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Epidemiology

Nocturnal pain, is the pain different compared with pain during the day? An exploratory cross-sectional study in patients with hip and knee osteoarthritis

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Objective: To explore characteristics of nocturnal pain and to identify differences in participants' characteristics and osteoarthritis (OA) symptoms between hip and knee OA participants with and without nocturnal pain.

Methods: Data for this exploratory cross-sectional study were obtained from an online survey, distributed through social media and patient associations in the period from April 2020 until May 2020, which was conducted in 101 participants with (self-reported) hip or knee OA. Descriptive statistics were used to provide insight into the characteristics of the study population. Pain intensity, localization, dimension, and impact of (nocturnal) pain on sleep were described and compared with daytime pain.

Results: Nocturnal pain was reported by 76/101 (75%) participants. Participants with nocturnal pain scored higher visual analogue scale (VAS) scores for their nocturnal pain compared with their pain at the moment (respectively: median VAS score 49.5 vs. 40.0). Their day pain rating indexes of sensory-discriminative dimension were higher compared with their nocturnal pain. Comparison between participants with and without nocturnal pain showed that participants with nocturnal pain were affected by intermittent, constant, and radiating pain. Pain had more impact on their sleep and they scored their pain at its worst higher compared with participants without nocturnal pain.

Conclusion: In participants with nocturnal pain (75%), we found that their VAS pain scores were not in harmony with their pain expressed in words. This study increases awareness of nocturnal pain in OA patients in general practice. More research is needed to provide general practitioners possible interventions for patients with OA and nocturnal pain.

Lay summary

Nocturnal pain is an important part of the pain experience in osteoarthritis (OA) and highlighted as key concern by patients with hip and knee OA. Reports have shown a wide range in prevalence of nocturnal hip and knee pain in OA patients (14%–85%). We found that participants with nocturnal pain (76/101 = 75%) were more often affected by both intermittent and constant pain, reported higher pain scores for pain at its worst and pain had more impact on their sleep compared with those without nocturnal pain. Participants with nocturnal pain scored higher visual analogue scale (VAS) scores for their nocturnal pain compared with their pain at the moment. On the other hand, they scored the pain expressed in words higher for their day pain than for their nocturnal pain. More research is needed to explore factors that associate with nocturnal pain and to explore how healthcare professionals can support people with nocturnal pain.

Key words: cross-sectional study, nocturnal pain, osteoarthritis hip, osteoarthritis knee

Introduction

Clinically, most common sites of osteoarthritis (OA) are the hip and the knee.[1] Most patients with hip and knee OA are treated in primary care and pain is the most frequently mentioned symptom of patients when consulting their general practitioner.[2] OA pain is typically experienced as intermittent weight-bearing pain, for example during walking and climbing stairs[3] and is eventually transitioning to a more persistent/constant chronic pain, also in rest.[4] Nocturnal pain is an important part of the pain experience in OA and highlighted as key concern by patients with hip and knee OA.[5] In addition, (intrusive) nocturnal pain is a highly ranked determinant in the decision by physicians on whether a patient should undergo total joint replacement.[6–8] Reports have shown a wide range in prevalence of nocturnal hip and knee pain in OA patients (14%–85%).[5,9–11] Nocturnal pain was also present regardless of the stage of OA, but severity increased as the disease progressed.[9]

Although nocturnal pain might have great impact on quality of life (QOL) in patients with hip and/or knee OA, there are difficulties in understanding the complexity of nocturnal pain.[9] The experience of OA pain is modulated by contextual, psychological, and biological factors.[12] Therefore, it is not surprising that nocturnal pain is experienced and expressed in various ways.[9] Qualitative studies suggest that pain experienced during the night differs from daytime pain and is

Key messages

- Pain is common in patients with hip and knee osteoarthritis.
- Pain appears to be an important reason for consulting the general practitioner.
- In our survey, 75% of the participants reported nocturnal pain.
- Patients with nocturnal pain reported more pain and sleep problems in general.
- Their VAS pain scores were not in harmony with their pain expressed in words.

often expressed as more severe.[5,9] Research up until now has mentioned possible mechanisms to play a part in the nocturnal pain experience: (i) heightened awareness and catastrophizing thoughts at night (psychosocial); or (ii) preceding daytime activity patterns and resting positions (mechanical).[9] It is important to focus on nocturnal pain in individuals with hip and knee OA to better understand the possible pathways leading to different types of (nocturnal) pain in order to identify strategies to reduce the impact of these pain symptoms. Furthermore, more knowledge on nocturnal pain could be beneficial to enable general practitioners to educate patients.

The aim of this study is to explore the characteristics of nocturnal pain compared with day pain. Additionally, this study aims to identify differences in patient characteristics and OA symptoms between patients with and without nocturnal pain. This pilot study might provide more information on the phenomenon of nocturnal pain in persons with hip or knee OA, serving as a foundation for further research and adequate interventions.

Patients and methods

General design

The data for this exploratory cross-sectional study were acquired from participants with self-reported OA using a freely accessible, online Dutch survey in the period from April 2020 until May 2020. This survey was spread in various ways, namely through physiotherapists nationwide, social media (i.e. Facebook, LinkedIn), a Dutch OA patient association (PAL) and through a patient platform about OA (Artrose Gezond). Participants were eligible if they met the following criteria: (i) reported hip and/or knee pain in the last week, (ii) did not (yet) receive a joint replacement in the most painful joint at this moment, (iii) were aged 45 years or older, and (iv) (a) had self-reported hip or knee OA diagnosed by a doctor or a physiotherapist or (b) met the National Institute of Health and Clinical Excellence (NICE) guideline diagnosis criteria (1) aged ≥45, (2) activity-related joint pain, and (3) has either no morning joint-related stiffness or morning stiffness that lasts no longer than 30 min.[13] Participants were included if they had at least completed the nocturnal pain questionnaire. Participants were asked to select their most painful joint (hip or knee) and all questions asked reflected to this joint. The Daily Board of the Medical Ethics Committee Erasmus MC of Rotterdam, The Netherlands informed us that the rules laid down in the Medical Research Involving Human Subject Act (also known by its Dutch abbreviation WMO) do not apply to the current research. All participants were informed about the use of the data by Erasmus University Medical Center and all data were processed anonymously. The researchers received an anonymized data file.

Nocturnal pain

Participants were asked whether they had complaints of pain in their joint during the night (yes/no) and whether they had been awake from pain during the night (yes/no). More information about nocturnal pain was obtained by a slightly adjusted McGill Pain Questionnaire (MPQ) (Dutch Language Version; MPQ-DLV),[14] where we transformed pain into nocturnal pain (MPQ-N). The MPQ-N contains 4 components: a pain glossary to determine the nature and intensity of the nocturnal pain, questions about the effect of the nocturnal pain on daily life (QOL), the impact visual analogue scales (VAS scales) for nocturnal pain intensity (0–100; higher score is more nocturnal pain; participants were asked to report their pain on 3 different manners (i) nocturnal pain during past week, (ii) the nocturnal pain when it is least, and (iii) the nocturnal pain at its worst, questions about localization (same location, radiating and jumping pain) and the course of nocturnal pain (intermittent/periodic pain, continuous pain, or transient [variable, but never gone]). The MPQ-N also contains a verbal descriptor inventory to discriminate pain dimensions, consisting of 63 descriptive adjectives distributed over 20 groups. Participants were asked to select those adjectives which are most related to their pain experience, with a maximum of 1 adjective per group. The range of number of words chosen (NWC) and pain rating index (PRI) scores differ per dimension, each descriptor is ranked on a 0 (“none”) to 3 (“severe”) intensity scale.[14,15] This part discriminates 3 dimensions of the experience of pain: sensory-discriminative dimension (e.g. location, intensity, NWC 0–12; PRI 0–36), affective-emotional (e.g. depression, anxiety, NWC 0–5; PRI 0–15), and cognitive-evaluative (e.g. thoughts of the cause and significance, NWC 0–3; PRI 0–12).

Other determinants

Study characteristics of the population, including: age, sex, height and weight (to calculate body mass index [BMI]), education level, (self-) employment, earlier radiograph of the affected joint, pain medication use, presence of comorbidities (i.e. restless leg syndrome, anxiety/panic attacks, chronic fatigue syndrome, depression, fibromyalgia, cancer, migraine, tension headache, irritable bowel syndrome, neck injury [including whiplash], lower back pain, neurological disorders, diabetes mellitus, hypertension, cardiovascular diseases, pulmonary–liver–kidney, or stomach disorders), and duration of complaints were collected by means of self-reported online questionnaires. The original MPQ was used to measure pain during the day. The MPQ contains the same components as described above for nocturnal pain (equal to MPQ-N). In contrast to MPQ-N, where the participants reported their nocturnal pain past week, in this questionnaire they were asked to report their current (day). The Intermittent and Constant Osteoarthritis Pain (ICOAP)

questionnaire was used to assess 2 forms of pain: intermittent and constant pain.[16] With a 5-point Likert scale (0–4; not at all—extreme): intermittent and constant pain were explored, standardized scores were calculated (0–100). Impact of chronic pain on sleep was measured with the Pain and Sleep Questionnaire-3 items (PSQ-3). This questionnaire consists of 3 items measured on a 100 mm VAS assessing (range 0 ["never"]–100 ["always"]): trouble falling asleep due to pain, awakening by pain during the night and in the morning.[17] Knee Injury and Osteoarthritis Score (KOOS)[18] and the Hip disability and Osteoarthritis Outcome Score (HOOS)[19] were used to measure OA-related joint problems. Sum scores of the subscales (i.e. pain, symptoms, function in daily living [ADL], function in sport and QOL) were standardized into percentage scores (0–100). Higher scores represent less joint-related problems. Physical activity was measured using the International Physical Activity Questionnaire Short-Form (IPAQ-SF).[20] The total score was transformed into minutes of metabolic equivalent of task (MET) per week (sum of minutes walking [3.3 MET], moderate activity [4.0 MET], and vigorous activity [8.0 MET]) and categorized into 3 categories: inactive (MET minutes <600), minimally active, or healthy active (MET minutes >1,500).[21] Clinical hip and knee OA were determined according to the NICE criteria, which are: (i) aged ≥45, (ii) activity-related joint pain, and (iii) no morning joint-related stiffness or morning stiffness ≤30 min.[13]

Statistical analysis

Descriptive statistics were used to provide insight into the characteristics of the study population. Chi²-test and *t*-test were used for between-group (presence of nocturnal pain compared with no nocturnal pain) differences. Statistical analyses were performed using SPSS-V-24.0 for Windows (SPSS Inc.).

Results

Recruitment and response

A total of 230 unique participants started the open access survey and gave informed consent. Of those 230 participants we had to exclude 85 participants, because they did not meet our inclusion criteria. Reasons for exclusion were: did not report joint pain (n = 26), underwent joint replacement of their most painful joint (n = 30), not aged ≥45 (n = 10), and not reported a diagnosis of hip and/or knee OA or did not meet the NICE criteria (n = 19). Of the 145 potential participants, 44 dropped out of the survey before completing the MPQ-N questionnaire (Fig. 1).

Characteristics of participants

Of the 101 included participants 81% (n = 82) completed the whole survey. Table 1 presents the characteristics of the study population. The participants had a mean age of 62.1 years (SD = 8.4), 86% of them were female, and 39% had a high education level (Table 1). Most participants (n = 76) reported one of their knees as most painful joint and 25 participants reported one of their hips as most painful joint. A total of 76 (75%) of the participants reported nocturnal pain and 48 (49%) of the participants with nocturnal pain reported that they had been awake last night due to pain. The group with nocturnal pain reported 1 or more comorbidities more often compared with the group without nocturnal pain (65% vs. 4% P < 0.01). In the nocturnal pain group, there was a relatively higher prevalence of the hip as most painful joint (29%) compared with the group without nocturnal pain (12% [P = 0.09]) (Table 1).

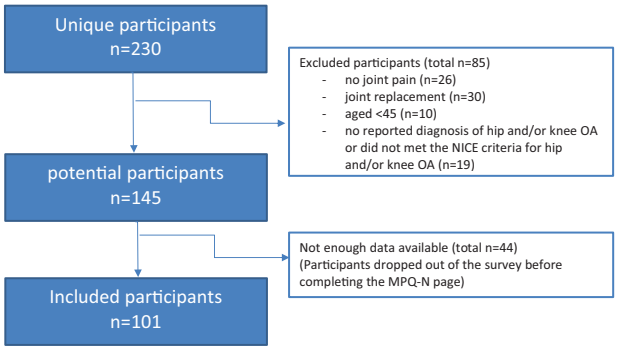

Fig. 1. Flowchart of including participants.

Differences in (day)pain between participants with and without nocturnal pain

Participants with nocturnal pain experienced both intermittent and constant (day)pain more often compared with participants without nocturnal pain (respectively: for intermittent pain a median score of 45.0 vs. 30.0 and for constant pain a median score of 42.5 vs. 15.0). Participants with nocturnal pain reported radiating of their (day)pain more often compared with participants without nocturnal pain (61% and 36%, respectively). The VAS score of the current (day)pain and the pain it is least were not significantly different between the groups (respectively: median VAS score 20.0 vs. 13.0). The VAS score of the (day)pain at its worst was significant higher in the group with nocturnal pain compared with the group without nocturnal pain (respectively: median VAS score = 74.0 and median VAS score = 64.0). The impact of pain on sleep was significantly worse in the group with nocturnal pain compared with the group without nocturnal pain (Table 2). The scores for all subscales of the HOOS and KOOS were lower in the group with nocturnal pain. The subscale pain, ADL and QOL were all significantly lower, indicating more joint-related problems compared with participants without nocturnal pain (Table 2).

Differences in experiencing nocturnal pain and day pain in participants with nocturnal pain

Table 3 shows the differences in daytime and nocturnal pain for participants who reported nocturnal pain. There was no difference between both pains when it is at least and at its worst. The current (day)pain score vs. pain past nights showed significant differences. The reported pain score for nocturnal pain past night was significantly higher (median VAS 49.5) compared with the current (day)pain (median VAS 40.0 [P < 0.01]) (Table 3). Significant differences were found in the sensory-discriminative dimensions (both NWC and PRI): day pain was scored higher and more words were chosen for day pain compared with their nocturnal pain (NWC median 5.0 vs. median 4.0; PRI median 8.0 vs. 7.0) for day pain and nocturnal pain, respectively). Figure 2a shows the chosen words for day pain and Fig. 2b for nocturnal pain. The most common words chosen for day pain

Table 1. Characteristics of the study population and the subgroups.

	Total study population	Presence of nocturnal pain	Absence of nocturnal pain	*P*
Number of participants	101	76	25	
Age in years, mean (SD)	62.7 (8.3)	62.2 (8.1)	64.2 (9.1)	0.29
Female, *n* (%)	85 (84)	64 (84)	21 (84)	0.98
Body mass index (kg/m^2), mean (SD)	28.4 (5.1)	28.2 (5.2)	29.0 (4.8)	0.54
Education level, *n* (%)				0.08
Primary	12 (12)	6 (8)	6 (25)	
Secondary	46 (47)	36 (48)	10 (42)	
High	41 (41)	33 (44)	8 (33)	
(Self-) or employed, *n* (%)	39 (39)	29 (38)	10 (40)	0.87
Presence of a radiograph, *n* (%)	85 (84)	65 (86)	20 (80)	0.44
Use of any pain medication during the day, *n* (%)	59 (58)	46 (61)	13 (52)	0.46
Presence of ≥1 comorbidities, *n* (%)	50 (50)	49 (65)	1 (4)	**<0.01**
Most painful joint				0.09
Hip, *n* (%)	25 (25)	22 (29)	3 (12)	
Knee, *n* (%)	76 (75)	54 (71)	22 (88)	
Duration of complains in months				
For hip OA, median (25–75% perc)	42 (24–171)	42 (24–153)	132 (24–x)	0.74
For knee OA, median (25–75% perc)	60 (24–120)	60 (24–102)	84 (60–132)	0.42
Awake from the pain last night, *n* (%)	49 (49)	48 (63)	1 (4)	**<0.01**

For continuous variables mean and SD or the median and the 25–75 percentile is shown. For categorical variables absolute numbers and percentage (%) are shown. Due to incomplete entries, there are sometimes missing numbers. Differences in distribution between groups assessed with ANOVA or Pearson's χ^2 test/Fisher's exact test when appropriate. Significant differences ($P < 0.05$) are presented in bold.

were nagging and annoying (both *n* = 47), stiff (*n* = 45), tiring (*n* = 44), and stinging (*n* = 42), and for night pain annoying (*n* = 49), nagging and moderate (both *n* = 42), awkward (*n* = 40), and tiring (*n* = 36) (see Fig. 2[22,23]).

Discussion

In this exploratory cross-sectional study, we explored nocturnal pain in patients with hip and/or knee OA to elucidate the characteristics and enlarge the understanding of nocturnal pain. In this open study population 75% of our participants reported nocturnal pain. We found that participants with nocturnal pain were more often affected by both intermittent and constant pain, reported higher pain scores for pain at its worst and in these participants their pain had more impact on their sleep compared with participants without nocturnal pain. They also more often reported at least 1 comorbidity. When comparing daytime and nocturnal pain in participants with nocturnal pain we found that they scored their average nocturnal pain higher compared with their day pain on the VAS. On the other hand, the pain expressed in words (dimension sensory-discriminative, e.g. location, intensity) was scored higher for their day pain.

The proportion of participants (75%) who reported nocturnal pain is in line with a study from Woolhead et al. who found a prevalence of 81% of nocturnal pain.[9] This focus group of hip and knee OA participants, selected from the community as well as from existing OA cohorts, had on average low scores on the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC),[9] which is in line with our study population with relatively low scores on the HOOS and the KOOS. On the other hand, the prevalence of nocturnal pain we found is high compared with a study of Hawker et al.[5] (17%–18%) and to an earlier study we published based on a cohort study including participants with hip complaints suspected to be early hip OA (prevalence varied between 22% and 35%).[24] This earlier study is more focussed on participants in primary care in an early stage of their OA, which might also explain the difference in nocturnal pain prevalence. Furthermore, the way nocturnal pain is defined, for example using the Patient Generated Index,[5] discussing nocturnal pain in a focus group[9] or answering a question about nocturnal pain in a questionnaire[24] is of huge influence on the prevalence. It is also possible that we found relatively high prevalence of nocturnal pain due to the fact that our participants were aware of the topic and in other (cohort) studies nocturnal pain is just 1 item. Nocturnal pain was reported more often by participants with hip OA. However, this difference is not significant. This might be due to our sample size of participants with hip complaints (*n* = 25).

We found that participants with nocturnal pain were more affected by both intermittent and constant pain, their pain is more often radiating to other spots and the scores if the pain at its worst during the day was higher (±10 points). Our result were in line with Woolhead et al., where patients often described nocturnal pain as more severe.[9] Possible explanations why the pain in persons with nocturnal pain is more severe could be because people with nocturnal pain became more aware and anxious of pain, due to heightened awareness and a lack of distractions and activity during the night.[9] However, we did not find any differences in catastrophizing thoughts between participants with and without nocturnal pain. Another explanation given by Woolhead et al. is the amount of activities done in the preceding days. We did not find any differences in physical activity levels. However, it could still be possible that

Table 2. Differences in day pain between participants with (*n* = 76) and without nocturnal pain (*n* = 25).

	Presence of nocturnal pain (*n* = 76)	Absence of nocturnal pain (*n* = 25)	*P*
Type pain (ICOAP) (0–100)			
Constant pain	42.5 (15.0–75.0)	15.0 (2.5–40.0)*	**<0.01**
Intermittent pain	45.0 (30–58.8)	30.0 (12.5–42.5)	**<0.01**
Pain catastrophizing (PCS) (0–52)	8.5 (2.8–16.3)*	7.5 (2.0–22.5)*	0.71
Combi HOOS/KOOS (0–100)			
Pain	47.4 (38.9–60.0)	58.3 (47.2–69.4)	**<0.01**
Symptoms	53.6 (38.4–68.8)	60.7 (46.4–71.4)	0.35
ADL	54.4 (42.3–66.5)	64.7 (55.9–78.3)	**<0.01**
Sport	5.0 (0.0–25.0)*	25.0 (0.0–42.5)	0.12
QOL	37.5 (25.0–50.0)	46.9 (37.5–62.5)	**<0.01**
Physical activity level (IPAQ-SF), *n* (%)			0.65
Inactive	14 (23%)	3 (14%)	
Minimally active	19 (31%)	7 (32%)	
Healthy active	29 (47%)	12 (55%)	
Impact of pain on sleep (PSQ-3) (0–100)			
Trouble falling asleep due to pain	28.0 (10.0–67.0)	5.0 (1.0–20.5)*	**<0.01**
Awakening by pain during the night	50.0 (19.8–80.3)	3.0 (1.0–18.5)*	**<0.01**
Awakening by pain in the morning	39.0 (13.3–75.3)	5.0 (1.0–17.5)*	**<0.01**
MPQ			
(Day)pain raised gradually (vs. suddenly), *n* (%)	63 (84)	17 (71)	0.16
(Day)pain at same location, *n* (%)	56 (75)	18 (72)	0.8
(Day)pain radiates, *n* (%)	46 (61)	9 (36)	**0.03**
(Day)pain jumping, *n* (%)	12 (17)	1 (4)	0.12
Course of the (day)pain is			
Intermittent/periodic, *n* (%)	19 (25)	9 (36)	0.18
Continuous, *n* (%)	5 (7)	3 (12)	
Transient, *n* (%)	52 (68)	13 (52)	
VAS score current pain (0–100)	40.0 (18.3–54.5)	31.0 (4.5–47.0)	0.12
VAS score pain when it is least (0–100)	20.0 (8.0–32.3)*	13.0 (1.0–26.5)*	0.18
VAS score pain at its worst (0–100)	74.0 (60.0–84.0)*	64.0 (27.0–79.0)	**<0.01**
Use of pain medication during the day, *n* (%)	46 (61)	13 (52)	0.46
Dimensions (NWC)			
Sensory-discriminative (0–12)	5.0 (3.0–7.0)	5.0 (3.0–6.0)	0.38
Affective-emotional (0–5)	2.0 (1.0–3.0)	1.0 (0.0–3.0)	0.36
Cognitive-evaluative (0–3)	3.0 (3.0–3.0)*	23.0 (2.5–3.0)*	0.78
Dimensions (PRI)			
Sensory-discriminative (0–36)	8.0 (5.0–13.0)	7.5 (4.0–10.8)*	0.55
Affective-emotional (0–15)	2.0 (1.0–4.0)*	3.0 (1.0–4.0)*	0.53
Cognitive-evaluative (0–12)	5.0 (5.0–7.0)	5.0 (3.0–5.5)	**0.04**

For continuous variables the median and the 25–75 percentile are shown. For categorical variables absolute numbers and percentage (%) are shown. Due to incomplete entries, there are sometimes missing numbers. Due to the round of numbers, the percentages added together will not always be exactly 100%. HOOS/KOOS, higher scores represent less joint-related problems; PSQ-3, higher scores represent higher impact on sleep.
*Not normal distributed. Significant differences ($P < 0.05$) are presented in bold.

activity can influence the presence of nocturnal pain and that persons with nocturnal pain are more physically active and accepting the possible consequences of more severe pain. We could not investigate this with our measurements. More research to understand and explain what affects the pain is needed. The impact of pain on sleep is also higher in participants with nocturnal pain and had a more negative impact on their sleep. This is in line with previous research in hip and knee OA[5,9,10] and with studies reporting how pain affects sleep in general.[25,26]

Participants with nocturnal pain reported higher intensity of nocturnal pain in the past nights compared with their current (day)pain as measured with a VAS score. Contrarily, the score on the sensory-discriminative dimension (both NWC and PRI) of (day)pain was significantly higher than the score on the same dimension for nocturnal pain. This dimension represents among other things "nociceptive pain."[15,27] Therefore, we find it remarkable that the difference in intensity between nocturnal and daytime pain is oppositely directed. The contradictory might indicate that the descriptors

Table 3. Differences in day pain (MPQ) and nocturnal pain (MPQ-N) in participants with nocturnal pain (n = 76).

	Day pain	Nocturnal pain	*P*
Pain raised gradually (vs. suddenly), *n* (%)	63 (84)	63 (86)	1.00
Pain at same location, *n* (%)	56 (75)	60 (81)	0.18
Pain radiates, *n* (%)	46 (61)	45 (59)	1.00
Pain jumping, *n* (%)	12 (17)	10 (14)	0.75
VAS score current (day)pain/nocturnal pain past week (0–100)	40.0 (17.5–55.0)	49.5 (29.3–69.0)	**<0.01**
VAS score pain when it is least (0–100)	20.0 (7.5–34.0)*	17.0 (8.3–31.0)	0.53
VAS score pain at its worst (0–100)	75.0 (60.0–83.0)*	71.0 (58.5–83.5)*	0.45
Use of pain medication during the day/before sleeping, *n* (%)	During day 52 (55)	Before sleep 46 (61)	1.00
Dimensions (NWC)			
Sensory-discriminative (0–12)	5.0 (3.0–7.0)	4.0 (3.0–6.0)	**<0.01**
Affective-emotional (0–5)	2.0 (1.0–3.0)	2.0 (1.0–3.0)	0.74
Cognitive-evaluative (0–3)	3.0 (3.0–3.0)*	3.0 (3.0–3.0)*	0.25
Dimensions (PRI)			
Sensory-discriminative (0–36)	8.0 (5.0–13.0)	7.0 (4.0–9.5)*	**0.03**
Affective-emotional (0–15)	2.0 (1.0–4.0)*	2.0 (1.0–4.0)*	1.00
Cognitive-evaluative (0–12)	5.0 (5.0–7.0)	5.0 (5.0–6.0)	0.40

For continuous variables the median and the 25–75 percentile are shown. For categorical variables absolute numbers and percentage (%) are shown.
Significant differences (P < 0.05) are presented in bold.
*Not normal distributed.

Fig. 2. Word cloud for day pain (a: left; the central word 'Nagging') and nocturnal pain (b: right; central word 'Annoying'). The words have been translated back from the Dutch MPQ(N) to English based on 2 articles.[22,23]

of de MPQ are less suitable for nocturnal pain, and that the VAS measures a different component of pain.[28] Other possible explanation might be: expressing pain in words is different compared with expressing pain in a number. In contrast to our result, in a study investigating the difference in day and nocturnal pain in people with rheumatoid arthritis, no difference in day and nocturnal pain (VAS scores) was found.[29] More research is needed to elucidate in what way nocturnal pain differs from daytime pain, for example: is it a difference in severity or in perception of the pain?

To our knowledge, this is one of the first studies that focuses on nocturnal pain in a relatively large OA population and shows the differences in pain scores and pain dimensions between people with and without nocturnal pain. A strength of this study was the use of validated questionnaires (on pain) in the survey. These questionnaires have good measurement properties in adults with hip and/or knee OA. There were also some limitations, firstly the small proportion of participants without nocturnal pain. Another limitation of the study is the possibility of participation and selection biases (excluding people with OA without internet access and an under-coverage of elderly) due to our open online surveys.[30] As in most questionnaire surveys, our study sample contained more women than men.[30] Also self-reporting bias and the possibility of survey fatigue are possible. Finally, in the present study, the participants were aware of the topic of the survey—nocturnal pain—which could make the results we found not generalizable for the general population of people with hip and knee OA. We want to emphasize that our study was explorative rather than hypothesis driven. Through this study we want to increase the awareness of nocturnal pain in people with OA among general practitioners. The results could be beneficial for general practitioners in the explanation of OA and pain to patients. We explored that pain is experienced differently during the day and night. More research is needed to provide general practitioners possible interventions for patients with OA and nocturnal pain.

In conclusion, the majority of our participants with self-reported hip or knee OA reported nocturnal pain (75%). Indications were found that participants with nocturnal pain experienced more pain, had more disabilities in daily life and had less QOL than participants without nocturnal pain. We found some contradicting results in how participants with nocturnal pain experienced their day and nocturnal pain. More research is needed to support these findings, to explore other factors associated with nocturnal pain and to support the understanding of the nocturnal pain experience in patients with hip and/or knee OA.

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Authors' contributions

All authors contributed to the conception and design of this study. ACB, RR, and DS contributed to the analysis of data. All authors contributed to the interpretation of data. Article drafts were written by ACB and critically revised by all authors. The final version of the article was approved by all authors.

Ethical approval

The Daily Board of the Medical Ethics Committee Erasmus MC of Rotterdam, The Netherlands informed us that the rules laid down in the Medical Research Involving Human Subject Act (also known by its Dutch abbreviation WMO) do not apply to the current research.

Conflict of interest

None declared.

Patient and public involvement

Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Data availability

Datasets analysed during the current study are available from the corresponding author on reasonable request.

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