseisten tekijöiden varhaiseen tunnistamiseen kipua kokevilla henkilöillä. Tulehduskipulääkkeiden ja opioidien käyttö ikääntyneillä oli runsasta. Huolellista harkintaa tulee käyttää näiden lääkkeiden määräämisessä ikääntyneelle väestölle, ja vasta-aiheet ja mahdolliset riskit tulee tuntea. Erityishuomiota tulee kiinnittää niihin ikääntyviin henkilöihin, jotka sijoittuvat matalampaan sosioekonomiseen luokkaan, ovat ylipainoisia ja joilla on metabolinen oireyhtymä.

CONTENTS

ABBREVIATIONS

AGS	American Geriatrics Society
APP	Approach
ATC	Anatomic therapeutic chemical
AUDIT-C	Alcohol Use Disorders Identification Test for Consumption
BD	Behavioral Distraction
BMI	Body mass index
CD	Cognitive Distraction
CDI	Children's Depression Inventory
CI	Confidence interval
CNS	Central nervous system
COX-1	Cyclooxygenase-1
COX-2	Cyclooxygenase-2
CRP	C-reactive protein
DOR	Delta opioid receptor
EFA	Emotion-Focused Avoidance
DIS	Distraction
EGFR	Estimated glomerular filtration rate
EXT	Externalizing
FPS	Facial Pain Scale
GABA	Gamma-aminobutyric acid
GOAL	Good Ageing in Lahti Region
HDL	High-density lipoprotein
HRQoL	Health-related quality of life
IASP	International Association for the Study of Pain
IC	Internalizing/Catastrophizing
IP	Information Seeking/Problem Solving
IS	Information Seeking
JIA	Juvenile idiopathic arthritis
KOR	Kappa opioid receptor

KELA	Kansaneläkelaitos, The Social Insurance Institution of Finland
LTPA	Leisure-time physical activity
MetS	Metabolic syndrome
MOR	Mu opioid receptor
NRS	Numeric Rating Scale
NSAID	Non-steroidal anti-inflammatory drug
OR	Odds ratio
PCQ	Pain Coping Questionnaire
PS	Problem Solving
PSS	Positive Self-Statements
RCT	Randomized controlled trial
SD	Standard deviation
SF-36	36-item Short Form Survey
SNRI	Serotonin-noradrenaline reuptake inhibitor
SPQ	Structured Pain Questionnaire
SSS	Seeking Social Support
USA	United States of America
VAS	Visual Analogue Scale
VRS	Verbal Rating Scale
WHO	World Health Organization

ORIGINAL PUBLICATIONS

I Marttinen M.K., Santavirta N., Kauppi M.J., Pohjankoski H., Vuorimaa H. (2018). Validation of the Pain Coping Questionnaire in Finnish. European Journal of Pain 22(5): 1016–1025

II Marttinen M.K., Kautiainen H., Haanpää M., Pohjankoski H., Vuorimaa H., Hintikka J., Kauppi M.J. (2018) Pain-related factors in older adults. Scandinavian Journal of Pain (Epub ahead of print)

III Marttinen M.K., Kautiainen H., Haanpää M., Pohjankoski H, Hintikka J., Kauppi M.J. (2018) Analgesic purchases among older adults – a population-based study (submitted)

1 INTRODUCTION

Pain is known to be a major factor affecting the quality of life in children and older adults (Varni et al. 1996b, Schanberg et al. 1996, Bernfort et al. 2015, Chen et al. 2003, Lacey et al. 2014). Evaluating pain is known to be complex (Jensen et al. 1986, Breivik et al. 2008). Pain is always subjective and includes an emotional component (IASP 2018). Self-reporting has long been considered the most reliable method of measuring pain in children aged six years and older (Beltramini et al. 2017) and in older adults, also with possible cognitive impairments (Bicket and Mao 2015, Booker and Haedtke 2016, Hadjistavropoulos et al. 2010).

Juvenile pain coping is a process under pediatricians' increasing attention. The growing consensus supports the significance of pain coping in the understanding of prolonged pain in children (Reid et al. 1998, Gil et al. 1993, Claar et al. 2008). Coping signifies purposeful cognitive and behavioral efforts to deal with the negative impact of stress (Lazarus 1993). More precise knowledge about each individual's pain coping style may enhance the optimization of treatment and also help professionals to predict psychological adjustment and pain levels (Bennett-Branson 1993, Gil et al. 1993, Keefe et al. 1990, Olson et al. 1993).

The Pain Coping Questionnaire (PCQ) is the first validated pain coping measurement developed specifically for children (Reid et al. 1998). It comprises pain coping strategies, indicating how often children would execute each strategy when in pain. In 1998, the 39 original PCQ items were grouped into eight conceptually derived first-order scales (Information Seeking, Problem Solving, Seeking Social Support, Positive Self-Statements, Behavioral Distraction, Cognitive Distraction, Externalizing, Internalizing/Catastrophizing) and three higher-order scales (Approach, Emotion-Focused Avoidance, Distraction) in an exploratory factor analysis. The PCQ has been translated into Finnish, but the translation has lacked a proper validation. To date, only Reid and colleagues had been able to confirm the higher-order exploratory factor structure of the PCQ. In pain treatment, besides pain intensity, it is important to distinguish the cognitive-emotional processed related to pain, as an understanding of these may lead to mechanisms of improvement

(Wicksell et al. 2011). A higher-order analysis would yield more information on the hierarchical structure of coping with pain.

The number of studies regarding pain in older adults has multiplied during the last decade. However, the overall consensus highlights the under-assessment, under-diagnosing, and under-treatment/mistreatment of persistent pain in older people (Gagliese and Melzack 1997, Tracy and Sean Morrison 2013, Veal et al. 2015, Nawai et al. 2017). It has been suggested that pain prevalence in older adults would be as high as 86% (Miranda et al. 2012) . Pain-related interference is an obvious problem in older age groups (Blyth et al. 2001, Gagliese and Melzack 1997).

The association between chronic pain and sociodemographic factors has been presented in adults aged 25 years and older (Elliott et al. 1999). Sadness and loneliness have been reported to be more frequent among older adults with pain (Rapo-Pylkko et al. 2016, Jaremka et al. 2014). Furthermore, pain is known to associate with depression and obesity in older people (Han et al. 2016, Reid et al. 2003, McCarthy et al. 2009).

According to a large literature review regarding pain management in older adults (92 studies from 1990 to 2014), paracetamol was considered to be the first-line therapy (Makris et al. 2014). NSAIDs may be used if contraindications are not present (Makris et al. 2014, Abdulla et al. 2013). Opioid administration may be considered with both (moderate to severe) cancer and non-cancer pain, but only after a precise individual deliberation and with careful monitoring (Abdulla et al. 2013, Huang and Mallet 2013). Neuropathic drugs should be considered for neuropathic pain (Abdulla et al. 2013), the prevalence of which is known to increase with advancing age (Schmader et al. 2010). The treatment strategy should be based on a proper assessment of the quality of pain and the patient's individual needs (Spahr et al. 2017, Torrance et al. 2006). Large studies evaluating analgesic use in the general aged population are scarce, and the study settings are subject to wide variety. It remains unclear how large a proportion of the older population actually uses pain medication, whether the use is regular or on an as-needed basis, and whether the medication consists of NSAIDs, paracetamol, neuropathic drugs, or opioids (Rapo-Pylkko et al. 2016, Gnjidic et al. 2014).

Pain management could be further improved with a better understanding of the pain experience and a better assessment of multiple factors that may affect and relate to pain. Firstly, the objective herein was to determine the first- and the higher-order factor structure and to validate the Finnish version of the PCQ, thus providing tools for a better understanding of children and adolescents in pain. Secondly, the priority was to explore pain-related factors in the older adult population. Better knowledge

about the factors related to pain would facilitate the distinguishing of the risk group in which pain may become chronic, in addition to improving pain prevention. Thirdly, the analgesic purchases by older adults were considered in order to clarify the analgesic administration profile among older community-dwelling citizens.

2 REVIEW OF THE LITERATURE

2.1 Definition of pain

2.1.1 The definition and experience of pain

According to definition by The International Association for the Study of Pain (IASP), pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage (IASP 2018, IASP 1994). Thus, pain is always subjective and includes an emotional component (IASP 2018, Wade et al. 1990). Reported pain should be regarded as pain even in the absence of tissue damage (IASP 2018).

Based on a classification by duration, pain may be regarded as acute or chronic. Although chronic pain has classically been defined as pain which persists past the normal time of healing (Merskey 1994) and lacks the warning function of physiological nociception (Treede et al. 2015), a significant difference between acute and chronic pain does not originate from the concept of time alone. Acute pain is commonly a symptom of a disease or injury, while chronic pain is an individual condition (although often originating from an underlying condition) (Bicket and Mao 2015) and should be treated as one (Niv and Devor 2004, Raffaeli and Arnaudo 2017). Usually, pain may be regarded as chronic when it recurs for over 3–6 months (Treede et al. 2015).

The pain experience does not equate pain intensity. The experience of pain is always subjective and consists of sensory, cognitive-evaluative, and affective-motivational dimensions (Wade et al. 1990, Price et al. 1987). Pain interference is an important element that is not always parallel to either pain intensity or tissue damage but is in a key role in terms of the effect on the individual's quality of life. Pain interference refers to the degree to which pain interferes with an individual's physical, mental, and social activities (Amtmann et al. 2010). Negative emotions—for example, anger, frustration, anxiety, and depression—are important contributors of the overall unpleasantness of chronic pain (Wade et al. 1990).

2.1.2 Types of pain

Pain has originally been characterized as nociceptive or neuropathic; however, they sometimes occur together and are referred to as multi-mechanistic pain (Pergolizzi et al. 2017). Nociceptive pain arises from a peripheral noxious stimulus interpreted by the brain (Pergolizzi et al. 2017). Neuropathic pain has classically been defined as pain with a demonstrable lesion or disease of the somatosensory nervous system (IASP 2018). However, according to a more liberal approach, it may also occur without an obvious injury but arise from a dysfunction or inappropriate signal transmission (Fornasari 2012). Later on, it has been suggested to be useful to further classify neuropathic pain into possible, probable, and definite neuropathic pain (Finnerup et al. 2016).

However, the characterization of pain—especially of chronic pain—is rarely this simple. As a result of multi-morbidity, chronic geriatric pain seldom arises from one etiology (Thakral et al. 2016). For example, due to complexity, the up-to-date classification of chronic pain for the ICD-11 divided chronic pain into seven groups (primary pain, cancer pain, posttraumatic and postsurgical pain, neuropathic pain, headache and orofacial pain, visceral pain, and musculoskeletal pain) in order to be able to execute the classification combining the etiology, type, and location of pain (Treede et al. 2015). However, as far as possible, the type of pain should be carefully identified in order to achieve optimal treatment regimens and better outcomes (Spahr et al. 2017, Torrance et al. 2006).

2.2 Prevalence of pain

Children who are predisposed to persistent pain are severely impaired in their daily activities, such as attending school, and may suffer from severe emotional distress (Coffelt et al. 2013, Zernikow et al. 2012). According to a Norwegian study (N=1,238, school children aged 8–18), the prevalence of pain within the previous 3 months was 60% (Haraldstad et al. 2011). Therein, pain-related sleep disturbances, absences from school, and restricted social activities were reported (Haraldstad et al. 2011). Estimates of recurrent and chronic pain in children suggest a prevalence of 15%–25% (Mazur et al. 2013). In 2011, a large systematic review reported the prevalence of chronic and recurrent pain in children and adolescents as follows: 8%–83% for headache, 4%–53% for abdominal pain, 14%–24% for back pain, 4%–40% for musculoskeletal pain, 4%–49% for multiple pains, and 5%–88% for other types

of pain (King et al. 2011). In a large Finnish study examining musculoskeletal pain in school children, 32% of the children reported having pain at least once a week, and half of these children still had pain at the 1-year follow-up (Mikkelsson et al. 1997). Therein, 43% of the children with widespread pain reported absences from school due to pain (Mikkelsson et al. 1997).

The ageing of the population is one of the most pervasive phenomena globally. Chronic pain has been considered to be one of the leading conditions in later life in terms of commonness and economic burden (Bicket and Mao 2015). Study results regarding the prevalence of pain among older adults show a wide variety (prevalence of 14%–86%) (Abdulla et al. 2013, Miranda et al. 2012, Barkin et al. 2005, Blyth et al. 2001, Bicket and Mao 2015, Brattberg et al. 1996, Larsson et al. 2017, Patel et al. 2013, Satghare et al. 2016), but so do the study settings. Additionally, the prevalence of pain among hospitalized seniors has been reported to be high and frequently undertreated (Gianni et al. 2010). Pain-related interference has been reported to be significant (Blyth et al. 2001, Gagliese and Melzack 1997). Examples of systematic reviews exploring population-based settings and presenting the prevalence of pain among older people are presented in Table 1. They show that pain prevalence varies greatly depending on population characteristics, study settings, and various assessment methods.

In 2015, Karttunen and colleagues presented the results of their study examining the persistence of chronic non-cancer musculoskeletal pain among Finnish community-dwelling older adults aged 76 years and older (Karttunen et al. 2015). At baseline, half of the participants reported chronic pain (Karttunen et al. 2015). Three out of four of these individuals continued to experience pain over the follow-up and, thus, objectively had persistent pain (Karttunen et al. 2015).

Chronic pain comprises an enormous economic burden to society. In 2010, the total costs associated with chronic pain among the adult population in the USA were estimated to be $560–635 billion (Gaskin and Richard 2012). This amount comprises both medical treatment and loss of worker productivity (Gaskin and Richard 2012). The direct and indirect costs of patients with a diagnosis related to chronic pain have been estimated to account for one tenth of the Swedish gross domestic product (32 billion EUR/year) (Gustavsson et al. 2012). The heaviest burden, however, is the one that is carried by the individual and his or her family members. Pain has been cited as one of the most disabling conditions for older people (Ettinger et al. 1994, Leveille et al. 2002).

Table 1. Examples of systematic reviews with a population-based setting and presenting the prevalence of pain among older people.

STUDY	Miranda et al. 2012, BMC Musc Disord	Otones Reyes et al. 2019, Pain Manag Nurs	Jackson et al. 2015, Lancet	Fayaz et al. 2016, BMJ Open	Zaki et al. 2015, Pain Manag Nurs
N	116,091	34,024	N/A	N/A	N/A
AGE GROUP	Over 60 years	Mean age over 60 years	N/A, general older adult population	Over 75 years	Geriatric population
FEMALES	Predominantly	N/A	N/A	Over half of subjects	24%–60%
DESIGN / SETTING	Systematic review, 25 studies	Systematic review, 23 studies	Systematic review and meta-analysis	Systematic review and meta-analysis, 19 studies	Systematic review, 19 studies
TYPE OF PAIN	Chronic musculoskeletal pain	Chronic pain and frailty	Any type of chronic pain 56%, Lower back pain 31%, Headache 49%, Musculoskeletal pain 39%, Joint pain 42%, Widespread pain 22%	Chronic pain up to 62%, Chronic widespread pain up to 21%	Chronic pain
PREVALENCE	14%–86%	45%–70%			42%–91%

2.3 Pain assessment

2.3.1 Pain assessment in children

According to the literature, the lack of proper pain assessment tools results in the underestimation and under-treatment of pain in children (Manworren and Stinson 2016, Beltramini et al. 2017). Pain-causing conditions in childhood and adolescence vary significantly in nature. Age and the stage of cognitive development constitute challenges, and not all age groups should be approached similarly (Beltramini et al. 2017, Manworren and Stinson 2016). Children in the non-verbal stage of development or with cognitive impairments are at an increased risk of underestimated and under-treated pain, but they are also more vulnerable to pain (Manworren and Stinson 2016).

Regarding chronic pain, headache has been reported to be the most common in children and adolescents (King et al. 2011). Multiple conditions, however, may induce pain, and pain should thus be assessed actively in order to optimize comprehensive and proper treatment (Manworren and Stinson 2016, Cummings et al. 1996). Psychological factors as well as somatic symptoms and pain have been suggested to predict the development of widespread pain in adolescents (Mikkelsson et al. 2008). Effective pain management in children results from three steps: 1) recoding pain history, 2) selecting an appropriate pain assessment tool and completing a comprehensive pain assessment, and 3) evaluating the effectiveness of the treatment (Manworren and Stinson 2016).

In general, pain in children aged six years and older should be assessed using a self-report (Beltramini et al. 2017). Several scales exist, but medical professionals need to target their use carefully (Beltramini et al. 2017, Manworren and Stinson 2016). The Visual Analogue Scale (VAS) has been considered the gold standard for children aged six years and older, but the use of multiple scales is often required (Beltramini et al. 2017). For younger children, behavioral pain scales play a key role (Beltramini et al. 2017), but they carry the risk for bias, as they may be positive due to other unwanted conditions, such as hunger or the cold (Beltramini et al. 2017).

2.3.2 Pain assessment in older adults

All older adults with chronic pain should undergo a comprehensive geriatric pain assessment (Reid et al. 2015). Treatment planning should always be based on an understanding of the patient's treatment goals and expectations, comorbidities, and cognitive and functional status (Makris et al. 2014, Bicket and Mao 2015). A 5-step approach (self-report, pathology, behaviors, caregiver input, analgesic trial) has been encouraged to be adopted (Brant 2018). As suggested in the above, chronic pain in older adults almost always reflects a result of a chronic underlying condition (Bicket and Mao 2015, Larsson et al. 2017). Multi-morbidity is common in an advanced age, and older adults likely have multiple underlying diagnoses that contribute to pain (Bicket and Mao 2015). Therefore, pain in older adults is often multimodal in nature, and comprehensive pain assessment is required (Herr 2011, Bicket and Mao 2015).

According to a comprehensive report by Bicket and colleagues in 2015, common causes of chronic pain in older adults include rheumatoid and osteoarthritis, spinal canal stenosis, diabetic peripheral neuropathy, trigeminal neuralgia, postherpetic neuralgia, peripheral vascular disease, central post-stroke pain, myofascial pain, and fibromyalgia (Bicket and Mao 2015). Obviously, cancer-related pain is a major pain-causing condition in the aged population (Bicket and Mao 2015). Additionally, postsurgical pain may become chronic (Bicket and Mao 2015).

The evaluation of pain intensity is known to be complex (Jensen et al. 1986, Breivik et al. 2008). Self-reporting has been considered to be the most reliable method of measuring pain (Booker and Haedtke 2016), also for older adults with possible cognitive impairments (Booker and Haedtke 2016, Hadjistavropoulos et al. 2010). Several pain assessment scales exist, such as the Numeric Rating Scale (NRS), Visual Analog Scale (VAS), Verbal Rating Scale (VRS), and Facial Pain Scale (FPS) (Bicket and Mao 2015).

Recently, Amtmann and colleagues examined the psychometric properties of a pain interference assessment bank (PROMIS-PI). The result of the study indicated a good reliability and validity of the bank. (Amtmann et al. 2010.)

Seniors with cognitive impairment are at an increased risk of improper pain assessment and treatment (Bicket and Mao 2015). These individuals, however, may communicate in several ways to report ongoing pain (facial expressions, verbalization, body movements, changes in interaction with other people or the environment) (Bicket and Mao 2015). The DOLOPLUS-2 scale may be effective in identifying pain in older adults with dementia (Ando et al. 2016). The Pain Assessment in Advanced Dementia (PAIN-AD) scale may be used, although studies

regarding its reliability and validity exhibit controversy (Ersek et al. 2006). Increasing effort needs to be paid to the administration of multiple pain assessment scales, in addition to a proper assessment of functional status in everyday activities, in adults of an advanced age who have impaired cognition (Hadjistavropoulos et al. 2007).

2.4 Pain coping

2.4.1 Definition of pain coping

Pain always includes a psychological component. Especially chronic pain produces a stressor to an individual, and may disturb their psychological balance (Andruszkiewicz et al., 2017). Children and adolescents are known to use various strategies to deal with prolonged or subacute pain (Weekes and Savedra 1988, Sposito et al. 2015, Nilsson and Willman 2016). These strategies include both psychological/social support, physical (e.g., relaxation methods) and pharmacological treatment strategies (Nilsson and Willman 2016).

The idea of measuring pain coping is to distinguish the ongoing cognitive, behavioral, and emotional processes connected to pain in children and adolescents with recurrent or chronic pain. Additionally, the effectiveness of treatment may also be studied (Claar et al. 2008, Simons et al. 2015, Kashikar-Zuck et al. 2013).

By definition, coping refers to purposeful cognitive and behavioral efforts to overrule the negative impacts of stress (Lazarus 1993). Cognitive strategies refer to changing the way an individual thinks or feels about a stressor, while behavioral strategies denote actually changing the way an individual deals with a stressful situation (Hermsen et al. 2016). It has been debated whether coping is more a process with the potential to change over time and across situations, or a trait that is more consistent in nature (Lazarus 1993). These aspects complement each other. In pain coping, concepts such as adaptive versus non-adaptive coping (Claar et al. 2008, Simons et al. 2015, Kashikar-Zuck et al. 2013) and active versus passive coping are often used (Edwards et al. 2016, Baastrup et al. 2016, Boschen et al. 2016). Non-adaptive strategies (e.g., passive avoidance of a stressor, catastrophizing) have been suggested to associate with increased pain (Kaminsky et al. 2006). On the other hand, in children and adolescents, accommodative strategies and minimized catastrophizing have been suggested to associate with better adjustment and more positive outcomes (Compas et al. 2012, Eccleston et al. 2004, Jensen et al. 1991,

Kashikar-Zuck et al. 2013). Catastrophizing signifies negative cognitive and emotional schema summoned during actual or anticipated pain (Quartana et al. 2010, Darnall et al. 2017).

Studies evaluating children's pain coping in diverse medical pain-causing events and conditions have found similar strategies by observation. The early reports from the 1980s–90s already suggested strategies such as information and support seeking, distraction, catastrophizing/denial and avoidance, approach, emotional manipulation, and calming self-talk/talking with someone (Ellerton et al. 1994, Brown et al. 1986, Altshuler and Ruble 1989). However, importantly, patients never fall into one precise coping category, and coping strategies are thus always individual and complex to measure (Walker et al. 2008). In addition, it has been presented that, for example, catastrophizing may serve as both an active and a passive way of coping—as a form of disengagement (passive) and as an appeal for help (active) (Walker et al. 2008).

The literature supports the use of cognitive-behavioral therapy in children and adolescents with chronic pain (Eccleston et al. 2009, Kashikar-Zuck et al. 2012, Palermo et al. 2010, Schanberg et al. 1997). Therapy strategies aim for improvement in children's daily functioning and a reduction in emotional distress (Kashikar-Zuck et al. 2013).

Although the main focus in the current study was on pediatric pain coping, evaluating pain coping also plays a role in geriatric pain assessment. In general, older adults have been reported to use fewer avoidant coping strategies and to have better impulse control than younger age groups (Diehl et al. 1996, Molton et al. 2008). Aging has long been known to modify an individual's coping (Lazarus and DeLongis 1983). As individuals get older, they usually become more discerning and efficient in the application of coping strategies (Brennan et al. 2012). Assessed by the Chronic Pain Coping Inventory (Jensen et al. 1995), task persistence, pacing, and coping self-statements were reported to be the most common coping strategies in older adults in one study (Ersek et al. 2006). In 1997, Hopman-Rock and colleagues suggested that seeking social support as a coping style would be a more important predictor of the experienced quality of life than either pain chronicity or physical disability (Hopman-Rock et al. 1997).

More negative thoughts about the consequences of pain, concerns and emotional pain-related representations, lower perceived self-efficacy, more catastrophizing and more activity avoidance, as well as an increase in pain itself have been suggested to be the most relevant contributors to declined physical functioning in older adults (Ilves et al. 2019, Hermsen et al. 2016). On the other hand, impractical coping (e.g.,

avoidance of analgesic use) may result in a loss of activity and, thus, lead to frailty and disability.

2.4.2 Significance of pain coping

It has been suggested that children's coping strategies may originate from the early child–parent interactions, manifesting either positive or negative coping models (Walker et al. 2008).

Coping with pain affects children's adjustment to pain. Especially in childhood, the pain coping style of chronic pain patient groups, such as catastrophizing, has rather consistently been found to positively relate to pain intensity and pain-related emotional stress (Simons et al. 2015, Edwards et al. 2016, Vervoort et al. 2010, Varni et al. 1996a). Additionally, baseline catastrophizing was suggested to predict pain and disability in a 6-month follow-up among school children (Vervoort et al. 2010). According to the Biobehavioral Model of Paediatric Pain, coping strategies are a key intervening factor in the relationship between children's functional status and pain perception (Varni et al. 1996b).

Experiences related to chronic illnesses often incite negative emotions in children and adolescents (Miers et al. 2007). Factors related to chronic illnesses (e.g., long periods of hospitalization) may have major negative effects on the child's self-concept (Failo et al. 2018). The importance of the family members' support to a child, but also of the medical professionals' support to the caregivers, is highlighted (Failo et al. 2018).

2.4.3 The Pain Coping Questionnaire (PCQ)

The Pain Coping Questionnaire (PCQ) was developed and validated in 1998 by Reid and colleagues (Reid et al. 1998). The PCQ was the first – and remains the only – pain coping measurement tool developed specifically for children. It has been proved to have good psychometric quality and is executable in multiple pain conditions (Reid et al. 1998, Hermann et al. 2007). Additionally, it is applicable to children from eight years of age onwards (Reid et al. 1998).

In the English version of the PCQ, 39 items describing pain coping strategies were included. Exploratory factor analysis (data from healthy children and adolescents) was executed, and the items were grouped into eight coping scales (Information Seeking [IS], Problem Solving [PS], Seeking Social Support [SSS],

Positive Self-Statements [PSS], Behavioral Distraction [BD], Cognitive Distraction [CD], Externalizing [EXT], Internalizing/Catastrophizing [IC]) (Reid et al. 1998). The scales were further analyzed in the arthritis/headache sample, and three second-order scales emerged (Approach [APP], Emotion-Focused Avoidance [EFA], Distraction [DIS]) (Reid et al. 1998).

Subsequently, three studies have examined the psychometric properties of the PCQ and adequately validated the measurement in other languages (Catalan, Danish, Dutch) (Thastum et al. 1999, Bandell-Hoekstra et al. 2002, Huguet et al. 2009). The Danish translation suggested a seven-scale first-order structure, combining the original Information Seeking and Problem Solving scales (Information Seeking/Problem Solving [IP]) outlined by Reid and colleagues (Thastum et al. 1999, Reid et al. 1998). In the referred study, the structure was achieved with 36 items (items 1, 9, and 36 excluded) (Thastum et al. 1999). The Dutch version suggested a first-order structure of eight scales (Bandell-Hoekstra et al. 2002). The Catalan translation was studied in both school children and adults, comparing the original and the Danish version (Huguet et al. 2009, Reid et al. 1998, Thastum et al. 1999). The confirmatory factor analysis supported the seven-scale model presented in the Danish version (Thastum et al. 1999, Huguet et al. 2009). The coping strategies comprising the PCQ are presented in Table

2.5 Pain management in children

The pharmacokinetics and pharmacodynamics of analgesics vary with the age of the patient (Mazur et al. 2013). Paracetamol and NSAIDs have been regarded as medicines of choice in children aged three months and older (Mazur et al. 2013). Opioid administration should not be avoided in cancer pain (Friedrichsdorf and Postier 2014). Non-pharmacological methods, e.g. emotional support, playing, and relaxation techniques, play a key role in children (Mazur et al. 2013).

2.5.1 Juvenile idiopathic arthritis (JIA)

JIA is the most common chronic rheumatic disease in childhood, with pain as its major symptom (Giancane et al. 2017). JIA comprises a group of several clinically

heterogeneous arthritides (Giancane et al. 2016). JIA is diagnosed based on the following criteria: onset prior to the age of 16 years, and arthritis persisting for longer than 6 weeks (Giancane et al. 2016, Prakken et al. 2011). Different JIA subtypes include systemic, oligoarticular, seropositive polyarticular, seronegative polyarticular, enthesitis-related, juvenile psoriatic, and undifferentiated (Giancane et al. 2016, Barut et al. 2017).

Table 2. The coping strategies comprising the Pain Coping Questionnaire (PCQ). Subjects were advised to report how they would act when in pain for hours or days (1 = Never; 2 = Hardly ever, 3 = Sometimes, 4 = Often, 5 = Very often).

1	Ask questions about the problem
2	Focus on the problem and see how I can solve it
3	Talk to a friend about how I feel
4	Tell myself, don't worry, everything will be OK
5	Go and play
6	Forget the whole thing
7	Say mean things to people
8	Worry that I will always be in pain
9	Ask a nurse or a doctor questions
10	Think about what needs to be done to make things better
11	Talk to someone about how I am feeling
12	Say to myself, be strong
13	Do something fun
14	Ignore the situation
15	Argue or fight
16	Keep thinking about how much it hurts
17	Find out more information
18	Think of different ways to deal with the problem
19	Tell someone how I feel
20	Tell myself it's not so bad
21	Do something I enjoy
22	Try to forget it
23	Yell to let off steam
24	Think that nothing helps
25	Learn more about how my body works
26	Figure out what I can do about it
27	Talk to a family member about how I feel
28	Say to myself things will be OK
29	Do something active
30	Put it out of my mind
31	Get mad and throw or hit something
32	Think that the pain will never stop
33	Try different ways to solve the problem until I find one that works
34	Let my feelings out to a friend
35	Tell myself I can handle anything that happens
36	Do something to take my mind off it
37	Don't think about it
38	Curse out loud
39	Worry too much about it

The systemic form, characterized by recurrent fever and a rash, is the most common subtype (Barut et al. 2017). Seropositive polyarticular JIA, which is analogous to adult rheumatoid arthritis, is rare (Barut et al. 2017). The etiology is unclear, but an inflammatory response derived from both endogenous and exogenous antigens has been shown to play a central role in the pathogenesis (Barut et al. 2017).

The main targets of JIA treatment are to control the pain, to preserve function and normal development, and to induce disease remission and manage complications (Barut et al. 2017). NSAIDs play a marked role in the pharmacological therapy with both their analgesic and their anti-inflammatory effect (Barut et al. 2017), but the pain treatment today mainly focuses on the control of disease activity instead of painkillers (Stoll and Cron 2014).

2.6 Pain-related factors in older adults

2.6.1 Socioeconomic factors

The current consensus supports an increasing prevalence of persistent pain up until 70–80 years of age (Crook et al. 1984), followed by a decline among the oldest old (Helme and Gibson 2001, Carmaciu et al. 2007, Brattberg et al. 1996), although the prevalence of pain-related conditions increase along with aging (Reid et al. 2015, Finne-Soveri and Pitkala 2007). The decrease in pain prevalence may be partially due to the older adults' impaired visceral pain perception (Moore and Clinch 2004). Older adults may also adjust to pain by decreasing their locomotion, by coping with increased stoicism, and thinking that pain increases with aging and you should not complain (Finne-Soveri and Pitkala 2007). A few studies have suggested an increasing prevalence with increasing age (Jakobsson et al. 2003).

Multiple studies have suggested a higher prevalence of pain in women compared to men (Berkley 1997, Pieretti et al. 2016). In women, higher pain intensity, more frequent pain, more painful areas, and longer pain duration have been reported (Pieretti et al. 2016). Women are also more affected by pain (Pieretti et al. 2016). Plasma estrogen levels have been suggested to be correlated with recurrent pain in women (Marcus 1995). Male gonadal hormones may also have pain-inhibiting effects (Ceccarelli et al. 2003).

In 1999, Lancet published a large study regarding the association of sociodemographic factors with chronic pain in adults aged 25 and older (Elliott et

al. 1999). The prevalence of chronic pain increased when an individual was living in rented council accommodation and was unemployed or retired. In a Finnish study examining socio-economic differences in relation to pain in adults aged 40–60 years, women with a lower educational level as well as divorced or widowed men were more likely to report pain (Saastamoinen et al. 2005). Aside from these, a few studies have examined socioeconomic factors in relation to pain in the general adult population, primarily suggesting more pain in people with lower socioeconomic status (Riskowski 2014, Gonzalez-Chica et al. 2018).

Specifically regarding the older age groups, an association has been presented between severe knee pain and lower household income, lower educational level, and being unmarried (Han et al. 2016). In a study by Patel and colleagues, older adults with a lower educational level reported more pain compared to those with a higher educational level (Patel et al. 2013). Additionally, a low socio-economic position has been reported to associate with current pain interference in a study examining a total of 2,533 older adults (Lacey et al. 2013). Therein, the socioeconomic position measures included the age when the individual left school, as well as the longest job and current/most recent job (Lacey et al. 2013). Furthermore, increasing neighborhood socioeconomic status has been found to associate with decreasing negative chronic pain outcomes in older adults (Fuentes et al. 2007).

2.6.2 Morbidity

Acute pain is a protective mechanism in response to a harmful stimulus and, apart from a couple of exceptions, originates from tissue damage or a somatic disease (Swieboda et al. 2013). Therefore, the somatic aspects and pain-causing morbidities were not considered herein.

However, especially chronic pain is frequently associated with multiple disabilities (Alschuler et al. 2016). Chronic pain negatively interferes with physical functioning and participation in everyday life activities (Hartikainen et al. 2005, Rapo-Pylkko et al. 2015, Ehde and Hanley 2006). In older adults, decreased physical functioning may result in, for instance, an increased risk of falls. On the other hand, pain acceptance has been suggested to associate with lower pain intensity and lower physical disability (McCracken 1998).

2.6.3 Psychological and emotional factors

The pain experience is always multidimensional, comprising of not only physiological but also psychological aspects and subjective perceptions (Swieboda et al. 2013). Emotional aspects, such as suffering, are always present (Swieboda et al. 2013, IASP 2018).

Depression and depressive symptoms have long been known to associate with persistent pain among the older population (Han et al. 2016, Zis et al. 2017, Roy and Thomas 1986, Sanders et al. 2015, Reid et al. 2003). A 13-year follow-up examining older adults in pain (N=1,528, mean age 67.9 years) found an association between pain and depression over the follow-up, and neither aging itself nor frailty changed the association (Sanders et al. 2015). A two-year follow-up investigating a longitudinal relationship between depression, anxiety, and pain in 545 patients with severe lower extremity trauma highlighted the role of a negative mood (anxiety) in the persistence of acute pain (Castillo et al. 2006).

Recently, Karjalainen and colleagues examined pain in Finnish older adults with or without diabetes, suggesting a higher prevalence of pain related to diabetes in both women and men (Karjalainen et al. 2018). In their study, depressive symptoms and the number of comorbidities were found to associate with frequent pain (Karjalainen et al. 2018).

An association between sleep disturbances and pain has been suggested (Vitiello et al. 2009, Smith and Haythornthwaite 2004). Sleep disturbances may have a key role in the development and maintenance of chronic pain (Finan et al. 2013). Vitiello and colleagues have suggested long-term improvements in chronic pain with short-term improvements in sleep in adults over 60 years of age (Vitiello et al. 2009).

Sadness has been reported to be more prevalent among older adults in pain than among those with no pain (Rapo-Pylkko et al. 2016), and loneliness has recently been highlighted as a predictor of many health-affecting concerns (insomnia, pain, fatigue) considering older adults (Jaremka et al. 2013). A lack of social support or contacts has been suggested to associate with pain in multiple studies (Baker et al. 2017, Alonso and Coe 2001, Bradbeer et al. 2003, Gil et al. 1987), but the protective effects of a social network on morbidity and mortality outcomes have been evident for a long time (Kawachi and Berkman 2001, Berkman et al. 2000, Holt-Lunstad et al. 2010).

2.6.4 Lifestyle aspects

Obesity and pain both comprise a burden on the individual, the healthcare system, and society (Taylor et al. 2014). The association between pain and obesity in older adults has been demonstrated in several studies (Heim et al. 2008, McCarthy et al. 2009, Ray et al. 2011, Okifuji and Hare 2015). Obesity is a major risk factor for osteoarthritis (Kulkarni et al. 2016), for example, and osteoarthritis is one of the leading pain-causing conditions in older adults (Peat et al. 2001). A significant association between central obesity and chronic pain has been shown to exist among community-dwelling adults aged 70 and older (OR 2.03, 95% CI 1.36–3.01) (Ray et al. 2011). Therein, chronic pain was defined as pain in at least one of eight predetermined locations at least some of the time with at least moderate severity over the preceding three months. In the study, the prevalence of pain exceeded 50% (Ray et al. 2011).

In a study examining the prevalence of metabolic syndrome (MetS) in patients with fibromyalgia, a 5.56-fold risk of MetS was discovered (Loevinger et al. 2007). Additionally, Duruöz and colleagues have found a significant difference in age and disease duration between chronic lower back pain patients with and without MetS (Duruoz et al. 2012). The consensus supports the consideration of the MetS risk factors in chronic lower back pain patients (Duruoz et al. 2012, Ha 2011). Neuropathic pain is closely related to MetS, which is determined as the presence of hyperglycemia (Callaghan and Feldman 2013). It has been shown that diabetics are more likely to have neuropathy if other components of MetS are also present (Isomaa et al. 2001), and half of all diabetics with neuropathy experience neuropathic pain (Abbott et al. 2011).

Studies examining the association of smoking and alcohol consumption with pain are scarce. A few larger studies have examined smoking and chronic pain in adults, suggesting smoking as a risk factor (Shiri et al. 2010, Shiri et al. 2007, Shi et al. 2010). Whether alcohol consumption increases or decreases subjective pain is unclear (Brennan and Soohoo 2013, Castillo et al. 2006).

Patients with lower back pain are recommended to remain physically active (Bekkering et al. 2003, Waddell et al. 1997), and different exercise methods have been actively used in the treatment of lower back pain (Chan et al. 2011, Suni et al. 2006). However, in 2012, a one-year follow-up study investigating the correlation between leisure time physical activity (LTPA) and lower back pain among cleaners (N=188) showed no correlation with and no positive effect of LTPA on pain during an episode of acute lower back pain (Jespersen et al. 2012). Additionally, in a meta-

analysis considering an association between lifestyle risk factors and lumbar radicular pain, high levels of LTPA were associated with an increased risk of lumbar radicular pain (Shiri et al. 2007).

Intrinsically, the nature of the pain needs to be determined when evaluating the treatment options. Yet, despite the contradictory study results, the overall consensus recommends exercise especially for musculoskeletal pain patients (Meng and Yue 2015, O'Connor et al. 2015).

2.7 Pain management in older adults

2.7.1 Recommendations

The overall consensus highlights the under-assessment, under-diagnosis, and under-treatment/mistreatment of persistent pain in older people (Gagliese and Melzack 1997, Tracy and Sean Morrison 2013, Veal et al. 2014). Proper assessment constitutes a basis for optimal pain management (Malec and Shega 2015). The treatment should focus on pain reduction, improvements in functioning, and an enhanced quality of life (AGS 2009, Fine 2012). According to the AGS, it is unrealistic to expect that the pain will completely disappear in all cases (AGS 2009).

Older adults may have different stages of cognitive impairment and dementia, which need to be taken into account in pain assessment and management planning, as cognitive impairment has been demonstrated to be a risk factor for, for instance, receiving unscheduled pain medication or fewer pain medication (Nygaard and Jarland 2006, Reynolds et al. 2008). Furthermore, difficulties in the physical accessibility of treatment, the cost of medication, multimorbidity, and polypharmacy may cause challenges in older adults' pain management (McCleane 2007). Importantly, age-related alterations in pharmacokinetics and pharmacodynamics (reduced muscle mass, increased body fat, decreased renal and hepatic function, etc.) may cause multiple challenges in pharmacological pain management (Fine 2012, AGS 2009).

Analgesic administration should follow the principle of "start slow and go slow" (AGS 2009). According to a large literature review regarding pain management in the older adult population (92 studies from 1990 to 2014), paracetamol was considered to be the first-line pharmacological therapy, followed by NSAIDs in the absence of contraindications (Makris et al. 2014). The use of COX-2 selective

inhibitors has been associated with fewer gastrointestinal adverse effects compared to other NSAIDs, but the other types of NSAID-related toxicities are the same (Fine 2012, By the American Geriatrics Society Beers Criteria Update Expert 2019). Non-pharmacological modalities always need to be added to pharmacological ones (Makris et al. 2014, Abdulla et al. 2013). Opioid administration may be considered with moderate to severe cancer and non-cancer pain, but only after precise individual deliberation and with careful monitoring (Abdulla et al. 2013, Naples et al. 2016, Huang and Mallet 2013). Neuropathic conditions should be managed with neuropathic drugs (Pickering et al. 2016).

Long-term opioid administration for chronic non-cancer pain remains controversial (Galicia-Castillo 2016). Multiple studies have suggested tramadol or other weak opioids as the first-line opioid for acute and chronic pain (Makris et al. 2014, Naples et al. 2016, Reid et al. 2015). On the other hand, a few studies have proposed a preference of low-dose strong opioids for older adults (Huang and Mallet 2013, Guerriero 2017, van Ojik et al. 2012). For neuropathic conditions, gabapentinoids and especially SNRIs have been suggested as preferred over TCAs (Pickering et al. 2016).

However, expert groups have also issued warnings concerning several analgesics in special patient groups. The American Geriatrics Society's (AGS) Beers Criteria for potentially inappropriate medication use in older adults (the 2019 update) highlights the use of non-pharmacological methods in older adults, as the administration of all analgesics may comprise challenges among older people (AGS 2009). According to the Beers Criteria, NSAIDs should be avoided in long-term use in older adults, and SNRIs, TCAs, and tramadol should be used with caution (By the American Geriatrics Society Beers Criteria Update Expert 2019). The AGS also suggests the avoidance of antiepileptics, TCAs, SNRIs, and opioids in individuals with a history of falls and fractures (By the American Geriatrics Society Beers Criteria Update Expert 2019).

2.7.2 Prevalence studies considering analgesics administration in older adults

Prevalence studies considering the administration of analgesics among older adults in a population-based setting are scarce (Rapo-Pylkko et al. 2016, Nawai et al. 2017, Veal et al. 2015, Pokela et al. 2010, Koponen et al. 2013). Some studies regarding the use of analgesics among older adults exist (Enthoven et al. 2014). Steinman and

colleagues studied alterations in analgesics use among older adults in the USA between 1999 and 2010 (mean age 75 years) (Steinman et al. 2015). They found that opioid use had more than doubled, paracetamol use had remained stable, NSAID use had decreased slightly, and the use of gabapentinoids had increased slightly during the follow-up period (Steinman et al. 2015). In 2010, it was presented that 23% of community-dwelling older adults in Finland took analgesics on a daily basis (Pokela et al. 2010).

Halla-aho and colleagues studied the use of analgesics for musculoskeletal pain among home-dwelling older adults in two cohorts, 1999 vs. 2009 (Halla-aho musculoskeletal). In the 1999 cohort, 36% had used prescribed analgesics for interfering joint pain and 38% for interfering back pain, whereas the proportions in the 2009 cohort were 42% and 48%, respectively (Halla-aho et al. 2013).

The use of over-the-counter analgesic may induce remarkable bias in the estimates. Referring to what is presented in the literature, the overall amount of NSAIDs used most likely exceeds what is presented in the prevalence studies, when combined with the amount obtained over the counter (Enthoven et al. 2014). In 2002, it was estimated that over-the-counter administration would have accounted for 54% of all ibuprofen sold in Finland (Turunen et al. 2005). In the referred study, the setting was questionnaire-based ("how often do you use prescribed/over-the-counter analgesics?"), and the participants were randomly selected citizens (N = 3,282) (Turunen et al. 2005). More recently, in 2015, Sarganas and colleagues studied analgesics use in a population-based setting and presented the following prevalence figures in adults aged 65 years and older: overall analgesics use 19.5%–20%, over-the-counter analgesics 3.7%–4.5%, and prescribed analgesic 13%–16 % (Sarganas et al. 2015). However, regarding older adults, a strong association between increased age and the use of only prescribed analgesics was found (Sarganas et al. 2015).

A recent study pointed out a concern as to whether the monitoring of the proper dose and analgesic selection in older adults is sufficient, as 30% of the study subjects with moderate to severe pain felt they needed stronger pain medication, and 15% were concerned they were using too much pain medication (Nawai et al. 2017). Additionally, according to Karttunen and colleagues, 41% of community-dwelling older adults with chronic musculoskeletal pain hoped a physician would pay more attention to their pain management (Karttunen et al. 2014). According to another study by Karttunen and colleagues, only 15% of Finnish older adults with chronic pain were taking analgesics regularly (Karttunen et al. 2015).

2.7.3 Non-steroidal anti-inflammatory drugs (NSAIDs)

Non-steroidal anti-inflammatory drug is a term referring to drugs with analgesic, anti-inflammatory, antithrombotic, and antipyretic effects. The mechanisms behind both the desired and adverse effects originate from the inhibiting effect of NSAIDs on cyclooxygenase enzymes (COX-1 and/or COX-2), which are involved in prostanoid (prostaglandins, prostacyclins, thromoxanes) synthesis (Wehling 2014, Schjerning et al. 2009, Harirforoosh and Jamali 2009, Harirforoosh et al. 2013). In particular, NSAIDs and selective COX2 inhibitors inhibit cyclooxygenase through competing with arachidonic acid for the active site of the enzyme, thus inhibiting its conversion to prostaglandin H (Jozwiak-Bebenista and Nowak 2014). The term NSAIDs often includes propionic acid derivatives (e.g. ibuprofen, naproxen), acetic acid derivatives (e.g. ketorolac, indomethacin, diclofenac), oxicams, fenamates, as well as second-generation NSAIDs, namely selective COX-2 inhibitors (Harirforoosh and Jamali 2009). In addition, the oldest NSAID, salicylate (e.g. acetylsalicylic acid) has originally been included (Harirforoosh and Jamali 2009).

According to the literature, NSAIDs are a major cause of drug-related morbidity among the older population (Wehling 2014). Contradictorily, the majority of the side effects of NSAIDs are related to inflammation (Harirforoosh and Jamali 2009), as NSAIDs develop a change in the balance between COX-1 and COX-2 activities in the body (Harirforoosh et al. 2013). For example, the effects of non-selective NSAIDs on the gastrointestinal tract originate from the inhibition of the protective effects of cyclooxygenases on the gut mucosa (Wehling 2014, Sostres et al. 2010). Furthermore, the gastrointestinal side effects are associated with the expression of nitric oxide, which is implicated in inflammatory conditions (Harirforoosh et al. 2013). It has been estimated that gastrointestinal ulcers may occur in several percent of all chronic unprotected, high-dose NSAID users (Wehling 2014). The use of selective COX-2 inhibitors has been reported to reduce the risk of gastrointestinal complications (e.g. perforation, motility impairment, bleeding) significantly (Sostres et al. 2010, Jarupongprapa et al. 2013). The main risk factors of gastrointestinal complications related to NSAID use include a previous peptic ulcer, age, and concomitant aspirin use (Sostres et al. 2010).

NSAIDs also have renal side effects, which can be as severe as acute or chronic kidney injury (Musu et al. 2011). The prevalence of renal adverse effects has been estimated to be 1%–5% among NSAID users (Harirforoosh and Jamali 2009). Various forms of renal failure have been reported: for example, sodium retention, hyperkalemia, and papillary necrosis (Breyer et al. 2001, Whelton and Hamilton

1991). Changes in renal function may influence the cardiovascular system (Harirforoosh and Jamali 2009), such as sodium retention resulting in arterial hypertension (Wehling 2014). The cardiovascular adverse effects include fluid retention, increasing blood pressure, heart failure, and atherosclerotic events (Wehling 2014, McGettigan and Henry 2006, Trelle et al. 2011). The effects of NSAIDs on ion channels (Ca2+ induced K+ channels) have been thought to be one explanation of the cardiotoxicity (Harirforoosh and Jamali 2009, Brueggemann et al. 2010). It has been estimated that chronic high-dose NSAID use in the long term may triple the risk of cardiovascular events (Wehling 2014). Additionally, increased mortality in association with NSAID use has also been reported (Gislason et al. 2009). It has been presented that, aside from the gastrointestinal effects, COX-2 selective inhibitors do not differ from other NSAIDs in terms of other drug-related toxicities (Fine 2012).

A 13-fold increase in the risk of hemorrhagic peptic ulcer disease has been demonstrated in concomitant use of NSAIDs and warfarin (Fine 2009). Concomitant use of NSAIDs and diuretics has been shown to double the risk of hospitalization for congestive heart failure in adults aged 55 years and older (Heerdink et al. 1998). In addition, the use of concomitant SSRIs strongly increases the risk of gastrointestinal bleeding (de Jong 2003).

NSAIDs may be considered for short-term musculoskeletal or inflammatory pain if contraindications are not present (Fine, AGS, Makris, Abdulla). The concomitant use of a proton-pump inhibitor is recommended, although recent studies have suggested that proton-pump inhibitors are unable to prevent NSAID-related gastrointestinal adverse effects (Scarpignato et al. 2015).

Topical NSAIDs have been regarded as a safer and effective alternative to systemic NSAIDs in older adults, especially in local arthrosis and arthritis-related pain, for example, but the risk of systemic adverse effects is also present with topical products (Makris et al. 2010).

A few studies have estimated NSAID administration in older adults, comprising diverse study settings. In community-dwelling adults aged 70 and older, the prevalence of regular NSAID use has been reported to be 8% and that of as-need use 3% (NSAID definition: selective COX-2 inhibitors, non-selective COX-1 and COX-2 inhibitors), and the mean treatment duration was almost 5 years (Gnjidic et al. 2014). In a large population-based study published in 2010, Vandraas and colleagues retrieved all NSAID prescriptions (NSAID definition: all Mo1A drugs within the World Health Organization Anatomical Therapeutic Chemical

classification system [ATC], excluding glucosamine, nabumetone, and selective COX-2 inhibitors) for chronic gout, rheumatoid arthritis/ankylosing spondylitis, and/or severe coxarthrosis and gonarthrosis of community-dwelling adults aged 60 years or older from the nationwide Norwegian Prescription Database (Vandraas et al. 2010). According to their results, 7% of the seniors had received a NSAID prescription for these conditions during a one-year interval (Vandraas et al. 2010).

According to a study by Pilotto and colleagues, 25% of adults over 65 years of age had used NSAIDs (one third chronically) (Pilotto et al. 2003). In a Canadian retrospective study using Alberta Blue Cross Database data of over 60,000 aged citizens, the prevalence of NSAID use was 27% (Hogan et al. 1994). However, acetylsalicylic acid, most commonly used for an antithrombotic indication, was included in these two analyses. Selective COX-2 inhibitors were not included. In a study reviewing 16 NSAID use–related papers, the prevalence of a daily administration of NSAIDs was evaluated to be as high as 20%–30% among older adults (Findley and Bulloch 2015). The definition of NSAIDs has proved crucial in comparing prevalence studies. Originally, acetylsalicylic acid has been considered a member of the NSAID family, but it has not been included very often in newer studies. Additionally, new-generation NSAIDs, COX-2 selective inhibitors, have been included in several newer studies. Examples of studies evaluating the prevalence of NSAID use in a population-based setting are presented in Table 3.

2.7.4 Paracetamol (acetaminophen)

Paracetamol is well tolerated, but increasing numbers of paracetamol-induced liver intoxications (dose-dependent) have been reported (Jozwiak-Bebenista and Nowak 2014).

The mechanism of action of paracetamol is unclear, but it has been suggested to act as a factor reducing a ferryl protoporphyrin IX radical cation within the peroxidace site of the cyclooxygenace enzyme (Jozwiak-Bebenista and Nowak 2014, Anderson 2008). This ferryl protoporphyrin IX radical cation is needed in tyrosine-385 oxidation into tyrosine-385 radicals, which are needed in the conversion of arachidonic acid to prostaglandin H (Anderson 2008).

Table 3. Examples of studies evaluating NSAID administration among older adults in a population-based setting. Presenting population-based studies.

STUDY	Hogan et al. 1994, CMAJ, Canada	Pilotto et al. 2003, Drugs and Aging, Italy	Vandraas et al. 2010, Eur J Clin Pharmacol, Norway	Landi et al. 2013, J Am Med Dir Assoc	Gnjidic et al. 2014, Pain, Australia
N	61,601	3,154	984,457	354	1,696 men
AGE GROUP	Over 65 years	Over 65 years	Over 60 years	Over 80 years	Over 70 years
DESIGN / SETTING	At least one prescription within 6 months	Cross-sectional	Data from the Norwegian Prescription Database	Prospective cohort	Cross-sectional, self-report
NSAID DEFINITION	Non-selective COX-1 and COX-2 inhibitors as well as acetylsalicylic acid, COX-2 inhibitors not included	Non-selective COX-1 and COX-2 inhibitors as well as acetylsalicylic acid, NSAIDs referred to as 'Others' included	ATC: Mo1A, excluding glucosamine, nabumetone, and COX-2 inhibitors	N/A	Selective COX-2 inhibitors, non-selective COX-1 and COX-2 inhibitors
PREVALENCE	27%	25%	7%	12%	Regular use 8%, as-needed use 3%

The adverse effects of paracetamol are less frequent compared to NSAIDs, which may be partially due to the fact that paracetamol mostly acts centrally and not much peripherally (Anderson 2008). In the central nervous system, it influences pain stimulus conduction through the spinal cord to the thalamus and the cerebral cortex via the COX, the descending serotoninergic pathways, the L-arginine/NO-pathway, and the cannabinoid system (Jozwiak-Bebenista and Nowak 2014). Also, paracetamol only weakly inhibits COX-1 (Jozwiak-Bebenista and Nowak 2014). It has a markedly stronger effect on COX-2, which, however, may carry a risk of coxib-like adverse effects, such as hypertension, myocardial infarction, and renal failure, in long-term and high-dose use (Jozwiak-Bebenista and Nowak 2014).

Paracetamol has long been considered the drug-of-choice in geriatric pain management (Nawai et al. 2017, Makris et al. 2014, Abdulla et al. 2013). Recently, however, physicians have been encouraged to consider not prescribing paracetamol for patients with lower back pain and osteoarthritis due to possible inefficacy (Machado et al. 2015). Its possible inefficacy in chronic pain conditions may be considered as one major 'adverse effect' (Machado et al. 2015).

In 2013, a Finnish study presented the prevalence of regular or as-needed paracetamol use to be 31% among community-dwelling older adults over 75 years of age (Koponen et al. 2013). In this study, paracetamol was the most prevalent analgesic in frail (54%) and pre-frail (34 %), but not in robust (19%) individuals, who predominantly used NSAIDs (25%) (Koponen et al. 2013). In a recent study examining the analgesics administration profile among community-dwelling older adults (over 70 years of age) in the USA, 28% of the studied individuals had used paracetamol during the preceding two weeks (Nawai et al. 2017). Therein, paracetamol was the most prevalent analgesic (Nawai et al. 2017).

2.7.5 Opioids

Opioid administration is a worrying and growing phenomenon worldwide; the inappropriate use of prescribed opioids is also referred to as an epidemic (Manchikanti et al. 2012). Opioid-related overdose deaths have been reported to have doubled in the USA from 2000 to 2014 (Rudd et al. 2016). A significant proportion of the increase in deaths was associated with the addition of long-acting oxycodone to the drug formulary (Dhalla et al. 2009). The opioid crisis is no longer regarded as a medical problem, but a public health crisis (Pergolizzi et al. 2017).

Several matters need to be considered when prescribing opioids to older adults. The challenges and adverse effects related to opioid administration are emphasized in later life due to age-related physiological changes, cognitive impairment, multimorbidity, and polypharmacy (Makris et al. 2014). The physiological changes include, for example, altered renal function, changes in absorption, and frailty (Makris et al. 2014, Reid et al. 2011). Cognitive impairment may pose a challenge in pain assessment (Makris et al. 2014), but decreased mental health functioning has been reported.

When opioids are prescribed, the appropriate dose needs to be carefully titrated (Abdulla et al. 2013). Both desired and adverse effects need to be monitored regularly (Abdulla et al. 2013, Huang and Mallet 2013, O'Mahony et al. 2015). Adverse effects are relatively frequent, potentially with severe consequences (Papaleontiou et al. 2010, Benyamin et al. 2008, Pergolizzi et al. 2017, Pergolizzi et al. 2008). Common reported adverse effects include dizziness (potentially leading to falls), constipation, nausea and vomiting, respiratory depression, pruritus and urinary retention, and a decline in cognitive function (Papaleontiou et al. 2010, Benyamin et al. 2008, Pergolizzi et al. 2008, Schug et al. 1992). Older people are especially prone to developing confusion and cognitive decline when using opioids. In addition, the risk of falls and fractures comprises a major risk in older adults (Perttila et al. 2018). It is important to mention that the tendency to develop opioid-related tolerance, according to reports, may develop as rapidly as within days (Collett 1998).

Three opioid receptor peptides have been identified: the mu- (MOR), delta- (DOR), and kappa-opioid receptor (KOR) (Pergolizzi et al. 2017, Stein 2016). The majority of the commonly used opioid agonists have the greatest affinity to MORs, and the KOR and DOR effects are merely dose-dependent (Pergolizzi et al. 2017). All receptors are known to activate the K+ and to inhibit the Ca2+ channels (Pergolizzi et al. 2017). K+ channel activation leads to neuron hyperpolarization, thereby raising the pain threshold (Pergolizzi et al. 2017). Ca2+ current inhibition, instead, leads to a decreased release of excitatory neurotransmitters (Pergolizzi et al. 2017, Zhang et al. 2005). Thus, all receptors mediate analgesia (Stein 2016). The effects of MORs also include euphoria, constipation, respiratory depression, and reduced inflammation, while the effects of DORs entail convulsions, anxiolysis, and constipation and effects of KORs diuresis, dysphoria, and reduced inflammation (Stein 2016).

Opioids have traditionally been classified as weak (tramadol, codeine) and strong (e.g. morphine, oxycodone), although the classification has been less used in recent reports (Rosenblum et al. 2008). Morphine is metabolized in the liver, and both

important metabolites, morphine-6-glucuronide (M6G) and morphine-3-glucuronide (M3G), have significant effects in the body (Prostran et al. 2016). M6G functions as an analgesic, and M3G may cause neuroexcitatory effects (Prostran et al. 2016). Most opioids are metabolized by CYP450 isoenzymes (Gianni et al. 2009).

Oxycodone is a semi-synthetic opioid with 1:2 equivalence to morphine (Ordonez Gallego et al. 2007). No significant difference has been found in the analgesic efficacy of oxycodone versus morphine in cancer pain (Kalso and Vainio 1990, Heiskanen et al. 2000).

In addition to binding to opioid receptors, tramadol inhibits serotonin and noradrenaline receptors (Chau et al. 2008) and may cause SNRI-like adverse effects, such as hyponatremia (By the American Geriatrics Society Beers Criteria Update Expert 2019).

Individual variability in codeine metabolism should be recognized (Chau et al. 2008). Codeine is a pro-drug and has a 200-fold weaker affinity to MOR compared to morphine (Chidambaran et al. 2017). Eighty percent of codeine is inactivated by CYP3A4, and only 5%–10% is O-demethylated to morphine by CYP2A6 (Chidambaran et al. 2017). More than a hundred polymorphisms of CYP2A6 have been identified (Chidambaran et al. 2017). The polymorphisms comprise major challenges in the prediction of an individual's clinical response to codeine, as individuals may be poor, intermediate, or ultra-rapid codeine metabolizers (Chidambaran et al. 2017).

Buprenorphine has, in some studies, been presented as being preferred for older adults due to its favorable pharmacokinetic properties (Huang and Mallet 2013). Buprenorphine is a partial agonist of, but has a high affinity to MOR (Chen et al. 2014). Therefore, the MOR-mediated adverse effects, such as respiratory depression, develop to a lesser extent in comparison to other opioid receptor agonists. Additionally, buprenorphine slowly dissociates from the MOR, producing a prolonged duration of action (Chen et al. 2014). Furthermore, as buprenorphine is a KOR antagonist, the KOR-mediated effects, such as dysphoria, are diminished (Chen et al. 2014). For the past decade, a buprenorphine patch has been probably the most prevalent opioid among older adults (Mercadante et al. 2016). On the other hand, Lalic and colleagues recently found that transdermal opioid administration was the strongest predictor of opioid use persistence in older adults aged 65–84 years (OR 4.24, 95% CI 3.85–4.68), as well as in adults over 85 years of age (OR 3.47, 95% CI 3.02–3.98). In the oldest old, initiation on a strong opioid also strongly predicted persistent use. (Lalic et al. 2018.)

The advantages of using opioid receptor antagonists have been discussed (Holzer 2010, Powell et al. 2002, Hoskin and Hanks 1991). A study considering oral alvimopan for the shortening of postoperative ileus, subcutaneous methylnaltrexone for the reduction of constipation, and oral naloxone with oxycodone for pain treatment, showed a favorable adverse effect profile in all three entities (Holzer 2010). Therein, the analgesic effect was reported to be constant. In addition, the rewarding effects of morphine have been suggested to be prolonged when combined with an ultra-low dose antagonist (Powell et al. 2002). In 2014, a favorable profile of the prolonged-release oxycodone/naloxone combination in comparison to prolonged-release oxycodone in terms of efficacy, rates of observed constipation, tolerability, and cost-effectiveness was reported (Burness and Keating 2014).

Opioid-induced adverse reactions were recently reported as being frequent in male patients of the Korea Veterans Hospital. The odds of adverse reactions increased significantly in long-term use. Compared to codeine use, individuals using morphine and oxycodone had 653 and 473 % increased odds of adverse reactions. (Kim et al. 2018.)

The decision as to whether a weak or strong opioid should be selected when the need for an opioid in an older adult arises is complex due to the lack of evidence regarding safety and tolerability (Prostran et al. 2016). Recent suggestions have highlighted the importance of proper assessment of the pain quality upon which the selection should be based (Malec and Shega 2015).

A recent Canadian recommendation regarding opioid therapy for non-cancer pain suggested the following: the optimization of non-opioid pharmacotherapy and non-pharmacological therapy; a trial of opioids (rather than continued therapy) for patients with no history of substance abuse or any other active psychiatric condition; avoiding the use of opioids in patients with active substance abuse or a history thereof; stabilizing the psychiatric disorder before the trial of opioids in patients with active psychiatric disease; adjusting the morphine-equivalent daily dose to less than 50–90 mg for patients who are beginning the opioid therapy for chronic non-cancer pain; rotation to another opioid in patients with current opioid use but persistent problematic pain and/or problematic adverse effects; tapering opioids to the lowest effective dose in chronic non-cancer pain patients using the equivalent of 90 mg morphine or more daily; a formal multidisciplinary program for patients with chronic non-cancer pain who are using opioids but experiencing serious challenges in tapering (Busse et al. 2017).

Opioids have also proved effective in neuropathic pain, but only as a second- (tramadol) and third-line therapy (strong opioids) (Finnerup et al. 2015). Opioid-

related adverse effects and the development of tolerance need to be taken into account in pain management (Abdulla et al. 2013).

To date, studies evaluating opioid use in older adults have been scarce. During the current decade, it has been estimated that approximately 5%–9% of community-dwelling older adults use opioids chronically for non-cancer pain (Campbell et al. 2010, Karp et al. 2013, Nawai et al. 2017, Hamina et al. 2017a). In 2011, Marcum and colleagues presented the prevalence of analgesics administration among community-dwelling seniors with symptomatic lower limb osteoarthritis (Marcum et al. 2011). Half of the participants in their study reported taking at least one non-opioid analgesic, while one in ten reported taking some opioid analgesic (Marcum et al. 2011).

Pitkälä and colleagues examined the change in opioid administration among institutionalized older adults over an eight-year follow-up (2003–2011). The prevalence of regular opioid use doubled within 8 years in both nursing homes (12% vs. 23%) and assisted living facilities (9% vs. 17%). (Pitkala et al. 2015.) The use of opioids had increased further in a subsequent 6-year follow-up (Roitto et al. 2019). Furthermore, in 2014, Veal and colleagues studied opioid consumption among older adults living in a fulltime care facility and found that 28% had used opioids regularly, and only half of these subjects with optimized paracetamol. The most prevalent opioid was immediate-release oxycodone (15% of all subjects), followed by a buprenorphine patch (13%) and codeine, with or without a combined analgesic (8%). (Veal et al. 2014.)

2.7.6 Neuropathic drugs

The prevalence of neuropathic pain is known to increase with age (Schmader et al. 2010). The evaluation of pain quality and the recognition of the neuropathic component of pain is important, as higher pain and disability scores reduce the quality of life and a higher prevalence of psychological disorders has been shown to associate with neuropathic pain (Smith and Torrance 2012). The current study focused on gabapentinoids (pregabalin, gabapentin) and tricyclic antidepressants (TCAs; amitriptyline, nortriptyline). However, since the serotonin-noradrenaline reuptake inhibitors (SNRIs) duloxetine and venlafaxine have recently become preferred in managing older adults' neuropathic pain (Finnerup et al. 2015), they are also briefly discussed below.

Gabapentin was originally developed as an anticonvulsant, and its analgesic effect was presented 20 years ago (Mellick et al. 1995). Gabapentinoids are particularly effective in neuropathic pain (Toth 2014). Both gabapentin and pregabalin were originally designed as GABA analogs, but neither has any significant effect on GABA levels (Lanneau et al. 2001, Patel and Dickenson 2016). The precise mechanism of action of gabapentinoids remains unclear, but it is assumed that they bind to calcium channel subunits that regulate the activation and inactivation of calcium currents (Patel and Dickenson 2016, Hobom et al. 2000), thereby inhibiting the release of neurotransmitters in neuronal tissues (Chincholkar 2018). Gabapentinoids have been reported to associate with increased sedation, dizziness (potentially leading to falls), and visual disturbances (Mathiesen et al. 2014) but are still considered well tolerated (Toth 2014). Gabapentinoids have been suggested to double the risk of falls among older people (Mukai et al. 2019). They are excreted through the kidneys, thus accumulating in renal dysfunction (Toth 2014).

Tricyclic antidepressants and SNRIs have been reported to be efficacious in multiple chronic pain conditions, such as diabetic neuropathy and migraine (Jackson and St Onge 2003). A recent meta-analysis including 23 RCTs specified the drug-related adverse effect risk profiles (Riediger et al. 2017). The common side effects were concluded to be as follows: drowsiness/dizziness, dry mouth, constipation, headache and weight gain for amitriptyline and nortriptyline; nausea/vomiting and drowsiness/dizziness for venlafaxine; and nausea/vomiting, dizziness, fatigue, gastrointestinal symptoms, and headache for duloxetine (Riediger et al. 2017, Sansone and Sansone 2008). A recent large systematic review and meta-analysis evaluated the overall tolerability of antidepressants used for chronic pain as being high (Riediger et al. 2017).

The analgesic effects of both TCAs and SNRIs involve binding to noradrenaline and serotonin transporters, leading to an increase in these neurotransmitters in the synaptic cleft (Obata 2017). In particular, the noradrenaline reuptake inhibition–mediated activation of the alpha2-adrenergic receptors in the spinal cord dorsal horn inhibits hyperalgesia and allodynia (Obata 2017). The increase in serotonin in the synaptic cleft plays an auxiliary role, but the precise mechanism of action is not clear (Obata 2017). It has been suggested that serotonin inhibits the generation of painful stimuli in the central nervous system, but, contrarily, also increases pain transmission from the periphery (Ferjan and Lipnik-Stangelj 2013).

Amitriptyline inhibits serotonin reuptake more than it does noradrenaline uptake, whereas nortriptyline has more effect on noradrenaline (Sansone and Sansone 2008). Venlafaxine inhibits serotonin reuptake at low doses and noradrenaline uptake at

high doses (Sansone and Sansone 2008). Duloxetine has been suggested to inhibit the reuptake of both serotonin and noradrenaline relatively equally and has thereby proved very effective (Sansone and Sansone 2008).

The NNT (number needed to treat) for neuropathic drugs varies significantly between disease states (Finnerup et al. 2015), which may be considered a problem when using these drugs. According to what was presented in 2015 in the updated recommendations for the treatment of neuropathic pain in adults (not only older people) by Finnerup and the IASP Neuropathic Pain Special Interest Group, the combined NNTs for neuropathic drugs were: 7.71 for pregabalin (95% CI 6.5–9.4), 7.16 for gabapentin (95% CI 5.9–9.1), 6.40 for serotonine-noradrenaline reuptake inhibitors (95% CI 5.2–8.4), and 3.57 for TCAs (95% CI 3.0–4.4) in the adult population (Finnerup et al. 2015).

Prevalence studies regarding neuropathic drug administration among older adults are extremely scarce, and a literature search did not find an even relatively recent study that would have comprehensively evaluated TCA, gabapentinoid, or SNRI use for a pain indication among community-dwelling older adults.

A few existing guidelines suggest gabapentinoids and SNRIs rather than TCAs for older adults due to the major anticholinergic effects of TCAs (Pickering et al. 2016, McGeeney 2009). SNRIs (duloxetine, venlafaxine) have recently gained more favor among older adults (Pickering et al. 2016). The favorable effect of duloxetine in the treatment of ostheoarthritis pain in older adults has been suggested (Abou-Raya et al. 2012). Additionally, Karp and colleagues recently encouraged the use of duloxetine in the management of comorbid depression and chronic lower back pain in older adults (mean age 71 years) (Karp et al. 2010).

2.7.7 Non-pharmacological modalities

As knowledge regarding drug-related adverse effects is increasing, non-pharmacological modalities have gained support in the management of pain in older adults (Park and Hughes 2012). According to the AGS Beers Criteria, non-pharmacological modalities should form the base for chronic pain management in older adults (AGS 2009). IASP encourages the use of a multidisciplinary approach in chronic pain management (IASP 2018).

Non-pharmacological methods include, for example, exercise, cognitive and behavioral techniques (e.g. problem solving, distraction, goal setting), acupuncture, mindfulness, massage and osteopathic manual therapies, as well as movement-based

approaches and physical therapy (Makris et al. 2014, Wehling 2014, Tick et al. 2018). The importance of socialization has also been reported (Kroenke et al. 2013). Lifestyle approaches (diet, sleep hygiene) may be beneficial (Tick et al. 2018). According to several studies, non-pharmacological methods have proved safe, can reduce pain and improve functioning, and should be included in pain management whenever possible (Makris et al. 2014, Abdulla et al. 2013, Shekelle et al. 1999).

In addition to pain reduction, non-pharmacological therapies have the ability to, for instance, reduce anxiety and depression, improve sleep, and increase an individual's sense of well-being and recovery motivation (Tick et al. 2018).

2.7.8 Factors associated with the use of analgesics

In 2010, Pokela and colleagues presented the results of a study in which they examined factors associated with daily and as-needed analgesics use in community-dwelling older adults over 75 years of age in Finland. Therein, female sex, poor self-rated health, and the use of more than ten non-analgesic drugs were found to associate with any analgesic use, and moderate and poor self-rated health were associated with opioid use. (Pokela et al. 2010.) Interestingly, while Pokela and colleagues (2010) found opioid and daily analgesic use to be inversely associated with depressive symptoms, another Finnish study by Gilmartin and colleagues reported analgesic use to be independently associated with depressive symptoms in patients with Alzheimer's disease (Gilmartin et al. 2015).

According to Sarganas and colleagues, adults (18–79 years of age) with low socio-economic status and who are overweight were found to use significantly more prescribed analgesics than adults with high socio-economic status, whereas high education and physical activity exceeding 2 hours per week were associated with lower use of prescribed analgesics (Sarganas et al. 2015). Additionally, in 2004, a relationship was found in a study by Turunen and colleagues between frequent analgesics use and high age, low mood, unemployment, and pain (Turunen et al. 2005).

Hamina and colleagues studied long-term opioid use in Finnish older adults with or without Alzheimer's disease. Therein, factors associated with chronic opioid use included Alzheimer's disease, female sex, rheumatoid arthritis, low socioeconomic status, a history of substance abuse, and chronic benzodiazepine use (Hamina et al. 2017a). Furthermore, multiple studies outside Finland have investigated factors

related to and predicting long-term opioid use in adults of all ages, suggesting high baseline opioid dose, the use of transdermal opioids, depression or other psychiatric conditions, nicotine dependence, the use of non-opioid analgesics, previous benzodiazepine use, patient expectations about using opioids in the future, poor overall health, and higher levels of reported distress as predictors (Lalic et al. 2018, Quinn et al. 2017, Thielke et al. 2017, Rogers et al. 2013).

2.7.9 Clinical aspects

Successful pain management requires the balancing of the benefits and harms of the available drugs, as well as lifestyle interventions and the treatment of the underlining cause as far as possible (Kalso et al. 2013).

Non-pharmacological modalities should always form the basis of chronic pain management and should also be given a role in the management of acute pain (AGS 2009, Hadjistavropoulos et al. 2007, Makris et al. 2014, Abdulla et al. 2013).

Previous study findings have indicated that the NSAID prescribing practices do not align with the guidelines for safe use in older adults (Gnjidic et al. 2014). The mechanisms behind NSAID toxicity are well reported, but the consequences frequently remain uncontrolled in clinical practice (Wehling 2014).

On the other hand, NSAIDs have proved effective in multiple inflammatory and chronic pain conditions affecting older adults, such as osteoarthritis, rheumatoid arthritis, and gout (Fowler et al. 2014). NSAIDs also improve stiffness and function (Golden et al. 2004), which may markedly affect the quality of life.

Opioids have earned their place as an important part of the treatment of severe acute pain and cancer pain (Chou et al. 2009). The selection of the appropriate opioid is challenging, and the study results are incongruous. However, one should emphasize that the literature consensus supports the individual consideration of the opioid selection and dosing according to the patient's health status, history, therapeutic goals, and the predicted adverse effects (Chou et al. 2009). During the treatment optimization process, careful surveillance and the assistance of an expert team in challenging cases has been recommended (Abdulla et al. 2013, Naples et al. 2016). Along with their undisputable effect in cancer pain, strong opioids have proved useful in different types of surgical procedures and may be used from newborns to older patients (Kokki et al. 2012, Panagiotou and Mystakidou 2010). Also, it has been presented that a combination of morphine and gabapentin produces better analgesia than either independently (Mao et al. 2011), which supports the use

of neuropathic drugs as adjuvants even in the absence of an obvious neuropathic condition.

In addition to pain assessment and pharmacological and non-pharmacological pain management, monitoring the treatment effectiveness has proved important (Hadjistavropoulos et al. 2007). According to an interdisciplinary expert consensus statement, the functional status (activities of daily living, mobility, sleep, appetite, weight changes, mood, and cognitive impairment) needs to be comprehensively assessed (Hadjistavropoulos et al. 2007). Pain management may be considered adequate if at least one or more of these domains demonstrates improvement in follow-up (AGS 2009).

In conclusion, importantly, despite the multiple potential adverse effects of all generally used analgesics presented above, pain should be treated effectively. The importance of individual deliberation and the monitoring of treatment effectiveness may thus be highlighted (Haanpaa et al. 2010, Abdulla et al. 2013, Chou et al. 2009).

2.8 Pain and quality of life

Several studies have demonstrated the important role of pain and pain coping in determining children's health-related quality of life (Varni et al. 1996b, Schanberg et al. 1996). It has been highlighted that assessing only pain intensity is insufficient in children (Manworren and Stinson 2016). The impact of pain on children's quality of life (sleep, activities, social, school, etc.) also needs to be carefully assessed using specific pain assessment tools (Manworren and Stinson 2016). The combination of these should form the basis for planning the pain management (Manworren and Stinson 2016).

Pain intensity and pain coping strategies have been suggested to have an independent relationship with multiple domains that comprise the health-related quality of life (HRQoL) in children with juvenile idiopathic arthritis (JIA) (Sawyer et al. 2004). In 2016, Rabbitts and colleagues reported an association between higher widespread pain scores and functional impairment and poorer HRQoL in children aged 10–18 years (Rabbitts et al. 2016). Additionally, according to a study by Hunfeld and colleagues, the quality of life of 128 adolescents decreased as the intensity and frequency of pain increased, but the adolescents' pain also reduced the quality of life of their family members (Hunfeld et al. 2001).

The effects of pain on the quality of life in adult age groups are evident (Lapane et al. 2015, Jensen et al. 2007, Bernfort et al. 2015, Chen et al. 2003, Lacey et al.

2014). As the population is aging, the quality of life of the aged population has become an increasing interest for citizens, politicians, and researchers alike. Not only the etiology of pain but also the impact on the overall quality of life should be assessed (Herr and Garand 2001). Notably, it has been presented that pain reduction does not always improve the quality of life as expected (Niv and Kreitler 2001). However, especially among the oldest old, pain-related functional limitations and a frequent need for assistance in daily living have been reported (Jakobsson et al. 2003). Physical and especially psychological disability as mediators in the relationship between the quality of life and pain chronicity in older adults have been underlined (Hopman-Rock et al. 1997). According to a study by Jakobsson and colleagues, a low quality of life was not solely related to age, but also strongly to being affected by pain (Jakobsson et al. 2003). Additionally, Vartiainen and colleagues recently suggested that decreased HRQoL in chronic pain mainly originates from the psychological aspects and not the intensity of pain (Vartiainen et al. 2016).

Chronic pain should not be regarded as the expected outcome of aging (Bicket and Mao 2015, Thielke et al. 2012). Pain in older adults nearly always results from a physical or psychological pathology (Bicket and Mao 2015). Not only medical professionals, but older adults themselves require a shift in attitude. Older adults' pain perception has been presented as one major challenge for better pain management (Bicket and Mao 2015, Herr and Garand 2001), as pain is often considered inevitable with aging and seniors themselves may have drifted towards a threshold where they tolerate some pain and consider that to be normal (Gagliese and Melzack 1997). On the other hand, a recent meta-analysis has suggested an age-related increase in the pain threshold, but not in pain tolerance (Lautenbacher et al. 2017). According to what was presented in the meta-analysis, evidence for an age-related increase in pain tolerance is stronger than the evidence for a decrease (Lautenbacher et al. 2017). Proper pain assessment is the key to understanding the effect of pain on a person's quality of life.

2.9 Summary of the Literature

Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage (IASP 2018, IASP 1994). Pain always includes an emotional component (IASP 2018, Wade et al. 1990), and suffering, for example, is always present (Swieboda et al. 2013, IASP 2018). Acute pain may be regarded as a symptom of a disease or injury, while chronic pain should be seen as a condition in its own right (Bicket and Mao 2015).

Pain interference is not always parallel to either pain intensity or tissue damage, but it is in a key role in affecting an individual's quality of life. Children with persistent pain are severely impaired in their daily activities, such as attending school, and may suffer from severe emotional distress (Coffelt et al. 2013, Zernikow et al. 2012). Moreover, pain-related sleep disturbances, absences from school, and restricted social activities have been reported (Haraldstad et al. 2011). In older adults, chronic pain has been considered one of the leading conditions in terms of commonness and economic burden (Bicket and Mao 2015). Chronic pain negatively interferes with physical functioning and participation in everyday life activities in older adults (Ehde and Hanley 2006).

Especially chronic pain constitutes a stressor to an individual and may disturb his or her psychological balance (Andruszkiewicz et al. 2017). Pain coping refers to purposeful cognitive and behavioral efforts to overrule the negative impacts of stress (Lazarus 1993). Non-adaptive strategies (e.g. passive avoidance of a stressor, catastrophizing) have been suggested to associate with increased pain in children (Kaminsky et al. 2006). However, more negative thoughts about the consequences of pain, concerns and emotional pain-related representations, lower perceived self-efficacy, more catastrophizing, and more activity avoidance, as well as an increase in pain itself, have been suggested to contribute to declined physical functioning in older adults as well (Ilves et al. 2019). The Pain Coping Questionnaire (PCQ) was the first – and remains the only – pain coping measurement tool developed specifically for children (Reid et al. 1998). After its release, three studies have examined the psychometric properties of the PCQ and adequately validated the measurement in other languages (Catalan, Danish, Dutch) (Thastum et al. 1999, Bandell-Hoekstra et al. 2002, Huguet et al. 2009).

The relationship between pain and socioeconomic factors, gender, age, disability, psychological and emotional factors, loneliness, sleep disturbances, and

lifestyle aspects have been presented in multiple studies in older adults (Ehde and Hanley 2006, Crook et al. 1984, Carmaciu et al. 2007, Berkley 1997, Han et al. 2016, Vitiello et al. 2009, Heim et al. 2008, Shiri et al. 2010).

The overall consensus highlights the under-assessment, under-diagnosis, and under-treatment/mistreatment of persistent pain in older people (Gagliese and Melzack 1997, Tracy and Sean Morrison 2013, Veal et al. 2014). The treatment should focus on pain reduction, improvements in functioning, and enhanced quality of life (AGS 2009, Fine 2012). The role of non-pharmacological pain management is emphasized in older adults (AGS 2009, Makris et al. 2014).

Pharmacological pain management in older adults comprises multiple challenges, and several aspects need to be taken into account when planning the treatment (AGS 2009, Abdulla et al. 2013). These include the difficulty of pain assessment in older adults with possible cognitive impairment and dementia, difficulties in the physical accessibility of treatment, the cost of medication, multimorbidity, polypharmacy, age-related alterations in pharmacokinetics and pharmacodynamics, and thereby multiple potential adverse effects (AGS 2009, Fine 2012, McCleane 2007, Nygaard and Jarland 2006, Reynolds et al. 2008).

The administration of analgesics should follow the principle of "start slow and go slow" (AGS 2009). Paracetamol has been considered to be the first-line pharmacological therapy, followed by NSAIDs in the absence of contraindications (Makris et al. 2014). Opioid administration may be considered with moderate to severe cancer and non-cancer pain, but only after precise individual deliberation and with careful monitoring (Abdulla et al. 2013, Naples et al. 2016, Huang and Mallet 2013). Long-term opioid administration for chronic non-cancer pain remains controversial (Galicia-Castillo 2016). Neuropathic conditions should be managed with neuropathic drugs, and gabapentinoids and especially SNRIs have been suggested as being preferred over TCAs (Pickering et al. 2016).

3 AIMS OF THE STUDY

The current study discusses the pain experience in special age groups: in children/adolescents and in older adults. The primary aim of the study was to develop tools for a better understanding, assessment, and management of pain in these age groups. The overall consensus highlights the under-assessment, under-diagnosis, and under-treatment/mistreatment of pain in both children and older people. The Pain Coping Questionnaire provides a unique tool for understanding pain coping in children and adolescents and may improve the recognition of vulnerable coping at the very early stage of pain becoming chronic. It was hypothesized that identifying specific factors related to pain in older adults would result in the emergence of groups at risk of persistent pain and enhance preventive pain management in the future. Furthermore, improving the knowledge about the administration of analgesics among the community-dwelling older adults was pursued.

The main objectives of the study are presented below:

1. To determine the first- and second-order factor structure and validity of the Finnish translation of the Pain Coping Questionnaire for Finnish children and adolescents (I)

2. To examine the self-evaluated pain severity and interference, as well as the factors related to pain among community-dwelling older adults (II)

3. To examine the analgesic purchases of community-dwelling older adults by utilizing data from the Social Insurance Institution of Finland (III).

4 METHODS

4.1 Study subjects and data collection

Studies I–III comprised a total of 1,511 subjects. All data were managed anonymously with admission codes.

Study I:

The study population (N_{total} = 91) consisted of two samples: JIA patients and juvenile patients with chronic non-inflammatory musculoskeletal pain symptoms. Out of a total of 97 participants, six were excluded from the analyses due to one or more missing value. Therefore, the final analyses were performed with 91 patients (65 girls and 26 boys aged 8–15 years, mean age 13.7±2.2 SD). All patients were recruited and all measures implemented during routine clinical visits at the hospital.

The JIA patients were recruited in 2006–2007 at the Rheumatism Foundation Hospital in Finland, with a catchment area covering the whole country (Vuorimaa et al. 2009). For the patients with JIA, the inclusion criteria were as follows: (1) a JIA diagnosis established at least one year prior to the study (Petty et al. 2004) and (2) age between eight and fifteen years at the beginning of the study. The current data were collected in a follow-up study, which was attended by 64 JIA patients (45% of the 142 patients recruited at baseline).

Patients with non-inflammatory musculoskeletal pain symptoms (N=33) were recruited in 2013–2017 at Päijät-Häme Central Hospital, Finland. The inclusion criteria were as follows: (1) referral to the central hospital due to musculoskeletal pain, (2) age between 13 and 17 years, (3) persistent pain over 3 months, (4) pain not explained by a chronic illness, and (5) substantial pain-related disability, including poor school attendance and poor sleep (Vuorimaa et al. 2019). The enrolment process of study participants in Study I is presented in Figure 1.

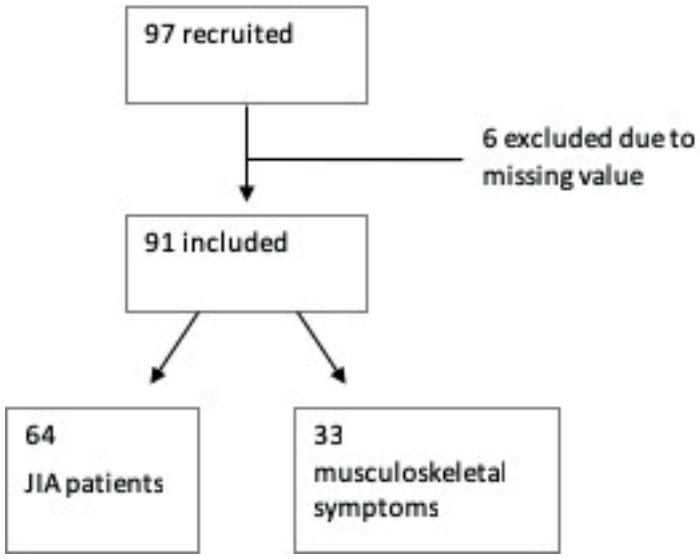

Figure 1. Flow chart presenting the inclusion of subjects in Study I.

Studies II and III:

A total of 2,815 senior citizens (66% of the 4,272 individuals invited) were followed in 2002–2012 in a large Good Ageing in Lahti Region (GOAL) cohort study (Fogelholm et al. 2006). The GOAL population introduces a stratified (age, sex, 14 municipalities) random sample of older adults from the Päijät-Häme Region, Finland. The region is located in Southern Finland and consists of both rural and urban areas, with approximately 220,000 inhabitants. The sample was relatively comprehensively representative of the Finnish aged population.

The studies herein focused on the data from 2012, which was the end point of the longitudinal study. The rationale for the cross-sectional focus was that this was the only year of the GOAL data collection from which the complete data regarding prescribed pain medications were retrievable. Of the 2,815 participants who attended at the GOAL baseline in 2002, 1,697 (60%) remained in attendance in 2012. Out of these, 277 participants who had not answered both pain questions (SF-36 pain intensity and interference) were excluded. Therefore, all statistical analyses were executed with 1,420 participants. Hospitalized patients or those in need of

institutional care did not participate. Figure 2 presents the flow chart of participants in Studies II and III.

The GOAL study population comprised three age groups (born in 1926–30, 1936–40, and 1946–50). In 2012, these birth cohorts represented subjects aged 62–66, 72–76, and 82–86 years. The mean age of all 1,420 participants was 71.2 years (SD 7.3). The proportion of women was 55% (784/1,420).

The GOAL data consisted of a questionnaire as well as clinical and laboratory data. All data were collected during four clinical visits in 2002, 2005, 2008, and 2012 (Fogelholm et al. 2006). Data regarding prescribed pain medications were retrieved retrospectively from the Social Insurance Institution of Finland. The Palmenia Centre for Continuing Education, Lahti, Finland, was tasked with the collection and preservation of the original GOAL data (Fogelholm et al. 2006).

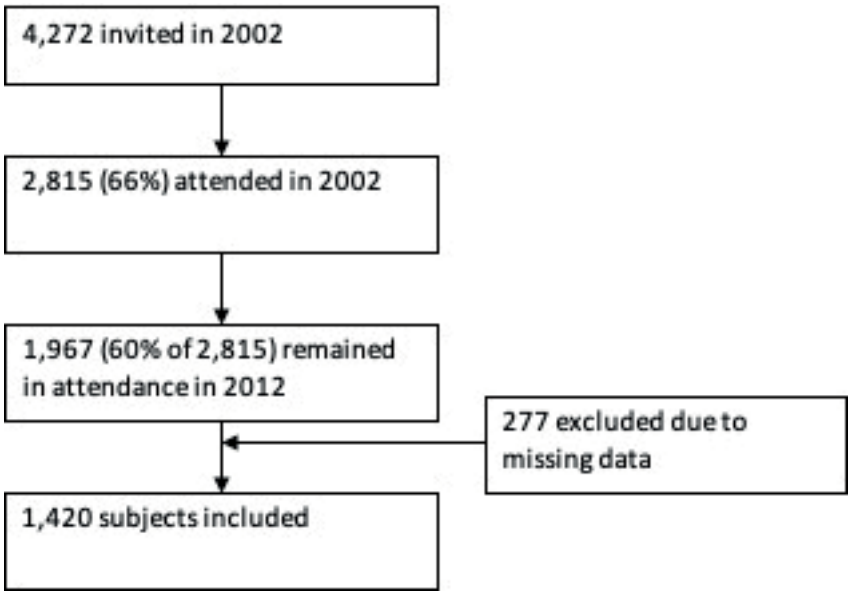

Figure 2. Flow chart presenting the inclusion of participants in Studies II and III.

4.2 Study designs

Study I

The translation process of the PCQ was executed by an interdisciplinary team comprising an authorized translator, a psychologist, a pediatric rheumatologist, and a professional senior researcher. The form was first translated from English into Finnish, then back-translated into English by an independent authorized translator (who did not participate in the first translation session), and then finally accepted in a joint session in which all of the above participated.

In the PCQ instructions, participants were advised to report how they would act when in pain for hours or days on a Likert scale (1: Never–5: Very often). The strategies were presented as patterns of behavior by continuing the sentence 'When I am hurt or in pain for a few hours or days, I…' (e.g. 'Try to forget it' or 'Do something I enjoy').

The PCQ construct validity was tested using the validated Finnish version of the Children's Depression Inventory (CDI) as a measure of depression or mood disturbances (Kovacs 1985, Almqvist 1988), and the Structured Pain Questionnaire (SPQ) as a measure of pain frequency (King et al. 1996, Mikkelsson et al. 1998).

Study II

Data on the study participants' SF-36 bodily pain, demographics, life habits, morbidity, and symptoms were imbedded in the GOAL questionnaires. In the two-item SF-36 Bodily Pain questionnaire, participants indicated how severe pain (100 = none, 80 = very mild, 60 = mild, 40 = moderate, 20 = severe, 0 = very severe) they had experienced during the previous four weeks and how much (100 = not at all, 75 = a little bit, 50 = moderately, 25 = quite a bit, 0 = extremely) this pain had disrupted their everyday work and activity (at home or outside of home) during the previous month (Ware and Sherbourne 1992). Bodily pain was calculated as the mean of the SF-36 pain intensity and SF-36 pain-related interference scores. The distribution of self-reported SF-36 pain intensity (Pain Intensity), SF-36 pain-related interference (Pain Interference), and SF-36 bodily pain (Bodily Pain) is presented in Figure 3.

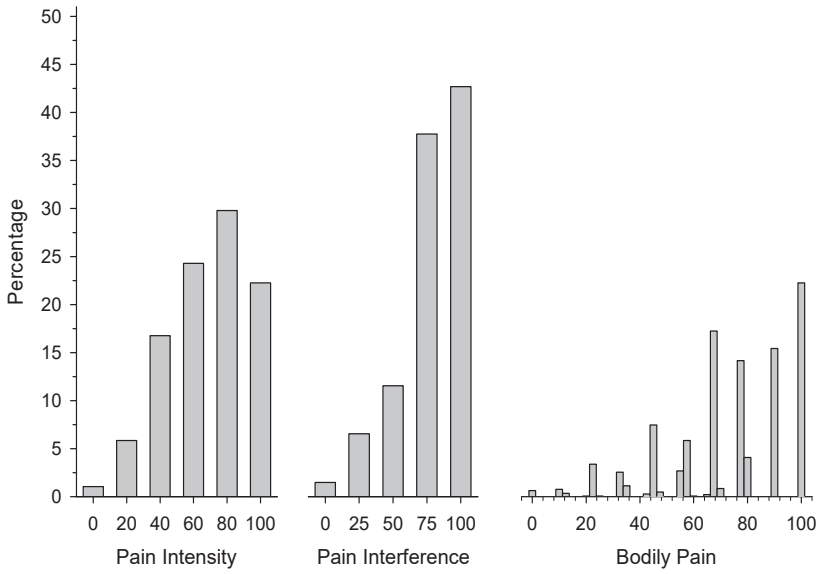

Figure 3. Distribution of self-reported SF-36 pain intensity (Pain Intensity), SF-36 pain-related interference (Pain Interference), and SF-36 bodily pain (Bodily Pain) among 1,420 GOAL participants.

Based on the self-reports, the participants were divided into four pain groups (group I [0–45, moderate to very severe pain intensity and interference], group II [47.5–70], group III [77.5–90], group IV [100, no pain intensity and interference at all]). The rationale for the four pain groups was to consider separately the subjects who had reported high levels of both pain intensity and pain interference (I) and those who had reported none (IV). The rest were divided into two groups (II–III) to equate the group sizes.

Factors related to SF-36 bodily pain were examined. The factors considered included multiple questionnaire variables, clinical variables, and variables derived from a laboratory sample.

Study III

The study participants' pain medication purchases six months prior to and six months after the GOAL questionnaire data collection were considered. Data were retrieved from the Social Insurance Institution of Finland (KELA).

In the first analysis, based on the bodily pain scores, the participants were divided into four pain groups (group I [0–45, moderate to very severe pain intensity and interference], group II [47.5–70], group III [77.5–90], and group IV [100, no pain intensity and interference at all]). The groups were established in order to be able to combine pain intensity and pain-related interference and to consider the analgesic purchases in relation to these. Analgesic purchases were considered separately for three GOAL age groups (62–66, 72–76, and 82–86 years).

In the second main analysis, participants were divided into two groups (opioid, non-opioid) based on whether or not they had purchased opioids. Factors related to opioid use were examined.

In the third analysis, a multivariate analysis was executed to examine factors associated with purchases of Level 1 (NSAIDs and paracetamol) and Level 2–3 analgesics (opioids).

4.3 Measurements

4.3.1 The CDI (Study I)

The Finnish version (validated in a Finnish sample by Almqvist and colleagues in 1988; Almqvist 1988) consists of 26 of the 27 items included in the English version; the question regarding suicide was excluded for ethical reasons (Kovacs 1985). The score for each item varies from zero to two. Thus, the total score varies from zero to 52. Higher values indicate increasingly severe depression.

4.3.2 The SPQ (Study I)

The questionnaire uses a five-level frequency classification of pain over the preceding 3 months (seldom or never, once a month, once a week, more than once a week, almost daily). Each of the seven pain areas (neck, upper and lower extremities, chest, upper back, lower back and buttocks) was scored from zero to five, the total score (frequency and area combined) ranging from zero to 28. The body area concerned was marked on a picture beside the question to help the child to recognize it.

4.3.3 The GOAL questionnaire (Studies II–III)

The GOAL questionnaire used in the current studies consisted of questions regarding overall health, lifestyle, attitudes, and the subjective quality of life. All of the utilized GOAL variables are presented in Table 4.

Morbidity constituted diagnoses made by medical professionals (cardiovascular, musculoskeletal, psychiatric, pulmonary and neurological diseases, diabetes mellitus type II, neoplasms, and fibromyalgia), and self-reported symptoms (joint pain, back pain, neck pain, headache, insomnia, depression). Data provided by means of laboratory tests (fP-Glucose, fP-Triglyceride, high-density lipoprotein [fP-HDL], estimated glomerular filtration rate [eGFR, ml/min/1.73m2], high-sensitivity C-reactive protein [S-hs-CRP], rheumatoid factor, serum uric acid) as well as clinical data (weight, height, blood pressure, waist circumference) were considered. Furthermore, the number of doctor's appointments during the previous 12 months was considered.

Metabolic syndrome was determined as the presence of three or more of the following components: 1) waist circumference ≥ 102 cm for men and ≥ 88 cm for women; 2) fP-Triglyceride ≥ 1.7 mmol/L or treatment for dyslipidemia; 3) fP-HDL ≤1.03 mmol/L for men and ≤ 1.29 mmol/L for women, or treatment for dyslipidemia; 4) systolic blood pressure ≥ 130 mmHg or diastolic blood pressure ≥ 85 mmHg, or antihypertensive medication; 5) fP-Glucose ≥ 5.6 mmol/L or the use of medication for hyperglycemia (Alberti et al. 2009).

The household income was determined as follows: taxable household income was divided by the square root of the number of people living in the household, indexed to the year 2017 (Francoeur 2002). The 3-item Alcohol Use Disorders Identification Test-Consumption (AUDIT-C) tool was used to evaluate the weekly doses of alcohol consumed (Bush et al. 1998). Leisure Time Physical Activity (LTPA) reflected the physical activities, lasting over 30 minutes and making them sweat and chuff at least a little bit, that the participants chose to do during their free time (high [6–7 times a week], moderate [3–5 times a week], low [1–2 times a week or less, or not possible due to injury or illness]) (Yusuf et al. 1996).

4.3.4 Analgesics

National register data regarding prescribed pain medication purchased 6 months before and after the study visit were retrieved from the Social Insurance Institution of Finland (KELA). KELA maintains a nationwide register of all prescriptions and

medication purchases. The analgesics considered were level 1 (NSAIDs [M01AE01, M01AE51 ibuprofen; M01AE03 ketoprofen; M01AH01, M01AH05, M01AH06 COX-2 selective inhibitors; M01AC06 meloxicam; M01AE02, M01AE52 naproxen; M01AB05 diclofenac; M01AB01 indometin]; N02BE01, N02BE51 paracetamol) and level 2–3 analgesics (N02AA01 morphine; N02AA03 hydromorphone; N02AA05 oxycodone; N02AA55 oxycodone-naloxone; N02AA59, N02AJ06 codeine combinations; N02AB03 fentanyl; N02AE01 buprenorphine; N02AX02, N02AJ14 tramadol and tramadol combinations), in addition to gabapentinoids (N03AX23 gabapentin; N03AX16 pregabalin) and tricyclic antidepressants (TCAs [N06AA09, N06CA01 amitriptyline; N06AA10 nortriptyline]). All examined analgesics are presented in Table 4. Acetylsalicylic acid was excluded from the NSAIDs due to its major use as an antithrombotic drug.

4.4 Statistical analyses

Study I:

SPSS versions 23 and 24 (SPSS, Chicago, IL, USA) were used to execute the statistical analyses. The descriptive values of the variables were expressed as means and standard deviations and percentages with 95% confidence intervals. Two-sided p-values of < 0.05 were considered statistically significant in the analyses. Cronbach's coefficient alpha was used to estimate the reliability. Univariate analyses were applied to describe the data. Differences between groups were tested by the independent sample t-test.

Exploratory factor analysis was used to determine the first- and second-order factor structure. The principal axis factoring method was used for the first-order analysis and the maximum likelihood factoring method for the second-order analysis. Promax rotation was used due to the psychometric content of the measured questionnaire. Regression analysis was applied to compute the higher-order factor scores. The highest factor loading was accepted when lambda was ≥ 0.40, and the difference in magnitude between loadings on two separate factors needed to exceed 0.20. The percentage of variance accounted for by each factor was used to determine the number of factors included in the rotation. The Kaiser-Meyer-Olkin measure of

sampling adequacy and Bartlett's test of sphericity were employed to evaluate whether exploratory factor analysis was appropriate for the present data set.

Table 4. Variables examined in Studies II and III. World Health Organization Anatomical Therapeutic Chemical classification system [ATC].

GOAL DATA	THE SOCIAL INSURANCE INSTITUTION OF FINLAND MEDICATION DATA
Bodily Pain	NSAIDs
Sex	M01AE01 ibuprofen
Age	M01AE51 ibuprofen
Cohabiting	M01AE03 ketoprofen
Retirement	M01AH01COX-2-selective inhibitors
Education years	M01AH05 COX-2-selective inhibitors
Household income	M01AH06 COX-2 selective inhibitors
Lifestyle aspects	M01AC06 meloxicam
Smoking	M01AE02 naproxen
Alcohol consumption	M01AE52 naproxen
Leisure-time physical activity	M01AB05 diclofenac
Clinical data	M01AB01 indometacin
Body mass index	N02BE01 paracetamol
Obesity (body mass index > 30)	N02BE51 paracetamol
Metabolic syndrome	Opioids
Waist circumference	N02AA01 morphine
Blood pressure	N02AA03 hydromorphone
Symptoms	N02AA05 oxycodone
Joint pain	N02AA55 oxycodone-naloxone
Back pain	N02AA59 codeine combinations
Neck pain	N02AJ06 codeine combinations
Headache	N02AB03 fentanyl
Insomnia	N02AE01 buprenorphine
Depression	N02AX02 tramadol and tramadol combinations
Morbidity (diagnosed)	N02AJ14 tramadol and tramadol combinations
Cardiovascular disease	Neuropathic drugs
Diabetes mellitus type II	N03AX23 gabapentin
Musculoskeletal disease	N03AX16 pregabalin
Pulmonary disease	N06AA09 amitriptyline
Psychiatric disease	N06CA01 amitriptyline
Neurological disease	N06AA10 nortriptyline
Neoplasm	
Fibromyalgia	
Laboratory tests	
Glucose, mMol/L	
Triglyceride, mMol/L	
HDL, mMol/L	
eGFR, mL/min/1.73 cm2	
hsCRP, mg/L	
Uric acid, uMol/L	
RF positive, n (%)	
Visited physician over three times	

To test construct validity, bivariate correlations were calculated to analyze the relationship between PCQ scales and the CDI. To test criterion validity, bivariate correlations were calculated to analyze the relationship between PCQ scales and pain frequency.

Study II

All statistical analyses were carried out with Stata version 15.1 (StataCorp, College Station, TX, USA).

Statistical significances for the hypothesis of linearity across categories of SF-36 bodily pain were evaluated by using the Cochran-Armitage test for trend and analysis of variance with an appropriate contrast. In the case of a violation of the statistical assumptions (e.g. non-normality), a bootstrap-type method was used (10,000 replications). The normality of variables was evaluated by the Shapiro-Wilk W-test.

Study III

The Stata version 15.1 (StataCorp LP, College Station, TX, USA) statistical package was used for the analyses.

The descriptive statistics included means and SDs for continuous variables and numbers and percentages for categorical variables. Statistical comparisons between the groups were performed by the t-test, Chi-squared test, or the Fisher-Freeman-Halton test when appropriate. In the case of a violation of the assumptions (non-normality), a bootstrap-type test was used. Multivariate logistic regression was applied to investigate factors related to opioid use. As predictors, the following were included: pain levels and LTPA (as ordinal variables); sex, MetS, and smoking (as dicotomous variables); and age, education years, Audit-C, and number of morbidities (as continuous variables). The Hosmer-Lemeshow goodness-of-fit statistics were used for the assessment of the final models. The normality of the variables was evaluated with the Shapiro-Wilk W test.

4.5 Ethical aspects

The principles of the Declaration of Helsinki (World Medical Association Declaration of Helsinki. Ethical Principles for Medical Research involving Human

Subjects) were followed. The approval for the study was granted by the Regional Ethics Committee of Tampere University Hospital. All participants—and in connection with those under 15 years of age, also their parents—gave their written informed consent prior to data collection.

There were no conflicts of interest.

5 RESULTS

5.1 The PCQ (Study I)

5.1.1 Descriptive data

The mean CDI score was 6.1 ± 6.4 (SD, [CDI: range for each item 0–2, total score 0–52]). The mean SPQ score was 6.3 ± 6.5 (SD, [SPQ: range for each pain area 0–7, total {frequency and area combined} score 0–28]). The level of depressive symptoms in girls was higher than in boys (6.7 ± 7.0 [SD] vs. 4.5 ± 4.2 [SD], respectively). Girls also had higher pain frequency levels (6.8 ± 0.8 [SD] vs. 5.0 ± 6.0 [SD]).

5.1.2 First-order factor structure

Several steps preceded the final first-order factor structure. First, an eight-factor structure with all 39 original items was tested using the principal axis factoring method with promax rotation. However, in this set, only one item (item 27: Talk to a family member about how I feel) loaded primarily onto the eighth factor, and this structure was rejected as inadequate. Principally, as determined prior to the analyses, the highest factor loading was accepted when lambda was ≥ 0.40, and the difference in magnitude between loadings on two separate factors needed to exceed 0.20. Secondly, the forced seven-factor model was tested, but it was rejected due to inadequacy (see determinants of adequacy above). Several other potential structures were examined but rejected as incongruent. A common denominator for all the rejected structures was the incongruous role of item 27 in the analyses. Finally, item 27 was deleted due to its poor fit in any hypothetic structure examined.

The satisfactory exploratory first-order eight-factor structure with 38 items was accomplished using the principal axis factoring method with promax rotation. One item within the Problem Solving scale had a weak loading (lambda = 0.377).

However, the referred item still distinctly loaded more highly on PS than on any other factor and was, as a result, retained in the analysis.

Table 5. Comparison of the first-order factor structures of the Finnish, English (Reid et al. 1998), and Danish (Thastum et al. 1999) versions of the PCQ. The factor abbreviations in boldface equate to what was presented in the original English structure (Reid et al. 1998).

Number	Item	Marttinen et al.	Reid et al.	Thastum et al.
1	Ask questions about the problem	IS	IS	excluded
2	Focus on the problem and see how I can solve it	PS	PS	IP***
3	Talk to a friend about how I feel	SSS	SSS	SSS
4	Tell myself, don't worry, everything will be OK	PSS	PSS	PSS
5	Go and play	BD	BD	BD
6	Forget the whole thing	CD (IC -0.329)	CD	CD
7	Say mean things to people	EXT (-0.403)	EXT	EXT
8	Worry that I will always be in pain	IC	IC	IC
9	Ask a nurse or a doctor questions	SSS (IS 0.321)	IS	excluded
10	Think about what needs to be done to make things better	PS	PS	IP***
11	Talk to someone about how I am feeling	SSS	SSS	SSS
12	Say to myself, be strong	PSS	PSS	PSS 0.39**
13	Do something fun	BD (IC -0.374)	BD	BD
14	Ignore the situation	CD	CD	CD
15	Argue or fight	EXT	EXT	EXT
16	Keep thinking about how much it hurts	IC	IC	IC
17	Find out more information	IS	IS (PS 0.45)	IP***
18	Think of different ways to deal with the problem	PS (SSS 0.305)	PS	IP***
19	Tell someone how I feel	SSS	SSS	SSS
20	Tell myself it's not so bad	PSS	PSS	PSS
21	Do something I enjoy	BD (PS 0.470)	BD	BD
22	Try to forget it	CD (SSS -0.311)	CD	CD
23	Yell to let off steam	EXT	EXT	EXT
24	Think that nothing helps	IC	IC	IC
25	Learn more about how my body works	IS	IS	IP***
26	Figure out what I can do about it	IC	PS	IP***
27	Talk to a family member about how I feel	excluded	SSS	SSS
28	Say to myself things will be OK	PSS	PSS	PSS
29	Do something active	BD	BD	BD
30	Put it out of my mind	CD	CD	CD
31	Get mad and throw or hit something	EXT	EXT	EXT
32	Think that the pain will never stop	IC	IC	IC
33	Try different ways to solve the problem until I find one that works	PS	PS	IP***
34	Let my feelings out to a friend	SSS	SSS	SSS
35	Tell myself I can handle anything that happens	PSS	PSS	PSS
36	Do something to take my mind off it	BD (CD 0.339)	BD 0.40*	excluded
37	Don't think about it	CD	CD	CD
38	Curse out loud	EXT	EXT	EXT
39	Worry too much about it	IC	IC	IC

BD, Behavioral Distraction; CD, Cognitive Distraction; EXT, Externalizing; IC, Internalizing/Catastrophizing; IS, Information Seeking; PS, Problem Solving; PSS, Positive Self-Statements; SSS, Seeking Social Support. Item 27 ('Talk to a family member how I feel') was excluded due to statistical reasons. All factor loadings exceeding 0.30 are presented.

*Reid and colleagues only accepted loadings exceeding 0.45.

** Thastum and colleagues only accepted loadings exceeding 0.45, and the difference in magnitude between the highest and second highest loading needed to exceed 0.20.

*** Thastum and colleagues integrated Information Seeking and Problem Solving into one, generating the factor IP = Information Seeking/Problem Solving.

The communalities of all strategies were considered tolerable. The eight-factor model explained 61.4% of the total variance. The factor structure accomplished in

comparison to the structures presented by Reid and colleagues and Thastum and colleagues is presented in Table 5 (Reid et al. 1998, Thastum et al. 1999).

5.1.3 Higher-order factor structure

The higher-order factor structure was examined with an exploratory factor analysis. A three-scale structure using maximum likelihood factoring with promax rotation emerged as the most coherent. The scales achieved were Approach, Emotion-Focused Avoidance, and Distraction. The factor scores of these scales were computed with the regression method (Landau 2004). Factor scores exceeding lambda = 0.4 were accepted. Behavioral Distraction loaded on both Approach and Emotion-Focused Avoidance. Only Cognitive Distraction loaded on Distraction. Positive Self-Statements also weakly loaded on Distraction, but evidently had a higher loading on Approach. Cronbach's alpha exceeded 0.75 for all first- and higher-order scales. The higher-order structure is presented Table 6.

Table 6. Higher-order factor loadings among the Finnish PCQ scales.

First-order scales	APP	EFA	DIS
PSS	0.675		(0.304)
IS	0.643		
SSS	0.773		
BD	0.429	-0.411	
PS	0.607		
IC	(0.329)	0.577	
EXT		0.513	
CD			0.886

BD, Behavioral Distraction; CD, Cognitive Distraction; EXT, Externalizing; IC, Internalizing/Catastrophizing; IS, Information Seeking; PS, Problem Solving; PSS, Positive Self-Statements; SSS, Seeking Social Support; APP, Approach; EFA, Emotion-Focused Avoidance; DIS, Distraction. An exploratory higher-order structure was executed using maximum likelihood extraction with promax rotation. Factor loadings exceeding 0.40 were accepted; loadings exceeding 0.30 are presented.

Descriptive statistics regarding the higher-order factor scores for children aged 9–12 years and adolescents aged 13–18 years, for girls and boys, and for JIA patients and patients with non-inflammatory musculoskeletal symptoms only showed a significant difference in JIA vs. non-inflammatory musculoskeletal symptoms for Emotion-Focused Avoidance (JIA 1.9 ± 0.5 [SD] vs. other 2.3 ± 0.7 [SD], p= 0.011).

5.1.4 Validity analyses

Coping strategies were expected to be related to higher CDI and SPQ scores. A higher CDI score was positively related to EFA ($r = 0.511$, $p < 0.001$) and negatively related to DIS ($r = -0.234$, $p = 0.027$). A higher SPQ score was positively related to EFA ($r = 0.433$, $p < 0.001$) and to APP ($r = 0.261$, $p = 0.013$).

5.2 Pain prevalence in older adults (Study II)

Seventy-eight percent of the participants had experienced pain (SF-36 bodily pain < 100). The prevalence of a moderate to very severe pain intensity in everyday work and activity during the previous month was 24% (SF-36 pain intensity 0–40) and of moderate to very severe pain-related interference 20% (SF-36 pain interference 0–50).

5.2.1 Pain-related factors in older adults (Study II)

There was a clear association between a decreasing prevalence of cohabiting as well as lower education and increasing experienced SF-36 bodily pain. Additionally, the mean household income was inversely proportional to pain, being lowest in group I (1,610 euros/month [SD 0.89], $p < 0.001$). The demographics and socioeconomic factors in relation to SF-36 bodily pain are presented in Table 7.

The prevalence of obesity increased linearly with pain in terms of mean BMI, BMI over 30, and waist circumference in both male and female participants. The mean BMI was 2.5 units (kg/m2) higher in group I than in group IV ($p < 0.001$). In group I, 40% had a BMI of over 30, compared to the corresponding 20% in group IV. The difference in mean waist circumference between subjects in group I and those in group IV was 8 cm for females ($p < 0.001$) and 5 cm for males ($p = 0.002$), indicating more pain among the obese.

The proportion of low LTPA was highest and that of high LTPA lowest in group I. There was no difference in smoking between groups. Alcohol consumption was inversely related to experienced pain (AUDIT-C 2.3 [SD 2.1] in group I vs. 2.8 [SD 2.3] in group IV, $p < 0.001$).

Morbidity in terms of diagnoses (cardiovascular diseases, diabetes mellitus type II, musculoskeletal diseases, pulmonary diseases, neurological diseases, neoplasms

and fibromyalgia) and self-reported symptoms (joint pain, back pain, neck pain, headache, insomnia, depressive symptoms) was reported to be highest in participants with the most pain, frequency linearly decreasing with decreasing pain. No difference in blood pressure was found.

Table 7. Demographics and socioeconomic factors according to four SF-36 bodily pain levels (groups I–IV) among 1,420 GOAL subjects.

	SF-36 Bodily pain				
	I (0-45) N=244	II (47.5-70) N=382	III (77.5-90) N=478	IV (100) N=316	P-value
Female sex, n (%)	157 (64)	226 (59)	245 (51)	156 (49)	**
Age, mean (SD)	74 (8)	71 (7)	70 (7)	71 (7)	**
Cohabiting, n (%)	148 (61)	255 (67)	350 (73)	230 (73)	**
Pension, n (%)	220 (90)	316 (83)	385 (81)	250 (79)	**
Education years, mean (SD)	9.1 (2.9)	9.7 (3.3)	9.8 (3.2)	10.1 (3.3)	**

** $p < 0.001$. Groups I–IV: group I (0–45, moderate to very severe pain intensity and interference), group II (47.5–70), group III (77.5–90), group IV (100, no pain intensity and interference at all).

Regarding data derived from laboratory testing, the plasma triglyceride level was highest (mean 1.39, SD 0.76, $p = 0.028$) and the plasma high-density lipoprotein level lowest (mean 1.50, SD 0.42, $p = 0.006$) in group I. The serum hs-CRP was highest in group I. The proportion of participants with positive rheumatoid factor was the highest in group I. No significant differences were found in serum glucose, eGFR, or serum uric acid levels.

5.3 Analgesic purchases (Study III)

Eighty-four percent of the participants had purchased some prescribed analgesics. Analgesics were most frequently obtained by individuals in group I, the percentage decreasing linearly with the groups. The three age groups (62–66 vs. 72–76 vs. 82–86 years) did not differ significantly from each other in terms of drug distribution or purchasing prevalence.

NSAID administration emerged as substantial. In group I, 91% had purchased NSAIDs. In group IV, the percentage was 70%. The overall NSAID purchasing percentage was 77%. Paracetamol was in the clear minority, with an overall administration percentage of 41% (62% in group I; 27% in group IV). Of all

participants, 8% had purchased gabapentinoids, and 4% had purchased tricyclic antidepressants.

Of all participants, 32% had purchased opioids—the corresponding figure in group I was 52%, but 23% of those who reported no pain intensity and no pain-related interference at all (group IV) were also on opioids. Of the participants with moderate to very severe SF-36 bodily pain, 10% had purchased strong opioids.

When comparing subjects who had and had not used opioids, a moderate mean difference was found in SF-36 pain intensity (61 [SD 26] in the opioid group vs. 72 [SD 23] in the non-opioid group) and in pain-related interference (71 [SD 27] vs. 82 [SD 22], respectively) ($p < 0.001$).

Several morbidities were more prevalent in the opioid group. MetS was present in 47% of the participants in the opioid group compared to 40% in the non-opioid group ($p = 0.009$). The proportion of those with a BMI of over 30 was higher in the opioid group (31% vs. 26%, $p = 0.049$). Forty-eight percent of the subjects in the opioid group had visited a doctor more than 3 times during the previous 12 months, as opposed to the 29% in the non-opioid group ($p < 0.001$). The prevalence of purchasing the other examined analgesics was significantly higher in the opioid group. Serum hs-CRP and uric acid levels were significantly higher among opioid users. The pain scores, demographic factors, and clinical data of participants who were and were not on opioids are presented in Table 8.

There was no difference in socioeconomic factors, age, sex, smoking, alcohol consumption, leisure-time physical activity, or the prevalence of insomnia between the opioid and non-opioid group. In addition, no differences in blood pressure, serum glucose, triglyceride, or HDL levels, nor in eGFR were found.

Multivariate analyses revealed that only a higher number of morbidities was found to independently associate with purchases of Level 1 (NSAIDs and paracetamol; ORLevel1 1.30, 95% CI 1.04–1.63, $p = 0.020$) and Level 2–3 analgesics (opioids; ORLevel2-3 1.53, 95% CI 1.30–1.79, $p < 0.001$). At the time of the questionnaire data collection, 16% of the participants in the opioid group reported no SF-36 pain intensity at all and 30% no SF-36 pain-related interference at all. In addition to morbidities, according to multivariate logistic regression, MetS was the only factor to independently associate with opioid administration in these subjects ($OR_{intensity}$ 1.99, 95% CI 1.10–3.60, $p = 0.022$; $OR_{interference}$ 1.60, 95% CI 1.05–2.43, $p = 0.029$).

Table 8. Pain, demographic factors, and some clinical data of 1,420 GOAL participants who had (Yes) and who had not (No) used opioids during the considered one-year time interval. Opioids include weak, intermediate, and strong opioids, as well as the paracetamol-codeine combination.

	Opioids purchased		
	No N=960	Yes N=460	P-value
Pain			
Bodily Pain, mean (SD)	77 (21)	66 (25)	<0.001*
Intensity, mean (SD)	72 (23)	61 (26)	<0.001*
Interference, mean (SD)	82 (22)	71 (27)	<0.001*
Demographics			
Female sex, n (%)	534 (56)	250 (54)	0.65
Age, mean (SD)	71 (7)	72 (7)	0.16
Cohabiting, n (%)	662 (69)	321 (70)	0.75
Education years, mean (SD)	9.8 (3.2)	9.6 (3.1)	0.37
OECDsgrt[a], mean (SD) 1000€	1.8 (1.1)	1.7 (0.6)	0.40
Clinical			
BMI[b], mean (SD)	27.8 (4.8)	28.4 (4.7)	0.021*
Obese (BMId≥30), n (%)	241 (26)	139 (31)	0.049*
Waist cm, mean (SD)			
Female	92 (14)	94 (13)	0.057
Male	100 (11)	103 (11)	0.002*
MetS[c], n (%)	385 (40)	218 (47)	0.009*
Morbidity (diagnosed), n (%)			
Cardiovascular disease	413 (43)	225 (49)	0.037*
Diabetes mellitus type II	101 (11)	56 (12)	0.35
Musculoskeletal disease	330 (34)	231 (50)	<0.001*
Pulmonary disease	69 (7)	55 (12)	0.003*
Psychiatric disease	27 (3)	22 (5)	0.057
Neurological disease	25 (3)	16 (6)	0.36
Neoplasm	47 (5)	44 (10)	<0.001*
Visited physician ≥ 3 times, n (%)	282 (29)	223 (48)	<0.001*

*P-values less than 0.05 were considered statistically significant. Data are presented as mean values (SD) and as absolute values and percentages. [a]OECDsgrt, OECD square root–determined household income; [b]BMI, body mass index; [c]MetS, metabolic syndrome.

6 DISCUSSION

To the best of the author's knowledge, the current study was the first to evaluate the validity of the Finnish PCQ adaptation and the fourth PCQ validity study outside the English-speaking countries (Reid et al. 1998, Thastum et al. 1999, Bandell-Hoekstra et al. 2002, Huguet et al. 2009). The Finnish PCQ factor structure emerged as satisfactory both culturally and statistically, and the validity analysis supported the legitimacy of future national use.

The current study presented a self-reported SF-36 bodily pain profile of community-dwelling older adults in a sample that relatively well represented the general Finnish aging population. Socio-economic factors, lifestyle aspects, several morbidities, and some clinical measurements were considered as related factors. The vast majority of the participants reported to have endured pain in their everyday activities. Individuals who reported the most pain possessed several factors that have previously been shown to relate to social exclusion and higher morbidity.

Based on the data retrieved from the Social Insurance Institution of Finland, analgesics were commonly purchased. Over three out of four participants had obtained prescribed NSAIDs, and one third had purchased opioids. However, the drug distribution emerged as surprising, as paracetamol purchases were in a clear minority compared to NSAID purchases, and neuropathic drug use emerged as minor. Age made no marked difference in drug distribution and purchasing prevalence. Only the number of morbidities was independently associated with analgesic purchases in all subjects, though metabolic syndrome was also independently associated with opioid purchases in subjects with no pain at all.

6.1 THE PCQ

First-order structure

The 38-item, eight-factor structure emerged as the most coherent. Regarding previous PCQ validity research, two studies had arrived at a comparable eight-factor solution (Reid et al. 1998, Bandell-Hoekstra et al. 2002). Thastum and colleagues, in their Danish adaptation, presented a seven-factor structure (Information Seeking and Problem Solving combined), with three of the original 39 items excluded (Thastum et al. 1999). In the current analysis, specific constitutional criteria were followed in the structural examination. Due to a poor fit to any scale, item 27 was excluded. Item 18 loaded on its scale, PS, relatively weakly but was included due to its important role as a part of the factor from the clinical perspective.

Overall, the solution herein was discovered to be relatively analogous to what was presented by Reid and colleagues in 1998. The only differences concerned two items: 9 ('Ask a doctor or a nurse questions') and 26 ('Figure out what I can do about it'). In the version by Reid and colleagues, item 9 was included in IS, whereas it loaded on SSS in the current study. From the cultural and linguistic perspective, item 9 could logically fit into both referred scales. In Finnish culture, for some patients, doctor's or nurse's appointments may be the only place where they are able to talk about difficult issues. In the present study, item 26 loaded on IC, whereas in the study by Reid and colleagues, it loaded on PS. In the Finnish wording, item 26 denotes a deep concentration on the problem and may thus relate to internalizing the problem. In conclusion, PS, IS, and SSS all lacked one of the original items, while IC and SSS both gained one compared to what Reid and colleagues presented. (Reid et al. 1998.)

Higher-order structure

To date, only Reid and colleagues had been able to achieve an exploratory higher-order factor structure of the PCQ (Reid et al. 1998). The reliability of the Catalan translation was tested in a confirmatory factor analysis comparing the English eight-factor and the Danish seven-factor structure in both children and adults—the seven-factor structure proved most coherent in both children and adults, and a higher-order confirmatory structure was achieved with both tested models in children but not in adults (Huguet et al. 2009).

In the current study, exploratory factor analysis was selected for the investigation of the higher-order structure due to comparability with the English solution. The three-scale structure achieved demonstrated many similarities to the structure presented by Reid and colleagues in their arthritis/headache sample; in the in the present study, BD loaded on both APP and EFA, whereas in the English version it loaded on DIS (Reid et al., 1998). In the present study, BD was included in APP due

to conceptual reasons; in the Finnish translation, the items comprising the BD scale suggest activity and problem solving in coping, which are prominent qualities of the APP scale. Additionally, regarding translational difficulties, the Finnish wording of the items comprising the CD scale do not represent problem solving itself but rather activity to put the problem aside. Previously, it has been argued that distraction is not simply a subtype of avoidance coping because it involves the active redirecting of attention towards an alternative target (Compas et al. 2001). This was a possible reason why CD alone constituted the DIS scale.

Validity analysis

Considering the descriptive statistics, patients with non-inflammatory musculoskeletal symptoms tended to use more EFA strategies than JIA patients, which is most probably due to the fact that there were more adolescents in the non-inflammatory group. It is possible, however, that non-inflammatory pain without an acceptable diagnosis may provoke the worry and anxiety that is prominent in EFA. In the present study, higher CDI and SPQ scores were positively related to EFA. The results supported what has been presented in the previous reports (Reid et al. 1998, Thastum et al. 1999). Reid and colleagues found a positive correlation between EFA and pain intensity as well as pain duration among arthritis patients; EFA and depression also correlated in the headache sample (Reid et al., 1998). Additionally, Thastum et al. (1999) previously presented positive correlations between IC and pain frequency. In children, a lack of understanding and a mental praxis base may lead to an outburst of EFA strategies, when there is a need to deal with unwanted physical or mental conditions. EFA strategies include, for instance, ruminating, helplessness, arguing, and worrying (Varni et al. 1996a). In several studies, EFA strategies, especially aspects of catastrophizing, have been found to associate with multiple pain outcomes in adolescents (Wicksell et al. 2011, Kashikar-Zuck et al. 2013, Welkom et al. 2013, Chatkoff et al. 2015, Edwards et al. 2016). The non-adaptive aspects of EFA strategies were underlined in the current study, as an elevated pain frequency and depressive symptoms associated with EFA.

In 2008, Walker and colleagues presented a validation of pain coping profiles that aimed to be clinically more useful compared to the traditional classification. They identified six coping profiles: Avoidant, Dependent, Self-reliant, Engaged, Infrequent, and Inconsistent. Avoidant and Dependent copers had high levels of symptoms (e.g. depression) and disability and were characterized by catastrophizing, whereas Self-reliant and Engaged copers had higher pain mastery efforts. The

authors suggested an individual selection of treatment options, such as a family intervention for Dependent copers and psychotropic medication for Avoidant copers. (Walker et al. 2008.) The assessment of both the referred profiles and the classical classification presented in the current study may be beneficial in clinical practice in terms of achieving a more individualized identification of coping style for each patient.

In the present study, a higher CDI score was also strongly negatively correlated to DIS. Previous studies have suggested that children's use of distraction strategies would be associated with less distress (Eccleston 1995, Reid et al. 1998, Compas et al. 2001). Higher SPQ was positively related to APP, which was unexpected and may be due to the fact that the pain level was relatively moderate in the sample.

6.2 PAIN IN OLDER ADULTS

Prevalence of pain

The majority of the participants in the study had endured pain in their everyday activities. Despite it being somewhat in line with the literature (Mantyselka et al. 2004, Rapo-Pylkko et al. 2017, Karttunen et al. 2014, Karjalainen et al. 2018), the high prevalence was surprising. The result was notable, considering that the study population consisted of community-dwelling older adults who volunteered for the study, and not patients. The result highlights the importance of resources and education, focusing on the prevention and treatment of pain in the community, as well as on the national and international level.

One fifth of the participants had experienced moderate to severe pain-related interference, which is an important finding. Pain-related interference and psychological factors have been suggested to be key aspects in the pain-related decrease in the quality of life (Vartiainen et al. 2016, Niv and Kreitler 2001). According to the present and previous studies, pain should be regarded as a factor to which active efforts should be targeted in order to prevent the decrease in the quality of life (Niv and Kreitler 2001). In the present study, multiple non-medical factors were found to relate to pain. Whether the experienced interference was physical rather than psychological and whether the participants (especially those with a scarce social network) were able to unburden themselves regarding the pain experience are important questions in terms of the quality of life and require further investigation. In terms of the unburdening, the role of professionals is highlighted.

The significance of a high prevalence of pain to society is undisputable. It is known, that chronic pain patients are among the most frequent users of the health care system (Becker et al. 1997). It has previously been estimated that fewer than 2% of persons experiencing pain were treated by a pain management specialist and that several individuals were not being treated at all (Breivik et al. 2006, Karttunen et al. 2015). The majority of pain patients are treated by other than pain specialists, who may lack knowledge and experience in pain management, especially in more complex types of pain, such as in neuropathic pain. In addition to the direct harm caused by pain in everyday life functions, pain-related interference may also originate from a subjective frustration of feeling like the pain is not adequately treated or the person in pain is not sufficiently heard. Older adults with pain may also be in substantial need of assistance in their everyday activities due to pain, and without system-level organizing, the need may relatively easily be ignored. It may be hypothesized that primary care does not have enough resources to focus on pain patients. In the present study, however, almost half of the participants who had purchased opioids had visited a doctor frequently, indicating that these individuals should also have been candidates for non-pharmacological interventions and a careful monitoring of treatment effectiveness and adverse effects, had these had been available.

Evaluating pain is not simple (Jensen et al. 1986, Breivik et al. 2008). In the current study, pain estimates were based on self-reporting, which has been considered the most reliable method of measuring pain (Booker and Haedtke 2016), also for older adults with possible cognitive impairments (Booker and Haedtke 2016, Hadjistavropoulos et al. 2010). Persons with cognitive impairment are at an increased risk of inadequate pain assessment and treatment (Bicket and Mao 2015).

Pain-related factors

Socio-economic factors demonstrated marked variety between the pain groups. As presented in the Methods section, the participants were divided into four pain groups (group I [0–45, moderate to very severe pain intensity and interference], group II [47.5–70], group III [77.5–90], and group IV [100, no pain intensity and interference at all]) according to SF-36 pain levels. Education years and mean household income were the lowest among participants in group I. Pensioners and those living alone—thus, without regular social contacts—reported the most pain. The results supported what has been presented in previous studies (Gonzalez-Chica et al. 2018, Elliott et al. 1999, Baker et al. 2017). It is known that a social network has protective effects against morbidity and mortality outcomes (Holt-Lunstad et al. 2010) and that

loneliness may predict multiple health concerns affecting older adults, such as pain (Jaremka et al. 2013). On the other hand, ineffective pain coping may disturb individuals' social relationships and, therefore, lead to loneliness.

A BMI of over 30 and a large waist circumference in particular were related to higher levels of pain in the current study. As hypothesized, musculoskeletal symptoms were related to pain. Furthermore, the LTPA reports supported the assumption of restricted mobility possibly due to pain. These may also be related to obesity.

The current concern is that an increasingly large proportion of older adults in the Western countries will become marginalized. According to the result herein, a fragile social network as well as a low socio-economic status and educational level, which characterize social exclusion, are more frequent in those with pain. Additionally, obesity, which has also been linked to social exclusion (Lewis et al. 2011), was found to be related to more pain. Therefore, seniors with a scarce social network or obesity are at an increased risk of pain, and preventive methods should be targeted at these individuals. From the clinical perspective, the lack of a cohabitant and a low educational and economic status are relatively easily assessable objective factors, which may serve as warning signs for several health-related concerns. One alternative would be to arrange organized group activities and exercise groups for older adults in order to increase the sense of community but also to encourage physical activity.

Analgesic purchases

Proper assessment should form the basis of adequate pain management (Reid et al. 2015). This includes defining the quality of the pain (nociceptive, neuropathic).

The majority of the current participants had purchased prescribed analgesics during the considered year. As expected, the prevalence of analgesic purchases was the highest in group I. However, analgesics were also purchased by subjects who, at the time of the questionnaire data collection, had reported little or no pain. The drug distribution and purchasing prevalence did not differ markedly between the three age groups (62–66, 72–76, and 82–86 years).

Three out of four participants had purchased NSAIDs, which comprises a remarkable proportion. Markedly smaller prevalences have been found in previous Finnish studies (Hamina et al. 2017b, Pitkala et al. 2015, Pitkala et al. 2002), which may be partly due to different study settings. In addition, prior studies have usually taken into account regularly taken analgesics, whereas the present study also considered pro re nata drugs. Remarkably, the majority of those experiencing no

pain at all at the time of the questionnaire data collection had purchased NSAIDs during the considered year. It is possible that NSAIDs relieved pain rather effectively when used frequently, which is why pain was not reported. On the other hand, considering the aspect of pain perception, seniors may tolerate some pain and consider it normal, thus reporting no pain despite a clinically relevant pain-causing condition. Additionally, the amount of NSAIDs administered may actually be even higher than what was estimated herein, when the amount obtained over the counter is considered (Enthoven et al. 2014). In older adults, however, a strong association has been found between increased age and the use of only prescribed analgesics (Sarganas et al. 2015).

Despite the similar suggestion by Hartikainen and colleagues in 2005 (Hartikainen et al. 2005), it was surprising that the purchasing of paracetamol, which has been recommended as the gold standard in geriatric pain management (Makris et al. 2014), was in a clear minority compared to the prevalence of NSAID purchases. However, medical professionals have recently been encouraged to consider whether to not use paracetamol for patients with lower back pain and osteoarthritis due to possible inefficacy (Machado et al. 2015), which may explain the lower prescribing percentage. Additionally, it is most likely that a major part of older adults' pain is due to musculoskeletal diseases, for which NSAIDs are effective (Mason et al. 2004). Furthermore, the incremental availability of selective COX-2 inhibitors may have increased the use of NSAIDs due to their suggested more favorable gastrointestinal profile (Sostres et al. 2010, Jarupongprapa et al. 2013). It is possible that, for this reason, clinicians regard selective COX-2 inhibitors as "safe" for older adults, despite the evident renal and cardiovascular adverse effects (Shi and Klotz 2008).

Opioids were prescribed significantly more frequently than neuropathic drugs. TCA purchases were found to be minor. Overall, neuropathic drugs were relatively underrepresented, although the prevalence of neuropathic pain is known to increase with age (Schmader et al. 2010). Referring to the guidelines, duloxetine and venlafaxine (which were not included in the present study) are preferred (Pickering et al. 2016), but nortriptyline and gabapentinoids may also be considered for neuropathic pain conditions in seniors if contraindications are not present (Abdulla et al. 2013). It is possible that a fear of anticholinergic adverse effects and the fact that TCAs are considered to be antidepressants restricted their use. Furthermore, according to the Beers criteria, TCAs and gabapentinoids should be used with caution in older adults due to multiple potential adverse effects (syncope, anticholinergic effects, etc.)(By the American Geriatrics Society Beers Criteria Update Expert, 2019). Additionally, TCA administration needs to be properly

scheduled and monitored. However, the lack of experience in neuropathic pain management by clinicians probably also partially explained the low prevalence compared to other analgesics.

In their study, Steinman and colleagues investigated alterations in the use of analgesics between 1999 and 2010 in the United States and found that opioid administration doubled during the decade, whereas other analgesics remained relatively stable (Steinman et al. 2015). Pitkälä and colleagues (2015) also noted the increase in opioid administration in their follow-up study (Pitkala et al. 2015). In the present study, some opioids were purchased by more half of those with the most pain, but also by almost one fourth of those with no pain at all at the time of the questionnaire data collection. In 2013, Pitkälä and colleagues presented a prevalence of regular opioid use of 17% in older adults living in assisted living facilities and of 23% in older adults living in nursing homes (Pitkala et al. 2015).

Referring to what was discussed above, older adults' pain management is often the responsibility of general practitioners, who, in addition to having limited time and resources, may not have an expert pain management team to refer to. Despite multiple potential adverse effects, opioids may be seen as a tempting choice to be prescribed. Opioids are at least relatively effective in almost all pain conditions and are not absolutely contraindicated for any patient group. However, the increasing use of opioids communicates the message that physicians seem to be in urgent need of proper and continuing education in pain assessment and management and that a pain management consultant or team should be easily available, especially to general practitioners. Such a team could most likely be organized relatively easily at least in larger health care centers, if this were considered a priority.

Importantly, the low level of paracetamol purchases may also partially be due to the increasing opioid consumption. The majority of the purchased opioids consisted of mild opioids, most likely a paracetamol-codeine combination. Especially for older adults, clinicians may avoid prescribing both paracetamol and a paracetamol-codeine combination for fear of patient-related inadequate dose titration and, moreover, an exceeded paracetamol dose limit. It is possible that a NSAID and a paracetamol-codeine combination has been seen as an easy and effective combination for both acute and chronic pain conditions regardless of the quality of the pain. However, codeine administration poses multiple challenges in terms of pharmacokinetics and adverse effects (Kirchheiner et al. 2007, Heintze and Fuchs 2015), especially in older adults. The efficacy of codeine in an individual is not easily predictable, as a lack of CYP2D6 activity makes individuals poor codeine metabolizers, while CYP26D duplication makes for ultra-fast metabolizers (Kirchheiner et al. 2007).

However, importantly, opioids are an effective and adequate treatment option for multiple pain conditions, such as cancer pain. Additionally, in the present study, opioid purchases, as well as NSAID and paracetamol purchases, were only independently associated with a higher number of morbidities in all subjects, which may signify that the indication for prescribing analgesics has most likely been adequate. It is possible, however, that individuals receiving analgesics may also have multiple interfering medical conditions that may somehow be pain-related and the lack of structures (especially in primary care) that would support the use of non-pharmacological treatment modalities may drive physicians to easily selecting pharmacological modalities.

To determine which opioid to choose (when there is an indication for such a choice) is far from simple. Patient-related expectations, the risk profile, and the pain-causing condition need to be carefully assessed and evaluated (Abdulla et al. 2013, Chou et al. 2009). Transdermal opioids, especially a buprenorphine patch, have recently become relatively frequent among older people. Hamina and colleagues found that long-term use of transdermal opioids was more than twice as frequent among patients with Alzheimer's disease than seniors without Alzheimer's disease (Hamina et al. 2017a). However, transdermal opioids have also been shown to be the strongest predictor of chronic opioid administration (Lalic et al. 2018). Weak opioids may be considered especially for acute pain conditions (Makris et al. 2014, Reid et al. 2015), but it has also been suggested that a low-dose strong opioid could be a better choice for some individuals in order to achieve the maximum effect in relation to adverse effects (van Ojik et al. 2012). All in all, role of opioids in the management of chronic non-malignant pain remains controversial (Abdulla et al. 2013, American Geriatrics Society Panel on the Pharmacological Management of Persistent Pain in Older Persons 2009, By the American Geriatrics Society Beers Criteria Update Expert 2019).

Factors related to opioid purchases

As discussed above, opioid purchasing emerged as substantial.

As regards morbidities, cardiovascular, musculoskeletal, and pulmonary diseases as well as malignancies were more prevalent among individuals who purchased opioids. The opioids primarily comprised weak opioids, which may be an easy and effective choice for, for instance, osteoarthritis pain. Opioids constitute an important part of pharmacological therapy in many acute non-cancer conditions (e.g. myocardial infarction, chronic obstructive pulmonary disease related breathlessness,

hip fracture) (Trost and Lange 2012, Ekstrom et al. 2015, Lindestrand et al. 2015), but many of these conditions do not require opioid administration after the acute in-hospital phase. Acute conditions should therefore not explain the high prescribing rates. The association with internal medicine diseases may be due to multi-morbidity.

Patients with a lower socio-economic status, alcohol abuse, or a mental health disorder have been reported to be less likely to receive opioids in hospitals or have them prescribed to them (Calcaterra et al. 2016, Joynt et al. 2013). An elevated use of opioid analgesics among smokers has been suggested (Yoon et al. 2015). According to the results of the present study, no difference was found in socioeconomic factors, age, sex, smoking, alcohol consumption, LTPA, or the prevalence of insomnia between the opioid and non-opioid group. Interestingly, there was no difference in participants' glomerular filtration rates or blood pressures between groups. NSAIDs are relatively contraindicated in kidney diseases and hypertension (Whelton and Hamilton 1991, Frishman 2002, Gooch et al. 2007), and gabapentinoids, for instance, accumulate in chronic kidney disease and may cause vertigo (Tawfic and Bellingham 2015, By the American Geriatrics Society Beers Criteria Update Expert 2019), which could have explained the tendency to prescribe opioids instead.

Multiple studies have demonstrated an association between obesity and MetS, and pain (Eslami et al. 2017, Loevinger et al. 2007, Ray et al. 2011). According to Ray and colleagues 2011), a bidirectional pathway may explain this association. In their thorough community-based study, both BMI and abdominal obesity were associated with chronic pain in older adults; it was suggested that chronic pain possibly leads to decreased activity and, conversely, metabolic impairment predispose to pain. (Ray et al. 2011.) Regarding the current study, especially a BMI of over 30 and a large waist circumference were related to the most pain.

MetS consists of insulin resistance, dyslipidemia, elevated blood pressure, and central obesity (Kaur 2014). Elevated serum uric acid and hs-CRP levels are often present (Kaur 2014, Chen et al. 2007). In the current study, only central obesity and elevated hs-CRP were found to be related to more pain. However, MetS was independently associated with opioid administration in individuals who had used opioids but reported no pain intensity and pain-related interference. Additionally, the prevalence of MetS and obesity, as well as hs-CRP and serum uric acid levels, were significantly higher in participants using opioids than in those who had not purchased opioids. The prevalence of MetS has been suggested to be higher among alcohol- and opioid-dependent male inpatients compared to the general population (Mattoo et al. 2011).

Interestingly, on the molecular level, grave obesity has recently been found to associate with decreased u-opioid receptor (MOR) availability in the brain (Karlsson et al. 2015). It is known that decreased MOR availability leads to diminished opioid sensitivity and to opioid tolerance (Al-Hasani and Bruchas 2011). Further studies are needed to specify whether the MetS/obesity–opioid use association evolves from the molecular level, or whether obesity, for instance, intensifies musculoskeletal symptoms, thereby leading to a need for opioids.

6.3 STRENGTHS AND LIMITATIONS

Study I

The small sample size must be addressed as a limitation in Study I. Secondly, the cross-sectional setting did not enable the investigation of causality, which would have been informative. Thirdly, a confirmatory factor analysis would have been statistically preferred in the higher-order analysis (Aroian 2005). However, it was appropriate to observe the exploratory method used by Reid and colleagues, in order to be able to compare the results achieved herein to what they had presented (Reid et al. 1998). Fourthly, the use of other factors related to coping, such as self-efficacy, aside from CDI and pain frequency would have strengthened the current results in terms of validity. Finally, adding a generic quality of life scale would have clarified the meaning of pain coping in children's and adolescents' lives.

Studies II–III

The major strength—the combination of self-reporting, clinical data, data provided by laboratory sampling, and pain medication data—may be highlighted. Regarding pain measurements, the SF-36 bodily pain scale has a favorable fit to the population-based study setting. Furthermore, the sample size was satisfactory. The sample is relatively well representative of Finnish community-dwelling older adults.

A few limitations need to be addressed. The questionnaire structure regarding pain severity may have induced some bias as regards the total pain prevalence estimates. The alternatives included very mild and mild pain, and it is likely that the majority of seniors had experienced some pain during the preceding month. However, almost one fifth of all participants had experienced moderate to very severe pain. Furthermore, the exact pain location and chronicity, the nature of the

pain (neuropathic, nociceptive), the clinical situation related to analgesics administration, the exact number and doses of analgesics, and the amount of medicines purchased over the counter were not retrievable. Also, there was a lack of a temporal association between the pain assessment and the analgesic purchases. It is possible that the pain was not yet present at the time of the self-reporting, or, conversely, the administered drugs had already relieved the pain, which is why some subjects who had purchased analgesics did not report having pain. Additionally, the pattern of analgesics prescribing has most likely been for as-needed use, which has also been reported to be the most common in previous studies (Reid et al. 2010), but this cannot be stated for certain. Pro re nata administration may, to some extent, overestimate the purchasing prevalence. On the other hand, the participants only represented the overall healthy seniors; those who suffer the most disability and are in need of institutional care—who may have used even higher amounts of analgesics—did not participate.

6.4 FUTURE PERSPECTIVES

Pain coping is a promising mediating factor, but the exact mechanisms of improvement in pain treatment require mediation analyses (Baron and Kenny 1986, Kazdin and Nock 2003). Understanding the mechanism of change—for example, mediation—may bring order to the interventions, help to foster improvement in the clients, and enable the identification of the treatment moderators (Kazdin and Nock 2003). EFA strategies, such as pain reactivity, catastrophizing, and pain impairment beliefs, typically function as mediators when pain or disability is the outcome (Wicksell et al. 2011, Kashikar-Zuck et al. 2013).

Despite the promising results herein, further studies are needed to broaden the experience with the PCQ's applicability to larger samples and especially healthy children and adolescents. Furthermore, attention should be paid to moderating factors (e.g. diagnosis), parental factors, and their relationship to the pain coping strategies. Medical professionals treating pediatric pain need to focus on examining pain coping in order to identify which coping styles are effective for each individual in the long term. Pain intervention studies in the field of acceptance and commitment therapy have shown that avoiding negative psychological events and sensations may produce short-term relief (Hayes 1999) but, on the other hand, lead to a narrow and inflexible function and increased disability (Wicksell et al. 2011, Wicksell et al. 2008).

In addition to pain severity, pain-related interference was reported to be relatively high among older adults. It is important to consider pain intensity and pain-related interference separately, as they rarely are analogous. Further research is needed to clarify whether the interference was rather physical or psychical. It has been suggested, however, that persistent non-cancer pain does not automatically equate with suffering in older people (Shega et al. 2013).

It has been debated whether clinicians are lacking in courage to provide sufficient pharmacological treatment for older adults' pain (Upshur et al. 2006, Lin et al. 2007). According to what has been presented herein, analgesics prescribing emerged as active. Further studies are needed to specify the amount of analgesics use among the community-dwelling older adult population.

Despite the active use of analgesics, however, the majority of the participants reported endured pain. Non-pharmacological modalities (e.g. physical therapy, cognitive behavioral therapy, pain education) and organized social networking should be given a prominent role in pain prevention and management along with drug prescribing (Kroenke et al. 2013, Shekelle et al. 1999, Makris et al. 2014, Abdulla et al. 2013). The majority of older adults experiencing chronic pain are treated by primary care physicians. Resources for an active use of non-pharmacological modalities may, to some extent, be available in at least larger health-care centers, but the problem lies in the lack of structures supporting their efficient use and the lack of multidisciplinary teamwork. An organized multidisciplinary team specializing in chronic pain management should also be available in primary care. Older adults are at an increased risk of drug-related adverse effects, which supports the use of non-pharmacological modalities. Pharmacological strategies, especially opioids, should be applied only if adequately executed non-pharmacological strategies have proved ineffective (Abdulla et al. 2013).

The high pain prevalence should also be noted as a warning sign of a potential decrease in the quality of life, but also in a person's physical and mental state. Inadequate pain management may result in decreased activity levels and, thus, a risk for frailty and disabilities, but also in weight gain as well as increased comorbidity and poorer outcomes. Furthermore, as a secondary adverse effect, it may cause an increased financial burden.

The results herein need to be considered thoroughly by health care providers and clinicians in order to recognize the high prevalence of pain and the risks related to it. Moreover, specific pain conditions and the quality of pain need to be recognized and evaluated, as neuropathic pain, for example, has been demonstrated to be strongly associated with pain-related interference (Thakral et al. 2016, Smith and

Torrance 2012). Unfortunately, regarding neuropathic pain, SNRIs were not included in the present study. Further studies are needed to evaluate the role of venlafaxine and duloxetine in the management of pain in older adults.

A large body of evidence supports proper pain assessment, the active use of non-pharmacological modalities, and a careful monitoring of pain coping and treatment efficacy in special age groups (Abdulla et al. 2013, Kroenke et al. 2013, Shekelle et al. 1999, Makris et al. 2014, Herr and Garand 2001, Manworren and Stinson 2016, Beltramini et al. 2017, Varni et al. 1996b, Reid et al. 1998). However, all this requires resources and expertise. The results of the present study indicate that broader expertise, such as a special pain management team (also in primary care), and better consulting practices at clinics could lead to better outcomes. Accordingly, it may be suggested that primary care would include pain clinics similar to what is currently offerd in specialized health care. The idea would be to recruit and educate pain nurses and physical therapists, and possibly also a social worker who, with the assistance of a consultant general practitioner, would organize the pain services of the district. This should involve close contact with a pain management specialist in specialized health care.

In conclusion, pain is a frequent and evident factor affecting the quality of life in special age groups (Varni et al. 1996b, Schanberg et al. 1996, Bernfort et al. 2015, Chen et al. 2003, Lacey et al. 2014). Very young or old age, an immature developmental state, or impaired cognition must not be regarded as reasons for not assessing pain adequately (Herr and Garand 2001, Herr 2011, Booker and Haedtke 2016, Manworren and Stinson 2016, Beltramini et al. 2017). Incremental resources need to be focused on pain prevention and management at clinics. The importance of the involvement of a multidisciplinary team with targeted goals concerning the affected domains of the quality of life in pain management needs to be highlighted (Niv and Kreitler 2001). There is also a need for individualized deliberation regarding pain assessment and management in order to reach the optimal goal in pain treatment.

7 CONCLUSIONS

According to the presented results, the following conclusions may be drawn:

1. An exploratory first- and higher-order factor analysis the PCQ provided a both culturally and statistically satisfactory structure in the Finnish translation. The reliability and validity of the PCQ in future national use may be encouraged. The results also support the reliability of the PCQ as an internationally used measurement.

2. Regarding older adults, pain was reported to be more severe in terms of intensity and interference by subjects who were obese or had morbidities or a low socio-economic status.

3. NSAID and opioid purchases were revealed to be extensive, whereas paracetamol and neuropathic analgesics were in the minority. Further consideration of NSAID- and opioid-related contraindications is required.

4. A higher number of morbidities was found to independently associate with purchases of NSAIDs, paracetamol, and opioids. Metabolic syndrome and morbidities were found to independently associate with opioid administration in those who reported no pain at all at the time of the questionnaire data collection.

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PUBLICATIONS

PUBLICATION I

Validation of the Pain Coping Questionnaire in Finnish

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ORIGINAL ARTICLE

Validation of the Pain Coping Questionnaire in Finnish

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Abstract

Objective: The Pain Coping Questionnaire (PCQ), the first validated pain coping measurement developed specifically for children, has lacked proper validation in Finnish. The original PCQ by Reid et al. (Pain 1998; 76; 83–96) comprises eight-first-order and three higher-order scales. The aim herein was to determine the factor structure and validity of the Finnish PCQ translation in Finnish children.

Methods: Exploratory factor analysis was used for the first-order and higher-order classification of 91 recruited patients aged 8–15. Cronbach's alpha was used for reliability. Relationships between the Children's Depression Inventory, patient-reported pain frequency and pain coping strategies were examined.

Results: Analyses were executed with 38 items; one was excluded. A structure of eight-first-order (Internalizing/Catastrophizing [IC], Positive Self-Statements [PSS], Information Seeking [IS], Seeking Social Support [SSS], Cognitive Distraction [CD], Externalizing [EXT], Behavioural Distraction [BD], Problem Solving [PS]) and three higher-order scales (Approach [APP], Emotion-Focused Avoidance [EFA], Distraction [DIS]) proved the most consistent. Four first-order scales (PSS, CD, EXT, BD) emerged as identical to the original solution. Internal consistency reliability coefficients for all individual first- and second-order scales were satisfactory. A higher CDI score was positively related to EFA and negatively to DIS, and pain frequency positively related to APP and EFA.

Conclusion: The exploratory factor analysis of the PCQ provided a both culturally and statistically satisfactory structure in the Finnish translation. This supports the reliability and validity of the PCQ in future national use and the value of the questionnaire also outside English-speaking countries.

Significance: This study showed both culturally and statistically satisfactory factor structure of PCQ in the Finnish translation. This result supports reliability and validity of the PCQ in the national use in the future. The result shows that the PCQ is a reliable method to be used in different linguistic and cultural surroundings and, thus, encourages using it in various countries. The data consist of two patient groups, adolescents with JIA and musculoskeletal pain. Pain and specifically coping with pain are important aspects of clinical work. A valid pain coping scale may enhance distinguishing vulnerable pain coping style in children and adolescent before pain becomes chronic.

1. Introduction

Coping signifies purposeful cognitive and behavioural efforts to overrule the negative impact of stress (Lazarus, 1993). A growing consensus supports the significance of pain coping in the understanding of prolonged pain in children (Reid et al., 1998; Thastum et al., 1999; Bandell-Hoekstra et al., 2002; Hermann et al., 2007; Claar et al., 2008; Huguet et al., 2009; Ostlie et al., 2009; Kashikar-Zuck et al., 2013; Simons et al., 2015; Agoston et al., 2016; Baastrup et al., 2016; Gaultney et al., 2017). To measure pain coping is to distinguish the ongoing cognitive, behavioural and emotional processes connected to pain in children and adolescents with recurrent or chronic pain. Measurement of pain coping can help test the mechanisms of treatment studies (Claar et al., 2008; Kashikar-Zuck et al., 2013; Simons et al., 2015), while the psychosocial treatments that address coping typically have pain intensity or adaptive functioning as primary outcomes. Pain coping often encompasses adaptive versus nonadaptive (Claar et al., 2008; Kashikar-Zuck et al., 2013; Simons et al., 2015) and active versus passive coping (Baastrup et al., 2016; Boschen et al., 2016; Edwards et al., 2016).

The Pain Coping Questionnaire (PCQ), the first validated pain coping measurement for children, was developed and validated by Reid et al. (1998). Apart from Reid and colleagues, three studies have examined the psychometric properties of the PCQ and established an adequate validation in other languages besides English (Danish, Catalan, Dutch) (Reid et al., 1998; Thastum et al., 1999; Bandell-Hoekstra et al., 2002; Huguet et al., 2009). In the original English version of the PCQ, Reid et al. (1998) included 39 items describing pain coping strategies, indicating how often children would execute each strategy. Reid et al. conducted a factor analysis (data from healthy children and adolescents), and the 39 items were grouped into eight conceptually derived scales (Information Seeking, Problem Solving, Seeking Social Support, Positive Self-Statements, Behavioural Distraction, Cognitive Distraction, Externalizing, Internalizing/Catastrophizing). These first-order scales were analysed further in the arthritis/headache sample for which all participants were recruited from neurology and rheumatology clinics. Three second-order scales emerged (Approach, Emotion-Focused Avoidance, Distraction). In the Danish translation with data from mostly healthy youth, Thastum and colleagues excluded three items (1, 9, 36) and, with the remaining 36 items integrating the original Information Seeking and Problem Solving scales, suggested a seven-scale first-order factor structure (Thastum et al., 1999). Bandell-Hoekstra et al. (2002) presented eight scales in the cross-sectional Dutch version but were unable to confirm the higher-order scales. Huguet et al. (2009) studied the Catalan version in both school children and adults, comparing the models by Reid et al. and Thastum et al. (1999). Their confirmatory factor analysis supported the seven-factor structure that Thastum et al. had previously suggested (Thastum et al., 1999; Huguet et al., 2009).

So far, only Reid et al. (1998) have been able to confirm an exploratory second-order factor structure of the PCQ. In this study, one primary objective was to investigate whether a consistent second-order structure would surface. Regarding the PCQ, a first-order factor analysis provides specific information about children's coping patterns. However, second-order analysis would give more information about the hierarchical structure of coping with pain. Moreover, it would yield a more parsimonious and interpretable picture of children's pain coping for clinical use.

To date, the PCQ has been the only pain coping measurement that has been (1) proved to have good psychometric quality, (2) designed specifically for children and adolescents, (3) subjective, (4) executable across a wide range of pain conditions and (5) validated in multiple languages and cultures (Reid et al., 1998; Hermann et al., 2007; Huguet et al., 2009). In childhood diseases with frequent pain episodes, that is in juvenile idiopathic arthritis (JIA) and juvenile fibromyalgia, it is important to have tools to distinguish vulnerable pain coping. For instance, JIA may have episodes of fatigue and physical disability (Ostlie et al., 2009; Gaultney et al., 2017), possibly affecting social life such as school functioning (Agoston et al., 2016). In particular, in paediatric chronic pain patients, pain coping styles, for example catastrophizing, are rather consistently found to be positively related to pain intensity and pain-related emotional stress (Varni et al., 1996; Vervoort et al., 2010; Simons et al., 2015; Edwards et al., 2016). In pain treatment, besides pain intensity, it is important to distinguish the cognitive–emotional processes related to pain, because these may be the possible mechanisms of improvement (Wicksell et al., 2011).

Since there remains uncertainty regarding the factor structure of the PCQ, with the second-order structure in particular, the aim of this study was to determine the first- and second-order factor

structures of the Finnish translation of the PCQ. A valid pain coping scale may improve the recognition of vulnerable coping at the very early stage of pain becoming chronic. The hypotheses for the validity analyses are that emotion-focused coping strategies would be positively associated with depressive symptoms and pain frequency, whereas active coping methods, such as distraction, would be associated with less pain and less depressive symptoms.

2. Methods

2.1 The PCQ

The original Pain Coping Questionnaire (Reid et al., 1998) comprises 39 pain coping strategies indicating children's behaviour when in pain. In the form's instructions, the subjects are advised to report how they would act when in pain for hours or days on a Likert scale, a higher value indicating more frequent behaviour (1: Never – 5: Very often). The strategies are presented as patterns of behaviour by continuing the sentence 'When I am hurt or in pain for a few hours or days, I…' (e.g. 'Try to forget it', 'Do something I enjoy'). The PCQ is independent of the cause of pain and can be used with children as young as 8 years of age.

An interdisciplinary team comprising an authorized translator, a psychologist, a paediatric rheumatologist and a professional senior researcher translated the original questionnaire from English to Finnish. The translated version was back-translated into English by an independent authorized translator who did not participate in the first translation session. The final Finnish version was created in a joint session in which all of the above participated, with access to the original, translated and back-translated versions of the PCQ scale.

2.2 The CDI and pain

The Finnish version of the Children's Depression Inventory (CDI) was used to measure the depression/mood disturbances of the patients (Kovacs, 1985). The scale has previously been validated in a Finnish sample (Almqvist, 1988). The Finnish version includes 26 of the 27 items of the English version: The question about suicide was excluded for ethical reasons. The score for each item varies from zero to two, and the total score thus varies from zero to 52. Higher values indicate increasingly severe depression. In this study, the internal consistency of the scale was good ($\alpha = 0.85$).

Pain was measured by means of the Structured Pain Questionnaire (King et al., 1996; Mikkelsson et al., 1998), which has been used previously in paediatric studies (El-Metwally et al., 2004; Vuorimaa et al., 2011). The questionnaire uses a five-level frequency classification of pain over the preceding 3 months (seldom or never, once a month, once a week, more than once a week, almost daily). Each of the seven pain areas (neck, upper and lower extremities, chest, upper back, lower back and buttocks) was scored from zero to five, the total (frequency and area combined) score ranging from zero to 28. The body area concerned was marked on a picture beside the question to help the child to recognize it. The internal consistency of the scale was good ($\alpha = 0.81$).

2.3 Study population

The study population consisted of two samples. For the patients with juvenile idiopathic arthritis (JIA; $n = 64$), the inclusion criteria were (1) a JIA diagnosis established at least 1 year prior to the study (Petty et al., 2004) and (2) aged between eight and 15 years at the beginning of the study. The JIA patients were recruited at the follow-up of a larger study in 2006–2007 at the Rheumatism Foundation Hospital in Finland, with a catchment area covering the whole country (Vuorimaa et al., 2009). Of the 142 patients recruited during routine clinical visits at baseline, 64 attended the follow-up study in which the current data were collected. In addition, 33 patients with chronic noninflammatory musculoskeletal pain symptoms were recruited in 2013–2017 at Päijät-Häme Central Hospital, Finland. A total of 97 patients were recruited during routine clinical visits. We excluded all patients with one or more missing value ($n = 6$). Therefore, the final analyses were performed with 91 subjects (65 girls, 26 boys). All measures were implemented at the hospitals.

The principles of the Declaration of Helsinki (2013) were followed. All patients and their parents received both oral and written information on the study and gave their written informed consent. The study protocol and procedures were accepted by the Ethical Committee of the Päijät-Häme Hospital District.

2.4 Statistical analyses

The factor analyses are described in detail in the Results section. Cronbach's coefficient alpha was

used to estimate the reliability. Univariate analyses were applied to describe the data. Differences between groups were tested by independent samples *t*-test. To test construct validity, the Children's Depression Inventory (CDI) score and, to test criterion validity, the patient-reported pain frequency score were examined in relation to the second-order factor solution achieved using a zero-order correlation coefficient. According to previous studies, the coping strategies were expected to be related to depressive symptoms and pain frequency. Two-sided *p*-values of <0.05 were considered statistically significant in the analyses. All statistical analyses were executed with SPSS versions 23 and 24 (SPSS, Chicago, IL, USA).

3. Results

3.1 Participants

The mean age of the patients was 13.7 ± 2.2 (SD) years. The mean of depressive symptoms measured by CDI was 6.1 ± 6.4 (SD) and the mean of pain frequency 6.3 ± 6.5 (SD). In CDI, the level of depressive symptoms in girls [6.7 ± 7.0 (SD)] was higher than in boys [4.5 ± 4.2 (SD)]. Girls also had a higher pain frequency level [6.8 ± 0.8 (SD)] than the boys [5.0 ± 6.0 (SD)]. The descriptive data show that the patients had an elevated level of depressive symptoms and pain frequency compared to other pain studies (El-Metwally et al., 2004; Vuorimaa et al., 2011); as a group, however, the patients were not suffering from depression or strong pain symptoms.

3.2 First-order factor analysis

Several steps in the first-order exploratory factor analyses preceded the exploratory factor analysis result above. First, an eight-factor structure with all 39 items was tested. However, in this set, only one item (item 27) loaded primarily on the eighth factor. Principally, the highest factor loading was accepted when λ was ≥0.40. Also, the difference in magnitude between loadings on two separate factors needed to exceed 0.20. In the case of many items, these criteria were not met. Several other potential structures examined supported the incongruous role of item 27 in the analysis.

The final exploratory analysis was executed with 38 items, without item 27. Item 27 was excluded due to its poor fit to any hypothetic structure examined, as mentioned above. A satisfactory eight-factor solution was accomplished using the principal axis factoring method with promax rotation (see Table 1). The communalities of all strategies were considered tolerable (the weakest = 0.268). The Kaiser–Meyer–Olkin measure of sampling adequacy (0.77) and Bartlett's test of sphericity (2237.3, df = 704, $p < 0.001$) indicated that exploratory factor analysis is appropriate for this data set (Field, 2009). The eight-factor model explained 61.4% of the total variance.

Eliminating item 27 led to a satisfactory eight-factor solution. One item in the Problem Solving scale had a weak loading, λ = 0.377, but it was still distinctly higher than on any other factor and the item was retained in the analysis. Two items loaded on two factors (λ ≥ 0.40; items 7 and 21) but were both subsumed under the highest loading factor. Cronbach's alpha internal consistency reliability coefficient for each scale was commendable (all exceeding 0.76). All internal consistency reliability coefficients are presented in Table 2.

To test construct validity, bivariate correlations were calculated to analyse the relationship between PCQ first-order subscales and CDI (Table 3; Kovacs, 1985; King et al., 1996). CDI showed significant correlation with IC ($r = 0.408$, $p < 0.001$), EXT ($r = 0.288$, $p = 0.006$) and BD ($r = -0.335$, $p = 0.001$). To test criterion validity, bivariate correlations were calculated to analyse the relationship between PCQ first-order subscales and pain frequency. There was a significant correlation between IC ($r = 0.398$, $p < 0.001$), EXT ($r = 0.327$, $p = 0.002$) and PS ($r = 0.257$, $p = 0.015$), and pain frequency (Table 3).

3.3 Second-order factor analysis

An exploratory analysis of maximum likelihood higher-order factoring with promax rotation was used to examine the higher-order structure of the eight-first-order scales. The factor scores of these scales were computed with the regression method (Landau and Everitt, 2004). Three higher-order scales emerged (Approach, Emotion-Focused Avoidance, Distraction; Table 4). Factor loadings exceeding λ = 0.40 were accepted. Cronbach's alpha reliability coefficients were satisfactory (Table 2). The goodness of fit (variance accounted 51.6%, $\chi^2 = 5.42$, *p*-value = 0.609; Edwards et al., 2016) was tolerable. Behavioural Distraction loaded on both Approach and Emotion-Focused Avoidance. Only one-first-order factor (CD) loaded on the Distraction higher-order scale. Positive Self-

Table 1 The Finnish PCQ first-order factor analysis.

	Factors							
Items	IC	PSS	IS	SSS	CD	EXT	BD	PS
8 Worry that I will always be in pain	0.931							
16 Keep thinking about how much it hurts	0.602							
24 Think that nothing helps	0.777							
26 Figure out what I can do about it	0.436							
32 Think that the pain will never stop	0.798							
39 Worry too much about it	0.827							
4 Tell myself, don't worry everything will be OK		0.935						
12 Say to myself, be strong		0.717						
20 Tell myself it's not so bad		0.703						
28 Say to myself things will be OK		0.756						
35 Tell myself I can handle anything that happens		0.847						
1 Ask questions about the problem			0.637					
17 Find out more information			0.872					
25 Learn more about how my body works			0.614					
3 Talk to a friend about how I feel				0.661				
9 Ask a nurse or a doctor questions			(0.321)	0.429				
11 Talk to someone about how I am feeling				0.723				
19 Tell someone how I feel				0.672				
34 Let my feelings out to a friend				0.587				
6 Forget the whole thing	(−0.329)				0.629			
14 Ignore the situation					0.419			
22 Try to forget it				(−0.311)	0.527			
30 Put it out of my mind					0.717			
37 Don't think about it					0.855			
7 Say mean things to people				(−0.403)		0.694		
15 Argue or fight						0.723		
23 Yell to let off steam						0.362		
31 Get mad and throw or hit something						0.776		
38 Curse out loud						0.627		
5 Go and play							0.605	
13 Do something fun	(−0.374)						0.582	
21 Do something I enjoy							0.551	(0.470)
29 Do something active							0.747	
36 Do something to take my mind off it					(0.339)		0.507	
2 Focus on the problem and see how I can solve it								0.450
10 Think about what needs to be done to make things better								0.497
18 Think of different ways to deal with the problem				(0.305)				0.377
33 Try different ways to solve the problem until I find one that works								0.424

BD, Behavioural Distraction; CD, Cognitive Distraction; EXT, Externalizing; IC, Internalizing/Catastrophizing; IS, Information Seeking; PS, Problem Solving; PSS, Positive Self-Statements; SSS, Seeking Social Support. Exploratory factor analysis was performed using the principal axis factoring method and promax rotation. Item 27 ('Talk to a family member how I feel') was excluded due to statistical reasons. All factor loadings exceeding 0.30 are presented. $N = 91$. Eight-factor structure explained 61.35% of the total variance.

Statements also weakly (−0.304) loaded on Distraction, but evidently had a higher loading on Approach.

Table 5 shows the descriptive statistics regarding second-order factor scores for primary school-aged children (9–12 years) and lower and upper secondary school-aged adolescents (13–18 years), for girls and boys, and for JIA patients and patients with noninflammatory musculoskeletal symptoms. The only significant difference between the scores was found for Emotion-Focused Avoidance in JIA patients vs. patients with noninflammatory musculoskeletal symptoms (JIA 1.9 ± 0.5 (SD), other 2.3 ± 0.7 (SD), $p = 0.011$). No other differences reached statistical significance.

3.4 Validity analysis

To measure construct and criterion validity of the subscales, the scales were correlated with clinical

Table 2 Internal consistency reliability (Cronbach's alpha) of the eight-first-order and three-second-order scales of the PCQ.

First-order exploratory analysis	
Scales	Cronbach's alpha
Internalizing/Catastrophizing	0.892
Positive self-statements	0.895
Information seeking	0.781
Seeking social support	0.867
Cognitive distraction	0.789
Externalizing	0.762
Behavioural distraction	0.793
Problem solving	0.852
Second-order exploratory analysis	
Subscales	Cronbach's alpha
Approach	0.911
Emotion-focused avoidance	0.845
Distraction	0.789

Table 3 Zero-order correlations between the Children's Depression Inventory (CDI) score, patient-reported pain frequency and pain coping scales.

Coping scales	CDI (n = 89)	Pain (n = 89)
Approach	0.029	0.261*
Positive self-statements	−0.052	0.132
Information seeking	0.043	0.208
Seeking social support	0.027	0.201
Behavioural distraction	−0.335***	−0.050
Problem solving	0.103	0.257*
Emotion-focused avoidance	0.511***	0.433***
Internalizing/Catastrophizing	0.408***	0.398***
Externalizing	0.288***	0.327**
Distraction	−0.234*	−0.154
Cognitive distraction	−0.031	−0.037

CDI, Children's Depression Inventory score (Kovacs, 1985); Pain, structured pain questionnaire (SPQ) score (King et al., 1996). Due to missing data $N_{CDI,\ Pain} = 89$.
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

data. According to previous studies, coping strategies were expected to be related to depressive symptoms and pain frequency. Specifically, Emotion-Focused Avoidance would be more likely to be associated with depressive symptoms (Landau and Everitt, 2004; Field, 2009; Kashikar-Zuck et al., 2013; Edwards et al., 2016). The correlations between CDI score and patient-reported pain frequency and the second-order pain coping scales are presented in Table 3 (Kovacs, 1985; King et al., 1996). A higher CDI score was positively related to Emotion-Focused Avoidance ($r = 0.511$, $p < 0.001$) and negatively to Distraction ($r = -0.234$, $p = 0.027$). Pain frequency was positively related to Emotion-Focused Avoidance ($r = 0.433$, $p < 0.001$) and to Approach ($r = 0.261$, $p = 0.013$).

4. Discussion

To the best of our knowledge, this study was the first evaluating the validity of the Finnish PCQ adaptation and fourth outside the English-speaking countries (Reid et al., 1998; Thastum et al., 1999; Bandell-Hoekstra et al., 2002; Huguet et al., 2009). Our exploratory factor analysis supported the structure of eight-first-order and three higher-order scales. The results demonstrate adequate validity and reliability. The administration of the Finnish PCQ in future studies may be justified.

4.1 First-order factor structure

In the exploratory factor analysis executed with 38 items, an eight-factor first-order structure with the subscales of IC, PSS, IS, SSS, CD, EXT, BD and PS proved the most coherent. The original validation of the PCQ by Reid et al. (1998) also presented an eight-factor first-order structure, as did the Dutch version by Bandell-Hoekstra et al. (2002). The Danish adaptation with only 36 items supported a seven-factor structure with a combined seventh subscale of IS/PS (Thastum et al., 1999).

In the present study, item 27 was excluded. As presented in the results section, specific criteria were followed in constituting the first- and second-order scales, and item 27 poorly met these criteria. The analyses were thus executed with 38 items. Four scales (PSS, CD, EXT, BD) emerged as identical to Reid's and colleagues' solution (Reid et al., 1998). Item 18 loaded relatively weakly on PS, but was included in the factor due to its important role as a part of the factor in question.

Compared to the original solution by Reid et al. (1998), the changes in the current result only concerned two items, 26 and 9. In the present study, item 9 (included in IS is the solution by Reid et al.) was included in SSS. In the structure by Reid et al. (1998), item 27 (excluded from our analysis) also loaded on SSS. In the present study, item 26 loaded on IC, whereas in Reid's and colleagues' study, it loaded on PS (Reid et al., 1998). Therefore, PS, IS and SSS all lacked one item, and IC and SSS both gained one compared to the Reid et al.'s study (Reid et al., 1998). However, from a statistical, cultural and linguistic perspective, all of these differences seemed rational and the items in question fit well into the scales they primarily loaded on. In the

Table 4 Higher-order factor loadings among the Finnish PCQ scales in comparison with the exploratory higher-order structure of the arthritis/headache sample by Reid et al. (1998).

	Higher-order factor structure of the Finnish PCQ			Higher-order factor structure by Reid et al.		
Coping subscales	Approach	Emotion-focused avoidance	Distraction	Approach	Emotion-focused avoidance	Distraction
Positive self-statements	0.675		(0.304)	0.61		
Information seeking	0.643			0.89		
Seeking social support	0.773			0.54		
Behavioural distraction	0.429	−0.411				0.65
Problem solving	0.607			0.81		
Internalizing/Catastrophizing	(0.329)	0.577			0.67	
Externalizing		0.513			0.72	
Cognitive distraction			0.886			0.89

Exploratory higher-order factor analysis was executed using maximum likelihood extraction with promax rotation. Factor loadings $\lambda \geq 0.40$ were accepted and loadings $\lambda \geq 0.30$ are presented. The total variance explained by three higher-order factors was 51.64%.

Table 5 Means and standard deviations (SD) of the Finnish PCQ second-order scales by sex, age and diagnosis group.

	Sex			Age group[a]			Diagnosis group[b]		
Coping scales	Girls *M* (SD)	Boys *M* (SD)	t-test$_{Sex}$	9–12 years *M* (SD)	13–18 years *M* (SD)	t-test$_{Age}$	JIA *M* (SD)	Other *M* (SD)	t-test$_{Diagn}$
Approach	2.7 (0.6)	2.7 (0.6)	0.325	2.6 (0.5)	2.8 (0.7)	−1.264	2.7 (0.6)	2.7 (0.7)	−0.233
Emotion-focused avoidance	2.1 (0.7)	1.9 (0.5)	−0.139	1.9 (0.5)	2.1 (0.7)	−1.847	1.9 (0.5)	2.3 (0.7)*	−2.609*
Distraction	3.2 (0.8)	3.3 (0.9)	1.653	3.2 (0.8)	3.3 (0.9)	−0.326	3.3 (0.8)	3.2 (1.0)	0.119

$N_{Girls} = 65$, $N_{Boys} = 26$, $N_{9–12} = 33$, $N_{13–18} = 58$, $N_{JIA} = 62$, $N_{Other} = 29$.
*$p < 0.05$.
[a]Age = primary school (9–12 years) vs. lower and upper secondary school pupils (13–18 years).
[b]Diagnosis group. JIA = patients with juvenile idiopathic arthritis; Other = patients with chronic noninflammatory musculoskeletal pain symptoms.

Finnish PCQ translation, item 9 creates a warm and conversational connotation, thus fitting well into the SSS factor. In the Finnish wording, item 26, which was included in IC, denotes a deep concentration on the problem. It may thus relate to internalizing the problem. Along with translational difficulties, this divergence may be related to cultural differences.

4.2 Higher-order factor structure

Thastum et al. (1999) only focused on the first-order factor analysis. Bandell-Hoekstra et al. (2002) were also not able to achieve the second-order structure. Huguet et al. (2009)tested the questionnaire's reliability with confirmatory analysis, investigating children and adults separately. They compared the eight-factor structure by Reid et al. (1998) and Bandell-Hoekstra et al. (2002) and the seven-factor structure by Thastum et al. (1999), suggesting that the seven-factor structure with Information Seeking and Problem Solving combined was the most suitable for both age groups. They also accomplished second-order structures with both tested models in children.

In the current study, exploratory factor analysis was used to examine the higher-order structure. A three-factor model was achieved (Table 4). The factors had several similarities to those Reid et al. (1998) presented in their arthritis/headache sample. The only differing first-order scale was BD, which in the present study loaded relatively equally on Approach and EFA (a negative association), whereas in the suggestion by Reid et al. it loaded on Distraction. One possible explanation for this difference is that, in the Finnish translation, the items forming BD suggest activity and problem solving in coping, which is a prominent quality in the Approach scale. In the present study, CD alone formed the Distraction scale. In the Finnish CD scale, the items do not represent problem solving, but rather activity in putting the problem aside. Previously, it has been argued that distraction is not simply a subtype of avoidance coping, because it involves actively redirecting attention to an alternative target (Compas et al., 2001). The means and standard deviations from the PCQ scales (APP, EFA, DIS) in the sample were primarily comparable with the Reid et al.'s

study sample of healthy children and adolescents and the recurrent pain sample (Reid et al., 1998). However, in the Finnish sample, the level of EFA in both sexes and age groups was lower than Reid et al. presented in the studies. Cultural aspects may explain the difference.

Considering the descriptive statistics, no major differences between groups emerged (see Table 5). Sex, age and diagnosis group (JIA vs. noninflammatory musculoskeletal symptoms) were examined separately. Patients with noninflammatory musculoskeletal symptoms tended to use more EFA strategies than JIA patients. This result is most probably related to the fact that there were more adolescents in the noninflammatory group. It might also be possible that noninflammatory pain without a clear and acceptable diagnosis may provoke worry and anxiety prominent in EFA.

4.3 Validity analysis

Thastum et al. (1999) previously presented positive correlations between IC and pain frequency. This was in concordance with the studies of Reid et al. (1998), in which a positive correlation was found between EFA and pain intensity, as well as pain duration in arthritis patients, and between EFA and depression in headache patients. The current study supported these findings. Both higher pain frequency and more depressive symptoms were positively related to EFA. Children may lack the understanding and means to deal with ongoing unwanted physical and mental health conditions, which may burst out as a utilization of EFA strategies, for example ruminating, helplessness, arguing and worrying (Varni et al., 1996). Emotion-Focused Avoidance, especially aspects of catastrophizing, has been found in several studies to associate with multiple pain outcomes in adolescents (Wicksell et al., 2011; Kashikar-Zuck et al., 2013; Welkom et al., 2013; Chatkoff et al., 2015; Edwards et al., 2016). The current study also underlined the nonadaptive aspect of this scale, as it was associated with an elevated level of pain frequency and depressive symptoms. Pain frequency was also associated with the Approach factor. This result was unexpected and might be due to the fact that the level of pain was not very high in the sample. Depressive symptoms and Distraction had a negative, although not very strong, correlation. This is in line with previous studies, in which children's use of distraction strategies was related to less distress (Eccleston, 1995; Reid et al., 1998; Compas et al., 2001).

Pain coping in childhood and adolescence is multidimensional (Edwards et al., 2016). Although pain coping is a promising mediating factor, the exact mechanisms of improvement in pain treatment require mediation analyses (Baron and Kenny, 1986; Kazdin and Nock, 2003). Understanding the mechanism of change – for example mediation – brings order to the interventions, helps to foster improvement in the clients and enables the identification of the moderators of treatment (Kazdin and Nock, 2003). Recent studies (Wicksell et al., 2011; Kashikar-Zuck et al., 2013) in the field of pain rehabilitation have shown that Emotion-Focused Avoidance types of coping – for example pain reactivity, catastrophizing and pain impairment beliefs – typically function as mediators when pain or disability is the outcome.

4.4 Significance of the results

Children and adolescents are known to use various strategies to deal with prolonged or subacute pain (Weekes and Savedra, 1988; Sposito et al., 2015; Nilsson and Willman, 2016). The PCQ was the first measurement developed specifically for children to measure pain coping (Reid et al., 1998). Its popularity most likely originates from its reliability and validity in administration with several pain problems and in multiple cultures (Reid et al., 1998; Thastum et al., 1999; Bandell-Hoekstra et al., 2002; Huguet et al., 2009). It is also relatively short and executable for very young children (from 8 years of age).

However, linguistic and structural resemblance should be taken into consideration. On average, the Finnish culture, behaviour and problem control differ indisputably from the Danish or American. In the present study, cultural aspects have been taken into account in the translation process.

As a limitation of this study, the small sample size must be addressed. Further research is needed to broaden the experience with the PCQ's operability for larger masses and healthy children and adolescents. Also, the study was cross-sectional in nature, which does not enable conclusions to be drawn about the direction or causality of the relationships between pain coping and clinical data. Furthermore, second-order analyses were executed using exploratory factor analysis instead of the statistically preferred confirmatory factor analysis (Aroian and Norris, 2005). However, one of the main purposes of the present study was to compare the results to those presented by Reid et al. (1998). Thus, it was appropriate to follow their study methodically. Additionally, only CDI score and patient-reported pain

frequency were investigated in relation to pain coping strategies in the validity analyses. Using other coping-related factors, such as self-efficacy, would have strengthened the current results. Furthermore, adding a generic quality-of-life scale would have clarified the meaning of pain coping in children's and adolescents' lives.

Our results, the higher-order factor structure of the pain coping scale, provide an avenue for future research. However, attention should also be paid to moderating factors (e.g. diagnosis) and parental factors as well as their relationship to the pain coping strategies presented. An important question is, Which coping styles are effective in the long term for children who have pain symptoms? Recent pain intervention studies in the field of acceptance and commitment therapy (Hayes et al., 1999) have shown that avoiding negative psychological events and sensations may produce short-term relief. However, this pattern may lead to a narrow and inflexible function and increased disability (Wicksell et al., 2008, 2011).

In conclusion, the explorative factor analysis of the PCQ provided both culturally and statistically satisfactory structure in the Finnish translation, which supports the reliability and validity of the PCQ in future national use. The results show that the PCQ is a reliable method to be used in different linguistic and cultural surroundings and, thus, encourages its use in various countries.

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Author contributions

Maiju Marttinen has designed the study and analyzed the data and written the manuscript. Nina Santavirta has designed the study, analysed the data and written then manuscript, professor Markku Kauppi has the lead the research project and written the manuscript, Heini Pohjankoski has collected the data and written the manuscript, Hanna Vuorimaa has collected the data, designed the study protocol, analysed the data and written the manuscript.

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