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Type: Article

2025.10.043

Date
2025

Citation
Altan, Robert, Dillon, St

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tient Perceptions, Beliefs, and Behaviors i

n Bone-Related Disease and Pain Management:

A Cross-Sectional Study. Journal of Manipu

lative and Physiological Therapeutics, 48 (

1-5). pp. 365-372. ISSN 0161-4754

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Patient Perceptions, Beliefs, and Behaviors in Bone-Related Disease and Pain Management: A Cross-Sectional Study

Robert Allan, PhD, Stephanie Dillon, PhD, Nicole Booth, MSc, Joshua Dickson, MSc, Gareth Shadwell, MSc, Howard Hurst, PhD, and Jonathan Sinclair, PhD

Abstract

Objective: The purpose of this study was to examine methods of pharmacologic and nonpharmacological pain management for people with bone-related diseases.

Methods: Bone-related disease incidence, treatment, and pain management strategies were assessed using an anonymous online survey in 2021. The survey included questions about demographics, disease characteristics, and pain coping. One-sample χ^2 goodness of fit tests, 2-way Pearson χ^2 tests of independence, and probability values were used for data analysis.

Results: Respondents were primarily postmenopausal females, aged 55-60 years old, with moderate disease activity, with osteoporosis most commonly reported. Responses suggest medical professionals' advice for pain management included multiple medications, especially analgesics. Dietary interventions also played an important role with vitamin D and calcium supplementation regularly being reported. Patients seek to use alternative methods of pain relief and disease management, with many respondents reporting nonpharmacological pain relief treatments playing a significant role in coping with their bone disease. Although respondents aged 46 to 50 opted against nonpharmacological relief, those aged 56 to 60 years reported they were willing to try nonpharmacological interventions that reduced pain, with the choice of treatment based on "how it made me feel."

Conclusion: A substantial number of respondents believed that more research is required into pain relief for bone-related diseases, with those affected by these conditions seeking a more acute and analgesic approach to managing pain. Most respondents answered "yes" when asked if nonpharmacological pain relief treatments play a sufficient role in coping with their bone-related pain. (J Manipulative Physiol Ther 2025;48;365-372)

Key Indexing Terms: *Bone diseases; Osteoporosis; Osteoarthritis; Pain*

Introduction

Bone diseases such as osteoporosis, osteoarthritis, and osteopenia are characterized by low bone mass, deterioration of bone tissue, and/or disruption of bone microarchitecture. Many bone-related diseases can lead to compromised bone strength and an increased risk of fractures[1] and are often associated with increased morbidity and mortality—with decreased quality of life and increased disability-adjusted life span. Additionally, there is a large economic cost of bone diseases, with the osteoporosis economic burden within the European Union alone previously being reported as €37 billion.[2]

The dysregulation of bone homeostasis occurs across a spectrum from "lack of bone" to "excessive bone."[3] Although the prevalence, controlling mechanisms, and treatments of bone disease will ultimately differ depending on each disease and its manifestation, one thing that remains synonymous with bone-related diseases is the associated pain.[4] Although bone-related diseases often cause direct pain through their symptoms, others, such as osteoporosis, are often painless and produce indirect pain through their symptomatologies, such as increased fracture potential.[5]

Treatment of bone diseases will ultimately focus on correcting the homeostatic imbalance and include medical, pharmacologic, and dietary interventions. For example, therapies to promote bone regeneration have previously focused on bone transplantation,[6] stem cell therapy,[7] and drug therapies. Pharmacologic treatment can often be confusing, for example, for bone diseases that manifest as a reduction in bone mass (ie, osteoporosis), drug therapies

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Paper submitted November 7, 2024; in revised form September 29, 2025; accepted October 13, 2025.

0161-4754

https://doi.org/10.1016/j.jmpt.2025.10.043

can work to either promote bone formation or prevent bone resorption—with bone formation therapies suggested to be most efficient.[8] Common pharmacologic treatments include supplemental bisphosphonastes[9] such as alendronic acid, ibandronic acid, risedronic acid, zoledronic acid, and pamidronate to slow bone resorption through anti-osteoclastic effects. Raloxifene reduces fracture risk and improves bone mechanical properties,[10] whereas parathyroid hormone (PTH) has been suggested to increase the presence of new, immature mineral at the lacuna wall with higher carbonate content[11]—with hormone replacement therapy (HRT)[12] and pain relief medication (opioids, paracetamol, nonsteroidal anti-inflammatories [NSAIDs])[4] also featuring heavily.

Although drug therapies appear to be the first line of defense for treating bone-related diseases, it is not always feasible, with nonpharmacological dietary modifications offering a more pragmatic solution. To this end, calcium intake, vitamin D status, and protein consumption are considered essential for bone metabolism homeostasis predominantly as they are required for bone strength due to their role in the bone matrix.[13] Elsewhere, Anthocyanins are suggested to promote bone formation through differentiation of mesenchymal stem cells into the bone-building osteoblast cells while also inhibiting osteoclastogenesis—the production of osteoclasts that promote the resorption phase of bone remodeling[14] and are often implicated in a homeostatic imbalance between "bone building" and "bone resorption" processes.

However, despite such treatments, the associated pain and discomfort experienced with such bone diseases may require further nonpharmacological interventions for analgesic purposes. Such interventions include heat application[15,16] and near-infrared light irradiation,[17] cold application,[16,18] transcutaneous electrical nerve stimulation (TENS),[19] relaxation techniques,[20] massage,[21] and manual therapies.[22] Therefore, the purpose of this survey was to examine prescribed, used, and preferred methods of pharmacologic and nonpharmacological pain management in those with bone-related diseases.

Methods

Participants and Study Design

In this cross-sectional study, bone-related disease incidence, treatment, and pain management strategies were assessed using an anonymous online survey (JISC online survey platform). Respondents were recruited globally through social media (Twitter, Instagram, LinkedIn, Facebook). To be eligible to participate, individuals were required to be aged between 18 and 65 and with a bone-related disease, including but not limited to, osteoporosis, osteonecrosis, osteoarthritis, osteogenesis imperfecta (brittle bone disease), Paget's disease, and fibrous dysplasia. A total of 120 participants (108 females, 11 males, 1 nonbinary) completed the survey.

Ethics

All respondents provided informed consent via the first question on the survey; failure to give consent prevented any further completion of the survey. Ethical approval for the study was granted by the University of Central Lancashire Ethics Review Panel (reference: HEALTH 0183) in line with the principles of the Declaration of Helsinki.

Survey

Four subject matter experts reviewed the survey for face validity in its various iterations, providing feedback and suggesting alterations prior to ethical review and subsequent circulation. The survey was available online for completion for 8 months between the dates March 20, 2021, and November 20, 2021. All survey responses were anonymous. Respondents provided some demographic and lifestyle choice information (ie, alcohol consumption, smoking) followed by answering a series of multiple choice, Likert scale-based (remission, mild, moderate, severe), and binary yes or no questions. The survey comprised a total of 18 questions and divided into 4 main sections outlined below:

Demographics. Initially, Q4-7 respondents were required to provide some demographic information, including Q4, sex (male, female, nonbinary); Q5, age range (18-25, 26-30, 31-35, 36-40, 41-45, 46-50, 51-55, 56-60, and 61-65 years); Q6, smoking status (yes or no); and Q7, current alcohol consumption (none, 1-2, 3-4, 5-6, 7-9, and 10+ units/day).

Bone Disease Characteristics. The second section (Q8-11) featured questions that allowed respondents to select multiple options for all except Q9 and was designed to gain an understanding of respondent's current disease diagnosis (Q8) (osteoporosis, osteonecrosis, osteoarthritis, osteomalacia, osteopenia, osteogenesis imperfecta, Paget's disease, fibrous dysplasia, and others), Disease activity (Q9) (remission, mild, moderate, and severe), and medication currently being taken (Q10) (none, bisphosphonates, raloxifene, PTH, calcium, vitamin D, HRT, testosterone treatment, paracetamol NSAIDs, opioids, steroid injection, and other). This section also featured the Q11. Do you suffer from any additional condition that might influence your bone disease (none, type 1 diabetes, lupus, rheumatoid arthritis, celiac disease, hyperthyroidism, and postmenopause).

For Q8, the nature of the responses meant that they were grouped into osteoporosis, osteoarthritis, osteoporosis and osteoarthritis, osteopenia, fibrous dysplasia,

and any other combination of 2 or more conditions. For Q10, the responses were first utilized to create a variable to determine whether respondents were taking single, multiple, or no medications for their associated condition and additionally for each of the available medication options for this question, binary yes or no variables were created for each based on whether patients indicated that they did or did not use that medication. For Q11, the nature of the responses meant that they were grouped into none, postmenopause, lupus, rheumatoid arthritis, celiac disease, hyperthyroidism and postmenopause, and any other conditions.

Coping With Pain. The final section (Q12-16) featured questions that allowed respondents to select multiple options for all and was designed to allowed respondents to provide information on Q12. What treatments has a medical professional advised for pain management (none, heat application, cold application, pain killers, relaxation techniques, TENS, massage, hypnosis, assistive devices ie, walking stick, manual therapy (physiotherapy) and other) and Q13. What leads your choice for nonpharmacological treatments (medical professionals' advice, recommendation from friend or relative, recommendation from others with your disease what I see in the news, scientific evidence, how it made me feel, and other). This section also featured additional questions, Q14. What would prevent you from utilizing these nonpharmacological treatments (expense, access to specialized equipment, how it made me feel, scientific evidence that shows it does not work, scientific evidence that shows it makes my symptoms worse, and others), Q15. Which do you regularly use to cope with bone disease associated pain (none, heat application, cold application, pain killers, TENS, relaxation techniques, massage, hypnosis, assistive devices, manual therapy, and others) and Q16, which (even just once) have you attempted to use, featuring the same responses available for Q15.

For Q12, Q15, and Q16, the responses were first utilized to create a variable to determine whether respondents had been recommended/utilized single, multiple, or no treatments for their associated condition and additionally for each of the available options for these question, binary yes or no variables were created for each based on whether patients selected each specific option. For Q13 and Q14, the responses were first utilized to create a binary variable to determine whether single or multiple factors influenced their choice/prevented them from using treatments, and additionally for each of the available options for this question, binary yes or no variables were created for each based on whether patients indicated that they did or did not select that option.

Future Directions. The final section (Q17-18) featured questions that allowed respondents to select a single option for all and was designed to allow respondents to provide information regarding future directions of bone disease treatment and research. Both questions in this section were binary (yes or no) and provided information on Q17: Do nonpharmacological pain relief treatments (shown in previous questions) play a sufficient role in your coping with bone-related disease and Q18? and Is more research into pain relief strategies surrounding bone-related diseases necessary?

Data Analysis

The questionnaire data were entered into SPSS v27 (IBM, SPSS) software, and categorical data for each survey question were coded. Proportions for categorical variables following statistical analyses are expressed as total (N) and also percentages (%). One-sample chi-square (χ^2) goodness of fit tests were used for each question and also the baseline indices in order to contrast the proportion of participants that had selected each response. In addition, 2-way Pearson χ^2 tests of independence were used to undertake bivariate cross-tabulation comparisons, specifically to test differences in responses to each question between key demographic variables/bone disease characteristics: age, gender, current disease diagnosis, and medication currently being taken. Probability values were calculated by Monte Carlo simulation, and statistical significance for all analyses was accepted as the $P < .05$ level.

Results

Participant Demographics

The baseline/demographic characteristics of the study population are described in Table S1. There were significant differences in responses for Q4. "Age" ($\chi^2_{(7)} = 280.00$, $P < .001$) with the majority of participants being aged between 56 and 60 years and Q6. "Gender" ($\chi^2_{(2)} = 174.65$, $P < .001$) with the majority of participants being female. Furthermore, finally, there were also significant differences in responses for both Q7. "Smoking behavior" ($\chi^2_{(1)} = 83.33$, $P < .001$) with the majority of participants being nonsmokers and also Q8. "Alcohol" consumption ($\chi^2_{(4)} = 171.92$, $P < .001$), which showed that the majority of participants consumed no alcohol or only 1 to 2 units per week.

Bone Disease Characteristics

The bone disease characteristics of the study population are also described in Table S2. There were significant differences in responses for Q8. "Current disease diagnosis" ($\chi^2_{(5)} = 102.40$, $P < .001$) with the majority of participants identifying as suffering from osteoporosis and for Q9. "Disease activity" ($\chi^2_{(3)} = 56.13$, $P < .001$) with the majority of participants exhibiting moderate disease activity. For

Q10, "medication currently being taken" there was first a significant difference in responses ($\chi^2_{(2)} = 96.95$, $P < .001$) in terms of whether single, multiple, or no medications were utilized, with the majority of respondents adopting multiple medications. For the binary outcomes, for the none ($\chi^2_{(1)} = 80.03$, $P < .001$), bisphosphonates ($\chi^2_{(1)} = 53.33$, $P < .001$), raloxifene ($\chi^2_{(1)} = 116.03$, $P < .001$), PTH ($\chi^2_{(1)} = 83.33$, $P < .001$), HRT ($\chi^2_{(1)} = 76.80$, $P < .001$), testosterone treatment ($\chi^2_{(1)} = 100.83$, $P < .001$), paracetamol ($\chi^2_{(1)} = 26.13$, $P < .001$), NSAIDs ($\chi^2_{(1)} = 43.20$, $P < .001$), opioids ($\chi^2_{(1)} = 73.63$, $P < .001$), and steroid injection ($\chi^2_{(1)} = 112.13$, $P < .001$) options, significantly more respondents indicated that they did not utilize these treatments. However, for vitamin D significantly more ($\chi^2_{(1)} = 12.03$, $P = .001$) participants responded that they did adopt this treatment modality. For Q11, "Do you suffer from any additional condition that might influence your bone disease," there was first a significant difference in responses ($\chi^2_{(6)} = 191.53$, $P < .001$), with the majority of respondents either suffering from no additional condition or from postmenopause.

Coping With Pain

The disease treatments utilized by the study population are described in Table S3 and in Figures S1-S6. For Q12, "What treatments has a medical professional advised for pain management," there was first a significant difference in responses ($\chi^2_{(2)} = 96.95$, $P < .001$) in terms of whether single, multiple, or no medications were utilized, with the majority of respondents having been recommended multiple medications. For the binary outcomes, none ($\chi^2_{(1)} = 24.30$, $P < .001$), heat application ($\chi^2_{(1)} = 10.80$, $P = .001$), cold application ($\chi^2_{(1)} = 38.53$, $P < .001$), relaxation techniques ($\chi^2_{(1)} = 76.80$, $P < .001$), TENS ($\chi^2_{(1)} = 73.63$, $P < .001$), massage ($\chi^2_{(1)} = 80.03$, $P < .001$), hypnosis ($\chi^2_{(1)} = 116.03$, $P < .001$), assistive devices ($\chi^2_{(1)} = 36.30$, $P < .001$), manual therapy (physiotherapy) ($\chi^2_{(1)} = 43.20$, $P < .001$), and other ($\chi^2_{(1)} = 38.53$, $P < .001$) options, significantly more respondents indicated that they did not utilize these treatments. However, for pain killers significantly more ($\chi^2_{(1)} = 4.80$, $P = .028$) participants responded that they did adopt this treatment modality.

For Q13, "What leads your choice for nonpharmacological treatments," for the binary outcomes, medical professionals' advice ($\chi^2_{(1)} = 4.80$, $P = .028$), recommendation from friend or relative ($\chi^2_{(1)} = 50.70$, $P < .001$), recommendation from others with your disease ($\chi^2_{(1)} = 32.03$, $P < .001$), what I see in the news ($\chi^2_{(1)} = 50.03$, $P < .001$), scientific evidence ($\chi^2_{(1)} = 13.33$, $P < .001$), and other ($\chi^2_{(1)} = 86.70$, $P < .001$) options, significantly more respondents indicated that they did not utilize these treatments. However, for how it made me feel, significantly more ($\chi^2_{(1)} = 4.03$, $P = .045$) participants responded that this was a choice for their nonpharmacological treatments.

For Q14, "What would prevent you from utilizing these nonpharmacological treatments," for the binary outcomes, access to specialized equipment ($\chi^2_{(1)} = 28.03$, $P < .001$) and other ($\chi^2_{(1)} = 112.13$, $P < .001$) options, significantly more respondents indicated that they did not utilize these treatments.

For Q15, "Which do you regularly use to cope with bone disease associated pain," there was first a significant difference in responses ($\chi^2_{(2)} = 46.60$, $P < .001$) in terms of whether single, multiple, or no medications were utilized, with the majority of respondents using multiple approaches. For the binary outcomes, none ($\chi^2_{(1)} = 50.70$, $P < .001$), cold application ($\chi^2_{(1)} = 73.63$, $P < .001$), relaxation techniques ($\chi^2_{(1)} = 36.30$, $P < .001$), TENS ($\chi^2_{(1)} = 73.63$, $P < .001$), massage ($\chi^2_{(1)} = 45.63$, $P < .001$), assistive devices ($\chi^2_{(1)} = 45.63$, $P < .001$), manual therapy ($\chi^2_{(1)} = 56.03$, $P < .001$), and other ($\chi^2_{(1)} = 22.53$, $P < .001$) options, significantly more respondents indicated that they did not utilize these treatments. However, for pain killers significantly more ($\chi^2_{(1)} = 4.03$, $P = .045$) participants responded that they did adopt this treatment modality.

Finally, for Q16, "Which have you attempted to use," there was first a significant difference in responses ($\chi^2_{(2)} = 51.65$, $P < .001$) in terms of whether single, multiple, or no medications were utilized, with the majority of respondents using multiple approaches. For the binary outcomes, none ($\chi^2_{(1)} = 56.03$, $P < .001$), cold application ($\chi^2_{(1)} = 9.63$, $P = .002$), relaxation techniques ($\chi^2_{(1)} = 24.30$, $P < .001$), TENS ($\chi^2_{(1)} = 45.63$, $P < .001$), massage ($\chi^2_{(1)} = 24.30$, $P < .001$), manual therapy (physiotherapy) ($\chi^2_{(1)} = 13.33$, $P < .001$), and other ($\chi^2_{(1)} = 34.13$, $P < .001$) options, significantly more respondents indicated that they did not utilize these treatments. However, for pain killers ($\chi^2_{(1)} = 7.50$, $P = .006$) and heat application ($\chi^2_{(1)} = 4.03$, $P = .045$), significantly more participants responded that they did adopt these treatment modalities.

Future Directions

The respondent's perceptions and beliefs regarding future directions for bone pain research are described in Table S4. There were significant differences in responses for both Q17 "Do nonpharmacological pain relief treatments play a sufficient role in your coping with bone-related disease" ($\chi^2_{(1)} = 4.03$, $P = .043$) and Q18 "Is more research into pain relief strategies surrounding bone-related diseases necessary" ($\chi^2_{(1)} = 97.20$, $P < .001$), with the majority of respondents answering yes to both questions.

Two-Way Cross-Tabulation Analyses

Age. There were significant differences as a function of "age" in the binary responses to "Q10. Medication currently being taken" for both calcium ($\chi^2_{(7)} = 17.93$,

$P = .012$) and vitamin D ($\chi^2_{(7)} = 16.59$, $P = .02$) showing that the 56 to 60 was the predominant age range who utilized these treatment modalities.

There were also significant differences as a function of age in the responses to "Q11. Do you suffer from any additional condition that might influence your bone disease" ($\chi^2_{(42)} = 158.13$, $P < .001$), with the 56 to 60 being the predominant age range who suffered from postmenopause.

There were significant differences as a function of age in the binary responses to "Q13. What leads your choice for nonpharmacological treatments" for both How it made me feel ($\chi^2_{(7)} = 17.30$, $P = .016$) with the 56 to 60 age group being the predominant age range who selected this option. Finally, there we also significant differences as a function of age in the binary responses to "Q17. Do nonpharmacological pain relief treatments play a sufficient role in your coping with bone-related disease" ($\chi^2_{(7)} = 17.30$, $P = .009$) with 56 to 60 being the predominant group who selected yes and 46 to 50 predominantly being the age group selecting no.

Gender. There were also significant differences as a function of "gender" in the responses to "Q10. Medication currently being taken" ($\chi^2_{(4)} = 10.29$, $P = .036$), with females predominantly adopting multiple medications. There were also significant differences as a function of gender in the binary responses to "Q10. Medication currently being taken" for calcium ($\chi^2_{(2)} = 10.55$, $P = .005$) where males predominantly selected no, vitamin D ($\chi^2_{(2)} = 23.64$, $P < .001$), where females predominantly selected yes and paracetamol ($\chi^2_{(2)} = 28.85$, $P < .001$), where females predominantly selected no.

There were significant differences as a function of gender in the responses to "Q11. Do you suffer from any additional condition that might influence your bone disease" ($\chi^2_{(12)} = 133.50$, $P < .001$), with females predominantly suffering from postmenopause. Finally, there we also significant differences as a function of age in the binary responses to "Q17. Do nonpharmacological pain relief treatments play a sufficient role in your coping with bone-related disease" ($\chi^2_{(2)} = 6.73$, $P = .035$), with females predominantly selecting yes.

Current Disease Diagnosis. There were significant differences as a function of "current disease diagnosis" in the responses to "Q10. Medication currently being taken" ($\chi^2_{(10)} = 25.07$, $P = .005$), with osteoporosis and other combination of 2 or more conditions predominantly adopting multiple medications. There were also significant differences as a function of current disease diagnosis in the binary responses to "Q10. Medication currently being taken" for vitamin D ($\chi^2_{(5)} = 28.26$, $P < .001$), where osteoporosis, osteoporosis and osteoarthritis, and other combination of 2 or more conditions predominantly selected yes.

There were significant differences as a function of current disease diagnosis in the responses to "Q11. Do you suffer from any additional condition that might influence your bone disease" ($\chi^2_{(30)} = 69.74$, $P < .001$), with osteoporosis predominantly suffering from postmenopause.

There were significant differences as a function of current disease diagnosis in the responses to "Q12. What treatments has a medical professional advised for pain management" ($\chi^2_{(10)} = 27.91$, $P = .001$) in terms of whether single, multiple, or no medications were advised, with osteoporosis and osteoarthritis and other combination of 2 or more conditions predominantly being advised multiple medications. There were also significant differences as a function of current disease diagnosis in the binary responses to "Q12. What treatments has a medical professional advised for pain management" for painkillers ($\chi^2_{(5)} = 11.27$, $P = .046$), where osteoarthritis, osteoporosis and osteoarthritis, and other combination of 2 or more conditions predominantly selected yes.

Finally, there we also significant differences as a function of current disease diagnosis in the binary responses to "Q13. What leads your choice for nonpharmacological treatments" ($\chi^2_{(5)} = 13.05$, $P = .023$), with osteoarthritis, and osteoporosis and osteoarthritis predominantly led by single factors.

Discussion

The aim of the current investigation was to assess bone-related disease incidence, treatment, and pain management while surveying the used and preferred methods of pharmacologic and nonpharmacological pain management in sufferers of bone-related diseases. Most respondents were female, aged between 56 and 60 years old, were nonsmokers and consumed minimal levels of alcohol per week—with none and 1 to 2 units per week being the most common responses. From a disease perspective, the majority of respondents suffered from moderate disease activity, with osteoporosis being most commonly reported. Many respondents did not suffer from additional diseases that might influence their current prognosis such as type 1 diabetes, lupus, rheumatoid arthritis, celiac, and hyperthyroidism. However, a significant number did report being postmenopausal, which has regularly been shown to influence bone health through rapid loss of bone density and deleterious alterations in bone architecture that ultimately influences bone strength.[23] Of those who reported being postmenopausal, most were female aged 56 to 60 suffering from osteoporosis. Key findings highlight that although many respondents were prescribed multiple combinations of pain management, they were willing to try different options that included nonpharmacological pain relief strategies. A significant number of respondents highlighted they believed more research into pain management of associated bone-related diseases is required.

Pharmacologic interventions for bone disease seek to re-establish the homeostasis of bone remodeling. Nowadays, acute and chronic bone pain is attenuated through the use of analgesics (such as paracetamol), NSAIDs, and opioids.[24] Indeed, respondents herein highlighted that medical professional's advice for pain management included multiple medications, pain killers more so than any others; particularly in those suffering from osteoporosis and osteoarthritis, or a combination of 2 or more diseases. It has been suggested that the prescription of this class of analgesics is based on the assumption that bone pain pathophysiology is similar to mechanisms that cause pain in other tissues, something which requires further investigation.[24] For pain alleviation in osteoarthritis patients, it has been reported that ~60% of patients depend on NSAIDs, ~44% paracetamol, and ~27% on opioids. [25] Paracetamol is usually first prescribed due to its availability as over-the-counter medication,[25] although evidence suggests the efficacy of paracetamol for osteoarthritis pain is low.[26]

Pharmacologic therapies appear to be the first line of defense for treating bone-related diseases by seeking to promote bone formation and/or prevent bone resorption. Due to the varied conditions of respondents herein, no single pharmacologic intervention was significantly obvious across the sample population. However, our results highlight that although multiple medications are being prescribed, significantly more respondents take pain killers alongside other, more pragmatic methods such as dietary control—including vitamin D supplementation and, in those aged 56 to 60, calcium. Those with osteoporosis, osteoporosis and osteoarthritis, or a combination of 2 or more bone diseases predominantly opted for vitamin D. Males tended not to take calcium, whereas females tended to opt for vitamin D and against paracetamol. Therefore, although pharmacologic treatment of bone disease to restore a hormonal imbalance that might disrupt the homeostatic process of bone remodeling is the first step in the treatment of these ailments, it is clear that many patients who suffer from bone-related diseases seek to improve their condition through dietary control measures. Indeed, calcium and vitamin D supplementation are broadly utilized to assist in those suffering from bone-related diseases primarily due to the important roles they are considered to play in the proper mineralization of bone for optimal skeletal health.[27] The importance of vitamin D is thought to focus around its role in increasing the intestinal efficacy of calcium and phosphorous absorption in the gut, ultimately important in the proper formation of bone mineral matrix.[27] However, despite this, meta-analysis of 23 studies investigating the influence of vitamin D supplementation on bone mineral density concluded minimal benefits were apparent, with only small benefits noted at the femoral neck.[28] Conversely, the importance of calcium to the maintenance of the bone mineral matrix seems obvious and has been extensively reviewed.[29-32]

Irrespective of the efficacy of supplementation, what is clear from our data is that patients seek to use alternative methods of treatment beyond pharmacologic interventions when searching for a suitable pain/disease management strategy. Not only is pharmacologic and dietary intervention important, but more respondents believed that other nonpharmacological pain relief treatments play a sufficient role in coping with bone disease. To this end, respondents reported trying multiple approaches, with pain killers and heat applications adopted most frequently. Heat therapy and cold application have regularly been suggested to be efficient analgesics for treating muscular pain.[33] Presently, limited research is available that highlights the influence of nonpharmacological analgesics, such as heat and cold therapy, on bone-related pain. Mechanisms of bone pain are well presented, for example, it has been suggested that increased intraosseous pressure in the bone marrow drives bone-related pain by stimulating mechanosensitive nociceptors that innervate the bone.[34] Other work suggests sensory nerves that innervate the bone might play an important role in cancer-associated bone pain, suggesting suppression of the activity of bone-innervating sensory nerves may have potential therapeutic effects on the induction of pain.[35] Therefore, the use of topical analgesics for pain relief may well be justified and requires further investigation.

Despite this, many reports still focus on pharmacologic analgesics for pain alleviation,[36] whereas research into the nonpharmacological approaches mentioned herein, cold and heat therapy, is lacking. Cold therapy mechanisms of analgesia have been suggested to be linked to reduced neural conductance velocity[37]; however, similar research is not available for heat therapy. In the present survey, when adjusting for age, respondents 46 to 50 years old chose not to use nonpharmacological relief, but those 56 to 60 years old did, with females more likely to than males. The choice of nonpharmacological relief was based on "how it made me feel," more so than other options that included medical professionals' advice, advice from friends or fellow sufferers, what is portrayed in the news, and scientific evidence. Therefore, this would suggest that research investigating pain relief strategies, particularly in bone disease patients, should place importance on subjective measures and opinion as well as the controlling mechanisms of action. Furthermore, future research should look to direct its attention toward identifying suitable nonpharmacological pain relief in bone disease patients, with careful consideration placed upon the type of treatment, availability, associated cost, and efficacy.

One element that has not been considered within the scope of the current survey is that of behavior change to deal with pain. Often pain management strategies employ cognitive behavioral therapy based multidisciplinary approaches to drive functional improvement.[38] When suffering with chronic pain, the fear of moving because of

pain can be more disabling than the pain itself.[38] Some of these behavioral changes might include the nonpharmacological approaches herein, and many will encompass physical exercise. Although our survey did not address physical exercise directly, this is often prescribed through health care providers. Ultimately, further research is required into treatment selection alongside long-term outcomes.

Limitations

This study has several limitations. First, the study is limited to those responding online, which limits participants to those who have internet access and speak English, introducing bias. The responses relied on participant recall, which is another source of bias. No direct measurements were made; thus, it is unknown what the individual characteristics were for each survey participant. Finally, despite this being a global survey, we obtained a very small sample; thus, the findings may not necessarily be applicable to the general population.

Conclusion

A substantial number of respondents believed more research is required into pain relief from bone-related diseases, with those with bone-related diseases seeking a more acute, analgesic focus toward pain. Most respondents answered "yes" when asked if nonpharmacological pain relief treatments play a sufficient role in coping with their bone-related pain.

Funding Sources and Conflicts of Interest

No funding sources or conflicts of interest were reported for this study.

Contributorship Information

Concept development (provided idea for the research): R.A., S.D., H.H., and J.S.
Design (planned the methods to generate the results): R.A., N.B., J.D., G.S., H.H.
Supervision (oversight, organization, and implementation): R.A., S.D., H.H., J.S.
Data collection/processing (experiments, organization, or reporting data): R.A., N.B., J.D., G.S.
Analysis/interpretation (analysis, evaluation, presentation of results): R.A., H.H., J.S.
Literature search (performed the literature search): R.A., S.D., N.B., J.D., G.S., H.H., J.S.
Writing (responsible for writing a substantive part of the manuscript): R.A., G.S., H.H., J.S.
Critical review (revised manuscript for intellectual content): S.D., N.B., J.D., G.S.

Practical Applications

- Respondents reported they are willing to try nonpharmacological interventions that reduced pain, with the choice of treatment based on "how it made me feel"—suggesting subjective measures around pain relief might drive adherence.
- A substantial number of respondents believed more research is required into pain relief from bone-related diseases, with sufferers of bone-related diseases also seeking a more acute, analgesic focus toward pain.
- Most respondents answered "yes" when asked if nonpharmacological pain relief treatments play a sufficient role in coping with their bone-related pain.

Supplementary Materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.jmpt.2025.10.043.

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